CHAPTER 48

FOOD SERVICE AND GENERAL COMMERCIAL REFRIGERATION EQUIPMENT

FOOD service requires refrigerators that meet a variety of needs. This chapter covers refrigerators available for restaurants, fast-food restaurants, cafeterias, commissaries, hospitals, schools, convenience stores, and other specialized applications.

Many of the refrigeration products used in food service applications are self-contained, and the corresponding refrigeration systems are conventional. Some systems, however, do use ice for fish, salad pans, or specialized preservation and/or display. Chapters 47, 49, and 50 have further information on some of these products.

Generally, electrical and sanitary requirements of refrigerators are covered by criteria, standards, and inspections of Underwriters Laboratories (UL), NSF International, and the U.S. Public Health Service.

Frame construction is usually of metal. Occasionally, wood is used in minor amounts, but it is rarely visible in the final assembly. Nonmetallic materials are used increasingly for interior liners, decoration, finish, trim, thermal break strips, and gaskets.

Stainless steel is the most common sheet metal used for these refrigerators. Other sheet metals used are aluminum and carbon steel, either hot- or cold-rolled. Stainless steel usually has a grained or polished finish when exposed in final assembly. Aluminum is generally unfinished, although it may occasionally be lacquered or coated with some other organic finish. Carbon steel may be black; plated; aluminized; or coated with either high-solids powder paint, enamel, or another special finish.

Insulation is usually one of the following: (1) foam polyurethane poured in place, (2) slab polyurethane, (3) slab polystyrene, or (4) glass fiber batts. Foam polyurethane is advantageous because it conforms to various cavity shapes and provides added structural integrity through adherence bonding to cabinet liners.

REACH-IN AND SPECIALTY CABINETS

The **reach-in refrigerator** or freezer is an upright, box-shaped cabinet with straight vertical front(s) and hinged or sliding doors (Figure 1). It is usually about 2.5 to 3 ft deep and 6 ft high and ranges in width from about 3 to 10 ft. Capacities range from about 20 to 90 ft^3. Undercounter models 3 ft high with the same dimensions are also available. These capacities and dimensions are standard from most manufacturers.

The typical reach-in cabinet (Figure 1) is available in many styles and combinations, depending on its intended application. Other shapes, sizes, and capacities are available on a custom basis from some manufacturers (Figure 2).

There are many varied adaptations of refrigerated spaces for storing perishable food items. Reach-ins, by definition, are medium- or low-temperature refrigerators small enough to be moved into a building. This definition also includes refrigerators and freezers built for special purposes, such as mobile cabinets or refrigerators on wheels and display refrigerators for such products as beverages, pies, cakes, and bakery goods. The latter cabinets usually have glass doors. Candy refrigerators are also specialized in size, shape, and temperature.

Refrigerated vending machines satisfy the general definition of reach-ins, but they also receive coins and dispense products

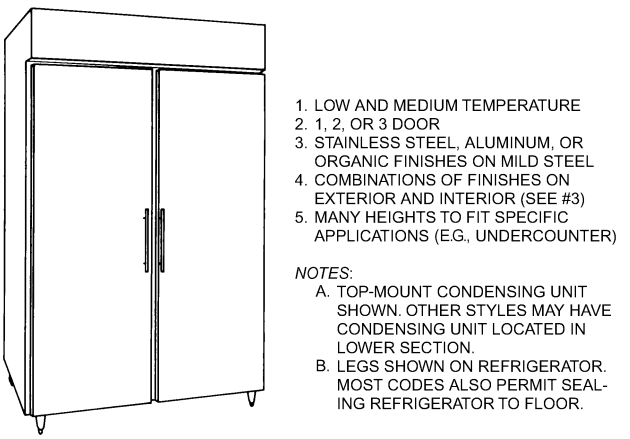

Fig. 1 Reach-In Food Storage Cabinet Features

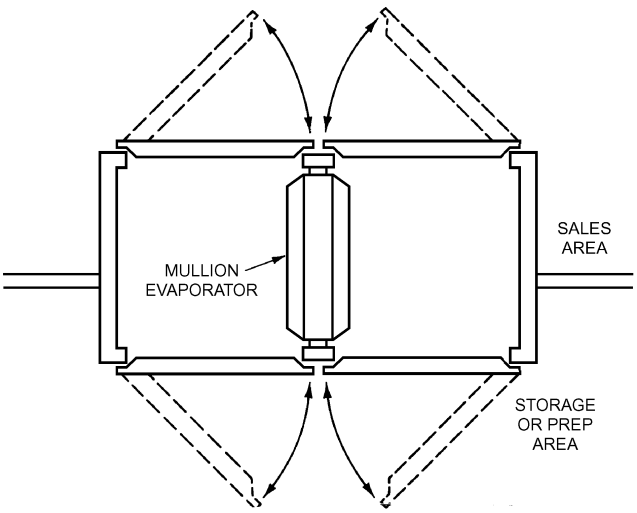

Fig. 2 Pass-Through Styles Facilitate Some Handling Situations

The preparation of this chapter is assigned to TC 10.7, Commercial Food and Beverage Cooling, Display and Storage.

