

Chapter 8

STORAGE AND HANDLING REQUIREMENTS

Appropriate storage and handling of veneers, substrate and veneered panels is a critical factor in producing good quality products.

Requirements for storage and handling of veneer, substrate and veneered panels are provided in the AS/NZ 1859 series dealing with reconstituted wood-based panels:

- Part 1 Particleboard (Ref.2)
- Part 2 Medium density fibreboard (MDF) (Ref.3)
- Part 3 Decorative overlaid wood panels (Ref.4).

The following recommendations for storage and handling are essential in order to maintain veneers and panels in good order and condition:

- The storage area should be located in an enclosed dry building, which should minimise rapid changes in temperature and humidity. The area should be well ventilated with good air circulation. Open-sided sheds should not be regarded as dry stores. It is recommended that the humidity and temperature in the storage area be recorded.
- All packs should be evenly supported at each end and at intervals of not more than 600mm. Where packs are multiple stacked, all supports should be vertically aligned (Fig.9). This will reduce the potential for colour change of exposed edges if exposed to ultra-violet light.
- Should it be necessary to store in the open, veneers, layons and decorative overlaid wood panels should be covered with waterproof sheet, supported on battens laid on top of the pack allowing air to circulate around and over the pack. The cover sheet should protect both sides and ends to floor level and be tied to prevent lifting.
- The stack should be kept dry and clear of the ground, and be placed so that it will not be exposed to mechanical damage.
- Where packs are supported on bearers manufactured from decorative overlaid wood panels, care should be taken to ensure water does not make contact with the bearers. Added care can be taken by supporting each bearer on natural timber packing or other impervious material. The minimum thickness of packing should be 38mm.
- To avoid staining and fading, the sheets should not be exposed to the weather while awaiting installation.
- The surface should be kept free of contaminants, e.g. dust, oil and adhesives that will affect the overlaying of veneer, plastic laminate and other surface finishes.
- Sheets should be installed in accordance with the manufacturer's instructions.
- Small quantities of formaldehyde may be emitted from wood-based panels. Under normal conditions, atmospheric concentrations of formaldehyde will be well below recommended threshold levels. If large quantities of panels are stored together, there may be risk of formaldehyde build-up. Provisions for ventilation in storage areas should prevent formaldehyde build-up.

Chapter 12

FINISHING VENEERED PANELS

12.1 General requirements

Panels produced by veneered panel companies leave the factory as raw, unfinished products. This means that even if they meet all standard requirements, their performance and quality in the final veneered products depends on the further handling and manufacturing process, which is usually undertaken by furniture or joinery companies. The veneered panel producer does not have any control on how the panels will be handled and what production procedures will be applied. Therefore, it is critical that a manufacturer of veneered products who receives the raw panels understands and strictly follows the requirements and guidance developed for the veneer and veneered panels.

An important stage in the manufacture of veneered products is the finishing process. It is usually undertaken by furniture or joinery companies or by a specialised finishing factory.

The finishing of veneered panels should be taken with special care in order to eliminate any problems that could affect product quality and performance.

There are many different finishing systems, methods and equipment used on veneered products. This information is readily available in various finishing manuals, handbooks and training materials and is not within the scope of this manual. However, typical problems and faults related to finishing systems are described and provided on how to prevent them. Recommendations on proper finishing procedures are also outlined.

There are many claims related to poor performance and quality of veneered panels and products due to problems with finishes. Such claims are often difficult to investigate due to the many potential causes of the problem and lack of quality control records. Each problem has to be traced individually by enquiring into every detail of application in as methodical a manner as possible. The problem is very complicated when the fault is caused by more than one factor.

It is often difficult to get accurate and detailed information from a manufacturer or user of the product. In such a case, finding the facts becomes almost impossible.

12.2 Selection of coatings

Recommendations for the selection of coatings for finishing of veneered panels have been developed by the Australasian Furnishing R&D Institute (AFRDI/Furntech) at the request of the Decorative Wood Veneers Association (Ref.1). The information provided in this Chapter is based on these recommendations.

It is important that the selection of finish is suitable for the end use application of the finished piece of furniture. For example, a highly decorative display cabinet does not need the same durable coating as a kitchen table or a laboratory bench.

The guidelines for the selection of coatings for veneered panels are provided in Table 2.

