1

Cabinetry

One of the largest components of a residential kitchen or bathroom is the storage system planned for the space. An organized storage area is also important in laundry rooms, hobby centers, home offices, closets, and dressing rooms.

Learning Objective 1: Describe the differences between frame and frameless cabinetry as it relates to case construction material and sizing differences.

Learning Objective 2: Recognize some of the sources offering interior storage systems.

Learning Objective 3: Explain the difference between cabinet doors or fronts constructed from solid woods versus veneer surfacing materials.

Learning Objective 4: Provide a comprehensive listing of planning concerns when working with vendors.

Learning Objective 5: Outline the key categories of the KCMA Certification Program process and the KCMA Environmental Stewardship Program.

Learning Objective 6: Identify typical cabinet configurations and available sizing for kitchens, bathrooms, and other home storage centers.

Design professionals in the kitchen and bathroom industry may be representatives of specific manufactured cabinet companies or may have a referral relationship with area showrooms that represent different cabinet companies. Some design professionals, known as *independent kitchen designers*, do not align themselves with any specific cabinet company. They develop plans based on generic cabinet specifications and then invite their clients to source products from kitchen dealerships representing large manufacturing companies or smaller local manufactured cabinetry.

Within the cabinet industry, broad categories are used to identify the configuration of the cabinet, the availability of custom sizing, the sophistication of interior cabinet accessory systems, and the variety of finishes and architectural accouterments offered by the producer.

In North America, kitchen cabinets historically were built by local cabinet or woodworking shops and were created for each project. Today, a great majority of kitchen cabinet systems is produced in highly sophisticated manufacturing facilities, both in North America and internationally. There are sizing differences between cabinets built in the United States and those built in Canada and internationally.

As a design professional, you may work for a retail organization representing specific cabinet manufacturers or directly for a cabinet manufacturer or distributor. You may work for a company that actually fabricates cabinets in a woodworking shop. Or you may be familiar with cabinets in general sense but focus your work on creating a generic space plan.

Regardless of how you interact with the cabinet source, it is important that you are familiar with:

- How the cabinets are built
- The functional hardware available for various cabinet components
- The special-purpose storage systems integrated inside cabinetry
- Materials used on the exterior of the cabinetry
- Door and front styles typically offered by manufacturers
- The industry's efforts to responsibly manage these resources

CABINET TYPES

Regardless of the type of business you are affiliated with, in North America cabinet specifiers work with four broad categories. Within each of these, the quality levels, production costs, retail selling price, delivery schedules, and reliability factors vary. The following stock, semi-custom, custom, and millwork cabinetry definitions apply to the United States. (What is called a semi-custom cabinet in the United States is called a custom cabinet in the international community.)

Stock

Stock cabinet manufacturers offer a full range of cabinets in specified sizes designed to meet the needs of most consumers at a cost-effective price. They offer the most popular door styles, finishes, and accessories with limited modifications, and the cabinets may be in stock at cabinet distributors, home centers, and lumberyards. Because stock cabinets are produced in quantity, the cabinet manufacturers cannot stop their assembly lines for special units; therefore, their catalogs generally reflect the entire product offering.

This type of manufacturing method provides the specifier good value because of the economies of manufacturing. The biggest advantages of stock cabinetry are its availability, specified quality level, and consistency of service from large, stable manufacturers. Stock cabinets offer an excellent product for a project that has budget or time constraints. Because styles and special sizes are limited, you should investigate the breadth of the line before designing with the product.

However, designers need not forgo creative cabinet design when using stock cabinets. Once you are familiar with the line, consider adapting specific case types to usage ideas appropriate for the project you are working on. For example, use wall cabinets as shallow base units by adding a toe-kick.

Stock cabinets do vary in quality levels. Some lines use doors of mismatched or lower-quality woods. They may use thin laminates or actual paper products to simulate wood on finished sides. The parts of the case may be glued together with no mechanical fasteners, which is not as durable a method of case construction as combining both glue and mechanical fasteners. Make sure you carefully compare the construction of the stock cabinets you are considering for the project you are designing. One line may be just right for a laundry room application, while a sturdier product may be required for the adjacent kitchen. The cabinets shown in Figure 1.1 are an example of stock cabinets.

Semi-Custom

Semi-custom cabinets are produced by both stock and custom manufacturers. This type of product is produced on an assembly-line basis, but the offerings include more interior fittings

FIGURE 1.1 A kitchen using stock cabinets
Courtesy of Wellborn Cabinet, Inc.

in the form of accessories and some custom cabinet size possibilities. Typically, a wider finish and style palette is offered as well.

This product combines the advantage of an assembly-line process with the ability to create limited custom cabinet sizes. Traditionally, semi-custom products also offer more door styles and finishes.

Semi-custom cabinets come in a wide variety of quality and price levels. Because they may be high on style but limited in their size offerings, review the manufacturer's catalog carefully before beginning the design process. The cabinets shown in Figure 1.2 are an example of semi-custom cabinets.

FIGURE 1.2 A kitchen using semi-custom cabinets
Courtesy of Wellborn Cabinet, Inc.

FIGURE 1.3 A kitchen using custom cabinets

Courtesy of Plain & Fancy Custom Cabinetry

International cabinet producers who focus on finely engineered specific styles—used to define their cabinet branding—neither recommend nor offer extensive customization. Therefore, the manufacturing definition of semi-custom defines their highest level of product offering.

Custom

Custom cabinet manufacturers make one kitchen at a time. The cabinets are not produced until the kitchen has been designed and all details are finalized. Custom cabinets may be made by a local fabricator or in a large manufacturing facility. Generally, these manufacturers publish a specifications manual listing a range of specific cabinet sizes, but special sizes are available for a perfect fit. One-of-a-kind, handmade specialty pieces, such as mantel hoods, turned-wood posts, curved/angled cabinetry elements, and free-standing furniture pieces are also available.

These totally custom *built-to-order* cabinets are considered *furniture-grade* cabinet systems. The cabinets shown in Figure 1.3 are an example of custom cabinets. Manufacturers of such cabinets generally offer the latest in functional hardware, technology, construction methods, and case materials and the most extensive array of accessories available. These companies offer new, trendsetting styles and finishes to the market. Custom cabinets have a longer lead time than stock or semi-custom offerings. Much like custom furniture, an 8- to 20-week delivery time is to be expected.

Millwork Cabinetry

Cabinetry defined as *millwork* is produced just as custom cabinets are. In addition, millwork companies produce their own panel stock as well as the cabinet door collection offered. This allows for grain that is more sophisticated and color matching throughout the kitchen exteriors and for additional paneling that may be used within the nonstorage sections of the room. The cabinetry pictured in Figure 1.4 is an example of millwork. The millwork house also may offer elaborately constructed custom furniture pieces that are assembled prior to finishing within the manufacturing facility and shipped as one entire piece.

FIGURE 1.4 A kitchen using millwork cabinetry

Design by Pietro A. Giorgi, Sr., CMKBD, and Ellen Cheever, CMKBD, ASID, CAPS, Giorgi Kitchens & Designs. Photo by Peter Leach

International Definitions of Kitchens

- Custom-made, English "bespoke" or "one-off" kitchen: A set of cabinets made specifically for one client or one project.
- Fitted kitchen: A set of cabinets sized and scribed to the room, allowing the cabinetry to become part of the woodwork of the house.
- Unfitted kitchen: A set of cabinets that are not scribed to the walls, ceiling, or floor of the room. Although they are secured to the wall for stability, they appear more like furniture than casework.

RESPONSIBLE RESOURCE MANAGEMENT IN THE CABINET INDUSTRY

Because forests provide numerous environmental benefits, it is essential that we protect and sustain them. They moderate climate change, improve air quality, aid in water conservation, and preserve biodiversity. In order to maintain these benefits and ensure that forests meet long-term human needs, it is vital we practice sustainable forestry.

Sustainable forestry practices ensure that the resources removed from forests are at a level the forests are capable of renewing without damaging their future prosperity. Sustainable practices preserve the environment and valuable forest resources. In addition to sustainable forestry, most certification programs support selective harvesting.

Selective harvesting is the practice of periodically removing mature trees in order to allow young trees to grow. Trees that are near their death or have grown to an unproductive diameter can stunt younger trees from growing properly. By periodically harvesting

particular trees, forest regeneration is improved. Selective harvesting leads to a healthier forest, thus preserving the environment and the social benefits forests provide. This practice of selective harvesting is also referred to as "a managed forest" or "managing the forest."

From Forest to Cabinets: Protecting the Environment while Creating Beautiful Kitchens and Bathrooms

Within the global community, the United States is envied for its natural wood resources; according to the US Forest Service, approximately one-third of our nation's land area is forestland. Canada is also a nation rich in wood natural resources.

Within North America, about one-third of all our forests are considered hardwood forests, with 90 percent of them located in the eastern United States. Hardwood trees require from 50 to 120 years to reach a harvestable size. Approximately 50 percent of the lumber produced is not useable for kitchen, bath, or other fitted room cabinetry because it contains characteristics not accepted in furniture.

In today's foresting industry, managed forestlands are far more the norm than unmanaged lands. The industry is working feverishly to grow trees fast enough to be harvested to meet the demand for hardwoods while managing forests for future yield. The term "old growth" refers to large trees that have grown in natural forests. Smaller, younger trees are grown on farms specifically to be harvested for the furniture, cabinetry, and building industries.

What does managed forestry mean to the kitchen or bathroom designer? From a design standpoint, logs harvested from managed forests can have a different appearance than those from *old-growth* logs. Therefore, it is almost impossible to create new cabinetry that has the same aesthetic as antique furniture. The width of wood planks available today and the acceptability of certain wood characteristics have changed. Equally if not more important is the fact that the lack of oversight in the harvesting of veneers and wood products elsewhere in the world have led conservationists to develop certifications attesting to the responsible resource management of all types of wood producers: notably, cabinet manufacturers. Responsible designers specify products that have recognized certification.

Certified Wood

Over 50 certification programs worldwide address the many types of forests around the world. In addition to both US and Canadian government programs, two important certification programs specifically relate to kitchen cabinetry: the Forest Stewardship Council (FSC) and the Environmental Stewardship Program (ESP) managed by the Kitchen Cabinet Manufacturers Association (KCMA).

For the purposes of this volume on kitchen and bathroom materials, we focus on the KCMA ESP. Additional information can be gathered at www.kcma.org as well as KCMA's website, www.GreenCabinetSource.org.

FIGURE 1.5 Kitchen Cabinet Manufacturers Association Environmental Stewardship Program

KCMA Environmental Stewardship Program

In all categories of materials for residential kitchens, there are products that are considered green. The KCMA developed the Environmental Stewardship Program (ESP), which holds the cabinet industry to higher standards than other environmental programs because of its holistic approach to manufacturing, examining the process from growth and harvesting of raw materials to manufacturing the end product (see Figure 1.5).

Since the program's inception in 2006, the ESP certification requirements have been based on currently attainable materials and have been amended as new, improved materials became available. In January 2012 the criteria were changed to address formaldehyde emission limits.

The KCMA ESP takes a holistic approach to environmental stewardship, providing companies with tangible ways to support sustainability in areas of air quality, product resource management, process resource management, environmental stewardship, and community relations. The program is a point-based evaluation system, with companies qualifying for official ESP certification by accumulating 80 out of a possible 105 points in five categories. Full details of the program can be reviewed at www.kcma.org/Professionals/Environmental_Stewardship_Program.

Responsible Resource Management Criteria

Reprinted Courtesy of the Kitchen Cabinet Manufacturers Association

Following is an overview of the responsible resource management criteria.

Air quality

- Mandatory requirement: 100 percent of particleboard, medium-density fiberboard, and plywood used in the cabinets must meet the formaldehyde emission level of the California Air Resources Compwood ATCM [airborne toxic control measure] and must be third-party certified to meet low-formaldehyde-emission standards.
- 75 percent of cabinets must be finished in the United States or Canada. Finishes can emit no greater hazardous air pollutants than allowed by local plant operating permits.

Product resource management

- 80 percent of particleboard and medium-density fiberboard used in cabinets must contain 100 percent recycled or recovered fiber content.
- Manufacturers earn points if they have kitchen cabinets that are also chain-of-custody (COC) certified through a recognized sustainable forestry program.
- Hardwoods, softwoods, and plywood purchased are COC certified through a recognized sustainable forestry program.
- Hardwood and softwood lumber are certified-sourcing certified through a recognized sustainable forestry program.
- Manufacturers utilize an annual, written training plan to educate their hardwood suppliers of their preference for purchasing certified lumber.

Process resource management

- Manufacturer has a comprehensive recycling program for process wastes.
- Manufacturer has a program for tracking and reducing process wastes with documented goals and reports.
- Manufacturer uses processed byproducts to generate alternative energy.
- Manufacturer has a documented energy conservation program.

Environmental stewardship

- Manufacturer is required to have a written policy stating a firm commitment to environmental quality.
- Manufacturer has an environmental management system.
- Manufacturer reviews environmental practices and policies of its key vendors and contractors.

(*continued*)

- Manufacturer has a documented program that promotes the use of renewable/recycled materials.

Community relations

- Manufacturer demonstrates community involvement and leadership through service or charitable organizations.
- Manufacturer observes all federal, state, and local environmental requirements.

Mandatory requirement: ESP participant agrees to report to KCMA within 60 days of any local, state, or federal citation in excess of $50,000 per violation, explaining the circumstances of the citation or violation. Such citation or violation could lead to termination from the program.

Points are awarded for meeting each of these criteria. Manufacturers must earn at least 80 of a possible 105 points and must earn points from each category to be certified.

Available at www.greencabinetsource.org/Learn_about_ESP/Certification_Requirements

Debate around the Dangers of Formaldehyde

Both clients and designers are worried about the formaldehyde emission risk in cabinets manufactured outside the United States as well as within our borders. The ESP certification was updated in 2012, restricting materials to only those that had low-formaldehyde-emitting levels.

There are two general schools of thought regarding the danger of formaldehyde emissions.

- One group of experts believes that formaldehyde is a toxic material that should be eliminated. There are cabinet materials that are formaldehyde-free.
- A second group of experts believes that products can emit very low levels of formaldehyde and be considered safe for the vast majority of users.

KCMA has published the following informational overview of wood products and the emissions of formaldehyde.

WOOD & EMISSIONS

Wood products, such as those used in cabinets, can emit low amounts of formaldehyde

Formaldehyde, a naturally occurring chemical present in human breath, is widely used. It has been studied extensively and is typically encountered in the home in low levels. Like many other chemicals, if encountered in high levels, it can have negative health effects. Most people have no reaction to low-level formaldehyde emissions, but a small percentage of the population has acute sensitivity to it and other chemicals.

All wood species, and therefore all wood products, contain and emit small amounts of formaldehyde. An oak tree, for example, emits 9 parts per billion (ppb) of formaldehyde. It follows that any wood cut from that oak tree also contains small amounts of formaldehyde, as do all wood products. Formaldehyde also is found naturally in a wide range of fruits, vegetables, mushrooms, seafood, meats, and coffee.

(*continued*)

All cabinetmakers use composite wood in the construction of cabinets. It is an essential material for industry products extending the yield from the harvest of trees, making cabinetry more affordable. Composite wood generally is made with small amounts of urea formaldehyde adhesives in order to achieve durability and performance expected by consumers in the difficult kitchen environment that varies exposure to extreme heat, cold, diverse cooking products (mustard, ketchup, alcohol, and the like), detergents, water and heavy usage.

Action to Manage Formaldehyde Exposure in the Home

If you are among those with known sensitivities to formaldehyde, the US Department of Health and Human Services (HHS) recommends that consumers do the following to prevent exposure to formaldehyde:

1. Use lower-emitting pressed wood products, such as those that are labeled CARB (California Air Resources Board) compliant, or made with ultra-low-emitting formaldehyde (ULEF) or no-added formaldehyde (NAF). **Cabinets displaying the KCMA Environmental Stewardship Program (ESP) certification seal are required to use 100 percent CARB compliant pressed wood.** Beginning 2013, all pressed wood sold in the US must be CARB compliant. The CARB product emission standards are the lowest in the world.
2. Increase ventilation, particularly after bringing new sources of formaldehyde into the home. Open windows and use fans to bring in fresh air. The kitchen and bath generally already are the best ventilated rooms in a house with frequent air exchanges the norm.
3. Use air conditioning and dehumidifiers to maintain moderate temperature and reduce humidity levels.
4. Studies have shown that readily available laminated products are among the lowest emitters of formaldehyde.

KCMA ESP certified cabinetry meets the HHS guidelines for managing formaldehyde exposure. A recent study of formaldehyde by the National Academy of Sciences stated that the emission levels to which most consumers would be exposed are well below thresholds that would cause harm. This would include ESP certified cabinets.

From GreenCabinetSource.org, the website of the Kitchen Cabinet Manufacturers Association (www.greencabinetsource.org/Manufacturing/Wood_and_Emissions)

Designers should base their specifications on the client's level of sensitivity to formaldehyde emissions and request for formaldehyde-free products. Designers also should take a proactive role in continuing their education around this important issue that faces our industry, staying abreast of new research and/or product innovations.

KCMA CERTIFICATION PROGRAM

In addition to responsible resource management certification, KCMA has managed a Performance Testing and Certification Program for cabinet construction.

While many good-quality cabinets are not certified, in some markets and situations it is important to end users to have certified cabinets. Therefore, it is important for you as a

designer to be aware of the certification requirements for cabinet construction and durability. Cabinets and bathroom vanities bearing the KCMA Certification have met or exceeded the necessary requirements and are recommended by KCMA.

You should also be aware of the KCMA certification requirements (see "About the KCMA Certification Program") so you can recommend cabinets that meet or exceed these standards of manufacturing to your clients.

About the KCMA Certification Program

Reprinted Courtesy of the Kitchen Cabinet Manufacturers Association

KCMA sponsors the nationally recognized voluntary testing and certification program for cabinets, ANSI/KCMA A161.1, Performance and Construction Standard for Kitchen and Vanity Cabinets. The program is referenced by US government agencies, architects, builders, remodelers, and other specifiers. Cabinets that comply and bear the KCMA certification seal [see Figure 1.6] are recognized in the marketplace as quality products able to perform after a rigorous battery of tests simulating years of typical household use.

Tests are performed by approved third-party independent laboratories. Samples for testing are selected in an unannounced visit to the manufacturing plant.

- The KCMA Certification Program assures the specifier or user of kitchen cabinets and bath vanities that the cabinet bearing the blue and white seal complies with the rigorous standards set by the American National Standards Institute (ANSI) and sponsored by the Kitchen Cabinet Manufacturers Association (KCMA). Further, the cabinet is an exact duplicate of samples that have been independently tested for conformance to ANSI/KCMA A161.1-2000.
- The KCMA Certification Program is open to all cabinet manufacturers. Manufacturers may certify one, several, or all of their cabinet lines. Because of this option, only those lines certified are listed in the annual KCMA Directory of Certified Cabinet Manufacturers.
- Compliance with ANSI/KCMA standards is assured by initial cabinet testing, periodic unannounced plant pick-up and testing, and additional testing resulting from complaints. All testing is performed by an experienced independent laboratory.

FIGURE 1.6 ANSI/KCMA logo
Courtesy of Kitchen Cabinet Manufacturers Association

- These cabinets also comply with the provision of Paragraph 611-1.1, "HUD Minimum Property Standards—Housing 4910.1" 9/8/86.
- Companies not licensed with the KCMA Certification Program may not claim or imply conformance with these standards for their products. KCMA, as the proprietary sponsor, reserves the right to question any claims of conformance and to test the products of any manufacturer making such claims. Should KCMA discover that a manufacturer is falsely representing that his products meet these standards, KCMA will take appropriate legal action.

Requirements Cabinet Must Meet to Earn the KCMA Certification Seal

- All cabinets must be fully enclosed with backs, bottoms, sides, and tops on wall cabinets; and backs, bottoms, and sides on base cabinets, with certain specified exceptions on kitchen sink fronts, sink bases, oven cabinets, and refrigerator cabinets.
- All cabinets designed to rest on the floor must be provided with a toe space at least two inches deep and three inches high.
- All utility cabinets must meet the same construction requirements as base and wall cabinets.
- Doors and drawers must be properly aligned, have means of closure, and close without excessive binding or looseness.
- All materials must ensure rigidity in compliance with performance standards.

(*continued*)

- Face frames, when used, must provide rigid construction.
- For frameless cabinets, the ends, tops/bottoms, and back shall be of thickness necessary to provide rigid construction.
- Corner or lineal bracing must be provided at points where necessary to ensure rigidity and proper joining of various components.
- All wood parts must be dried to a moisture content of 10 percent or less at time of fabrication.
- All materials used in cabinets must be suitable for use in the kitchen and bath environment where they may be exposed to grease, solvents, water, detergent, steam and other substances usually found in these rooms.
- All exterior exposed surfaces and edges, except the edges of end panels and the edges of back panels, shall be free of saw marks and other imperfections and shall be filled and sanded, edge-banded, or otherwise finished to ensure compliance with the performance standards.
- All exterior exposed parts of cabinets must have nails, staples set, and holes filled.
- All exposed construction joints must be fitted in a workman-like manner consistent with specifications.
- Exposed cabinet hardware must comply with Builders Hardware Manufacturing Association finishing standards.

