

# TMT in Window Manufacture

## Fitness of TMT for Use as Window Frame Material

The main aspects of using TMT as window frame material consist in increased resistance towards wood-decaying fungi, reduced swelling and shrinkage as well as decreased heat conductivity. The durability of most TMTs ranges from classes 1 "very durable" to 3 "moderately durable". The equilibrium moisture as well as swelling and shrinkage are reduced by approx. 50 %. The reduction of its mechanical strengths and brittling of the wood due to modification have a limiting effect on its use. The intensity of treatment should be selected in such a way that an optimal characteristics profile is achieved. The target should not be highest possible durability since Durability Class 3 is required by both DIN 68800-1:2011-10 and VFF Fact Sheet HO.06; however, this should definitely be attained. The window design and procedural steps in the manufacture need to be accorded with the specific characteristics profile. The fitness of a certain TMT for use in window design must be identified by testing.

## Normative Bases (Windows)

CE marking has been statutorily required for windows and external pedestrian doorsets (no fire protection and/or no smoke leakage) since 1 February 2010. This is based on DIN EN 14351-1/A1 (current issue: 2010-08), which is independent of material and, therefore, also applies to windows in which TMT is used. Marking is performed by manufacturers (or importers) in their own responsibility in accordance with Conformity Level 3. For that purpose, mandatory properties are to be specified after initial testing (Initial Type Testing ITT) and an Internal Production Control must be introduced to be permanently maintained. Properties for which no performance has been determined or for which no determined performance is to be declared, the abbreviation npd (no performance determined) can be indicated (unless legal requirements exist in the country of destination). In Germany, for example, parameters for the heat transition coefficient and air permeability are required by building law (cf. energy saving ordinance EnEV).

## Timber Selection, Required Qualities

The application of TMT as frame material presupposes that the wood properties relevant to window manufacture are guaranteed. Therefore, at least the species of wood, assortment, process or treatment step and batch or the date of manufacture need to be specified for each specific TMT. This is also required if declared acc. to CEN/TS 15679. Generally, a quality acc. to Class J2, blue-stain free acc. to EN 942, is recommended. The statements according to DIN EN 13307-1, EN 14220, DIN EN 14221 and to VFF Fact Sheets HO.02 and HO.06-1 must be complied with. Moreover, TMT can be approved as timber fit for window making on the basis of VFF Fact Sheet HO.06-4: 2010-03 "Wood species for the manufacture of windows Part 4: Modified timber". Also, on-going quality assurance in the TMT manufacture is of importance. The production process and the product can be certified by the "Quality label TMT" granted by the EPH.

## Manufacture of Scantlings

Laminated scantlings can be manufactured both homogeneously (all lamellas similar) and in combination with lamellas of natural wood (Fig. 1). The required bonding quality (the glueing of surfaces and dovetailing) can be secured by applying PVAc (D4), EPI or PUR glueing systems. Due to the lower wood moisture and the more hydrophobic nature of TMT, manufacturers' recommendations need to be observed or suitability tests performed. Pressure and pressing time need to be adjusted to the modified properties. Especially with view of asymmetrically designed scantlings, the processing moisture should largely correspond to the moisture during usage in order to limit later dimensional changes and provide for sufficient dimensional stability. The raw densities and swelling coefficients of adjacent lamellas must not differ widely for the same reason.



Fig. 1: Window sash of a composite scantling

Institut fuer Holztechnologie  
gemeinnuetzige GmbH

Zellescher Weg 24  
01217 Dresden · Germany

+49 351 4662 0  
+49 351 4662 211  
info@ihd-dresden.de  
www.ihd-dresden.com

## Contact persons



Timber Modification  
Dr. rer. silv.  
**Wolfram Scheiding**  
+49 351 4662 280  
wolfram.scheiding@ihd-dresden.de



Windows  
**Lutz Neugebauer**  
+49 351 4662 302  
lutz.neugebauer@ihd-dresden.de

## Window Manufacture

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### Profiling

Profiling can be performed applying usual tools and settings. The sharpness of tools (carbide-tipped edges) is, especially for TMT, a decisive prerequisite for high-level woodworking quality. If required, the feed rate needs to be adjusted. Sharp-edged profiles should be avoided and profiled edges chamfered. Since the handling of TMT produces very fine sawdust and a distinctive odour, intensive exhaust facilities and ventilation must be guaranteed and in place.