individually. Generally, the full product load of a vending machine is not accessible to the customer. Beverage-dispensing units dispense a measured portion into a cup rather than in a bottle or can.

Types of Construction

Reach-in refrigerators are available in two basic types of construction. The older style is a wood frame substructure clad with a metal interior and exterior. The newer style is a welded assembly of exterior panels with insulation and liner inserts.

Materials used on exteriors and interiors are stainless steel, painted steel, aluminum-coated steel, aluminum, and vinyl-clad steel with wood grain or other patterns. The requirements are for a material that (1) matches or blends with that used on nearby equipment; (2) is easy to keep clean; (3) is not discolored or etched by commonly used cleaning materials; (4) is strong enough to resist denting, scratching, and abrasion; and (5) provides the necessary frame strength. The material chosen by an individual purchaser depends a great deal on layout and budget.

Temperature Ranges

Reach-in refrigerators are available for medium- or low-temperature ranges. The medium-temperature range has a maximum of 41°F and a minimum of 33°F core product temperature, with the most desirable average temperature close to 38°F. Low-temperature refrigerators cover a range of core product temperatures between –10 and +10°F. The desirable average core product temperature is 0°F for frozen foods and –5°F for ice cream. Both temperature ranges are available in cabinets of many sizes, and some cabinets combine both ranges.

Refrigeration Systems

Remote refrigeration systems are often used if cabinets are installed in a hot or otherwise unfavorable location where the noise or heat of the condensing units would be objectionable. Other special circumstances may also make remote refrigeration desirable.

Self-contained systems, in which the condensing unit and controls are built into the refrigerator structure, are of two general types and are usually air-cooled. The first type has the condensing unit beneath the cabinet; in some designs it takes up the entire lower part of the refrigerator, while in others it occupies only a corner at one lower end. The second type has the condensing unit on top.

There is no advantage to locating a self-contained condensing unit beneath the refrigerator; although the air near the floor is generally cooler, and thus beneficial to the condensing unit, it is usually dirtier. Putting the condensing unit on top of the cabinet allows full use of cabinet space, and although the air passing over the condenser may be warmer, it is cleaner and less obstructed. In addition, top mounting of both condensing unit and coil offers physical and constructional advantages. Having the condensing unit and coil in the same location gives a refrigeration unit that can be removed, serviced, and replaced in the field as a whole. Servicing can then be done at an off-site repair facility.

Styles

Reach-in refrigerators have doors on the front. Refrigerators that have doors on both front and rear are called **pass-through** or **reach-through refrigerators**. Doors are either full height (one per section) or half height (two per section). Doors may have windows or be solid, hinged, or sliding.

Interiors

Shelves are standard interior accessories and are usually furnished three or four per full-height section. Generally, various types of shelf standards are used to provide vertical shelf adjustment.

Modifications and Adaptations

Food Service. These applications often require extra shelves or tray slides, pan slides, or other interior accessories to increase food-holding capacity or make operation more efficient. Because certain stored foods create a corrosive atmosphere in the enclosure, the evaporator coil may have special coatings or fin materials to prevent oxidation. As use of foods prepared off-premises increases, on-site storage cabinets are becoming more specialized; there is growing pressure for designs that consider new food shapes, as well as in-and-out handling and storage.

Beverage Service. If reach-ins are required, standard cabinets are used except when glass doors and special interior racks are needed for chilled product display.

Meal Factories. These applications, which include airline or central feeding commissaries, require rugged, heavy-duty equipment, often fitted for bulk in-and-out handling.

Retail Bakeries. Special requirements of bakeries are the dough retarder refrigerator and the bakery freezer, which permit the baker to spread the work load over the entire week and to offer a greater variety of products. The recommended temperature for a dough retarder is 36 to 40°F. The relative humidity should be in excess of 80% to prevent crusting or other undesirable effects. In the freezer, the temperature should be held at 0°F. All cabinets or wheeled racks should be equipped with racks to hold 18 by 26 in. bun pans, which are standard throughout the baking industry.