Test Cabinets Must Pass to Earn the KCMA Certification Seal

- All shelves and bottoms are loaded at 15 pounds per square foot, and loading is maintained for seven days to ensure that there is no excessive deflection and no visible sign of joint separation or failure of any part of the cabinets or the mounting system.
- Mounted wall cabinets are gradually loaded to 600 pounds without any visible sign of failure in the cabinet or the mounting system.
- To test the strength of base-front joints, a load of 250 pounds is applied against the inside of cabinet-front stiles for cabinets with drawer rail, or 200 pounds is applied for cabinets without drawer rail, to ensure reliable front joints that will not open during stress in service or during installation.
- To test the ability of shelves, bottoms, and drawer bottoms to withstand the dropping of cans and other items, a three-pound steel ball is dropped from six inches above the surface. After the test, the drawer must not be damaged and must operate as before the test with no visible sign of joint separation or failure of any part of the cabinet or mounting system.
- To test the ability of cabinet doors and connections to withstand impacts such as children may cause in falling against a cabinet, a 10-pound sandbag is used to strike the center of a closed cabinet door and repeated with the door opened to a 45-degree angle. The door must operate as before the test and show no damage or sign of separation or failure in the system.

Two Drawer Tests Required

- To test the ability of drawers and drawer mechanisms to operate with loading during normal use, drawers are loaded at 15 pounds per square foot and operated through 25,000 cycles. The drawers must then remain operable with no failure in any part of the drawer assembly or operating system, and drawer bottoms must not be deflected to interfere with drawer operation.
- To test the ability of the drawer-front assembly to withstand the impact of closing the drawer under normal use, a three-pound weight is dropped 8 inches against the drawer assembly. After 10 drops, there must be no evidence of looseness or structural damage to the drawer-front assembly that impairs operation.

Two Door Operation Tests Measure Durability

- To test the ability of doors, hinges, and means of attachment to withstand loading, 65 pounds of weight is applied on the door. The weighted door is slowly operated for 10 cycles from 90 degrees open to 20 degrees open and returned to the 90-degree position. The door must remain weighted for 10 minutes, after which the door and hinges must show no visible signs of damage, and connections between cabinet-and-hinge and door-and-hinge must show no sign of looseness.

(*continued*)

- To test the ability of doors, door-holding devices, hinges, and attachment devices to operate under the stress of normal use, doors are opened and closed through a full 90-degree swing for 25,000 cycles. At the test's conclusion, the door must be operable, the door-holding device must hold the door in closed position, hinges must show no visible signs of damage, connections between cabinet-and-hinge and door-and-hinge must show no sign of looseness, and other specifications must be met.

Four Finish Tests Conducted

- These tests create, in accelerated form, the cumulative effects of years of normal kitchen conditions of pre-finished cabinets. Cabinet finishes are inspected to ensure that stringent standards of appearance are also met. To test the ability of the finish to withstand high heat, a cabinet door is placed in a hotbox at 120 degrees Fahrenheit and 70 percent relative humidity for 24 hours. After this test, the finish must show no appreciable discoloration and no evidence of blistering, checks, or other film failures.
- To test the ability of the finish to withstand hot and cold cycles for prolonged periods, a cabinet door is placed in a hotbox at 120 degrees Fahrenheit and 70 percent relative humidity for one hour, removed and allowed to return to room temperature and humidity conditions, and then placed in a coldbox for one hour at -5 degrees Fahrenheit. The cycle is repeated five times. The finish must then show no appreciable discoloration and no evidence of blistering, cold checking, or other film failure.
- To test the ability of the finish to withstand substances typically found in the kitchen and bath, exterior exposed surfaces of doors, front frames, drawer fronts and end panels are subjected to vinegar, lemon, orange and grape juices, tomato catsup, coffee, olive oil, and 100-proof alcohol for 24 hours and to mustard for one hour. After this test, the finish must show no appreciable discoloration, stain, or whitening that will not disperse with ordinary polishing and no indication of blistering, checks, or other film failure.
- To test the ability of the finish to withstand long periods of exposure to a detergent and water solution, a cabinet door edge is subjected to exposure to a standardized detergent formula for 24 hours. The door edge must then show no delamination or swelling and no appreciable discoloration or evidence of blistering, checking, whitening, or other film failure.

Available at www.kcma.org/Homeowners/Performance_Testing_and_Certification_Program

Industry Acceptance of the KCMA Environmental Stewardship Program

In 2007, the National Association of Home Builders and the International Code Council collaborated to establish a nationally recognizable standard definition of green building. ANSI has approved the National Green Building Standard (NGBS). This standard references KCMA's ESP and awards points for attaining such certification for kitchen cabinetry. This endorsement satisfied the rigorous ANSI requirements for balance and openness. The NGBS remains the only *green* standard recognized by ANSI.

CABINET SIZING SYSTEMS: IMPERIAL AND METRIC

Because the cabinet industry is an international one, there are two common methods of sizing cabinets: the English Imperial system, based on inches, and the International Metric Standard. Cabinets produced in the United States use the English Imperial system and, therefore, build cabinets in inch dimensions. Cabinets produced in other parts of the world use metric dimensioning.

Sometimes metric cabinets are referred to as *32 mm* or *System 32* cabinets. The term "32" refers to the basic metric sizing of all these cabinets: All the holes, hinge fittings, cabinet

joints, and mountings are set 32 millimeters (mm) apart. This spacing is based on the boring equipment used in the manufacturing process.

An exact translation between the two systems is called a *hard conversion*. The resulting converted inches, millimeters, or centimeters is mathematically correct but is not used in the international cabinet manufacturing industry. Designers must be aware that the two measuring systems do not produce cabinets of the exact same sizing. Planners should work in the sizing system used by their cabinet manufacturer and avoid converting between the two systems if possible. If a conversion is necessary, most drawing programs provide a hard conversion option. Numerous smart phone apps are available to provide such a conversion.

Cabinet manufacturers in the United States give product dimensions in inches. Canadian companies often use both imperial and metric measurements. Most European cabinet companies use metric dimensions for their cabinets. We have included Tables 1.1 and 1.2 listing hard metric conversions. The information given in the balance of this book lists imperial dimensions in inches in most cases. Other metric conversions can be found in various tables available on the Internet and in apps.

TABLE 1.1 Metric Conversions

From Metric to Imperial			From Imperial to Metric		
mm	**cm**	**Inches**	**Inches**	**mm**	**cm**
2.5	0.25	$\frac{1}{8}$"	$\frac{1}{16}$"	1.59	0.16
5.0	0.50	$\frac{3}{16}$"	$\frac{1}{8}$"	3.18	0.32
7.5	0.75	$\frac{5}{16}$"	$\frac{1}{4}$"	6.35	0.64
10.0	1.00	$\frac{3}{8}$"	$\frac{3}{8}$"	9.53	0.95
12.5	1.25	$\frac{1}{2}$"	$\frac{1}{2}$"	12.70	1.27
15.0	1.50	$\frac{5}{8}$"	$\frac{5}{8}$"	15.88	1.59
17.5	1.75	$\frac{11}{16}$"	$\frac{3}{4}$"	19.05	1.91
20.0	2.00	$\frac{3}{4}$"	$\frac{7}{8}$"	22.23	2.22
22.5	2.25	$\frac{7}{8}$"	1"	25.40	2.54
25.0	2.50	1"	3"	76.20	7.62
50.0	5.00	2"	6"	152.40	15.24
100.0	10.00	4"	9"	228.60	22.86
150.0	15.00	5-$\frac{7}{8}$"	12"	304.80	30.48
200.0	20.00	7-$\frac{7}{8}$"	15"	381.00	38.10
250.0	25.00	9-$\frac{7}{8}$"	18"	457.20	45.72
300.0	30.00	11-$\frac{13}{16}$"	21"	533.40	53.34
350.0	35.00	13$\frac{3}{4}$"	24"	609.60	60.96
400.0	40.00	15$\frac{3}{4}$"	27"	685.80	68.58
450.0	45.00	17-$\frac{11}{16}$"	30"	762.00	76.20
500.00	50.00	19-$\frac{11}{16}$"	33"	838.20	83.82
550.0	55.00	21-$\frac{5}{8}$"	36"	914.40	91.44
600.0	60.00	23-$\frac{5}{8}$"	39"	990.60	99.06
650.0	65.00	25-$\frac{9}{16}$"	42"	1066.80	106.68

(*continued*)

TABLE 1.1 (*Continued*)

From Metric to Imperial			From Imperial to Metric		
mm	**cm**	**Inches**	**Inches**	**mm**	**cm**
700.0	70.00	27-9/16"	45"	1143.00	114.30
750.0	75.00	29-1/2"	48"	1220.00	122.00
762.0	76.20	30"	51"	1295.40	129.54
800.0	80.00	31-1/2"	54"	1371.60	137.16
850.0	85.00	33-1/2"	57"	1447.80	144.78
900.0	90.00	35-7/16"	60"	1524.00	152.40
915.0	91.50	36"	72"	1828.80	182.88
950.0	95.00	37-3/8"	84"	2133.60	213.36
1000.0	100.00	39-3/8"	96"	2438.40	243.84
1050.0	105.00	41-5/16"	108"	2743.20	274.32
1100.0	110.00	43-5/16"	120"	3048.00	304.80
1150.0	115.00	45 1/4"			
1200.0	120.00	47 1/4"			
1220.0	122.00	48"			
1250.0	125.00	49-3/16"			
1300.0	130.00	51-3/16"			
1350.0	135.00	53-1/8"			
1400.0	140.00	55-1/8"			
1450.0	145.00	57-1/16"			
1500.0	150.00	59-1/16"			
1800.0	180.00	70-7/8"			
2130.0	213.00	83-7/8"			
2154.0	215.40	87-1/8"			
2410.0	241.00	94-7/8"			
2440.0	244.00	96-1/16"			

Typical Imperial Cabinet Widths	Imperial Conversion	Typical Metric Cabinet Widths
6"	5-7/8"	15 cm
9"	11 3/4"	30 cm
12"	15 3/4"	40 cm
15"	17 3/4"	45 cm
18"	19-3/4"	50 cm
21"	23-5/8"	60 cm
24"	25-5/8"	65 cm
27"	27-5/8"	70 cm
30"	31-1/2"	80 cm
33"	35-1/2"	90 cm
36"	37-3/8"	95 cm
39"	39-1/2"	100 cm

(*continued*)

42"	41-$\frac{1}{2}$"	105 cm
45"	43$\frac{1}{4}$"	110 cm
48"	45$\frac{1}{4}$"	115 cm
51"	47$\frac{1}{4}$"	120 cm

Source: Table reprinted courtesy of Niagara Artcraft Woodwork Co. Ltd

TABLE 1.2 Typical Metric Cabinet Sizing

Depths			
35.0 cm + Door (2.5)	14$\frac{3}{4}$"		
53.0 cm	21-$\frac{15}{16}$"		
60.0 cm	24-$\frac{9}{16}$"		
Widths			
15.0 cm	5-$\frac{7}{8}$"	60.0 cm	23-$\frac{5}{8}$"
25.0 cm	9-$\frac{13}{16}$"	70.0 cm	27-$\frac{9}{16}$"
30.0 cm	11-$\frac{13}{16}$"	76.2 cm	30"
35.0 cm	13$\frac{3}{4}$"	80.0 cm	31-$\frac{1}{2}$"
40.0 cm	15$\frac{3}{4}$"	85.0 cm	33-$\frac{1}{2}$"
45.0 cm	17-$\frac{11}{16}$"	90.0 cm	35-$\frac{7}{16}$"
50.0 cm	19-$\frac{11}{16}$"	91.5 cm	36"
55.0 cm	21	$\frac{5}{8}$" 100.0 cm	39-$\frac{3}{8}$"
Heights (Including Subbase/Toe Height/Leg Dimensions— 15 cm = 5-$\frac{7}{8}$")			
27.2 cm	10-$\frac{11}{16}$"	104.0 cm	40-$\frac{15}{16}$"
40.0 cm	15$\frac{3}{4}$"	118.4 cm	46-$\frac{5}{8}$"
49.6 cm	19-$\frac{1}{2}$"	134.4 cm	52-$\frac{15}{16}$"
65.6 cm	25-$\frac{3}{16}$"	144.0 cm	56-$\frac{11}{16}$"
78.4 cm	30-$\frac{7}{8}$"	175.0 cm	68-$\frac{7}{8}$"
87.0 cm	34$\frac{1}{4}$"	215.4 cm	84-$\frac{13}{16}$"
94.4 cm	37-$\frac{13}{16}$"	231.4 cm	91-$\frac{1}{8}$"
		241.0 cm	94-$\frac{7}{8}$"

Source: Table reprinted courtesy of Niagara Artcraft Woodwork Co. Ltd

As you consider representing a cabinet line, make sure you find out how the cabinet is sized: Are the cabinets sized on an imperial system, are they sized in a metric system, or are they a hybrid of the two? This is important, as there may be slight differences in cabinet case sizing that will affect the cabinet's fit with adjacent appliances and other pieces of equipment.

Mathematical Conversions

Here are the formulas for converting common measurements from one measurement system to the other:

- To convert inches to centimeters, multiply the inches by 2.54; for example, 23$\frac{5}{8}$ inches (23.63 inches) × 2.54 = 60 cm
- To convert centimeters to inches, divide the centimeters by 2.54; for example, 60 cm ÷ 2.54 = 23.63 inches (23$\frac{5}{8}$ inches)

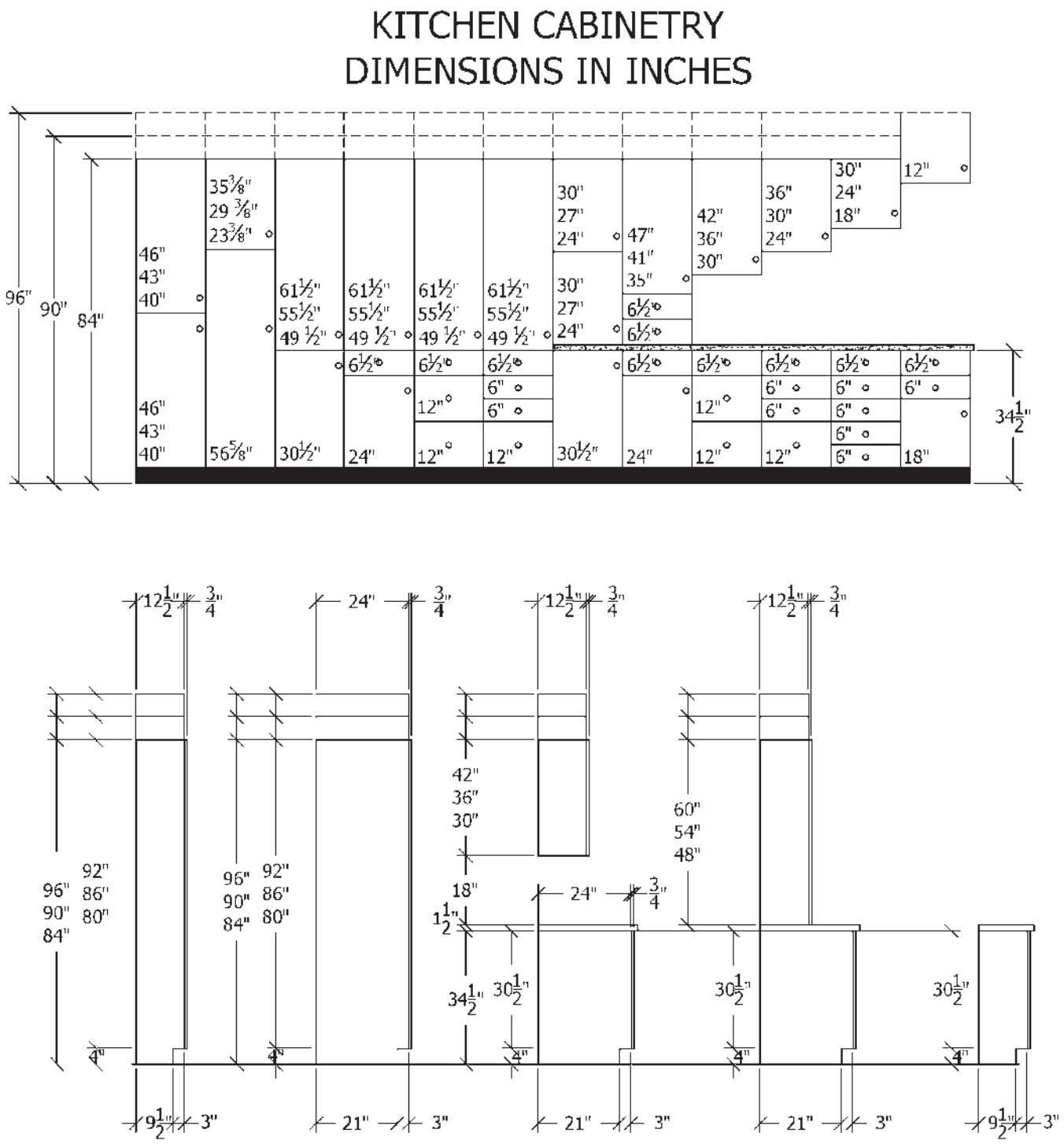
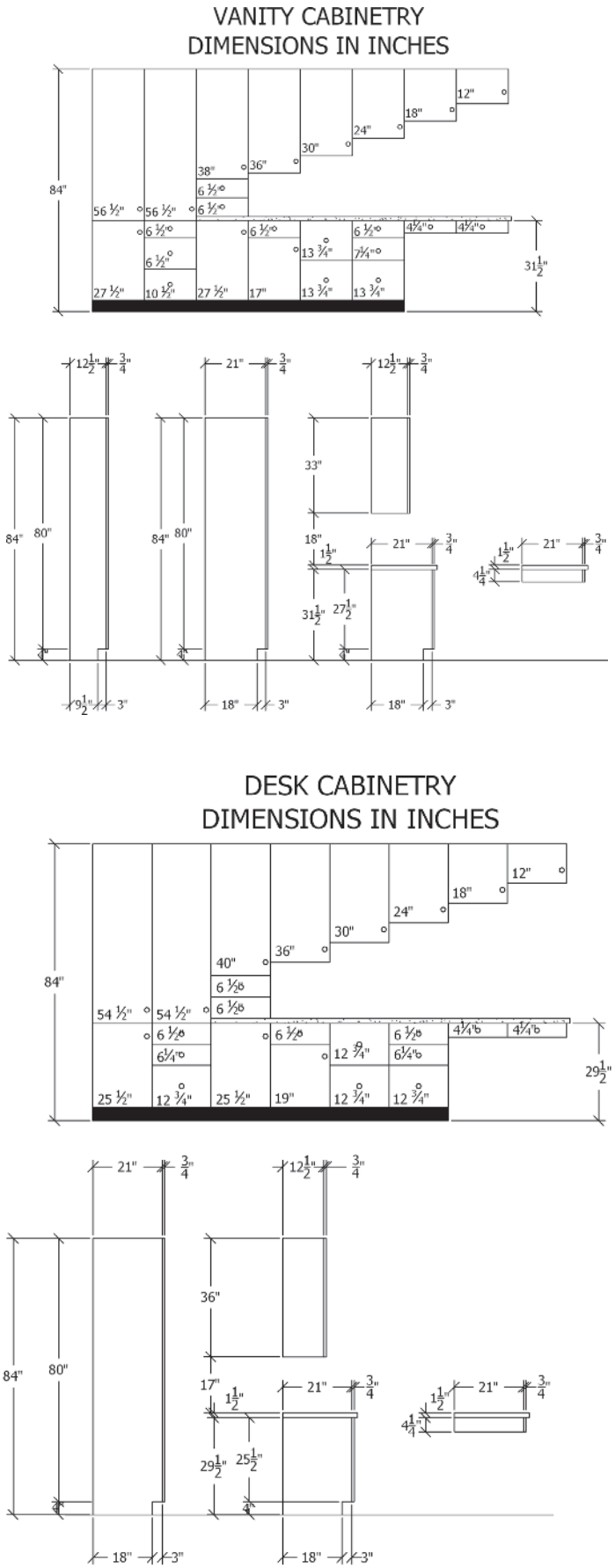


FIGURE 1.7 Typical imperial cabinet dimensions.

- To convert inches to millimeters, multiply the inches by 25.39; for example, $23\frac{5}{8}$ inches (23.63 inches) × 0.04 = 599.96 cm
- To convert millimeters to inches, divide the centimeters by 25.39; for example, 599.96 cm ÷ 25.39 = 23.63 inches ($23\frac{5}{8}$ inches)

See Figure 1.7 for typical cabinetry dimensions in inches, and Figure 1.8 for cabinetry dimensions in metric.

