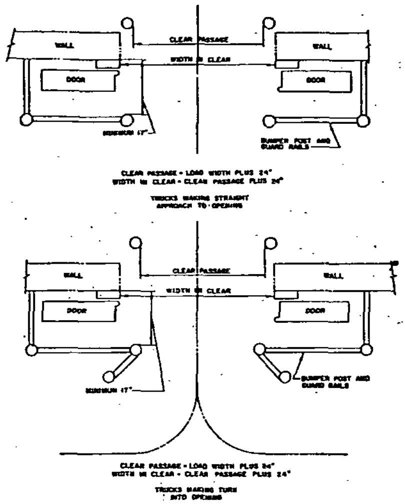

Fig. 6 .... Warehouse Door Protection

Vestibules. An effective way to minimize loss of refrigeration through door openings is to provide a vestibule equipped with a pair of double-acting doors. See Fig. 7. This arrangement drastically reduces the interchange of warm and cold air.

A vestibule should be deep enough so that, on entering, the power operated horizontal door should be well on its way to the closed position before the double-acting doors are activated. Heat in the floor of the vestibule contributes strongly to good operation. Very heavy traffic can justify the use of a separate refrigeration unit to control the temperature and humidity of the air in the vestibule.

The horizontal sliding door in Fig. 7 is 6 ft wide and the double-acting door is 8 ft wide, based on a 48 in. pallet load. The 8 ft width is selected to minimize truck damage to the double-acting doors. It is strongly recommended that (1) double-acting doors be hung on a steel channel frame, (2) spring steel bumpers be provided on both sides of each leaf, and (3) heat be supplied at the sides, head, and sill to prevent freezing.

Trucking platforms. Increasing regulations on temperature control during all steps of product handling has led to the refrigerated trucking platform designed as an anteroom to the cold storage space. With the platform space maintained at about 45 F or lower, frozen product can be handled without exposure to warm humid ambient conditions, thus holding more favorable product temperatures and avoiding damage to the product packaging because they can be kept essentially dry. The platform doorways are equipped in many cases with special devices, such as a polyurethane bumper around the sides and head on the outside of the opening, to reduce *the intake of ambient air to a minimum.*

FIRE PROTECTION

Ordinary sprinkler systems cannot be applied to refrigerated space without modification. Two types of modified systems are in use, the brine system, and the dry pipe system.

The *brine system* (Fig. 8) employs the ordinary sprinkler scheme, but the pipes in the refrigerated spaces are filled with calcium chloride brine. The brine is maintained under greater pressure than the city water, and is sealed off from it by special check valves *A* and *B*. The individual distributing headers are sealed off by similar valves *C*. The distributing header pressure is maintained above the brine stand pipe pressure by a brine pump. The booster pump can be used to pump city water to the plant at increased pressure through valve *B*, *by manually opening the normally closed valves C*, on this line. Additional special check valves are installed in the city water supply line before it enters the plant to insure against brine flowing into the city water mains.

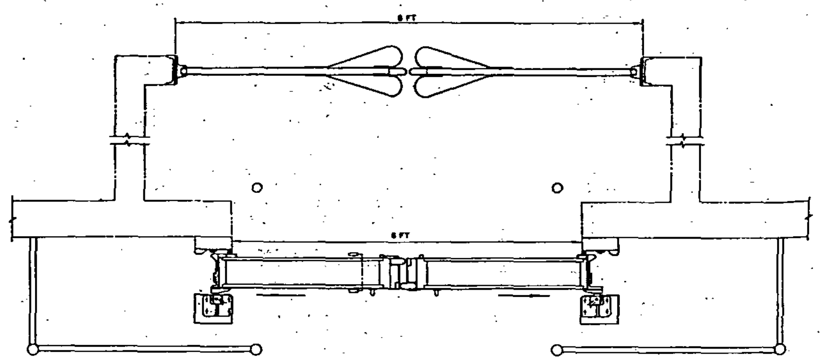

Fig. 7 .... Vestibule Door Arrangement

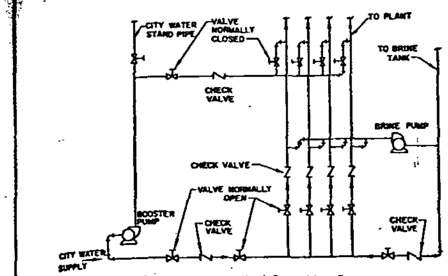

Fig. 8 .... Brine-Filled Sprinkler System

In the *dry pipe system*, the sprinkler pipes in the refrigerated spaces are filled with dry compressed air. The water is sealed off from the compressed air by a special dry pipe valve. The air pressure, which is carefully controlled, keeps this valve closed as long as no sprinkler failure occurs. When the air pressure is relieved the water pressure forces the valve open and feeds water into the sprinkler system.

