TIMBER DECKING ASSOCIATION

TDA TECHNICAL BULLETIN

metal fixings

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Introduction

This TDA publication is intended to provide general guidance on metal fixings for use with outdoor structures in wood. For the purposes of this publication, “metal fixings” are considered to be:

- **nails**
- **screws**
- **concealed clips**
- **bolts**
- **pre-formed connectors**

The information is given in good faith and without warranty. For advice about the suitability of a specific brand of fixing, always check the manufacturers own recommendations before use.

Metal Fixings

The timber used for permanent outdoor structures like decks has a long life expectancy and only fixings with similar service life should be used in their construction.

Corrosion is the biggest threat to the performance of metal fixings. Its consequences range from unsightly stains on the surface of wood to the loss of load bearing capability and premature failure. As the deterioration of a fixing is often unseen, failures can occur without any warning causing the safety of the entire structure to be compromised.

1. Corrosion

Corrosion is a complex subject and there are many factors that can influence the onset and rate at which metals corrode. The main ones include:

- Exposure conditions: wet/dry, heat/cold, coastal locations
- The acidity of the wood and presence of extractives like tannin
- Presence of wood preservatives or other chemical products
- The use of dissimilar metals in close proximity

Once corrosion commences, the wood around the fixing starts to break down to become sponge like, absorbing and holding moisture against the fixing to maintain the rate at which it degrades. The corrosion process can be accelerated significantly in the salt laden air of coastal locations or if the wood contains high levels of moisture or is exposed to wet and humid conditions.

Whilst the principal threat is rust there are a number of other forms of corrosion:

1.1. Reaction to natural wood extractives

One common occurrence is when a chemical reaction takes place between a metal and the natural extractives of acidic species of wood. Extractives like tannate are a common feature of hardwoods and some softwoods like western red cedar and douglas fir. Tannate reacts with iron to form dark/black stains that can quickly affect the visual appearance of the structure.

1.2. Reaction to wood preservatives and other chemical products

The life expectancy and performance of most softwoods is improved significantly by the use of wood preservatives applied by a pressure impregnation process. The level of treatment is tailored to suit both the species of wood and application (in ground or water or out of ground) to give a predictable service life.

A number of different wood preservative formulations are approved and used in the production of decking and landscaping components. All such treatments along with other chemical solutions like acid rain, fertilisers and swimming pool chemicals increase the corrosion risk to unsuitable metal fixings.

The best (and most widely used) preservatives for outdoor wood have copper as the primary active ingredient to prevent attack from fungal decay (wood rot). Because copper is present there is the potential for an electro chemical reaction between dissimilar metals. This is called bi-metallic corrosion (also known as galvanic corrosion) and can proceed rapidly to weaken the connection and compromise the safety of the structure. It is easily prevented by not using different metal fixings in close proximity. For example, when installing hot dipped galvanised steel connectors like joist hangers always use hot dipped galvanised screws or nails. Similarly, washers on bolts should be the same material as the bolt shaft and nut or made from an inert material like plastic.

Only naturally durable timber or wood that has been pressure treated appropriately should be used to create permanent outdoor structures. These timbers can last almost indefinitely so it is essential that metal fixings are appropriate for the job. Every connector, screw, clip, nail, or bolt that may be at risk of corrosion must be made from suitable materials and installed properly.

2. Suitable materials

Austenitic stainless steel, silicone bronze or copper are highly resistant to corrosion. These materials are highly effective in external locations and will have a long life in the most demanding corrosive environments.

Where budget considerations preclude the use of these materials, use hot dipped galvanised fixings. These are by far the most widely available and commonly used metal fixings for exterior use. However, do remember that this type of fixing is coated (galvanised) during manufacture with a layer of protective zinc, the thickness of which does have a bearing on its corrosion resistant performance. If the layer of zinc is thin then the fixing can still be vulnerable if it is damaged during installation or degraded by a corrosive environment. For example, the process of hammering home nails or bolts or driving screws can damage the zinc layer and give rise to rust and staining on the surface. Always make sure that the level of galvanised protection is fit for the use intended. If in any doubt, check with the manufacturer before use.

