tion will depend on the individual characteristics of the operation.

Small Restaurants

For the small restaurant owner, the refrigeration equipment manufacturer has provided the package type of refrigerators and cabinets which enable the smaller operator to have the advantages of refrigeration in many of the foregoing classifications. Self-contained and portable equipment, such as reach-in refrigerators, beverage coolers, water coolers, and ice cream cabinets are made in a variety of sizes and afford the smaller restaurant owner a flexible means of locating his refrigeration equipment where space is important. Additional demands in his business or expansion can be handled with additional packaged units.

SPECIFYING AND SIZING EQUIPMENT

For all establishments, a careful analysis of menu, anticipated volume, materials delivery frequency, and on-premises preparation procedures will be necessary in order to specify equipment properly, both as to type and size. Tables 3, 4, and 5 are examples of material that can be helpful.

ICE MAKER SIZES

The size of the ice maker should be based on the total weight of ice required per 24 hr day. Ice maker ratings are usually given on a nominal basis and for standard conditions. Therefore, care must be taken to select the size of the machine in terms of actual, rather than nominal, makeup water and ambient temperatures. In addition, most bins have high-level cutoffs, which prevent the machines from operating when the bins are full. Small bins may not, therefore, allow machines to operate at full capacity unless the ice is constantly being removed from the bins. Reasonable design procedure is to select a machine with actual 24 hr capacity at design conditions equal to daily need with a bin that has enough capacity to hold at least the output of the longest normal non-holiday shut-down. For example, a restaurant that is open from 11 a.m. to 10 p.m., and uses 150 lb of ice per day, would need a machine that produces 150 lb per day (6.25 lb per hr), and a bin that holds at least 81.25 lb (13 hr of continuous shutdown × 6.25).

Where ice replaces or supplements mechanical water cooling, the first glass of water drawn will use about 1/10 lb of ice. The amount of additional ice used for succeeding servings will depend on the temperature of the water and the type of ice used.

WATER COOLERS

The amounts of water required per person and per seat for restaurant and cafeteria service are:

Restaurant table service: 0.1 gal per (hr) (person)
Restaurant soda fountain, sandwich bar, and diners: 0.5 to 0.75 gal per hr per seat
Public cafeteria: 0.083 gal per hr per person
Office-factory cafeteria: 0.1 gal per hr per person.

The recommended water temperature is from 40 to 45 F.

INSTALLATION

Good installation, and proper periodic maintenance, are required for satisfactory life for good equipment. All refrigeration equipment in the food service industry should be considered as permanent capital equipment, and purchased not only on the basis of the original investment, but also on the basis of probable costs of installation, cleaning, service and maintenance.

Every piece of refrigeration equipment, even the smallest self-contained item, needs some installation. It must be unpacked, set level, and, if nothing else, have its electrical cord plugged into a suitable outlet. Even here, a trained mechanic should check for satisfactory operation at startup. Larger equipment may require the running of electrical wires, installation of switches, starters, etc., may call for plumbing connections, and some types require separate installation of the refrigeration condensing unit, controls, etc.

Local codes may require expensive local inspection and testing unless equipment is listed by Underwriters' Laboratories, National Sanitation Foundation, etc.

Thus, it pays to find out how many installation costs can be saved by purchasing equipment that is equipped with all necessary plumbing traps, clean-outs, etc., and conforms fully with all applicable codes. But even if the manufacturer has done his part completely, the actual installation is very important. The equipment must be level, the electrical wiring must be adequate in capacity and must be installed correctly, and the plumbing hookups must be properly made. In addition, the equipment should be installed with an eye to future service possibilities, and, wherever possible, should be so placed that parts likely to require service are easily accessible.

CHAPTER 59

RETAIL FOOD STORE REFRIGERATION

Display Refrigerators, Product Temperatures, Adverse Heat Sources Processing Refrigerators, Humidity and Temperature, Wrapped Meat Storage, Temperature and Defrost Control, Walk-In Coolers, Refrigeration Equipment, Liquid Receivers, Water Cooling Towers, Valve Settings, Air-Cooled Condensers, Ventilation Fans

IT is not the purpose of this chapter to deal with the internal design of the refrigerators used in the food store but rather to deal with the application of refrigeration equipment in these stores. Refrigeration equipment used in today's self-service retail food store may be grouped into the broad classifications of *display* refrigerators; *storage* refrigerators; *processing* refrigerators and refrigeration, and *mechanical* refrigeration machines.

