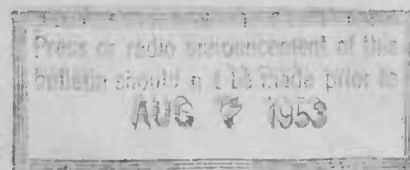


Building **Walk-In Freezers**

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**Agricultural Experiment Station
Oregon State College
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In recent years there has been a great increase in the use of refrigeration on the farm. It provides storage during the peak of harvest and supplies the food products at a later date when they are more expensive.

Cold storage has the advantage of little preparation and ease and quickness of handling. It is generally considered on the farm as storage between 30°-40° F. Products like apples and potatoes can be stored for many months while milk, and more perishable fruits can be kept for several days longer than would ordinarily be possible.

On the farm, frozen food is generally considered food frozen solid at about 0° F. This requires considerable preparation in packaging. It has the advantage that food can be stored for much longer periods of time and can be kept, as a rule, in better condition. Specific information on packaging and storing various foods may be obtained in OSC Agricultural Experiment Station Circular of Information 526, Station Bulletin 494, Extension Bulletin 732, and Extension Bulletin 688.

Due to the advantages of both cold storage and frozen storage, many refrigeration units are designed to take care of both a 0° F. and a 35° F. room.

The purpose of this circular is to answer the many questions as to how such units can be built, what type of insulation should be used, the type of construction, the size and types of mechanical refrigeration units, etc. From this data, a person should be able to figure what work can be done by himself, and what should be contracted. It also enables him to make the necessary purchases to construct this particular refrigeration unit.

Methods of Construction

There are two general types of construction: rigid insulation, which is fastened in place by asphalt, and blanket and fill insulation, which is placed between two walls. Both are good types of construction, and the choice will be dependent upon the experience and skill of the individual or contractor in handling these two different types of construction. Actual material costs are higher when rigid insulation is used, but due to the savings in labor it might be cheaper than fill or blanket insulation, in which it is necessary to build two walls.

Building for blanket and fill insulation

Blanket and fill insulation is perhaps the easiest type of construction for a home builder or local carpenter. The essential parts are an outer wall, a vapor seal, insulation, and an inside wall. See Figure 1.

There is little difference in construction between building either within an existing structure or making a building especially built for the freezer and cold storage unit. In both cases the floors, joists, beams, and foundations should be adequate to hold the load. Normally, a structure designed to hold 40 pounds per square foot should be adequate.

In general, cover the inside stud walls, ceiling and floor joists, etc., with wood sheathing or 3/8" exterior grade plywood. This makes a smooth surface to apply the vapor seal paper. Galvanized nails should be used to nail on the wood sheathing or plywood. See Figure 1.

All freezer or cold storage units that are wider than 10 feet and which are built on concrete floors laid upon the ground should provide ventilation beneath the cold storage and freezer structure. This is done to prevent ice and water from accumulating beneath the concrete floor. Ventilation can take the form of drain tile laid beneath the floor in such a way that the inlet is exposed to the outside air. It is not possible to do this in a structure that is already built. Ventilation can be provided in this case by building a floor on 2 x 4 sleepers laid flatwise 16" O.C. See Figure 3. These sleepers should be treated to prevent rot. Ventilation is secured by venting the spaces between the 2 x 4's.

Selection of insulation

Most commercial types of insulation for refrigeration vary only slightly in their resistance to transfer heat. The following types of insulation have proved satisfactory: mineral wool, cork, specially tested and prepared redwood bark, fir byproducts, corn stalks, sugar cane stalks, etc. The selection of one type over another should be considered as to its fire resistance, ease of application, degrees of settling, moisture absorption, etc. Of particular importance is the ease in which it may be applied. It is difficult to use some types of fill insulation overhead, as they have a tendency to drain out through small cracks and holes. It is perfectly all right to use a fill insulation in the floors and walls and a batt-type insulation in the ceiling. Flyscreen is sometimes used on the ceiling to hold fill insulation. The screen is tacked on at 6" intervals as work progresses.

Ordinarily 6 to 8 inches of insulation should be used in a 35° F. room and 10 to 12 inches in a 0° F. room.

Use of shavings for insulation

Dry planer shavings have been successfully used for insulation in the past. At least 12" should be used in the case of a 35° F. room and 18" in the case of a 0° F. room. Also, care must be used in selecting a wood shaving that does not give a taste or odor to food, such as cedar. Shavings should also be packed to a density of about 8 or 9 pounds per cubic foot.

Low ceilings

Ordinarily at least 6' 6" ceiling height for both a walk-in freezer and cold storage room should be allowed. For many buildings, this is not possible as there may be only 7' 6" in the clear to build. If there is 6" of insulation for both ceiling and floor of a cold storage room, and 10" in the case of a freezer room, then there would be 6' 6" inside for a cold storage room, but only 5' 10" for a freezer room. The freezer could then be a reach-in if one is satisfied with a small room.

Sometimes a large walk-in freezer is wanted. More ceiling can sometimes be made available by insulating the space between the floor joists overhead. The vapor barrier paper is then passed around each joist to the space of the ceiling overhead. The open space where the overhead joists meet the side walls of the freezer will have to be blocked and covered with vapor barrier paper and sealed tight. Insulation then can be placed in this space between the joists. For this latter method to be satisfactory there should be at least 4" between the bottom of the joists overhead and the ceiling of the freezer and this space should be filled with insulation.