Table 2. Guidelines for selection of coating systems for veneered products

Type of finish	Properties	Typical application area
Nitrocellulose	<ul style="list-style-type: none"> • Simple, easy to use • Fast drying • Economical 	<ul style="list-style-type: none"> • General lounge and bedroom furniture • Furniture restoration • Wall panelling • Casket manufacture
Pre-catalysed	<ul style="list-style-type: none"> • Improved mar and scuff resistance • Fast drying • Medium water and solvent resistance 	<ul style="list-style-type: none"> • Dining room tables • Wall panelling • Office furniture
Acid catalysed	<ul style="list-style-type: none"> • High build • Superior mar and scuff resistance 	<ul style="list-style-type: none"> • Dining and office furniture • Utility furniture • High use areas
Polyurethane	<ul style="list-style-type: none"> • Excellent chemical solvent and water resistance • High build • Excellent mar and scuff resistance 	<ul style="list-style-type: none"> • Vanity units • Kitchen cupboards & doors • Kitchen units • Laboratory, hotel and office fittings and furniture • Bars and restaurants

When selecting the finish, it is also important to take into account the type of veneer used in the veneered panel. Open grained veneers may require filling, especially if a high gloss finish is desired, or a more flexible lacquer. Some species of timbers contain a high level of various extractives (eg. phenols, tannins), which can cause discolouration when reacting with the finish. These species are best sealed with a specially formulated "isolator" to stop the chemicals in the wood reacting with the chemicals in the topcoat. Lacquer manufacturers can provide advice as to the most suitable coating system for particular species.

It may be necessary to use two or more coating systems on a piece of furniture. For example, a dresser or sideboard needs a very durable serving surface, while the vertical surfaces can have a less durable, but just as an attractive coating.

REMARK

Under no circumstances should two-pack products be put over single pack coatings.

12.3.9 Incorrect choice of lacquers

The choice of sealer and lacquer is very important. Problems often occur if components of the finishing system are incompatible with each other. In such cases, it is difficult to solve a dispute between the user and the suppliers of these various finishing components. It is essential that all the components of a finish are compatible and come from one supplier/producer.

12.3.10 Improper handling of finished panels & products

When a satisfactory finish has been obtained, it is essential to ensure that proper handling procedures are applied in order to maintain the quality of the finish. The following precautions should be undertaken:

- Allow ample time for lacquers to cure thoroughly before handling and packaging, otherwise damage to the lacquer will occur.
- The finished panels should not be placed into enclosed boxes too soon after lacquering, as there will not be sufficient air circulation to cure the lacquer.
- Panels should not be stored in damp, draughty or hot warehouses or factories.
- Maintenance instructions should be provided by the supplier of the finished product and should be strictly followed by the users of the veneered products. In particular, if an inappropriate cleaning agent is used regularly it will damage the coating and allow moisture to enter. This will lead to the loss of gloss, whitening, embrittlement and veneer checking.

12.4 Recommendations on finishing procedures

- Veneered panels should be stored according to standard requirements in order to eliminate any factor that could affect the quality of the panels. Storage and handling requirements are described in Chapter 8. In particular, it is important that veneered panels are not exposed to damp and humid conditions. Several veneer cracking problems have been attributed to exposure of furniture or veneered panels to such conditions for several weeks.
- It is essential to check the moisture content of panel before the finishing process. This requirement is particularly important if the finishing is done by a sub-contractor in another factory, as the moisture content of veneered panels can easily increase while in transit. Finishing materials should not be viewed as barriers to moisture content changes – they really only slow the process due to their low moisture vapour transmission characteristics.
- The panels should be free from marks, indentations, etc. that will detract from the panel's final appearance. They should be clean – dust and grit will adversely affect finish. Oil, wax and other contaminants also need to be removed before a lacquer is applied. If necessary a grease remover should be used.
- It is essential that the type of finish selected for a piece of furniture or other products is suitable for the end use application – domestic or commercial, damp or dry conditions, light, general or heavy use.
- Finishes should be applied under controlled environmental conditions, away from draughts, dust, moisture and other contaminants.
- It is essential that the manufacturer's instructions are carefully followed and that finishing products from different suppliers not be mixed or used on the same board.

Chapter 13

MANUFACTURING AND MAINTENANCE OF VENEERED PRODUCTS

Generally, the manufacturing process, which uses veneered panels, involves machining, joining and assembly of various components. However, the production methods and procedures depend on the type of products, their design and the machinery available at particular manufacturing premises.

The description of various production methods is not within the scope of this manual. However, it is important to highlight that manufacturing companies have a great responsibility for the quality of final veneered products. High quality properly manufactured veneered panels can be seriously affected if further manufacturing procedures and maintenance of the final products do not meet the requirements specific to veneered products. Therefore, it is essential that all parties involved in the production of the products and their users strictly follow recommendations and requirements developed for the veneered products.

