

Key points

- EN 13986 'Wood-based panels for use in construction' is the European standard covering wood-based board materials including plywood. It is a harmonised standard and therefore plywood is required to be CE marked
- Before plywood can be CE marked the manufacturer must first produce a Declaration of Performance (DoP) describing the technical characteristics of the plywood
- All essential characteristics as listed in EN 13986 should be listed in a DoP but at least one should have a declared performance value
- EN 12369-2:2011 "Wood-based panels – Characteristic values for structural design – Part 2: Plywood" gives design information on plywood based on the classification system described in EN 636 'Plywood – Specifications'
- Plywood used in damp or wet conditions, unless made from inherently durable species, should be treated with a wood preservative and have a suitable bond class according to EN 636
- Plywood exposed to the weather and having long term service life expectations should have no open defects (e.g. knots, holes, splits) on the exposed face(s) and should be protected by a surface coating
- Plywood is hygroscopic, and therefore the moisture content will vary with changing environmental and climatic conditions of the surrounding air
- Plywood directly off the presses will have a low moisture content which will increase over time to typical value of 10% to 12% under normal conditions
- The bonding quality of plywood can be laboratory tested in Ireland, see the WTI website for more information

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Plywood

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Introduction

This information sheet describes the current requirements in relation to the design, specification and supply of plywood. Its purpose is to ensure that manufacturers, specifiers, designers, builders and users understand what the requirements are for these products in Ireland; these requirements include a Declaration of Performance (DoP), marking and accompanying documentation as required by European standards and legislation. It is important to note that this information sheet does not claim to be a legal interpretation of EU Regulations.

The standards covering plywood include:

- EN 13986:2004+A1:2015 "Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking"
- EN 636:2012+A1:2015 "Plywood. Specifications"
- EN 12369-2:2011 "Wood-based panels – Characteristic values for structural design – Part 2: Plywood"
- EN 314-1:2004 "Plywood — Bonding quality — Part 1: Test method"
- EN 314-2:1993 "Plywood. Bonding quality. Requirements"
- EN 12871:2013 "Wood-based panels. Determination of performance characteristics for load bearing panels for use in floors, roofs and walls"

There are other standards dealing with testing, appearance, and calculation methods for mechanical properties etc. that are outside the scope of this information sheet. There are also standards covering durability, mainly related to biological attack from fungi and insects (see list of WTI information sheets on WTI website).

The main requirements relevant to structural plywood used for construction are addressed in this information sheet; plywood marking is also covered and there are helpful suggestions in relation to the specification of plywood.

Description of Plywood

Plywood is manufactured from thin veneers of wood peeled from a log. These veneers are glued together under high pressure and heat with different glues being used for different end uses. The veneers are usually laid at right angle to each other to increase the stability of the board material. Some plywood has specific outer veneers e.g. of a hardwood to give an attractive appearance. Where the outer veneers are of hardwood and the core veneers of softwood species, the durability will be based on the softwood species.

Plywood usually has different properties in the length (major axis) and width (minor axis) and this should be taken into account in any design or end use.

Plywood directly off the presses will have a low moisture content which will increase over time to typical value of 10% to 12% under normal conditions. Plywood veneers like other wood-based materials, are hygroscopic, and therefore the moisture content of plywood depends on the humidity of the surrounding air. Plywood used in certain end uses may need to be conditioned to appropriate moisture content levels and in some cases may require small gaps left between the plywood boards to allow for expansion.

The timber species and the glue used in manufacture determine the plywood's suitability for a particular end use or for a specific use class.

EN 13986 Wood-based panels for use in construction

This is a harmonised standard and is the principal standard covering the major board materials. As a harmonised standard it also sets out requirements for CE marking. The standard was first published in 2004 (and amended in 2015) and sets out the required tests for structural and non-structural boards in dry, humid and external conditions; it also covers boards for use specifically in structural floors, roof decking and wall sheathing.