Table 1

Suitable Materials

Metal fixings should be made from one of following materials:

- **Stainless steel: (austenitic grade 316 is best)**
- **Silicone bronze**
- **Carbon steel with a high performance protective coating**
- **Hot dipped galvanised steel to BS specification (BS7371 Part 6) or better**
- **Copper**

Table 2

Unsuitable Materials

Fixings made from the following should not be used on outdoor wood projects:

- **Aluminium (not recommended for use with pressure treated wood)**
- **Electro plated metals – the protective barrier is only thin and can be easily damaged or burned off when driving nails or screws.**
- **Standard uncoated ferrous metals**
- **Brass**

3. Basic good practice

There are a number of good practices when using metal fixings that will add to the quality and performance of the structure.

3.1 Design to avoid moisture retention

Always build a slight fall into a timber decked surface and lay grooved deckboards in the direction of fall.

Overhang components like handrails, deck copings and post caps and leave spaces between boards, board ends, and posts (5mm minimum) and where a structure joins a building (10mm minimum) to allow water to drain freely.

Ensure under deck areas are well ventilated.

3.2 Fixing deckboards

Commercially available deckboards come in widths ranging from around 90mm to 145mm. Two fixings should always be used to secure boards at each point where a joist is crossed. These should be positioned 25% in from each side. This minimises the risk of splitting and prevents undue movement caused by the natural changes in moisture levels of wood through the seasons of the year.

On grooved boards, position fixings at the bottom of a groove, flush with the bottom. This holds the board more firmly, prevents splintering of narrow ridges and movement in the timber causing the fixing to rise above the surface and become a hazard to deck users. Ensuring the fixing is flush with the bottom of the groove also eliminates the possibility of creating a blockage point in what is designed as a water drainage channel.

Always pre-drill fixing points at the end of boards. For nails, the fixing point should be no closer than 15mm to the end of the board; for screws the recommended distance is 25mm. This could make screw fixing of abutting boards difficult to achieve unless a double joist or additional batten is used to provide the required space for fixing (see paragraph 4.4 on Screws).

Figure 1

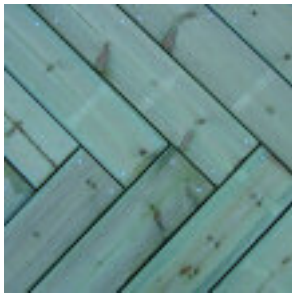


Figure 2

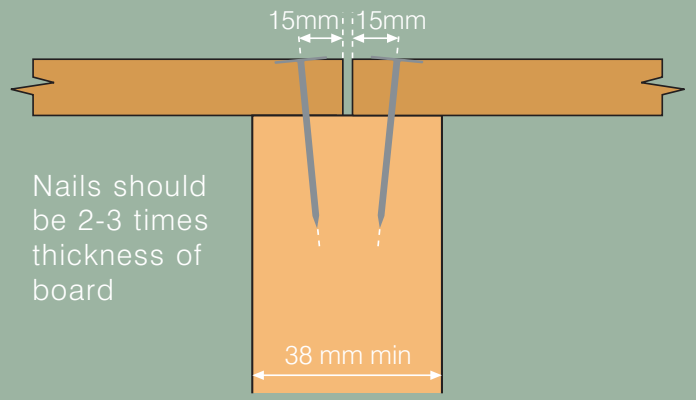
Pre-drilling pilot holes for fixings (nails or screws) prevents splitting at board ends. When installing hardwood, pre-drill all fixing points.

3.3 Only apply fixings to “dry” timber

No matter what timber is being used, it should have a moisture content less than 20% at time of installation to minimise defects and fixing issues that can arise when wood shrinks.

Only apply fixings to pressure treated wood after treatment and only after the component has re-dried to a moisture content of 20% or less.