Building the vapor seal

The vapor seal is necessary around the entire warm side of the cold storage or freezer structure, to prevent moisture from coming into the insulation and subsequently either reducing its insulation value or deteriorating the material. More freezers and cold storage

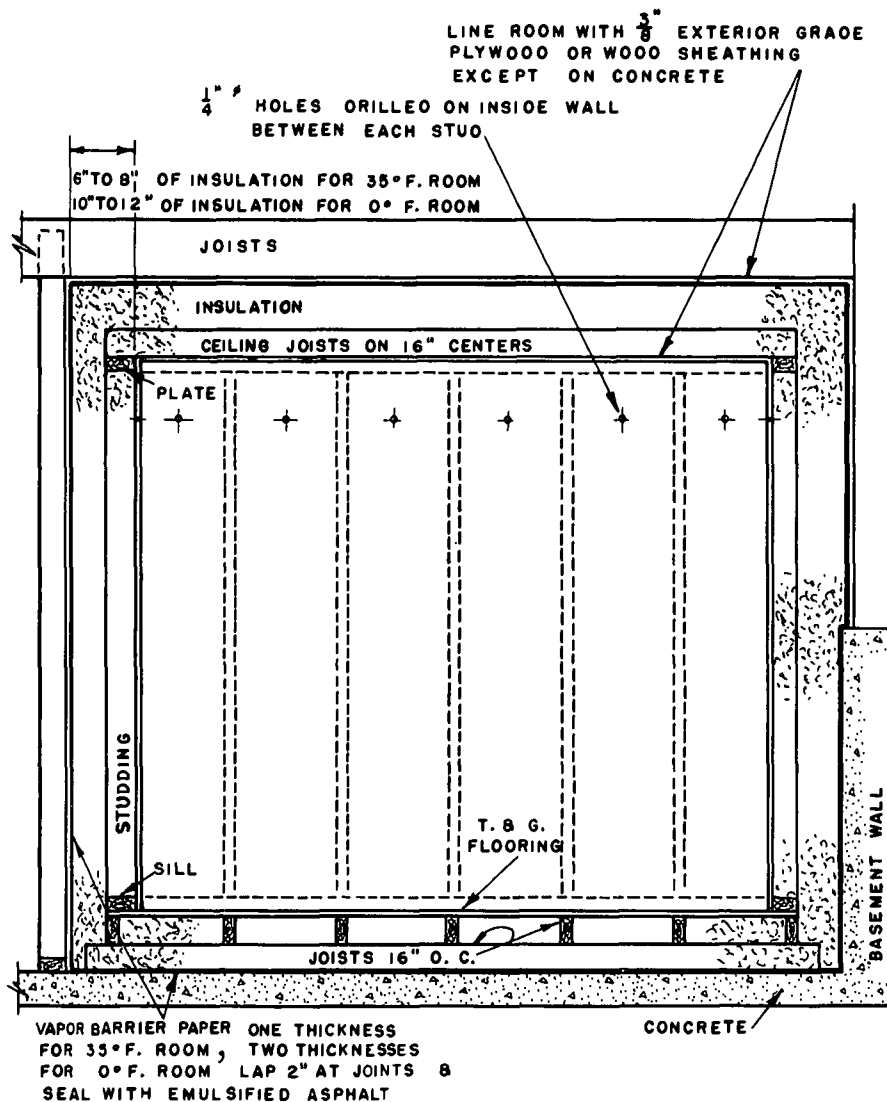


FIGURE 1. A METHOD OF BUILDING A FREEZER OR COLD STORAGE ROOM WITH FILL OR BATT INSULATION

VAPOR BARRIER PAPER ONE THICKNESS FOR 35° F. ROOM, TWO THICKNESSES FOR 0° F. ROOM LAP 2" AT JOINTS & SEAL WITH EMULSIFIED ASPHALT

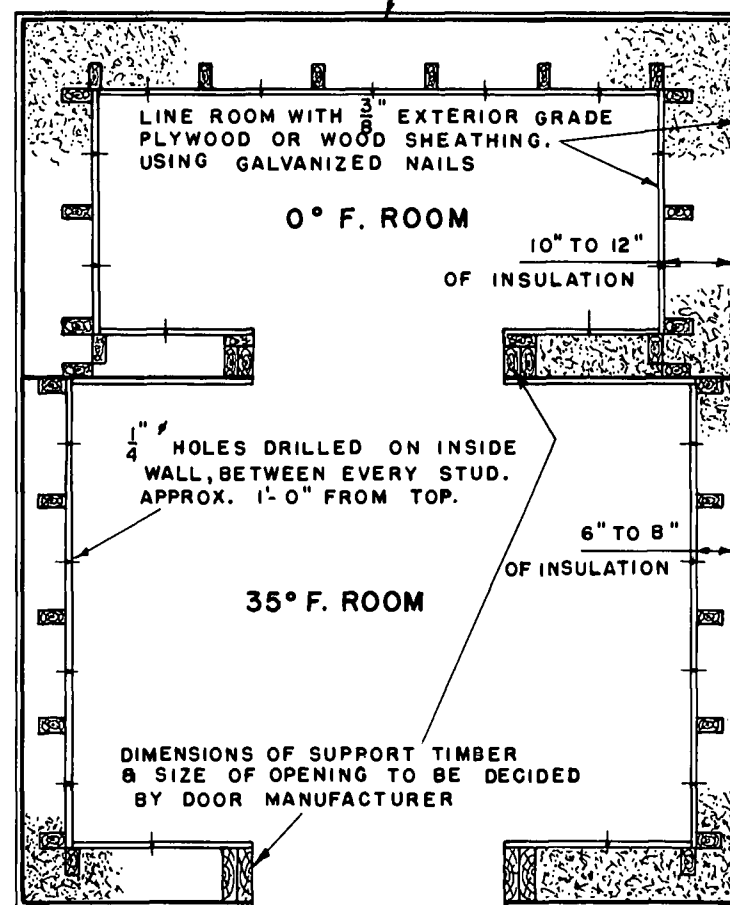


FIGURE 2. GENERAL FLOOR PLAN OF COOLER AND FREEZER

rooms have failed because of an inadequate vapor barrier than any other cause. The easiest way for most builders is to use a regular type vapor barrier paper. Two layers should be used in the case of the zero room and either one or two layers in the case of the 35° F. cold storage room. This paper should be continuous inside over all the 3/8" plywood or wood sheathing wall and over the concrete walls and floors as well. Where the joints meet, they should be lapped for 2" and sealed with an emulsified asphalt. When it is necessary to nail the paper onto the wall, galvanized iron roofing nails should be used. Care should be taken to go into the center of the stud and prevent splitting of the wood and subsequent leaking of moisture around the nail. Each one of these galvanized nails should be painted over with emulsified asphalt to prevent leakage. Particular care should be taken at the door to bring the paper out around to the edge at the door frame.

