

AWS

Additional Resources

Appendix B

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These additional resources are provided to assist in the use and understanding of the *Architectural Woodwork Standards*; however, none of what is included within this Appendix is to be interpreted as part of the *Architectural Woodwork Standards* for compliance purposes.

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Quality Control Enforcement Options

Architectural Woodwork Institute Quality Certification Program (QCP)

Your reputation depends on others when you specify architectural woodwork. The Quality Certification Program (QCP) provides the means to ensure that the quality you specify is the quality you get.

The AWI Quality Certification Corporation (AWI QCC) is a fully independent, international credentialing body and is the sole administrator of the QCP. To fulfill its mission, which is to Verify, inspect, report and enforce architectural woodwork standards compliance, the QCP:

- Performs more than 500 inspections annually;
- Inspects firms and projects throughout Asia, Africa, Europe, and North America.
- Is ISO 65 compliant;
- Retains a highly experienced team of inspectors, each of whom must possess a minimum of 15 years experience in the architectural woodwork industry; they must pass the 150 question written test, adhere to a strict conflict of interest policy, and undergo extensive training by the QCP.

Established in 1995, the QCP provides design professionals and owners a means of verifying the skills and competence of the architectural woodwork manufacturers on a project-specific basis. As a design professional or project owner, you are protected if the woodwork delivered to a QCP project does not meet specifications. One of the major benefits of the quality certification program is that it provides the resources to prevent noncompliant woodwork from being installed on the job site.

The QCP accredits eligible woodworking firms to certify that their work complies with the project specifications and the Architectural Woodwork Standards (AWS). QCP verifies compliance with the specifications and the standards through the inspection process. This includes all certified projects registered to new program participants, all projects for which it receives an inspection-request from the design professional and/or the owner, and dozens of randomly chosen projects each year.

Woodworking firms earn certification credentials through comprehensive testing, rigorous inspections, and the submittal of 10 trade references. Moreover, they must demonstrate the ability to fabricate, finish, and/or install work in accordance with the quality grade criteria set forth in the Architectural Woodwork Standards (AWS).

QCP suggested specification language 1 — Quality Standard: Unless otherwise indicated, comply with “Architectural Woodwork Standards” for grades of interior architectural woodwork, construction, finishes, and other requirements.

Provide AWI Quality Certification Program [labels] [certificates] indicating that woodwork [including installation] complies with requirements of grades specified. This project has been registered as AWI/QCP Number _____

OR, the contractor, upon award of the work, shall register the work under this Section with the AWI Quality Certification Program. (800-449-8811)

The QCP is endorsed by every leading organization that values quality, including the U.S. General Services Administration (GSA) and the American Subcontractors Association (ASA). Put the QCP to work for you. For more information, please visit our website www.awiqcp.org, or call (800) 449-8811.



Architectural Woodwork Manufacturers Association of Canada Guarantee and Inspection Service (GIS)

AWMAC regional chapters manage the GIS monitoring program, initiated in 1990. AWMAC GIS Certified Inspectors review, inspect and report on pretender specifications if requested, sample units when specified and shop drawings. Inspectors also perform a comprehensive final inspection of the architectural woodwork for the project owner. The AWMAC GIS program offers, through its members in good standing, a two year AWMAC Guarantee Certificate on projects which have the recommended GIS wording specified in the tender documents.

GIS MANDATE

In order to ensure that the quality of materials and workmanship of the architectural woodwork specified are in compliance with the current AWMAC Architectural Woodwork Standards (AWS), the AWMAC Guarantee and Inspection Service program (GIS) must be specified and be considered an integral component of the scope of work.

GIS OBJECTIVE

The objectives of the Guarantee and Inspection Service are:

1. To assist the design authority in achieving “good architectural woodwork”.
2. To offer the owner, customer, design authority, and woodwork contractor an assurance that strict monitoring of the architectural woodwork requirements on a given project will meet the specified AWMAC standards.

GIS WORDING FOR SPECIFICATIONS

Architectural woodwork shall be manufactured and/or installed to the current AWMAC Architectural Woodwork Standards and shall be subject to an inspection at the plant and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for this project. (Contact your local AWMAC Chapter for details of inspection costs). Shop drawings shall be submitted to the AWMAC Chapter office for review before work commences. Work that does not meet the AWMAC Architectural Woodwork Standards, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to the owner.

If the woodwork contractor is an AWMAC Manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. The AWMAC Guarantee shall cover replacing, reworking and/or refinishing any deficient architectural woodwork due to faulty workmanship or defective materials supplied and/or installed by the woodwork contractor, which may appear during a two (2) year period following the date of issuance.

If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the owner with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of the architectural woodwork contract.

For more information about AWMAC and the GIS Program visit our website at www.awmac.com and contact your local AWMAC Chapter office or phone the GIS office at: 1-866-447-7732.



Woodwork Institute

- Assurance Options -

Certified and Monitored Compliance Programs

One of the greatest joys of being a design/specification professional is seeing your ideas become reality. The Woodwork Institute (WI) has been sharing your vision since 1951.

Currently over 10,000 design/specification professionals use our *Architectural Woodwork Standards* (AWS). The AWS establishes a minimum standard of quality, while giving you the flexibility to pair your vision with your customer's desires. The AWS is offered free of charge to members of the design/specification community in our service area.

Our Directors of Architectural Services (DAS), are employed throughout our service area, and provide knowledge from significant years of first-hand experience in the millwork industry. Their primary focus is compliance verification (inspection service); however, as registered AIA/CES instructors, they also provide numerous hours of standards/quality assurance/industry-based education. Additionally, our DAS's are available as an unbiased, industry consultation service. Education, consultation, and inspection services (when specified through one of our quality assurance programs), are provided free of cost to the design/specification community.

In conjunction with the AWS, WI also offers two distinct quality assurance options:

CERTIFIED COMPLIANCE PROGRAM (CCP)

A discipline of quality control used in conjunction with the AWS, providing a non-biased means of confirming conformance to your plans and specifications. Requiring Certified Compliance informs others of the expected specifications, without bidder discrimination. When receiving certified shop drawings, you are assured they conform to your specifications and AWS requirements, leaving verification of your design intent as your primary concern. Evidence of Certification is provided primarily by issuance of a Certified Compliance Certificate, listing the items certified, the applicable Grade, and whether installation is included. Additionally, shop drawings and each elevation of casework and/or countertops shall bear an individually serial-numbered "Certified Compliance Label," if so specified. The CCP started in 1959, and now certifies over 1,700 projects annually.

MONITORED COMPLIANCE PROGRAM (MCP)

A discipline of quality affirmation used in conjunction with the AWS, providing non-biased reviews/inspections of your project from its beginning through completion with WI Certification, without bidder discrimination. Requiring Monitored Compliance informs others of the quality demanded in what you have designed and specified for your client. The Institute will issue written progress reports throughout the duration of the project. The shop drawings, millwork products, and installation (of all involved parties), will progressively be inspected for compliance to your specifications and the specified Grade per the AWS. Evidence of Monitored Compliance is provided by issuance of a Monitored Compliance Certificate, listing the items certified, the applicable Grade, and whether installation is included. Additionally, shop drawings and each elevation of casework and/or countertops shall bear an individually serial-numbered "Certified Compliance Label." The MCP started in 2001, and has now become the premier quality control option.

For more information, please visit our website at www.woodworkinstitute.com, or call 916-372-9943.

NOTES

CSI Guide Specification

Section 06 41 00

Wood & Laminate Casework

CSI Section 06 41 00

Wood and Plastic Laminate Casework

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Woodwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are **[bold, in brackets]**. Comments are shaded.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. **[Wood Casework] [Plastic Laminate Casework]**.
2. **[Plastic Laminate] [Solid Surface] [Wood]** countertops.
3. Hardware typically furnished by the casework manufacturer.
4. Shelving.
5. **[Decorative metalwork incorporated into wood casework.]**
6. Structural supports incorporated into wood casework.
7. **[Factory finishing.]**

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:

1. Metal support brackets and fittings that are part of the building structure.
2. Plumbing, electrical fixtures, and telephone equipment.

C. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Plumbing: Fixtures and fittings installed in countertops.
3. Wood Doors.

1.02 REFERENCES

- A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*.

All of the other standards are referenced within the AWS.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards*.
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:

1. Submit four **[finished]** samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", and plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.

Include Item 1 if there is any factory finished wood or veneer included in this Section.

Include Item 2 if any wood is to be provided for job site finishing.

2. Submit a sample in the specified finish of each hardware item that will be visible at exposed surfaces when the job is complete.

CSI Section 06 41 00

Wood and Plastic Laminate Casework

C. [Mockups:

Mockups shouldn't be necessary for most projects. Include this item if full sized samples are desired.

1. **Provide mockups of one base cabinet, one wall hung cabinet, and one countertop. Base cabinet shall have at least one drawer. Mockup shall be of the material and finish to be provided. The Approved Mockup may be incorporated in the project.]**

1.04 QUALITY ASSURANCE

- A. Work shall be in accordance with the Grade or Grades specified of the *Architectural Woodwork Standards*.

B. [Association Quality Assurance Program.]

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to a specific project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

- D. Single Source Responsibility: A single manufacturer shall provide and install the work of described in this Section.

1.05 DELIVERY STORAGE AND HANDLING

- A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.
 1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
 2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

- A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

- A. Lumber shall be in accordance with the *Architectural Woodwork Standards* Grade specified for the product being fabricated. Moisture Content shall be 6% to 12% for boards up to 2" (50.8 mm) inch nominal thickness, and shall not exceed 19% for thicker pieces.
- B. Veneers shall be in accordance with the *Architectural Woodwork Standards* requirements for its use and the Grades.
- C. Core shall be [MDF] [particleboard] meeting the requirements of *Architectural Woodwork Standards*.

Particleboard or MDF are recommended as core materials.
- D. Veneer core plywood shall be a non-telegraphing hardwood manufactured with exterior glue.
- E. Plastic Laminate shall meet the requirements of the *Architectural Woodwork Standards* for its intended use.

CSI Section 06 41 00

Wood and Plastic Laminate Casework

F. [Cabinet Liner shall be type CLS.]

Include this Item if you intend to use cabinet liner at semi-exposed surfaces.

G Edgeband

1. Veneer of the same species and cut as the exposed surfaces.
2. [PVC] [ABS] [high pressure decorative laminate].

PVC and ABS edgeband are available to match many laminate patterns. PVC is more durable than laminate and it is less subject to glue failure. PVC is available in 3mm and 0.5mm thicknesses. 0.5mm is generally used at case bodies, and 3mm may be used at doors, drawer fronts, and false fronts. ABS is a new product that claims to have the positive qualities of PVC without the environmental down side.

H Adhesives used shall be [type I] [type II].

Type I glue is water proof; Type II is water resistant. Type II is satisfactory except in a very wet environment.

I Hardware:

1. Pulls: [_____].
2. Drawer Guides shall be [full extension] [¾ extension] AWS approved.

If you specify brand and model of drawer guides, specify for pencil drawers, box drawers, file drawers, and lateral file drawers, as applicable.

3. Hinges: [five knuckle Grade 1 hinges] [concealed European style Grade II hinges minimum 120° opening]
Brand, Model. Hinges shall be AWS compliant.

The AWS requires Grade I hinges for schools, hospitals and recommends such for police and fire facilities, and other high usage applications.

4. Door Catches: [_____]

If self closing hinges are selected catches will not be required. Self closing Grade I hinges are not available.

5. Shelf Supports: Shelf supports for adjustable shelves in wall-hung cabinets and the upper half of tall cabinets shall be designed to prevent shelves from sliding forward in a seismic event.

Bored hole shelf support systems and metal shelf ladders have both been determined to provide satisfactory support.

6. Locks

- a. Door locks: [_____].
- b. Drawer locks: [_____].
- c. Glass door locks: [_____].
- d. [_____].
- e. Provide [_____] keys per lock.
- f. Elbow Catches: [_____].

Elbow catches will only be necessary at the inactive leaf of locking pairs of doors. If no door locks are required, elbow catches will not be necessary.

7. Sliding glass door hardware: [_____].

Sliding glass doors that are more than 1 ½ times as tall as they are wide should be installed using top hung hardware. Tall, thin glass doors on bottom roller systems will tip and bind.

8. Etc.

Other hardware items may include wire grommets, keyboard trays, and other specialty items.

2.02. FABRICATION

A. Wood Casework

1. Casework shall meet the requirements of the *Architectural Woodwork Standards* [Premium Grade] [Custom Grade] [Grades shown on plans].

The AWS allows the use of Economy Grade for custodian's closets and utility rooms regardless of the Grade specified for the project as a whole (unless otherwise specified). This is usually the only application for Economy Grade.

CSI Section 06 41 00

Wood and Plastic Laminate Casework

2. Casework shall be *Architectural Woodwork Standards* CONSTRUCTION TYPE [A, frameless] [B, face frame] and cabinet and door INTERFACE STYLE [1, overlay] [2, flush inset].

Typically TYPE A and STYLE 1 go together while TYPE B goes with either STYLE 1 or 2. Almost all plastic laminate casework is TYPE A and STYLE 1.

3. Exposed Surfaces shall be [[species], [cut]], [[book][slip] matched] [material suitable for opaque finish]] meeting the requirements of the AWS for the Grade specified.

The species is the species of tree, such as Oak or Maple. The cut used is the angle of the face of the board to the growth rings. Flat sawn or plain sliced is the most common cut. Quarter sawn or Rift cut lumber is cut with the face at right angles to the growth rings, giving a vertical grain appearance. Match refers to the way veneer leaves are matched within a panel. Book match is the most common.

- a. [Blueprint Match: veneers at room(s) [_____] shall be blueprint matched.

This item is only necessary if there is an area where a blueprint match is desired. Similar language must be inserted in the Sections specifying wood paneling, wood trim, and wood doors.

1. All work in this/these area(s) shall be AWS Premium Grade.
 2. Casework, paneling, doors and wood trim shall be provided by the same manufacturer.
 3. Veneers shall be taken from the same flitch, to be selected by the architect.
 4. Faces at cabinet doors, drawer fronts and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.
 5. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.
 6. All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.]
4. Exposed interior surfaces shall be [per the requirements of the AWS] [veneer of the same species as the exposed faces] [low pressure melamine overlay].

The default choices in the AWS are very well thought out. It should only be necessary to call out a material here if you wish for something special.

5. Semi-exposed surfaces shall be [per the requirements of the AWS] [veneer of the same species as the exposed faces] [low pressure melamine overlay].

The default choices in the AWS are very well thought out. It should only be necessary to call out a material here if you wish for something special.

6. Doors, drawer fronts, and false fronts shall be [flush overlay] [reveal overlay] [lipped] [flush inset].

STYLE 1 flush overlay is the most common door style and usually goes with TYPE A construction. The other door styles are generally used with face frame construction.

B. Plastic Laminate Casework:

1. Shall be *Architectural Woodwork Standards* [Custom] [Premium] Grade.

The AWS allows the use of Economy Grade for custodian's closets and utility rooms regardless of the Grade specified for the project as a whole (unless otherwise specified). This is usually the only application for Economy Grade.

2. Exposed interior surfaces shall be [low pressure melamine overlay] [low pressure melamine overlay of a color and pattern compatible with exposed surfaces] [high pressure laminate matching exposed surfaces].

The AWS default choices for exposed interiors and semi exposed surfaces are well matched with the AWS Grades. The items above and below are not necessary unless you have specific desires.

3. Semi-exposed surfaces shall be [low-pressure melamine overlay] [cabinet liner] [laminate matching exposed surfaces].

4. Doors, drawer fronts, and false fronts shall be [flush overlay] [reveal overlay].

STYLE 1 flush overlay is the most common door style and usually goes with TYPE A construction. The other door styles usually go with face frame construction. Plastic Laminate casework is not usually constructed with face frames.

- a. [Edgeband at doors, drawer fronts, and false fronts shall be 3mm [PVC] [ABS].]

PVC and ABS edgeband come in 3mm and 0.5mm thicknesses. 3mm edgeband on doors and drawer fronts is more durable, but the thicker edge will be more noticeable if the laminate is a wood grain or other pattern rather than a solid color.

CSI Section 06 41 00

Wood and Plastic Laminate Casework

- C. Drawers shall meet the requirements of the AWS for the Grade or Grades specified.

The AWS does an excellent job of matching drawer materials and construction methods to the casework Grade. If something special is desired, modify this Item.

- D. Laminated Plastic Countertops:

1. Laminate shall be **[Manufacturer]** **[Pattern]**.
2. Core material shall be **[particleboard]** **[MDF]** **[exterior grade hardwood plywood with a non-telegraphing grain]**.

Particleboard and MDF are satisfactory in most environments. The AWS requires water resistant Particleboard or MDF at tops with sinks. Plywood is recommended only in the most abusive wet environments.

3. Back splashes shall be **ASSEMBLY** **[1-Wall mount, jobsite assembled]** **[2-Deck mount, manufacturer assembled]**.

If a preference is desired it shall be so specified, otherwise the Assembly method shall be manufacturers option.

4. Back splashes shall be **[butt joint]** **[cove]** **[per drawings]** and shall be [____] inches (millimeters) high.

If several backplash details are used, label "per drawing", and be sure all tops are clearly detailed in the plans.

5. Front edges shall be **[self edge]** **[no drip bullnose edge]** **[waterfall edge]** **[no drip tilt edge]** **[three millimeter PVC edge]** **[wood edge]**.

As mentioned above, if several details are to be used, make sure they are clearly shown or labeled on the plans.

- E. Solid Surface Countertops:

1. Solid surface shall be **[brand]** **[pattern]** **[color]**.
2. Back splashes shall be **[butt joint]** **[cove]** **[per details]** and shall be [____] inches (millimeters) high.

If several backplash details are used call out "per details," and be sure all tops are clearly detailed in the plans.

- F. Front edges shall be **[self edge]** **[no drip bullnose edge]** **[waterfall edge]** **[no drip tilt edge]**.

As above, if several details are to be used make sure they are clearly shown or labeled on the plans.

- G. Factory Finishing

1. All products provided in this Section shall be factory finished using *Architectural Woodwork Standards* finish system [____].
2. Finish shall be AWS **[Premium]** **[Custom]** Grade.

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Verify the adequacy and proper location of any required backing or support framing.
- B. Verify that mechanical, electrical, plumbing, and other building components affecting work in this Section are in place and ready.

3.02. INSTALLATION

- A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
 1. Installation shall conform to the AWS Grade of the items being installed.
- B. All work shall be secured in place, square, plumb, and level.

CSI Section 06 41 00

Wood and Plastic Laminate Casework

- C. All work abutting other building components shall be properly scribed.
- D. Mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end, shall be countersunk.
- E. Equipment cutouts shown on plans shall be cut by the installer.

3.03. ADJUSTING & TOUCH UP

- A. Before completion of the installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.
- B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items that cannot be repaired shall be replaced.

3.04. CLEANUP

- A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification

Section 06 42 00

Paneling

CSI Section 06 42 00

Paneling

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in **[bold, in brackets]**. Comments are in shaded background.

PART 1 - GENERAL

1.01. SUMMARY

A. Section Includes:

Select the applicable items from the list below

1. **[Solid or Veneered Wood Paneling.]**
2. **[High Pressure Decorative Laminate Wall Covering.]**
3. **[Solid Surface Wall Covering.]**
4. **[Solid Phenolic Wall Covering.]**
5. **[All furring, blocking, shims, and methods of attachment from the face of the wall out.]**

Include Item 5 if installation is included.

6. **[Factory finishing.]**

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:

1. Casework, Soffits or other Filler Panels.
2. Room, Closet, or Access Doors.
3. Any structural wood framing of plywood.
4. Exposed base.

C. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Casework.
3. Wood Doors.
4. Wood Trim.

1.02. REFERENCES

- A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

All of the other standards you would reference are within the AWS.

1.03. SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards*.
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:

1. Submit four **[finished]** samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.

CSI Section 06 42 00

Paneling

2. **[Submit four additional samples of each material for the use of the paint trade.]**

Include this Item if materials are to be finished at the job site.

- C. **[Mockups:**

Mockups shouldn't be necessary for most projects. Include this Item if full sized samples are desired.

1. **Provide a mockup of one Section of paneling, including an outside and an inside corner. The mockup shall be of the material and finish to be provided.]**

1.04. QUALITY ASSURANCE

- A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

- B. **[Association Quality Assurance Program.]**

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

- C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.
3. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.
 1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry, and the area broom clean.
 2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06. SCHEDULING

- A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01. COMPONENTS

- A. Meeting the requirements of the *Architectural Woodwork Standards*.

1. Lumber shall be sound and kiln dried.
 - a. Exposed lumber shall be **[[species], [cut]] [closed grained hardwood]**.

The species is the species of tree, such as birch or oak. The cut is the angle of the face to the grain, such as plain sliced or rift. Book match is the most common. Use closed grain hardwood for painted wood paneling.

2. Veneer shall be **[species] [cut] [[book] [slip]]** matched.

The match is the way the veneers are arranged on the panel. Book match is the most common.

3. Panels for opaque finish shall be **[MDO] [MDF] [closed grain hardwood veneer]**.
4. Core material for laminated panels shall be **[MDF] [Particleboard]**.
5. Laminate shall be **[manufacturer] [pattern]**.

CSI Section 06 42 00

Paneling

6. Solid surface shall be [manufacturer] [pattern].
 - a. All solid surface at any room or area shall be from the same batch to prevent color mismatch.
7. Solid Phenolic shall be [manufacturer] [pattern].

2.02 FABRICATION

Select the appropriate items below

- A. Paneling shall be *Architectural Woodwork Standards* [Economy] [Custom] [Premium] Grade.
- B. Stile and Rail Wood Paneling:
 1. Stiles and rails shall be [3/4] [1] inch thick.
 2. Joints at stiles and rails shall be securely fastened with dowels or biscuits.
 3. Panels shall be [flat] [raised].
- C. Flat Veneered Paneling:
 1. Panels shall be [full width] [selectively reduced] [balanced sequence matched panels] [blueprint matched].
 2. Visible edges and reveals shall be [filled and painted] [match faces] [per details].
 3. Outside corners shall be [lock mitered] [mitered and splined] [per detail].
 4. [Blueprint Match: Work at room(s) [_____] shall be blueprint matched.

This item is only necessary if there is an area where a blueprint match is desired. This could apply if there is transparent finish flat wood paneling adjacent to Wood Doors and Wood Casework. Similar language must be inserted in the Sections specifying casework, wood trim, and wood doors.

 - a. All work in this/these area(s) shall be AWS Premium Grade.
 - b. Casework, paneling, doors and wood trim shall be provided by the same manufacturer.
 - c. Veneers shall be taken from the same flitch, to be selected by the architect.
 - d. Faces at cabinet doors, drawer fronts, and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.
 - e. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.
 - f. All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.]
- D. High Pressure Decorative Laminate Paneling:
 1. Panels shall be [full width -OR- selectively reduced].
 2. Visible edges and reveals shall be [filled and painted] [match faces] [per details].
 3. Outside corners shall be [lock mitered] [mitered and splined] [per detail].
- E. Solid Surface Paneling:
 1. Panels shall be [manufacturer], [pattern].
 2. Reveals shall be provided for expansion a maximum of 96" (2438 mm) on center.
 3. Reveals shall be [butt jointed and caulked] [covered with a trim batten] [splined with a loose spline].
 4. Outside corners shall be [hard seamed] [per details].
- F. Solid Phenolic Core Paneling:
 1. Reveals or slip joints shall be provided for expansion a maximum of 96" (2438 mm) on center.
 2. Reveals shall be [butt jointed and caulked] [be provided with a trim batten].
 3. Outside corners shall be [butt jointed] [trimmed with a metal corner mold] [per details].

CSI Section 06 42 00

Paneling

G. [Factory Finishing:

This Item will not apply to HPDL, Solid Surface, or SPC paneling. As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers.

1. All products provided in this Section shall be factory finished using **Architectural Woodwork Standards** finishing system [_____].
2. Finish shall be AWS [Premium] [Custom] Grade.]

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Verify the adequacy and proper location of blocking and support framing.
- B. Verify that mechanical, electrical, plumbing, and other building components (supplied by others), affecting work in this Section are in place and ready.

3.02. INSTALLATION

- A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
 1. Installation shall conform to the AWS Grade of the items being installed.
- B. All work shall be secured in place, square, plumb, and level.
- C. All work abutting other building components shall be properly scribed.
- D. Mechanical fasteners at exposed and semi-exposed surfaces shall be countersunk and filled.

3.03. ADJUSTING & TOUCH UP

- A. All nicks, chips, and scratches shall be [sanded smooth] [filled and retouched]. Damaged items that cannot be repaired shall be replaced.

Use "sanded smooth" if the work is to be finished at the job site. Use "filled and retouched" if the materials are to be factory finished.

3.04. CLEANUP

- A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification

Section 06 46 00

Wood Trim

CSI Section 06 46 00

Wood Trim

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in **[bold, in brackets]**. Comments are in shaded background.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Select the applicable items from the list below.