In relation to plywood the standard lists 18 different properties in Table 7 ('Performance characteristics for wood-based panels for internal use as structural floor and roof decking on joists as well as structural wall sheathing on studs') that can be determined. There are similar tables for other plywood uses that give properties to be determined depending on whether the plywood is for structural or non-structural use and also dependent on the service class (dry, humid or external use i.e. essentially service class 1, 2 or 3). In relation to this information sheet the most relevant properties for plywood are considered to be:

Property in EN 13986	EN 13986 clause
Bending strength	5.1
Bending stiffness	5.2
Bonding quality	5.3
Durability (moisture resistance)	5.6.5 and 5.3
Biological durability	5.17
Racking resistance	5.15.3
Embedment strength	5.19

Marking

The standard gives 'general' marking requirements in addition to CE marking requirements; these general marking requirements relate to marking for technical classes specified in Annex A or based on declared values according to Tables 1 to 7.

The complete marking information should be placed on the accompanying commercial documents if it does not appear in full on the product itself, on a label attached to the product, or on the packaging.

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CE MARKING

CE marking is more than the CE symbol; it can cover information in accompanying documentation as well as marks on the plywood, labels and/or packaging.

Essential characteristics

The essential characteristics are outlined in Table ZA.1.1 for structural components and in Table ZA.1.2 for non-structural components. There are 15 essential characteristics given in Table ZA.1.1 with durability being one of them but having 6 separate related properties. The essential characteristics relate to board materials in general but not all apply to. This information sheet only deals with the properties listed in the table above. It should be noted that all the essential characteristics should be listed in a DoP although a performance value for every essential characteristic does not need to be declared however at least one essential characteristic is required to have its performance declared.

Assessment and verification of constancy of performance (AVCP)

The standard sets an 'Assessment and Verification of Constancy of Performance' (AVCP) level applicable to the plywood. This AVCP level determines the procedures to be followed for CE marking. Under the Construction Products Regulations (CPR) there are five levels of AVCP, ranging from 1+ (the highest level) to 4 (the lowest level). Plywood used in construction usually has a level of 2+. All AVCP levels require the manufacturer to have a Factory Production Control (FPC) system in place and quality control operations are described in EN 13986.

The level of AVCP for structural plywood is 2+ and 1 if the plywood has undergone some process to improve its reaction to fire classification. Both AVCP 1 and 2+ levels require the input of a notified body in the initial inspection of the manufacturing plant and the FPC system as well as continuous surveillance, assessment and evaluation of the FPC system.

This information sheet deals only with the AVCP level of 2+ where the notified body is primarily involved in the initial assessment and the surveillance of the FPC system; a AVCP level of 2+ applies to plywood used in structural applications.

When the notified body is satisfied that the manufacturer

has complied with the requirements of EN 13986 a Certificate of Conformity of the FPC is issued.

Once the Notified Body has issued a Certificate of Conformity and the manufacturer had drawn up a DoP for the product the manufacturer may then affix the CE mark.

The CE mark would typically contain the following information about the product:

- The CE symbol on the plywood*
- The last two digits of the year in which the CE mark was first affixed
- The name and address of the manufacturer, or their identifying mark*
- The unique identification code of the product-type
- The reference number of the Declaration of Performance*
- The level or class of all relevant essential characteristics declared
- The dated reference to the harmonised technical specification applied (EN 13986:2004+A1:2015)*
- The identification number of the notified body*
- The intended use as laid down in the harmonised technical specification applied.

All the essential characteristics relevant to the declared intended use should be listed and the manufacturer should declare performances against those essential characteristics that they wish to declare values for, however there has to be a performance value declared against at least one of the essential characteristics.

EN 13986 describes marking requirements including information which should be directly placed on each panel or if this is not possible on a label attached to the panel; with some panels e.g. where the panel is veneered or coated it can be on the packaging for aesthetic reasons. A typical CE mark appearing on a plywood panel should include:

The items marked * above and;


The description of the panel as:

- 1) nominal thickness
- 2) indication 'PT', in case of treatment with biocides against biological attack;

Information on performance values of essential characteristics:

- 1) technical class;
- 2) reaction to fire class, including the additional classification, if any, and only if not taken from Table 8 of EN 13986;
- 3) release of formaldehyde: class E1 or E2.