Use caution in selecting the materials for the vapor barrier. One of the difficulties is that either the asphalt or the paper used will cause an odor in the food. Most types of emulsified asphalts are free from this particular defect; but there are many asphalts, especially those used for coating roofing, in which a mineral solvent is used which gives considerable odor to food.

Many papers fail because they are not vapor proof and allow moisture vapor to penetrate through them. This is true of most building papers.

The vapor barrier paper can consist of Brownskin Vapor-Seal, Bird's Neponset 50 pound, Ruberoid's Giant Sheathing 50 pound black glossy surfaced, and certain types of metal-surfaced papers or equivalent. Do not use roofing paper, tarred felts, red rosin paper, or common building paper--they are not satisfactory.

Use care in selecting the asphalt for sealing the laps and joints as these points may be a source of odors within the freezer or cold storage room as well as the paper. Flintkote Company's Standard Odorless Asphalt Emulsion, B. F. Nelson Manufacturing Company's Odorless Asphalt Emulsion, Asphalt Products Company's Hydro-Proof and Bitumul's Laycold are satisfactory products.

Building the inner wall

The inside framework begins at the floor. Usually, it consists of two layers of joists. One that is run in one direction and the other that is crossed over in the opposite direction at right angles.

Usually for the 0° F. room, it consists of two or three layers of joists built in this manner. Please note Figure 1. This type of construction minimizes the passage of heat through the wood. It is well to brace the floor joists to prevent their turning by using spacer blocks or bridging between each set of joists. This is usually done with short lengths of the same width material as the joists. Care must be used in selecting the proper width of joists if it is necessary to meet a desired floor line. In some cases, it may be necessary to rip one layer of joists to the right width. Insulation is then placed between the joists. Over the top of these joists the floor is placed, generally a vertical grain tongue and groove board. At the outside edge of the proposed inside wall, a 2 x 4 sill is laid. On top of this, the studs are placed usually at about 16" on center. At the door it is necessary to meet both the inside and outside wall. On top of the inside studs are placed a 2 x 4 plate. Then the inside ceiling joists are set up on top of this. These are all held in place by 16-penny nails. See Figures 1 and 2. At this time, one will find that the inside framework is fairly loose and is not sufficiently braced. When the inside walls of plywood or wood sheathing are fastened on these studs they will be adequately braced. A 3/8" exterior-grade plywood or 3/4" wood sheathing is best for the inside walls. The insulation can then be poured. Starting at the bottom, boards are nailed

horizontally and insulation filled to the level of each horizontal piece nailed on. Care must be used in placing the insulation to see that all corners are filled and that the insulation is reasonably packed. Caution should be exercised to see that it is not rammed too tightly in place. Manufacturer's recommendations should be followed. In the case of plywood, it may be necessary to rip off the last foot near the top, in order to fill this last foot with insulation.

Fill insulation can be used in the ceiling by covering the bottom of the ceiling joists with fly screen at 6" intervals and applying insulation at each interval. Also, batt insulation can be placed between the joists.

After construction all the interior walls should have quarter-inch holes drilled between each stud on the inside only. See Figure 1. Any moisture in the insulation is sucked out through these holes by the evaporator coils.

During the construction, particular care must be made in meeting the doors. Normally, the doors will be bought and will come in a standard type frame. This frame is pushed in place between studs made especially for this purpose. The studs should be made to fit this framework of the door; and as a rule, manufacturer's directions should be followed as to spacing of the studs and size of material. Particular care should be taken to see that the floor line meets the threshold of the door and does not provide a place where someone can stumble at the threshold.

The inside should then be painted with a regular type refrigeration enamel that will not give a taste to the food.

Building with rigid-type insulation

The surface to which rigid-type insulation is to be applied should be reasonably even, whether of masonry or wood frame. In the case of masonry, it may be necessary to resurface them with portland cement plaster to obtain a wall with sufficient evenness to enable the blocks of insulation to stick to the surface when asphalt is later applied. Frame stud walls should be covered with 3/8" exterior-grade plywood or some type of wood sheathing.

Individual manufacturers of insulation vary as to what constitutes the best method of making a vapor barrier. In general, the methods are as follows. On masonry walls, concrete primer is applied with a spray gun. Then the surface is mopped with either a hot asphalt or a suitable cold type asphalt. Care must be used to select an asphalt recommended by the manufacturer of the insulation. In the case of a plywood or wood surface, a vapor barrier paper is applied of a type described under fill insulation. This is asphalted in place and nailed on with galvanized roofing nails. This paper is then thoroughly mopped with either a suitable hot or cold asphalt.

Individual units of insulation are then dipped in a hot asphalt on one side and placed directly against this mopped-on surface. Normally, blocks of insulation are from 2 to 4 inches thick and one foot wide to three feet long. These are applied in units directly against this vapor seal paper and in continuous rows so that there is a complete layer of insulation around the walls, floor, and ceiling. See Figure 4. If it is necessary to have more than two thicknesses of the insulation, it is customary to apply the insulation with the long side in the opposite direction. It is merely necessary to dip each block in hot asphalt before applying. Care must be taken to apply one piece right next to the other and leave no cracks between the insulation. Due to the fact that this asphalt as a rule is hot and there is a possibility of burns, either leather gloves, ice picks, or some similar tool should be used to lift the blocks of insulation and put them in place. It also may be necessary to cut certain blocks to fit at the ceiling, corners, etc. This can be done with a saw.

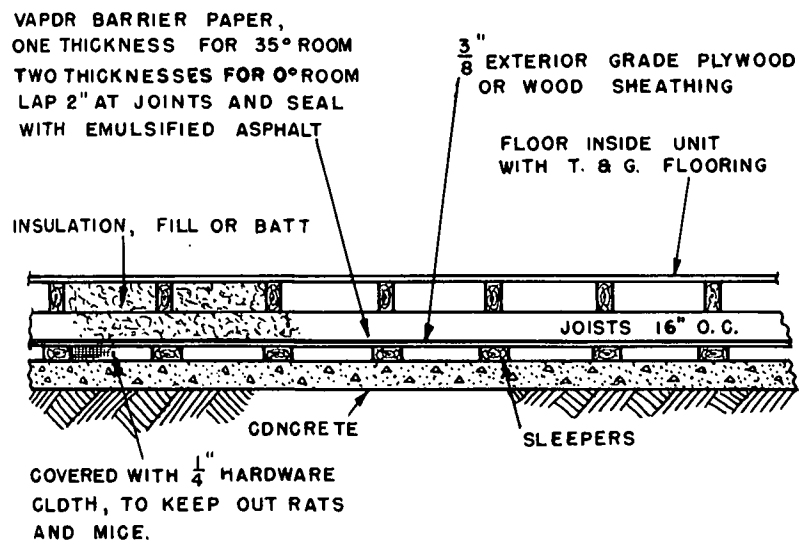


FIGURE 3. A METHOD OF VENTING BENEATH A COLD STORAGE ROOM OR FREEZER, WHEN STRUCTURE IS BUILT ON CONCRETE, LAID ON THE GROUND. THIS IS NECESSARY ONLY IF THE STRUCTURE IS MORE THAN 10 FT. WIDE.