1. **[Interior Wood Door Frames.]**
2. **[Wood Door and Window Casings.]**
3. **[Wood Aprons.]**
4. **[Wood Base and Shoe Moldings.]**
5. **[Wood Chair Rails.]**
6. **[Wood Cornices.]**
7. **[Wood Fascia and Soffits.]**
8. **[Wood Stops, Stools, and Sills.]**
9. **[Factory finishing.]**

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Wood Paneling.
3. Wood and Plastic Laminate Casework.
4. Wood Doors.

1.02 REFERENCES

- A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

All of the other standards you would reference are within the AWS.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards*.
2. **[Furnish a AWS Certified Compliance Label on the first page of the shop drawings.]**
3. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:

1. Submit four **[finished]** samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.
2. **[Submit four additional samples of each material for the use of the paint trade.]**

Include this Item if materials are to be finished at the job site.

CSI Section 06 46 00

Wood Trim

1.04 QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

B. **[Association Quality Assurance Program.]**

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

D. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Lumber shall be sound, kiln dried, and in accordance with the *Architectural Woodwork Standards* requirements for its use and the Grade specified.

B. Particleboard, MDF, and Plywood shall meet the requirements of the AWS for the Grade specified and their intended use.

C. Veneered components shall be in accordance with the *Architectural Woodwork Standards* requirements for the Grade specified.

1. **[Core shall be [particleboard] [MDF].]**

If this item is not included, core is at the manufacturer's option, subject to requirements of the AWS. Particleboard or MDF are recommended as core materials.

2. Adhesives used shall be **[Type I] [Type II].**

Type I glue is water proof; Type II is water resistant. Type II is satisfactory except in a very wet environment.

2.02 FABRICATION

A. Interior Millwork shall be *Architectural Woodwork Standards* **[Custom] [Premium]** Grade.

B. Door Jambs shall be **[flat jamb with applied stop] [Plowed jamb with a T stop] [rabbeted].**

C. Wainscot height shall be [____] inches above finish floor.

CSI Section 06 46 00

Wood Trim

- D. Trim for opaque finish.
1. Moldings shall be **[MDF]** **[closed grain hardwood]**.
 2. Flat trim items shall be **[MDF]** **[MDO]** **[closed grain hardwood veneer]**.
 - a. Exposed edges shall be **[sanded and filled if necessary]** **[edge banded with closed grain hardwood veneer]**.

- E. Trim for transparent finish:
1. Moldings shall be **[species]**, **[cut]** **[as indicated in the finish schedule]**.
 2. Exposed faces of veneered items shall be **[species]** **[cut]** **[match]** **[as indicated in the finish schedule]**.

- F. **[Blueprint Match: Work at room(s) [_____] shall be blueprint matched:**

Include this Item if there is a room or area where a blueprint match is desired.

1. **All work in this/these area(s) shall be AWS Premium Grade.**
2. **Casework, paneling, doors, and wood trim shall be provided by the same manufacturer.**
3. **Veneers shall be taken from the same flitch, to be selected by the architect.**
4. **Faces at cabinet doors, drawer fronts, and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.**
5. **Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.**
6. **Solid wood elements such as base, casing, and frames shall be well matched for color and grain, and shall be compatible in color and grain with veneered elements.**
7. **All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.]**

- G. **[Factory Finishing**

1. **[All products provided in this Section shall be factory finished using "Architectural Woodwork Standards" finish system [_____].]**
2. **[Finish shall be AWS [Premium Grade] [Custom Grade] [the same Grade as the items being finished.]**

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify the adequacy and proper location of any required backing or support framing.
- B. Verify that mechanical, electrical, plumbing, and other building components effecting work in this Section are in place and ready.

3.02 INSTALLATION

- A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
 1. Installation shall conform to the AWS Grade of the items being installed.
- B. All work shall be secured in place, square, plumb, and level.
- C. All work abutting other building components shall be properly scribed.
- D. Mechanical fasteners used at exposed and semi-exposed surfaces shall be countersunk.

CSI Section 06 46 00

Wood Trim

3.03 ADJUSTING & TOUCH UP

- A. All nicks, chips and scratches shall be **[sanded out]** **[filled and re-touched]**. Damaged items which cannot be repaired shall be replaced.

Use "sanded out" if material is to be finished at the job site. Use "filled and retouched" if the materials are factory finished.

3.04 CLEANUP

- A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification

Section 08 14 00

Wood Doors

CSI Section 08 14 00

Wood Doors

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in **[bold, in brackets]**. Comments are in shaded background.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Select the applicable Items from the list below.

1. **[Flush Wood Doors]** **[Transom Panels]**
2. **[Stile and Rail Wood Doors.]**
3. **[Fire-Rated Wood Doors.]**
4. **[Wood Doors with HPDL faces.]**
5. **[Sound Rated Wood Doors including gaskets and automatic door bottoms.]**
6. **[X-ray Resistant Wood Doors.]**
7. **[Bullet Resistant Wood Doors.]**
8. **[Wood Louvers, Glass Stops, and Astragals.]**
9. **[Glazing.]**

If glazing is included here, delete it below. If it is not included here, show it under "Excluding".

10. **[Factory finishing.]**

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:

1. Cabinet doors.
2. Metal or Vinyl doors with wood cores.
3. Garage, Metal, and Fiberglass doors.
4. Metal grills or Louvers.
5. [Glazing.]

C. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Door Hardware.
3. Door Frames.

1.02 REFERENCES

- A. *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

The other standards you would reference are within the AWS.

- B. ANSI/WDMA I.S. 1A, latest edition.
- C. ANSI/WDMA I.S. 6A, latest edition.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance to the requirements of the *Architectural Woodwork Standards*.
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

CSI Section 08 14 00

Wood Doors

B. Samples:

1. Submit four **[finished]** samples of each species and cut of wood to be used. Veneer samples to be minimum 12" (305 mm) by 12" (305 mm) . Samples shall represent the range of color and grain expected to be provided.

Samples may not be necessary for painted or LP covered doors.

2. **[Submit four additional samples of each material for the use of the paint trade.]**

1.04 QUALITY ASSURANCE

- A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

- B. **[Association Quality Assurance Program.]**

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

- C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

- D. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.
 1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
 2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

- A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

- A. Flush Wood Doors:

Select below the types of doors that are required.

1. **[Doors shall meet the requirements of ANSI/WDMA Extra Heavy Duty performance level.]**

AWS requires ANSI/WDMA Heavy Duty performance level for all doors. Require Extra Heavy Duty for doors that will see frequent and heavy use such as classrooms, patient rooms, and public restrooms. See Section 9 of the AWS for more discussion of duty levels.

2. Faces of wood veneered doors intended for transparent finish shall be **[species] [cut]**, with **[book] [slip]** veneer match.

Veneer may be plain sliced, quarter sliced, rift, or rotary cut. The match is the system of matching veneer leaves on the panel. Book matched is the most common system; slip match is also frequently used. Rotary cut veneers may be wide enough to make single leaf faces.

3. Faces at Plastic Laminate faced doors shall be **[manufacturer] [pattern]**.
4. Faces at doors for opaque finish shall be **[closed grain hardwood -OR- MDO -OR- MDF]**.

CSI Section 08 14 00

Wood Doors

5. Core shall be [hollow grid] [Particleboard] [staved lumber] [structural composite lumber] [per door schedule].

Particleboard or SCL are recommended as core materials.

B. Stile and Rail Doors:

1. [Doors shall meet the requirements of ANSI/WDMA Extra Heavy Duty performance standard.]

AWS requires ANSI/WDMA Heavy Duty performance level for all doors. Require Extra Heavy Duty for doors that will see frequent and heavy use such as classrooms, patient rooms, and public restrooms. See Section 9 of the AWS for more discussion of duty levels.

2. Lumber shall be [species, cut] [closed grain hardwood].

Select closed grain hardwood for opaque finish.

3. Core material for panels shall be [MDF] [water resistant MDF] [SCL] [exterior grade hardwood plywood].

Custom Grade allows solid lumber panels. Include this Item if Premium Grade is specified and you prefer one core material over another.

4. Core material for stiles and rails shall be [MDF] [SCL] [stave core].

Custom Grade allows solid lumber stiles and rails. Include this Item if Premium Grade is specified and you prefer one core material over another.

5. Type I adhesives shall be used at exterior doors.

6. [Lights shall be [tempered] [laminated] safety glass.

Include this Item if glazing is included in this Section.

- A. Lights at exterior doors shall be [_____].

Insert your preferred insulated or low e glazing.

2.02 FABRICATION

- A. Slab doors shall be *Architectural Woodwork Standards* [Custom] [Premium] Grade:

1. Doors shall be [3] [5] [7] ply construction.

Three ply construction is only used for Laminate faced doors.

2. Exterior doors shall be assembled with Type 1 glue.

3. Size of doors; type, size, and location of lights and louvers; astragals, edging, flashing, and specialty hardware; X-ray and sound requirements, and transom panels shall be as indicated on the door schedule.

4. Fire-rated doors shall be of the construction standard of the manufacturer and conform with the requirements of all applicable labeling agencies.

5. Provide blocking as required for surface mounted hardware to prevent the need for through bolting.

Specify a blueprint match if there is an area where casework, doors, and panels should all be sequence matched. Similar language must be inserted in the Sections specifying wood paneling, wood trim, and casework.

6. [Blueprint Match: Work at room(s) [_____] shall be blueprint matched:

- a. All work in this/these area(s) shall be AWS Premium Grade.
- b. Casework, paneling, doors and wood trim shall be provided by the same manufacturer.
- c. Veneers shall be taken from the same flitch, to be selected by the architect.
- d. Faces of cabinet doors, drawer fronts and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.
- e. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.
- f. All components including casework, paneling, doors and trim shall be factory finished at the same time in the same facility.]

- B. Stile and Rail Doors shall be *Architectural Woodwork Standards* [Custom] [Premium] Grade.

1. Panels:

- A. Shall be [1/2 (12.7 mm)] [3/4 (19 mm)] [1 3/8 (34.9)] [1 3/4 (44.5 mm)] inches thick.

Use 1/2" or 3/4" panels for flat panel construction. Use thicker panels for raised panels.

CSI Section 08 14 00

Wood Doors

B. [Veneered panels shall be [book] [slip] matched.]

Use this item if Premium Grade is specified.

2. Sticking and panel edge details shall be [per plans] [per manufacturer's standard details as selected by architect].

C. Factory Finishing:

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

1. All products provided in this Section shall be factory finished using *Architectural Woodwork Standards* finishing system [_____].
2. Finish shall be AWS [Premium -OR- Custom] Grade.

PART 3 - EXAMINATION

3.01 EXAMINATION

- A. Verify that frames are set square, plumb, level, and in plane.
 1. Report openings that are not within tolerance to the General Contractor for correction before hanging doors.

3.02 INSTALLATION

- A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
 1. Installation shall conform to the AWS Grade of the items being installed.
- B. Doors shall be secured in place, square, plumb, and level.
- C. Hardware shall be installed complete and as recommended by the manufacturer.

3.03 ADJUSTING & TOUCH UP

- A. Before completion of the installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.
- B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items which cannot be repaired shall be replaced.

3.04 CLEANUP

- A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

1

Submittals

1 - Submittals

WHAT TO EXPECT

"The Woodworkers shall submit shop drawings, samples, brochures, etc. on all items of architectural woodwork. Shop drawings shall be of sufficient detail in scale to determine compliance with the intent of the Quality Standard Grade specified." - from an office Master Specification

In commonly used Guide Specifications, the scale, level of detail and quantity of shop drawings actually required for custom architectural woodwork are described rather broadly. The key to achieving the most detailed and useful set of drawings is clear and continual communication between the architect/designer and the woodwork manufacturer, from the earliest stage of design.

PURPOSE

Shop drawings are the means by which the design intent is turned into reality, serving as the primary instructions for woodwork engineering and fabrication, and as a guide for other trades. As the primary communication among woodworker, general contractor and design professional, shop drawings serve a valuable coordinative function. Good shop drawings are the extension of the design into the area of engineering. They should indicate methods of construction, exact material selections, finishes, method of attachment and joinery, exact dimensions and should include the woodworker's technical suggestions.

LEVEL OF DETAIL

The level of detail required on shop drawings is established by the Quality Grade and complexity of the project. The specifier is at liberty to specify any level of detail as a requirement of the project and of the contract documents. It should be noted that requirements for local codes and utilization of fire retardant wood products are to be researched and directed by the design professional and are not the responsibility of the woodworker.

What constitutes the minimum expectation for a set of shop drawings? The answer is not simple, since there are many variables as to the complexity, quality and type of work being specified.

A suggested level of detail and scale of drawings has been established in tabular form and is provided on the following pages to be used as a guideline.

APPROVALS

The approval stage provides the architect/designer a final opportunity, prior to fabrication, to make changes or correct mistakes. Shop drawings, however, are not an extension of the design development process; therefore, changes of intent made during shop drawing review will in many cases involve an increase in cost and time.

During the review process the design professional should consider the following:

- Only two copies are necessary for checking purposes. After being reviewed, one marked copy should be returned to the woodworker with a request for the required number of prints or a sepia from which the owner's representative may make prints.

- Those charged with review of shop drawings should be completely familiar with woodwork fabrication, and be responsible for insuring compliance with referenced Standards as well as design intent.

- Deviations from the original plans are often recommendations for improvement, and not necessarily a "flying in the face" of instructions. It is as wrong for a checker to arbitrarily stamp "Redraw and Resubmit" on a shop drawing that proposes a change as it is wrong to automatically accept a folio of drawings because they contain duplicates of the original plans.

The four common levels of approval are:

- Approved
- Approved As Noted
- Redraw and Resubmit
- Disapproved

Approvals are generally indicated by a stamp on each of the drawings. When selecting "Approved As Noted" rather than "Redraw and Resubmit," the design professional can often save weeks of production time provided the intent and all changes are clearly marked on the drawings.

SCHEDULING

Most projects are encumbered by a tight production schedule, especially for the finish trades such as woodworking, painting, carpeting and wall coverings. Prompt review of shop drawings and accurate coordination of multiple trades can save weeks of time and eliminate problems before construction begins.

We recommend the design professional work with the woodwork manufacturer to determine the maximum "approval-to-fabrication" timeline needed to keep the job on schedule (e.g., "Shop drawings must be returned approved to fabricate seven (7) days after submittal.")

SCHEDULES VS. DRAWINGS

In some cases shop drawings are not required to communicate the necessary quality, type, quantity and details of an item. Tabular schedules are used instead, generally for such items as doors, frames, stock factory cabinets, closet shelves, and furniture items.

THE PROCESS

It is the role of the design professional and the contractor to coordinate the woodworker's shop drawings with work of all other trades and to insure the "hold" dimensions are actually held. It is also the responsibility of the architect or contractor to give field changes to all parties so that if dimensions are changed, each subcontractor and material supplier can be held responsible for his work.

2

Care and Storage

2 - Care and Storage

PERMANENT FURNITURE

Architectural woodwork should be treated like fine furniture, particularly that which is constructed of wood finished with a transparent finish system.

Fine architectural work is finished with a commercial finish which is durable and resistant to moisture. Allowing moisture to accumulate on, or stay in contact with, any wood surface, no matter how well finished, will cause damage. Prevent direct contact with moisture, and wipe dry immediately should any occur.

TREATMENT

With the exception of true oil-rubbed surfaces, modern finishes do not need to be polished, oiled, or waxed. In fact, applying some polishing oils, cleaning waxes, or products containing silicone may impede the effectiveness of touch-up or refinishing procedures in the future.

CLEANING

No abrasives or chemical or ammonia cleaners should be used to clean fine woodwork surfaces.

Routine cleaning is best accomplished with a soft, lint-free cloth lightly dampened with water or an inert household dust attractant. Allowing airborne dust, which is somewhat abrasive, to build up will tend to dull a finish over time.

Remove oil or grease deposits with a mild flax soap, following the directions for dilution on the container.

IMPACT

Avoid excessive or repetitive impact, however lightly applied. The cellular structure of the wood will compact under pressure. Many modern finishes are flexible, and will show evidence of impact and pressure applied to them.

HEAT

Avoid localized high heat, such as a hot pan or plate, or a hot light source, close to or in contact with the finished surface. Exposure to direct sunlight will alter the appearance of fine woodwork over time.

HUMIDITY

Maintain the relative humidity around the woodwork in accordance with the guidelines published in this standard, every hour of every day, to minimize wood movement.

ABUSE

Use the trims, cabinets and fixtures, paneling, shelving, ornamental work, stairs, frames, windows, and doors as they were intended. Abuse of cabinet doors and drawers, for example, may result in damage to them as well as to the cabinet parts to which they are joined.

REPAIR AND REFINISHING

Contact a local woodworking firm, or the offices of the associations, to explore the options for repair or refinishing. It is often cost effective to replace damaged woodwork elements rather than attempting large scale, on site refinishing.

3

Lumber

3 - Lumber

LUMBER used in architectural woodwork is divided into two groups:

HARDWOODS: Lumber obtained from angiosperms, usually deciduous trees (broadleaf trees). There are more angio sperms on Earth than any other plant group, over 200,000 species. About 900 of those species are commonly available for lumber or veneer throughout the world.

SOFTWOODS: Lumber obtained from gymnosperms, about 600 of which are coniferous trees such as pine, spruce, and fir. The gymnosperms are among the largest and oldest living plants.

NOTE: The above groups have **NO** relationship to the density or “hardness” within or between various species. Some softwoods are harder than some hardwoods, and hardness varies greatly between species within each group.

AWS lumber grades will always be referenced when specifying architectural woodwork. Selection of the **AWS** Grade for the finished product (Premium, Custom, or Economy) will define both materials and workmanship for that product. Lumber grades defined by the lumber manufacturers’ associations allow some defects which the architectural woodworker must remove (cut out), or otherwise work around (by gluing, etc.).

The selection of the proper wood species for an architectural design can be the end result of a number of contributing factors and conditions. Intended use, costs, hardness, and relative stability are among many important considerations.

The architect and designer may make his selection from a large variety of foreign and domestic species, now commercially available. The unique quality that wood imparts to design is that each species has its own distinguishing characteristics. Once the species is chosen, its effectiveness may vary according to the manner in which it is sawn, sliced as veneer, treated, and finished.

This Section is designed to counsel the architect and designer in the comparisons, considerations, and species which should be evaluated before decisions are made and specifications are written. This Section will help you correlate and tabulate the information needed. An informed choice will reward the owner with the best possible performance by a natural building material.

WOOD AS A PLANT

The trunk and its branches: The cross section of a tree shows the following well-defined features in succession from the outside to the center: (1) bark and cambium layer; (2) wood, which in most species is clearly differentiated into sapwood and heartwood; and (3) pith, the small central core. The pith and bark, of course, are excluded from finished lumber.

Most branches originate at the pith, and their bases are intergrown with the wood of the trunk as long as they are alive. These living branch bases constitute intergrown or tight knots. After the branches die, their bases continue to be surrounded by the wood of the growing trunk and therefore loose or encased knots are formed. After the dead branches fall off, the stubs become overgrown, and subsequently clear wood is formed.

All growth in thickness takes place in the cambium layer by cell division. No growth in either diameter or length takes place in wood already formed; new growth is purely the addition of new cells, not the further development of existing cells.

ANNUAL RINGS

Most species grown in temperate climates produce well-defined annual growth rings, which are formed by the difference in density and color between wood formed early and late in the growing season. The inner part of the growth ring formed first is called “spring wood,” and the outer part formed later in the growing season is called “summer wood.”

Spring wood is characterized by cells having relatively large cavities and thin walls. Summer wood cells have smaller cavities and thicker walls, and consequently are more dense than spring wood. The growth rings, when exposed by conventional methods of sawing, provide the grain or characteristic pattern of the wood. The distinguishing features of the various species are thereby enhanced by the differences in growth ring formation.

Some tropical species, on the other hand, experience year long even growth which may result in less obvious growth rings.

SOFTWOODS AND HARDWOODS

Native species of trees and the wood produced by these trees are divided into two botanical classes: hardwoods, which have broad leaves; and softwoods, which have needle-like or scale-like leaves. This botanical classification is sometimes confusing, because there is no direct correlation between calling a species a hardwood or softwood and the hardness or softness of the wood itself. Generally, hardwoods are more dense than softwoods, but some hardwoods are softer than many softwoods. If hardness is a desired characteristic, refer to the Comparative Table of Wood Species later in this section.

HEARTWOOD

Heartwood consists of inactive cells formed by changes in the living cells of the inner sapwood rings, presumably after their use for sap conduction and other life processes of the tree have largely ceased. The cell cavities of heartwood may also contain deposits of various materials that frequently provide a much darker color. Not all heartwood, however, is darker. The infiltrations of material deposited in the cells of heartwood usually make lumber cut therefrom more durable when exposed to weather. All wood, with the possible exception of the heartwood of Redwood and Western Red Cedar, should be preservative-treated when used for exterior applications.

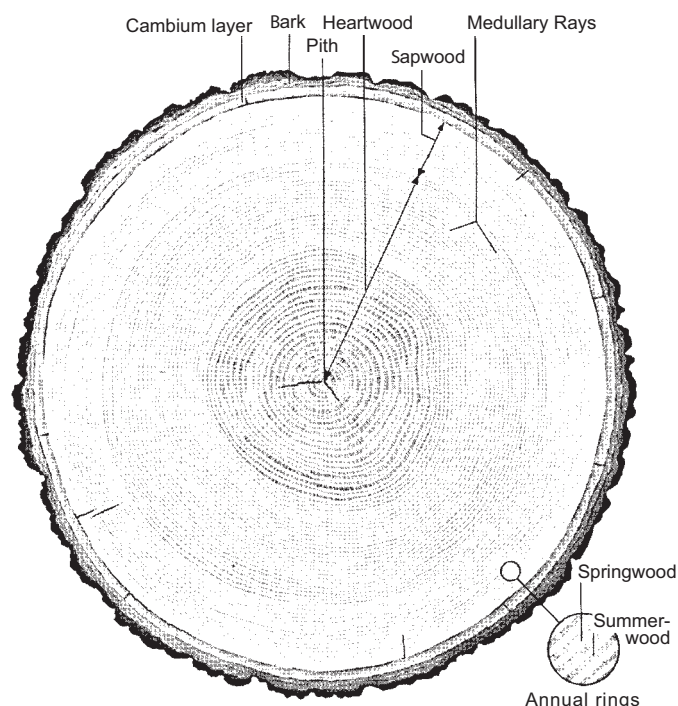
SAPWOOD

Sapwood contains living cells and performs an active role in the life processes of the tree. It is located next to the cambium and functions in sap conduction and storage of food. Sapwood commonly ranges from 1” to 2” (25-50 mm) in thickness. The Maples, Hickories, Ashes, and some of the Southern Yellow Pines and Ponderosa Pine may have sapwood 3” to 6” (76-152 mm) in thickness, especially in second growth trees.

3 - Lumber

MEDULLARY RAYS

Medullary rays extend radially from the pith of the log toward the circumference. The rays serve primarily to store food and transport it horizontally. They vary in height from a few cells in some species to four or more inches in the oaks, and produce the fleck (sometimes called flake) effect common to the quarter-sawn lumber in these species.



End use determines the importance of Hardness in selecting a species for each particular type of application. Counters, door frames, wall treatments in high-traffic areas, etc., are obvious uses of wood products where hardness and resistance to abrasion must be considered. In many other applications these factors, relatively speaking, are not of great importance.

The **DIMENSIONAL STABILITY** column is helpful in selecting woods for use where humidity conditions may vary widely and where design or fabrication of a wood product does not allow free movement or the use of plywood. The column figures indicate extreme conditions and show the maximum amount of movement possible in a 12" (305 mm) wide piece of unfinished wood where its moisture content increases or decreases from 10% to 5%. The possible change in dimension demonstrates that unfinished interior woodwork must be carefully protected prior to finishing by keeping it in rooms where relative humidity is between 25% and 55%. The column also shows the variation between species, and between flat grain and edge grain where such cuts are available commercially.

Careful analysis of the table will make it possible for an architect, designer or specification writers (who may have only a limited knowledge of architectural wood species) to make an informed selection. It is our intent that this tool will enhance understanding between the manufacturer of the woodwork you have designed and your profession, thereby enabling the building industry to better service the client.

COMPARATIVE TABLE OF WOOD SPECIES

In order to simplify species selection, the Comparative Table of Wood Species (pg. 436) has been prepared showing pertinent characteristics of some species of domestic and foreign woods used by the architectural woodwork industry. The table can quickly confirm or deny the wisdom of a species selection by the architect or designer or conversely lead to a proper selection after studying the characteristics.

COST has been broken into both Lumber and Plywood headings, with data divided into Low, Moderate, High, and Very High [V. High]. (Important: Market conditions cause these relationships to vary. Current ratios are likely to be different.) The reason for cost variations in the two products is obvious when we consider the physical differences. Generally, the prices of veneered products reflect the relatively high labor and equipment cost and relatively low material cost in their manufacture. On the other hand, the price of lumber in most species reflects cost factors that are exactly the opposite. In spite of their physical differences, the two products are always compatible, and both are essential to complete design freedom in contemporary buildings.