Retail Stores. Stores use reach-ins for many different nonfood items. Drugstores often have refrigerators with special drawers for storage of biological compounds. (See the section on Nonfood Installations.)

Retail Florists. Florists use reach-in refrigerators for displaying and storing flowers. Although a few floral refrigerator designs are considered conventional in the trade, the majority are custom built. The display refrigerator located in the sales area at the front of the shop may include a picture window display front and have one or more display access doors, either swinging or sliding. A variety of open refrigerators may also be used.

For the general assortment of flowers in a refrigerator, most retail florists have found best results at temperatures from 40 to 45°F. The refrigeration coil and condensing unit should be selected to maintain a high relative humidity. Some florists favor a gravity cooling coil because the circulating air velocity is low. Others, however, choose forced-air cooling coils, which develop a positive but gentle airflow through the refrigerator. The forced-air coil has an advantage when the in-and-out service is especially heavy because it provides quick temperature recovery during these peak conditions.

Nonfood Installations. A variety of applications use a wide range of reach-ins, some standard except for accessory or temperature modifications and some completely special. Examples are (1) biological and pharmaceutical cabinets; (2) blood bank refrigerators; (3) low- and ultralow-temperature cabinets for bone, tissue, and red-cell storage; and (4) specially shaped refrigerators to hold column chromatography and other test apparatus.

Blood bank refrigerators for whole blood storage are usually standard models, ranging in size from under 20 to 45 ft^3, with the following modifications:

- Temperature is controlled at 37 to 41°F.
- Special shelves and/or racks are sometimes used.
- A temperature recorder with a 24 h or 7 day chart is furnished.
- An audible and/or visual alarm system is supplied to warn of unsafe blood temperature variation.
- Sometimes an additional alarm system is provided to warn of power failure.

Biological, laboratory, and mortuary refrigerators involve the same technology as refrigerators for food preservation. Most

biological serums and vaccines require refrigeration for proper preservation and to retain highest potency. In hospitals and laboratories, refrigerator temperatures should be 34 to 38°F. The refrigerator should provide low humidity and should not freeze. Storage in mortuary refrigerators is usually short-term, normally 12 to 24 h at 34 to 38°F. Refrigeration is provided by a standard air- or water-cooled condensing unit with a forced-air cooling coil.

Items in biological and laboratory refrigerators are kept in specially designed stainless steel drawers sized for convenient storage, labeled for quick and safe identification, and perforated for proper air circulation.

Mortuary refrigerators are built in various sizes and arrangements, the most common being two- and four-cadaver self-contained models. The two-cadaver cabinet has two individual storage compartments, one above the other. The condensing unit compartment is above and indented into the upper front of the cabinet; also ventilation grills are on the front and top of this section. The four-cadaver cabinet is equivalent to two two-cadaver cabinets set together; the storage compartments are two cabinets wide by two cabinets high, with the compressor compartment above. Six- and eight-cadaver cabinets are built along the same lines. The two-cadaver refrigerator is approximately 38 in. wide by 94 in. deep by 77 in. high and is shipped completely assembled.

Each compartment contains a mortuary rack consisting of a carriage supporting a stainless steel tray. The carriage is telescoping, equipped with roller bearings so that it slides out through the door opening and is self-supporting even when extended. The tray is removable. Some specifications call for a thermometer to be mounted on the exterior front of the cabinet to show the inside temperature.

ROLL-IN CABINETS

These cabinets are very similar in style and appearance to reach-in cabinets. Roll-ins (Figure 3) are usually part of a food-handling or other special-purpose system (Figure 4). Pans, trays, or other specially sized and/or shaped receptacles are used to serve a specific system need, such as the following:

- Food-handling for schools, hospitals, cafeterias, and other institutional facilities
- Meal manufacturing
- Bakery processing
- Pharmaceutical products
- Body parts preservation (e.g., blood)

The roll-in differs from the reach-in in the following ways:

- The inside floor is at about the same level as the surrounding room floor, so wheeled racks of product can be rolled directly from the surrounding room into the cabinet interior.
- Cabinet doors are full height, with drag gaskets at the bottom.
- Cabinet interiors have no shelves or other similar accessories.

The racks that roll in and out of these cabinets are generally fitted with slides to handle 18 by 26 in. pans, although some newer systems call for either 12 by 20 in. or 12 by 18 in. steam table pans. Racks designed for special applications are available, but usually custom designed.

Manufacturers and contractors offer various methods of insulating the floor area. This is important if the roll-in is to hold frozen food.