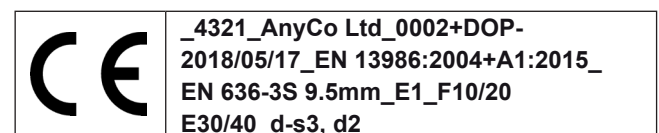
A typical plywood mark on the panel for an AVCP level of 2+ is shown below:

CE mark:	Description of mark:
	CE Symbol
4321	Identification number of the notified body
AnycO Ltd	Name or identifying mark of the manufacturer
00010-DOP-2013/05/30	Reference number of the DoP
EN 13985:2004+A1:2015	Number and year of the European standard
EN 636-3 S	Unique identification code of the panel and its intended use (S – structural, 3 - Exterior)
9,5 mm	Nominal thickness
E1	Performances of some of the essential characteristics
F10/20 E30/40	Technical class
d-s3, d2	Reaction to fire class

The above mark is described in A.3.2 labelling of Annex ZA and if it cannot be given directly on each panel then it should be on a label fixed to each panel; for construction plywood it would be expected to be on each panel rather than on a label fixed to the panel. The above mark should be accompanied with commercial documentation which would include that required by ZA.3.1.

The accompanying documentation should include the above information and the full CE mark; additional information on characteristic values could be given in the DoP. The technical classes above are based on those in EN 636 but design values should be taken from EN 12369-2 or the DoP if no technical class is given or if more accurate design values can be used from the DoP.

In the above mark the plywood is not treated otherwise it would have 'PT' in the mark. The reaction to fire class is based on Table 8 of the standard i.e. it is classified without further testing (CWFT; floorings would be designated as Dfl-1 provided the minimum density is 400 kg/m³ and the minimum thickness is 9 mm – this designation should be given if the intended use was flooring. As the performance is not given the reaction to fire could be declared as NPD in the DoP.



An example of the above mark applied to a panel given in a different format.

EN 636 Plywood - Specifications

This is an important standard for plywood as it specifies bonding quality requirements by reference to EN 314 parts 1 and 2. It also describes technical classes and requirements for factory production control as well as marking.

Plywood marks are defined by bond classes EN 636-1, EN 636-2 and EN 636-3 related to the proposed conditions of use;

- EN 636-1 Dry conditions: Use Class 1 of EN 335 e.g. Warm roofs/ Intermediate floors/ Internal timber frame walls
- EN 636-2 Humid conditions: Use Class 1 and 2 of EN 335 E.g. Cold roofs / Ground floors / Ext timber frame walls
- EN 636-3 Exterior conditions: Use Class 3 of EN 335 e.g. Fully exposed weather conditions.

EN 636 requires that the letter ‘S’ is applied to mark for structural plywood for example EN 636-1 S and ‘NS’ for non-structural general use e.g. EN 636-1 NS.

EN 636 also gives a classification system based on bending strength and MoE bending as an alternative to full-scale testing to EN 789. The classification system is based on minimum values for bending and stiffness derived from test. The classification system in EN 636 should not be used for structural design (EN 12369-2 gives the appropriate design properties for the classification system); the EN 636 system is related to testing to EN 310 and EN 326-2.

EN 12369-2 Wood-based panels- Characteristic values for structural design - Plywood

This important design standard for plywood applies to the following:

- Panels with five or more layers and with a minimum thickness of 6 mm
- The ratio of the cumulative veneer thickness in alternative directions does not exceed 2,5
- The mean density of the wood species should be greater than 350 kg/m³ and not exceed 750 kg/m³

The standard gives load duration classes based on EN 1995-1-1 (EC5); the Irish National Annex to EC5 places wind loads in instantaneous and snow loads in short term categories.

The 5th percentile characteristic values are defined for strength, density and modulus of elasticity (MoE).

Characteristic design values based on the EN 636 classification system are given in a number of tables including:

Table 2: Bending, tension and compression

Table 3: Modulus of elasticity in bending, tension and compression

Table 4: Shear properties related to density.

Characteristic values are derived in panels with moisture

content determined by a temperature of 20 °C and a relative humidity of 65%. The characteristic values should be used for designs according to EN 1995-1-1.

Where panels are structurally used under service class 1, 2 and 3 conditions, performance values inferred by the classification listed in Table 2 and 3 should be modified according to the service class and the duration of load (kmod, kdef) given in EN 1995-1-1.

EN 12871 Wood-based panels – Performance specifications and requirements for load bearing use

For the performance characteristics of wood-based structural panels used in floors, roofs and walls this standard specifies testing for:

- Concentrated load tests and assessment methods for floor and roof decking
- Soft body impact assessment methods and a classification system for floors, roofs and walls
- Racking (by reference to EN 594)

EN 315 Plywood: tolerances on dimensions

EN 315 specifies tolerances of plywood panels (length, width, thickness) as well as tolerances for edge straightness and the panel being square. The reference moisture control is 10% (±2%). The tolerances on the nominal length and width should be +/- 3.5 mm.