FIGURE 1.7 (*Continued*)



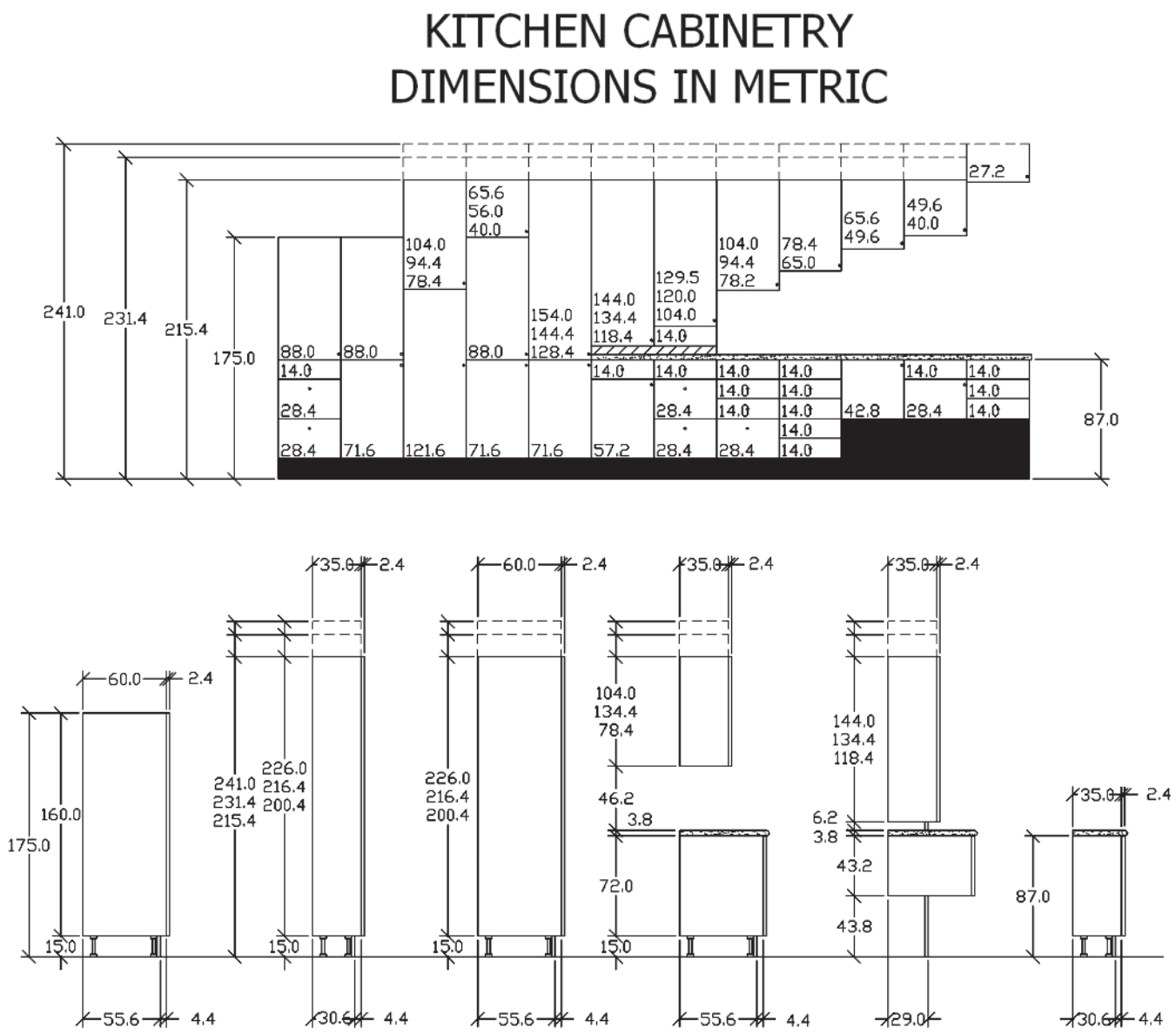


FIGURE 1.8 Typical metric cabinet dimensions.

CABINET MANUFACTURING SYSTEMS

As you consider cabinet options, one of the first decisions you must make is whether you will represent a cabinet featuring frame construction or one featuring frameless construction. Your product offering may be manufactured in North America or may be imported from another part of the world.

Cabinet Joinery Methods

Cabinet joinery methods can include all of the details shown in Figure 1.9. In nearly all cases, the joints are held together with staples or brads to allow glue time to cure. It is glue that locks the joints. Rabbet and dado cuts are used in case construction. Dovetail joints and dowels provide more drawer strength.

FIGURE 1.8 (*Continued*)

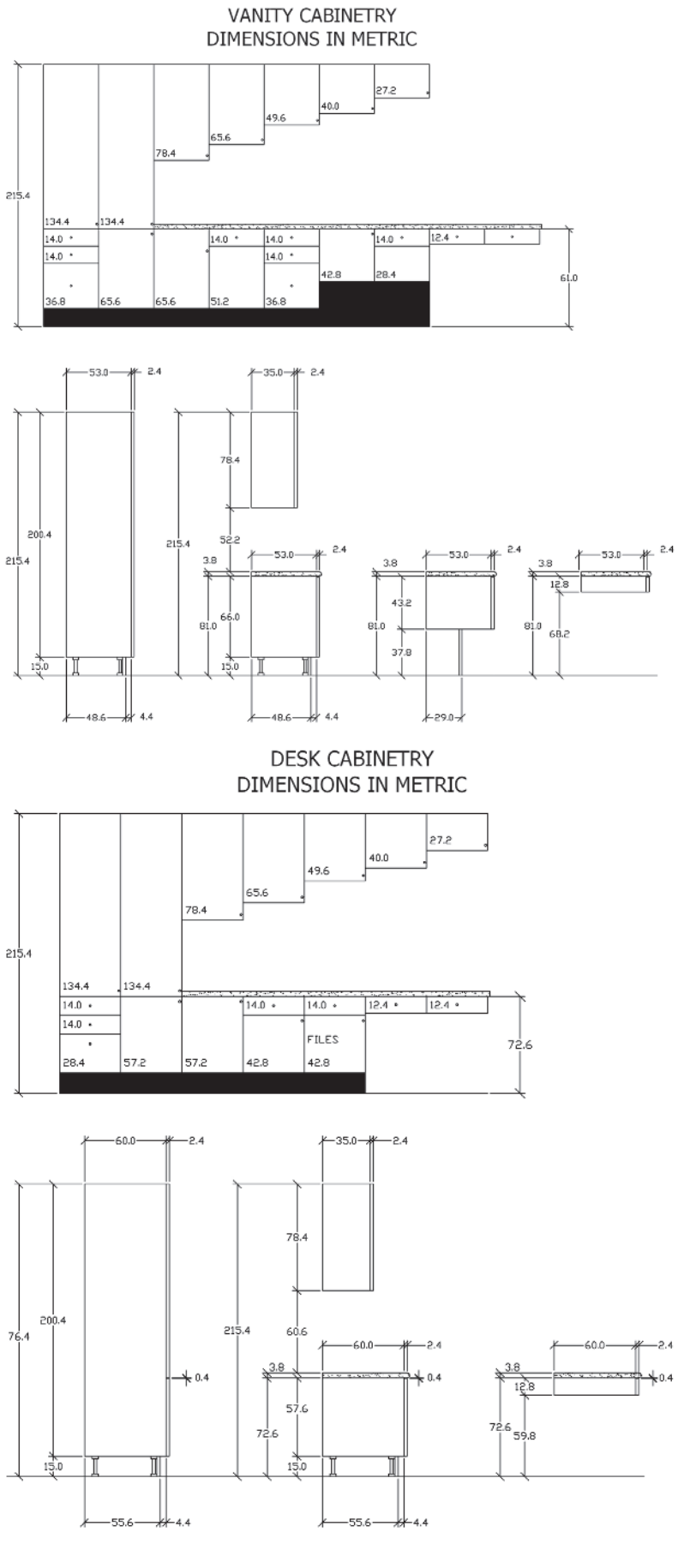
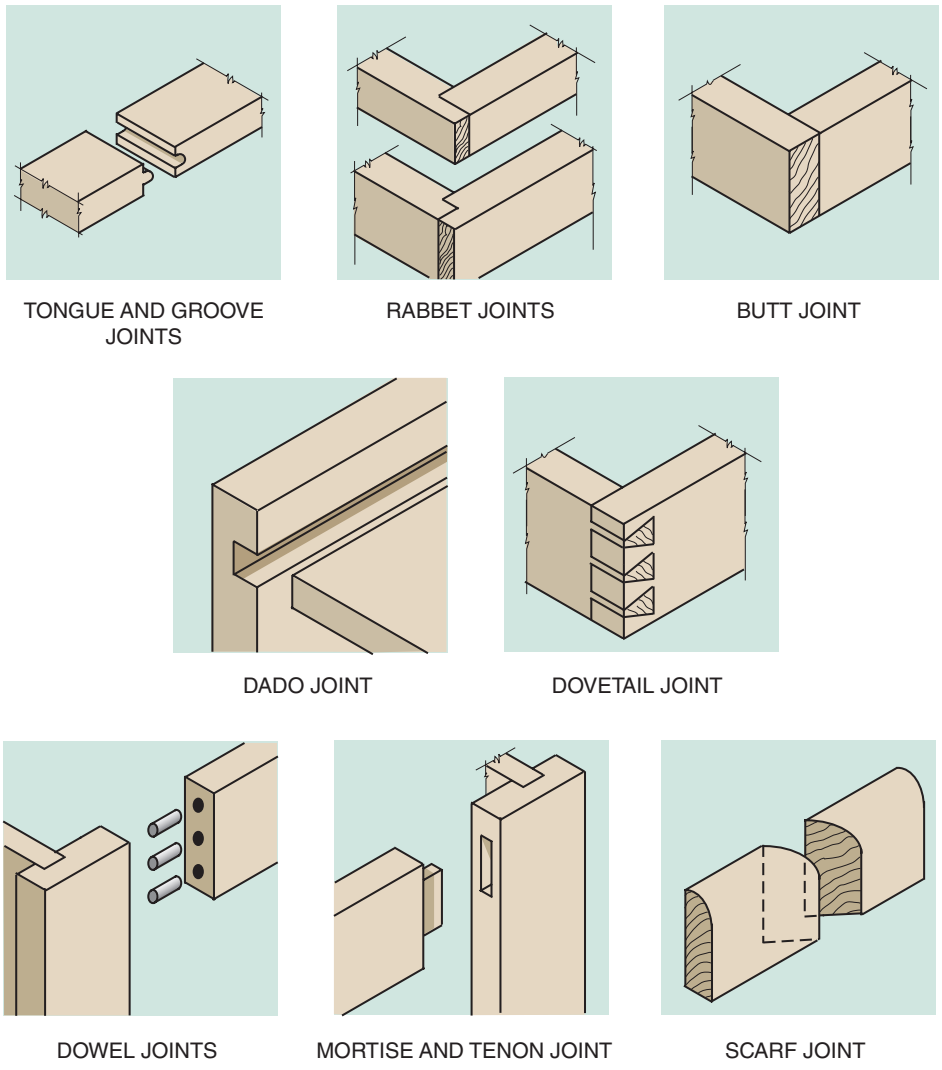


FIGURE 1.9 Cabinet joinery methods



Definitions

- **Dowel:** A short, round wooden stick with ends cut flat. In cabinet construction, dowels are used chiefly to reinforce corners.
- **Lap Joint:** A joint made by overlapping two ends or edges and fastening them together.
- **Mortise-and-tenon:** A slot cut into a board, plank, or timber, usually edgewise. The mortise receives a projecting part, or tenon, of another board, plank, or timber to form a joint. Many years ago, mortise-and-tenon joints were used in house building. Today, they are used mainly in assembling cabinets.
- **Mullion/muntin:** A vertical post or other upright that divides a window or other opening into two or more panes. Sometimes only ornamental.
- **Rail:** A cross member of a panel door or a frame cabinet face.
- **Stiles:** Vertical flanking members on a panel door or a frame cabinet face to which the horizontal top and bottom rails are secured.

Frame Construction

In frame cabinet construction, component parts make up the sides, back, top, and bottom of the cabinet (see Figures 1.10 and 1.11). These parts are then joined together and attached to the face frame, which is the primary support for the cabinet. Doors and drawers are then fit in one of three ways: flush with the frame (*inset*), partially overlaying the frame ($\frac{1}{4}$ inch *overlap or lip*), or completely overlaying the frame.

Frame cabinets are the easiest of the three systems to install because the clearance tolerances are more generous than those in inset or full overlay cabinetry, and may offer extended stiles to facilitate scribing on the job site. However, this method of construction has less interior storage space because the interior size of drawers or rollout accessories is smaller than the overall width of the cabinet.

- $1\frac{1}{4}$ to $1\frac{1}{2}$-inch front frames are usually made of hardwood, $\frac{1}{2}$ inch to $\frac{3}{4}$ inches thick. Some cabinet manufacturers offer 1-inch-thick framing. Rails, stiles, and mullions are doweled (or mortise-and-tenon) as well as glued and stapled for rigidity. Lap joints and screws are also used.
- End panels typically consist of $\frac{1}{4}$-inch to $\frac{3}{4}$-inch plywood, composite or engineered board that is dadoed into the back of the stiles and then glued, stapled or nailed in place. They are secured square in each corner with a plastic, metal, or fall-off scrap material gusset. Some manufacturers provide a full top to increase stability.

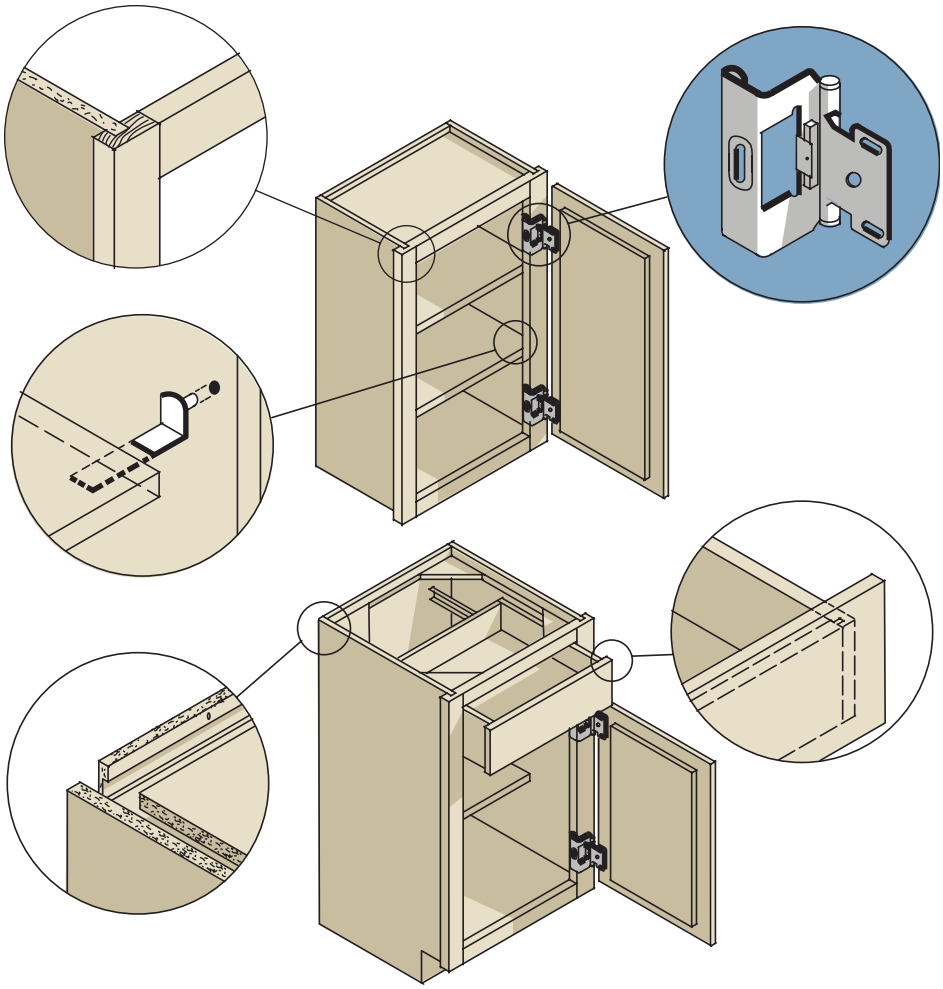


FIGURE 1.10 Typical framed cabinet component parts. Framed cabinets are fitted together with various forms of wood joinery and without special hardware fittings. Door hinges attach to face frame and generally do not have multiple adjustments.

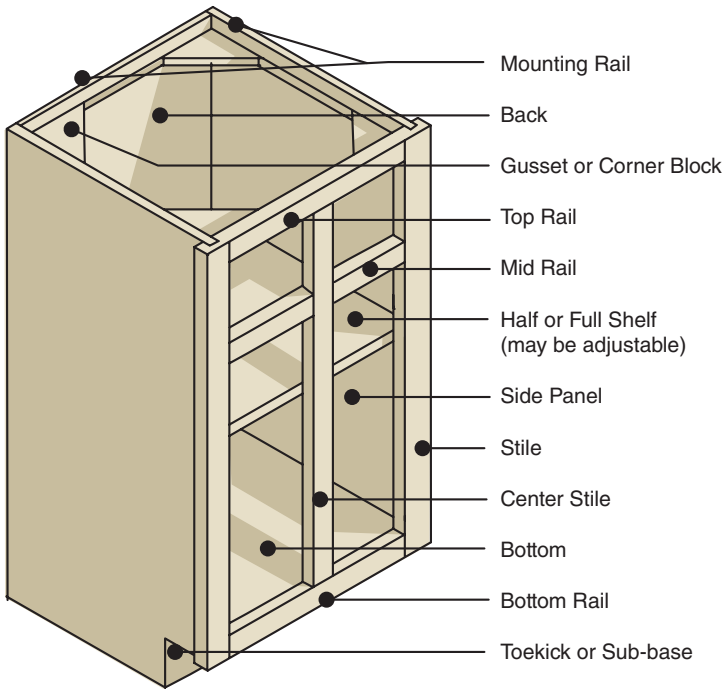


FIGURE 1.11 Typical framed cabinet construction details

- Backs are generally $\frac{1}{8}$-inch hardboard to $\frac{3}{4}$-inch plywood or composite board.
- Bottoms and tops are 3- or 5-ply plywood or composite board. They are $\frac{1}{4}$ inch to $\frac{1}{2}$ inch thick and are dadoed into the sides of the cabinet.
- Shelves are lumber, plywood, or particleboard, $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in specification, with square or rounded front edges. Plywood and composite board shelves are generally banded with hardwood or with a wood-grained edging material.

Frameless Construction

Frameless construction is the second major category of case construction. While both types of cabinetry are built in the United States, the majority of cabinetry built in Canada and imported from other international manufacturers is frameless. With this method of construction, these case parts form a box that does not need a front frame for stability or squareness. Doors and drawers cover the entire face of the cabinet (see Figures 1.12 and 1.13).

- $\frac{5}{8}$-inch to $\frac{3}{4}$-inch composite board, plywood, or engineered wood sides are connected to the back, top, and bottom with either a mechanical fastening system or a dowel method of construction.
- Backs are $\frac{1}{4}$ inch, $\frac{1}{2}$ inch, or $\frac{3}{4}$ inch.
- Tops are $\frac{1}{2}$ inch or $\frac{3}{4}$ inch.
- The sides are drilled for adjustable shelf clip holes or dadoed for fixed shelves.
- The doors are bored for adjustable, fully concealed, self-closing hinges.
- Generally all exposed edges are banded.

The major advantages of frameless construction are total accessibility to case interior and the clean, simple design statement made by the finished product. Additional planning expertise is required to ensure proper clearance between these full overlay doors/drawer heads and adjacent cabinets and appliances of the plan. The fit and finish of the cabinets to adjacent walls and the overhead ceiling also requires knowledge about the use of scribe trim molding and fillers.

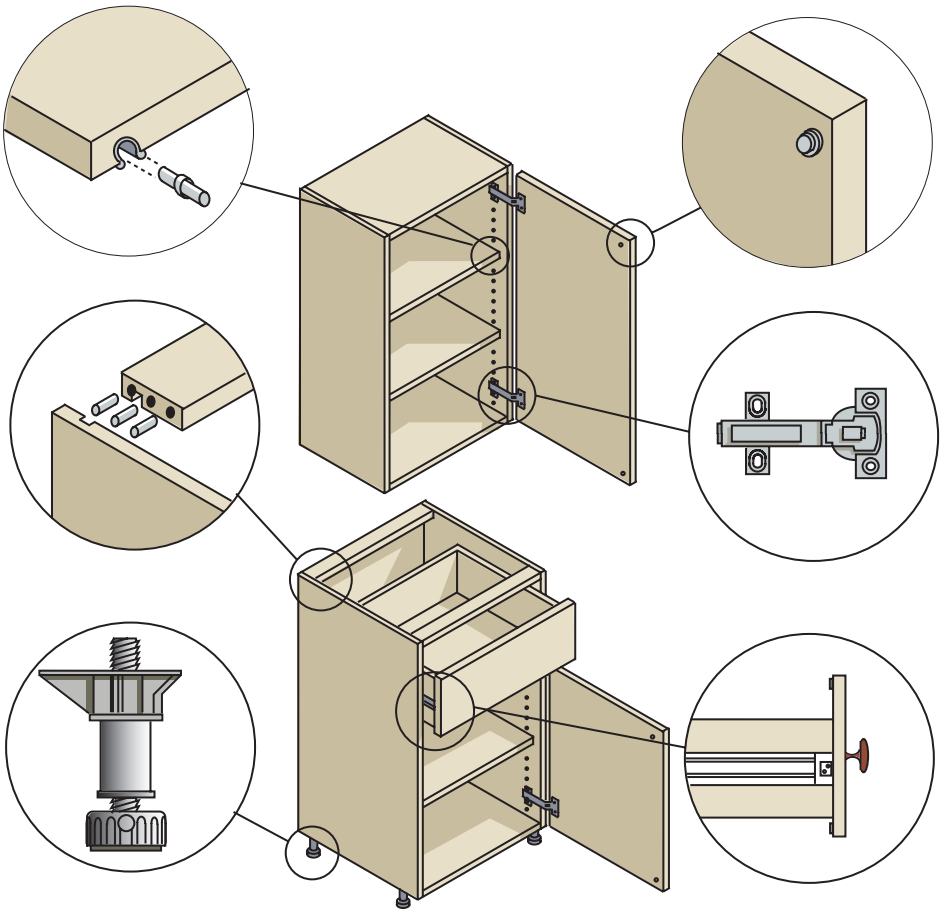


FIGURE 1.12 Typical frameless cabinet component parts. Typical frameless cabinet construction is oriented to hardware and production. Pins and dowels, which might be wood or metal, are made to fit specific holes, all of which are drilled when the cabinet is manufactured. Hinges are completely concealed. Leveling legs may be used instead of an attached subbase.

