necessary for the operator to be in position to wait on customers in any part of the store. For this reason, the processing department should be so arranged that the operator can view any part of the store from where he is working. A glass partition around the processing room is suggested for this and for sanitary purposes.

A utility cooler, equipped with a double row of meat rails on each side, is required to handle the needs of the plant as well as those of the retail store. It is 10 × 6½ ft with an 8½ ft ceiling. The locker room is provided with 19 tiers of lockers, six high on the floor and with three tiers two high on top of the freezer cabinet. Door lockers are 17 in. high × 20 in. wide × 30 in. deep. Drawer lockers (two lower ones) are 23 in. high × 20 in. wide × 30 in. deep. Allowing a minimum of 17 in. for ceiling plate evaporators plus 114 in. for lockers requires 10 ft 11 in. inside for ceiling height.

The floor is 19 × 8 ft, which allows sufficient floor space for the lockers, a freezer cabinet and a 34 in. aisle with 1 in. clearance allowed at back of lockers. The processing equipment need be little more than required for a small retail meat store: a power grinder, scales, cutting blocks, work tables, knives, and other hand tools. Such items as trackage, power meat saws, smoke cabinets, lard rendering equipment and other special items may not be required. In selecting such equipment, it is best to consult with the operator who, if he is an experienced butcher or meat cutter, will know what he will need.

The refrigeration requirements are based on the following:

1. The plant capacity is based on 120 lockers, plus a 25 percent additional volume of retail meat sales.
2. Peak ambient conditions 95 F, except floor over unheated basement at 80 F for summer.
3. Water for condensing unit, 70 F maximum.
4. Electric service: 220 volt, 3-phase, 60-cycle, and 110 volt, 1-phase, 60-cycle.
5. Design temperatures: Chill room 35 F, locker room 0 F, freezing cabinet inside locker room, with shelf plates, −20 F.
6. Insulation: Chill room 4 in. corkboard; locker room 6 in. corkboard (or equivalent).

The refrigeration load is summarized as follows:

Chill Room

LOAD	
Heat leak and normal service, Btu per day	52,300
Product load at 2 lb per locker per day would equal 240 lb, with an addition of 25 percent for retail trade = 300 lb. However, since an average weight of one beef carcass is at least 500 lb, this weight should be taken as the minimum product load for any chill room. Chill from 95 to 35 F, Btu	22,600
Total load, Btu per day	74,900
Hourly load based on 18-hr compressor running time, Btu	4161

As automatic defrosting is required in the chill room compressor running time should not exceed 18 hr. The fan motor load may be added after cooling unit is selected.

Freezer Cabinet

LOAD	
Product load, 2 lb per locker per day, reduced from 45 to 0 F, Btu	31,200
Hourly load, based on 24-hr compressor running time, Btu	1300

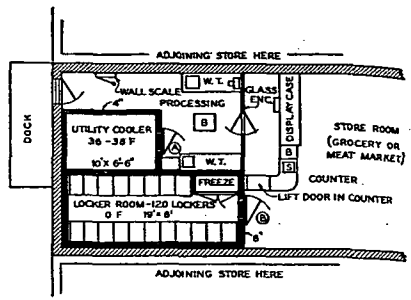


Fig. 2 .... Frozen Food Locker Plant Combined with Grocery and Meat Market (Plan A)

Heat leak is disregarded, since the freezer cabinet is installed inside the locker room. Product load based on two lb per day per locker is the minimum allowable. In some cases, experience shows, a heavier product load allowance may be advisable.

Locker Room

LOAD	
Heat leak plus light service only, Btu per day	162,060
Hourly load based on 24-hr compressor running time, Btu	6753

Automatic defrosting is not required, and calculations are based on peak ambient temperature; therefore, 24-hr compressor running time may be used for freezer and locker room.

Refrigeration Equipment Selection

Condensing units. One unit is needed for chill room, with minimum capacity required of 4161 Btu per hr, plus fan motor load at refrigerant temperature of 18 F (15 F deg difference +2 F deg suction line drop; 35 F room −17 F deg difference = 18 F refrigerant).

A second unit to handle combined locker room and freezer load (6753+1300=8053 Btu per hr total). This unit should be selected at −22 F refrigerant temperature. (20 F deg difference+2 F deg suction line drop; 0 F locker room −22 F deg difference = −22 F refrigerant.)

Either air-cooled or water-cooled units may be selected (condensing medium; air at 80 F if condensing unit is in basement, at 95 F if not, or water at 70 F). By referring to manufacturers' condensing unit capacity tables, the proper models or sizes may be specified for the above. For example, one manufacturer shows a capacity of 5900 Btu per hr for a ½ hp water-cooled unit at 18 F refrigerant and 70 F inlet water which might be used for the chill room; and another of 8540 Btu per hr for a 2 hp (3-phase) water-cooled unit at −22 F refrigerant and 70 F inlet water, which might be used for the locker room and freezer. (The display case may be connected to the chill room condensing unit by selecting the unit with sufficient additional capacity for that purpose, and by adding the proper controls for this type of multiple operation.) Total compressor horsepower, therefore, would be 2.5.