3 - Lumber

COMPARATIVE TABLE OF WOOD SPECIES

Species	Costs (1)		Practical Size Limits (2)			Hardness	Dimensional Stability (3)
	Lumber	Plywood	Thick-ness	Width	Length		
Ash	Moderate	Moderate	2-1/2"	5-1/2"	12'	Hard	10/64"
Basswood	Low	No data	2-1/2"	5-1/2"	10'	Soft	10/64"
Beech	Low	No data	1-1/2"	5-1/2"	12'	Hard	14/64"
Birch, Yellow - natural	Moderate	Moderate	1-1/2"	5-1/2"	12'	Hard	12/64"
Birch, Yellow - select red	Moderate	Moderate	1-1/2"	4-1/2"	11'	Hard	12/64"
Birch, Yellow - select white	Moderate	Moderate	1-1/2"	4"	11'	Hard	12/64"
Butternut	High	V. High	1-1/2"	4-1/2"	8'	Soft	8/64"
Cedar, Western Red	High	Moderate	3-1/4"	11"	16'	Soft	10/64"
Cherry, American Black	High	High	2-1/2"	4"	7'	Hard	9/64"
Chestnut - wormy	High	No data	3/4"	5-1/2"	10'	Medium	9/64"
Cypress, Yellow	Low	No data	2-1/2"	7-1/2"	16'	Medium	8/64"
Fir, Douglas - flat grain	High	Moderate	3-1/4"	11"	16'	Medium	10/64"
Fir, Douglas - vertical grain	High	No data	1-1/2"	11"	16'	Medium	6/64"
Hickory	Low	Moderate	1-1/2"	4-1/2"	12'	Very Hard	11/64"
Mahogany, African - plain sawn	High	High	2-1/2"	9"	15'	Medium	7/64"
Mahogany, African - quarter sawn	V. High	V. High	2-1/2"	5-1/2"	15'	Medium	5/64"
Mahogany, Genuine (American)	High	V. High	2-1/2"	11"	15'	Medium	6/64"
Maple, Hard - natural	Moderate	Moderate	3-1/2"	7-1/2"	12'	Very Hard	12/64"
Maple, Hard - select white	Moderate	High	2-1/2"	5-1/2"	12'	Very Hard	12/64"
Maple, Soft - natural	Moderate	No data	3-1/2"	7-1/2"	12'	Medium	9/64"
Oak, English Brown	V. High	V. High	1-1/2"	4-1/2"	8'	Hard	No data
Oak, Red - plain sawn	Moderate	Moderate	2-1/2"	7-1/4"	12'	Hard	11/64"
Oak, Red - rift sawn	High	High	1-1/16"	3-1/2"	8'	Hard	7/64"
Oak, Red - quarter sawn	High	High	1-1/16"	5-1/2"	8'	Hard	7/64"
Oak, White - plain sawn	Low	High	1-1/2"	5-1/2"	10'	Hard	11/64"
Oak, White - rift sawn	High	High	3/4"	3"	8'	Hard	7/64"
Oak, White - quarter sawn	High	High	3/4"	4"	8'	Hard	7/64"
Pecan	Low	Moderate	1-1/2"	4-1/2"	12'	Hard	11/64"
Pine, Eastern or Northern White	Moderate	No data	1-1/2"	9-1/2"	14'	Soft	8/64"
Pine, Idaho	Moderate	No data	1-1/2"	9-1/2"	16'	Soft	8/64"
Pine, Ponderosa	Moderate	Moderate	1-1/2"	9-1/2"	16'	Soft	8/64"
Pine, Sugar	Moderate	No data	3-1/4"	11"	16'	Soft	7/64"
Pine, Southern Yellow	Low	No data	1-1/2"	7-1/2"	16'	Medium	10/64"
Poplar, Yellow	Low	No data	2-1/2"	7-1/2"	12'	Medium	9/64"
Redwood, flat grain heartwood	Moderate	No data	2-1/2"	11"	16'	Soft	6/64"
Redwood, vert. grain heartwood	Moderate	No data	2-1/2"	11"	16'	Soft	3/64"
Teak	V. High	V. High	1-1/2"	5-1/2"	8'	Hard	6/64"
Walnut, American Black	Moderate	High	2-1/2"	4"	6'	Hard	10/64"
Walnut, Nogal	Moderate	No data	3/4"	9-1/2"	9'	Medium	12/64"
Zebrawood, African - quarter sawn	V. High	V. High	1-1/2"	7"	14'	Hard	7/64"

(1) Market conditions will cause these relationships to vary. These are raw costs without consideration of labor.

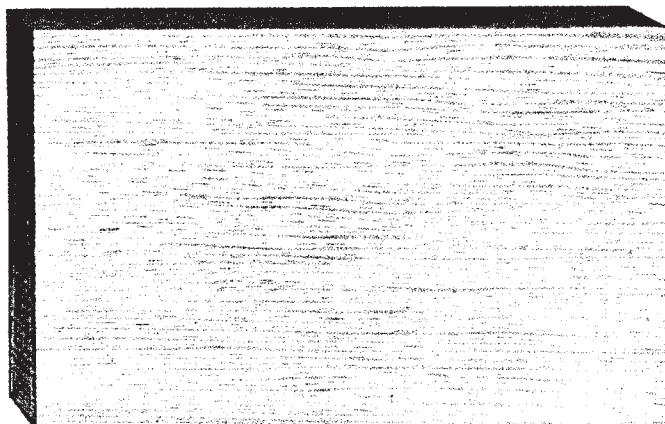
(2) Maximum practical sizes without lamination/gluing. Only 10% of any order is required to be at maximum sizes.

(3) These figures represent possible width change in a 12" (304.8 mm) board when moisture content is reduced from 10% to 5%. Figures taken are for plain sawn unless indicated otherwise in the species column.

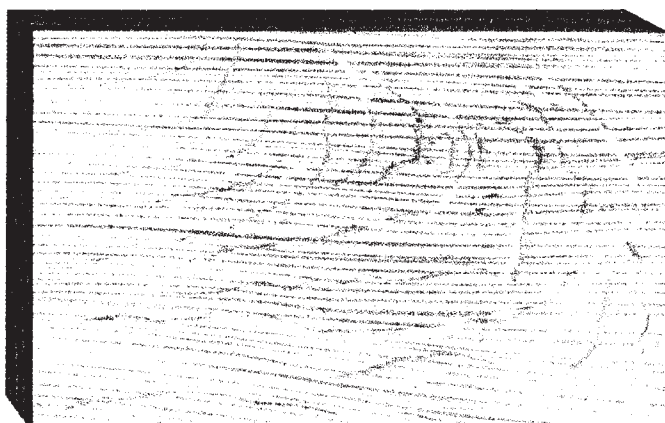
3 - Lumber



Plainsawn Lumber



Riftsawn Lumber



Quartersawn Lumber

ASH, WHITE (*Fraxinus americana*)

While White Ash has always enjoyed widespread use for industrial products where hardness, shock resistance, stability and strength were important, its acceptance for architectural woodwork is increasing. It is open grained and has a strong and pronounced grain pattern. The heartwood is light tan or brown and its sapwood creamy white. Color contrast between the two is minor and its blond effect makes it particularly appealing when a light or near natural finish is desired. Finished with darker tones it presents a very forthright, honest, and virile effect. Its cost is moderate

and it is readily available in lumber form. In veneered form some size limitation may be experienced but it can be easily produced on special order.

BIRCH, YELLOW - "Natural" (*Betula alleghaniensis*)

BIRCH, YELLOW - "Select Red" (heartwood) (*Betula alleghaniensis*)

BIRCH, YELLOW - "Select White" (sapwood) (*Betula alleghaniensis*)

Yellow Birch has been and continues to be one of the prominent wood species used for architectural woodwork. This is due not only to its attractive appearance but also to its general availability both as lumber and as veneered products, its adaptability to either paint or transparent finish, and its abrasion resistance. The heartwood of the tree varies in color from medium to dark brown or reddish brown while its sapwood, which comprises a better than average portion of the tree, is near white. Despite its wide usage some confusion exists as to the common terms used to describe Birch lumber and/or veneer. Virtually all commercially used Birch is cut from the Yellow Birch tree, not from the White Birch tree, which botanically is a distinct species. The term "Natural" or "Unselected" Birch means that the lumber or veneer may contain both the sapwood, or white portion, as well as the heartwood, or dark portion, of the tree in unrestricted amounts. The term "Select Red" Birch describes the lumber or veneer produced from the heartwood portion of the tree, and the term "Select White" Birch describes the lumber or veneer produced from the sapwood portion of the tree. To obtain "Red" or "White" Birch exclusively requires selective cutting with corresponding cost premium as well as considerable restriction on the width and length availability in lumber form. Birch, in veneer form, is readily available in all "selections" and is usually rotary cut. While some sliced veneer is produced which simulates the same grain effect as lumber, its availability and cost reflect the same cutting restrictions that are incurred in producing the "select" forms of Birch lumber.

CHERRY, AMERICAN BLACK (*Prunus serotina*)

Wild Black American Cherry is a fine and especially stable close grained cabinet and veneer wood. Its heartwood color ranges from light to medium reddish brown. Its sapwood, which is a light creamy color, is usually selectively eliminated from the veneer and lumber. In some respects it resembles Red Birch, but has a more uniform grain and is further characterized by the presence of small dark gum spots which, when sound, are not considered as defects but add to its interest. Cherry is available in moderate supply as lumber and architectural paneling and is usually plain sawn or sliced. Exceptionally rich appearance is achieved with transparent finishes which, together with its fine machining characteristics, justifies its identity with Early American cabinetry and furniture manufacturing, thus adding to its prestige as one of our most desirable native woods.

3 - Lumber

CYPRESS, YELLOW (*Taxodium distichum*)

While Cypress is still prevalent throughout the south, distinction should be made between the type now generally available and what was once known as "Tidewater Red Cypress." The latter, once the "premium" wood for exterior applications, is now virtually extinct and subject to limited usage. The currently available Cypress lumber, while similar in appearance, does not contain the heartwood of inherently high decay resistance once associated with the species, and in lumber form contains a high percentage of sapwood. Thus, like most softwoods, preservative treatment is imperative if used on the exterior. While this does not preclude its exterior application, it is perhaps more generally utilized for paneling where its strong, bold grain is best displayed.

FIR, DOUGLAS (Flat Grain) (*Pseudotsuga taxifolia*)

Douglas Fir is a large, fast-growing species and is native to the northwest. It accounts for much of the lumber produced in North America. While the preponderance of its production is developed for structural and construction type products, some of its upper grades are used for stock millwork and specialized woodwork. Its heartwood is reddish tan while its sapwood is creamy yellow. Since its growth rings are conspicuous, a rather bold grain pattern develops when either plain sawn for lumber or rotary cut as is common in plywood. Some lumber and veneer is cut edge or vertical grain, producing a superior form of the product since the tendency to "grain-raise" is greatly reduced.

MAHOGANY, AFRICAN (plain sawn) (*Khaya ivorensis*)

This, one of the true Mahoganies, is perhaps the most widely used of the several Mahogany species. This is due to its excellent cutting and working characteristics and versatility. While its use has been largely for interior purposes, its innate stability and moderate decay resistance justifies its consideration for selected and demanding exterior applications. It has a very pleasing open grain, with its heartwood ranging in color from light to medium dark reddish brown. In lumber form it is more readily available as plain sawn and selectively so as quartersawn. In veneer form the quarter or "ribbon striped" cut predominates, but plain sliced, as well as many of the exotic "figure" cuts, can be produced on special order.

MAHOGANY, GENUINE OR AMERICAN (*Swietenia macrophylla*)

This Mahogany species is commonly known as "Honduras Mahogany," but actually encompasses all of this species that grow throughout Mexico, Brazil, Peru, and Central America. Its traditional identity with fine cabinetry and furniture justifies its position as one of the finest woods for this purpose. Its stability, workability, warm appearance, and firm grain make it a favorite of all woodworking craftsmen. It is a semi-open grain wood, with its heartwood color ranging from light tan to a rich golden brown depending to some extent on the country of its origin. Its outstanding stability and decay resistance expands its potential to include exterior applications for "monumental" projects. It is most generally available as plain sawn lumber and plain sliced veneer with different veneer cuts available on special order.

MAPLE, HARD - "Natural" (*Acer saccharum*)

MAPLE, HARD - "Select White" (Sapwood) (*Acer saccharum*)

Hard Maple is very similar in general characteristics to Yellow Birch. It is heavy, hard, strong, and resistant to shock and abrasion. The heartwood of the tree is reddish brown and its sapwood is near white with a slight reddish-brown tinge. Another natural characteristic is the prevalence of dark mineral streaks (predominantly in the heartwood), which can be minimized in the sapwood by selective cutting. Like Birch, common usage of descriptive terms does occasion some confusion. The term "Natural" or "Unselected" Maple indicates that the lumber or veneer may contain both the white sapwood and the darker heartwood. The term "White" Maple means that the lumber or veneer is selected and separated from the pieces containing the dark heartwood. Unlike Birch, the heartwood is so low in content that no comparable selection is available. Maple's close identity with furniture and specialized industrial use overshadows its potential for architectural woodwork. Its modest cost, and pleasing, mild grain pattern warrants its consideration, especially on items subject to hard usage.

ENGLISH BROWN OAK (*Quercus robur*)

The English Brown Oak, or Pollard Oak is a tree which varies in height from 18-40 m [60'-130'] depending on soil conditions. It varies in color from a light tan to a deep brown with occasional black spots. It produces burls and swirls which are very brittle and fragile, but beautiful work can be obtained with their use. English Brown Oak is considered one of the finest woods in use today.

English Brown Oak is obtained from trees which have had their tops cut out before reaching maturity. This pruning leads to the production of a number of new branches around the cut, and if these are subsequently lopped off, more new branches are formed.

This wood is difficult to season and to work, tending to warp and twist in drying and to tear in working. The best figure is obtained from trees which have been cut over regularly every few years, the branches never being left sufficiently long for the production of large knots. The constant exposure of freshly cut surfaces promotes attack from parasites, the result being that a considerable portion of these trees become decayed sooner or later. This has made the timber relatively scarce and costly.

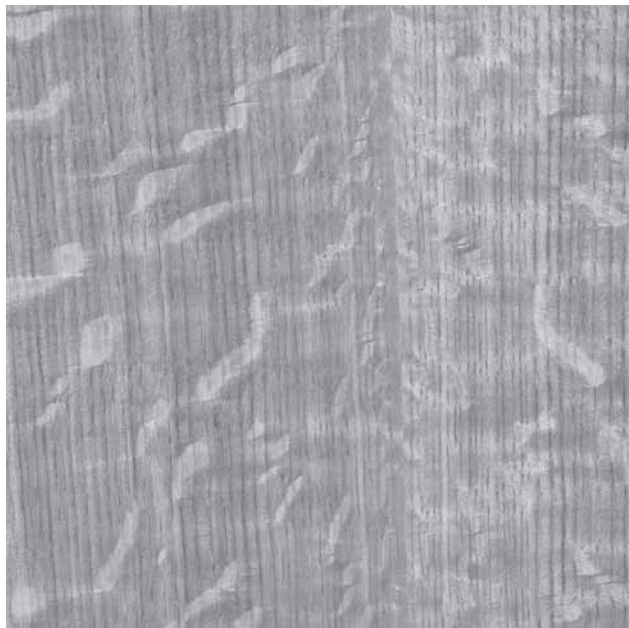
OAK, RED (plain sawn) (*Quercus rubra*)

OAK, RED (rift sawn) (*Quercus rubra*)

Red Oak is one of the most abundant of our domestic hardwoods. Its moderate cost, strength, wearability, and appealing grain characteristics make its use widespread. It is open grained and in its plain sawn or sliced form expresses a very strong "cathedral" type grain pattern. The heartwood is reddish tan to brown and very uniform in color. Its sapwood is lighter in color and minimal in volume, making its elimination by selective cutting very easy. Red Oak is also available in rift sawn or sliced form, which produces a very uniform straight-grained effect. Less frequently it is quarter sawn or sliced, still producing a straight grain but with the fleck (sometimes called flake) of the medullary ray accented. Some sacrifice in width and length availability occurs when producing either rift or quarter sawn lumber.

3 - Lumber

OAK, WHITE (plain sawn) (*Quercus alba*)



OAK, WHITE (quarter sawn) (*Quercus alba*)

White Oak, like Red Oak, is perhaps one of the best-known hardwoods in the world, and its use for architectural woodwork is widespread. It is hard and strong. Its heartwood has good weathering characteristics, making its use for selected exterior applications appropriate. It is open grained and in its plain sawn form is highly figured. The heartwood varies considerably in color from light grayish tan to brown, making the maintenance of color consistency difficult. Its sapwood is much lighter in color, is fairly prevalent, and its elimination is accomplished by selective ripping. White Oak is often rift sawn or sliced, producing a very straight-grained effect or frequently quarter sawn or sliced, producing straight grain, but with the fleck (sometimes called flake) of the medullary ray greatly pronounced. The special cuts mentioned are more readily attained in veneer form since the solid lumber cutting techniques greatly restrict its width and length potential.

PINE, PONDEROSA (*Pinus ponderosa*)

Ponderosa Pine is said to be the softwood species most commonly used for exterior and interior woodwork components. Its heartwood is tannish pink, while its sapwood is a lighter creamy pink. Its supply is extensive; found in commercial quantities in every state west of the Great Plains. Ponderosa Pine grows in pure stands and is abundant in mixed stands. Also, like most Pines, the proportion of sapwood is high and its heartwood has only a moderate natural decay resistance. Fortunately, its receptivity to preservative treatment is high, and since all Pines should be so treated when used on the exterior, it can be used interchangeably with them.

PINE, SOUTHERN YELLOW (Short Leaf) (*Pinus echinata*)

Southern Yellow Pine, commonly called Short Leaf Pine, is commercially important in Arkansas, Virginia, Missouri, Louisiana, Mississippi, Texas, and South and North Carolina, and is found in

varying abundance from New York and south central Pennsylvania, south and westerly to eastern Texas and Oklahoma.

The yellowish wood is noticeably grained, moderately hard, strong, and stiff. A cubic foot of air-dried Southern Yellow Pine weighs 36 to 39 pounds. It is used extensively in house building, including framing, ceiling, weather boarding, panels, window and door frames, casing, and carved work. The grain shows well in natural finish or when stained. Frames of overstuffed furniture, chairs, desks, agricultural machinery, wood pulp, mine props, barrels, and crates are also made of this Pine.

POPLAR, YELLOW (*Liriodendron tulipifera*)

Yellow Poplar, sometimes incorrectly called "Whitewood," is an extremely versatile and moderately priced hardwood that is well adapted to general interior woodwork usage. It is even textured, close grained, stable, of medium hardness, and has an inconspicuous grain pattern. The heartwood is pale greenish yellow while the sapwood is white. Occasional dark purple streaks also occur. The tight, close grain results in outstanding paintability, while its modest figure and even texture permits staining to simulate more expensive hardwood. Due to its indistinct grain figure, Poplar is seldom used for decorative veneered products. Its white sapwood is not appropriate for use in exterior applications.

REDWOOD, FLAT GRAIN (Heartwood) (*Sequoia sempervirens*)

Redwood is the product of one of nature's most impressive accomplishments. The enormous size and unique inherent characteristics of this tree produce a material ideally suited for exterior applications. Its heartwood color is a fairly uniform brownish red, while its very limited sapwood is lemon colored. In its plain sawn form medium "cathedral" type figure develops, while in the vertical grain a longitudinal striped figure results. Its availability in "all heartwood" form with its outstanding natural resistance to decay accounts for its wide usage for exterior purposes. It is considered a very stable wood and its paint retention qualities are excellent. Redwood's principal identity with painted exterior application should not preclude its consideration for either exterior or interior use with transparent finish. Its pleasing and uniform color lends itself to a variety of such finishes suggesting the warmth and honesty of wood in its natural state. The enormous size of the trees yields lumber of unusually character-free widths and lengths.

TEAK (*Tectona grandis*)

Teak is one of the most versatile and valuable woods and has attained great prestige value. The figure variations are extensive and it is available in both lumber and veneered products. Adding to its appeal is its distinctive tawny yellow to green to dark brown color, often with light and dark accent streaks. It is perhaps most appealing in plain sawn or sliced cuts. While it has unique stability and weathering properties, making it ideal for exterior applications, its high cost usually limits its use to decorative interior woodwork, most often in veneer form. Its great beauty and interest dictate it being finished in its near "natural state."

3 - Lumber

AMERICAN BLACK WALNUT (*Juglans nigra*)

American Black Walnut is perhaps our most highly prized domestic wood species. Its grain pattern variations are extensive and in veneered form produces, in addition to its normal plain sliced cut, quartered or "pencil striped" as well as specialty cuts such as crotches, swirls, burls, and others. Its heartwood color varies from gray brown to dark purplish brown. The sapwood, which is very prevalent in solid lumber, is cream colored and its complete elimination by selective cutting is very costly. Fortunately, if this natural effect is felt to be undesirable, its appearance can be neutralized by sap staining in the finishing process. The growth conditions of Walnut result in significant width and length limitations in its lumber form. Its potential is best expressed in veneered products.

ZEBRAWOOD, AFRICAN (quarter sawn) (*Brachystegia fleuryana*)

The Zebrawood tree is an equatorial tree of medium size, obtaining a height of about 65' (20 m) with a diameter of about 3' (1 m). The sapwood is pale in color and distinct from the heartwood, which is of a creamy yellow color veined or striped with very dark brown or black. The striped effect is seen at its best when the wood is quarter sawn.

The wood is reported to be easy to saw but somewhat difficult to work with other tools. It is claimed that there is little tendency for the wood to "work" after seasoning. It has been used for a number of years for cabinet work, fine joinery, fancy turnings, and veneers. By careful selection of veneered material, the skilled craftsman can obtain very beautiful effects in paneled work. In large panels, a very striking and attractive result may be obtained when using Zebrawood.

OTHER SPECIES

There are many other species, both domestic and imported, used in fine woodworking. Nearly all are ecologically sound and appropriate for use. Using fine hardwoods for architecture gives value to the species, encouraging improved forest management techniques and the continuation of the species. As of March 2001, there are only four tree species listed on the Convention on International Trade in Endangered Species (CITES) Appendix I restricted table: Brazilian Rosewood, Monkey Puzzle Tree, Guatemalan Fir, and Alerce. Contact your local woodwork manufacturer for up-to-date information or visit www.cites.org.

USE OF RECLAIMED TIMBER

Interest in timber salvaged or reclaimed from old logs cut from old growth forests has increased recently.

Logs harvested over 100 years ago and transported by water often sank en-route to mills. The resulting "lost underwater forest" lay on the bottoms of rivers and lakes until recently as proper environmental and mechanical procedures for retrieving them have been developed.

Reclaimed submerged materials are utilized in all aspects of construction of fine furniture, architectural woodwork and musical instruments. Submerged lumber is generally processed in both solid lumber, plain sliced and rotary veneer.

The uniqueness of the harvesting procedures, the high quality of the material and unusual aesthetic qualities are a few of desirable traits associated with this special material.

Some of the characteristics unique only to reclaimed submerged timber are:

- Greater density due to tighter growth rings than currently harvested stock;
- Beautiful variance of color gained from the transfer of mineral absorption found naturally in bottom sediments and water;
- Substantial increase of ease in milling due to sap replacement;
- Superior tonal qualities;
- A more pristine appearance;
- Aspects of Historical importance as well as environmental consciousness is added to any project;
- Complete use of the harvested resource.

Check availability and differences in aesthetic qualities before selecting.

ENGINEERED PRODUCTS

Structural Composite Lumber (SCL) — A man-made composite that utilizes grain oriented wood strands from a variety of tree species, providing an alternative to dimension lumber. The material is engineered for strength and stability. While SCL is not really "lumber," it is marketed as a lumber substitute. SCL can be specified as core, stile backers, and core for stiles and rails, so long as all other criteria of the AWS are met in relation to its use.

ÆSTHETIC CHARACTERISTICS

One of the qualities which contributes to the widespread use of wood is the option offered for æsthetic selection. It varies between species, between two logs of the same species, and between two boards from the same log. Æsthetic considerations in specifying wood are influenced by the following characteristics:

COLOR - The basic hue of the species, which may be further enhanced by the finishing process employed.

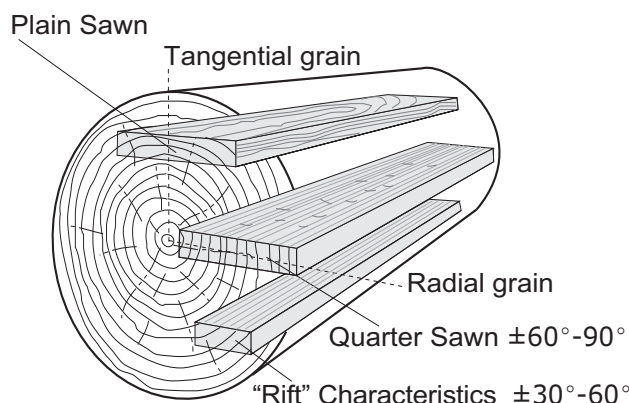
Sapwood and heartwood - The color of wood within a tree varies between the "sapwood" (the outer layers of the tree that continue to transport sap), which is usually lighter in color than the "heartwood" (the inner layers in which the cells have become filled with natural deposits). If desired, sapwood may be stained in the finishing process to blend with the heartwood. This difference in color is so pronounced in certain species that the sapwood is marketed under a different nomenclature from the heartwood. Some examples are:

- Select White Birch - sapwood of Yellow or Paper Birch
- Select Red Birch - heartwood of Yellow Birch
- Natural Birch - both sapwood and heartwood of any Birch
- Select White Ash - sapwood of White or Green Ash
- Select Brown Ash - heartwood of Black Ash
- Natural Ash - both sapwood and heartwood of any Ash
- Select White Maple - sapwood of the Sugar Maple

3 - Lumber

GRAIN

The appearance produced by the arrangement of wood fibers and pores of the species. Open grain woods are said to be ring-porous and usually show a distinct grain pattern. Close grain woods are said to be diffuse-porous with even grain.