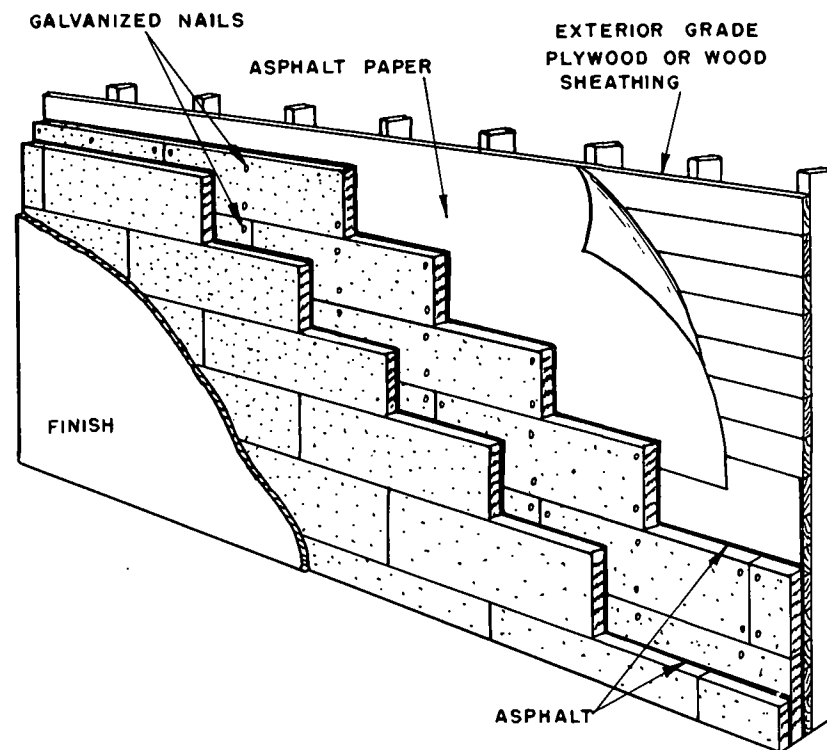


FIGURE 4. RIGID INSULATION

To make an interior finish with this type of insulation, it is customary to plaster over the walls and ceiling. In the case of the floor, concrete can be placed over the surface. Usually this concrete should be 4" thick and of a good mix. A light asphalt felt should be laid over the insulated floor to protect the insulation from moisture during placement.

Individual manufacturers may have slightly different specifications than has been listed here, and, of course, their recommendations for their products should be followed.

Construction of doors

Refrigeration doors may be either home built or factory made. Unless one is a cabinet maker or a very skilled carpenter, it is not wise to attempt to build the door at home. There are a number of very fine requirements that are necessary to make satisfactory doors. The plan shown in Figure 5 illustrates a satisfactory type of home-built door. Care should be used to dowel the joints together, especially where they meet an outside surface. A rigid-type insulation should be used within the door to prevent settling of the insulation. Only the best type dried and selected material should be used for the doors.

Ready-made doors are generally the easiest to install and perhaps the best to use. These doors are generally bought with hinges, latches, and framework. It is only necessary to place them into a stud framework and fasten them with large lag screws or plain screws. Manufacturer's recommendations should be followed as to the support of the doors and size of opening. Be sure the vapor barrier paper inside comes around and meets at the outside framework of the door.

Electrical Installations

It is well to have the electrician go over the freezer plan before construction. Conduit wiring should be used throughout the inside of the cold storage or freezer rooms. It is necessary to provide a vapor seal in the electrical wiring conduit where the wiring goes through the vapor barrier. This can most easily be accomplished by making a coupling or entrance ell at this point. See Figure 9. At the outside wall, the inside of the conduit is stuffed with a thick emulsified asphalt or some similar type of material to make the seal. This should also be done on the outside of the conduit at the vapor barrier.

If the conduit in the insulated wall is covered with a tube of cork or similar insulated material, it helps prevent an accumulation of moisture on the outside of the conduit.

The following points should be considered for wiring. The electrical motors for the compressor motors should have adequate wire sizes for their motors, with magnetic switches with motor running current protection and disconnecting means. There should be adequate vapor-proof light fixtures inside controlled by a switch with warning light outside. There must be a vapor-proof convenience outlet inside with adequate wire size for each blower coil. Also if blower coils are defrosted electrically, an electrical outlet with adequate wire size must be provided for the defroster.

On large walk-in 35° F. rooms, it is best to use a solenoid valve with thermostat along with the rest of the controls. An electrical outlet must be provided for this solenoid valve.

While it isn't necessary, it adds to the appearance if it is possible to have the conduit inside the walls and only appear when an outlet or a light fixture is necessary. See Figure 9. It is well to carry this conduit next to the inside cold wall, as much as possible, to prevent vapor from collecting in the lines. In the case of rigid-type block insulation, electrical outlets can be fastened to blocks of wood secured with asphalt in the insulation.