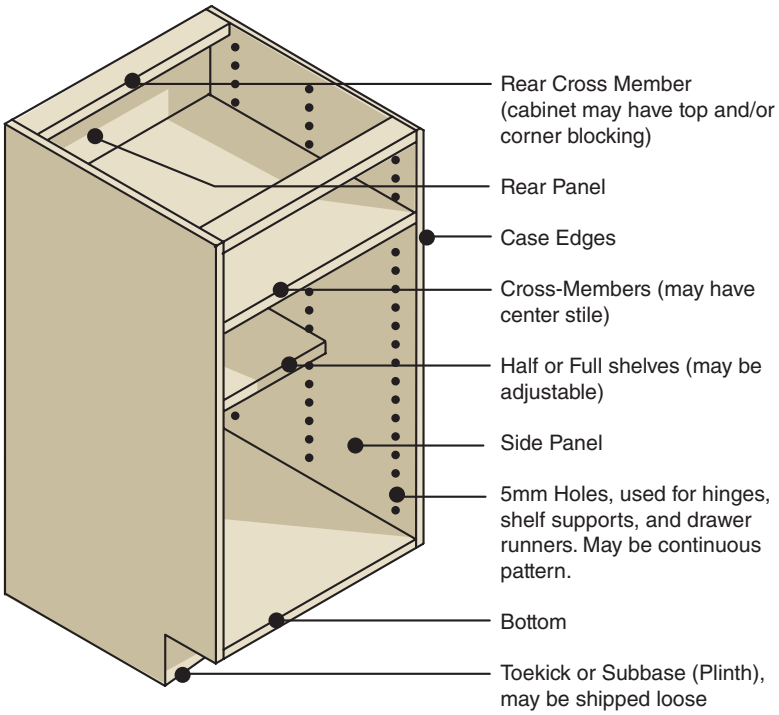


FIGURE 1.13 Typical frameless cabinet construction details

Hybrid Frame/Face Frame Construction

Some manufacturers have created a hybrid cabinet construction system allowing them to utilize the engineering method of frameless construction for the case while creating the look of handcrafted joinery by adding a nonfunctional face frame to the front exterior of the cabinet.

In this method of construction, the width of the face frame (less the thickness of the side material) extends beyond the case side, resulting in a void space between each cabinet.

CABINET INTERIOR STORAGE SYSTEMS

Drawer/Rollout Configurations

All kitchens include a combination of cabinetry featuring fixed or adjustable shelving combined with single drawers above doors or banks of drawers, which may be in two-, three-or four-drawer configurations. Most manufacturers also offer some type of roll-out shelf system, which is actually a drawer mounted on top of a shelf or to the inside vertical partitions of the cabinet.

The advantage of drawer storage or rollout storage is clear: the items stored within the cabinetry become much easier to see, retrieve, and replace.

Four major types of drawer construction systems are used within the cabinetry industry:

1. **Butt joint drawer system.** A butt joint drawer system secures the individual pieces of component parts together without an interlocking joint. Once thought to be a less durable form of construction, today's butt joint drawers, which utilize better adhesives and capture the bottom of the drawer in channels machined into drawer sides, front, and back, are as durable as a classic dovetail joint.
2. **Dovetail drawer system.** A four-sided wood drawer box engineered with dovetail joints is offered by many manufacturers. A hallmark of craftsmanship in fine woodworking for centuries, the dovetail joint is considered by many to be the preferred method of joining two pieces of wood together. The name comes from the protruding portion of the joint, reminding one of a dove's tail. Because of the interlocking nature of this joint, it readily accommodates the natural expansion and contraction of the wood over the life of the drawer without affecting the structural integrity of the joint.
3. **Metal drawer system.** Drawer slide manufacturers offer a totally integrated drawer system featuring a stainless steel, aluminum extruded, or other metal-type three-side

drawer system, which typically has a shaped profile top edge and bottom edge. The drawer bottom repeats the material selected for the case interior. These three-sided drawer component systems then connect directly to the drawer head and usually incorporate the drawer guide system into their construction. The drawer system may feature a solid drawer side or may allow a design statement to be added: Wood, glass, leather, or marble can be incorporated into the sides or face of some drawer systems.

4. **Miter-framed drawer system.** A four-sided miter-framed low-pressure melamine drawer system or a boxed melamine drawer system is considered an entry-level drawer. This type of interior normally matches the case interior. Miter-framed drawer systems score the core material of the drawer; then the sections of the drawer are folded together to form the box.

Planning Considerations

A key element of the cabinet specifications is to define the specific storage components planned behind the door and drawer fronts. As noted in the *Kitchen Planning* volume of the NKBA Professional Resource Library, kitchen planning has been studied for the last 150 years. Recently, a major manufacturer (Blum Inc., www.blum.com/us) continued this endeavor by identifying specific items maintained in a kitchen and studying the path of the cook as he or she worked in the space. This information is helpful when considering the options for an interior storage system and placing these items within cabinet interiors (see Figure 1.14).

The storage requirement for a specific kitchen is based on the client's collection of point-of-use countertop appliances, shopping habits, size of household, and lifestyle. Based on the Blum survey, on average, 360 individual activities occur each day in the kitchen. These activities include simple motions, such as removing a vegetable peeler from a drawer, peeling at the table and taking the peelings to the trash container, and finding a pot and lid to cook the potato. Over the course of 20 years, this amounts to approximately 2.6 million activities in the kitchen. Since items need to be accessed during many of these activities, placing them in their proper kitchen zone so they can be retrieved as quickly and easily as possible will help reduce work time and the physical effort required to complete kitchen tasks.

Home economists and other motion specialists have undertaken this type of work simplification study over the years. An overview of the academic research was first published in the *Beyond the Basics . . . Advanced Kitchen Design* textbook that was used for NKBA advanced training programs.

Back to the Basics: Become Familiar with the Concept of Motion Economy

To add value to your solution and the cabinets you specify, study or remember the long-standing time management principles as they relate to motion economy. Simply put, saving motion during any activity not only means saving the human worker energy; it also means saving the person's time. Time is one of our most valuable commodities today; indeed, for many people, it is priceless.

Work Simplification Principles Revisited

Be cognizant of the value of energy management. Each person has a finite amount of energy, depending on physical heritage, age, and general health. You can minimize the effort needed to cook in the new room if you are familiar with the research and ask the right questions when you first interview your client.

As you interview your client and review the space under development, remember that household tasks require several types and combinations of efforts:

- Mental effort to think through the task
- Visual effort as the eye directs the movements of the body
- Manual effort as the person reaches, lifts, carries, pulls, and pushes objects as part of the task
- Upper body strength and mobility required for bending, leaning, rising, turning, and stooping
- Pedal effort to walk, move, and stand

FIGURE 1.14 A collection of items stored in a kitchen
Courtesy of Blum Inc.

Designers can help their clients minimize the motion needed by employing four basic techniques.

1. **Eliminate unnecessary work.** By incorporating interior storage aids, no energy is needed to search, remove, and/or replace objects in the cabinet interior.
2. **Combine operations of elements.** Thinking through the sequences family members follow when using the kitchen will lead to a plan based on a logical, fluid path for the primary cook to follow.
3. **Change the sequence of an operation.** By carefully monitoring the food/equipment flow, storage/preparation/cook/usage steps can be minimized.
4. **Simplify the necessary operations.** Any plan enhancement that can simplify the operation at hand will save energy. Locating non-cooking–related activities along the perimeter of the cook's central workstations simplifies the cooking operation.

How high can the average cook reach? How much counter space does the cook use? It is also useful to be familiar with research projects that identify functional limits of reach, and the typical cook's *work curve*.

- **Functional limits.** Cornell University studied shoulder-to-grasping, fingertip reach of individuals 5 foot 3 inches to 5 foot 7 inches, and established 79.6 inch as the highest

comfortable overhead reach for these cooks. When the reach was over a 25-inch-deep counter surface, the top shelf height was lowered to 69 inches. In the same manner, 48 inches was set as the comfortable side-to-side reach and 24 inches off the floor was set as the lowest point or fingertip level from the floor (see Figure 1.15). This is excellent

FIGURE 1.15 Accessing lower base cabinet shelving or overhead shelving requires more energy than reaching storage levels closer to the countertop level.

Courtesy of Blum Inc.

FIGURE 1.16 Tall cabinet storage systems provide flexibility.
Courtesy of Blum Inc.

information to use when thinking about uninterrupted counter space or how and where wall cabinets or other types of above-countertop storage units might be located (see Figure 1.16).

- **Work curve.** The same study determined the normal work curve (or elbow circle) had a maximum depth of 16 inches. This is why the average countertop height, 25 inches, provides plenty of room for spreading out supplies or stacking plates in front of the user. This is also a very important measurement when designers are considering new and unique backsplash storage system solutions (see Figure 1.17).

FIGURE 1.17 Using countertop space
Courtesy of Blum Inc.

Storage Guidelines

When planning a kitchen, the designer must consider the homemaker's available time and energy level. These guiding principles should be followed: Build the cabinets to fit the cook, build the shelves to fit the supplies, and build the kitchen to fit the family.

Storage guidelines are based on three basic tenets:

1. Store supplies at their center of use.
2. Ensure all supplies are clearly visible.
3. Ensure all supplies are easily accessible.

To accomplish this, storage specialists suggest:

- Store items at the first or last place of use.
- Store items in multiple locations if used for different tasks.
- Store items that are used together in the same location.
- Store items so they are easy to locate at a glance.
- Store or group together like articles.
- Store frequently used items within easy reach. (Based on research, "easy reach" normally is defined as between eye level and hip level at the front of the cabinet's shelf, or placed anywhere within the confines of a pullout or rollout shelf.)
- Store items so they are easy to grasp at point of storage.
- Store items so they are easily removed when removing other items first.
- Place heavy equipment at or near floor level.
- Utilize all space for utmost efficiency. Share these principles with your clients before you complete the storage system layout and then remind them about these basic principles, which will guide them in organizing the kitchen (or bath) cabinetry after the installation is complete.

Help clients declutter by encouraging them to use all shelf/drawer space for utmost efficiency by prioritizing items according to frequency of use. The most frequently used items should get the best location. In addition, if something is not used, an important question to ask is: Should everything be returned to the new room? A *one-year test* is a good rule of thumb: If an item has not been used in one year, perhaps it should be repurposed or given away rather than stored.

Planning the Interior Cabinet System Based on Zones within the Kitchen

The new studies conducted by the Blum organization continue to focus on the need for designers to create asdynamic space, one that supports the cook's efforts by minimizing his or her physical exertion while producing a meal or completing other activities in a residential kitchen.

The key components of the dynamic space concept are to:

- Reduce the stress placed on the body, thus making it easier to work in.
- Shorten the distance traveled and time spent through proper zone planning (see Figure 1.18).

FIGURE 1.18 The cook's work path
Courtesy of Blum Inc.

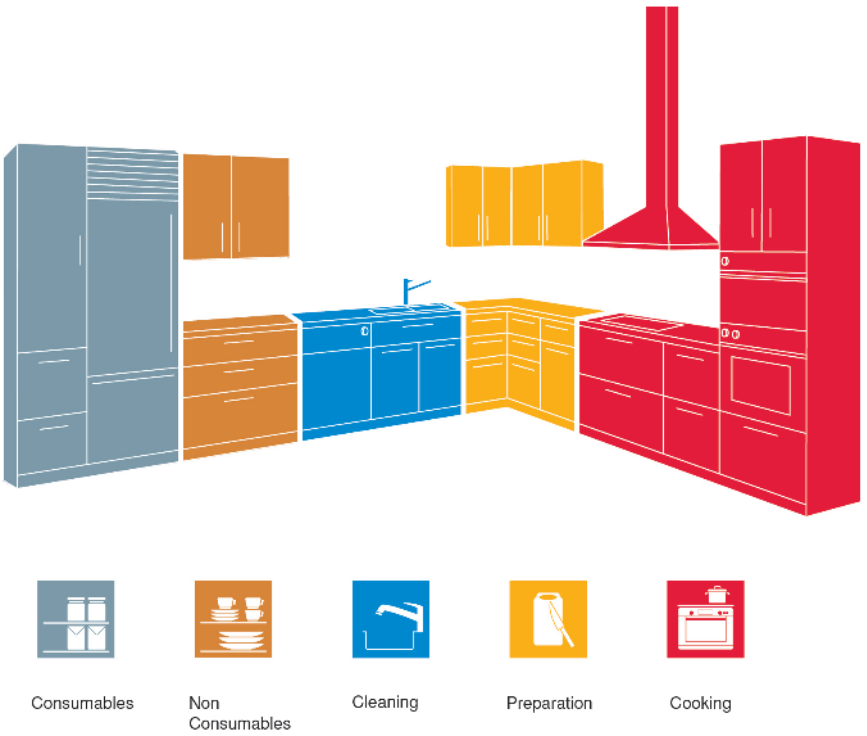


FIGURE 1.19 The kitchen divided into zones of activity
Courtesy of Blum Inc.

The storage guidelines referenced earlier discussed placement of frequently used items. The Blum survey gives us information that is more specific (see Figure 1.19.).

Research conducted by the Blum organization resulted in an observation that there were more than 100 zone changes per day in the kitchen of an average four-person household (an average based on the variety of household demographics and cooking habits). This survey is briefly referenced in the *Kitchen Planning* volume of the NKBA Professional Resource Library.

Because this information is an excellent foundation for specifying a cabinet interior storage system, we have included the details of this study.

On an average daily basis:

- People make 30 trips to and from some type of seated/dining/gathering area.
- Fifty separate activities are performed within the individual zone.
- Appliances are used 30 times.
- Doors and drawers opened and closed over 80 times.

Blum made comparisons of traditional planned kitchens to those planned in accordance with the *dynamic space* concept using the string study method. To identify a work pattern, string is attached to the worker's body. At the end of the day, the length of string is measured to establish the distance covered. After a typical day in a kitchen that had been carefully zoned based on anticipated activity, the total footsteps were reduced by as much as 25 percent, saving distance traveled, and time spent in the kitchen.

Zones

- **Consumables zone.** Items in the consumables zone consist of anything that is eaten and needs to be replenished. The refrigerator is a part of this zone since both perishable and nonperishable items are stored here.
- **Nonconsumables zone.** The nonconsumable zone contains items such as dishes, cutlery, glassware, plastic containers and their lids, jugs and pitchers, and a few small appliances.
- **Cleaning zone.** Items found in the cleaning zone are centered on the sink. Cleaning agents, sponges, dish detergents, and cleaning utensils are stored here. Space should also be planning for the trash can and recycling containers.
- **Preparation zone.** The preparation zone holds items used during meal preparation. The storage items in this zone require an assortment of drawer depths. Shallow spaces are needed for utensils, while deeper drawers are required for appliances, mixing bowls, pots and pans, and enclosed containers storing food-related ingredients or products.
- **Cooking zone.** The items in the cooking zone are needed close at hand. Centered on the cooktop, oven, and microwave, the area requires the storage of oven mitts to move pots, pans, baking dishes, and cookie sheets from the heat.

Based on this information, the cabinets themselves and their interior storage systems should be organized following these four key points:

1. Consider cabinet sizes based on the five kitchen zones identified.
2. Choose cabinets with ergonomic benefits to support the activities associated in each of these zones.
3. Create optimal access into the cabinet specified.
4. Organize the contents of the cabinet.

Special-Purpose Component Storage Systems

Both cabinet manufacturers and accessory manufacturers also offer special-purpose interior accessory programs that feature formed plastic, coated steel, or stainless steel units. For example, a recycling center may include two large plastic trash receptacles that slip into openings in a rollout shelf or sit in a rollout attached to the drawer. Spice shelves and canned-good storage systems may be available in wire or chrome offerings. Corner swing-out shelves may form plastic half-moon sections or a system designed from wire.

In addition to plastic, coated-wire, and chrome-wire systems, many custom manufacturers offer a full complement of wood accessory component systems, which maximizes the customization of a cabinet order specifically designed for the client.

All types of drawer systems have coordinating storage inserts to separate and conveniently store cutlery, serving pieces, silverware, spices, and knives. These storage systems may be

formed plastic, wire, or custom-made wood, sized to the specific drawer being constructed. The inserts may be designed as compartments storing a quantity of items or may be individually sized and shaped for specific kitchen utensils and cooking paraphernalia.

Figures 1.20, 1.21, and 1.22 present a series of images from various respected manufacturers of storage systems demonstrating the type of interior storage components designed for

FIGURE 1.20 Drawers can be organized with a variety of interior component parts.
Courtesy of Blum Inc.

FIGURE 1.21 Special-purpose cabinets are available to create a recycling center, use a narrow width of wall space, and organize the area underneath the kitchen sink.

Courtesy of Häfele America

FIGURE 1.21 (*Continued*)

FIGURE 1.22 Specially engineered base cabinet storage systems are available as pullout and swing-out systems for all kitchen centers. *Courtesy of Rev-A-Shelf*

FIGURE 1.22 (*Continued*)

FIGURE 1.22 (*Continued*)

inclusion in a variety of home storage areas. We go beyond the kitchen and bathroom, and include entertainment area, utility room, home office, and dressing room storage systems.

CABINET MECHANICAL/FUNCTIONAL HARDWARE

Cabinet Door Hinging: Frame Cabinetry

Traditional frame cabinets use a surface-mounted hinge that attaches to the inside edge of the frame and the outside edge of the door. The relationship of the door to the frame determines the type of hinging specified.

Square edge. For inset door styling, hinges have an exposed barrel with or without decorative finials at the top and bottom. Some hinge manufacturers offer a custom-designed European-style hinge, which fits on the inside of the framed case and does not have any exposed mechanical elements on the exterior. This type of hinge often is called a *concealed inset hinge*.

Profile (shaped) edge. For framed cabinetry offering an overlay door configuration (the door may lie completely against the face of the cabinet or be notched around the cabinet opening), similar hinges are designed that are shaped to fit the door profile. These hinges come in a variety of quality levels and a multitude of finishes.

Cabinet Door Hinging: Frameless Cabinetry

Frameless cabinetry uses totally concealed hinges on the inside of the cabinet: One hinge end is inserted in the door back and the other into the side of the cabinet. Most of these hinges are *demountable*, which means they easily snap on and off during installation. Typically they are adjustable in three directions (up and down, in and out, and left and right), allowing the installer to maintain correct reveal dimensions between the doors and drawers, critical in this type of cabinetry.

Hinges designed for full overlay cabinetry may be considered *low profile*, which means they do not protrude into the cabinet space more than 1 inch (2.50 cm) and typically are 110-, 120-, or 125-degree openings. The larger the opening, the easier it is to access the interior of the cabinet. Some oversize hinges are available, which allow the door to open a full 170 degrees. The client and designer need to compare and evaluate the advantages of the increased opening against the disadvantages with the overall size of the hinge.

Today, hinges are considered *self-closing* or *soft closing*. This means the frameless cabinetry door hinge slows its closing speed as it nears the cabinet face and then gently closes itself. This soft closing system reduces noise and wear and tear on the hinges in an actively used room.

Cabinet Door Hinging: Special Purpose

Some door opening hardware for frameless cabinetry is available with electronically controlled mechanisms that allow the door to open with a simple tap.

Hinges Designed for Thicker Doors

All of the hinges described above are designed for $\frac{3}{4}$-inch (often called $\frac{4}{4}$) door thicknesses. Some manufacturers offer full 1-inch-thick doors (called $\frac{5}{4}$ doors), which require special hinging considerations.

Oversize Hinges

Although frame cabinetry hinge sizing is very similar across brands, some manufacturers offer oversize hinges that add greatly to the aesthetics of old world rooms or very large spaces.

Sliding/Pocket/Bifold/TILT-up Hinging

In addition to the two cabinet hinging systems just described, cabinet manufacturers offer many special-purpose hinging systems. These include retractable door systems to conceal televisions, home office equipment, or a microwave. Doors tilt up or swing down. Several systems allow doors to slide left to right as well.

FIGURE 1.23 Wall cabinet with sliding door hardware system
Courtesy of Häfele America

Many innovations in cabinetry hardware allow doors to slide in front of one another (called a *sliding door*) (see Figure 1.23) or move to the left or right, and then make a right angle turn into a *pocket* (called a *pocket door*). These two types of hinging systems are often used in all types of cabinets: base cabinets, wall cabinets, and tall cabinets.

Special-purpose wall cabinet hardware is available that allows a door to swing up above eye level. Other specialty hinges are designed for cabinet doors that fold in the middle and are then pushed up providing full access to the cabinet interior (see Figure 1.24). These types of hinging apparatus are most common in frameless cabinetry. They require sophisticated side-mounted hardware components, which may intrude on some of the interior cabinet storage. They can be controlled manually or electronically

New electronically operated cabinet door systems are being introduced in both the European and North American markets. These doors may be a shutter configuration that extends to the counter in a closed position that, when activated by a remote control, are stacked at the top of the cabinet; they may be doors that open and slide in front of one another; or, they are available in doors that hinge up. Last, there are upper cabinet shelf hardware systems that allow the entire contents of the wall cabinet to be pulled down to countertop height (see Figure 1.25). Additionally, there is hardware that allows a countertop or cabinet to be raised or lowered in height.

New innovations continue to be launched in this special-purpose hardware category (see Figure 1.26). Designers wisely stay in close communication with their cabinet, new product development, marketing, or engineering counterparts to learn what the next innovation may be.

Interior Shelf Adjustability

Usually cabinet systems, whether frame or frameless, offer full-depth adjustable shelves in wall cabinets. Base cabinet shelves may be one-half the depth of the cabinet, three-quarters the depth of the cabinet, or full depth. Some custom manufacturers make these shelves adjustable as well; most stock and semi-custom producers fix the lower shelf in place.