OPEN GRAIN AND CLOSE GRAIN

The size and distribution of the cellular structure of the wood influences the appearance and uniformity. Open grain hardwoods, such as Elm, Oak, Ash, and Chestnut are ring-porous species. These species have distinct figure and grain patterns. Close grain hardwoods, such as Cherry, Maple, Birch, and Yellow Poplar, are diffuse-porous species. Most North American diffuse-porous woods have small, dense pores resulting in less distinct figure and grain. Some tropical diffuse-porous species (e.g., Mahogany) have rather large pores.

FIGURE

Various species produce different grain patterns (figures), which influence the selection process. There will be variations of grain patterns within any selected species. The architectural woodworker cannot select solid lumber cuttings within a species by grain and color in the same manner in which veneers may be selected.

METHODS OF SAWING

The sawing method, and the selection of boards after sawing the log will produce the following types of lumber:

PLAIN SAWN

Plain sawing, the most common type of lumber sawing, yields broad grain, the widest boards and least waste. The annular rings are typically 30 degrees or less to the face of the board.

QUARTER SAWN

Most often cut as Rift-and-Quartered, and then sorted for appearance, quarter sawn lumber is available in certain species, yields a straight grain, narrow boards, and fleck (sometimes called flake) or figure which runs across the grain in some species

(notably the oaks). Dimensional stability across the grain is the best. The annular rings run approximately 60 to 90 degrees to the face of the board, with the optimum being 90 degrees. Quartered lumber is generally more expensive than plain sawn.

RIFT SAWN

Rift sawing produces small flecks caused by cutting through the wood rays. Only certain species produce these flecks, primarily Red and White Oak. Rift cutting reduces yield and increases cost. The annular rings run about 30 to 60 degrees to the face of the board, with the optimum being 45 degrees.

FINISHING CHARACTERISTICS

The many species of wood vary considerably in their receptivity to the multitude of finishing processes on the market. Some woods, because of their open pores, will accept fillers while tighter grained woods will not. Some will show greater contrast between the "early wood" and the "late wood" when stained than others. Design professionals should take into consideration the finish that will be applied when selecting a particular species. Consult with a woodworker about finishing prior to selection or specification. Providing large samples of the desired finish to woodworkers during the design phase and bidding process will assure the designer of obtaining an acceptable final product, while enabling the woodworker to be aware of exactly what is required.

AVAILABILITY

The supply of lumber is in constant flux throughout the world. It is affected by many factors such as current demand, export regulations of the country of origin, natural forces of weather, fire, disease, political situations, etc. Consult a woodworker before specifying uncommon species, as well as large quantities of a species, thickness, width, or long length.

SIZE LIMITATIONS

Certain trees (species) naturally grow larger, thus producing longer and wider lumber. Other trees are smaller and produce narrow and shorter boards. The architectural woodworker must work with the available lumber, which must be considered when selecting any species.

COST

The cost of lumber, as with other commodities, is influenced by supply and demand, both of which are constantly changing. For current comparative costs consult a woodworker.

STRENGTH, HARDNESS, DENSITY

Always a consideration is the ability of the selected lumber species to sustain stress; resist indentation, abuse, and wear; and to carry its anticipated load in applications such as shelving and structural members. *The Wood Handbook*, published by the U.S. Forest Products Society, contains comprehensive data on the mechanical properties of wood.

3 - Lumber

DIMENSIONAL STABILITY, RELATIVE HUMIDITY, AND MOISTURE CONTENT

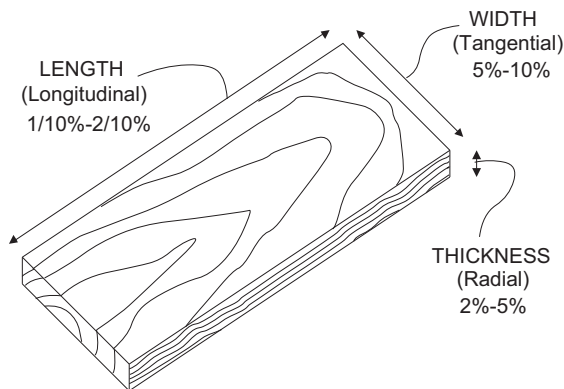
All woods are affected significantly by moisture and to a lesser degree by heat. Lumber swells and shrinks primarily in two directions: thickness and width. There is insignificant change in length. The changes in dimension due to moisture vary with different species, thus influencing the selection of lumber to use and the design elements.

Prevention of dimensional problems in architectural woodwork products as a result of uncontrolled relative humidity is possible. Wood products perform, as they have for centuries, with complete satisfaction when correctly designed and used. Problems directly or indirectly attributed to dimensional change of the wood are usually, in fact, the result of faulty design or improper humidity conditions during site storage, installation, or use.

Wood is a hygroscopic material, and under normal conditions all wood products contain some moisture. Wood readily exchanges this moisture with the water vapor in the surrounding atmosphere according to the relative humidity. In high humidity, wood picks up moisture and swells. In low humidity, wood releases moisture and shrinks. As normal minor changes in humidity occur, the resulting dimensional response in properly designed construction will be insignificant. To avoid problems, it is recommended that relative humidity be maintained within the range of 25% and 55%. Uncontrolled extremes - below 20% or above 80% relative humidity - are likely to cause problems. Together with proper design, fabrication, and installation, humidity control is the important factor in preventing dimensional change problems. The book *Understanding Wood* by Bruce Hoadley contains excellent data of wood and moisture.

SHRINKAGE

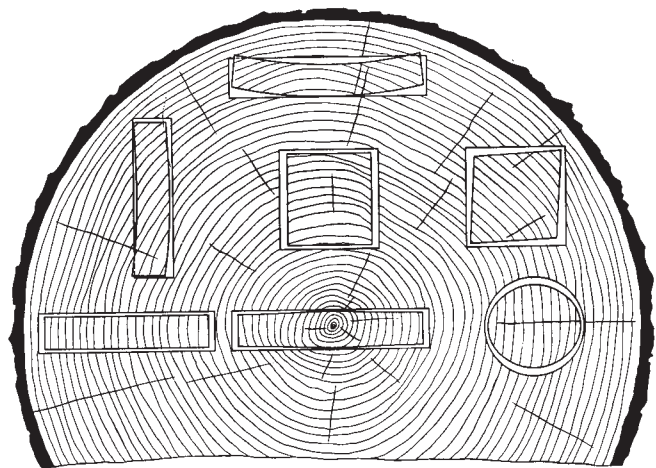
Due to Drying



TS=2RS

Tangential Shrinkage
Approximates Twice
the Radial Shrinkage

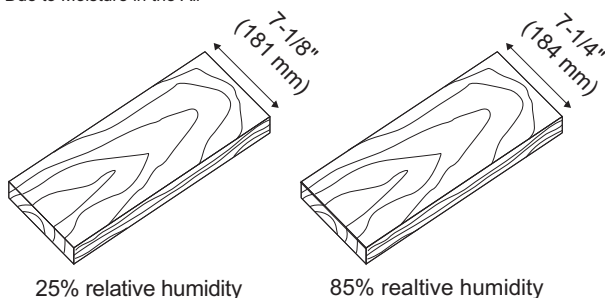
Shrinkage of 1" x 8" x 10'
Dried from Green to Oven Dry
Approximates: 3/64" in thickness
3/4" in width
1/8" in length



Wood is anisotropic in its shrinkage characteristics. It shrinks most in the direction of the annual rings when it loses moisture from the cell walls. This illustration from the USDA *Wood Handbook* shows the typical distortion of cuts from various parts of a log.

EXPANSION

Due to Moisture in the Air



25% relative humidity

85% relative humidity

Expansion of 1" x 8" x 10' when relative
Humidity increases from 25% to 85%

Moisture can also cause iron stain (oxidation) in wood, also referred to as blue/black stain. Iron stain is a natural reaction of acids with iron, oxygen, and moisture (either high relative humidity or direct moisture) in wood. Control of moisture is a simple way to protect wood products from iron stain.

ADAPTABILITY FOR EXTERIOR USE

Years of performance have shown certain species to be more durable for exterior applications. Heartwood shall be furnished when these species are designated for external use, excluding the sapwood. The following is a list of species generally considered acceptable for exterior use, from the *Wood Handbook* (USDA):

Eastern and Western Red Cedar	Oak, white
Cherry, black	Teak, old growth
Douglas, Fir	Redwood, heartwood
Mahogany, Genuine	Locust, black
Chestnut	Spanish Cedar

3 - Lumber

BALDCYPRESS (*Taxodium distichum*) has a long tradition as a species resistant to decay, but beware! There are at least nine other species of four different genus which are marketed under the common name cypress. Only the heartwood of *T. distichum*, often marketed as Tidewater or Red Cypress, is decay resistant. Sinker Cypress, that is old trees which have been brought up from below water in which they have been submerged for some time and properly cured and dried, is also resistant. None of this Cypress will come from new cutting, but as salvaged wood.

FIRE-RETARDANT WOOD

The natural fire-retardant qualities and acceptability of treatments vary among the species. Where items of architectural woodwork are required to have a flame spread classification to meet applicable building and safety codes, the choice of lumber species must be a consideration. Most treated species are structural softwoods. Following are some references to assist in making these choices. Additional data on various species may be available from the U.S. Department of Agriculture Forest Service, Fire Safety of Wood Products Work Unit — (608) 231-9269.

Flame Spread Classification: This is the generally accepted measurement for fire rating of materials. It compares the rate of flame spread on a particular species with the rate of flame spread on untreated Oak. Most authorities accept the following classes for flame spread:

Class I or A.	0-25
Class II or B.	26-75
Class III or C.	76-200

Built-up Construction to Improve Fire Rating: In lieu of solid lumber, it is often advisable, where a fire rating is required, to build up members by using treated cores clad with untreated veneers not thicker than 1 mm [1/28"]. Some existing building codes, except where locally amended, provide that facing materials 1 mm [1/28"] or thinner finished dimension are not considered in determining the flame spread rating of the woodwork.

In localities where basic model building codes have been amended, it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code.

Fire-Retardant Treatments (FRT): Some species may be treated with chemicals to reduce flammability and retard the spread of flame over the surface. This usually involves impregnating the wood, under pressure, with salts suspended in a liquid. The treated wood must be redried prior to fabrication. FRT wood may exude chemicals in relative humidity above 85%, damaging finishes and corroding metals in contact with the FRT surface. Consult with a woodworker about the resulting appearance and availability of treated woods prior to specification.

Hardwoods currently being treated (Flame spread less than 25) include 4/4 Red Oak, and 4/4 to 8/4 Poplar. These woods can be machined after treatment, although machining may void the label classification. Fire retardant treatment does affect the color and finishing characteristics of the wood.

According to the traditional model codes in the USA and subject to local code modifications, untreated wood and wood products can usually be used in up to 10% of the combined surface area of the walls and ceiling. Cabinetry, furniture, and fixtures are rarely fire rated, and can be built of combustible materials.

The National Building Code of Canada (1995), states:

3.1.5.7.1 - Combustible millwork including interior trim, doors and door frames, aprons, and backing, handrails, shelves, cabinets and counters is permitted in a building required to be of noncombustible construction.

Code requirements are reviewed and updated regularly. The design authority shall check document publication dates and local amendments to national codes, and shall inform the woodworker of requirements.

Face veneers are not fire-retardant treated, and combining untreated veneers with treated lumber will usually result in color and finishing contrasts.

Finishing of Fire-Retardant Treated Lumber: Fire-retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

Intumescent Coatings for Wood: It is possible to reduce flammability by using intumescent coatings in either opaque or transparent finishes. These are formulated to expand or foam when exposed to high heat, and create an insulating effect, which reduces the speed of flame spread. Improvements are continually being made on these coatings. Consequently, the specifier must ascertain whether they will be permitted under the code governing the project. The relative durability of the finish and the effect of the coating on the desired color of the finished product vary from manufacturer to manufacturer. In general, the coatings are less durable, softer, and more hygroscopic than standard finishes.

3 - Lumber

Wood Species (a)	Flame Spread Index (b)	Smoke Developed Index (b)	Source (c)
ASTM E 84 flame-spread indexes for various wood species of 19 mm thick [3/4"] solid lumber as reported in the literature.			
Birch, Yellow	105-110	no data	UL
Cedar, Western Red	70	213	HPVA
Cedar, Alaska (Pacific Coast yellow)	78	90	CWC
Cottonwood	115	no data	UL
Baldcypress (Cypress)	145-150	no data	UL
Fir, Douglas	70-100	no data	UL
Fir, Pacific silver	69	58	CWC
Sweetgum (Gum, red)	140-155	no data	UL
Hemlock, western (West Coast)	60-75	no data	UL
Maple, Sugar (maple flooring)	104	no data	CWC
Oak, Red	100	100	UL
Oak, White	100	100	UL
Pine, red	142	229	CWC
Pine, Eastern White	85	122	CWC
Pine, Western White	75	no data	UL
Pine, Northern White	120-215	no data	UL
Pine, Ponderosa	105-230	no data	UL
Pine, Southern Yellow	130-195	no data	UL
Pine, Lodgepole	93	210	CWC
Poplar, Yellow	170-185	no data	UL
Redwood	70	no data	UL
Spruce, Eastern (Northern, White)	65	no data	UL, CWC
Spruce, Sitka (Western, Sitka)	100, 74	no data, 74	UL, CWC
Walnut, Black	130-140	no data	UL
No reliable data is available on other species at the time of this printing.			
(a)-In cases where the name given in the source did not conform to the official nomenclature of the Forest Service, the probable official nomenclature name is given and the name given by the source is given in parentheses.			
(b)-Data area as reported in the literature (dash where data do not exist).			
(c)-CWC, Canadian Wood Council (CWC 1996); HPVA, Hardwood Plywood & Veneer Association (Tests); UL, Underwriters Laboratories, Inc. (UL 527, 1971) from the Wood Handbook, Forest Products Society, 1999 - FPS catalog no. 7269			

PRESERVATIVE TREATMENTS

Modern technology has developed methods of treating certain species to extend their life when exposed to the elements. Some lumber species used for exterior architectural woodwork may be treated with an industry tested and accepted formulation. One such formulation is a liquid containing 3-iodo-2-propynyl butyl carbamate (IPBC) as its active ingredient, which must be used according to manufacturer's directions.

The Window & Door Manufacturers Association (WDMA), through the treatments and coatings committee, has reviewed information from third party testing laboratories which indicates that the number of formulations at the stated in-use concentration meet the requirements of WDMA I.S.4, latest edition. The formulations are acceptable for use under the WDMA Hallmark Water-Repellent Non-Pressure Preservative Treatment Certification Program and are adopted to meet all requirements.

3 - Lumber

IMPORTANT PRODUCT ADVISORY REGARDING DIMENSIONAL CHANGE PROBLEMS IN ARCHITECTURAL WOODWORK

This advisory concerns prevention of dimensional problems in architectural woodwork products as the result of uncontrolled relative humidity. It is further intended as a reminder of the natural dimensional properties of wood and wood-based products such as plywood, particleboard, and high pressure decorative laminate (HPDL) and of the routine and necessary care—and responsibilities—which must be assumed by those involved.

For centuries, wood has served as a successful material for architectural woodwork, and as history has shown wood products perform with complete satisfaction when correctly designed and used. Problems directly or indirectly attributed to dimensional change of the wood are usually, in fact, the result of faulty design, or improper humidity conditions during site storage, installation, or use.

Wood is a hygroscopic material, and under normal use and conditions all wood products contain some moisture. Wood readily exchanges this molecular moisture with the water vapor in the surrounding atmosphere according to the existing relative humidity. In high humidity, wood picks up moisture and swells. In low humidity, wood releases moisture and shrinks. As normal minor fluctuations in humidity occur, the resulting dimensional response in properly designed construction will be insignificant. To avoid problems, it is recommended that relative humidity be maintained within the range of 25-55%. Uncontrolled extremes—below 20% or above 80% relative humidity—can likely cause problems.

Oxidation is a reaction of acids in wood (e.g., tannic acid), with iron, oxygen, and moisture, whether this be relative humidity or direct moisture. Control of moisture is a simple way to protect wood products from stains as a result of oxidation.

Together with proper design, fabrication, and installation, humidity control is obviously the important factor in preventing dimensional change problems.

Architectural woodwork products are manufactured as designed from wood that has been kiln dried to an appropriate average moisture content and maintained at this condition up to the time of delivery. Subsequent dimensional change in wood is and always has been an inherent natural property of wood. These changes cannot be the responsibility of the manufacturer or products made from it. Specifically:

- Responsibility for dimensional change problems in wood products resulting from improper design rests with the designer/architect/specifier.
- Responsibility for dimensional change problems in wood products resulting from improper relative humidity exposure during site storage and installation rests with the general contractor.
- Responsibility for dimensional change problems in wood products resulting from humidity extremes after occupancy rests with engineering and maintenance.

NOTES

4

Sheet Products

4 - Sheet Products

There are a great variety of panels manufactured with differences in core materials, adhesives or binders, forming techniques, surface treatments, etc., which affect characteristics of the panels.

In addition, constant research gives rise to the production of new panel products. These new products are usually accompanied by data on test results of important characteristics for end-use purposes. In selecting new panel products for architectural woodworking, such data should be considered with reference to the AWS.

Many prefinished wood panels and decorative overlays have aesthetic and performance characteristics that meet or exceed the AWS, and should be evaluated, approved, and specified by the design professional when desired.

TYPES OF PANEL CORES

There are a wide range of core materials available for the fabrication of architectural woodwork. The primary core materials are covered in the AWS as follows:

INDUSTRIAL GRADE PARTICLEBOARD CORE - wood particles of various sizes that are bonded together with a synthetic resin or binder under heat and pressure.

Medium Density Industrial Particleboard is used in the broadest applications of architectural woodwork. It is especially well suited as a substrate for high quality veneers and decorative laminates.

When used as panels without any surface plies, the product is referred to as particleboard. *When used as an inner core with outer wood veneers, the panel is referred to as particle core plywood.* Industrial particleboard is commercially classified by "density," which is measured by the weight per cubic foot of the panel product.

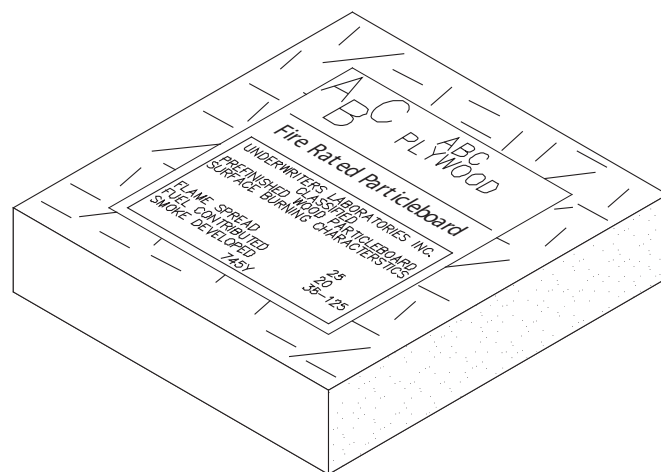
- Low Density [LD series] = generally less than 640 kg per m³ (40 pounds per ft³).
- Medium Density [M series] = generally between 640-800 kg per m³ (40-50 pounds per ft³).
- High Density [H series] = generally above 800 kg per m³ (50 pounds per ft³). Rarely used for woodwork.

MOISTURE RESISTANT PARTICLEBOARD CORE

Some Medium Density Industrial Particleboard is bonded with resins more resistant to swelling when exposed to moisture. The most common grades are ANSI 208.1-1999 Type M-2-Exterior Glue and M-3-Exterior Glue. Availability to the architectural woodworker is limited in some markets.

FIRE-RETARDANT PARTICLEBOARD CORE

Some Medium Density Industrial Particleboard has been treated during manufacture to carry a UL stamp for Class I fire rating (Flame spread 20, Smoke developed 450). This material is often used as a substrate for paneling requiring a Class I rating. Fire-retardant Medium Density Fiberboard is also available in some markets.

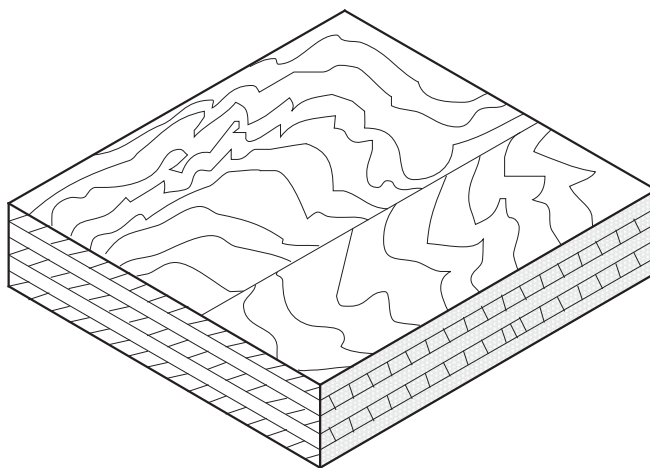


MEDIUM DENSITY FIBERBOARD (MDF) CORE - wood particles reduced to fibers in a moderate pressure steam vessel, combined with a resin, and bonded together under heat and pressure.

Due to the finer texture of the fibers used in manufacturing Medium Density Fiberboard (MDF) it is smoother than Medium Density Particleboard. The uniform texture and density of the fibers create a homogenous panel that is very useful as a substrate for paint, thin overlay materials, veneers and decorative laminates. MDF is among the most stable of the mat-formed panel products. When used as an inner core with outer wood veneers, the panel is referred to as MDF core plywood.

Some MDF is made to meet the ANSI 208.2-2002 reduced thickness swell criteria. Availability to the architectural woodworker is limited in some markets.

VENEER CORE - three or more layers (plies) of wood veneers pressed and glued into a single sheet.



What many think of as traditional "plywood," a panel made up of alternating layers of thin veneers, is called veneer core. Adhesive is placed between the veneer layers, and the panels are assembled under heat and pressure until the adhesive is set. The two outside layers of veneer are often selected for species, grain, and appearance; and are called the "face veneers."

4 - Sheet Products

COMBINATION CORE - A balanced blend of particleboard or fiberboard with veneer layers.

A combination of veneer core and particleboard/fiberboard core technologies, utilizing some of the advantages of each. This material should be evaluated and approved by the customer. Many products will meet the AWS.

HARDBOARD CORE - Hardboard is defined as inter-felted fibers consolidated under heat and pressure to a density of 500 kg per m³ (31 pounds per cubic foot) or greater.

Often used for casework backs, drawer bottoms, and divider panels, hardboard is available with either one side (S1S) or two sides (S2S) smooth. There are typically two types of hardboard core used by architectural woodworkers: Standard (untempered) and Tempered, which is standard hardboard subjected to a curing treatment increasing its stiffness, hardness, and weight.

AGRIFIBER/AGROFIBER CORE - Panel products made from straw and similar fiber are appearing in the marketplace. Boards which meet the ANSI 208.1 or 208.2 standards for Medium Density are acceptable for use under the AWS.

The characteristics of agrifiber/agrofiber core material performance vary by manufacturer, and are not included in the following table.

CHARACTERISTICS OF CORE MATERIAL PERFORMANCE

NOTE: It is important for the reader to understand the difference between “flatness” and “dimensional stability” characteristics. Particleboard and MDF are the recommended substrates for high pressure decorative laminate and wood veneer work because of their excellent flatness. Fair dimensional stability (expansion/contraction in panel size) is acceptable unless the product is exposed to wide swings in relative humidity, generally below 20% or above 80% with swings of more than 30 points.

Panel Core Type	Flatness	Visual Edge Quality	Surface Uniformity	Dimensional Stability	Screw Holding	Bending Strength	Availability
Industrial Particleboard (Medium)	Excellent	Good	Excellent	Fair	Fair	Good	Readily
Medium Density Fiberboard (MDF)	Excellent	Excellent	Excellent	Fair	Good	Good	Readily
Veneer	Fair	Good	Fair	Excellent	Excellent	Excellent	Readily
Lumber	Good	Good	Good	Good	Excellent	Excellent	Limited
Combination Core with composite crossbands	Excellent	Good	Excellent	Good	Excellent	Excellent	Limited
Combination Core with composite inner ply	Good	Fair	Good	Good	Good	Good	Limited
Moisture Resistant Particleboard	Excellent	Good	Good	Fair	Fair	Good	Limited
Moisture Resistant MDF	Excellent	Excellent	Excellent	Fair	Good	Good	Limited
Fire Rated Particleboard	Excellent	Fair	Good	Fair	Fair	Good	Limited

Notes: Various characteristics above are influenced by the grade and thickness of the core and specific gravity of the core species. Visual Edge Quality is rated before treatment with edge bands or fillers and Visual Edge Quality of lumber core assumes the use of “clear edge” grade. Surface Uniformity has a direct relationship to the performance of fine veneers placed over the surface. Dimensional Stability is usually related to exposure to wide swings in relative humidity. Screwholding and Bending Strength are influenced by proper design and engineering.