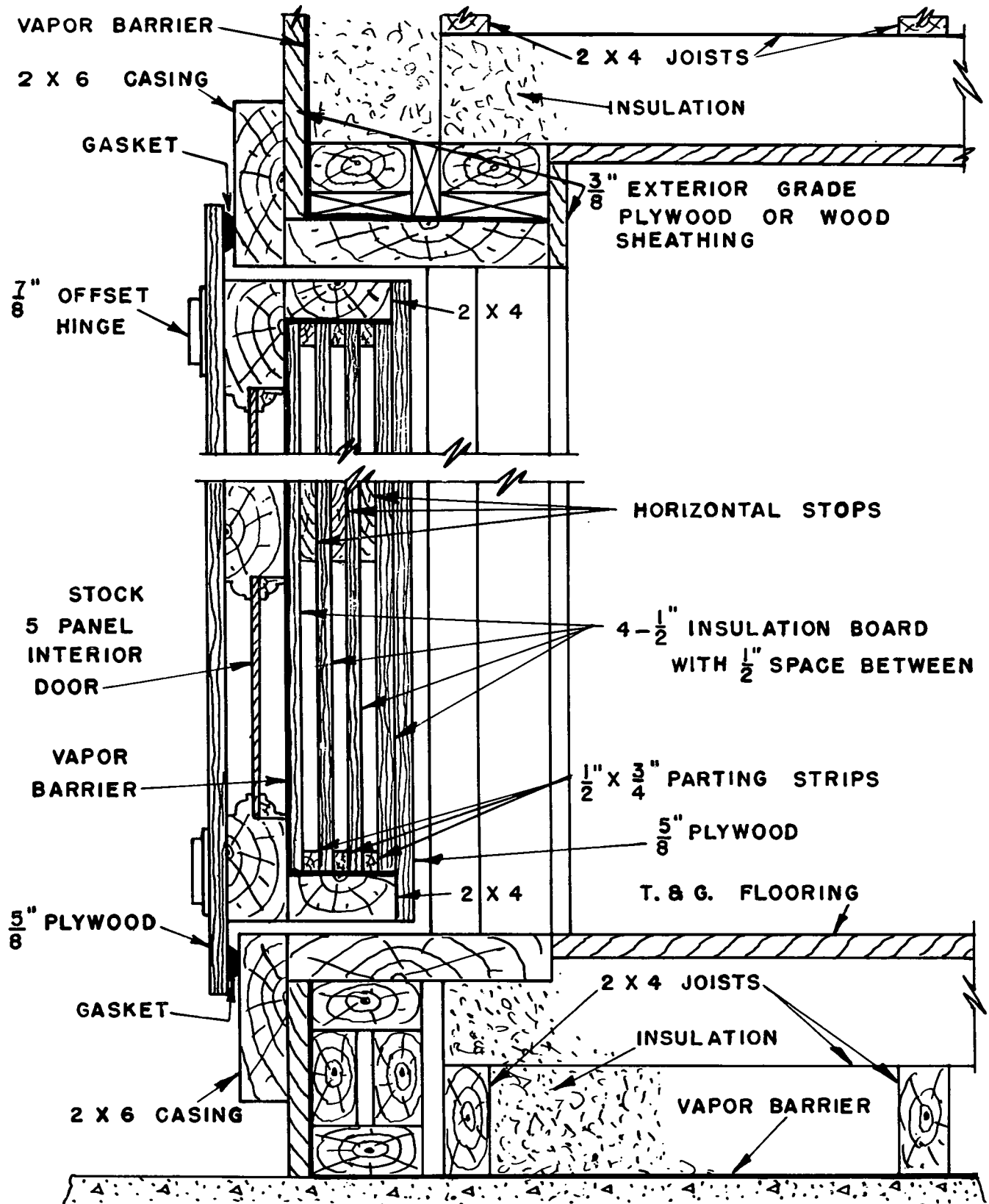


FIGURE 5. VERTICAL SECTION, HOME-BUILT DOOR DETAILS

Selection of Mechanical Equipment

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The hookups and suggestions given here are for farm walk-in refrigerator units with no individual unit larger than 500 cubic feet. For a larger installation, special-type equipment and installation is necessary.

Differences in size and volume of the refrigeration and temperatures inside and out, and the amount of food to be frozen at one time must be taken into account. It is difficult to state the size of a unit. On Tables 1 and 2 is listed the various size compressors, evaporators, or thermal expansion valves and other types of controls for various size units. This is based on a standard of 10 inches of insulation for the zero degree room, 6 inches of insulation on the 35 degree room, and for 4 inches of insulation in between the two rooms. It is assumed that this will be a commercial-type insulation that is adequately and properly installed in accordance with manufacturer's recommendations. For larger thicknesses of insulation, of course, these requirements would hold while for smaller thicknesses of insulation, larger type units would be necessary. These requirements for size of units are based on the normal requirements for most farm units. Larger installations that require a larger load or, in other words, more things to freeze or cool at one time, should, of course, be of a larger size.

Table 1. Recommended Sizes of Mechanical Refrigeration Units
for 0° F. Rooms*
(Based on Freon 12, air-cooled equipment)

Size of room	Condensor: (capacity at -20°F. suction and 80°F. ambient)	Evaporators		Thermal expansion valve minimum size	Drier minimum size
		Blower coil: (operating at 10°F. below room temperature)	Pipes, tubing, † or plate: (evaporator surface per cubic foot of freezer)		
	BTU/hour	BTU/hour	Square feet	Tons	Tons
0 to 25 cubic feet	1,000 (about 1/4 hp.)		1 1/2	1/4	1/4
25 to 50 cubic feet	1,300 (about 1/3 hp.)		1 1/2	1/3	1/3
50 to 100 cubic feet	1,900 (about 1/2 hp.)	2,000	1 1/4	1/2	1/2
100 to 200 cubic feet	2,900 (about 3/4 hp.)	3,000	1	3/4	3/4
200 to 300 cubic feet	3,900 (about 1 hp.)	4,000	1	1	1
(Walk-in)					
300-500 cubic feet	5,800 (about 1 1/2 hp.)	6,000	1	1 1/2	1 1/2
(Walk-in)					

*It is assumed that the walls contain 10 inches of commercial type insulation properly placed, and that this unit is next to a 35° room with 4 inches of insulation. Variations in the ratio of width to length of a freezer have small influence on capacity. It is assumed that the head room in all cases is at least 6 feet, and not over 8 feet.

The units listed above will take care of the average farm load. Where it is contemplated that great quantities of food will be placed in at one time, special calculations by an engineer should be made.

These units are specified for the average farm load and should not be used for locker plants and other commercial establishments.