The tolerances on thickness are shown in the table below:

Nominal thickness (t) mm	Un-sanded panels tolerances		Sanded panels tolerances	
	Thickness - within one panel mm	On the nominal thickness mm	Thickness - within one panel mm	On the nominal thickness mm
>= 3 <= 12	1,0		0,6	
> 12 <= 25	1,5	+ (0,8 + 0,03t) - (0,4 + 0,03t)	0,6	+ (0,2 + 0,03t) - (0,4 + 0,03t)
> 25 <= 30	1,5		0,8	
> 30	1,5		0,8	

Dimensions should be measured according to EN 324-1 while squareness and edge straightness should be determined according to EN 324-2 and these should be within 1 mm/m.

EN 322 ‘Wood-based panels – Determination of moisture content’ should be used to determine the moisture content of test pieces.

Marine plywood

Marine plywood is a special type of plywood developed for boatbuilding. The types of wood used in marine ply-

wood are restricted to certain tropical hardwood species and only highly water resistant glues can be used. The specification of marine plywood is outside the scope of EN 13986 and EN 636 but is covered by British Standard BS1088 “Marine plywood - Requirements”.

Marine plywood is not subject to CE marking requirements and does not need to have a DoP.

The terms “waterproof” or “WBP” (weather and boil proof) are obsolete and should no longer be used.

Structural plywood required for external use in construction should have an adhesive complying with Bond Class 3 of EN 636 and be marked EN 636-3 S.

Bonding Class - Plywood testing

EN 636 specifies the required bonding class for internal, humid and exterior conditions. EN 314-2 gives the bonding quality test requirements for the bonding classes and refers to EN 314-1 for the actual testing details. Tests involve water immersion (bond class 2 and 3 also require immersion in boiling water) and shear strength assessment.

There have been examples of plywood failure and concerns over the legality or correctness of some plywood marks. As a precaution the notified body responsible for monitoring the factory production control system operated by the manufacturer of the plywood could be contacted to verify that they have issued a certificate of conformity of the factory production control, that the certificate is still valid and that they are involved in the continuous surveillance of the factory production for the product. Also a relatively simple water based test could be carried on the plywood to give some confidence in its performance; for bond class 2 and bond class 3 a water boil test for 6 hours can often show up inadequate bonding in plywood. If the plywood veneers have commenced to delaminate from each other after the boiling water test, the plywood is unsuitable for humid and exterior conditions and is unlikely to be in compliance with the standard. Depending on the test results a decision can be made on whether or not to proceed with full testing in accordance with EN 314-1 which would require the involvement of a test laboratory.

Wood Technology Ireland has helped to establish a plywood testing service in CREST (Centre for Research in Engineering Surface Technology) in the Dublin Institute of Technology in Camden Row, Dublin 8. For further information see the WTI website or contact WTI or CREST directly.

Some common defects of plywood are shown below in examples 1 and 2.



Example 1: Gaps and over-lap defects in core veneers of plywood.



Example 2: Badly delaminated plywood – unsuitable for any end use.



Example 3: Good quality plywood.

Responsibilities under the CPR

The CPR places legal responsibilities not only on the manufacturer but also on importers, agents and distributors.

The DoP and CE mark are solely the responsibility of the plywood manufacturer and the user/specifier should ensure that the declared performances are adequate for the intended use. The company that places plywood for construction use on the market in the EU (usually an importer) has legal responsibilities under the CPR; these should be carried out before the product is placed on the market and include ensuring that;

- The tasks related to AVCP level 2+ have been carried out by the manufacturer
- The manufacturer has drawn up the appropriate technical documentation including the DoP
- The product bears the correct CE marking(which includes marking requirements in EN 636)
- The product, packaging or accompanying documentation bears their name and contact details
- Records of the above information are kept for a reasonable time usually a minimum of 10 years

Distributors also have certain responsibilities under the CPR; these include ensuring that all the information mentioned above in relation to importers has accompanied the product and that the product is correctly marked. This information must be available on request to a competent national authority and should be available on request to end users.

Under certain circumstances the responsibilities of a manufacturer can apply to an importer or a distributor; e.g. if either of these place the product under their own name or trademark or modify the product already on the market in such a way that the original DoP is affected.