Figure 3. Nailing board ends



Where board ends abut, pre-drill nail fixing holes and insert nails at an angle 15mm in from end

Figure 4. Board fixing point

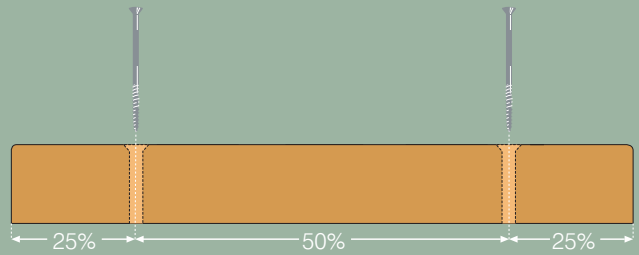
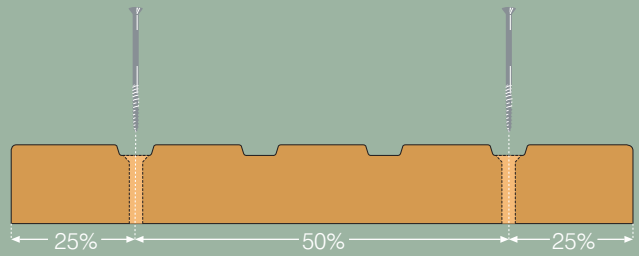


Figure 5. Grooved board fixing point



Fixing points on boards should be positioned 25% in from each side. On grooved boards the fixing point is at the bottom of the groove

4. Types of metal fixings

4.1 Bolts and landscape screws

Bolts and landscape screws are heavy-duty fixings. They should be used when installing components where strength and safety is critical; beams to posts; newels to beams or joists and ledger boards/wall plates to a building.

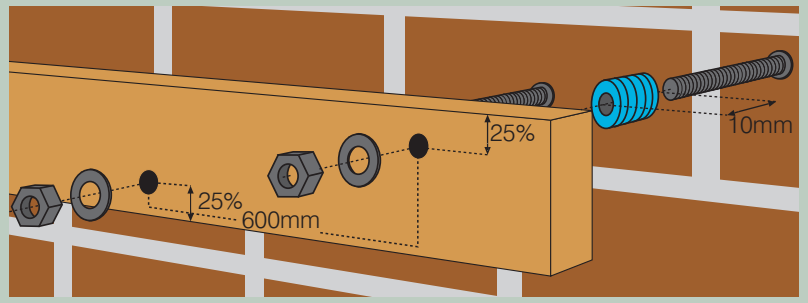
Bolts should be 25mm longer than the combined width of the components being joined. Drill holes in wood at the same size or slightly larger than the diameter of the fixing. For best results, particularly on visible fixing points, use dome headed, carriage bolts which are self anchoring when tightened.

When fixing ledger boards or wall plates to a building, expanding or chemically secured anchor bolts are recommended. Always ensure that any wall to which a ledger is fitted is structurally sound and capable of withstanding the additional loadings that will be placed on it. A space of at least 10mm should be left between the wall and the ledger board to permit any water running down the wall to drain away freely. This is particularly important if the finished deck is close to or above the damp proof course level (dpc) of a building.

Figure 6. Dome headed through bolt

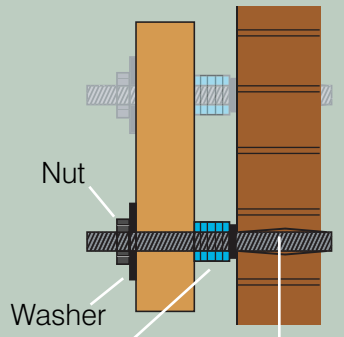
Figure 7. Expanding anchor joint

Figure 8. Ledger board fixing



A 10mm (minimum) gap should be left between the wall and the ledger board. Bolts should be positioned offset, 25% in from the top and bottom of the board, 600mm max apart.

Figure 9



Add washers to give 10mm minimum space

Expanding metal or chemically cured joint.

