Table 6 .... Pounds of Product Per 200# Live Hog, 1000# Live Beef, 220# Live Calf, and 90# Live Sheep

Product	Hog	Beef	Calves	Sheep
Livers	3.7	11.0	3.0	0.75
Hearts	0.73	3.65	0.75	0.25
Cheek Meat	0.5	4.0	1.0	
Kidneys	0.61	1.87	-	
Brains	0.24	0.81	0.5	
Tongues	0.38	5.0	1.0	0.5
Lips	0.28	0.7		
Tripe		10.5		
Tails		1.3	0.5	
Plucks			3.0	
Melts	0.31			
Chitterlings	1.25			
Snouts	0.5			
Ears	0.25			
Stomachs	1.6			
Glands	0.07			
Head Meat	0.61			
Gibleta	0.22			

Fig. 5. A typical room layout is shown in Fig. 6. The room shown in sketch is adequate for a 4000 per day hog kill. Refrigeration may be supplied by individual unit coolers, dry coil surfaces of the various types available, or existing brine spray decks. The time required to accomplish the desired result will depend upon refrigeration capacity, length of time high speed air circulation is used, and the manner in which the cooler is loaded. However, this type of cooler is usually operated on an overnight chill schedule with product from the preceding day's kill packaged the following morning.

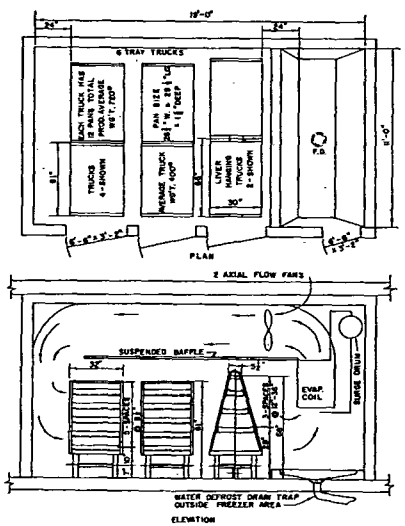

Fig. 5 .... Chilling Room for Variety Meats

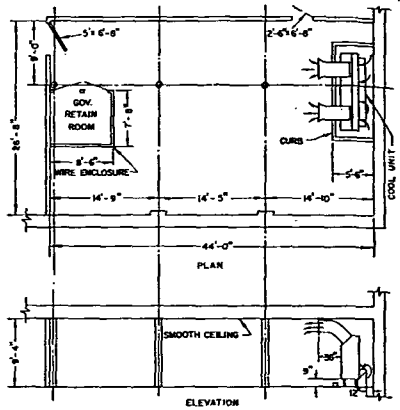

Fig. 6 .... Typical Layout for Cooler Room

Good results may be obtained in the cooler with 30 to 32 F dry-bulb temperature and 83 to 87 percent rh. A higher relative humidity will require much greater evaporator surface. Recirculation of defrosting liquid plus back pressure regulation is the recommended means of controlling relative humidity when a sprayed-surface unit cooler is used. Back pressure regulation, plus a generous factor of safety in sizing the evaporator surface is recommended for dry coil surface installations.

Recirculation of a portion of the brine in spray deck installations is the recommended means of control for brine spray decks.

The refrigeration equipment should be selected to produce the required refrigerating effect, using a maximum back pressure. Direct expansion ammonia units operating at a back pressure of 35 lb and a recirculated air capacity equivalent to 50 changes per hr referred to the gross volume of the room, give good results. It will be noted that approximately 10 F deg temperature difference between refrigerant and cooler temperature is the desired condition for proper cooler operation. Rapid air circulation should be provided during the first part of the chill period to absorb the excess vapor from the warm product. This is usually accomplished by using two-speed motors on unit cooler fans and auxiliary fans if brine sprays on decks are used. This also helps to prevent condensation on previously chilled products in the cooler.

While this method produces a satisfactory product, the shrink is very high. A survey of packers using this method indicates average shrinks as in Table 7.

QUICK CHILLING

A better method and one which is coming into more general use, consists of quick chilling at lower temperature and at higher air velocities, using the same type of truck equipment as in overnight chilling method.

This same method is used for chilling trimmings. Care must be exercised in the design of the quick chilling cabinet or room, to provide for the refrigeration load imposed by the hot product (Fig. 5). The results of an industry survey show

Table 7 .... Average Shrink with Overnight Chilling

Average Shrink	%
Beef, Hog Livers	4
Beef, Hog Hearts	6
Beef, Hog Cheek Meat	5
Beef, Hog Kidneys	1½
Hog Melts	1
Beef, Hog Brains	3½
Beef, Hog Tongues	4½
Hog Chitterlings	22
Hog Snouts	4
Hog Ears	1
Hog Stomachs	8

that approximately 50 percent of the larger establishments are using quick-chill in their variety meat operations.