† Some freezer plates have higher rates of heat absorption and manufacturer's recommendations should be followed.

It will be noted in each case a separate condensor unit is recommended for each room. This has proved superior. It has the added advantage that should one unit break down, the other unit is able to take over and operate both units for a short period of time if the proper refrigeration connections are made. Another simple method is to leave the door open between the two units when one compressor breaks down. Ideal conditions are not obtained; but a complete warmup is prevented, especially if the temperature is turned down a little on the 35° F. compressor if that is the one operating. If one condensing unit is used, as shown in Figure 7, it should have the capacity of the two units, as shown in Figure 6.

Table 2. Recommended Size of Mechanical Refrigeration Units
for 35° F. Rooms*
(Based on Freon 12, air-cooled equipment)

Size of 35° room	Condensor: (capacity at +20°F. suction and 80°F. am- bient)	Evaporators		Thermal expansion valve minimum size	Drier minimum size
		Blower coil: (operating at 10°F. below room tempera- ture)	Pipes, tubing,† or plate: (evaporator surface per cubic foot of freezer)		
	<u>BTU/hour</u>	<u>BTU/hour</u>	<u>Square feet</u>	<u>Tons</u>	<u>Tons</u>
100 to 200 cubic feet	2,000 (about 1/4 hp.)	1,400	0.6	1/3	1/3
200 to 300 cubic feet	2,700 (about 1/3 hp.)	2,000	0.6	1/3	1/3
300 to 500 cubic feet	4,000 (about 1/2 hp.)	2,700	0.6	1/2	1/2

*It is assumed that the walls contain six inches of commercial type insulation properly placed. Variation in the ratio of width to length of a freezer has small influence on capacity. It is assumed that the head room in all cases is at least 6' 6" and not more than 8 feet.

The units listed above will take care of the average farm load. Where it is contemplated that great quantities will be placed in at one time, special calculations by an engineer should be made.

These units are specified for the average farm load and should not be used for locker plants and other commercial establishments.

†Some freezer plates have higher rates of heat absorption and manufacturer's recommendations should be followed.

Condensing units

As a rule, it is well to use air-cooled condensor units for most farm units. Care must be used in placing the units so that there is adequate ventilation. If it is not possible to secure satisfactory ventilation, then it is necessary to use a water-cooled condensor. Water-cooled condensers require water under pressure, as well as a drain to take the excess water away. A water-cooled condensor is more efficient than an air-cooled one, but the installation costs are higher.

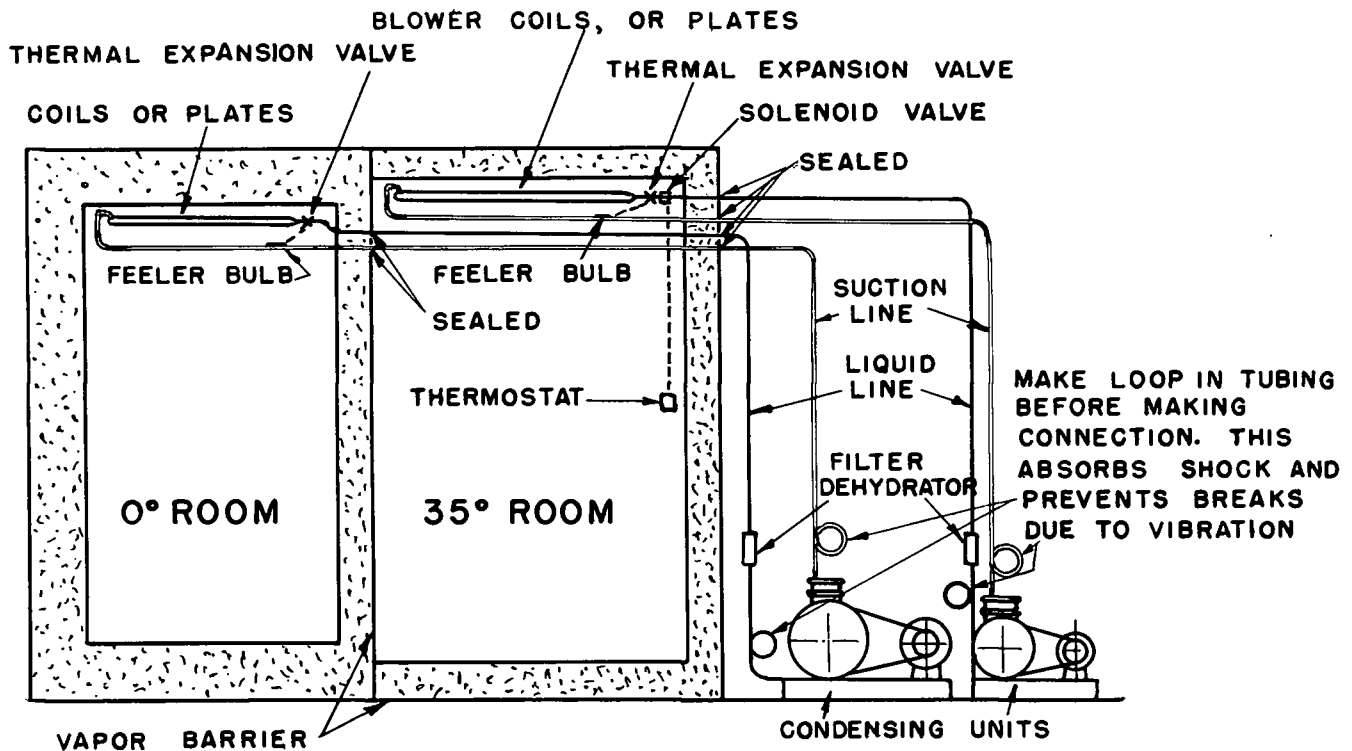


FIGURE 6. REFRIGERATION HOOK-UP FOR TWO CONDENSING UNITS.