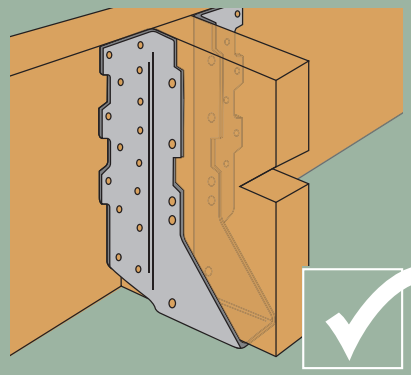
Figure 10. Use self anchoring dome headed bolts where appearance is important

Landscape screws come in a variety of styles and are extremely useful if only one side of a component is accessible. Most have either round or hexagonal heads. Preferably, pre-drill a pilot hole two-thirds the length of the fixing slightly smaller than the diameter of the shank of the fixing and use a washer. Some designs of landscape screw have a built in flange, which acts as a washer. Where a component like an edge board is to be installed over the fixing it is advisable to use countersunk head landscape screws for a smooth finish.

Figure 11.
Self-countersinking

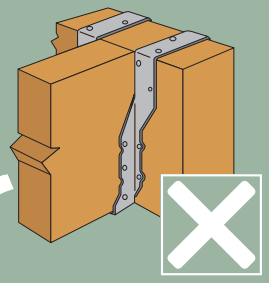
Figure 12.
Hexagon head

Figure 13



Face fixed joist hanger. Always fasten with nails or screws made from the same material

Figure 14



Joist hangers with wrap over arms are not recommended

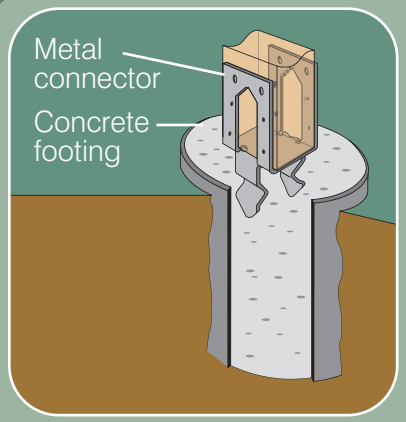


Figure 15

Figure 16

Post anchors secure support posts to concrete footings or slabs. Figure 15 shows a version embedded in concrete when wet. Other versions are available that can be bolted to dry concrete; or provide the ability to adjust post height or to provide a gap separating the base of the post from the floor (Figure 16) which is vital if pressure treated wood is not being used.

4.2 Pre-formed connectors

The use of pre-formed connectors not only makes deck construction easier it also strengthens the joint between one component and another significantly and prevents any splitting of wood or weak points that can occur if only nails or screws are used. Connectors are available for almost any situation where timber components are joined. The most widely used connectors for deck construction are post anchors and joist hangers.

Post anchors are used to secure the main load bearing posts of a deck to a concrete footing or solid surface. They are also useful for keeping timber out of direct ground contact or wet conditions as an added precaution to extend the performance life of the component.

Post anchors come in a variety of options. Some are designed to be embedded in wet concrete while others are for fixing to dry concrete footings, slabs or solid surfaces. In areas prone to high rainfall or where there is boggy ground or standing water use versions that lift the post clear of the ground.

Joist hangers are used to make secure joints between joists and beams or joists and ledger. Hangers are available in a number of different styles. Face fixed designs are preferable to designs with arms that wrap over the top of a joist as the arms may interfere with the smooth and secure fixing of the deckboard surface.

4.3 Nails

Nails can be used for many aspects of deck construction from creating the frame to fixing the deckboards. Annular ring shank nails give the best hold and resist the propensity of nails to ease upwards as wood expands and shrinks with the seasons. However, if there is likely to be any requirement in the future to lift boards for any reason then fixings that are more easily removed without damage to the board should be used.

In terms of length, nails should be at least 2-3 times the width of the top piece of wood being fixed. If the point of the nail is particularly sharp then it should be blunted by a hammer blow prior to fixing to prevent splitting of the wood.

All nail fixing points should not be closer than 15mm to the edge or end of a board. It is recommended that the fixing points at all board ends should be pre-drilled to prevent splitting. Galvanised nails should have a head that has a coating of sufficient thickness to withstand the hammering process and prevent the early onset of corrosion and staining of the wood.