### Surface Coating

An improved surface quality after profiling is an advantage (fibres are squeezed to a lesser extent), so that intermediate sanding may be omitted. Also TMT requires high-quality and overall coating (impregnation, including protection against blue stain, priming, intermediate coating and surface finishing). Thick-layered and well pigmented coating systems are recommended, since UV resistance of TMT as compared to natural wood has not been improved. If coating is missing, deficient or damaged, also TMT can be infested by mould or bluestain fungi in unfavourable conditions.

The required maintenance and care intervals during the lifetime of TMT can be extended thanks to its improved dimensional stability and lower tendency to cracking.

### Glazing, Sealing

Pre-tests with the specific TMT assortment are required to test the compatibility and fitness of sealants, sealing profiles and space-glazing blocks (cf. VFF Fact Sheet HO.06-4).

### Fasteners and Fittings

Predrilling for screwed joints is advisable in order to prevent predetermined breaking points. Regarding the application of fittings to TMT windows, the requirements of burglar protection apply. Due to the lower pH-values of TMT, dark complex joints may emerge in spots of contact with base metals and in the presence of moisture, as it is known of species of wood which are rich in tannin (oak, larch).

### Window Design

Proven window designs of natural wood can be transferred to TMT windows if the described material-specific characteristics are observed and subject to above-mentioned limitations. All partitions (supports, sash bars, muntins), types of window glazing, etc., are possible, also any well-known window systems, such as single-glazed windows, double-glazed windows, box-type windows and material composites (e.g., wood/aluminium). Regardless of the improved durability of TMT, all possibilities of structural wood preservation should be exhausted. Above-mentioned advice regarding the manufacture of scantlings applies to the corner joints of frames respectively. Mortise and tenon joints, dowel joints and mechanical joints are possible.

## Product properties of TMT Windows and Their Areas of Application

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Generally, no restrictions regarding TMT windows are to be expected with view of their performance (resistance to driving rain, permeability of joints, resistance to wind load), of their mechanical strength (vertical load and static warping) as well as to their permanent mechanical functionality. Limitations may exist due to their reduced breaking strength, possibly in the event of exposure to high impact, extreme wind load and, with large formats, in conjunction with the large mass of glass. For that reason, the testing of a TMT window design is recommended mainly with view of mechanical-dynamic stress (EN 12211 "Safety test", EN 13049 "Resistance to impact"). Due to its restrictions, scantlings completely made of TMT for use in burglar-proof windows are not recommended. By using composite scantlings (fittings fastened to natural wood), the benefits of TMT, also in burglar-proof windows, can be made use of. In any case, their design must be accorded to and tested for specific requirements.

A special aspect results from its reduced heat conductivity, as compared to natural wood of the same wood species. Depending on the window, the value of the heat transfer resistance of the entire window ( $U_w$ ) can thereby be improved by between 0.1 to 0.2 W/m<sup>2</sup>K.

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### Bibliography

- EN 14221:2006: Timber and wood-based materials in internal windows, internal door leaves and internal doorframes. Requirements and specifications
- EN 942:2007: Timber in joinery – General requirements
- EN 14351-1:2006+A1:2010: Windows and doors – Product standard, performance characteristics – Part 1: Windows and external pedestrian door-sets without resistance to fire and/or smoke leakage characteristics
- CEN/TS 15679:2007: Thermally Modified Timber – Definitions and characteristics
- DIN 68800-1:2001: Wood preservation – Part 1: General
- VFF Verband Fenster + Fassade: Fact Sheet HO.02: 2008-12 „Auswahl der Holzqualität für Holzfenster und -Haustüren“
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