It is strongly recommended that:

- Finished veneered panels are not stored in warehouses/factories that are damp, draughty or hot. Standard requirements for storage of veneered products should be strictly followed (Chapter 8). The same requirements apply to the conditions in a factory in which the manufacturing process takes place.
- Final veneered products should be carefully packed to protect against mechanical and/or environmental damage during transport and storage.
- Products should not be placed or installed in wet, damp or very hot rooms/buildings. These extreme conditions may cause a serious damage to the veneered products. Too early installation of the products in newly constructed buildings may be particularly devastating. There have been instances of severe deterioration of the products (such as desks, tables and panelling) delivered to a site before contractors have finished internal work.
- It is essential that a proper cleaning agent be used by the users of veneered products. If an inappropriate cleaning agent is used regularly, it will damage the coating and allowing the ingress of moisture. This will lead to the loss of gloss, whitening, embrittlement and veneer checking.

Chapter 14

COMPLEX PROBLEMS IN VENEERED PANELS

Problems can occur in veneered panels/products at any stage of the process if the manufacturing procedures are not strictly followed. Examples of typical failures related to each of the manufacturing stage have been described in the earlier chapters. However, in some cases many different factors can cause the failure of the final product, making it difficult to trace back through all the stages of the manufacturing process in order to determine the cause of the failure. Typical examples of such a failure are veneer checking and discolouration of veneered panels. These two types of problems frequently occur in the veneered products that have been improperly treated.

14.1 Causes of veneer checking and its prevention

There are many causes of veneer checking, but they can be eliminated or significantly reduced if proper manufacturing and quality control procedures are in place. The most frequent factors which affect veneer checking are the selection of veneer species, type of core material and construction methods, moisture content of veneer and the core, adhesive and the gluing process, conditioning and storage, finishing process and the maintenance of the final products (Ref.13 & 23). These factors are analysed below:

Cause 1: Veneer species and quality

Species that are highly porous or "ring porous" such as oak and walnut are very susceptible to checking. This is also true of those woods that have a high degree of figure. Greater density woods are most prone to checking. There will, of course, be some overlapping between various types of wood and no hard or fast rules can apply.

Quality of veneer used is extremely important as defects greatly increase the possibility of surface checking by providing weak zones. Cracking of the more popular straight grain veneers rarely occurs although exceptions have been noted when items have been stored in a humid area for some weeks before finishing.

Cracking of the so-called "exotic veneers" is more common. The main difficulty here is that these veneers are brittle and, at the recommended moisture content of 10%, are probably too distorted for any preparation to be carried out without severe splitting of the veneers. These brittle veneers have to be wetted to improve their handling characteristics. The excess water is then removed by the "flattening" process.

Cause 2 Moisture content changes

Veneer cracking and checking mainly occurs as a result of the movement of veneer or the substrate due to changes in moisture content. As the dimensions change, stresses between the veneer and the core occur. When these stresses reach the point where they exceed the structural strength of the veneer, a rupture of the fibres takes place. This, in effect, shows up as a check or minute split on the surface. The cracks closely follow the grain direction of the decorative veneer.

Changes in moisture content can occur if:

- The moisture content of veneer or/and the substrate prior the manufacturing process commences is too low or too high.
- The ambient conditions in the storage area do not meet requirements (too humid or too dry).
- The ambient conditions in the veneering factory do not meet requirements (too humid or too dry).

- Veneered panels are not protected against the moisture changes during the transport and storage before the finishing process starts.
- An inappropriate coating system is used and the veneered panels are not sealed and coated on all surfaces.
- The maintenance of the veneered surfaces while in service does not comply with the lacquer manufacturer's recommendations.
- Veneered products (eg furniture) are exposed to extreme environmental conditions while in service.

REMARK

Contrary to some manufacturers' expectations, lacquers do not stabilize the moisture content of the underlying veneer, they merely delay the first appearance of any cracks. While a more flexible lacquer will absorb some of the movement of the veneer, a lacquer with good performance in other respects cannot be expected to bridge over open cracks in the veneer.

Cause 3 Improper gluing and pressing procedures

The veneer checking can occur if:

- There is too much water in the glue mix. The glue mix should not be extended too much with wheat flour and additional water.
- Assembly time is too long. Assembly time has been shown to have a significant effect on veneer checking – the longer the assembly time the more checking that will subsequently occur. It is important to keep the assembly time to a minimum – within minutes of spreading.

Cause 4 Improper conditioning and finishing of panels

Cracking of veneer often occurs when panels have been exposed to damp conditions for several weeks before finishing (transport or storage). Therefore, it is essential that the factory in which the finish is applied has a special conditioning room for storing panels. The moisture content of panels before finishing should be in the middle of the range of experience in service. It will be at or below 12%. It is important to check the moisture content of panels before finishing to reduce the potential for veneer checking. Manufacturers should be aware that reasonable temperature and humidity requirements should be provided for storing completed furniture. If humidity rises substantially during storage, the manufacturers will encounter not only sticking drawers and doors, but also the possibility of creating veneer checking if that furniture is subsequently placed in dry ambient environment.