The quick-chilling cabinet or room should be designed to operate at an air temperature of approximately −5 F with velocities over the product of 500–1000 fpm. During initial loading, the air temperature may rise to 10 F. In the design of these quick-chilling units, refrigeration coils are used with axial flow fans for air circulation.

Prime surface evaporators are generally preferred for chilling variety meats on open trays because the defrost problems are minimized. Extended surface evaporators can be used with packaged products. Recommended defrosting method is with water and/or hot gas, except where units with continuous defrost are used. Chilling of the product is carried to the point where the outside of the meat is frosted or frozen to the extent that a resulting temperature 32 to 34 F is obtained when the product later reaches an even temperature throughout in the packing or tempering room. The time required to chill the product by this method depends upon the depth of the product in the pans, size of individual pieces, air temperature and velocity. Normally, ½ to 4 hr may be considered a satisfactory chill period to attain the required 32 to 34 F temperature. In addition to the obvious savings in time and space by this method, a very important advantage is the shrink, total shrink averaging ½ to 1 percent.

These values were obtained in the same survey as those in Table 7.

There is still another method of handling variety meats. It consists of packaging the product before chilling as near as possible to the killing floor. The packed containers are placed on platforms and frozen in a freezer similar to Fig. 5. Separators should be provided to permit air circulation between packages.

This method is used for preparing products for shipment frozen, or for freezer storage. The internal temperature of the product should reach 25 F for prompt transfer to storage freezer. For immediate shipment, the internal temperature of the product must be reduced to 0 F and this may be done by longer retention in the quick freezer. Here package material and size, with particular reference to package thickness, is most important, as rate of freezing is largely dependent upon these factors. As an example, a 5 in. thickness box will take from 16 hr upward, depending on type of product, package material, size, loading method, etc.

The dry-bulb air temperature in these freezers is maintained at from − 20 F to 0 F with air velocities over the product at 500 to 1000 fpm. The time required to reach the desired internal temperature is a combination of refrigeration capacity, size of largest package, insulating properties of package material, etc. With these factors in mind, a generous safety factor should be used in sizing evaporator coils for this type of service. It is recommended that these freezers be incorporated within refrigerated rooms. Recommended means of defrosting is by the water or hot gas method, except where units with continuous defrost are used. Aside from the advantages in handling, the shrink varies from 0 to ½ percent.

PACKAGING AND STORAGE

Packages for variety meats are at present far from any standard size or dimension. Present requirements insist upon a package that will stand shipping, with sizes to suit each individual establishment. The importance of the package is brought more sharply into focus when the hot pack freezing method is used. Here standardization of sizes and package materials to permit faster chilling and more economical handling in unit loads will pay dividends.

Storage of variety meats is dependent upon the end use by establishment involved. For short storage, under two weeks, and for local use, 32 to 34 F internal product temperature is considered good practice. If stored for shipping, the internal temperature of the product should be kept at 0 F or below. Recommended length of storage is a controversial question; type of package, freezer temperature and relative humidity, amount of moisture removed in original chill and the variations of the products themselves all affect storage life.

Packers' recommendations covering storage time vary on some of the above products from 2 to 6 months and longer with the comment that variety meats pick up rancidity on the surface and that soft muscle tissue dehydrates while freezing. More rapid freezing and a vapor-proof package are important factors in increasing storage life.

REFRIGERATION LOAD COMPUTATIONS

The average evaporator refrigerating load for a typical chilling process above freezing may be computed by using the following formula:

$$H_r = W_m s_m (t_1 - t_2) + W_t s_t (t_1 - t_2) + H_w + H_i + H_m \quad (1)$$

where

H_r = refrigeration load, Btu per hour.
W_m = weight of meat, pounds per hour.
W_t = weight of trucks, pounds per hour.
s_m = specific heat of meat, Btu per (pound) (Fahrenheit degree).
s_t = specific heat of truck, containers, or platforms (0.12 for steel), Btu per (pound) (Fahrenheit degree).
t_1 = average initial temperature, Fahrenheit.
t_2 = average final temperature, Fahrenheit.
H_w = heat gain through room surfaces, Btu per (square foot) (hour).
H_i = heat gain from infiltration, Btu per (cubic foot air leakage) (hour).
H_m = heat gain from mechanical equipment and lighting, Btu per hour.

QUICK-CHILL COMPUTATIONS

The following example will illustrate the method of computing the refrigeration load for a quick-chill operation.

Example 1. Find refrigeration load for chilling 6 trucks of offal from a maximum temperature of 100 F to 34 F in 2 hr. Each truck weighs 400 lb empty and holds 720 lb of offal. The specific heat is 0.12 for the truck and 0.75 for the offal. The room temperature is to be held at 0 F with an outdoor temperature of 40 F and a relative humidity of 70 percent. The walls, ceiling, and floor are insulated with 4 in. of cork.

Solution. Values for substitution in Equation 1 are obtained as follows:

$$W_m = \frac{6 \times 720}{2} = 2160 \text{ lb per hr}$$