What the shelf is made from, what the banding material is, and whether all four edges are banded impact whether the homeowner can turn the shelf if an edge is damaged during use. The core material also dramatically affects the deflection rate of the shelf and, therefore, how wide a cabinet can be without a center stile. To keep the box rigid, many manufacturers will not build a cabinet wider than 30 inches without a center stile. Other manufacturers have engineered their cases to allow the designer to specify a cabinet as wide as 42 to 48 inches with no center stile and with a shelf engineered so it can be stocked with evenly distributed weight without noticeable deflection.

FIGURE 1.24 Examples of wall cabinets with fold-up or swing-up door hardware

Courtesy of Blum Inc.

FIGURE 1.25 A special cabinet for a kitchen wellness center
Courtesy of Rev-A-Shelf

The maximum overall shelf length and weight limits are also determined by the shelf pin system selected to provide adjustability. Typical mechanical systems are:

- A metal strip, surface mounted or routed into the side of cabinetry, with locking shelf supports.
- A series of holes running the entire height of the cabinet, or clustered around typical shelf locations.
- 2 mm or 5 mm diameter holes are typical. A metal or plastic pin recesses into the hole. The shelf might simply sit atop this pin, or the pin might be designed to lock the shelf in place. This second approach is considered the best choice because it eliminates the possibility of shelves tipping.
- Shelf pins used for glass shelves are of the same design, with the addition of a small bumper to ensure the glass does not slip or slide out of place.

Drawer Guide (Slide) Systems

Other than small decorative antique drawers, which have a wood slide system, all manufacturers in the kitchen industry today offer well-engineered drawer guide systems. (Some manufacturers call them *slide* systems.)

Side-Mounted Systems

Epoxy-coated, side-mounted guide systems that have a slant at the back of the track so that the drawer guide self-closes once it is within 1 inch or so of the cabinet face are available in entry-level products. The guides allow the drawer to extend three-quarters of the way into the kitchen; a full-extension configuration can be specified.

Some heavy-duty side-mounted metal drawer guides are available for general-purpose use or for special-purpose applications, such as heavy double trash bins, file drawers, or other cabinetry that will carry extra weight.

A third type of side-mounted drawer guide system features a sophisticated rack-and-pinion system designed to carry a very large drawer that will be loaded with heavy cooking pots and pans.

Under-Mounted Systems

Under-mounted guide systems come in both *three-quarter extension* and *full extension*. These drawer guide systems are engineered to provide a self-closing or soft-close feature, be

FIGURE 1.26 Oversized wall or tall cabinet doors provide total accessibility to interior cabinet shelving.
Courtesy of Artcraft Kitchens

easy to remove and replace by users over the years, and include some type of adjustability so the drawer head can be slightly realigned against the case. These drawer guide systems also have a high load-bearing capacity and enclose the track system to simplify maintenance over the life of the drawer guide.

Special Purpose

A new opening feature is available for frameless cabinet systems that allows for a gentle opening, regardless of the drawer's width or weight factor. These drawers open automatically with just a touch of the drawer front or with a light pull on the handle. This system is based on an electrical drive that, once activated, opens the drawer for you.

Typically, modifications to the drawer system are not necessary when adding this electronic feature. It is important that an on/off switch is included, allowing the homeowner to deactivate the electronically controlled drawer opening system and therefore save energy when not

FIGURE 1.26 (*Continued*)

in use. The drawer system remains functional, whether the power is on or off; with a pull of the handle, the drawer runs smoothly in a manual operation mode.

CABINET SIZES

Each manufacturer publishes a paper or electronic catalog of its product range. A general discussion of the most widely used cabinet sizes and types is presented next.

Kitchen Cabinetry Units

Base Units and Special-Purpose Base Units

Base cabinets, which are set on the floor, are 21 inches deep in many systems built internationally. Most North American cabinets are 24 inches deep, front to back, and $34\frac{1}{2}$ to $34\frac{3}{4}$ inches high including the subbase (which is also called the *toe kick* or *plinth*). This raised portion underneath the cabinet is generally 4 to $4\frac{1}{2}$ inches high in domestic cabinetry and 6 inches high in international cabinetry.

The common base cabinet has a single drawer over a single door that has either a half shelf or a full shelf in the middle and a full shelf at the bottom of the cabinet.

North American single-door base cabinets generally are available in 3-inch increments, starting with 9 inches, then going to 12, 15, 18, 21, and 24 inches. The 9-inch-wide cabinet generally will not have a drawer and may not be available in heavily detailed door styles. Double-door cabinets are usually available in widths from 24 to 48 inches; however, some manufacturers do not provide 39-inch- or 45-inch-wide units. Others stop the line at 42 inches wide.

International metric sizing is based on centimeters, with typical sizes being 10 cm, 15 cm, 20 cm, and so on.

Special-Purpose Base Cabinets

In addition to the standard base cabinet, special-purpose base cabinets are available for specific needs. The listing of typical cabinets at the end of this section discusses each one of these types of cabinets.

Generally, the categories of base cabinets you can choose from are:

- **Drawer cabinets.** A cabinet that features two, three, four, or five drawers. Two-drawer units frequently are used today to create a recycling unit. Three- and four-drawer units typically are seen near the primary sink for flatware and kitchen linen storage (see Figure 1.27). Wide, two- or three-drawer units often are used below a cooking surface to store pots, pans, lids, and utensils used at the cooking surface. Try to avoid drawer units smaller than 15 inches wide because the interior drawer space will be too small to be functional.
- **Corner cabinets.** A variety of corner cabinets are available:
  Lazy Susan base cabinet: Generally requires between 33 and 36 inches of space on each wall. A round shelf swings out into the room and past the door opening. The door may be bifold (see Figure 1.28) or actually may swing through the cabinet interior. The wider the door, the more functional the circular shelf.
  Blind cabinet: A cabinet that has a shelf, pullout, or swing-out apparatus to provide accessibility into the corner (see Figure 1.29). A blind cabinet generally requires 42 to 48 inches of wall space. Although available in 36 and 39 inches, avoid any unit less than 42 inches wide to ensure reasonable access.

FIGURE 1.27 Examples of drawer organizing systems
Courtesy of Häfele America

FIGURE 1.27 (*Continued*)

Pie-cut cabinet. A corner cabinet that requires 36 inches on each wall (much like a Lazy Susan) and features stationary shelving as opposed to a rotating shelf (see Figure 1.30). Maximum shelf space is provided. One type of pie-cut unit may be rounded with a curved door.

- **Recycling center.** Specialized cabinets that are designed to hold bins to facilitate the separation and recycling of refuse (see Figure 1.31).

FIGURE 1.28 Example of base cabinet or Lazy Susan system
Courtesy of Wellborn Cabinet, Inc.

FIGURE 1.29 Corner cabinets with swing-out shelves
Courtesy of Wellborn Cabinet, Inc.

FIGURE 1.30 Decorative open corner pie-cut cabinet
Courtesy of Wellborn Cabinet, Inc.

FIGURE 1.31 Recycling center
Courtesy of Häfele America

FIGURE 1.32 Kitchen with special-purpose wall units: 42-inch-high wall cabinets extend to the ceiling, providing extra shelf space.
Design by Adel Visser, CKD, CBD, CID

- **Sink/cooktop cabinet.** Base cabinets with a voided top drawer or a tilt-down front that houses a plastic or stainless steel container. The tilt-down is designed to utilize the top-drawer space that would otherwise be lost once the cooktop or sink is installed. The drawer area can be replaced with a special cutout to receive a farmhouse sink or a front-controlled cooktop. These cabinets may be pulled away from the wall with decorative columns or turnings finishing each side, creating a focal point within the room. This type of cabinet configuration is called a *bump-out*.

Wall Units and Special-Purpose Wall Units

Wall cabinets that are fixed to the walls with screws generally are 12 inches deep. They come in a variety of heights ranging from 30, to 36, to 42 inches (see Figure 1.32). Some manufacturers offer sizes to 48 inches. The 30-inch-high wall units are designed to be installed in a room with 96-inch-high ceilings with an extended, flush, or recessed soffit (drop) above them. *Soffit* is an industry word identifying a boxed-in area above the cabinets. The proper construction term would be a *bulkhead*, made up of fascia (the front panel) and the soffit (the underside). However, it is typical in the industry to call the entire structure a soffit.

The 36-inch-high units are designed to be installed in a 96-inch-high room with a 6-inch trim connecting the cabinets to the ceiling. These units also are used in a 108-inch-high ceiling to provide better balance between the cabinet spacing and the architectural envelope of the room. The 42-inch-high wall units are designed to extend all the way up to a ceiling in a

FIGURE 1.33 A wall cabinet extends to the countertop, providing an appliance storage area.
Courtesy of Wellborn Cabinet, Inc.

96-inch-high room or to be used with an extended, flush, or recessed soffit in 108- or 120-inch-high ceilings.

For use above microwave ovens, hoods, refrigerators, or other tall obstructions, wall cabinets also are available 12, 15, 18, and 24 inches high. Some of these sizes are available 24 inches deep to provide an accessible wall cabinet above a refrigerator. Wall cabinets generally are installed from 15 to 18 inches off the finished counter surface. This clearance typically is required so small hand appliances can fit under the wall cabinet.

As a standard, wall cabinets feature two adjustable interior shelves in a 30-inch-high unit. The 36-inch and 42-inch-high units generally include three shelves. To maximize the accessibility of wall cabinets, always specify wall units without a center stile. Many manufacturers install this vertical support member in wall cabinets wider than 30 inches, which blocks access. If available, specify a manufacturer that provides an open space the entire width of the cabinet.

Special-Purpose Wall Cabinets

Appliance garage. An appliance garage is a cabinet with a roll-up door, called a *tambour* unit, that extends to the countertop. It is sometimes referred to as a small appliance garage. Appliance garages also can be used with regular cabinet doors (see Figure 1.33).

Corner cabinet. Much like base units, blind corner units and pie-cut cabinets are available. An angled, diagonal corner wall unit frequently is specified. These units typically require 24 inches of wall space. The blind unit requires 27 to 30 inches of wall space to ensure a reasonable cabinet opening.

Glass door cabinet. Full glass panels or glass sheets that are framed in the door material are popular (see Figure 1.34). The cabinet interior should be finished to match the exterior. Glass may be clear, frosted, or etched. The doors also may feature decorative, stained, or leaded glass patterns.

Microwave/television cabinet. Deeper wall cabinets with special retractable swing-up doors (horizontal or vertical) are manufactured for television and microwave appliances.

Open shelf unit. Open shelf units can be mixed attractively with enclosed cabinets to provide design relief to the overall room by introducing a display of the client's collectibles.

FIGURE 1.34 Glass door cabinets used in a small kitchen

Design by Mark T. White, CKD, CBD. Photo by Phoenix Photographic

FIGURE 1.35 Small kitchen with peninsula cabinetry

Design by Marie Lail Blackburn, CMKBD, CID

Peninsula cabinet. This type of wall cabinet is accessible from one or both sides, attached to at least one wall, and spans an open space between two rooms (see Figure 1.35).

Special interior accessories. Such accessories include door-mounted spice racks, interior step shelving, swing-out canned goods, or spice shelf units. Some manufacturers also offer wall cabinets that have built-in integral lighting systems which provide optimum task lighting above the work surface (see Figure 1.36).

Task lighting systems/interior lighting systems for cabinetry. Some manufacturers offer wall cabinets that have a built-in integral florescent, LED, or low-voltage halogen lighting system attached to the bottom of the cabinet to provide task lighting above the countertop work surface. Interior LED lighting systems are also available to illuminate the inside area of a cabinet when the door is opened.

Tall Units and Special-Purpose Tall Units

Tall cabinets are used for a variety of purposes in kitchen planning (see Figure 1.37). They come in two size categories: midheight, 48 to 72 inches, and full height, 84 to 96 inches.

They may be used as a tall closet with no shelves to house cleaning equipment, as a food storage cabinet with specialized swing-out shelves, or as a replacement for standard base or wall units with adjustable shelves and/or rollouts.

Tall units typically are specified in 12-, 18-, 21-, or 24-inch depths for kitchen use. These units often are available in 18-, 24-, 30-, or 36-inch widths.

Midheight units feature single-height doors. Full-height configurations include a tall door approximately 65 inches high below a smaller door. This door size is specified to minimize warpage problems.

Special-Purpose Tall Cabinets

Built-in oven unit. Cabinets that house double ovens or combination appliance stacks generally have one drawer below the oven. Single-oven cabinets have two or three drawers below the appliances. Many manufacturers provide a universal oven case, which has three drawers that are designed to be eliminated at the job site if necessary, to accommodate a double oven.

Built-in refrigerator unit. Some manufacturers offer a three-sided tall enclosure with a 24-inch-deep upper cabinet to surround a refrigerator.

FIGURE 1.36 LED cabinet lighting systems: An LED lighting system can be incorporated in base and/or wall cabinets. LED cabinet lighting greatly improves visibility into and under cabinets.

Courtesy of Rev-A-Shelf

Bathroom Cabinetry Units

Vanity Base Units

Some vanity base unit systems are designed to *float* off the floor and are installed 6 to 18 inches up the wall. Base cabinets, which are set on the floor, are 21 inches deep (front to back) and 30 to 34½ inches high, including a subbase or *toe kick* that is 4 inches high.

Cabinetry designed for bathroom storage include special-purpose base cabinets for linen storage, built-in hampers, and specially divided drawer or pullout storage for grooming aids and cosmetics. Suspended drawers are available to be used in a sit-down area sometimes planned for a grooming/makeup counter. For children's bathrooms, a step stool is available, which is concealed in the base cabinet toe-kick area or hidden in a low drawer.

FIGURE 1.37 Example of tall pantry solutions
Courtesy of Wellborn Cabinet, Inc.

Wall Units

Wall cabinets traditionally were designed for kitchen usage. However, creative designers adapt various wall unit sizes for interesting and functional bathroom applications. Specialized cabinets designed to be placed over the water closet (toilet) and extending down to the vanity countertop are offered in some lines in 6- to 8-inch-deep bathroom units.

Tall Units

Tall cabinets provide excellent storage in a bathroom space when countertop requirements have been met (see Figure 1.38). Tall cabinets are attractively used to separate double lavatories, or to flank lavatory or toilet areas (see Figure 1.39). Tall cabinets to be used as linen or utility cabinets are 84, 90, or 96 inches high (see Figures 1.40, 1.41, 1.42, 1.43, and 1.44). Some units offer concealed drop-down counters, providing a seated space in a small bathroom.

Fitted Furniture Cabinetry for Other Rooms of the Home

The kitchen and bathroom specialist often is asked to extend his or her expertise into other rooms of the home that would benefit from custom-designed built-in cabinetry. (See Figures 1.45, 1.46, and 1.47.) One such area is a home office. (See Figures 1.48 and 1.49.) The center may be a separate room, a niche off the kitchen, or a special area within the kitchen. In such a space, designers are asked to create a charging station for the family electronic equipment (phones, tablets, PCs, etc.).

FIGURE 1.38 Example of a freestanding vanity incorporating custom detailing above the mirror and a cabinet extending to the countertop.
Courtesy of Rev-A-Shelf

FIGURE 1.39 Freestanding vanity is flanked by two tall units.
Design by Ellen Cheever, CMKBD, ASID, CAPS, Pietro A. Giorgi, Sr., CMKBD, and Joseph Giorgi, Jr., CKD. Photo by Peter Leach

FIGURE 1.40 Mirrored cabinet slides up, revealing a television.

Design by Ellen Cheever, CMKBD, ASID, CAPS, Pietro A. Giorgi, Sr., CMKBD, and Joseph Giorgi, Jr., CKD. Photo by Peter Leach

FIGURE 1.41 Example of combining tall cabinets with grooming area units

Design by Yuko Matsumoto, CKD, CBD. Photo by Douglas Johnson Photography

FIGURE 1.42 Example of a center room bathroom vanity
Design by Elizabeth A. Rosensteel, codesigner Merideth Confort. Photo by Robert Reck

FIGURE 1.43 Example of a bathroom vanity with cabinets on both sides of the mirror.
Design by Victoria Shaw. Photo by Tim McClean Photography

FIGURE 1.44 Example of a bathroom vanity with tall cabinets and a laundry hamper.

Design by Karl F. Utzman. Photo by Jim Brady

FIGURE 1.45 A woman's closet incorporating rollout drawers, adjustable shelving, and plexiglas dividers to organize the space.

Design by Pietro A. Giorgi, Sr., CMKBD, Ellen Cheever, CMKBD, ASID, CAPS, and Joseph Giorgi, Jr., CKD. Photo by Peter Leach

FIGURE 1.46 Glass doors provide visibility to the items stored within. A center island facilitates storage.
Design by Pietro A. Giorgi, Sr., CMKBD. Photo by Peter Leach

FIGURE 1.47 A man's closet designed to organize the owner's tie collection.
Design by Pietro A. Giorgi, Sr., CMKBD. Photo by Peter Leach

FIGURE 1.48 A home office with a variety of storage options
Courtesy of Showplace Wood Products, Inc.

Other areas of the home that can benefit from a designer's knowledge are media centers, entertaining counter/bar areas, children's bedroom storage, laundry rooms, hobby centers, and garage workspaces. These are just a few of the rooms you may be asked to design.

Just as designing a kitchen or bathroom requires specialized training, so too does designing these auxiliary spaces. Utilize your knowledge of cabinetry construction and size flexibility while developing a specialized questionnaire to clearly understand what clients hope to accomplish in these other areas.

CABINET CORE MATERIALS

In both frameless and frame construction, the cabinet core materials (case and door component parts) determine cabinet stability. An overview of cabinet materials currently used by both large manufacturing facilities and smaller custom cabinet shops is presented next. Some of these materials are used for both cabinet component parts and as door substrates.

Composite Core Platforms

Today, with the advent of new technology and improved resin and glue methods, the best interior surface for many cabinet applications is an

FIGURE 1.49 A home library featuring a built-in bookcase

Design by Pietro A. Giorgi, Sr., CMKBD and Ellen Cheever, CMKBD, ASID, CAPS. Photo by Peter Leach

engineered substrate that has been covered with either a high- or low-pressure decorative laminate or hardwood plywood.

Particleboard

Particleboard was originally a byproduct of the western lumber and plywood mills, which utilized sawdust, shavings, and other fall-off from the industry and was considered waste. Today, lumber mills and woodworking facilities use these wood particulates to make particleboard; hence, the name. Because some type of particleboard is the most widely used core material for cabinet construction today, trees are now harvested specifically for particleboard production.

Particleboard obtained its name based on its composition of particles of wood fall-off bonded together with resin under pressure. The size and species of the particles in this type of engineered substrate generally vary depending on the designed end use.

For example, underlayment is a form of particleboard that has a low-density and low-resin content. Therefore, it is not recommended for a laminate substrate because it has lower dimensional stability, structural strength, and moisture resistance.

Most particleboard used in the kitchen and bath industry is rated using three classifications: M1, M2, and M3. M3 is the best-quality board for laminating partly because of its superior screw-holding capability and internal bond strength; however, M2 board also is widely used. These high-quality engineered substrates usually fall in the range of 40- to 45-pound density. This density rating is the weight of the board per cubic foot. Better particleboard materials are rated as inch 45-pound commercial grade. Many times a multilayered process is used to develop the stability and screw-holding capacity of the core material.

Medium-Density Fiberboard

One of the most frequently used types of substrate material is medium-density fiberboard (MDF). This board is made of even finer fibers than normal particleboard. Its density adds

superior screw-holding power, a very tight clean edge, and an extremely smooth surface. The MDF edge can be shaped to a profile and painted, resulting in an acceptable finished edge for many surfaces. MDF is a popular substrate for painted and veneered doors.

Fire-Rated Composite Core Material

A limited number of manufacturers offer a fire-rated composite core material for use in commercial applications requiring fire-resistant capability. This board is produced under a similar process as the materials with normal cores. The primary difference is that salts are added in the manufacturing process.

This board is more difficult to cut and machine than normal particleboard, is limited in sizes available, and is stocked by only a few distributors. Additionally, the salts in the board make it susceptible to moisture. Storage conditions are therefore a prime consideration, as is a balanced glue system that will be compatible with the board during fabrication.

Plywood

Some designers and consumers consider a solid-wood cabinet to be better than one made from man-made materials. Therefore, plywood often is used as a core material in cabinet construction. It provides good strength and superior screw-holding ability. Fire-rated plywood is also available in limited sizes. Salts are added to this plywood, so the same concerns exist for fire-rated plywood as those listed for fire-rated composite core material. When considering a plywood interior, designers should specify that the face veneers on the plywood do not produce a grain rise, that a high grade of solid core plywood be used to avoid the presence of voids in the built-up layers of veneer, and that the finish surface of the plywood have only a limited number of *plugs*. Plugs are football-shaped plywood sections that are used to replace knots in the veneer.

Engineered Combination Boards

Over the last decade, new alternative core materials have been created. These materials are called engineered boards. They combine the attributes of both plywood and particleboard. For example, engineered boards are available today with an industrial board core—providing stability—and plywood layers on each side completing the overall board thickness. Such engineered board satisfies the client or architect who has specified an *all-wood* case while accommodating the manufacturing requirements of dimensional stability within the board's stock.

Bio-based Architectural Panels

Nonstructural panels are made of recycled wheat stalks. These architectural panels are referred to as *wheatboard* or *agri board*. Such panels are made from recycled wheat stalks that are milled into fine particles, sorted, dried, and then bound together with a formaldehyde-free resin. The particles are then hot-pressed into sheets of the desired thickness. The sheet is sanded and cut to required sizes. It is produced in industrial-grade sizes and strengths, and it can be machined in the same way as wood fiber particleboard.