Cause 5 Improper maintenance of veneered products

Finishing materials should not be viewed as barriers to moisture content changes – they are only retarders. Moisture content changes are therefore possible which will result in veneer checking. The moisture change may occur if:

- The final product is exposed to extreme conditions of environment (too dry or too humid) or to changing conditions (dry-humid-dry-humid). There are areas in Australia where, during the winter period, the equilibrium moisture content of furniture in centrally heated rooms may be as low as 5-6%. However, in northern states during humid months the moisture content of timber products may be as high as 15%.
- Improper cleaning procedures are used (frequent wetting of veneered surface).
- Improper cleaning agent is used (eg. heavy-duty detergent or abrasives).

14.2 Discolouration of veneered products

14.2.1 Changes in colour of wood

The variation of colour within-species is a natural and valuable characteristic of wood, which makes solid wood and veneers much more attractive materials than the products that imitate wood's appearance.

The colour of wood depends mainly on the presence of extractives, complex organic compounds, such as polyphenolic compounds and quinines (Ref.8). It is impossible to maintain the colour exactly as it appears on the freshly dressed wood surface. When subject to long-term exposure to sunlight or moderate to strong interior lighting, these compounds undergo chemical change that result in the change of wood colour.

Even very clear finishes will change the colour of wood considerably. They fill the air spaces among the wood fibres and as they have a higher refractive index than air the result is a darkening of the colour. To obtain an indication of the effect of a clear finish on the colour of the wood, wetting a small area with water will give a good fast guidance.

14.2.2 Discolouration and staining of veneers

Veneer products are susceptible to discolouration and staining, which can be caused by various factors, such as:

- The effect of strongly acidic adhesives and/or coatings on the natural extractives in the wood, or from the reaction between extractives and strong alkalis.
- The reaction between tannin in timber and iron particles resulting in dark iron tannates. Many species have a high tannin content which reacts with iron to form black/grey and insoluble iron tannates if the wood is in a wet condition. Such stain is limited to the surface. Spotty iron tannate staining may even result from the atmospheric fallout of particles produced in tool sharpening, etc. Aluminium, monel metal and galvanized steel do not cause staining but in the latter case it is important that the galvanizing remains undamaged during the driving of the nail (Ref.8).
- Degradation by UV light can occur due to the exposure to sunlight. The exposure to sunlight results in a gradual bleaching of red/dark woods and a yellowing of blonde woods. Such changes are limited to the surface layers of wood and the original colour can be regained by sanding or planing the surface. UV-inhibitors can be added to finishes to reduce the yellowing effect on lighter timbers.

A survey of the veneer panel producers and the users of the veneered products has been undertaken in Australia aiming to identify the most common problems related to veneer discolouration (20). The results of the survey enabled the researchers to summarise the most common and most typical examples of veneer discolouration and these are as follows.

- **Red/pinkish staining of blackwood, American cherry and European beech**
The discolouration occurs on veneered panels in the form of red stains. This is caused by the reaction between extractives in the timber and an acid from the glue system or the finish used in the panels.
- **White staining of steamed European beech veneers**
This discolouration problem was serious a few years ago, but the occurrence of white staining has significantly reduced after the results of an experimental research project were published in 1998 (Ref.19), which recommended only polyurethane lacquer be used on beech veneers to avoid white staining and that moisture resistant substrates be used with beech veneer in wet areas (kitchen & bathrooms).

- ***Iron contamination of glues and veneers***
 Grey or black discolouration of glues due to contact with iron has been reported. Both PVA and urea glues can be affected by iron contamination if stored in steel containers. Low pH acidic PVA is most susceptible to this problem. Sometimes the glue does not change its colour while in the container, but the discolouration is visible after the veneer is laminated on the substrate. Therefore, no steel component should be used in the glue container, even in the tap. This recommendation applies to both the glue suppliers and the glue users who often pour the glue into smaller containers after purchasing.
- ***Black staining of Tasmanian oak veneer.***
 This type of staining has been identified as a serious problem and occurs mainly in tropical Queensland (around Cairns and Port Douglas). Black spots have also been known to occur on black wattle veneer in tropical applications.
- ***Pink discolouration of American maple, silver ash and beech***
 Individual cases of pink discolouration have been reported. According to the information provided, only a small proportion of the total number of veneered products was affected, although they were manufactured by the same company at the same time.
- ***Discolouration due to the exposure to the ultraviolet (UV) light***
 Some veneered products are particularly sensitive to UV light. It was reported that sapele veneers become significantly darker when exposed to the UV light while jarrah veneers become lighter. Some manufacturers have observed different effects, which suggests colour changes may depend on variation between