FOOD FREEZERS

Some hospitals, schools, commissaries, and other mass-feeding operations use on-premises freezing to level work loads and operate kitchens efficiently on normal schedules. Industrial freezing equipment is usually too large for these applications, so operators use either regular frozen food storage cabinets for limited amounts of freezing or special reach-ins that are designed and refrigerated to operate as batch-type blast freezers.

Chapter 15 covers the industrial freezing of food products.

BLAST CHILLERS AND BLAST FREEZERS

These types of units are designed to rapidly chill or freeze food immediately after it has been cooked. Blast chillers and freezers are used by food-service establishments such as restaurants, hotels, and cafeterias, that cook large quantities of food items, chill or freeze them, and later reheat portions to be served. Blast chillers are designed to allow operators to comply with food preparation, handling, and storage guidelines on preventing the growth of dangerous

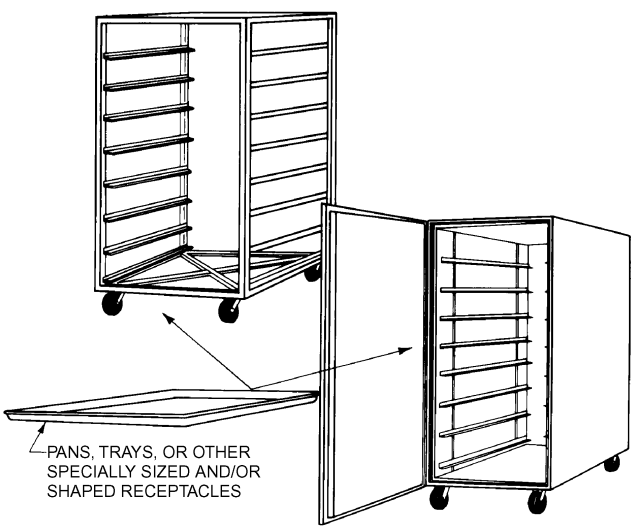

Fig. 3 Open and Enclosed Roll-In Racks

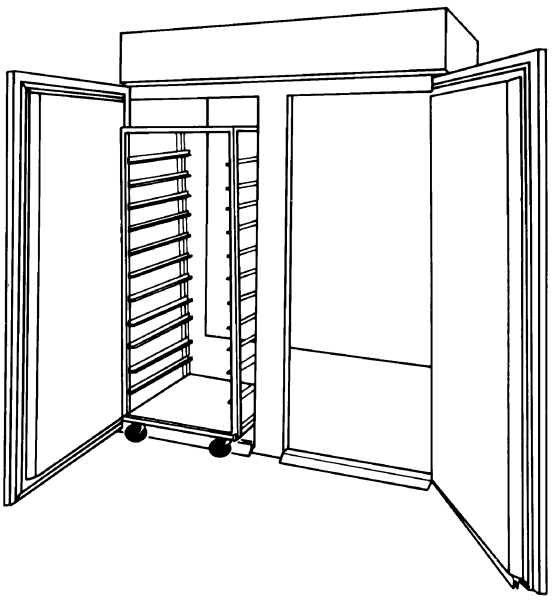

Fig. 4 Roll-In Cabinet —Usually Part of a Food-Handling or Other Special-Purpose System

bacteria. These guidelines mandate that food be cooked to a minimum core temperature of 160°F and held there for at least 2 minutes. The food is then immediately cooled to between 33 and 38°F within 2 to 4 hours. This not only prevents bacteria growth, but also helps preserve the appearance, flavor, texture, and nutritional value of the food item. Once cooled, refrigerated food must be stored at a temperature range of 33 to 38°F for a period not to exceed 5 days. Frozen food must be maintained below 0°F and can be kept for 8 weeks or longer.

Blast chillers for refrigerated food, and blast freezers for frozen food, are available in reach-in and roll-in models in a variety of sizes and capacities. They are designed to operate both as blast chillers and as storage refrigerators or freezers. Most blast chillers will automatically change over to storage mode when the blast-chill cycle is completed. Many of today's models are equipped with sophisticated microprocessor control systems that allow the operator not only to program the chill cycle, but also to obtain readouts, printouts, and alarms that document and monitor the entire process. Built-in food probes are commonly used to take readings and allow the control system to make adjustments if necessary.

WALK-IN COOLERS/FREEZERS

This type of commercial refrigerator is a factory-made, prefabricated, sectional version of the built-in, large-capacity cooling room. It closely matches the reach-in type in meeting a wide variety of applications.

