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Quality of sawn wood used for the construction of pallets

Qualité des bois utilisés pour la fabrication de palettes

Reference number
ISO/TR 11444:1995(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 11444, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 51, *Pallets for unit load method of materials handling*.

This document is being issued in the type 2 Technical Report series of publications (according to subclause G.4.2.2 of part 1 of the ISO/IEC Directives, 1992) as a "prospective standard for provisional application" in the field of sawn wood used for the construction of pallets because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

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This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than two years after its publication with the options of: extension for another two years; conversion into an International Standard; or withdrawal.

Annex A of this Technical Report is for information only.

Introduction

Components of wooden pallets typically exhibit major differences in physical and mechanical properties between pieces of identical shape, size and species. These differences are caused by natural variations in the growth of a living tree, the anisotropic characteristics of wood, and the manufacturing practices used in the conversion of wood into industrial and consumer products. Each of these differences significantly alters the physical, mechanical and aesthetic properties of wood and wood by-products.

The properties of wooden pallets of like design will vary significantly if the size, frequency, location and type of variation are not controlled. For example, a large knot located above the notch cut into a wooden stringer/bearer can cause potentially catastrophic failure of a pallet in bending, even when the pallet is carrying well below its rated load.

Some of the variations affecting the physical and mechanical properties of wood are a direct result of infestation or plant diseases such as American or European chestnut blight and Dutch elm disease. The unrestricted intercontinental distribution of pallets containing infested wood can and has resulted in the devastation of unresistant timber species.

Reasons for recognizing natural variations in wood in order to control the quality of sawn wood in pallets include:

— assembly of the most cost-effective pallet;

— selection of a superior pallet at minimal cost;

— determination of the life cycle cost between pallets of differing grades and quality;

— prediction of the strength of pallets of like design;

— prevention of potentially dangerous failure;

— control of the spread of plant disease.

The Technical Committee ISO/TC 51 has therefore decided to publish these guidelines, prepared by Working Group WG 5, in the form of a Technical Report.

In view of the way in which current ISO test methods and performance requirements for pallets are specified and the general move by national and international standardization bodies away from specifying strict material quality standards, this Technical Report does not provide grading rules intended to ensure a minimum strength quality of wood. It is essential that it remains possible to meet the performance requirements specified in ISO/TR 10233 using any hardwood or softwood, from any country in the world, by modifying the wood or fastenings content to achieve the required performance.

The guidelines, although related primarily to wooden pallets, may also be of value in relation to the construction of wooden packaging for industrial or agricultural purposes.

A list of International Standards related to this Technical Report is given in annex A.

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Quality of sawn wood used for the construction of pallets

1 Scope

This Technical Report gives information on the faults and features which may affect sawn wood used for the construction of pallets, and provides guidance on their effects in relation to the physical and mechanical properties of both components and complete wooden pallets.

It is strongly recommended that these guidelines be followed when wooden pallets are constructed for testing in accordance with ISO 8611, while their use in pallet manufacture should provide a more consistent level of performance.

NOTE 1 In view of the different timber species used for pallet construction in various parts of the world, it may be appropriate for member bodies adopting this Technical Report to add information about the characteristics of species used for the construction of pallets in their respective countries.

2 Moisture content

2.1 A proportion of the water in wet wood (around 25 %) is chemically bound in varying degrees to the wood fibres. Living trees and freshly felled sawn timber can contain even more water than this (up to 200 % of free water, with even more in certain species[1]).

2.2 There are two methods of measuring moisture content in common use. The most common method, a rapid test using an electrical moisture meter, is an essentially non-destructive test which is based upon the principle that the electrical resistance of wood varies with its moisture content. Meters are commonly marked to indicate a range between 6 % and 50 % moisture content, but their accurate range is normally from 9 % to 25 %. A skilled user can obtain results between these limits within ± 2 % of the true moisture content. They are particularly appropriate for pallet work where extreme accuracy is not needed.

The other method used takes at least several hours to achieve a reading and is destructive, in that it involves taking the whole piece of wood (or a tiny rectangular cut sample), weighing it to determine the mass of wood plus the water it contains, drying it to obtain the dry mass and calculating the moisture content as follows:

$$\text{Percentage moisture content} = \frac{(\text{mass of wet wood} - \text{mass of dried wood})}{\text{mass of dried wood}} \times 100$$

NOTE 2 Wood in which the mass of water is equal to the mass of dry wood has a moisture content of 100 %.

Known as the "oven-drying method", this is the more precise method, but is only necessary for accurate testing or for research work.

2.3 Before wood is stored or used to construct pallets, it is usually necessary to remove a portion of the water it contains. The reason for drying prior to storage is that wood of many species will decay if kept at a high moisture content for long periods and, even in the short term, susceptible species will suffer from mould and staining (see clause 4). Examples of this are the blue stain that particularly affects pine species, although spruces and others are also susceptible. Below about 20 % moisture content, a level known as the decay safety line (timber line), wood is generally safe from such discoloration or damage.

1) Moisture content can be above 100 % because of the method of definition where the mass of water is expressed as a percentage of the oven-dry mass of the wood.

2.4 Wet pallets are less stiff (i.e. bend more under a given load) and less strong (i.e. have a lower breaking strength and a lower maximum working load) than dry pallets. Allowance needs to be made for this both during the test and in actual usage, since their performance when under load can vary enormously with a change in moisture. The change can be typically, for Douglas fir, a reduction of 19 % in terms of strength comparing green timber with air-dry, or a 23 % change for European redwood (see table 1 for examples).