One of the primary advantages of this product is that the resin which binds the straw fibers together is formaldehyde-free and thus is free of harmful emissions, both in manufacture and in end use. Other benefits include reducing depletion of forestry resources by utilizing an agricultural waste product and the creation of a secondary source of farm income. Manufactured in the United States under the trademark Wheatboard, this industrial-grade particleboard is 5 to 10 percent lighter than its wood-pulp counterpart. The adhesive used to bind the fiber is nontoxic and emission-free once cured. The adhesive is also rated as an exterior-grade binder, making the end product more water-resistant than standard industrial-grade wood-pulp particleboards.

CABINET INTERIOR AND EXTERIOR FINISH MATERIALS/SYSTEMS

The materials used on the exposed parts of the cabinets and the finishing methods are both factors in cabinet quality and price. Cabinet manufacturers use a variety of materials for construction of cabinets. Some fine custom producers have 12 or more steps in the finish process and include hand wiping and sanding between steps. You should learn all the details of the finishing process used by the manufacturers you represent.

Melamine, Foil, Vinyl Surfaces

Thermally Fused Melamine

Melamine is an organic compound that is combined with other products to produce a resin considered a synthetic polymer. The resin is applied to a substrate and is referred to as thermally fused melamine (TFM), or as low-pressure laminate (LPL), low-pressure melamine, melamine component panels (MCP), or just melamine. These are melamine-impregnated papers that can be fused to a substrate by heat and pressure.

- **Advantages.** Cost effective. Good performance for most applications; availability of colors.
- **Disadvantages.** Tendency to chip and crack, which can be mitigated with better substrates and proper cutting tools. Not as impact resistant as high-pressure laminates.

Resin-Impregnated Foil

Resin-impregnated foil is an alpha-cellulose paper impregnated with urea, acrylic, or melamine resins. It is sometimes called paper or melamine paper. In Europe, it is called foil. In North America, this surfacing is often called thermofoil or thermoplastic in the cabinet industry.

Generally, impregnated papers are offered in wood grains and some solid colors. The paper can be used for profiling and can be embossed to simulate real wood veneer graining. Some manufacturers consider their product to be a synthetic veneer.

Impregnated papers have a cost advantage over high-pressure laminate and composite panels. The cost is about equivalent of the cost of vinyl, but resin-impregnated foil has a better look than vinyl.

There is a big difference between the durability of heavier and lighter weights of paper. The paper is measured in weight per square meter. Weights range from 18- to 30-gram papers (most imported from Japan), also known as low-basis-weight-papers, through intermediate weights (40 to 70 grams). Heavyweight paper has an internal impregnation that gives it some surface integrity. The heavier the weight, the more scratch and scuff resistant the paper will be. Lighter-weight papers use waxes or silicon coatings to protect the surface, and these will wear off under use.

A simple test to judge the quality of the paper is to attach a small piece of ordinary Scotch tape for a few hours to an unobtrusive spot. When the tape is removed, the surface of a high-quality, heavyweight paper should be unharmed.

- **Advantages.** Lower cost than LPLs because it is laminated on roll-laminating equipment, which is less expensive than thermo-fusing equipment; it does not chip as easily as LPLs.
- **Disadvantages.** Most paper suppliers are foreign, which means prices fluctuate sharply with the value of the dollar.

Hot-Stamped Transfer Foils

Hot-stamped transfer foils (HSTFs) are laminated by the continuous hot-roll method. They produce good printing quality and fidelity. HSTF is paint or ink reverse printed on a Mylar carrier foil, with an adhesive topcoat. Heat and pressure activate the topcoat and deposit the ink or paint, and the Mylar is peeled away. HSTFs are is offered in wood grains and solid colors and are used most often on edges and profiles.

HSTFs are self-seaming or self-trimming, since they leave only the Mylar backing where heat and pressure is applied. They can be used on medium-density fiberboard or wood but not on particleboard because it is not smooth enough to receive this type of foil surface.

- **Advantages.** Cost savings over most other methods of surfacing. Can be applied to curves and profiles with contour rollers, with virtually no evidence of a seam. Available in a wide range of colors and patterns.
- **Disadvantages.** Very thin material offers little stain, scuff, or wear resistance. Cannot fill gaps or defects, since it is almost without mass. Does not look as good on flat panels as papers or vinyls.

Vinyl Films

Vinyl films of 2 mm to 4 mm thick are used on many inexpensive cabinets and furniture items. Vinyl films are heat-laminated using adhesives. The surface of a panel laminated with vinyl film is not very durable unless it is top-coated.

- **Advantages.** Low cost; material is more impervious to water than melamine or foil surfaces.
- **Disadvantages.** Inferior quality of print and design.

Laminate Surfaces

Although laminate surfaces are used most often for counter surfaces, they also are excellent finish choices for contemporary cabinetry. Textured wood-finished laminate panels are a popular alternative to natural wood veneers. The laminate wood-textured panels are thermal fused to the backerboard material, minimizing the danger of delamination. The textured finish creates a realistic wood impression. Wood-grain laminate surfaces are easier to work with, provide a more consistent finished look, and require less care than naturally finished wood.

High-Pressure Laminates

High-pressure laminates consist of paper saturated with phenolic resin, layered and bonded under high pressure. Therefore, they are referred to high-pressure laminates (HPLs), and are produced in sheets in many decorative colors and in thicknesses typically from 0.030 to 0.050 inch. These products have been around a long time. In fact, for years they were the only laminates available. The most common uses of HPLs are for kitchen countertops, desktops, dining room and dinette tables, and restaurant countertops and workstations.

- **Advantages.** Best performance of any laminate for most purposes; available in a multitude of colors; readily available from several manufacturers in the United States, Canada, and Europe.
- **Disadvantages.** Relatively expensive; performance features may be excessive for most applications.

Continuous High-Performance Laminates

Continuous high-performance laminates are made of the same raw materials as HPLs and have the same basic characteristics as HPLs but are thinner and slightly softer. This means durability and impact resistance are proportionately lower.

- **Advantages.** Lower cost than HPLs but have many of the same performance characteristics; prelaminated panels available. Can be formed and rolled over carved door panels, as well as edging.
- **Disadvantages.** Less durable than high-pressure laminates.

Edge-Banding Choices

When considering laminate cabinetry, the edge-banding material must be evaluated also. Seven major edge-banding choices are available:

1. **Laminated vinyl.** A lamination of two materials, generally vinyl to vinyl, although ABS and paper backers may be used. The carrier is generally a rigid PVC 0.101- to 0.030-inch

thick and may be clear or in color. The surface is a printed or solid color lamination grade vinyl, usually reverse printed, and 0.002- to 0.008-inch thick.

2. **PVC.** A thermoplastic edge banding made of polyvinyl chloride, used to match vinyl, paper, paint, or high-pressure laminates. PVC offers unlimited color and pattern availability, a wide range of widths (to 3.5 inch), thicknesses (0.016–0.187 inch), surface textures, and gloss levels. The printed surfaces, as well as the solid colors, are generally top-coated with a UV-cured resin for protection.
   PVC is used mainly for straight-line and contour automatic edge-banding applications. Thicker versions are available preglued for hot air applications. PVC is not recommended for soft-form applications.
3. **Polyester laminate.** Decorative papers, often matching popular high-pressure laminates, are impregnated with polyester resin and laminated to a variety of backers. Typically produced in light and heavy weight versions, either can be preglued for heat bar or hot air application. The heavy weight version is excellent for straight-line, contour, and soft-form automatic edge-banding applications.
4. **Melamine.** The term "melamine edge banding" covers a broad range of paper edge-banding materials, including single-layer printed products, laminated foils, and continuous melamine laminates. Largely produced in Europe, melamine is an economical, preglued, automatic edge-banding product suitable for straight-line, contour, and soft-form edge-banding applications.
5. **Wood veneers**. Wood veneers that are either rotary cut or sliced from a variety of domestic and imported hardwood species. The veneers are sliced from $\frac{1}{25}$- to $\frac{1}{15}$-inch thick and are available plain or paper or fleece backed in varying degrees of flexibility. The backers provide stability and strength to the veneer and minimize splintering, cracking, and checking. The veneers may be finger- or butt-joined to produce continuous coil edge banding. Veneer edging products are suitable for straight-line, contour, and soft-form applications.
6. **Reconstruction wood strips.** A man-made veneer generally is manufactured in Europe. Light-colored woods are cut, dyed, and re-formed into logs before being sliced into sheets that approximate flat-cut or quartered veneer. This produces a consistent, custom-colored and grained wood veneer. These veneers can be processed into fleece- or paper-backed strips or coils for straight-line, contour, or soft-form automatic edge-banding applications.
7. **Hot-stamped transfer foils.** Laminated by continuous hot-roll method. Produce good printing quality and fidelity. HSTF is self-seaming or self-trimming. Offered in wood grains and solid colors and used most often on edges and profiles. Can be used on medium-density fiberboard or wood but not on particleboard.

Acrylic/Polyester/Lacquer Door Materials

A gloss or matte acrylic, polyester, or lacquer finishing material can be used to create a very consistent colored flat door design.

Manufacturers spray lacquer, polyester, or acrylic on the smooth substrate to create this contemporary finish (see Figure 1.50). The material is then sanded and buffed to create either a flat matte finish or a high-gloss finish. This finish typically is limited to flat doors. The finish wraps around the edge of the door so there is no edge tape requirement. The back of the door may remain matte, regardless of the exposed front sheet level.

Natural Wood

Woods are universally popular and generally available to the cabinet industry in the United States and Canada (see Figure 1.51). They are used in both local custom cabinet fabrication and in large national and international cabinet manufacturing facilities

Hardwood lumber is produced from deciduous trees that drop their broad leaves each year. *Softwood* lumber is produced from coniferous or evergreen species that have needles or scale-like leaves and remain green throughout the year.

FIGURE 1.50 A kitchen featuring acrylic doors
Courtesy of Jenn-Air

FIGURE 1.51 A kitchen featuring natural wood doors
Courtesy of Wellborn Cabinet, Inc.

Because of the differing inherent qualities and growth characteristics, the end uses of hardwoods are considerably different from those of softwoods. Softwoods normally are used in construction while hardwoods are reserved for flooring, furniture, and cabinets.

Hardwood versus Softwood

Door styles are designed two ways, using either solid wood or veneer:

1. Strips of solid wood are laid up to create a solid wood center panel and then are framed with stiles (vertical members) and rails (horizontal members), creating what is often called 5-piece solid wood doors because they have two stiles, two rails, and one center panel.
2. Veneers are constructed by adhering real wood, reconstituted wood, or wood-resembling/color laminates to engineered board substrate doors (often called slab doors).

Wood Warpage

Warping is a common worry in the kitchen and bathroom industry. The relationship between the relative humidity of the atmosphere at the place of installation and the moisture content of the wood causes changes in wood structure. If the moisture content of the wood is higher than the relative humidity, the wood will give off moisture and shrink in volume. If the wood is dryer than the relative humidity, it will take on moisture and swell.

The shrinking and swelling tendency of wood varies with the species and the direction of the grain. For minimal problems, the moisture content of the wood at the time of manufacture and finishing should be approximately the average moisture content that it eventually will attain in use, or slightly less. The possibility of warpage is considerably reduced when the cabinet is finished at a manufacturing facility. A cabinet that must be shipped to an area of different relative humidity should be finished, with all exposed surfaces covered, before it begins the journey. Unfinished casework installed in a new home without climate controls in place and then left unfinished for some time is a recipe for disaster.

In conjunction with the inherent warpage problem in woods, the door style construction will affect its stability. A stile-and-rail door with a fixed-in-place flat panel will not be stable. A similar door with a floating center panel will withstand humidity changes much better. A solid lumber door is susceptible to a great deal of movement while veneered plywood will overcome the wood's natural shrinkage and swelling tendencies. Alternative products also solve the warpage problems; steel, particleboards, hardboards, and laminates all relieve the cabinet of movement problems.

Popular Species

This discussion details popular solid woods used in cabinetry with a special note for woods selected as furniture-grade veneer for cabinetry. A full discussion about planning with veneers follows this review of wood concerns and dictionary of popular species.

General color—that is, categorizing wood by its color tones—is a good way to sort through the most popular species. Some hardwoods are used in the cabinet industry for both solid wood stock and veneer parts: cherry is a good example. Other woods are very rare and typically are selected only for use as a veneer: Bird's-eye maple is an example.

To begin the discussion about wood species, we have listed them in six possible color tones:

1. **Wood that is whitish:** Ash, maple, and sycamore
2. **Wood that is yellowish:** Birch, lacewood, Ponderosa pine, primavera, satinwood, and zebrawood
3. **Wood that is purple or crimson:** Bubinga and purple heart
4. **Wood that is reddish or pinkish:** Mahogany, lupus, beech, cherry, Douglas fir, pearwood, sapele, and western red cedar
5. **Wood that is brownish:** Alder, Brazilian rosewood, elm, oak, walnut, and teak
6. **Wood that is blackish or has gray tones:** Ebony

A more detailed description the most popular woods used in cabinetry is presented next. For more specific information about certain wood species, visit the Hardwood Information Center at the Hardwood Manufacturers Association's website (http://hardwood.org) or other similar information/ educational websites. However, never specify a wood you have not worked with for cabinetry without first consulting your supplier about the availability of the species in your area, the appropriateness of the wood for cabinetry, and special handling and costs associated with unusual woods. This discussion should be part of your estimating process—before the project is presented to the client—not part of the ordering process afterward.

Alder

Principally grown in the Pacific Northwest, where it is the most abundant commercial hardwood, alder is often used in place of cherry because the coloration is somewhat similar (see Figure 1.52). Red alder is a relative of birch—almost white when freshly cut, then quickly changing on exposure to air, becoming light brown with yellow or reddish tinges. Heartwood

FIGURE 1.52 Kitchen that combines alder wood and painted white finishes

Design by Richard Ourso, CKD, CAPS, codesigners Vickie Mire, CKD, CAPS, Michelle Livings, AKBD, CAPS, LEED. Photo by Chipper Hatter

is formed only in trees of advanced age, and there is no visible boundary between sap and hardwood. The wood is straight grained as well (see Figure 1.53).

Designers should be aware that alder is considered a relatively soft wood of medium density that has low bending strength, shock resistance, and stiffness.

Ash

Of the 65 species of trees and shrubs called ash, six—white, pumpkin, blue, black, green, and Oregon ash—are commercially important for lumber and other wood products. White ash grows throughout almost the entire wooded area of the United States east of the Great Plains, except the Gulf and South Atlantic coasts. It also grows in southern Ontario and Quebec. Green ash has practically the same geographic distribution, except it also grows along the coast, follows the tributaries of the Mississippi River westward across the prairies, and extends farther northward in Canada. Black ash grows along the Great Lakes and St. Lawrence River from New England westward to Minnesota and northeastern Iowa.

White ash shrinks moderately but can be kiln-dried rapidly and satisfactorily. Ash commonly is dried from the green condition in the kiln and requires 10 to 15 days for 1-inch lumber. It machines well, is better than average in nail- and screw-holding strength, and is intermediate for gluing. Other ash species have lower strength properties than white ash but still compare favorably with other native hardwoods. These species also split easier, shrink more, are average in workability, and perform somewhat less favorably than white ash when exposed to extreme cycles of moisture content.

The principal use of ash is in furniture, interior parts of upholstered furniture, kitchen cabinets, and architectural trim and cabinetry. Ash is straight-grained, still, strong and hard. White ash is superior to other ash species in these qualities. Ash also has good bending properties and high shock resistance, and it wears smooth in use.

FIGURE 1.53 Kitchen with alder wood doors
Design by Therese DuBravac

Birch

Yellow birch grows in the Great Lake states, New England, New York, New Jersey, Pennsylvania, and along the Appalachian Mountains into southern Georgia. It reaches its best development near the Canadian border. Sweet birch grows in New England, New York, New Jersey, and Pennsylvania and extends southward along the Appalachian Mountains to northern Georgia and Alabama. Paper birch has a transcontinental range extending throughout Canada to Alaska. In the United States, it occurs eastward from the Great Lake states to New York and New England.

The wood of yellow and sweet birch is relatively heavy, hard, and strong and has high shock resistance. Although the wood is difficult to work with hand tools, it can be shaped readily by machine and ranks high in nail-withdrawal resistance. Sweet birch ranks slightly above yellow birch in most strength properties. The wood of paper birch is considerably lighter than the other two birches and ranks below them in hardness, strength, and stiffness.

All birches shrink considerably during drying. Yellow birch must be seasoned carefully to prevent checking and warping. Eleven to 15 days are required to dry 1-inch lumber from the green condition to 6 percent moisture content. Because yellow and sweet birch are difficult to glue, special veneer and adhesive treatments usually are required to obtain the best results. They are glued more easily with synthetic-resin glues than with natural glues.

Yellow birch is one of the principal furniture woods in the United States because of its good machining and finishing properties, as well as its hardness, pleasing figure and attractive color. Sweet birch lumber and veneer also are used in furniture. Both species also are used in kitchen cabinets and architectural trim, paneling, and cabinetry. Much paper birch is used for specialty veneer products, such as toothpicks and tongue depressors.

Cherry

Black cherry is found principally throughout the eastern half of the United States but grows in significant commercial quantities only in the northern Allegheny Mountains.

Cherry wood is reddish and takes a lustrous finish. It is prized furniture wood and brings high prices in veneer log form. It is increasingly popular in kitchen cabinets (see Figure 1.54) and is often used in architectural trim, paneling, and cabinetry.

FIGURE 1.54 A kitchen with cherry wood doors

Design by Tracey Scalzo, CMKBD. Photo by Tom Harper Photography

Black cherry is relatively easy to dry, requiring 10 to 14 days to kiln-dry 1-inch lumber from green to 6 percent moisture content. It stays in place well after seasoning and is comparatively free from checking and warping. It is machined easily, can be sawn cleanly, turns well, and planes excellently with standard cutting angles. Screw-holding ability is good. Gluing also is good except when gum streaks are present. The wood has sufficient hardness to allow it to take hard use and withstand knocks without marring.

Cherry is a popular veneer because of the repetitive cathedrals seen throughout an elevation of plain sliced cherry veneer. Special quarter-sawn cherry can be specified to create a more ribbonlike grain pattern. Typical cherry wood characteristics, such as worm tracking, will be seen repetitively throughout an elevation of cherry veneers once laid up and sequence matched for a kitchen or bath project.

Hickory and Pecan

Typically, hickory and pecan are grouped together. However, botanically, they are slightly different: The true hickory has no fruit, and the pecan hickories are fruit bearing. These two species grow principally in the eastern United States in central and southern states.

Hickory and pecan color tones can vary widely: The sapwood of hickory is white, tinged with inconspicuous, fine brown lines, while the heartwood is pale to reddish brown. Both are coarse textured, with grain anywhere from straight to very wavy or irregular.

Mahogany

In some parts of the world, mahogany is considered an endangered species. The most notable area of concern is uncertified mahogany harvested from South American rain forests. African mahogany is more readily available and is not considered an endangered species.

The wood is medium hard, pink when freshly cut, darkening to copper-red-brown with pale golden brown tones (see Figure 1.55). The grain can be straight or wavy in solid woods. The texture is medium to coarse, with growth rings distinct. Therefore, noticeable color variations are present in laid-up solid panels.

Ribbon mahogany is a popular veneer often requested by designers or clients. Sapele veneer comes from the same wood specie family as mahogany, and is often substituted for mahogany veneer because it has a more consistent striped figure with broad alternating pink and red-brown bands of wood color. This repetitive grain appearance is the result of clearer rings and the greater hardness of this specie. Sapele and mahogany both have a coppery-red color.

FIGURE 1.55 A kitchen with mahogany wood

Design by Terri Schmidt, codesigners Linda Eberle, CKD, CBD, Keven Schmidt. Photo by Edmunds Studios

Lyptus wood, a plantation-grown hardwood from Brazil, is an environmental alternative to mahogany. Details of this eco-friendly wood are presented at the end of this section.

Maple

Commercial maples grow throughout the eastern and southeastern United States, with the exception of big leaf maple, which grows on the West Coast. Maple often is divided into two classes—hard maple and soft maple. Hard maple includes sugar maple and black maple. Soft maple is made up largely of silver maple and red maple with a very small proportion of box elder.

Maple is heavy, strong, stiff, and hard; has a high resistance to shock; and ranks high in nail-holding ability. The wood turns well on a lathe and is markedly resistant to abrasive wear. It takes stain satisfactorily and is capable of a high polish. The wood of soft maples is not as heavy, as hard, or as strong as that of the hard maples.

Maple is a consistently popular wood for furniture and cabinetry (see Figure 1.56). As much as 90 percent of the maple lumber produced is further manufactured into a variety of products, such as furniture, kitchen cabinets, architectural woodwork, and flooring.

Plain sliced maple, quartered maple, and bird's-eye maple often are used as veneer surfacing. Plain sliced maple features typical cathedral patterns. Quartered maple has a much more striped look because of the smaller size of the trees. Bird's-eye maple is a specialty product appreciated because of the figure created when clusters of cells within the maple explode after being frozen and then thawed in cold-climate maple forests. In natural products, the bird's-eye pattern is irregular, tending to cluster as opposed to being spread throughout the log.

For all maple veneers, the natural wood characteristics (e.g., mineral streaks) will be seen repetitively when maple veneer "leaves" are laid up together in an overall cabinet elevation.

Oak

Oak species are found throughout the United States. Commercial stands generally grow east of the Great Plains. Oaks are classified as white oaks or red oaks. Both red and white oaks are used extensively for furniture and flooring. White oak typically has a straighter grain and longer rays than red oak; therefore, it has more figures. Oak is the most popular wood for kitchen cabinets (see Figure 1.57) and is widely used in architectural trim, paneling, and cabinetry.