4 - Sheet Products

PLYWOOD

The term “plywood” is defined as a panel manufactured of three or more layers (plies) of wood or wood products (veneers or overlays and/or core materials), generally laminated into a single sheet (panel). Plywood is separated into two groups according to materials and manufacturing:

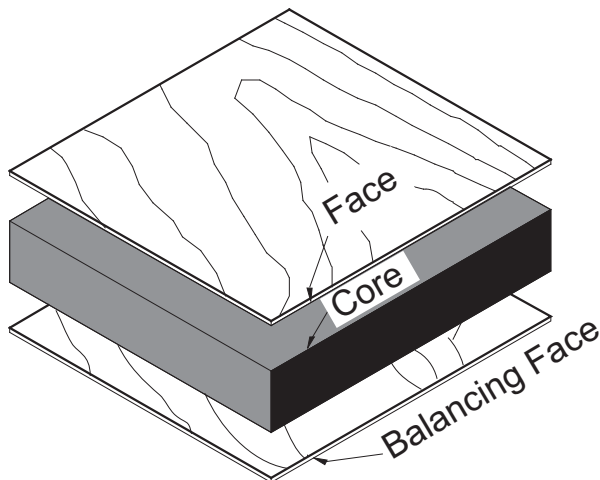
HARDWOOD PLYWOOD - manufactured of hardwood or decorative softwood veneers over a core material, such as medium density particleboard, medium density fiberboard, low density lumber, and/or other veneers.

SOFTWOOD PLYWOOD - Panels manufactured with softwood face veneers are described in standards published by the APA - The Engineered Wood Association. Softwood plywood is seldom incorporated into finished architectural woodworking projects, except to achieve specific design aesthetics. Softwood (construction) plywood is not recommended for use as a core material due to poor stability and core voids.

PANEL CONSTRUCTION BALANCE

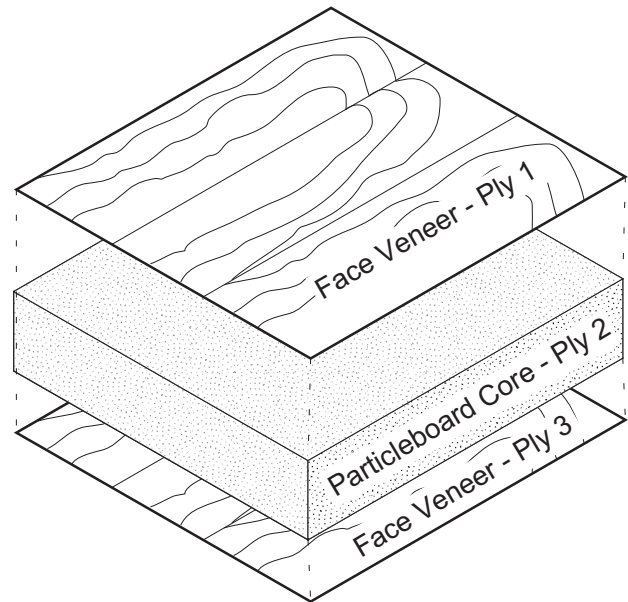
To achieve balanced construction, panels must be an odd number of layers (plies) symmetrical from the center line; e.g., all inner plies, except the innermost ply, should occur in pairs, using materials and adhesives on both sides that contract and expand, or are moisture permeable, at the same rate. A ply may consist of a single veneer, particleboard, medium density fiberboard, or hardboard. Each pair of inner plies should be of the same thickness and direction of grain. Each ply of each pair is placed on opposite sides of the innermost ply or layer, alternating grain directions from the center out. (Particleboard and MDF do not have a specific grain orientation.)

Balanced Construction

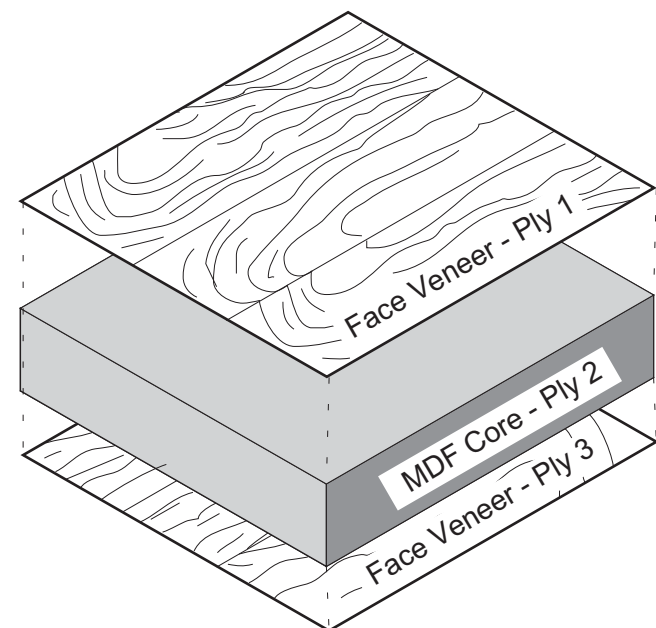


GENERAL RULES: The thinner the facing material, the less force it can generate to cause warping. The thicker the substrate, the more it can resist a warping movement or force.

TYPES OF PLYWOOD

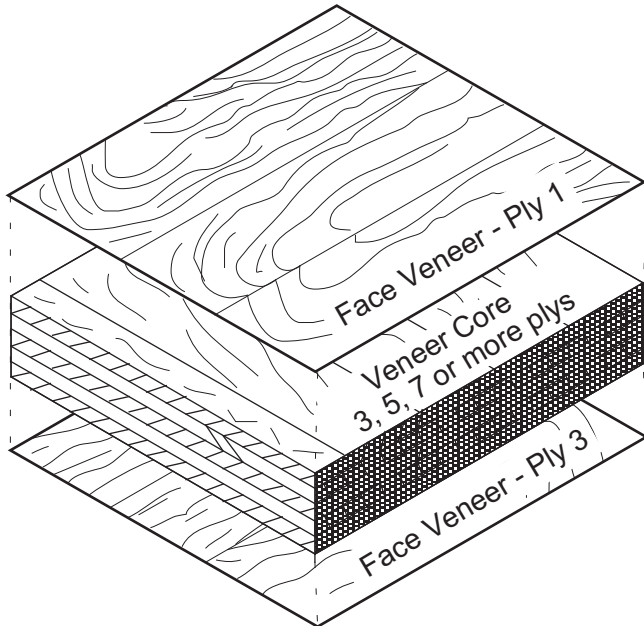


PARTICLEBOARD CORE PLYWOOD

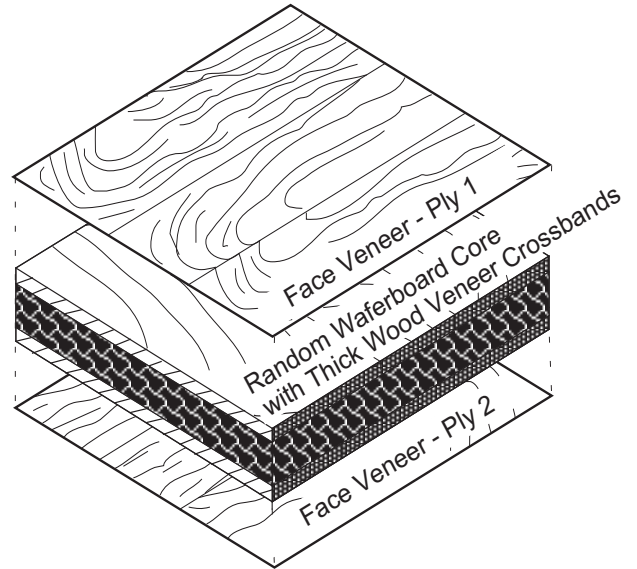


MEDIUM DENSITY FIBERBOARD CORE PLYWOOD

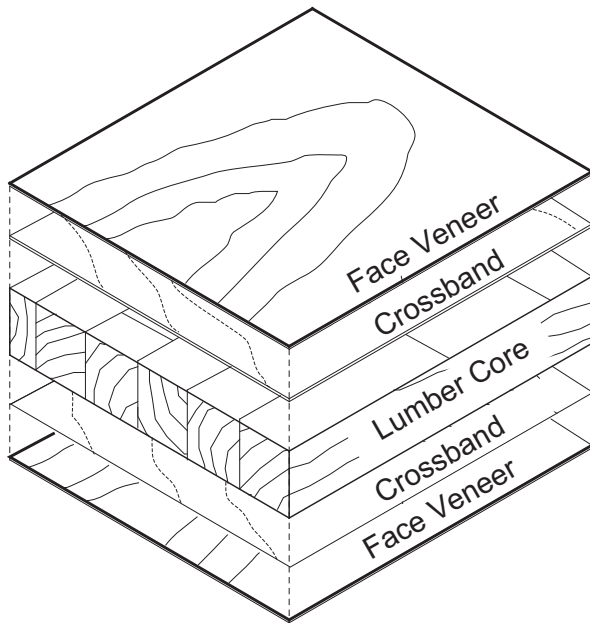
4 - Sheet Products



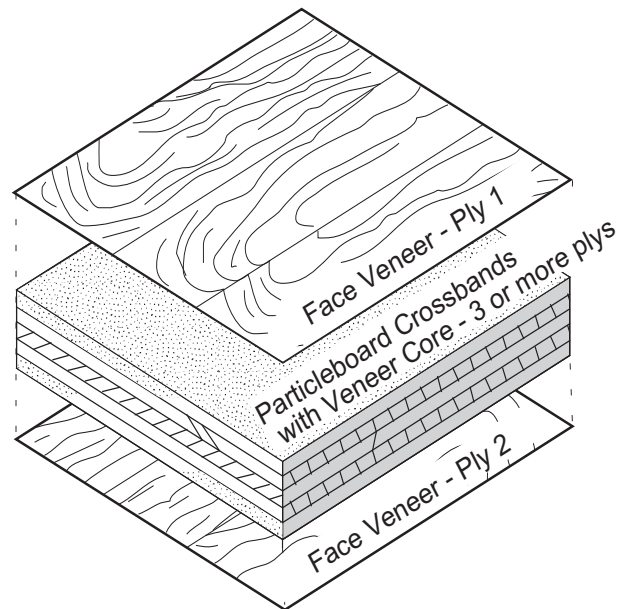
VENEER CORE PLYWOOD



COMBINATION CORE PLYWOOD



LUMBER CORE PLYWOOD



COMBINATION CORE PLYWOOD

4 - Sheet Products

TYPES OF FACING MATERIALS

WOOD VENEERS

Wood veneer is produced by veneer manufacturers in a variety of "industry standard" thicknesses. The slicing process is controlled by a number of variables. The thickness of the raw veneer has little bearing on the ultimate quality of the end product so long as show-through and sand-through is avoided.

HARDWOOD VENEER - Species: Available in many domestic and imported wood species.

Cut: Normally cut as plain sliced. Rift sliced and quarter sliced available in certain species at additional cost. Some species available as rotary cut.

SOFTWOOD VENEER - Species: Most common is Douglas fir; Pines are available; other softwoods in limited supply.

Cut: Most softwood veneer is Rotary cut. Plain sliced softwood veneer and "vertical grain" (quarter sliced) softwood veneer are limited in availability with the long lead times and higher prices associated with special orders.

DECORATIVE LAMINATES, OVERLAYS, AND PREFINISHED PANEL PRODUCTS

Decorative surfacing materials are often applied to wood product substrates such as industrial particleboard, fiberboard, hardboard, etc. Terminology and definitions of these overlay products follow, broadly grouped as:

THERMOSET DECORATIVE OVERLAY

Decorative thermally fused panels flat pressed from a thermoset polyester or melamine resin-impregnated web. Most products are pre-laminated to Industrial Particleboard or Medium Density Fiberboard substrates when they arrive at the woodwork fabricator. Performance characteristics are similar to High Pressure Decorative Laminate.

MEDIUM DENSITY OVERLAYS

Pressed resin-impregnated paper overlays, highly resistant to moisture, applied to suitable cores for both interior and exterior uses. The seamless panel face and uniform density furnishes a sound base for opaque finishes and paint.

THERMOPLASTIC SHEET

Semirigid sheet or roll stock extruded from a nonporous acrylic/polyvinyl chloride (PVC) alloy solid color throughout. Withstands high impact. Minor scratches and gouges are less conspicuous due to the solid color. Thickness ranges from 0.7 mm [.028"] to 6.4 mm [.250"]. Not recommended for horizontal surfaces where hot items may be placed and in areas near heat sources.

FOILS

These papers are generally referred to as "finished foils" in Europe. In the United States they have been called melamine papers, intermediate weight foils and impregnated foils. Not all foils are finished, nor are they all impregnated. Therefore foils vary in bond strength, porosity, cutting qualities and machinability. (Of limited use in custom architectural woodworking.)

VINYL FILMS

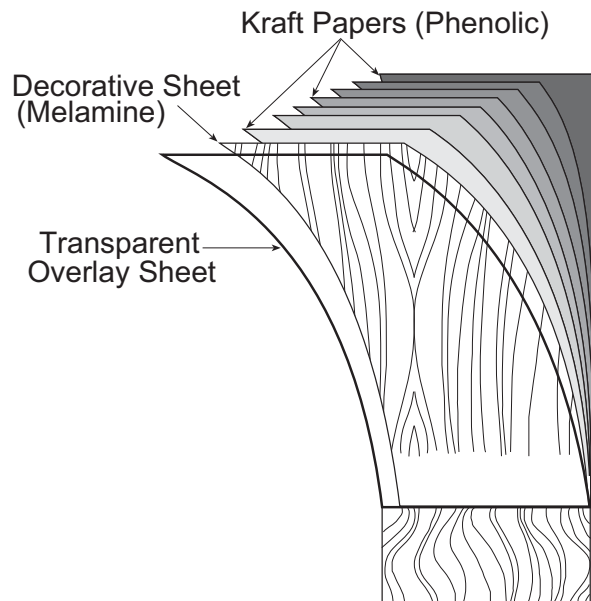
Polyvinyl chloride (PVC) film, either clear or solid color, used extensively for decorative vertical surfaces in mobile homes, recreational vehicles, commercial panels and movable walls. Product thicknesses range from 0.02" to .03 (0.5 mm to 0.8 mm). Some films are available with scuff-resistant top coatings. (Of limited use in custom architectural woodworking.)

BASIS WEIGHT PAPERS

Sometimes referred to as "micro-papers" or "rice papers," these overlays are printed paper coated with polyurethane, urea, polyester, acrylic, or melamine resins. They offer an economical alternative for low-wear surfaces. (Of limited use in custom architectural woodworking.)

H PRESSURE DECORATIVE LAMINATES

Resin-impregnated kraft paper substrates with decorative plastic face materials and a clear protective top sheet, formed under heat and pressure. The assembly offers resistance to wear and many common stains and chemicals. Common uses include casework exteriors, countertops, and wall paneling.



HPDL ELEMENTS

4 - Sheet Products

HPDL TYPES MOST COMMONLY USED

BASIC TYPES

Five basic types form the majority of applications of high pressure decorative laminate in North America: They are General Purpose, Vertical, Postforming, Cabinet Liner and Balancing Sheet laminates.

General Purpose (HGS and HGL) Used for most horizontal applications, such as desk tops and self-edged kitchen countertops, "HG" laminates offer durability, resistance to stains, and resistance to heat.

Vertical (VGS and VGL) A slightly thinner material, "VG" laminates are produced for areas which will receive less wear and impact than typical horizontal materials. They are an excellent choice for cabinet doors, the sides of casework, primarily decorative display shelves and vertical panels.

Postforming (HGP and VGP) Specifically for applications where a radiused surface is desirable, "P" laminates offer strong performance in both horizontal and vertical applications. A major advantage of formed surfaces on the exposed corners of casework and service counters is the edge's resistance to chipping damage. Most chip damage occurs at sharp 90° corners. Surfaces are thermoformed under controlled temperature and pressure. Not all manufacturers have post-forming machinery.

Flame Retardant (SGF, HGF, and VGF) These laminates are capable of providing flame retardant characteristics as determined by test methods required by the authority having jurisdiction. HGF is the most common type used.

Cabinet Liner (CLS) A thin vertical sheet, this type is designed for areas where the surface must be decorative, but will need to withstand little wear, such as the inside surfaces of cabinets and closets.

Backing Sheet (BKL) Backing materials are essential in the fabrication of most HPDL clad surfaces to prevent warping and to protect against dimensional instability of both laminate and substrate in conditions of changing temperature and humidity. Backing sheets are non-decorative, and both economical and effective in the creation of a successful application.

In summary, these types have the limitations of all high pressure decorative laminate:

- They are for interior use only, and may not be successfully used outdoors or under heavy exposure to the ultraviolet rays of the sun.
- They should not be used as cutting surfaces, because knives and other sharp tools will readily deface the surface and lower its other performance capabilities.
- They should not be exposed to caustic chemicals, such as drain and toilet bowl cleaners, which can permanently etch the surface.

- While they offer outstanding heat resistance, exposure to constant heat - from a curling iron, an electric skillet or coffee pot, for example - can harm the surface and may cause it to discolor or blister.

- Finally, basic HPDL types are veneering, and not structural materials. They must be adhered to satisfactory substrates for successful use.

SPECIALTY TYPES

The technological development of new high pressure decorative laminate products has multiple application opportunities for designers in every area from residential to contract, institutional, light industrial and custom commercial planning.

Variations in manufacturing technique, as well as in materials used, have created many new high pressure decorative laminate products. Some of these products offer enhancement of a basic characteristic; for example, heightened resistance to wear, impact or staining, or static dissipation.

Since these special materials in every case represent significant value added to basic HPDL, their cost is usually higher. Actual cost varies by material chosen, quantity specified, and manufacturer; you should work closely with your woodworker for material's cost on individual projects.

Specialty types available from several producers are summarized here. New types, and those offered by only one producer, appear constantly. Professional publications and manufacturers' literature will help keep you abreast of these new developments.

COLOR-THROUGH DECORATIVE LAMINATES. The interest in specifying solid color decorative laminates and the resurgence of interest in very pale pastels and neutral shades have caused increasing concern with the brown line visible at glued HPDL edges.

Color-through decorative laminates were formulated specifically to provide light colors without this brown line.

Color-through HPDL is produced in thicknesses of 0.050" to 0.060" (1.3 to 1.5 mm) and may be applied to substrates in three basic ways:

- As sheets, to form a decorative face with a true monolithic look;
- As edge trims, to match a face of conventional HPDL or to accent a natural material such as wood or leather;
- As decorative inlays.

Color-through HPDL may also be layered, in the same or several different colors, then sliced, routed or sandblasted for decorative dimensional and sculptural effects.

Color-through HPDL is produced with multiple layers of decorative papers, rather than the decorative-plus-kraft composition of conventional laminate. As a result, this material is slightly stiffer and slightly more brittle when flexed.

Selection of adhesive must take into consideration that a visible glue line will detract from the beauty of a fabricated piece. Adhesive should be untinted.

The bond created must be strong, too. Colorthrough HPDL contains a high level of melamine resin, and can generate considerable force when temperature and humidity fluctuate.

4 - Sheet Products

The substrate choice must be appropriate to resist this dimensional movement. Also, the substrate must sustain all anticipated tensile and flexural load, and must supply all needed screw-holding properties.

STATIC-DISSIPATIVE LAMINATES. High pressure decorative laminate is a good electrical insulator—in fact, it was for the specific purpose of electrical insulation that the product was originally developed.

HPDL does not store static electricity, and it is therefore a suitable material for use in hospital operating rooms, X-ray rooms, and computer room controlled environments where the accumulation and retention of static electricity must be avoided.

However, the growing need for work surfaces in areas such as electronic clean rooms, where electrostatic charges must be actively, continuously channeled away, has triggered the development of specifically conductive (static-dissipative) laminates.

These HPDL sheets have a conductive layer enclosed in, or backing, the sheet. Connected to suitable grounding, they create a decorative, sturdy, practical work surface. Applications include electronic workbench tops and work areas around instrument monitoring devices, in lab testing environments, around photo equipment and on computer desktops.

Antistatic laminates are produced in a number of compositions, thicknesses, colors and patterns. Consult manufacturers' literature for details.

CHEMICAL-RESISTANT DECORATIVE LAMINATES. For intermediate laboratories, the need for a work surface impervious to strong chemicals (acids and bases; dental, medical and photographic supplies), has long been met by drab industrial materials such as stainless steel, slate and soapstone.

There is a growing need for alternatives. High costs, both of materials and, in the case of stones, of support structures, are serious concerns, especially in construction and remodeling of schools and hospitals.

Chemical-resistant decorative laminates offer the familiar advantages of HPDL: resistance to wear, conductive and radiant heat, and impact; as well as ease in cleaning, color fastness, and relatively light weight.

These laminates may be applied on vertical as well as horizontal surfaces, to extend protection to cabinet doors and sides. And they may be postformed for seamless edges.

They may be specified in both vertical and forming thicknesses, and in a number of colors and patterns.

Adhesives should be specified carefully. Edges which may be exposed to chemical attack should be glued with chemical-resistant adhesives.

Formulation of chemical-resistant HPDL differs from producer to producer. Consult product literature to make sure the material you specify meets the needs of your projects.

FIRE-RATED DECORATIVE LAMINATES. Safer interiors are a primary concern for commercial, contract and institutional designers across North America. The threat of fire—and its concomitant hazard of smoke—has created a critical need for interior materials that address this concern without aesthetic sacrifice.

Every major manufacturer of HPDL materials offers fire- and smoke-retardant grades for interior application. The addition of fire retardant does not affect the performance characteristics of HPDL; wear and stain resistance, ease of maintenance, and color stability remain very strong.

Fire-rated high pressure decorative laminates are evaluated and certified according to ASTM-E-84 test procedures (cataloged as ASTM-E-84 Tunnel Test; and as Test No. 723 by Underwriters Laboratories, Inc. Similar Canadian testing is cataloged as CAN4-512-79).

With appropriate choices of substrate and adhesive, panels clad with fire-rated HPDL may be produced to comply with Class 1, I, or A, fire codes. Finished panels, already certified, may also be specified from some HPDL manufacturers.

Major applications of fire-rated HPDL include door, wall, and wainscot cladding in corridors, stairwells, entries, and elevators; as well as surfacing on fixtures and cabinetry. These materials are supplied in both horizontal and vertical types, in a wide range of colors and patterns.

They may not be postformed; the special formulation that produces fire retardant is not compatible with heat forming.

Adhesive choice for fire-rated HPDL is important. As with many types of FR particleboard, some PVA adhesives are incompatible with the fire-retardant chemical composition of the HPDL material. Resorcinol adhesives are best for both chemical compatibility and fire rating of the end product. Contact adhesives do surprisingly well in some cases. Verify test ratings with your HPDL manufacturer.

THICK LAMINATES. High pressure decorative laminate is produced by several manufacturers in thicknesses adequate to preclude the use of a substrate.

These HPDL products range in thickness from $\frac{1}{10}$ " to 1" (2.5 mm - 25.4 mm), and have decorative faces on both sides for balance. Unlike conventional sheets, thick laminates may be drilled and tapped, and offer significant screw-holding capacity. Screw holes must be centered at least $1\frac{1}{2}$ times the diameter of the screw in from any edge, horizontal or vertical.

Depending on thickness, these laminates may be used for many flat applications, such as toilet and dressing room partitions, workbenches, shelving, and table tops. Thick laminates are also used in cladding interior doors, where their special properties can eliminate the need for cross banding.

Durability and impact resistance of thick laminates exceed these same properties in comparably thick panels fabricated with an HPDL + medium density fiberboard + HPDL assembly.

Dimensional stability is slightly less predictable, because of the time required for humidity changes to affect movement through the many plies.

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Panels are heavy for their size—an asset in sturdiness of the end application, but a factor which must be considered when planning for time and cost of labor and transportation as well as for support structures.

DIMENSIONAL LAMINATES are conventional high pressure decorative laminates with deeply embossed finishes. These laminates are manufactured in a very broad range of colors and patterns, and add to the visual and tactile appeal of HPDL in both horizontal and vertical applications. Some dimensional laminates may be successfully postformed.

Typical embossed finishes include versions of leather, slate, woven fabric and reed. Selection and individual texture vary from one producer's line to another—these finishes are proprietary. Manufacturers can provide actual product samples.

Dimensional laminates are frequently specified for bar and restaurant tabletops, for retail fixtures and display walls, and for countertops.

Dimensional laminates offer the aesthetic and performance characteristics of conventional laminates; low points require a bit more attention in cleaning. Deeply embossed finishes are not recommended for high wear areas, because the highest points receive all the wearing force and may show wear more rapidly than matte-finish laminates.