Its function is to store foods and other perishable products in larger quantities and for longer periods than the reach-in refrigerator. Good refrigeration practice dictates that dissimilar unpackaged foods be stored in separate rooms because they require different temperatures and humidity and because odors from some foods are absorbed by others. Large food operations may have three rooms: one for fruits and vegetables, one for meats and poultry, and one for dairy products. A fourth room, at 0°F, may be added for frozen foods. Smaller food operations that use appropriate food packaging may require only two rooms; one for medium-temperature refrigeration and one for frozen storage.

Foam plastic materials have improved thermal insulation in both self-contained and remotely refrigerated sectional coolers. Polyurethane foam-in-place insulation between two skins of metal makes a light, water-resistant panel. Additionally, the foam is a very efficient insulator, allowing slimmer panels for equal insulation value compared to most other insulations.

The sectional cooler offers flexibility over the built-in type. It is easily erected and easily moved, and it can be readily altered to meet changing requirements, uses, or layouts by adding standard sections. Also, the sectional walk-in cooler can be erected outside a building, providing more refrigerated storage with no building costs except for footings and an inexpensive roof supported by the cooler.

Self-Contained Sectional Walk-In Coolers

The versatility of sectional walk-in coolers was greatly increased by the introduction of self-contained models. There are various methods of application. Figure 5 shows one arrangement; the top-mount refrigeration unit is labeled (A), the straddle mount unit is (B), and the side-mount unit is (C). These self-contained units use complete refrigeration systems, usually air-cooled, in a single compact package. The units are installed in the sectional cooler/freezer wall or ceiling panels.

Walk-In Floors

Sectional walk-in coolers termed floorless by the supplier are furnished with floor splines to fasten to the existing floor to form a base for the wall sections. Models with an insulated floor are also available.

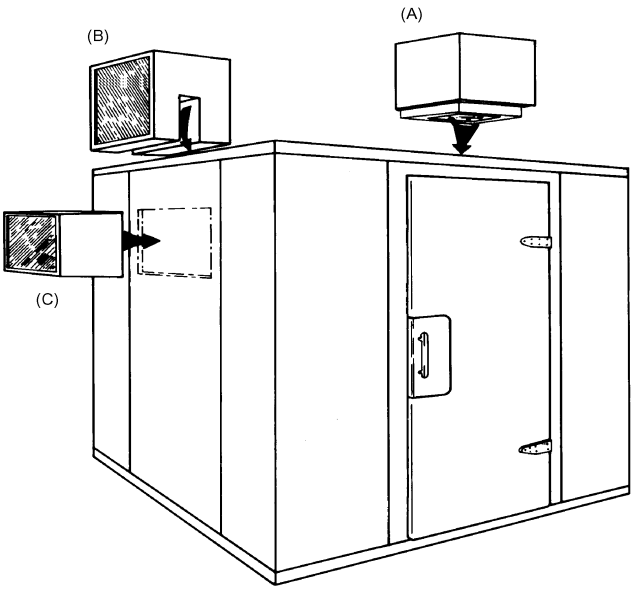

Fig. 5 Refrigeration Equipment Added to Make a Walk-In Cooler Self-Contained

A medium-temperature (above-freezing) cooler can be erected on an uninsulated concrete floor on the ground. Generally, floor losses are considered small.

Level entry is becoming more important as the use of hand trucks and electric trucks increases. The advantage and convenience of level entry afforded by a floorless cooler can also be obtained by recessing a sectional insulated floor.

Design Characteristics

The factory-made walk-in cooler consists of standard top, bottom, wall, door, and corner sections, which are shipped to the user and erected on the site. The frames are filled with insulation and are covered on the inside and outside with metal. The edges of these frames are usually of tongue-and-groove construction and either fitted with a gasket material or provided with suitable caulking material to ensure a tight vapor seal when assembled. These sections are assembled on the site with either lag screws or hooks operated from inside the cooler.

Exterior and interior surfaces may be painted and are made of one or more of the following:

- Galvanized steel
- Aluminum
- Aluminum-coated steel
- Stainless steel
- Vinyl-clad steel

Coolers may be used to hold sides or quarters of beef, lamb carcasses, crates of vegetables, and other bulky items. Food operations now rarely use such items. If they do, the items are broken down, trimmed, or otherwise processed before entering refrigerated storage. The modern cooler is not a storage room for large items, but a temporary place for quantities of small, partially or totally processed products.

The food cooler, therefore, is likely to be equipped with sturdy, adjustable shelving about 18 in. deep and arranged in tiers, three or four high, around the inside walls. Alternatively, the cooler is often provided with rolling racks that are actually shelving on wheels. These racks are rolled directly into and out of the cooler.