DISPLAY REFRIGERATORS

Open self-service type refrigerated display cases for both normal and low temperatures continue to be the most widely used type in present day food markets. However, in recent years, equipment manufacturers have been introducing an increasing number of multideck models for every perishable department in the food market. These models have been rapidly gaining in popularity with food store operators.

In many instances, under new concepts of store layout design, food store operators are using a combination of single-deck and multideck models of display refrigerators in practically every department of the store where perishables are displayed and sold. This trend is expected to continue, as many store operators are now choosing equipment that will provide more flexibility and variety of shelf sizes to meet specific merchandising requirements of the various sizes of a great variety of products.

In addition to the multideck cases, during the last few years, the air curtain type of display cooler has been introduced. It is most widely used in the Dairy Department, but in some stores it is also being adapted for the display of such items as chilled beverages, delicatessen, table-ready meats, and produce.

The trend toward large stores continues, and as competition between supermarkets increases, each new or remodeled store strives to be distinctively different and more attractive to shoppers. This, in turn, has produced more complex arrangements and layout of display refrigerators in the modern food market. However, the departmentalized style of operation which calls for cases allocated in proper relationship to expected sales volume in each department such as meats, dairy, etc., makes it necessary to apportion floor space so as to provide for balanced stocking of merchandise and smooth flow of traffic in relation to expected peak volume periods. A typical modern store plan is shown in Fig. 1.

PRODUCT TEMPERATURES

Display refrigerators are designed to merchandise food to maximum advantage, while providing as much refrigeration as is required for short term protection of the food which is to be sold within 24 to 72 hr from the time it is displayed. Therefore, the length of time that the merchandise can be kept in a display case is limited. Temperatures to be maintained are shown in Table 1.

Open refrigerators should not, for example, be used as product coolers. The merchandise when put into the case should not be warm but at or near the proper temperature. Adequate provision for refrigerated storage in other space is therefore needed. Food placed directly in the case upon delivery to the store should come from properly refrigerated trucks. There should be little or no delay in transferring perishables from storage or trucks to the display case.

A second consideration, frequently neglected, is the correct placement of merchandise within the case. The product on display should never be piled so high that it is out of the refrigerated zone and should never be stacked so densely that circulation of refrigerated air is blocked. Just how an open refrigerator should be stocked with food varies with the type of case. The recommendations of the manufacturer should be obtained and followed in every instance. Open type display fixtures are materially affected by the temperature and humidity and movement of the surrounding air. There must be no drafts over these fixtures or complete refrigeration failure may result.

Adverse Heat Sources

Refrigeration performance and food temperatures are also adversely affected by display lighting and other forms of radiant heat. Experience proves that high intensity lighting will raise product temperatures several degrees. The discoloration effect of light on smoked, cured and table-ready meats is very marked. Experience indicates that no more than 70 ft-candles of display lighting of all types should be used on smoked, cured, and table-ready meats unless these meats will be sold within 24 hr, because discoloration of the meat is directly proportional to both the light intensity and the length of time displayed.

Service refrigerators are sometimes used for the display of delicatessen type foods. In addition, they are sometimes used for the display of fish with crushed ice, instead of mechanical refrigeration.

Although the problems of the small store are much like

Table 1 .... Recommended Temperatures in Display Cases

Type Fixture	Temperature—F	
	Min*	Max*
Meat, display area	28	36
Meat, storage compartment	30	35
Produce, display area	35	45
Produce, storage compartment	35	45
Dairy	35	42
Frozen Food	—»	0
Ice Cream	—»	−12

* These temperatures are air temperatures, with thermometer in the refrigerated air stream and not in contact with the product.
Minimum temperatures for frozen food and ice cream are not critical; maximum temperature is the important factor for proper preservation of product quality.