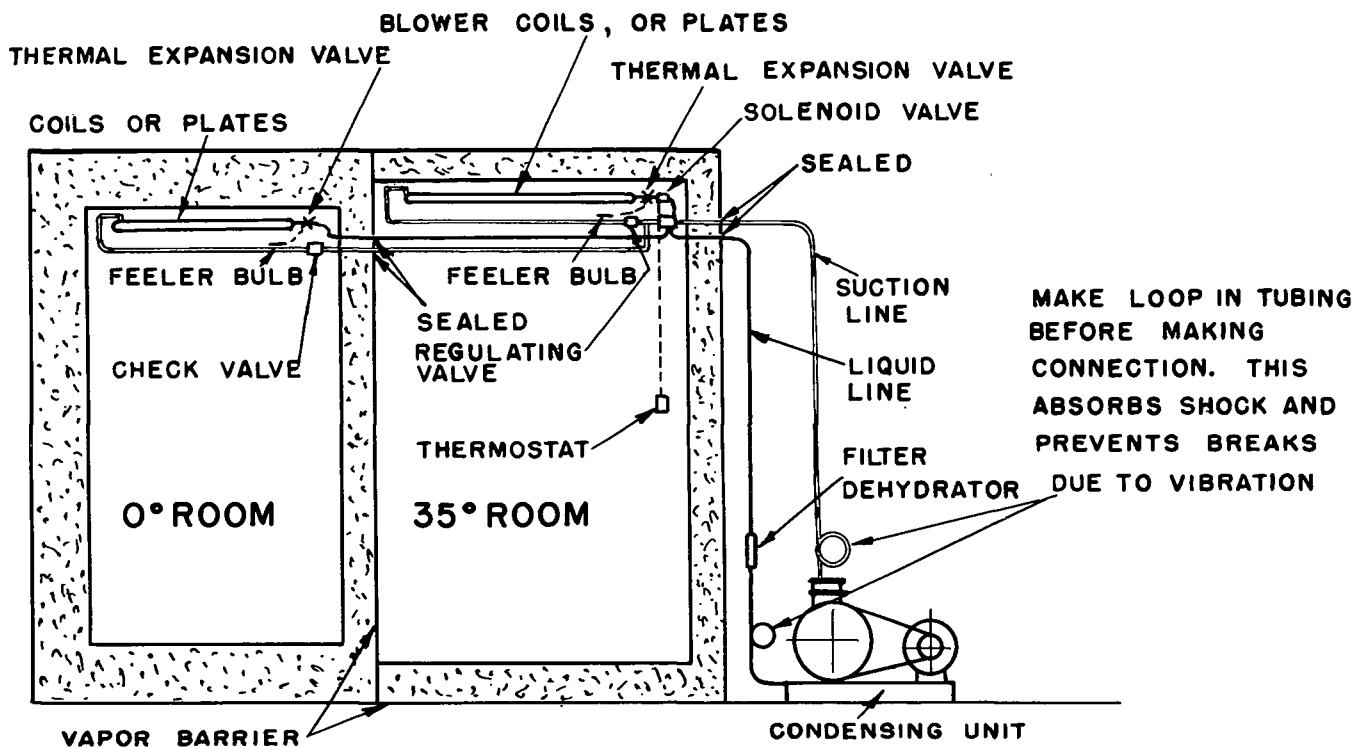
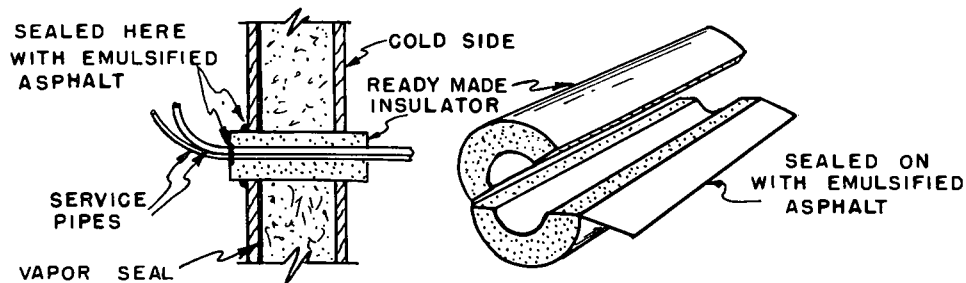
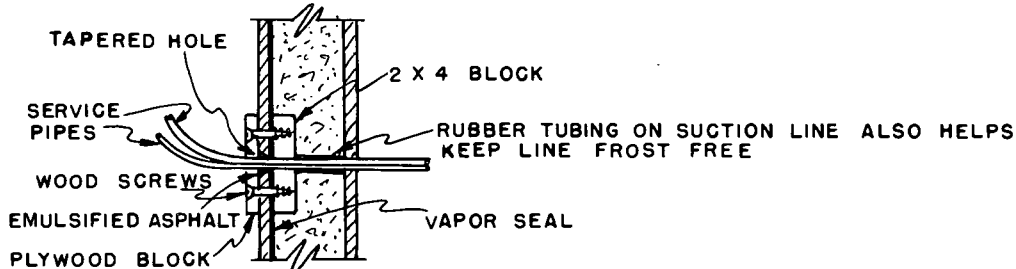


FIGURE 7. REFRIGERATION HOOK-UP FOR ONE CONDENSING UNIT.



A READY MADE PIPE INSULATOR THAT CAN BE USED AROUND SERVICE PIPES IN THE INSULATED WALL. IT SHOULD BE SEALED IN TIGHT AT THE OUTSIDE WALL AND WHERE THE EDGES MEET WITH EMULSIFIED ASPHALT



A 2 X 4 BLOCK IS FASTENED ON THE INSIDE OF THE OUTSIDE WALL WHILE BUILDING A HOLE IS THEN CUT IN THE INSULATED WALL AT THIS POINT THAT WILL JUST ALLOW THE SERVICE TO ENTER. THE HOLE IS TAPERED OUT FROM THE OUTSIDE. A WOOD BLOCK OF $\frac{3}{4}$ " WEATHER-PROOF PLYWOOD IS THEN BORED TO JUST FIT THE SERVICE PIPES. AFTER PLACING THE SERVICE PIPES IN THE WALLS THE BLOCK IS SLIPPED ON THE OUTSIDE OVER THE SERVICE PIPES. THE TAPERED HOLE IS THEN FILLED WITH EMULSIFIED ASPHALT AND THE $\frac{3}{4}$ " BLOCK FASTENED IN TIGHT TO THE WALL WITH SCREWS.