HPDL-CLAD DECORATIVE TAMBOURS extend the wide choice of color and finish, as well as the long wear and easy care attributes, of high pressure decorative laminate to flexible tambours for both architectural cladding and functional closure systems.

These tambours are produced by several major HPDL manufacturers; actual configurations vary from traditional flat slats and half-rounds to flexible grids, horizontal rectangles, and triangular slats. They may be specified in literally hundreds of color or pattern and finish combinations. Each producer's line should be carefully examined to give you a full grasp of the options open to you.

Tambours clad with high pressure decorative laminate are perhaps most important because of their capability for exact coordination with HPDL sheets. Thus, one color scheme can be effectively continued throughout the surfaces of a cabinet, a piece of furniture, even a room.

HPDL clad tambours provide visually appealing surfaces for walls and wainscoting, vertical areas of reception desks and bank counters, and flexible wraps around table pedestals and columns. They create exciting graphic effects on cabinet doors and drawer panels, as well as on full-size interior doors.

Tambours are relatively light in weight and may be easily installed with construction mastic; but, like conventional high pressure decorative laminate sheets, they are not structural materials, and must be adhered to an appropriate substrate.

Functional tambours, which slide along tracks or grooves, extend the color, finish and wear benefits of HPDL to roll-top desks, appliance garages and other storage areas.

NATURAL WOOD LAMINATES are one excellent example of the ongoing evolution of the high pressure decorative laminate process. Presently, natural wood laminates may be specified in two formats; both feature thin veneers of fine woods bonded under high pressure and heat to a core of kraft papers and phenolic resins. One process leaves the face of the wood untreated, and ready to finish. The other adds a protective face of melamine resin.

Performance characteristics vary with the presence or absence of the melamine resin.

In both cases, the ease of cutting and bonding, as well as the wear resistance, improve in comparison to raw wood veneer. With the melamine face, the natural wood assumes all the easy care and long wear properties of conventional high pressure decorative laminate.

Applications of these products involve public spaces, such as banks and reception areas of hotels, where the full beauty of fine wood is an important aesthetic asset.

METAL-FACED LAMINATES. Several manufacturers of high pressure decorative laminates now produce metal veneers with a backer of kraft paper and phenolic resin, and at least one product with a thermoplastic core between two metal sheets is presently available.

The material used for most metal laminates is interior-type anodized aluminum. Other materials, including copper and nickel alloys, may be specified in various formats.

The primary advantage of metal-clad laminates lies in their relative ease of fabrication, as compared to conventional metals. Such sheets may be cut, formed and machined with standard woodworking equipment. And the laminate backer makes for ease in gluing; the adhesives and techniques used for HPDL are appropriate. Metal laminates add light and visual drama for interior vertical surfaces. Walls, wainscoting, stairwells, columns and accent trims around ceilings are appropriate for their application. Inset trims, reveals and base moldings around furniture and casework can be very effectively accented with metal laminates. Freestanding panels faced with metal laminates should have similar veneer on their reverse sides, to control warping.

Metal faced laminates are recommended for vertical surfaces where resistance to abuse is not a major concern. These materials have largely replaced metallic foil-faced laminates, because of the greater beauty, increased durability, and generally higher quality of sheets with solid metal surfacing. Note: metal laminates will conduct electricity.

FLOORING LAMINATES are formulated specifically for surfacing panels used for access, or raised, floors. These laminates, available from several major producers of high pressure decorative laminate, combine the good looks and easy maintenance of conventional HPDL with greatly enhanced wear resistance, and feature the capability for permanent static dissipation.

Such flooring offers outstanding performance in areas such as hospitals, for cardiac and intensive care areas; electronic clean rooms and computer facilities; and high traffic areas, where heavy wear from both pedestrian and wheeled traffic is predictable.

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These laminates can be maintained with regular damp mopping, using water and a mild, nonflammable, organic cleaner. They do not require sealing, varnishing, buffing or waxing.

Stock selection of patterns is limited to frequently specified neutral colors and patterns; custom colors and patterns can be made available.

ENGRAVING STOCK for indoor signs and nameplates is available from some HPDL producers. It offers the resistance to stain, wear and impact of conventional laminates, and makes up easily into attractive, easy to clean, long lasting signage.

This material may be specified with a black, white, or red core, with two decorative faces, in many colors, patterns, and finishes.

CUSTOM LAMINATE PRODUCTS. Many architectural designers are unaware of the custom capabilities of high pressure decorative laminate manufacturers.

These capabilities extend from production of specially developed colors and patterns to individual layouts of surfaces to custom silk screening.

Typical uses include horizontal and vertical surfaces for games and sports from backgammon to bowling; custom lamination of maps, menus and charts; table tops and wall panels with logotypes or special graphics; hand inlaid patterns; laminated textiles; and special matches for corporate colors.

Your HPDL manufacturer will be happy to consult with you when custom services are needed for effective realization of a design.

Your woodworker will be an excellent partner for your design team when your designs call for custom treatments.

VOLUNTARY STANDARDS

Voluntary standards for the production of these overlay products are available from: National Electrical Manufacturers Association (NEMA), Rosslyn, VA; Laminating Materials Association (LMA), Oradell, NJ.

SPECIAL PRODUCTS

Included in this classification are special panel products such as lead-lined panels for X-ray areas; bullet-resistant panels for armor protected areas; honeycomb-core panels when light weight is a consideration, etc.

LEAD-LINED PANELS

Usually a sheet of lead of a specified thickness, to meet X-ray shield requirements, is laminated between 2 layers of core material. A decorative overlay and balancing sheet can then be applied as required.

PROJECTILE RESISTANT ARMOR (BULLET PROOFING)

Available as steel plate-, glass-, polycarbonate-, acrylic- or fiberglass-reinforced material which can offer protection against most available small-arms fire, depending upon the thickness specified. These panels are usually built into the interior of the structure of the counter, teller's lines, judge's benches, etc. Standards and tests for bullet resistance are set by both Underwriters Laboratories (UL 752) and the National Institute of Justice (N.I.J.-0108.01).

SOLID SURFACING MATERIALS

Solid surfacing materials are available and can be fabricated and/or supplied by many woodworkers. The products (and manufacturer's warranties) vary and must be fabricated according to manufacturer's recommendations, including the use of unique fasteners and adhesives. Many decorative inlays are available. Consult your woodworker about performance issues, materials, colors, and patterns.

COMPOSITE VENEERS

Composite veneers are slices of blocks or "flitches" made from pre-dyed veneer which has been laminated, and in some cases deformed, to produce a special grain and color characteristic.

Composite veneer has both advantages and limitations. The woodworker and the design professional may choose to use composite veneers for economical and/or æsthetic reasons.

Composite veneers are not meant as a substitute for real wood veneer. Each has its own place and proper application. The design professional, in consultation with a woodwork manufacturer, will determine which product to use on a specific project.

ACRYLIC AND METHACRYLATE SHEETS

Overlay materials typically 3.2 mm [$\frac{1}{8}$ "] thick with a high-gloss finish. Individual products should be evaluated and specified or approved by the design professional when desired. Manufacturer's performance test data is available for review.

SOLID PHENOLIC

A composite of solid phenolic resins molded with a homogeneous core of organic fiber reinforced phenolic and one or more integrally cured surfaces of compatible thermoset nonabsorbent resins. SPC has seen some use in recent years as wall surfacing, casework parts, and countertops.

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THERMOSET DECORATIVE OVERLAY SUMMARY TABLE

Tests for Resistance to:	Test Description ¹	Minimum Requirements		NEMA LD3-2000 VGL ²
		Solid Colors	Wood Grains	
Wear	A measure of the ability of a decorative overlaid surface to maintain its design or color when subjected to abrasive wear.	400 cycles	125 cycles	400 cycles
Scuff	A measure of the ability of a decorative overlaid surface to maintain its original appearance when exposed to scuffing.	No effect		<---Same
Stain	A measure of the ability of a decorative overlaid surface to resist staining or discoloration from contact with 29 common household substances.	No effect 1-10 Moderate 11-15		<---Same
Clean-ability	A measure of the ability of a decorative overlaid surface to be cleaned using a sponge.	No effect. Surface cleaned in 20 or fewer strokes		<---Same
Light ³	A measure of the ability of a decorative overlaid surface to retain its color after exposure to a light source having a frequency range approximating sunlight.	Slight		<---Same
High temperature	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to a high temperature [180° C (356° F)].	Slight		<---Same
Radiant heat	A measure of the ability of a decorative overlaid surface to resist spot damage when subjected to a radiant heat source.	No effect up to 60 seconds		<---Same
Boiling water ⁴	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to boiling water.	No effect		<---Same
Impact	A measure of the ability of a decorative overlaid surface to resist fracture due to spot impact by a steel ball dropped from a measured height.	380 mm [15"] without fracture		<---Same

¹ These test procedures are identical to those used by the National Electrical Manufacturers Association (NEMA) for testing high pressure decorative laminates. The minimum requirements to comply for SOLID COLORS meet or exceed NEMA Standard LD3- (latest edition for high pressure decorative laminates).

² This standard applies to decorative panel faces only.

³ Environmental regulations have caused certain colors to be subject to changes in appearance and the manufacturer should be consulted.

⁴ Melamine panels, when produced under conditions for optimum panel performance, may show slight effect. A shipment meeting 95% of the minimum requirements of the performance standard is in conformance.

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WOOD VENEER SPECIES - General characteristics of selected species:

Species	Cut and Details	Width to	Length	Flitch Size	Cost (1)	Availability
Mahogany	Plain Sliced Honduras Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Good
	Quartered Honduras Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Moderate
	Plain Sliced African Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Moderate
	Quartered African Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Good
Ash	Plain Sliced American White Ash	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good
	Quartered American White Ash	203 mm [8"]	3658 mm [12']	Small	High	Good
	Quartered or Plain Sliced European Ash	254 mm [10"]	3048 mm [10']	Medium	High	Limited
Anegre	Quartered or Plain Sliced Anegre	305 mm [12"]	3658 mm [12']	Large	High	Good
Avodire	Quartered Avodire	254 mm [10"]	3048 mm [10']	Large	High	Limited
Cherry	Plain Sliced American Cherry	305 mm [12"]	3353 mm [11']	Medium	Moderate	Good
	Quartered American Cherry	102 mm [4"]	3048 mm [10']	V. Small	High	Moderate
Birch	Rotary Cut Birch (Natural)	1220 mm [48"]	3048 mm [10']	Large	Low	Good
	Rotary Cut Birch (Select Red or White)	914 mm [36"]	3048 mm [10']	Medium	Moderate	Moderate
	Plain Sliced Birch (Natural)	254 mm [10"]	3048 mm [10']	Small	Moderate	Limited
	Plain Sliced Birch (Select Red or White)	127 mm [5"]	3048 mm [10']	Small	High	Limited
Butternut	Plain Sliced Butternut	305 mm [12"]	3048 mm [10']	Medium	High	Limited
Makore	Quartered or Plain Sliced Makore	305 mm [12"]	3658 mm [12']	Large	High	Good
Maple	Pl. Sl. (Half Round) American Maple	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good (2)
	Rotary Birdseye Maple	6096 mm [20"]	3048 mm [10']	Medium	V. High	Good
Oak	Plain Sliced English Brown Oak	305 mm [12"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Brown Oak	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Plain Sliced American Red Oak	4877 mm [16"]	3658 mm [12']	Large	Moderate	Good
	Quartered American Red Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American Red Oak	254 mm [10"]	3048 mm [10']	Medium	Moderate	Good
	Comb Grain Rift American Red Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
	Plain Sliced American White Oak	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quartered American White Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American White Oak	203 mm [8"]	3048 mm [10']	Medium	High	Good
	Comb Grain Rift American White Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
Hickory or Pecan	Plain Sliced American Hickory or Pecan	305 mm [12"]	3048 mm [10']	Small	Moderate	Good
Sapele	Quartered or Plain Sliced Sapele	305 mm [12"]	3658 mm [12']	Large	High	Good
Sycamore	Plain Sliced English Sycamore	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Sycamore	152 mm [6"]	3048 mm [10']	Medium	V. High	Limited
Teak	Plain Sliced Teak	305 mm [12"]	3658 mm [12']	Large	V. High	Limited (3)
	Quartered Teak	305 mm [12"]	3658 mm [12']	Medium	V. High	Limited (3)
Walnut	Plain Sliced American Walnut	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quarter Sliced American Walnut	152 mm [6"]	3048 mm [10']	V. Small	High	Rare

(1) Cost reflects raw veneer costs weighted for waste or yield characteristics and degree of labor difficulty.

(2) Seasonal factors may affect availability.

(3) Availability of blond Teak is very rare.

When Quartered or Plain Sliced (Pl. Sl.) are listed on the same line, the width dimensions are Plain Sliced; Quartered is narrower.

4 - Sheet Products

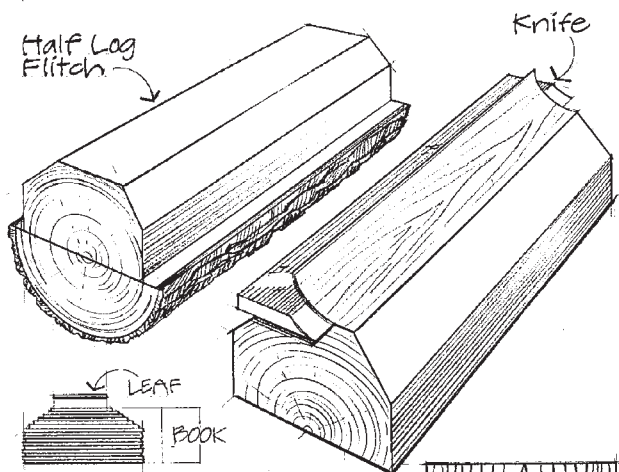
TYPES OF VENEER CUTS

The manner in which a log segment is cut with relation to the annual rings will determine the appearance of the veneer. When sliced, the individual pieces of veneer, referred to as leaves, are kept in the order in which they are sliced, thus permitting a natural grain progression when assembled as veneer faces. The group of leaves from one slicing is called a flitch and is usually identified by a flitch number and the number of gross square feet of veneer it contains. The faces of the leaves with relation to their position in the log are identified as the tight face (toward the outside of the log) and the loose face (toward the inside or heart of the log). During slicing the leaf is stressed on the loose face and compressed on the tight face. When this stress is combined with the natural variation in light refraction caused by the pores of the wood, the result is a difference in the human perception of color and tone between tight and loose faces.

The principal methods of slicing veneers and the general visual characteristics of the grain are:

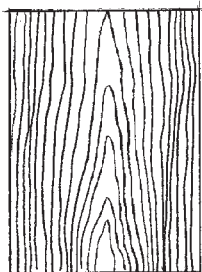
PLAIN SLICING (OR FLAT SLICING)

This is the slicing method most often used to produce veneers for high quality architectural woodworking. Slicing is done parallel to a line through the center of the log. A combination of cathedral and straight grain patterns results, with a natural progression of pattern from leaf to leaf.



Plain Sliced
Or Flat Sliced
(Slicer)

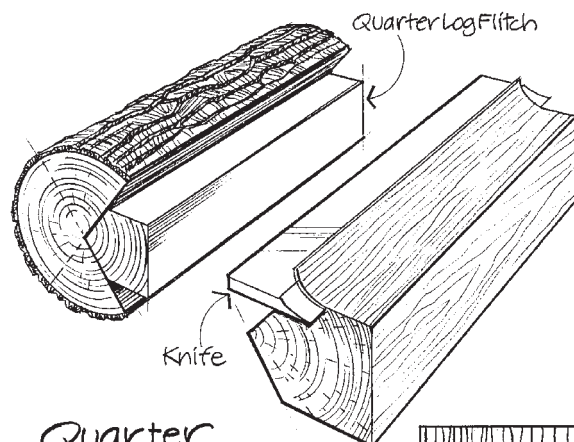
Leaf width depends on log size & placement in flitch.
Half Round A somewhat similar pattern is achieved by turning a half log flitch on a lathe.



Cathedral Pattern

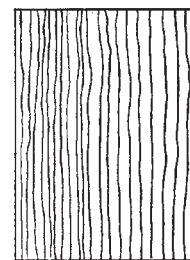
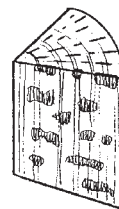
QUARTER SLICING (OR QUARTER CUT)

Quarter slicing simulates the quarter sawing process of solid lumber, roughly parallel to a radius line through the log segment. In many species the individual leaves are narrow as a result. A series of stripes is produced, varying in density and thickness from species to species. "Fleck" (sometimes called flake) is a characteristic of this slicing method in Red and White Oak.

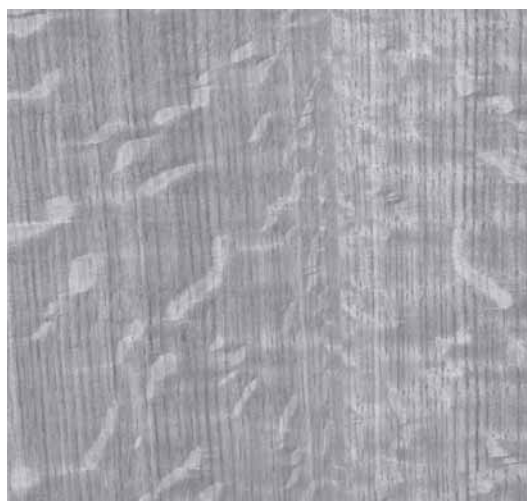


Quarter
Sliced
(Slicer)

Flake pattern is produced when slicing through medullary rays in some species, principally oak.



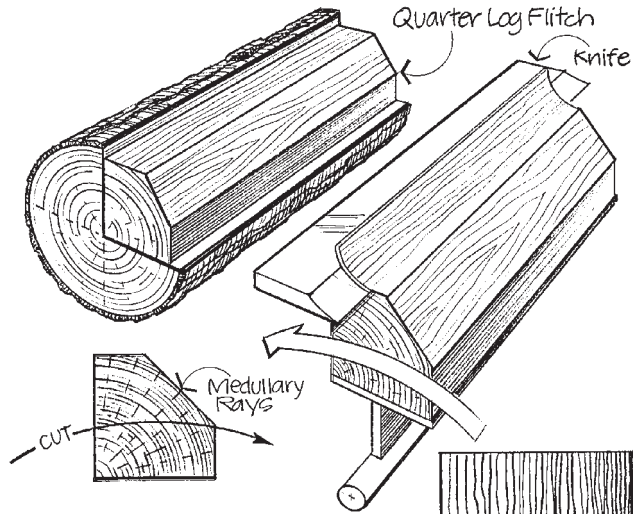
Narrow Striped Pattern



4 - Sheet Products

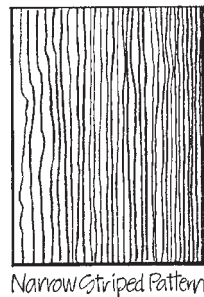
RIFT SLICING (OR RIFT CUT)

Rift veneers are produced most often in Red and White Oak, rarely in other species. Note that rift veneers and rift sawn solid lumber are produced so differently that a "match" between rift veneers and rift sawn solid lumber is highly unlikely. In both cases the cutting is done slightly off the radius lines minimizing the "fleck" (sometimes called flake) associated with quarter slicing.



Rift Cut (Lathe)

Angle of cut is 15° to the radial to minimize the ray flake effect in oaks.
Comb Grain is the portion which has VERY tight & straight grain.



Narrow Striped Pattern

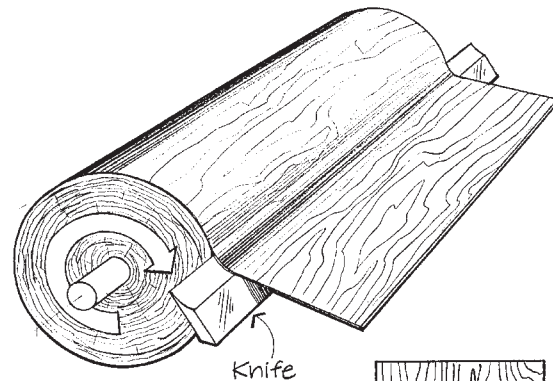
COMB GRAIN

Limited in availability, comb grain is a select product of the Rift process distinguished by tight, straight grain along the entire length of the veneer. Slight angle in the grain is allowed. Comb grain is restricted to Red and White Oak veneers.

ROTARY

The log is center mounted on a lathe and "peeled" along the general path of the growth rings like unwinding a roll of paper, providing a generally bold random appearance. Rotary cut veneers may vary in width and matching at veneer joints is extremely difficult. Almost all softwood veneers are cut this way. Except for a specific design effect, rotary veneers are the least useful in fine architectural woodwork.

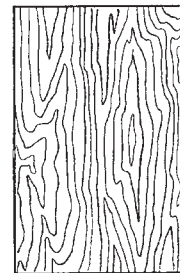
Rotary sliced fine hardwood veneers are used in a limited way, and usually for special figure and cut, in the manufacture of Premium Grade woodwork. Careful consideration, specification, and communication are recommended when rotary cut is contemplated.



Rotary (Lathe)

- Wide sheets
- Broad Pattern
- Difficult Matching

Used primarily on Economy or Commercial grades.



Very Broad Pattern

COMPOSITE VENEERS

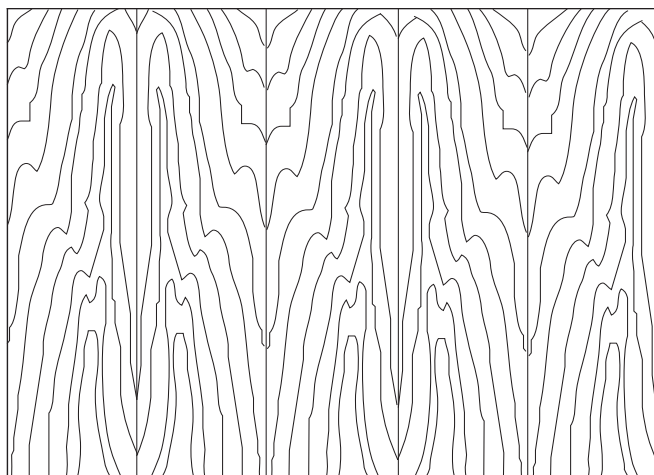
Sliced from fast-growing trees, these veneers are dyed and then reglued in molds to create "grain" patterns. The color is established during manufacture because the high percentage of glue lines resist staining by the woodworker. Must be specified by brand name and manufacturer's designation. "Matching" between components may not be possible.

4 - Sheet Products

MATCHING ADJACENT VENEER LEAVES

It is possible to achieve certain visual effects by the manner in which the leaves are arranged. As noted, rotary cut veneers are difficult to match; therefore most matching is done with sliced veneers. The matching of adjacent veneer leaves must be specified. Special arrangements of leaves such as “diamond” and “box” matching are available. Consult your woodworker for choices. The more common types are:

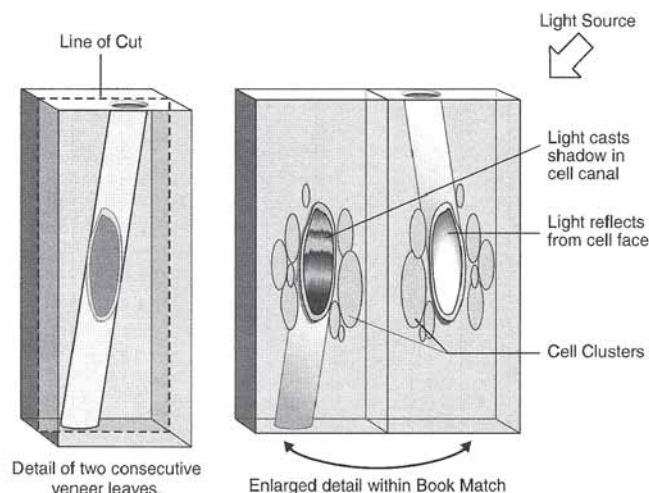
BOOK MATCHING



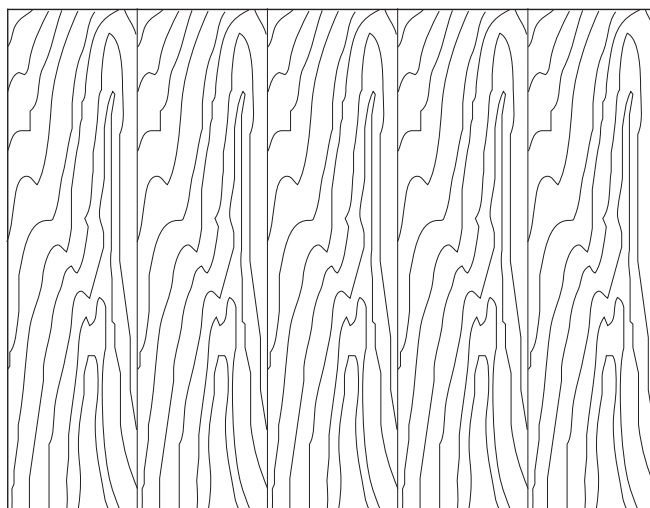
The most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces (leaves) are opened like the pages of a book.