Table 1 — Examples of strength properties of softwoods

Common name	Origin	Botanical name	Mean bending strength (N/mm^2)	
			Green	20 % moisture content (air dry)
Douglas fir	Canada	*Pseudotsuga menziesii*	54	66,6
Redwood	Eastern Europe	*Pinus sylvestris*	44	57,1

3 Deterioration and decay

This Technical Report gives only basic guidance on this complex and extensive subject.

Many types of timber decay can be spread by insects and worms and, in view of the fact that it is difficult for pallet manufacturers to distinguish between the two, it is advisable that none at all should be present.

Sporophores, surface mycelium, brash and punky wood can have major weakening effects and should be avoided in any pallet member.

Decay cannot occur in wood having a moisture content less than 15 % (based on oven-dry weight) and decay of consequence will not usually occur in wood having a moisture content less than 20 %. To prevent such deterioration, pallets should be stored in an environment that ensures that a moisture content of 20 % is not exceeded.

Decay will have a strength-reducing factor in relation to the volume of wood affected.

Mineral streaks and stains do not affect the structural strength of pallets and are acceptable.

4 Stains, moulds and weathering

4.1 Stain is the term used to describe a discoloration, frequently deep in the wood substance, caused by chemical reactions or fungi, whereas mould is the surface discoloration caused by staining fungi which can sometimes be brushed off and is easily removed by planing.

NOTE 3 Blue stain is often, but not always, a mould. It also frequently penetrates the sapwood, which is why this Technical Report does not define stain as chemical (mechanical) discoloration and mould as fungal discoloration even though this is true for over 99 % of staining fungi species. Blue stain is an anomaly, albeit an important one.

Stains and moulds generally have no significant structural or other detrimental effect on the performance of wooden pallets.

4.2 Weathering is the term applied to colour change due to exposure to light and/or water. It has no effect on the structural strength of wooden pallets.

5 Checks, splits and shakes (see figure 1)

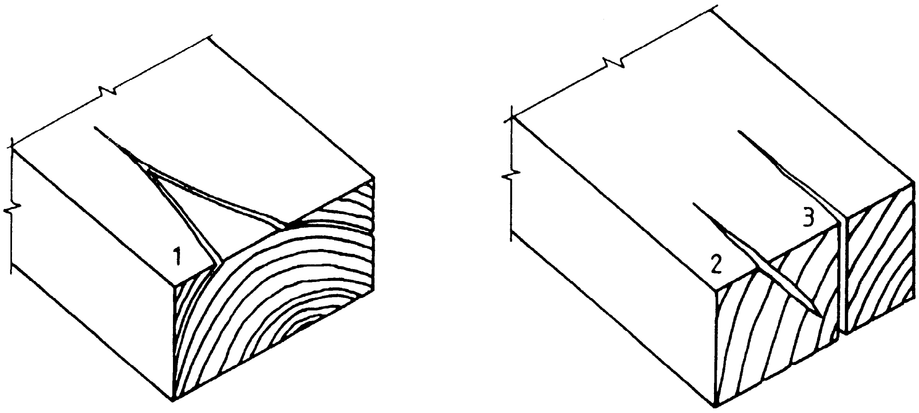
5.1 Shakes run circumferentially with the annual rings of the wood and are caused by excessive heat, drought or frost during growth. They normally occur in the weaker spring wood.

Checks occur radially and run parallel with the grain. They are produced during drying.

Splits occur at any angle, but are frequently parallel with length or breadth. They may be caused by nailing.

5.2 Measurement of the extent of checks, shakes and splits is a simple visual measurement of thickness, length and position.

5.3 The main effect in pallets is to weaken joints and it is common for end splits to develop around nails in susceptible species due to drying after assembly.



1 Ring shake
2 Radial check
3 End split

Figure 1 — Pallet components showing end shakes and splits

5.4 Most pallet designs can accommodate limited shakes, checks and splits, but certain components of particular designs are less able to do so. Tests carried out in accordance with ISO 8611 will highlight "weak link" components and indicate those components on which it is essential to exclude such defects. Normally, if shakes, checks and splits along the grain do not exceed in length the width of the component in which they occur, their effect is small.

6 Bark and wane

The requirements in relation to bark in wooden pallets are given in ISO/TR 10234.

The structural significance of wane is related to the reduction of cross-sectional area which may have an effect on fastening effectiveness or bending strength and stiffness.

7 Knots

Knots are branch bases embedded in the trunk which, even after the branch dies or is pruned, remain in the wood (see figure 2). Certain species, such as American southern pines, shed branches quickly and subsequent growth is little affected. Others, such as European spruce, are slow to lose branches and are typical of trees which retain large numbers of small, dead branches on the lower stem. In such trees, the resulting encased branch stubs cause a core of small, loose knots to form towards the centre of the log.

7.1 Knots are measured by a simple measurement of their diameter. It is necessary to have a method of measurement since certain fixed material/dimensional pallet standards (such as the UIC pallet) require limitations in knot size.

7.2 The prime deleterious effect of knots is to cause grain disturbance (localized grain slope) and, since any deviation of grain from the parallel (see clause 8) causes weakness, knots in pallets can be a major problem. Knots can also cause distortion of pallet components as they dry out.

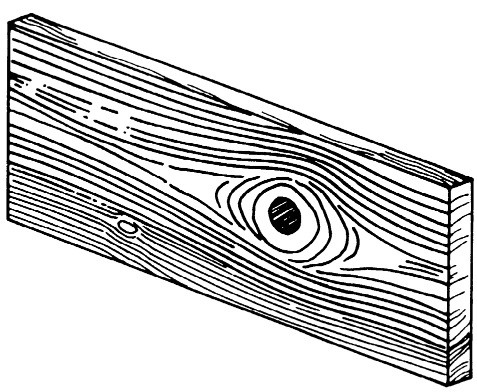


Figure 2 — Knot in a pallet board