Oak is hard, stiff, strong, and shock resistant. It is above average in all machining properties except shaping. The wood undergoes large shrinkage while drying; seasoning must be done carefully to avoid checking and warping.

Oak veneers are popular with straight grain cuts, typically called *quartered oak* or *rift-cut oak*.

FIGURE 1.56 A kitchen with glazed maple wood doors

Design by Ellen Cheever, CMKBD, ASID, CAPS and Pietro A. Giorgi, Sr., CMKBD. Photo by Peter Leach

FIGURE 1.57 A kitchen with rift-cut oak doors

Design by Bridgitte C. Fabi, CMKBD. Photo by Eric Hausman

Pine—Ponderosa

Ponderosa pine is the most widely distributed pine in North America, extending from British Columbia into Mexico and from the Pacific Coast to Nebraska. The wood is comparatively light in weight, soft, moderately weak in bending, and moderately low in shock resistance. The grain is generally straight but frequently shows dimpling on the tangential surface. It resists splitting when nailed but is only average in nail-holding ability. Ponderosa pine dries easily, either in dry kilns or by air seasoning, and is moderately low in shrinkage.

Ponderosa pine is the principal millwork species and is used for window framing, sashes, doors, molding, shelving, and paneling. It is well suited for furniture, kitchen cabinets, and architectural woodwork if hardness or high strength is not required.

Pine—White

Western white pine (*Pinus monticola*) grows on western mountain ranges from southern British Columbia and southwestern Alberta to northern Idaho, northwestern Montana, and eastern Oregon to the southern end of the Sierra Nevadas in California. Eastern white pine (*Pinus strobus*) grows from Newfoundland to Lake Winnipeg in Canada and southward through the Great Lake states and New England and in the Appalachians as far south as northern Georgia.

The wood of eastern and western white pine has similar characteristics. Both are moderately soft, straight-grained, light woods that are moderately low in shock resistance. They work easily with tools, are easy to glue, and hold paint very well. They do not split readily when nailed but have only medium nail-holding ability. They are easy to dry, shrink moderately, and stay in place well when properly dried. The occurrence of *wet pockets* or *wetwood* in some lumber may require special attention during drying.

Eastern white pine is more commonly used for furniture, although some western white pine is used. Western white pine often is used for colonial-period furniture reproductions.

Walnut

From ancient Greece through modern European history, walnut has been a wood favored by cabinetmakers. Walnut is a tough hardwood of medium density.

The sapwood of walnut is creamy white while the heartwood is brown to a dark chocolate brown, occasionally with purple, darker streaks. The wood develops a rich patina that grows more lustrous with age (see Figure 1.58). The wood usually is supplied steamed to darken the sapwood. It is generally straight grained but has wavy or curly grain and burled figure patterns.

FIGURE 1.58 Kitchen with walnut wood doors
Courtesy of Plain & Fancy Custom Cabinetry

Walnut is one of the few American wood species planted on tree farms as well as naturally regenerated. American walnuts are darker in color than are those from other parts of the world. All walnuts have lively color variations due to dark brown, dark gray, and black streaks following the ring pattern in the wood. Tones can be pinkish brown with blackish-brown streaks as well.

Specialty Veneers

Designers may be asked to specify exotic veneers (see Figures 1.59 and 1.60). Working with unique veneers is a specialty. Designers should collaborate with experienced experts before specifying unusual woods. Popular veneers are discussed next.

Special cuts of American popular wood species:

- **Anigre.** Anigre has a beautiful repetitive figured pattern that makes it a popular natural material to use. Laminates with the appearance of anigre woods are also very popular.
- **Bubinga.** Bubinga is an unusual wood with a distinctive figure.
- **Lacewood.** Lacewood is a highly figured decorative veneer.
- **Pearwood.** International manufacturers use natural pearwood. Simulated laminate pearwood is also used.
- **Wenge.** Wenge, a very dark, distinctly textured wood, is used by international manufacturers.

Planning Tips When Working with Veneers

Current design trends have led to a renewed interest in both real and man-made reproductions of natural woods veneered for cabinet decorative exteriors. This interest brings new design layout and product specification responsibilities to the kitchen and bath designer. Such an extension of your skill set will help you keep your clients happy, projects on schedule, and project profits safely guarded.

Veneers allow designers to work with a product that produces unlimited visual effects. Each species offers its own interplay of color, grain, figure, and texture. Each log within a species possesses an unrepeatable character produced by the individual circumstances of its growth. Figure adds yet another variable. Curly, fiddleback, mottle, pommelé, bird's-eye, burl, and crotch figures add unique texture and may be evident in varying emphasis in a given log. Definitions of these veneer figure names are included for your review later in the chapter. See "Common Veneer Terms.)

FIGURE 1.59 Bathroom with veneer wood doors

Design by Leslie Lamarre, CKD, CID, codesigners Erika Shjeflo, Casey Darcy. Photo by Bernard Andre Photography

FIGURE 1.60 Kitchen with veneer wood doors

Design by Brian M. Johnson. Photo by Phil Bell

Veneer experts recommend that designers:

- Appreciate that veneer work is very complex because layout options are species-specific and may be limited by product (the log or flitch) availability. It is important to present conceptual ideas to consumers cautiously after confirming with your supplier so that you do not *overpromise* and *underdeliver*.
- Realize the variability of pattern and color in wood veneers. This wood appearance uniqueness should be presented to consumers with as much caution as the specialist is accustomed to doing when discussing natural stone. If a client wants a perfectly matched series of wood panels, specify a reconstituted or laminate look-alike.
- Work with the natural colors of the wood. Veneers provide an impressive palette of colors: tans, browns, reds, violets, blonds, and pinks. This natural color should dictate the finish specified. If you choose to color or stain a veneer, you may lose the chatoyance of the grain pattern.
- Learn how the cutting method impacts the grain pattern. Grain patterns are naturally distinct from species to species and from log to log. The log's basic grain structure, created by the annual growth rings, produces different grain patterns depending on the direction the veneer is sliced in relationship to the log's growth rings. For example, veneers cut at a tangent to the ring (flat cut) produce narrow heart and cathedral grain patterns. Veneers cut through the radius (quarter cut) produce straight comb and ribbon-striped grain patterns.
- Understand that there are no solid wood options for imported exotic veneers such as bubinga or anigre. While it is easy to source domestic walnut solid stock to blend with domestic walnut veneers, exotic woods are not available in solid stock—it simply is not milled.
- Be prepared to overcome the consumer's misconception that veneer cabinets are less expensive than solid wood units. Unfortunately, cheap veneer wood furniture has led to a widespread misconception about the cost of veneers compared to solid wood products. Veneer work, when done right, using the most coveted logs, is more expensive than solid wood alternatives.

Veneer Cutting Methods

The way veneer is cut is an important factor in producing a variety of visual effects (see Figure 1.61). A mill conceivably could take a single panel, cut it in four/five different ways, and end up with four/five distinct-looking pieces of veneer.

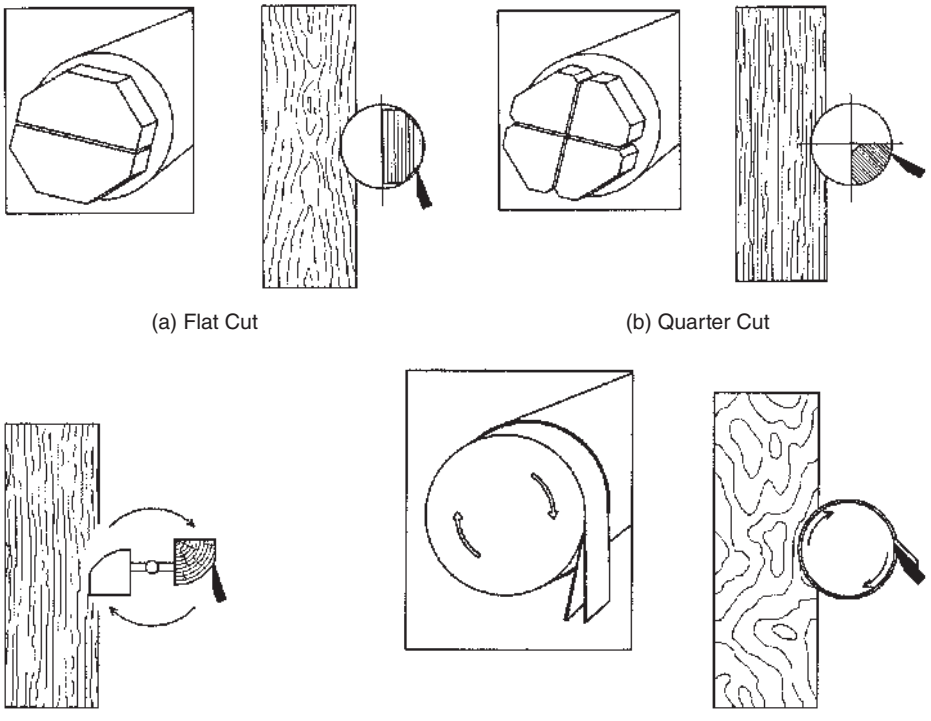


FIGURE 1.61 Veneer cutting methods
Courtesy of Dooge Veneers Inc.

Flat cut (plain slicing). A log is cut in half, lengthwise, and then placed on the slicer, where the knife cuts individual leaves of veneer parallel to the original cut. Flat cutting produces a cathedral or loop grain effect in the center of the leaf and straighter grain along the edges.

Quarter cut. A quartered section of log is placed on the slicer, and the knife cuts individual leaves of veneer at a 90-degree angle to the growth rings. Quarter cutting produces a striped effect—straight in some species and varied in others.

Rift cut. Typically, oak is rift cut. Oak produces cells that form a pattern of medullary rays that radiate from the center of the log. To avoid the bold flake effect of cutting oak on the true quarter, a quartered section of log is placed on a rotary slicer and veneer is cut at an angle, about 15 percent off the quartered position. Rift cutting produces a rift or comb grain effect.

Rotary cut. A full log is placed in the lathe and turned against a razor-sharp blade, which peels a continuous sheet of veneer along the annular growth rings. Rotary-cut veneer is exceptionally wide and produces bold, variegated grain markings.

Design Considerations

Grain matching varies with the investment made in the wood and the extent of the grain matching specified throughout the room. Following is a series of categories defining the different levels of grain matching possible for a kitchen, bathroom, or other room project.

1. In Level 1 projects (entry-level stock products), the drawer head and doors are cut en masse. Therefore, there is no grain matching on the veneer doors installed on the case. The fact that the grain pattern on the drawer of inexpensive veneer cabinets runs horizontally while the grain runs vertically for the door may not be considered a detriment by the client.
2. In Level 2 projects, the designer specifies grain matching within each unit: This means the door and drawer grain runs in the same direction and is cut from the same panel. Such a specification is more costly because it does not allow for *yield maximization* (getting the most number of doors and drawers out of each laid-up veneer sheet) when the veneer panels are cut from large 4- × 8-foot sheets of panel stock.
3. In Level 3 projects, grain is matched throughout each elevation: Each entire run of cabinets is cut from sequential panels or leaves from the same log. This type of project requires close collaboration; the designer must present a full set of finished plans to the wood supplier for sourcing and estimating before the final contract is signed.
4. In Level 4 projects, each door has balanced (centered and matched in width) veneer leaves on the surface. This effort is called *blueprint matching*. It is the customized manufacture of panels and doors of various sizes in which the entire room (not each individual elevation) is sequenced with door and cabinet component parts using continuously matched panels.

When specifying Levels 2, 3, and 4 grain matching, four special planning requirements exist:

1. The consumer must understand and accept that any damage to the veneer on the job site must be repaired by a finishing expert because the sequence-matched veneer pattern cannot be interrupted by a replacement piece. When specifying a veneer job, you already should have a working relationship with a local furniture refinisher or antique specialist because very sophisticated touch-up work in the field is required for sequence-matched veneer panels. You also can *never* order late veneer pieces for repair, replacement, or add-ons and expect them to match because they will be cut from a different flitch.
2. All appliance panels, accent pieces, and custom end panels must be cut from the same stock as the door panels. Typically, door stock is different from cabinet component parts; the mill source may even be different. Therefore, door-grade end panels and door-grade appliance panels must be ordered to maintain the grain appearance consistency. If open cabinets are mixed with enclosed units, you must contrast the materials or make sure you and the cabinet manufacturer have clearly agreed on the veneer specification and resulting procurement and assembly costing.

3. Understand that veneers never match solid woods. Therefore, it is wise to avoid using solid wood accents from the same wood species (if available) because the grain pattern, figure, and color will not match the veneers used.
4. Appreciate that when you curve veneer doors, you stretch the wood's molecular structure; therefore, the grain may take stain very differently.

Approve the veneer sample regardless of the level of complexity. For Level 3 and 4 projects, the actual flitch(es) that will best fit the specifications must be identified. This is done by inspecting veneer samples.

Normally, three leaves (sheets) are drawn from evenly spaced positions within a flitch to give a broad picture of how the grain pattern progresses through the flitch and what character marks develop. The sample is identified with the sheet and flitch number, along with a note identifying the total square footage of the flitch available. Placed side by side, these samples show the designer and client what is happening to the grain and character of the wood throughout the flitch from outside of the tree to the center.

Typically, younger wood on the outside will be narrower and will show fewer defects than wood found in the center. For upscale custom work, the client must approve the flitch sample and the log must be reserved for the project.

Only after the extensive selection process has been completed will manufacturing begin.

Special planning requirements exist when specifying Levels 2, 3, and 4 grain matching. Veneer is bundled and stored in the exact sequence in which it was sliced from the log. Before it is laid up for practical use, the designer or mill worker must select one of many methods of matching the individual leaves. Each method produces a unique visual effect and should be selected based on the type of veneer used, the visual effect desired, and the intended application.

Veneer grains are matched (laid-up) in several different ways, including slip match and book match.

Typically seen in the cabinet industry, a *slip match* is created when the pieces are joined together in the order they come from the flitch and have the same face kept up. A *book match* is created when the veneers are opened from the flitch, much like the pages of a book.

Special matches used in accent wood areas are reverse match, diamond match, and book and butt match (see Figure 1.62). These matches create a pattern by joining small veneer sections into a shaped pattern.

Alternatives to Natural Veneers: "Super-Natural" Man-Made Products

Anyone who has worked with veneers knows how temperamental they can be. Color variations, grain irregularities, and imperfections can result in low yield and much dissimilarity in the final product that will not satisfy the client.

Still, demand for veneers is growing. Sourcing raw natural veneers for projects that require minimum levels of surface structure inconsistency presents a continuing challenge. Therefore, designers are forced either to reconsider the species they want to work with or to dramatically increase budgets to accommodate the cost of super-quality raw veneers (think five-star luxury hotel prices).

One option is to consider engineered or reconstituted veneers. Another is to substitute with wood-inspired laminate products.

Reconstituted Woods

Reconstituted woods are real woods that have been reglued, resliced, and dyed to mimic woods that are more valuable. Reconstituted woods take consistency to a higher level. They are created by gluing together natural veneers in special presses and reslicing to get certain predetermined effects: faithful reproductions of either natural veneers or off-the-wall

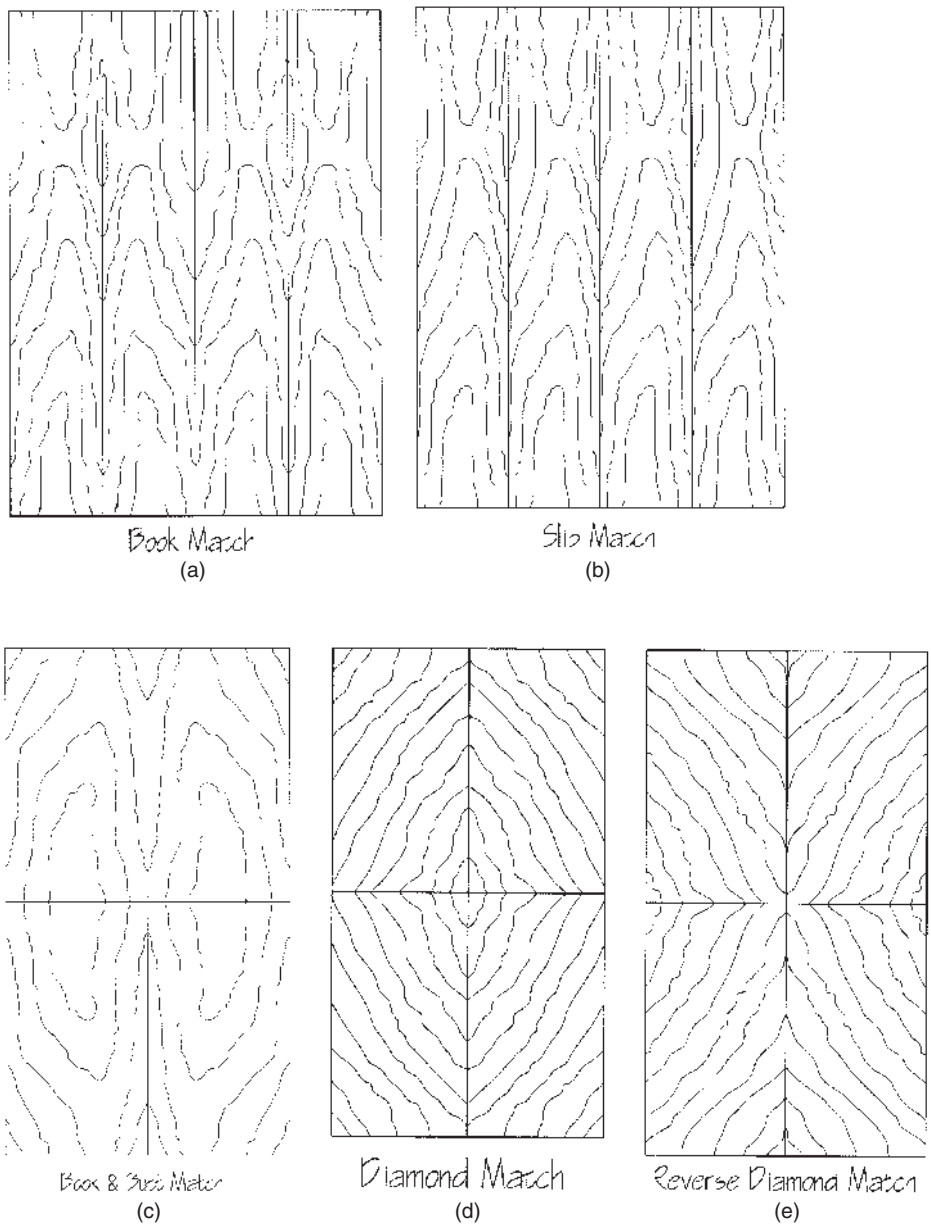


FIGURE 1.62 Veneer matching techniques
Courtesy of Dooge Veneers Inc.

geometric effects. These reconstituted and recut veneers demonstrate a responsible use of limited natural resources, and are becoming more available in the kitchen cabinetry industry.

Engineered veneers have greater grain consistency, color evenness, and a minimal amount of natural wood characteristics (which many feel are defects) because the wood is forested from fast-growing nondescript wood species, then rotary cut, laid up, pressed, and resliced, providing extreme consistency.

Laminate Alternatives

An alternative to natural or reconstituted veneer products is a decorative high-pressure laminate substitute.

Excellent products are available today from both international and domestic suppliers. Woodgrained laminates are far more interesting today than they were years ago because of manufacturers' ability to add texture to the surface and a natural randomness to the pattern, giving it a more lifelike, natural wood sensibility.

When considering a laminate substitute for a wood veneer, securing samples is the first step. Most laminate manufacturers make samples available to order via their Web site palette collections.

In addition to flat one-dimensional wood grain, there are textured finish alternatives, ranging from abstract form/line compositions, finely embossed wood graining, and wide grain ridges replicating the sophistication of natural wood grain.

In addition to the face specification opportunities, a wide variety of core materials are available. Considerations are the weight factor of the material, the performance characteristics required (fire rating, moisture resistant?), and its GREENGUARD classification (minimal emissions or urea-formaldehyde free).

When selecting a laminate material for cabinet door and drawer surfaces, the type of edge tape or door profile is as important as the face finish. Finishing the edges with a thicker PVC tape to blend, match, or contrast with the face is one option. An attractive international solution is a finely detailed aluminum frame on doors and drawers.

For all types of natural veneers, as well as for man-made materials inspired by natural veneers, specific terms describe the appearance of the veneer (see "Common Veneer Terms"). These terms are always used when referring to natural wood and those specifically dealing with the appearance of the veneer used in man-made products.

Common Veneer Terms

Utilizes top-quality veneer and generally has special requirements for balancing, sequencing, component width, etc.

Bird's-eye. The term given to the small to large eye-shape marking of figures found through select sheets of maple. This figure is random throughout the leaves.

Burl. Swirling grain around clusters of dormant buds, rings, or eyes. Available in white ash, olive ash, Carpathian elm, maple, mappa, myrtle, and walnut.

Chatoyance. Describes the iridescence of some veneer finishes. Created by the finishing process, which enhances the shimmer resulting when light reflects off the wood fibers at different angles. Also called moire or vibrance.

Crotch. Cut from the juncture of a tree's main branches and trunk where the tree has forked in two directions. Crotch figures often are subcategorized as flame, plume, rooster tail, feather, or burning bush. Available in mahogany.

Curly. A grade of maple veneer with a distinctive wide band or curl figure throughout. Also known as flame veneer. Curly maple veneer with a tight figure sometimes is referred to as a fiddleback.