The air in the sprinkler system must be dehydrated to avoid frost buildup in the pipes. *This is sometimes accomplished* by taking the suction to the air compressor, assigned to this duty, from the refrigerated space. An alternate is to use bottled nitrogen gas instead of air for filling and sustaining the pressure in the sprinkler system.

If the building is not sprinklered, a number of central reporting or warning systems (such as American District Telegraph) are available for installation in more hazardous areas to give an alarm outside the plant.

UTILITY SPACE

Shipping platform, corridors and elevator vestibules should provide liberal space for movement of goods to and from storage, pallet storage, battery charging, sorting, inspecting and checking and also for idle equipment. The shipping platform should be not less than *15 ft wide and preferably* 20 ft or wider. Floor heights of refrigerated cars and trucks vary widely, but average higher than for unrefrigerated. A shipping platform, height of 54 in. above the rail is recommended for reefer railroad cars. For trucks, a shipping platform height of 50 in. above the pavement is recommended. Local delivery trucks may be much lower. Some reefer truck beds are up to 58 in. above grade. Adjustable ramps at some of the truck spots will partly compensate for height variation. Five to seven railroad car spots per million cu ft are recommended. It is difficult to include sufficient truck spots in the smaller dimensions of the multi-story building, but the one story design gives ample length. Twelve to fifteen truck spots per million cu ft for the public warehouse should be provided if the building dimensions permit.

For multi-story buildings, the elevators must be of ample size and weight capacity to promptly and efficiently handle lift truck operation. It is preferable to have air conditioned vestibules of adequate size at elevator floor levels to avoid frost in the elevator shafts and other inherent problems.

Space must be provided for plant general office, locker room and machine room. A superintendent's and warehouse records office should be located near the center of operations.

A checker's office should be in view of the platform and traffic arrangement. Personnel warm-up rooms should be in view of the superintendent's office.

Rented space should be *isolated* from warehouse operations.

The machine room should include ample space for refrigerating equipment and its maintenance. It should be well-ventilated and have stand-by capacity for emergency ventilation. It should be segregated from other areas and have separate exists as required by most building codes. A maintenance shop and space for parking, charging and servicing warehouse equipment should be located adjacent to the machine room.

LOAD DETERMINATION

The refrigeration loads of warehouses of the same capacity will vary widely. Many factors, including building design, inside and outside temperatures, and most important, the type and the flow of the goods expected plus the daily freezing capacity, contribute to this load. Therefore, no rule of thumb can be applied. Experience of comparable buildings and operations is valuable, but an analysis of any projected operation should be made. Compressor and room cooling equipment should be designed for maximum daily requirements, which will be well above any monthly average.

The factors to be considered include:

1. Heat transmission through insulated enclosures.
2. Heat infiltration load from warm air passing into and cold air passing out of refrigerated space.
3. Heat from pumps or fans circulating refrigerated brine or air, power equipment, men working in refrigerated space, and heat from lights.
4. Heat *removed* from goods in reducing them from receiving to storage temperatures.
5. Heat produced by goods in storage.
6. Heat to be removed in freezing goods received unfrozen.
7. Other loads such as office air conditioning, car precooling, or special operations inside the building.

Heat leakage or transmission load can be calculated closely using the known overall heat transfer coefficient of various portions of the insulating envelope, the area of each portion, and the temperature difference between the lowest design cold room temperature and the highest average air temperature for 3 to 5 consecutive days at the building location. For *floors on ground, the average yearly temperature* should be used instead of the maximum.

Heat infiltration load varies greatly with these variables: size of room; number of openings to warm areas; protection on openings; traffic through openings; cold and warm air temperatures and humidities. Basis for calculation should be on experience remembering that most of the load occurs during the day operations.

See Chapter 27 of the 1961 Guide And Data Book for a complete analysis of load calculations.

Heat from pumps and fans can also be computed, being close to ¼ ton per hp. The useful load of a motor circulating refrigerated air or brine is reflected as heat to the refrigerating system, even though the motor is outside refrigerated space. The daily load of motors will vary with plant requirements, which normally allow shut down of part of the units except with near maximum loads. Heat due to men working, lights, etc., will vary from day to day with activity of movement and operating control. This load is subject to estimates *from experience*, except for that from total lights which should be in the range of 10 to 20 tons per million cu ft. One watt of lighting per sq ft requires one ton of refrigeration for each 3500 sq ft of floor area.