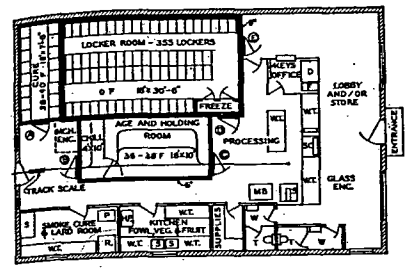


Fig. 3 .... Typical Frozen Food Locker Plant (Plan B)

Cooling units. Gravity or forced air units may be used in the chill room. For this example, assume that the forced air type is used. The temperature difference between the chill room and the refrigerant should be 10–15 F deg. Thus, 5900 ÷ 15 = 393 Btu is the required basic rating in Btu per (hr) (degree difference) of the evaporator required to match the condensing unit. A cooling unit having at least this capacity should be selected. The cooling unit selected from the manufacturer's tables has a basic rating of 400 Btu per (hr) (degree difference) with a 1/75 hp fan motor, and a motor heat dissipation of 222 Btu per hr. Since the fan is run continuously, the load from this source is added to heat leak, plus product load:

$$\frac{222 \text{ Btu per hr} \times 24 \text{ hr}}{18 \text{ (hr)}} = 296 \text{ Btu per hr}$$

The total load = 296 Btu per hr (fan load) + 4161 Btu per hr (heat leak + product load) = 4457 Btu per hr which is within the hourly capacity of the condensing unit selected. A thermostatic expansion valve is required.

Plates for the cabinet freezer may be selected from standard sizes. The number of square feet of freezing surface may be based on the number of lockers. One square foot for each five lockers is the accepted practice for small plants of this kind, 120 ÷ 5 = 24 sq ft of plate needed—one side only. A plate 22 × 48 in. is standard, having 7.4 sq ft on one side. Therefore, 24 ÷ 7.4 = 3.2 plates needed (use 4). One thermostatic expansion valve is needed.

Overhead plates for the locker room may be selected from standard sizes. The rating may be obtained from manufacturer's data. Using figures published by one manufacturer, we may select plates for this project as follows:

$$\frac{6753}{2 \times 24 \times 20} = 7$$

The selection, therefore, from this size is seven plates, which may be assembled in one bank. The 12 × 84 in. plate might also be used. Thus:

$$\frac{6753}{2 \times 14 \times 20} = 12$$

The selection from this size is 12 plates assembled in two banks of six plates each. Either 144 or 84 in. plates may be used on this project, with the latter having the advantage of better refrigeration distribution above the 34 in. aisle. Each bank of plates will require one thermostatic expansion valve.

A fair estimate of the operating cost may be determined by calculating the water and power usage (from manufacturers' tables) on a 60 to 80 percent running time basis.

This type plant does not require a complicated control system. The condensing units may be equipped with low pressure control, since the cooling units have been equipped with thermostatic expansion valves. If fluctuations occur in locker room temperatures when a heavy load is put on the freezer, a thermostatically controlled solenoid valve should be installed in the suction or liquid line to the locker room plates.

PLAN B—355 LOCKERS

Floor Plan B, Fig. 3 is for an average sized plant which may be operated as a separate business or as a complementary part of another business. A plant of this size is large enough to require the full time of an attendant, providing additional help may be available when needed during the peak season. Under average conditions, the operator of such a plant will have very little spare time for other responsibilities.

Facilities are provided in this layout for practically any normal service that may be needed in a frozen food locker plant, with the possible exception of slaughtering. Slaughtering facilities may be provided in a nearby location, at an out-of-town location, or may be done on the customer's premises.

This plant is laid out in such a way as to eliminate as much trucking and handling labor as possible. Chill and age rooms, for example, are accessible to the delivery platform in the rear, and the processing room is at the other end of the track. The main track runs straight through so that the use of turns and switches is reduced to a minimum. There is no insulation in the partition between the chill room and the aging room. A free-swinging door is installed between these two rooms. Ceiling height is 9 ft. Four pounds per day per locker are used as a basis for the refrigeration load in the chill and aging rooms. This will take care of short-time holding for the cure room and leave sufficient capacity to take care of peak requirements for other refrigeration needs.

The smoke, cure, and lard work rooms are located in the rear near the refrigerated cured meat room. A small utility kitchen is provided for the handling of fowl, fruits and vegetables.

The refrigerated room for the storage of cured meats is shown with enough wooden bins to accommodate 80 or more customers. These bins should be constructed of hardwood with removable bottoms or shelves to facilitate cleaning. The shelves should be sloped so that the drip will not fall on the shelf beneath. They may be fitted to slope forward with a trough to collect the drip and convey it to a portable receptacle. Bin sizes are usually 24 in. wide, 24 in. high, and 30 in. deep. Barrels or casks for wet cure may be substituted for all or part of the bins.

The locker room is provided with 355 lockers, and may be entered from the lobby. Hence, all patrons entering the locker room are in sight of the operator. Lockers for this room are selected with five in each tier, consisting of two lower drawer-type lockers 18 in. wide, 22 in. high and 30 in. deep, with three door-type lockers above 18 × 18 × 30 in. An additional group of 10 door lockers is located above the freezer cabinet.

The freezer cabinet is located inside the locker room. Provision is made for loading the freezer cabinets through a plug or utility-type door. The practice of placing foods to be frozen