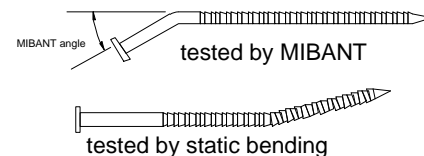


Methods of measuring strength of nails for wood pallets and packaging

The strength of nails in wood packaging and pallets is critical; there are as many failures due to nail pull-out, breakage or shear, as with wood breakage itself. As an example of the importance of this, all effective third party wood pallet quality schemes assess nail strength; these include LPR pallet (UK), CPC pallets (Canada) and Europallet (EPAL). Other examples of specifications stipulating minimum strength nails are large horticultural boxes BSI and CP1-CP9 chemical industry pallets. There are two very different methods of test in common use to determine nail strength. The MIBANT drop-hammer nail test and the static ISO test principal as used in the ROCKHI and VERUS nail test tools. (Described in other PalletLink Datasheets)



Nails after strength test

The factors that affect nail strength are:

- tensile strength of steel used in wire stock for nail manufacture (measured in N/mm²)
- minimum diameter of the finished nail wire shank
- minimum diameter of ring nails measured at the root of the thread
- length to thickness ratio of nail (long thin nails are more likely to bend when nailing into dense wood)
- speed of nail entry into the wood (hand speed or machine speed)

The units of measurement of nail strength are:

- *Mibant angle* - (proprietary) commonly used to evaluate USA *stiff-stock* nails and in PDS pallet software
- *Stiff-stock* - a non-quantitative measure) common in USA to describe strong nails, based on Mibant angle)
- *Newton-meters* - written Nm or N.m (a recognised EN ISO test method) ultimate torque at the elastic-limit

The latter method embodied in the ROCKHI and VERUS nail test tools is used in ISO 15629: 2001: *Pallets for materials handling - Quality of fasteners for assembly of new and repair of used wooden flat pallets* and is useful as a guide for setting the strength of pallet and case nails. This uses ISO 12777-1 to evaluate nail strength.

EN ISO 12777-1: 1997 *Methods of test for pallet joints, Part 1: Determination of bending resistance of pallet nails, other dowel type fasteners and staples*, is a fast internationally recognised method that does not use wood in the specimen nail tests. This makes it less liable to introduce the errors which arise from the use of timber which is a naturally variable material such as is used in Europallet nail test methods. ISO 15629 contains a specific measure of nail bending strength classed as *high, medium and low strength*. In general the USA use stronger nails than European pallet manufacture called *stiff stock* and these would often fall between *medium and high quality* level of ISO 15629

The MIBANT measures nail bend strength as an *angle of bend* measured after the elastic limit called MIBANT angle. As the Figure shows it tests nails near the head where rings are absent in the stronger part of the shank. Whilst this is acceptable for the dominant nail in North America - the helical nail which has constant strength from head to nail tip, for European ring nails with deep grooved (weakening) thread rings it gives a misleadingly high result. As shown by the Figure the European devices test at the weakest nail position by static bending in the ring grooved portion. As the ultimate applied torque is reached, the strength is measured in units of Newton-meters.

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