Face. Leaves of veneer that has been spliced together but has not yet been applied to a panel or backer sheet. In addition, the better side of any plywood panel in which the outer piles are of different veneer grades.

Fiddleback. Narrow bands of figure that run uninterrupted from edge to edge across the width of the veneer leaf. When book matched, a chevron pattern is formed. Most commonly available in anigre, maple, makore, and English sycamore.

(*continued*)

Figure. The pattern produced in a wood surface by annual growth rings, rays, knots, deviations from natural grain, such as interlocked, and wavy grain and irregular coloration.

Flares. Markings across the grain of the face. In book-matched material, the markings seem to extend across the width of the face.

Flake. Varies in size from dash marks to stretch marks. Created when the pith rays are cut across at an angle when slicing. Very common in quartered red and white oak.

Flitch. The complete bundle of thin sheets of veneer after cutting, laid together in sequence, as they were sliced or sawn.

Grain. The direction, size, arrangement, and appearance of the fibers in wood or veneer. The 8-foot grain direction in 4 × 8-foot veneer and plywood.

Hardwood. General term used to designate lumber or veneer produced from broad-leafed or deciduous trees. This is in contrast to softwood, which is produced from evergreen or coniferous trees.

Heartwood. The nonactive center of a tree generally distinguishable from the outer portion (sapwood) by its darker color.

Joint. The line between the edges of two adjacent leaves of veneer.

Joint, Open. Joint in which two adjacent pieces of veneer do not fit tightly together.

Knot. Cross section of a tree branch or limb with the grain usually running at right angles to that of the piece of wood in which it occurs.

Knot, Open. Opening produced when a portion of the wood substance of a knot has dropped out.

Knots, Sound, Tight. Knots that are solid across their faces and fixed by growth to retain their place.

Leaf (Leaves). Sliced sheet of a veneer flitch.

Log. The section of a tree that can be sawn or used for veneer.

Mottle. Describes a variegated or block pattern figure. The grain lines are broken and irregular, which differentiates the figure from curly.

Pommelé (pom-el-ay). A dense pattern of small rings enveloping one another. Resembles raindrops cascading down a window. Often described as looking like suede or fur. Most commonly available as sapele.

Softwood. Wood from trees classified as gymnosperm, primarily coniferous trees, such as pine, fir or cedar.

Adapted from Form Wood Industries, www.formwood.com/veneer-glossary.html

Finishing Systems

Although most cabinet manufacturers supply prefinished casework, designers should have a working knowledge of wood coloring and wood finishing.

Most cabinet companies finish cabinetry in the manufacturing facility. The prefinished cabinetry will then be protected from humidity changes during transport or installation at the job site. Unfinished wood can expand or shrink, which can compromise the case's stability. Damage to the wood door assembly can occur if extreme climate changes occur between cabinet assembly and cabinet finish.

A wide variety of finishing techniques is used within the cabinetry industry. Designers should review manufacturers' published information about finishing processes as well as their compliance with environmental protection guidelines or requirements.

The environmental concern regarding the cabinet finishing process focuses on limiting or eliminating hazardous substances called volatile organic compounds (VOCs). Some water-based stain systems eliminate VOCs; however, the durability of such systems may not be suitable for the planned usage of the cabinetry. Other finishing systems have been formulated to have very low VOC emission levels while providing an extremely durable finish. Regulations surrounding VOC emissions are continually changing within the cabinetry industry. Therefore, designers should work closely with manufacturers to understand chemical emission control or elimination efforts under way within the specific manufacturer's finishing department or as regulated by state environmental codes.

Variations in Color

The designer must understand why wood parts finish differently and why various wood species require special finishing considerations. For example, there can be different absorption rates present within one piece of wood. This defect is associated with random variation in porosity, such as the tissue around knots in pine.

The variation can be caused by how the tree grows or by a bundle of fibers growing in a wavy fashion within the tree and at angles to the vertical access. When the log is cut, some bundles of fiber are cut parallel to the main direction of growth and some are cut at an angle, exposing the fiber end with its open water-conducting channels or pores. Such open surface inevitably will assume darker hues than surfaces composed of near-parallel bundles of fiber, producing a "blotchy" effect when stain is applied. A similar variation in color caused by differing wood fibers occurs when veneer panels are rounded or solid wood moldings are curved.

Additionally, some natural wood colors will change to darker finishes in the presence of oxygen and light. For example, cherry will become much redder during the life of the furniture piece. When this darkening occurs in lacquered veneers, it is often viewed—erroneously—as the fault of the finish.

Successful designers carefully and completely review the types of color variation the client should expect and be willing to accept before the cabinet order is placed.

Enhancing Natural Wood Tones

The natural color of the wood can be enhanced simply by adding a coat of oil. The approximate color resulting from a transparent finish can be determined with a *wet test*. Simply moisten an area of the unfinished wood with clean water. The more porous woods will show a greater change in color than woods with closed grains.

Staining Woods

Stains are employed to bring out the full beauty of the grain or to emphasize the color of the woods. Woods with no color that must be stained are basswood, poplar, gumwood, and white pine. Light-colored woods that may be finished in their natural color or stained include ash, beech, birch, cherry, elm, oak, maple, chestnut, and mahogany.

Stain usually is not used on veneers or wood with natural beauty and rich color, such as butternut, mahogany, rosewood, teak, and walnut. These woods, which have a natural beauty of pattern and color, should receive a clear finish, which will magnify their beauty.

It must be remembered that a stain is not a finish and that a finishing coat must be applied over it, except in the case of varnish stains, penetrating wood-sealer finishes, and lacquer-containing stain.

Types of stain:

- **Water stain.** Powder, best applied with spray equipment. Will raise grain of wood. No preliminary sealer coat required.
- **NGR stain (non-grain-raising).** Stain in which powders are dissolved in a solvent other than water to minimize the problem of grain raising. Best applied with spray equipment, which carries mixture into the pores of the wood and later evaporates.
- **Spirit stain.** Powders soluble in alcohol, which are very quick drying. Best applied with spray equipment. Can result in a slight muddiness in the finish.
- **Pigmented wiping stain.** Effective in staining a cabinet made from different woods. Pigments are suspended in a penetrating resin vehicle to allow for more color coverage to conceal the differences in the various woods being used. This type of stain requires a wiping step in the finishing process.
- **Varnish stain.** Not often used for fine wood finishes, these stains fill, color, and add a gloss to the surface, all in one coat. When a product is made from less expensive grades of lumber, varnish stains may be successful because they give a uniform coloring to woods streaked with very soft and porous parts.

Coloring Woods

Paint, colored lacquer, and tinted varnish all provide a painted appearance on cabinetry. Painting will conceal the wood grain on tightly grained wood species. During painting, an undercoat primer with no gloss is applied, followed by a finish coat of high gloss, semigloss, or satin.

A colored lacquer or a tinted varnish provide a painted appearance as well; however, the grain is still seen through the finish. Pickled finishes (white pigment rubbed into woods to enhance the grain) give wood cabinets the look of an antique scrubbed surface. Pickling is most dramatic on woods with large pores, such as oak and ash, although it works well on others too.

Additionally, paint dragging—white or off-white paint left in cabinet joints and within distressed sections—heightens this old-world antique look. This appealing vintage effect works beautifully in many kitchens and bathrooms.

Sealing Woods

A sealer coat should be applied to a wood surface after a stain has been used, unless otherwise directed. The sealer coat is normally a thin coat of the material used for the coloring. The purpose of the sealer is to keep the stain from bleeding into succeeding coats, by sealing the pores and to smooth the wood for the final finish.

Top Coating (Finishing) Wood

The finish coat will give a high-gloss, stain-rubbed, or polish-rubbed finish. The most common clear finishes are lacquer, oil, penetrating wood sealer, polyurethane, varnish, and wax.

- **Lacquer finish.** A finish that generally has replaced varnish and shellac. Spray equipment is required for proper application. Lacquer offers a hard, durable, water-resistant surface. It is mirror smooth and transparent, enhances the colors over which it is laid, and brings out the beauty of the wood grain.
- **Oil finish.** A most satisfactory finish on hard or close-grained woods. When an oil finish is applied properly, the wood is impervious to water, heat, scratches and most stains.
- **Penetrating wood sealer finish and penetrating resin-oil Finish**. These finishes withstand stains, watermarks, minor burns, and scratches. These sealer finishes are of two general types: one contains wax and one contains varnish. The finish coating wax gives a soft sheen rather than a high gloss. Thin, medium, and heavy consistencies are available.

- **Polyurethane finish.** In addition to the conventional varnishes, several other synthetic clear coatings make excellent finishes for furniture. Of these finishes, the clear, oil-modified urethanes are the most popular. They are highly resistant to abrasion, scratching, water, chemicals, grease, solvents, food stains, alcohol, and oils. They form a coating on the surface without penetrating. They can be applied over bare wood, sealer, or a varnish finish. Do not apply a polyurethane finish over shellac or lacquer finish, unless it has been specifically formulated for polyurethane finishes.
- **Varnish.** Available in all gloss finishes. Provides a finish that is resistant to water, alcohol, and other liquids. Most varnishes today are made of synthetic resins that dry rapidly to form a hard surface coating that is exceptionally resistant to rough wear.
- **Wax finish.** A simple, effective way of finishing wood. Generally, the wax is applied over a dried and sanded sealer coat of shellac, varnish, or oil.

Vintage Finishes

In addition to a wide array of wood stains and fashionable colors for cabinetry, many consumers request cabinetry with hand-applied finishes creating an antique look. These finishes are reminiscent of a room that has developed the patina of a cherished but well-worn furniture piece. Generically, they may be called *vintage* (see Figure 1.63), multistep, or layered finishes.

Three broad categories of special effects are employed to create these finishes.

1. **Glazing.** Glazing is the application of a colored material after the base coat of stain or paint has been applied. There are four broad categories of glazing:
   a. **Patting glazing.** Applied on white wood edging after wear, before finish, with pat-pat-pat/sponge rhythm.
   b. **Burnished glazing.** Glazing applied over all surfaces and wiped off, leaving residue in all crevices and shaped elements. Also called a penetrating glaze, which means laying color into the pores of the wood, allowing it to contribute to the finished color of the wood.
   c. **Striated glazing.** A faux finish technique where the consistency of the glazing is such that it appears to be stripes of paint left from brush strokes in both a horizontal and a vertical direction.
   d. **Dry glazing.** Almost chalklike material is applied after burnishing with a glancing stroke: appears on lead raised edges. Identified as defining glazing, which means the wood grooves are highlighted by the glaze

FIGURE 1.63 Examples of cabinetry featuring vintage finishes

Design by James Howard, CKD, CBD; codesigners Steve Levin and Sonja Willman. Photo by Alise O'Brien Photography

2. **Physical distressing.** A person damages the wood finish to create the look of aged, beaten furniture. A variety of distressing systems are available; the techniques include dents, relief cuts, chisel cuts, peck marks, and worm tracking. Such distressing can mimic natural wear or be taken to an extreme level to create a rugged, worn look. Distressing is limited to wood; it is not applicable to veneers.
3. **Special effects.** Special effects involve the application of specialized materials to re-create the sense of an aged wood surface. Typically, many manufacturers employ three broad categories of special effects.
   a. **Crackle.** Crackle is a random look reminiscent of common finish deterioration seen in porcelain (a very small crackle application) or weather deterioration of a furniture finish caused when the finish dries and cracks because of exposure to heat.
   b. **Spatter/cowtailing.** Spatter can be large and watery, small pinpoint black or light/dark brown lacquer that is sprayed across the finish in a random fine pattern to add depth to the finish. Small wisps of accent paints, sometimes called *cowtailing*, may also be applied.
   c. **Wear-through**. Wear appears on the edge of the doors, the raise of moldings, and other areas where a finish naturally would have been worn off through the continual opening and closing of doors over years of use. Wear also appears on the door, drawer, and cabinet face frame.

TYPICAL DOOR STYLES

The door and drawer fronts are the most visible parts of the cabinets, so they determine the style of the cabinets and usually set the design theme for the entire space. While a single cabinetmaker might have dozens of door styles (see Figure 1.64), they generally fall into several broad categories. Following is a selection of commonly available styles.

Cabinet door styles fall into broad categories based on their basic shape. Additional variations are created by adding special treatments, such as beading, moldings, or beadboard.

Flat Doors: Veneer and Laminates

Flat doors are flat-shaped pieces of lumber, plywood, or engineered board substrate. If a veneer is used, the designer should verify what grade of veneer and how the door panels will be laid out permitting grain consistency per cabinet, per elevation, or not at all. The kitchen pictured in Figure 1.65 features full overlay flat doors.

This type of door style may have the edges finished in a PVC edge tape designed to blend with the doors, a finger-jointed wood veneer edge tape, or a solid wood edging.

Flat Doors with a Wood Frame

Laminate or wood doors may be of a slab configuration with a wood, thick PVC edging, or metal frame around the doors and drawers. This can provide a very high-tech, contemporary look, or can have a transitional sense if laminate and wood are combined.

Flat Doors with a Continuous Pull/C-Channel/J-Channel Integral Pull

A wood or laminate slab door can have a metal or routed wood pull that replaces a surface-mounted hardware piece (see Figure 1.66). This hardware may be placed at both the top of drawers and the top of doors to create two horizontal lines through the space. Alternatively, the hardware may be at the top of the doors and the bottom of the drawers so one wider strip is featured.

Miter-Framed Doors with Raised/Flat Panels

These doors have a frame made up of two horizontal rails and two vertical stiles, which are joined by a miter in each corner, with a panel floating in between. The door may have a flat

FIGURE 1.64 Typical door designs
Courtesy of Plain & Fancy Custom Cabinetry

FIGURE 1.65 Kitchen featuring a full overlay flat door
Design by Anastasia Rentzos, CMKBD. Photo by Averill Lehan/PAI

FIGURE 1.66 Kitchen with pulls at the top of the door
Design by Laurie Belinda Haefele. Photo by Mark Lohman Photography

or a raised center panel. The center panel may be made up of solid wood strips laid up as one panel or a veneer center panel. When this look is created by routing a one-piece door, it is a false raised panel door. If the panel is flat, it is a recessed panel door. If the center section is raised, it is called a raised panel door. A raised or recessed panel door with an arch that is formed into the top and/or bottom rail is called a cathedral door. These doors are typically seen in traditional settings.

Mortise-and-Tenon Doors with Raised/Flat Panels

Doors having a frame made of two horizontal members (called *rails*), two vertical members (called stiles) that have a square joined corner, and a panel floating in the center are mortise-and-tenon doors.

The door may have a flat or raised center panel (see Figure 1.67). The center panel may be made up of solid wood strips laid up as one panel or a veneer center panel. This door style is typically seen in traditional and old world settings. It can also be used in transitional rooms.

Specialty Doors

There is a wide variety of special materials used for accent doors in kitchen and bathroom cabinetry. Several of the most popular are detailed next.

MDF Carved or Shaped Doors

MDF material is shaped to emulate a mortise-and-tenon raised or flat-panel door. This type of base material typically is used under a painted surface and with resin-impregnated foil doors, often called a thermofoil finishing system.

Stainless Steel

Accent doors that feature a stainless steel pans are popular in both European and North American kitchens (see Figure 1.68). The stainless steel pan receives a second pan of stainless steel (called a *double pan* door) or has a laminate, wood, or melamine panel to match the case interior.

FIGURE 1.67 A kitchen with flat-panel doors
Design by the Neil Kelly Company

FIGURE 1.68 Stainless steel used as an accent
Design by Laurie Belinda Haefele, codesigner Colin Dusenbery. Photo by Colin Dusenbery

Specialty Center Panels

Miter-framed doors and mortise-and-tenon doors may feature center panels of contrasting veneers, wood, wire, lattice, glass, rattan, or other specialty materials. These types of doors typically are called *frame-only* doors.

Specialty Glass Doors

Many manufacturers offer cabinet doors that emulate the look of historic mullion windows found in colonial times, when glass was so difficult to produce it could only be made in small panes. These are typically called *mullion* or *muntin* doors. These accent doors may have an arch at the top or be a square design (see Figure 1.69). The mullions may be on only the face of the door backed by a solid piece of glass or may be divided-light mullions (some manufacturers will call mullions "tru-lites," rather than true lights). Regardless of the name, this type of specialty glass door has individual panes of plain glass, specialty glass, or beveled glass painstakingly placed within each opening created by the wood mullion.

FIGURE 1.69 Kitchen with specialty glass doors

Design by Jane Lockhart. Photo by Brandon Barre

CABINET MILLWORK DESIGN DETAILS

To accentuate fine cabinetry, traditional rooms today often feature architectural details from the past. Each manufacturer's offering of such architectural accoutrements are specific to that manufacturer; therefore, the designer will find a wide array of products to accentuate a kitchen or bathroom from the manufacturer.

These products include:

- **Columns.** Used to surround a specially designed sink or cooktop cabinet or to frame tall armoire cabinetry (see Figure 1.70)
- **Turnings.** Either half turnings flat against a cabinet or full turnings at the edge of islands, on the face of wall cabinets, or, again, around a special-purpose cabinet.

FIGURE 1.70 Traditional kitchen featuring decorative columns in armoire cabinet

Courtesy of Plato Woodwork Inc.

- **Brackets** (sometimes called *corbels*). Carved details to support mantel hoods (see Figure 1.71), countertop overhangs, and decorative shelves.
- **Curved molding.** May have classical shapes, such as a crown molding, with carved details in the form of flowers, leaves, or stylized patterns.

FIGURE 1.71 Decorative hood created with millwork details

Courtesy of Showplace Wood Products, Inc.

FIGURE 1.72 Decorative onlays add detail to hood apron panel
Design by Thomas Trzcinski, CMKBD

- **Onlay.** A decorative wood or plastic that is placed on the surface of a cabinet door or panel. Brings visual interest to flat areas and is used to decorate fireplace mantels, range hoods, and cabinetry headers (see Figure 1.72).

GENERIC CABINET NOMENCLATURE

Cabinet manufacturers use a code to designate each cabinet's size, use, and placement within the kitchen. Appendix A defines generic nomenclature and presents illustrations of various cabinets. This sample *manufacturer's specification list* will be similar to brochures provided to you by the manufacturers you sell. This list represents a stock manufacturer and includes only a fraction of the many products available to you through a custom manufacturer. In addition, this list includes only sizes and illustrations of framed cabinets. Most of the information for framed cabinets is typical for frameless cabinets.

After your review of this material, compare your manufacturer's specification brochures with this list. You will notice many similarities in both nomenclature and cabinetry.

General industry nomenclature is that the first two digits represent the width of the cabinet (12, 15, 18, 21, 24, etc.). The other sets of figures indicate height and/or depth choices, when available.

The letters generally indicate types of cabinets: B (base cabinets), W (wall cabinets), and specialty cabinets. For example, (BCW) is a blind corner wall. The letters L or R generally indicate left or right hinging. Thus, a U151284L is a utility cabinet 15 inches wide, 12 inches deep, and 84 inches high, with the hinge on the left.

SUMMARY

This chapter includes an expansive overview of the cabinet industry—from how cabinet systems are categorized by the availability of custom elements within an order, to how cabinets are fabricated and how they are dimensioned. We have also included an extensive discussion about interior storage systems based on current contemporary information provided by respected international manufacturers of storage systems and functional hardware.

In addition to this discussion on the mechanics of kitchen cabinetry, we have reviewed the decorative elements of cabinetry produced around the world. Different materials used for exteriors have been discussed, with a special focus on wood products.

Although it is not easy to compare cabinetry manufactured in imperial sizes to those manufactured in metric sizes, we have identified the differences and included charts to assist the designer in understanding the difference. The generic cabinet sizing examples included in Appendix A will give a designer an excellent overview of what types of products are available and how they are identified.

REVIEW QUESTIONS

1. What is the difference between a hard conversion and a soft conversion from imperial dimensions to metric dimensions? (See "Cabinet Sizing Systems: Imperial and Metric" pages 12–16)
2. Explain the difference between a stock cabinet, a semi-custom cabinet, a custom cabinet, and millwork cabinetry. (See "Cabinet Types" pages 2–4)
3. What is the difference in the manufacturing process between frame and frameless cabinetry? (See "Cabinet Door Hinging" page 38)
4. Explain why most frequently used items and/or foodstuffs in a residential kitchen should be stored between knee height and eye level of the principal user. (See "Work Simplification Principles Revisited" pages 25–26)
5. Explain the difference in a base corner cabinet between a Lazy Susan cabinet, a blind corner cabinet, a blind corner cabinet with a swing-out shelf, and a pie-cut corner cabinet. (See "Special-Purpose Base Cabinets" pages 44–45)
6. Explain the difference among the composite core platforms of particleboard, medium-density fiberboard, plywood, engineered combination boards, and agri boards. (See "Composite Core Platforms" pages 58–60)
7. Explain why finishing wood in the manufacturing facility protects a set of cabinets during transport or installation from warpage concerns. (See "Finishing Systems" page 80)
8. Define the four different levels of veneer work, with the first being entry-level, followed by Levels 1, 2, and 3 of custom veneer work. (See "Design Considerations" page 75)
9. In what part of the world is mahogany considered an endangered species? (See "Mahogany" page 69)
10. What is the difference between physical distressing and wear-through in vintage finish treatments? (See "Vintage Finishes" pages 82–83)
11. What is the difference between a miter-framed door and a mortise-and-tenon door, other than the choice selection of raised or flat center panels? (See "Specialty Center Panels" page 86)
12. Explain the difference between the KCMA Certification Program and the KCMA Environmental Stewardship Program. (See "About the KCMA Certification Program" pages 9–12)