Visual Effect - Veneer joints match, creating a symmetrical pattern. Yields maximum continuity of grain. When sequenced panels are specified, prominent characteristics will ascend or descend across the match as the leaves progress from panel to panel.

Barber Pole Effect in Book Match - Because the tight and loose faces alternate in adjacent pieces of veneer, they may accept stain differently, and this may result in a noticeable color variation. Book matching also accentuates cell polarization, causing the perception of different colors. These natural characteristics are often called barber pole, and are not a manufacturing defect.



SLIP MATCHING

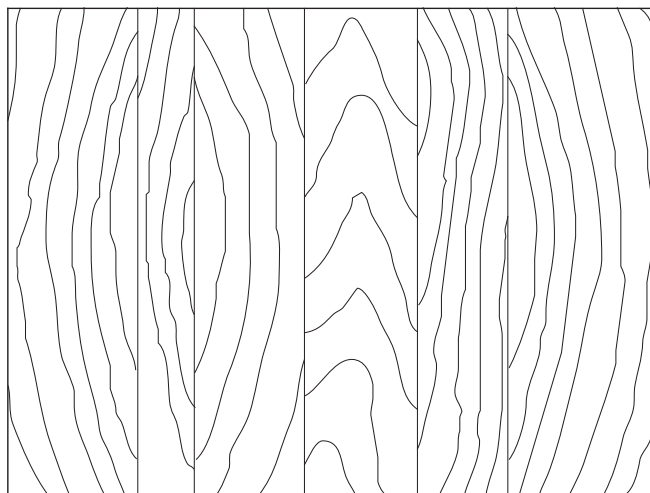


Often used with quarter sliced and rift sliced veneers. Adjoining leaves are placed (slipped out) in sequence without turning, resulting in all the same face sides being exposed.

Visual Effect - Grain figure repeats; but joints do not show visual grain match.

Note: The lack of grain match at the joints can be desirable. The relatively straight grain patterns of quartered and rift veneers generally produce pleasing results and a uniformity of color because all faces have the same light refraction.

RANDOM MATCHING



Veneer leaves are placed next to each other in a random order and orientation, producing a “board-by-board” effect in many species.

Visual Effect - Casual or rustic appearance, as though individual boards from a random pile were applied to the product. Conscious effort is made to mismatch grain at joints.

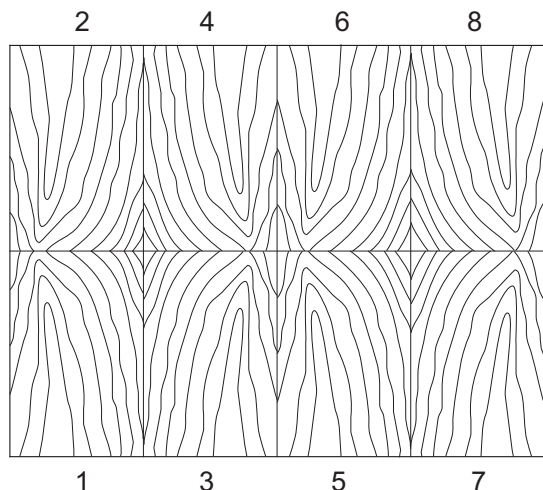
Degrees of contrast and variation may change from panel to panel. This match is more difficult to obtain than book or slip match, and must be clearly specified and detailed.

4 - Sheet Products

END MATCHING

Often used to extend the apparent length of available veneers for high wall panels and long conference tables. End matching occurs in three types:

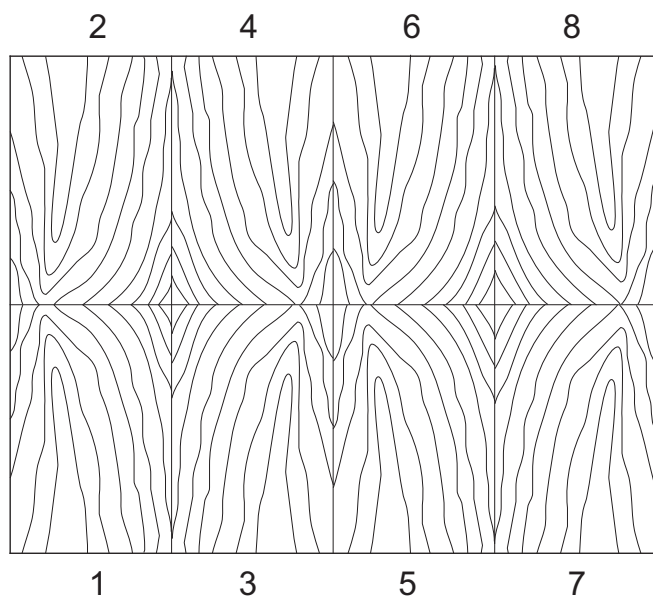
ARCHITECTURAL END MATCH



Leaves are individually book (or slip) matched, first end-to-end and then side-to-side, alternating end and side.

Visual Effect - Yields best continuous grain patterns for length as well as width. Minimizes misalignment of grain pattern.

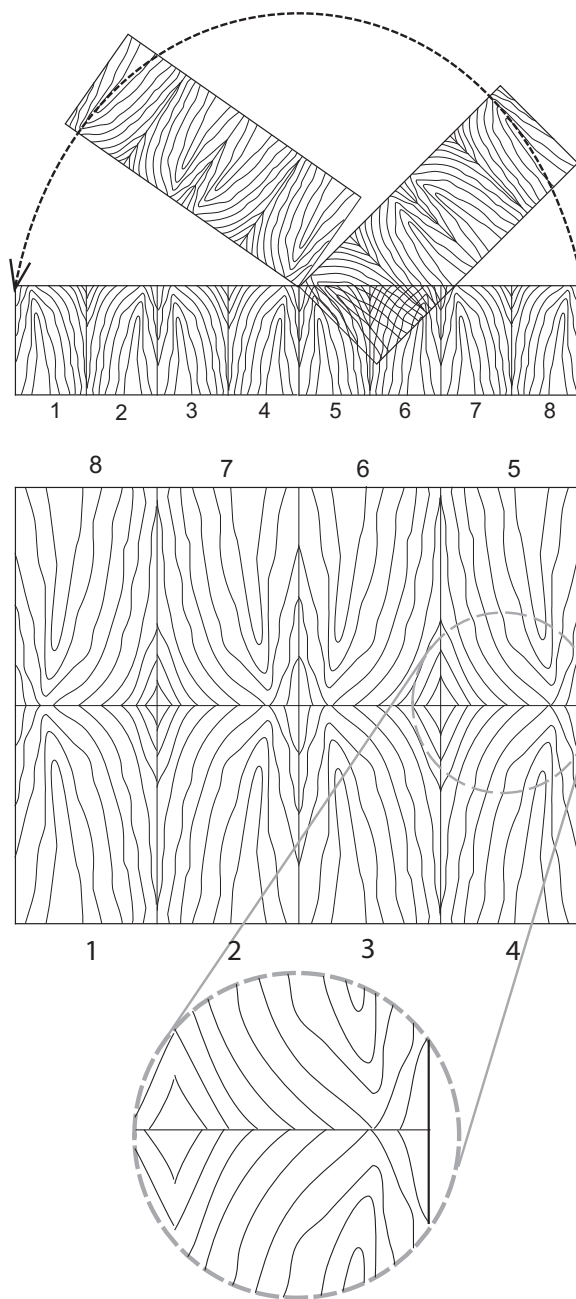
CONTINUOUS END MATCH



Leaves are individually book (or slip) matched, separate panels are stacked in sequenced order, either horizontally or vertically in the elevation. (Horizontal sequence illustrated.)

Visual Effect - Yields sequenced grain patterns for elevations, with pleasing blend of figure horizontally or vertically.

PANEL END MATCH



Natural Grain Pattern Mismatch Occurs

Leaves are book (or slip) matched on panel subassemblies, with sequenced subassemblies end matched, resulting in some modest cost savings on projects where applicable.

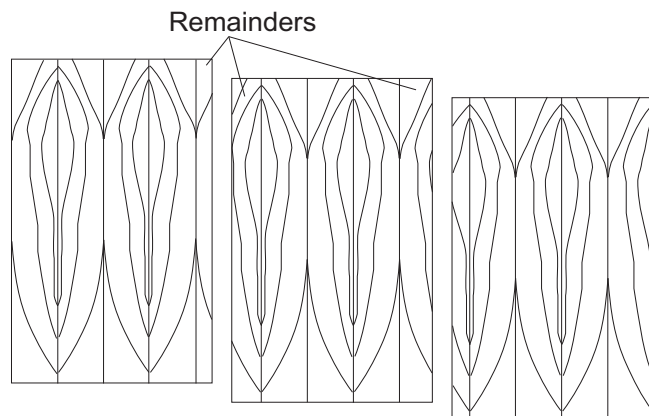
Visual Effect - For most species, yields pleasing, blended appearance and grain continuity. Some misalignment of grain pattern will occur, and is not a defect.

4 - Sheet Products

MATCHING WITHIN INDIVIDUAL PANEL FACES

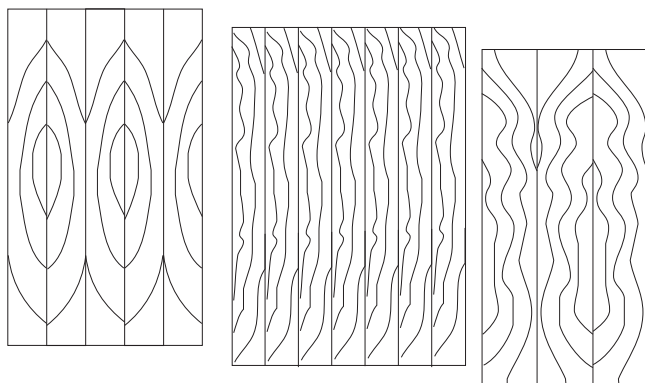
The individual leaves of veneer in a sliced flitch increase or decrease in width as the slicing progresses. Thus, if a number of panels are manufactured from a particular flitch, the number of veneer leaves per panel face will change as the flitch is utilized. The manner in which these leaves are “laid up” within the panel requires specification, and is classified as follows:

RUNNING MATCH



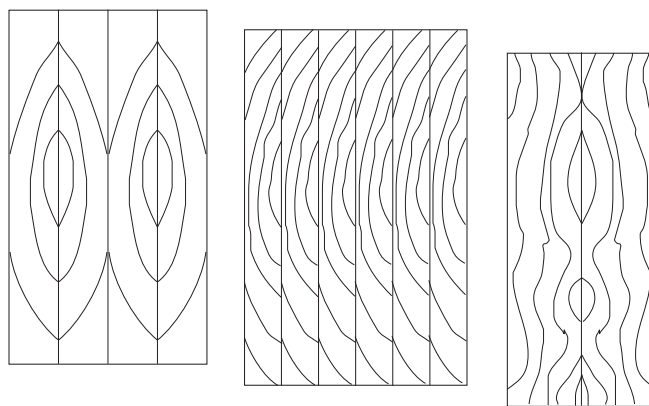
Each panel face is assembled from as many veneer leaves as necessary. This often results in a non-symmetrical appearance, with some veneer leaves of unequal width. Often the most economical method at the expense of aesthetics, it is the standard for Custom Grade and must be specified for other Grades. Running matches are seldom “sequenced and numbered” for use as adjacent panels. Horizontal grain “match” or sequence cannot be expected.

BALANCE MATCH



Each panel face is assembled from veneer leaves of uniform width before edge trimming. Panels may contain an even or odd number of leaves, and distribution may change from panel to panel within a sequenced set. While this method is the standard for Premium Grade, it must be specified for other Grades, and it is the most common assembly method at moderate cost.

BALANCE AND CENTER MATCH



Each panel face is assembled from an even number from veneer leaves of uniform width before edge trimming. Thus, there is a veneer joint in the center of the panel, producing horizontal symmetry. A small amount of figure is lost in the process. Considered by some to be the most pleasing assembly at a modest increase in cost over Balance Match.

FIRE-RETARDANT PANELS

FLAME SPREAD CLASSIFICATION

The various codes utilize flame spread classifications for wood and other materials. It is the responsibility of the specifier to determine which elements, if any, of the woodwork require special treatment to meet local codes. In most codes, the panel products used to fabricate casework and furniture are not regulated.

FLAME SPREAD FACTORS

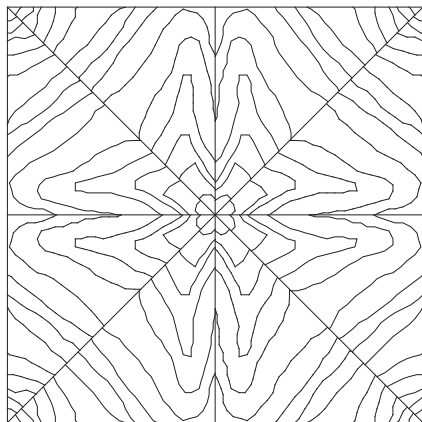
CORE - The fire rating of the core material determines the rating of the assembled panel. Fire-retardant veneered panels must have a fire-retardant core. Particleboard core is available with a Class I (Class A) rating and can be used successfully with veneer or rated high pressure decorative laminate faces. MDF (Medium Density Fiberboard) is available with a fire rating in some markets.

FACE - Some existing building codes, except where locally amended, provide that facing materials $\frac{1}{28}$ " (0.9 mm) or thinner are not considered in determining the flame spread rating of the panel. If state and local codes move toward adoption of the International Building Code provisions, it is possible that the $\frac{1}{28}$ " (0.9 mm) exemption may not be available. In localities where basic panel building codes have been amended it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code. Traditionally, face veneers are not required to be fire-retardant treated, and such treatment will adversely affect the finishing process.

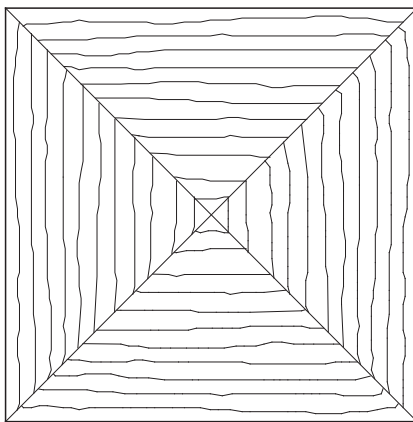
4 - Sheet Products

SPECIAL MATCHES

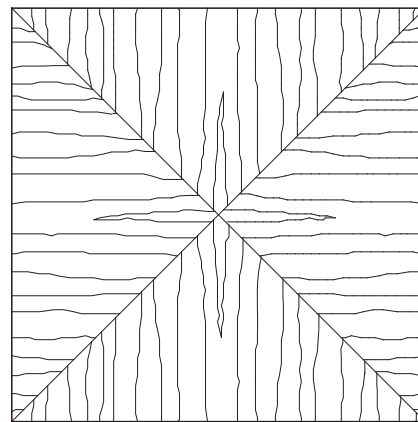
There are regional variations in the "names" of the following veneer leaf matching techniques. It is strongly recommended the design professional use both names and drawings to define the effect desired.



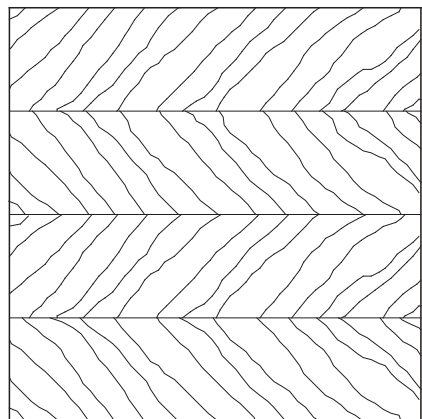
8 PIECE SUNBURST



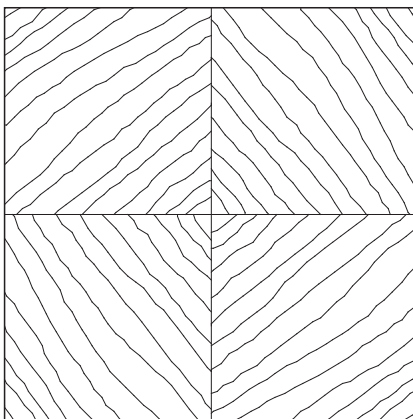
BOX MATCH



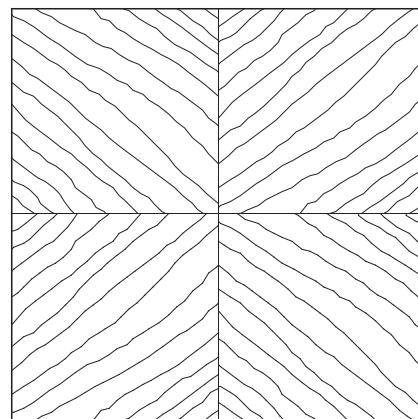
REVERSE OR END GRAIN BOX



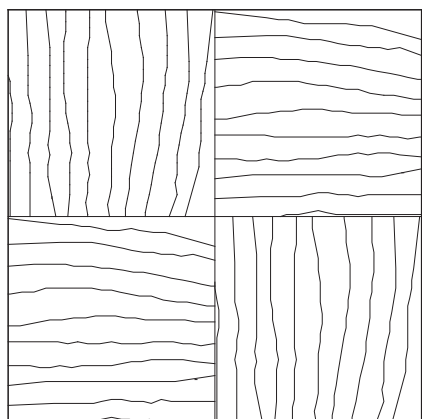
HERRINGBONE OR V-BOOK MATCH



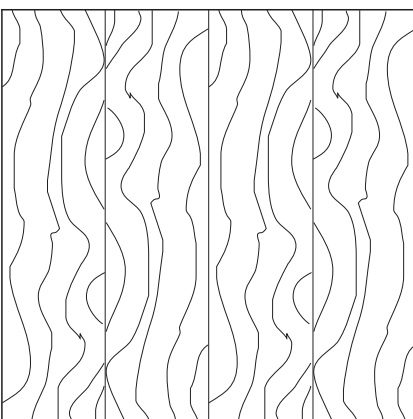
DIAMOND MATCH



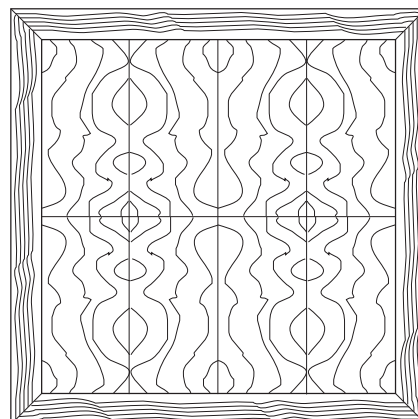
REVERSE DIAMOND MATCH



PARQUET MATCH



SWING MATCH



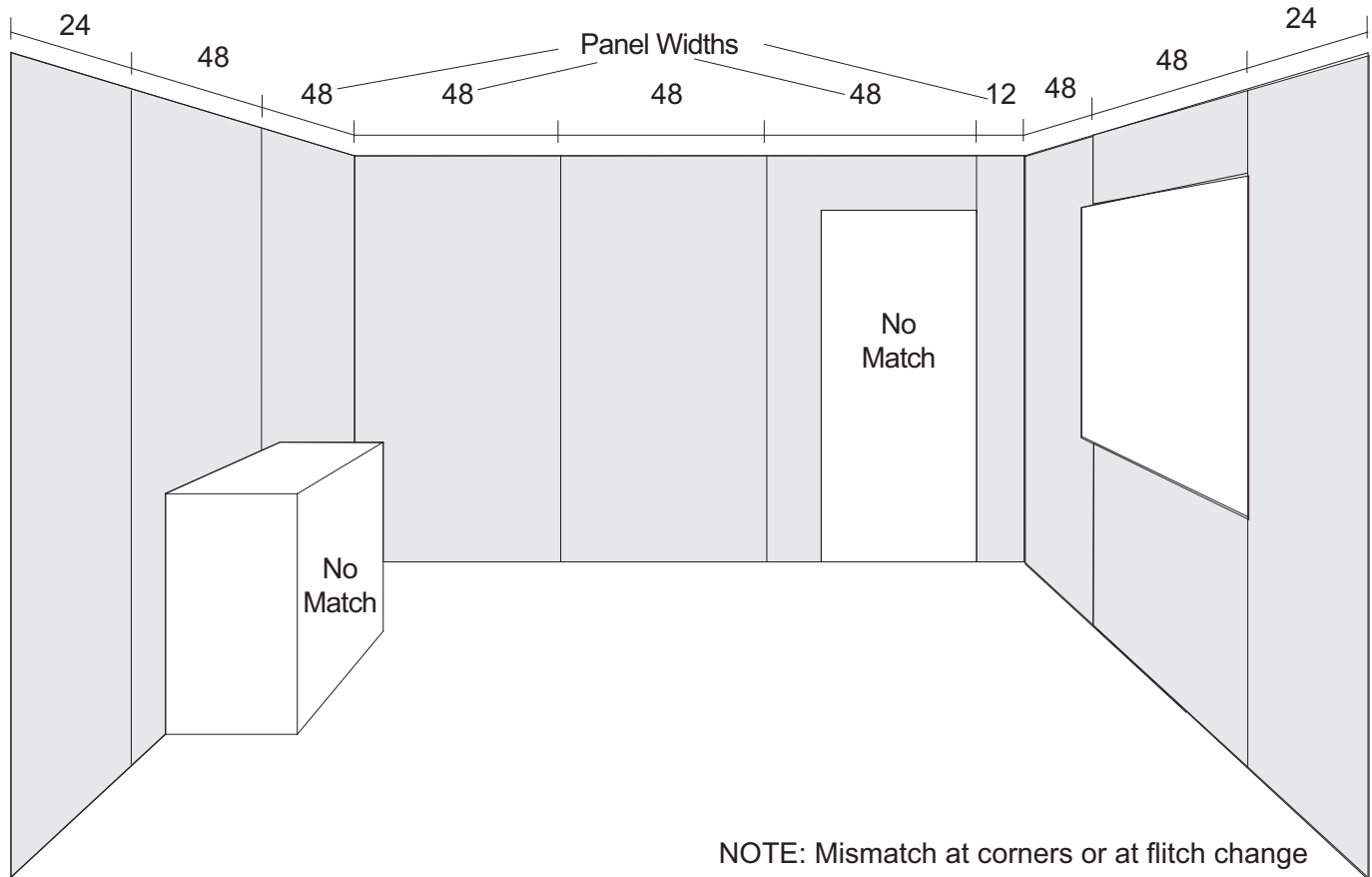
BOOK & BUTT MATCH W/ BORDER

4 - Sheet Products

METHODS OF MATCHING PANELS

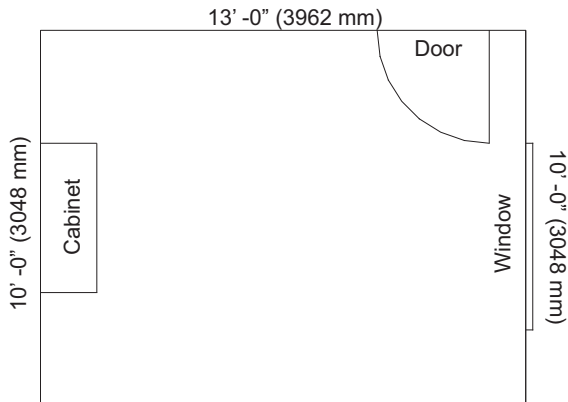
Veneered panels used in casework or paneling in the same area may be matched to each other. This important component of the project must be carefully detailed and specified. The natural growth patterns of the tree will cause the figure on the sequential panels to ascend, descend, or show a “grain progression” as the eye moves from panel to panel. These illustrations were developed in Imperial measure and have not been converted for this edition. The four common methods are:

PRE-MANUFACTURED SETS - FULL WIDTH



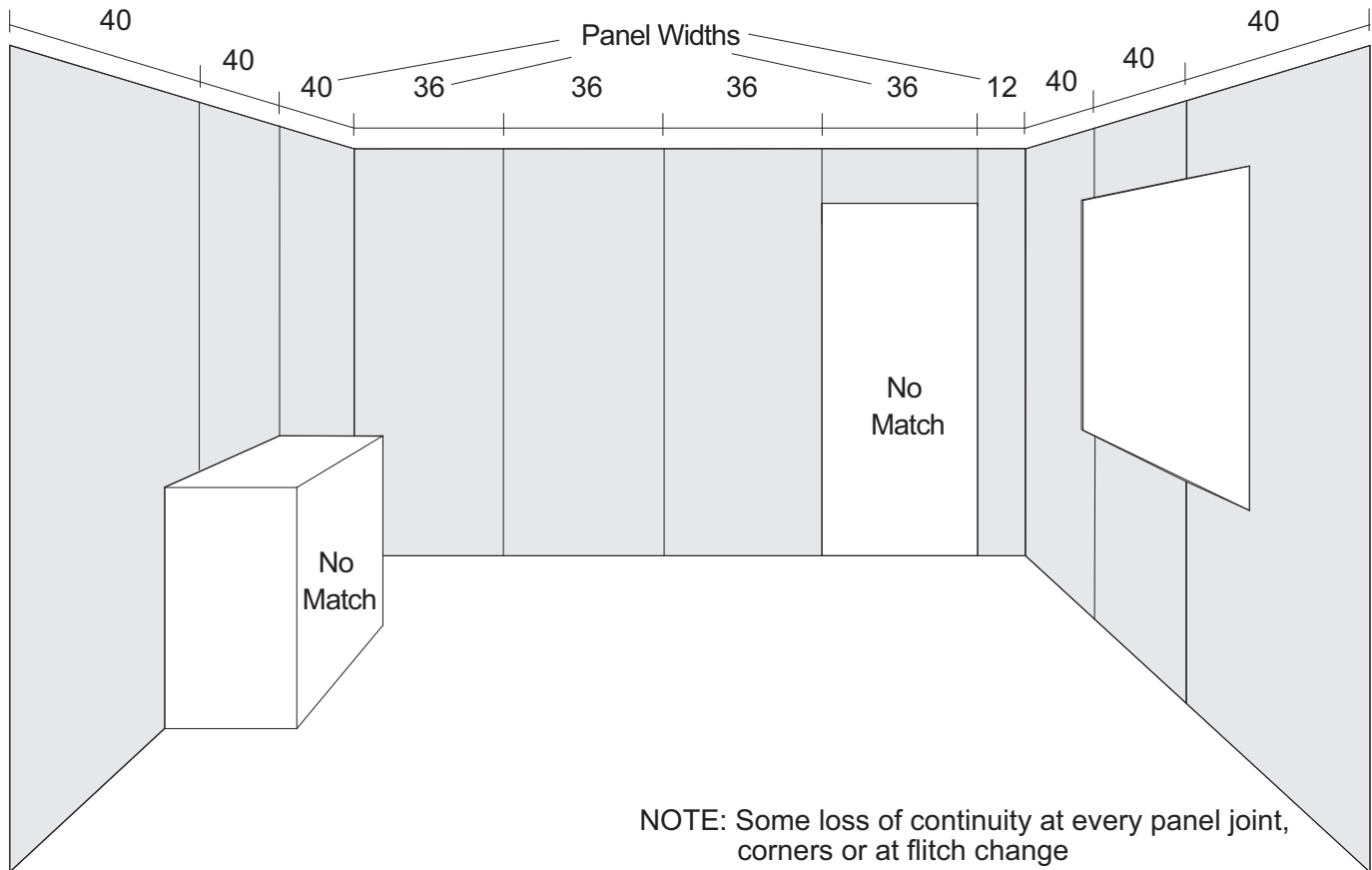
These are one step above stock plywood panels, usually made and warehoused in 4' x 8' or 4' x 10' sheets in sequenced sets. They may be produced from a single flitch or a part of a flitch, usually varying in number from 6 to 12 panels. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch. This is often the most economical type of special panel products.