High pressure nail guns should only be used with care because they have the potential to cause splitting and surface marks.

The heads of nails should not be driven below the surface unless the timber is known to have a high moisture content and shrinkage would leave the nail head exposed.

NOTE: Nails should not be used to fix hardwoods. This is because nails can cause splintering of the surface and are not strong enough to resist any movement caused by changes in the moisture content of a component.

Figure 17. Qualities of a timber deck screw

Drive recess
Cross style (PZ2) is industry standard. Square and star styles also available for improved driver bit stability and slip resistance.

Collar
Must be adequate enough to hold component and provide deep enough recess for drive efficiency

Ribbed collars
Ream the surface and self countersinks the screw

Material
Must be strong yet flexible and highly resistant to corrosion. Stainless steel or case hardened steel with suitable corrosion resistant outer coating are best.

Part threaded shaft
Eliminates the lifting or pulling apart of components that can occur with fully threaded screws

Single thread
Machined to facilitate fast entry without reaming with high pull out retention.

Machined point
Gives immediate grip. Helps avoid splitting when no pilot hole is used in softwood

Note: Pilot holes
Screws that comply with the above specification can be used without the need for pre-drilling on softwood species.

Hardwoods should always be pre-drilled.

4.4 Screws

Screws provide a number of advantages over nails; they hold very securely; are unlikely to lift if movement takes place in the wood; are easily removed to allow access to the under deck area; are less likely to be damaged during installation and hammer dents on the boarded surface are avoided.

Screws should be at least 2.5 times the width of the component being fixed. For example, to install 20mm thick deckboards, 50mm long screws should be used. For 30mm thick deckboards, 70mm screws are recommended.

The TDA recommends that all screw fixing points are pre-drilled and countersunk slightly below the surface. When countersinking, take care not to damage the surface or go too deeply below the surface to create a hole in which water can be held.

A number of screws have been developed in recent years specifically for laying deckboards. They include features such as tri-lobular shanks, self drilling threads, self countersinking heads and different protective coatings. Some designs are suitable for driving straight into wood without the need for pilot hole drilling. When using purpose designed decking screws always follow the manufacturers instructions.

When installing hardwood, pre-drill all fixing points slightly oversize (2mm is recommended) to allow for any movement in the timber and countersink. If the board is larger than normal or is supplied undry then more space for movement should be allowed for by drilling a recess through which a larger hole is made. A washer is then added under the screw head. For this type of fixing only stainless steel should be used. Dome headed screws will also prove more visually pleasing (see Figure 18).

Do not fix screws closer than 25mm to board ends. Where two boards abut one another then a double joist or batten will have to be installed to support the fixing. (see Figure 19) In this respect it makes sense to plan the deckboard laying so that butt joints occur on the same line otherwise the use of supplementary joists or battens will become excessive.

Power drivers

Use high speed power drivers with care as these can, in unskilled hands, burn the corrosion resistant coating from some screws and damage the surface of the wood. Preferably use hand held “impact” screw drivers. These are less likely to damage the drive recess and will insert the screw at the optimum speed to minimise coating burn.

DeckMark™ quality assured screws are widely available

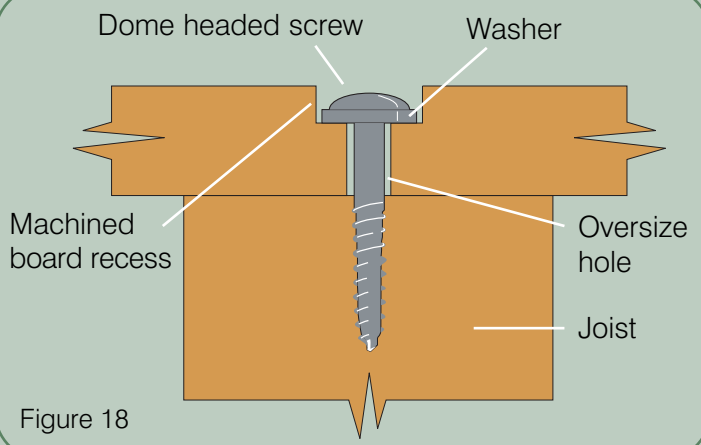
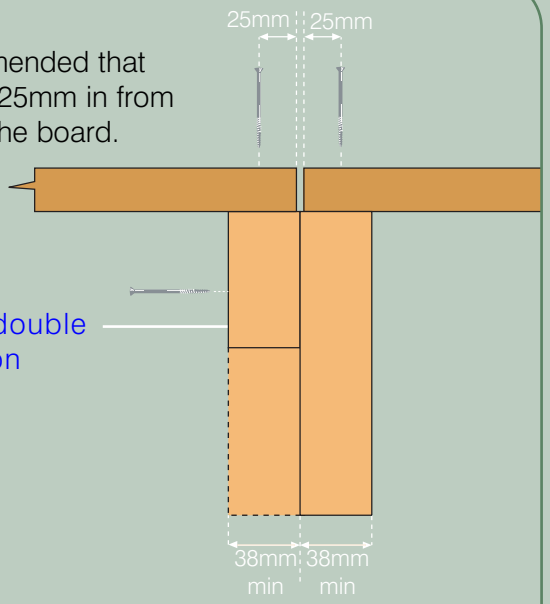


Figure 18

Figure 19

It is recommended that screws are 25mm in from the end of the board.



When screw fixing abutting boards install a batten or second section of joist to provide adequate support. The length of the batten / joist section should be equivalent to 3 deck boards in width.

4.5 Concealed clips

Through fixing with screws is the TDA's preferred method of securing deckboards however where aesthetic reasons require that fixing points should not be visible then concealed clips may be considered. A variety of clip styles are available and not all are universally suitable for use with both softwood and hardwood deckboards. Check suitability with the manufacturer, particularly when a board made from hardwood is specified. This is because clips tend not to leave a large enough gap between boards and natural movement that takes place in the wood can dislodge a concealed fixing and splinter the side of the board. To minimise the effects of board movement only install concealed clips when the moisture content of the board is below 20%. Clips also make it difficult to remove an individual board once it is fixed in position.

Concealed fixings do result in a clear surface effect but they require more care and time to install and this should be taken into account when calculating the construction budget and timetable.

4.6. Concealed fixing techniques

As an alternative to concealed clips, designers have the option of creating panels of boards which are back-fixed using a batten of wood on the underside. As recommended previously, two fixing points are used for each deckboard and a space of 5mm (min) is left between boards. Battens are spaced to coincide with the frame supports so that when the panel is

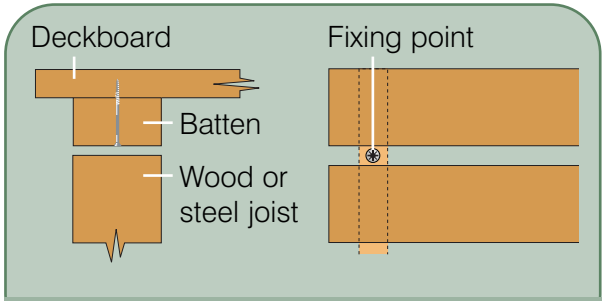


Figure 20. Concealed fixing technique

turned over and positioned in place it can be secured by screw fixing through the 5mm gap between boards. This is a very useful technique where:

a) Panelled effect is required
b) Steel is the substructure material such as on balcony installations
c) A panel needs to be removed for access to a manhole, lighting or for maintenance.

5. DeckMark quality products

The TDA operates a quality assurance scheme called DeckMark™ which verifies the quality standards of products used for decking and outdoor wood applications.

Details of DeckMark™ approved fixings can be found in the list of TDA members on our website www.tda.org.uk

Only use products and timber that complies with the TDA DeckMark quality assurance scheme.

Every effort has been made to ensure the guidance given in this publication is accurate and the TDA cannot accept any liability for loss or damage arising from the information contained herein or from a TDA member not complying with our recommendations.

Photographs
We are grateful to the following TDA members for permission to use photographs in this publication: Tite-Fix, Spax Screws, Hoppings Softwood Products, HLD

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