FLOOR PLAN KEY



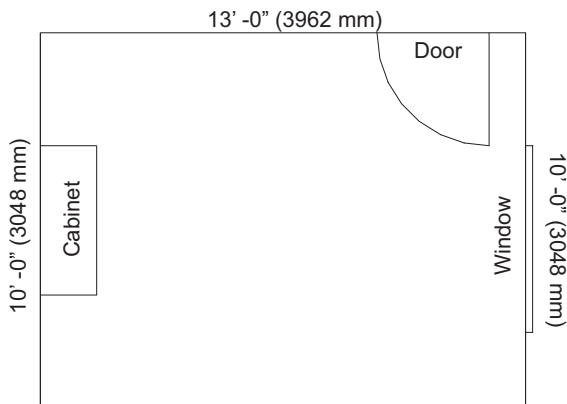
4 - Sheet Products

PRE-MANUFACTURED SETS - SELECTIVELY REDUCED IN WIDTH



These are panels just like those in the previous illustration, usually made and warehoused in 4' x 8' or 4' x 10' sheets in sequenced sets. They are often selected for continuity, recut into modular widths, and numbered to achieve the appearance of greater symmetry. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch.

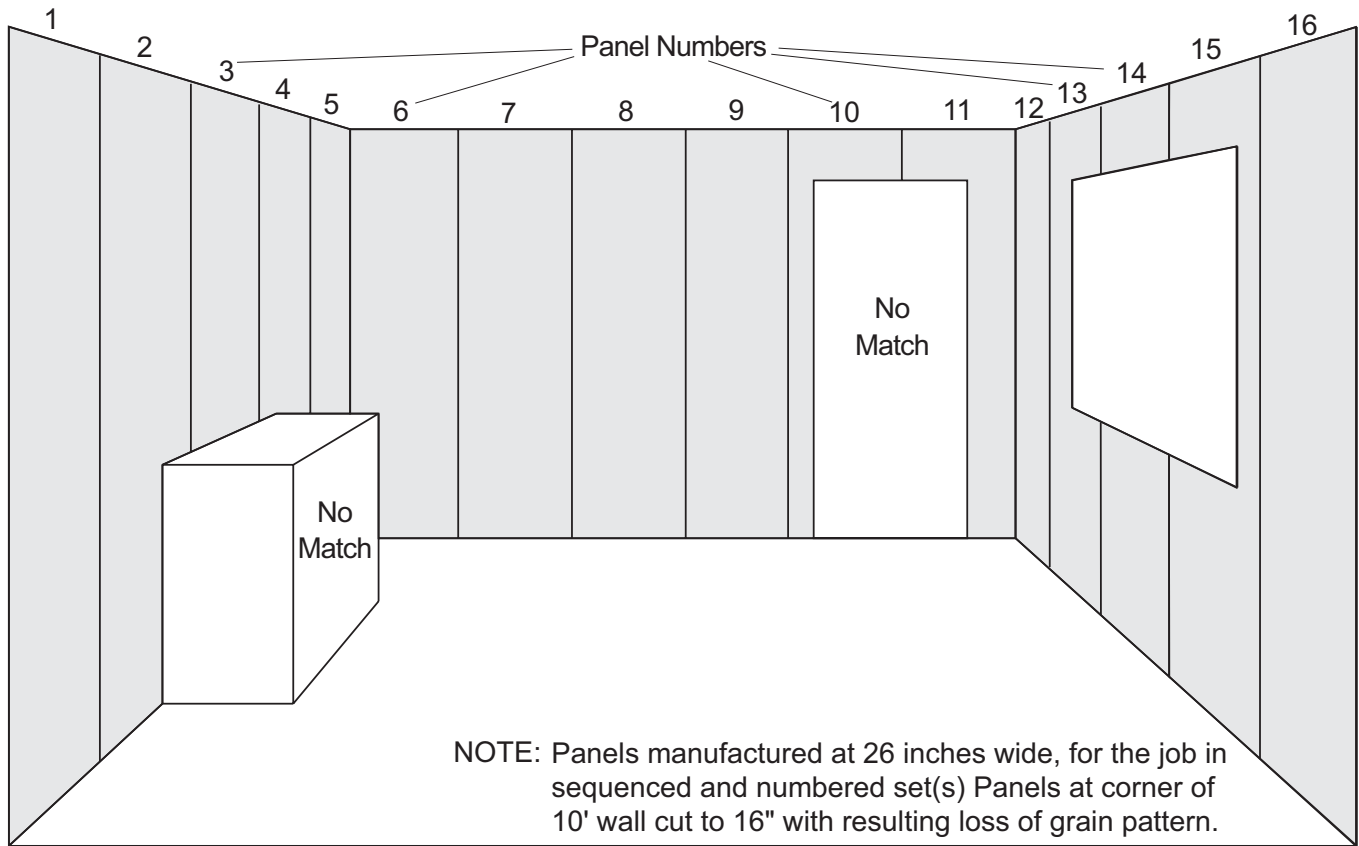
FLOOR PLAN KEY



SE-

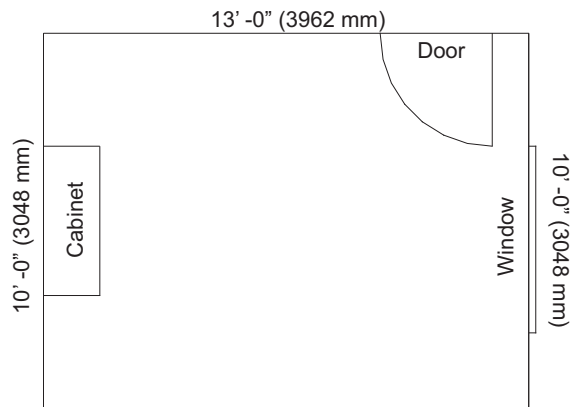
4 - Sheet Products

SEQUENCE-MATCHED UNIFORM SIZE SET



These sets are manufactured for a specific installation to a uniform panel width and height. If more than one flitch is required to produce the required number of panels, similar flitches will be used. This type of panel matching is best used when panel layout is uninterrupted, and when the design permits the use of equal-width panels. Some sequence will be lost if trimming is required to meet field conditions. Doors and components within the wall cannot usually be matched to the panels. Moderate in cost, sequenced uniform panels offer a good compromise between price and æsthetics.

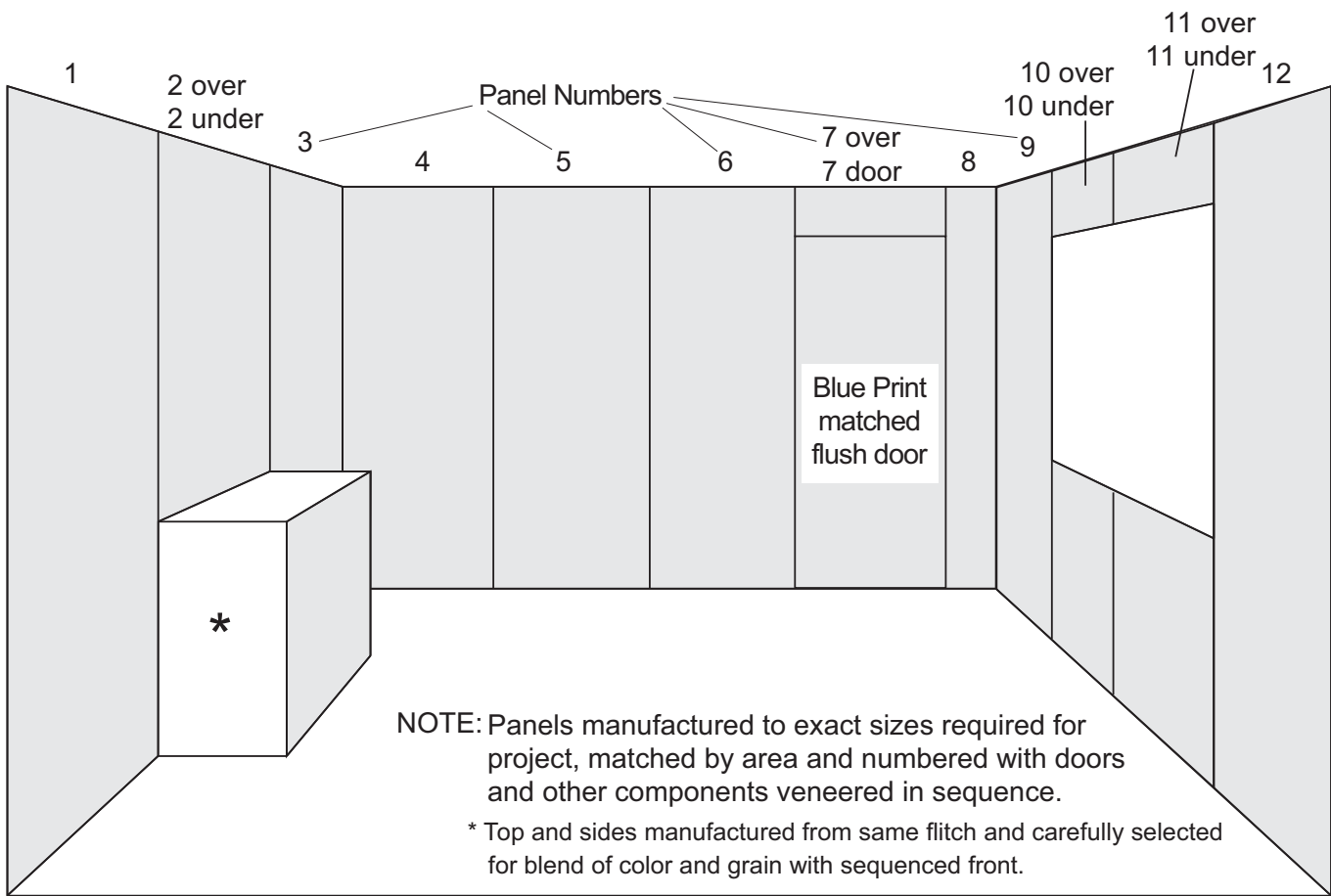
FLOOR PLAN KEY



BLUE-

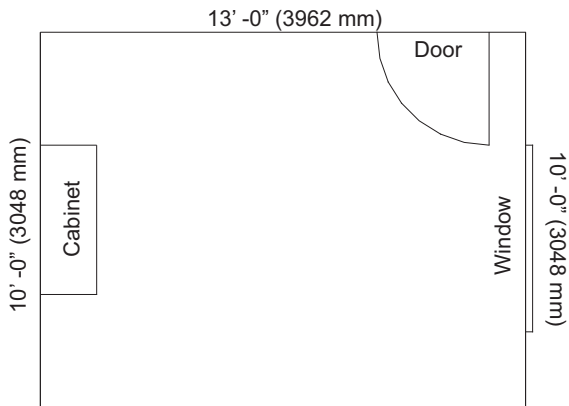
4 - Sheet Products

PRINT-MATCHED PANELS AND COMPONENTS



This method of panel matching achieves maximum grain continuity since all panels, doors, and other veneered components are made to the exact sizes required and in the exact veneer sequence. If possible, flitches should be selected that will yield sufficient veneer to complete a prescribed area or room. If more than one flitch is needed, flitch transition should be accomplished at the least noticeable, predetermined location. This method requires careful site coordination and relatively long lead times. Panels cannot be manufactured until site conditions can be accurately measured and detailed. This panel matching method is more expensive and expresses veneering in its most impressive manner.

FLOOR PLAN KEY



5

Finishing

5 - Finishing

DESCRIPTION AND PURPOSE

Specifying of factory finish is usually selected for high-quality work where superior appearance and performance of the finish is desired. Benefits of factory finishing include consistency, control of film thickness, environmental compliance, and the curing of the finish in a controlled atmosphere. Its use assumes a maximum degree of shop prefabrication so that site installation can be performed with a minimum amount of cutting, fitting, and adjustment to facilitate project completion.

The purpose of finishing woodworking is twofold. First, the finish is used traditionally as a means to enhance or alter the natural beauty of the wood. Second, the finish must protect the wood from damage by moisture, contaminants, and handling. It is important to understand that a quality finish must offer acceptable performance and also meet the aesthetic requirements of the project.

The AWS illustrates a number of finishing systems. The finishing system provides a protective surface for the product. Some of these systems are in general use; others are intended for special conditions and can only be applied under a strictly controlled environment. The cost of the systems vary, the higher performing finishes usually being more costly than the lower performing finishes. Unnecessary cost could be added to a project through over-specification.

- Systems are usually not compatible with each other. Trying to intermix systems could cause quality and/or performance problems.
- Old fashioned or consumer-oriented brush applied finishes are not recommended for factory finished fine architectural woodwork, and are not covered by the AWS.
- Finish systems often fail because too much top coat material is applied. Check with the finish system supplier for advice.

When specifying, please use the system name as set forth in the AWS. Involve your woodwork manufacturer early in the design process to evaluate the systems in relation to your project requirements. Choose performance characteristics which meet, but do not exceed, the needs of your project in the interest of value engineering.

Many prefinished real wood panels and decorative overlays have aesthetic and performance characteristics which meet or exceed the AWS, and shall be evaluated, approved and specified by the design professional when desired.

The listing of a finish system in the AWS does not imply an endorsement of the materials and/or methods or compliance with federal and/or local Environmental Protection Agency or other requirements. Some finishing professionals have, for example, found that polyurethanes and/or polyesters require special finishing procedures for a quantity of laboratory casework. Check with the finishing supplier for recommendations in the use of these products. In cases like these, catalyzed vinyl shall be the topcoat of choice.

WOOD FINISHES, STEPS AND COLOR

A variety of finishes are available for wood products. Aesthetically, systems may vary from no stain, to a single stain, to a multiple step application. Some samples will require multiple color and

finish steps in order to meet the architect's requirements. The existing system specified may not include all steps necessary to match the architect's example or requirements. Color and grain enhancement of some finishes require the build of one color step on another. This will sometimes require an additional step of a protective wash coat between color steps. Generally, this procedure adds to the depth and beauty of the finish. Each added step increases costs and shall be specified.

Special consideration should be given to raw wood parts on high pressure decorative laminate-clad (HPDL) cabinets such as wood pulls, wood trims, applied moldings, banded doors, drawer bodies, and wood cabinet interiors. Specifications regarding the responsibility for finishing (if any) shall be clarified by the design professional.

NOTE TO SPECIFIER

Too often, specifications call for finishes based on samples or guide language from a specialty manufacturer.

Examples include the over-specification of polyurethane or polyester top coats when they are neither necessary or available from the custom fabricator.

FINISH CURING

There are a variety of ways to cure a finish. For the most part the method should not concern the design professional or specification writer. It is the performance of the top coat which is important. Select the performance criteria which best meets the needs of your client from the finish tables. Finish chemistry, performance, value-to-performance ratio, and your finisher's abilities should be considered.

UV (ultraviolet light) curing is one of the methods for curing topcoats. It is typically used for high volume, repetitive applications, and requires special reactors to cure. It is currently done by a limited number of finishing operations. The process is environmentally friendly. A number of prefinished panel products are coated with materials designed specifically for UV curing. While UV cured top coats are not all alike, most are very high performance finishes. Consult with the fabricator for performance tests and details.

All factory finish systems utilize top coats with spray or flat line application that air dry within one hour, as is common practice, with the exception of waterborne polyesters, and two-component urethanes which may extend these time limits but will be dust free within 24 hours. Finishing materials will be selected for chemical compatibility with each other and with the substrate by the finishing professional.

COLOR "MATCH" AND CONSISTENCY

The term "color match" is often misleading. The best case achievable using a natural product like wood in a wide variety of lighting conditions is a good "blend" of color and tone throughout the project area. The natural color of the wood product is altered by the application of even a clear topcoat. Further alteration is achieved through the use of stains, glazes, bleaches, etc. All wood changes color; especially Cherry, Fir, genuine and African Mahogany, Walnut, Teak, and others. Filled nail holes will not

5 - Finishing

change with wood. The apparent consistency of the color is a combination of light reflectance, cellular structure, natural characteristics, applied colors, and sheen.

Color and “matching” of a sample are often highly subjective. Individual perception, ambient lighting, and reflectivity influence judgement. Design professionals are encouraged to consult directly with a woodworker during the design and selection phase of each project.

PREFINISHED WOOD PANELS

Many prefinished real wood panels and decorative overlays have aesthetic and performance characteristics which meet or exceed the AWS, and should be evaluated, approved and specified by the design professional when desired.

VENEER FINISHING

The fundamental construction of flush wood doors and hardwood veneered panel products is very similar. Both products use various substrates, or plies, with a top ply of hardwood veneer. As a result, the following observations and considerations apply equally to flush wood doors and hardwood veneered panel product

BLOTCHY APPEARANCE OF THE FINISHED SURFACE

Blotching occurs because some wood species exhibit an uneven distribution of large and small pores in their structure. The occurrence of this is readily apparent in such hardwood species as Maple and Birch and, to a lesser degree, in Cherry. This irregular distribution of pores usually causes an uneven absorption of stain, hence, an apparent blotchy appearance in the finish. Reduction of the blotching condition can sometimes be achieved by proper sanding, wash coating (prior to staining) or by choosing non-penetrating pigments, such as dyes, alcohol stains or glaze. When these steps are required or desired, they shall be specified in addition to finish system selection.

BARBER POLE, OR CANDY STRIPING

This effect is most evident when veneer leaves are book matched. Because book matched veneer panel or door faces are made up by turning every other piece (leaf) of veneer over, like the pages of a book, the face of one leaf and the back of the next leaf is exposed. This exposes the “tight” and “loose” face of the leaves. One of the most striking examples of Barber Pole effect can be seen in book matched rift and quarter cut oak. Check with your woodworker when you are considering specifying rift or quartered veneers.

TECHNIQUES TO CONSIDER

While a blotchy appearance and the “barber pole effect” may occur in any species, due to the natural characteristics of wood, there are steps that can be taken to reduce these effects. The following are two of the techniques that are of particular importance.

SANDING

While the selection of species, cut and match are major factors in the final appearance of any project, the first step, in controlling the quality of finished appearance, is proper sanding.

An important element of this standard is the statement “just prior to staining.” Specifications that indicate “factory shall finish sand prior to shipment” do not provide a correct solution for proper surface preparation. Such a directive fails to take into account the length of time panels will be stored at the job site, potential damage from handling and the effects of changes in the relative humidity. Proper sanding can only be done, just prior to staining/finishing.

The successful sanding of panels, or flush doors, is best accomplished with a hand block, powered pad sander, wide belt sander or stroke sander, exerting uniform pressure over the entire surface. Depending upon the condition of the surface it may be necessary to use successively finer grits of abrasive to properly prepare the surface, brushing off the surface between grits. The AWS sets forth the smoothness requirement for all Grades of work. Proper and complete surface preparation is the key factor in the successful finish procedure.

WASH COAT

A washcoat is a thin coat of material, usually clear lacquer or vinyl sealer (6 to 10 parts thinner to one part sealer, topcoat). A washcoat can fulfill several purposes such as: to stiffen the small wood fibers that are raised by the staining operation, so they can be cut off easily with fine sand paper (320 grit), to seal the stain, particularly if it is a bleeding type, to aid in the wiping and clean up of filler, and to minimize excessive penetration of stain or filler to minimize blotchiness. As with any finish process, samples should always be prepared to ensure that the desired finish is achieved.

BLUE STAIN

Blue stain occurs in Oak veneers when natural tannic acid in the wood comes in contact with iron and or moisture. Enough moisture may occur during heavy rains or high humidity in buildings not yet temperature controlled. The following is from a door manufacturer's care and handling brochure.

“To prevent blue stain, never use steel wool on the bare wood. Fine particles of the wool will cling to the door and cause trouble later. If you use shellac (a solvent for iron), it should not be stored in iron containers. To remove blue stain prior to finishing doors, we recommend a solution of oxalic acid crystals. The solution is made by dissolving 12 ounces of crystals in one gallon of lukewarm water. Use a plastic or rubber container. Wear rubber gloves while working with the solution. Apply it to the stained areas with a brush or sponge; allow the door to dry and sand with 150 to 180 grit sandpaper. The entire door surface should be treated to avoid spotting. Important: Failure to rinse the treated area adequately may have a damaging effect on the finish subsequently applied, or may cause damage to nearby glass, porcelain or other surfaces in confined areas. Damage may not result immediately, but may result during storage or after installation.”

5 - Finishing

FIRE-RETARDANT TREATED LUMBER AND COATINGS

Fire retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

“Fire-retardant” coatings usually are of the intumescent type. They may be water-based or solvent-based, but both contain ingredients which, under the influence of heat, produce gases and char-like products, resulting in the formation of a thick nonflammable crust that effectively insulates combustible substrates from heat and flame. However, these ingredients are for the most part water-sensitive and therefore reduce durability and range of usage of the coatings.

These coatings only delay the spread of fire and help contain it to its origin. To be of any appreciable value, fire-retardant coatings must be applied in strict conformance with the manufacturer's instructions. These finishes are not particularly durable and their use should be restricted to application over interior surfaces.

The need for, and effectiveness of, fire-retardant and fire-resistant finishes depends on the type of construction, nature of occupancy, and other technical features of the building. Because these finishes are considerably more expensive and have reduced durability, their use should be carefully limited to those areas where confining fire spread is the overwhelming consideration; for example, interior entrances, hallways, stairwells and ceilings.

STRIPPING RECOMMENDATION (WHEN SPECIFIED)

While the AWS does not cover the removal of existing finishes on woodwork, the methods and skill involved in large measure determine the quality of preservation, conservation, and restoration during Historical Work. Stripping is usually performed by specialists trained in historic work, but there are some architectural woodworkers who have such specialists on the staff. Regardless of the assignment of responsibility for existing finish removal, the following guidelines should be inserted in the contract documents by the design team:

- Strippers shall be environmentally sound, solvent based. Alkaline based products are not acceptable. All strippers shall be neutral based, not requiring additional neutralization treatment.
- Before stripping begins, all surfaces shall be tested (with the process and results recorded) to provide the least intrusive and damaging methods. Approval of the architect, design professional or conservator is required before execution of the work.
- Completely remove existing finish using multiple applications of the approved methods without gouging, splintering or otherwise damaging sound surfaces.
- Thoroughly remove all stripping residuals, include wax, before proceeding.
- Stripped surfaces shall be tested for evidence of acid or alkali, reworking the surface until it tests pH neutral.
- Carefully sand all surfaces by hand with no coarser than 220 grit garnet or aluminum oxide sandpaper to remove all signs of raised grain.