FIGURE 8. METHODS OF SEALING AROUND SERVICE PIPES IN THE INSULATED WALLS.

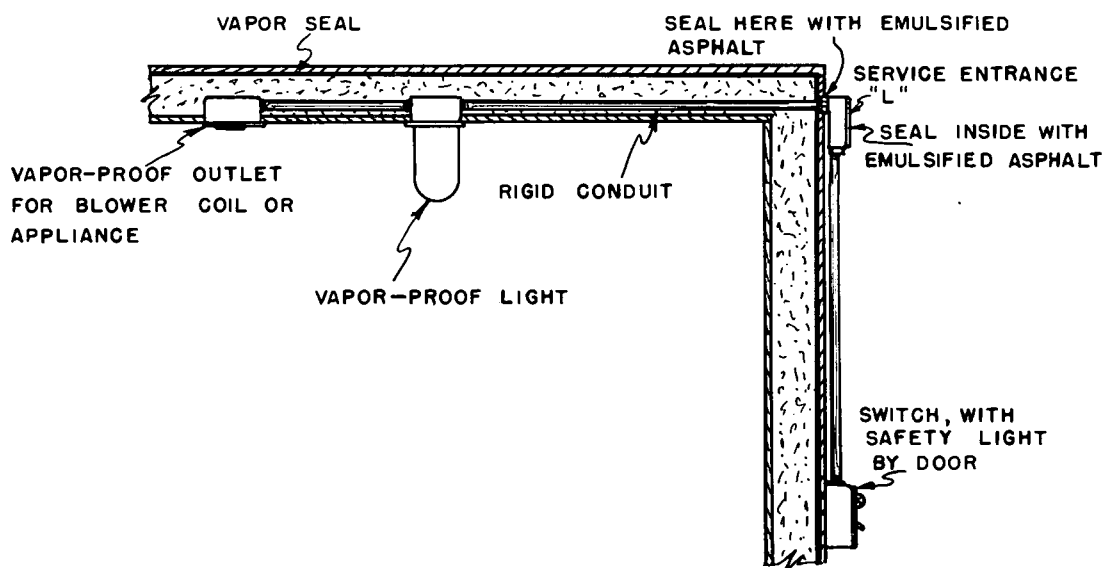


FIGURE 9. A METHOD OF WIRING THE INTERIOR OF A FREEZER ROOM OR COLD STORAGE ROOM



Figure 10. A blower coil hung from the ceiling. Note the provision for water drainage below.

Figure 11. Tubing hung from the ceiling. Freezer plates can be supported in a similar manner, or can be set up in the form of shelves.



Best results for the small farm has been found to be freon condensing units. There is less trouble with toxic gasses; and, as a rule, more trouble-free operation has been obtained.

The compressor motors should be adequately wired with the proper size wire to handle their particular unit. Most compressors of half horsepower and larger require a magnetic switch with thermal heaters. It is well to have motor running current protection on all motors of condensers, to protect them in case of a short overload or low voltage on the line. Unless one is thoroughly familiar with electrical wiring, the wiring should be done by a licensed electrician. See the section under electrical wiring.

Selection of evaporator

There are four general types of evaporators: Plates, pipes, tubing, and blower coils. Pipes, tubing, and plates are generally placed along the ceiling. These may be made of either copper or iron. Some units are prefabricated while others are made on the job. Plates are often arranged in the form of shelves. The surface of the evaporators exposed to the interior should be adequate to prevent drying out of the material or food within the freezer or cold storage room. See Tables 1 and 2 for capacities. As a rule, both freezer plates and blower coils have a greater capacity per square foot of evaporator surface than plain pipes and tubing.

Blower coils are becoming more popular. They are usually hung from the ceiling. Their advantages are their small size and compactness, ease of defrosting, and better circulation of air within the storage. Again, an adequate size blower coil must be used if satisfactory results are to be obtained. An undersized blower coil will dry out the food just as quickly as a small-size plate or coil and will require defrosting more often. Blower coils can be used in 35° rooms with a drain that will take off the excess water in between operating cycles of the refrigerant. In the case of 0° rooms, some method must be used to defrost the coils and the coils must be designed for freezing temperatures. Defrosting is generally accomplished either with hot gas, electricity, or water. All methods are satisfactory if properly designed.

Be sure to include a drain to water for all blower coils. A drain should have a continuous down hill run.

Selection of control units and miscellaneous equipment

The usual equipment for the refrigeration units is a thermal expansion valve and a dryer strainer combination. This, as a rule, has given very satisfactory results if care is used in having the proper size unit. On the larger rooms a thermostat controlling a solenoid valve before the thermal expansion valve gives better results than a thermal expansion valve alone. The sizes listed in Tables 1 and 2 should take care of freezers and cold storage rooms recommended. Some types of thermal expansion valves are multiple purpose in that they have a series of holes inside which can be selected for the particular size load. Care must be used during installation to use this proper size hole. Finally, when purchasing, match, if possible, the size tubing or pipe size of the thermal expansion valve with that of the compressor and blower coil or tubing. It will save fitting together the pieces later on with bushings and reducers which are apt to leak.

A dryer strainer unit is selected depending upon the size of refrigerating unit. The recommendations shown should be satisfactory for the freezers listed in the table. Again, match size of tubing, if possible, of the dryer strainer unit with the liquid line from the compressor. Larger size dryers and strainers are practical for smaller units.

Opening for service pipes and tubes

Provision must be made for the entrance through the walls for the liquid and suction lines from the compressor, for drainage of water from the blower coils, and for electrical wiring. Discussion of electrical entrances has been included under the heading of Electrical Installations. If possible, try to limit the number of places that service pipes enter. Of course, the water drains from blower coils must always be made to run down. A convenient setup is often made from a section of rubber hose from an automobile radiator. The rubber hose is made long enough to fit between the two walls. Two short pipe nipples are painted with gasket cement on the outside and forced into either end of the hose. The hose clamps are fastened to either end of the hose to hold the clamps on. This device is placed between the walls where it is desired to run tubing. A lock nut is placed on either end to hold the device in the wall. After the tubing is run through this device, asphalt emulsion is used to seal the end on the outside.

There are also conventional cork devices purposely made for permitting tubing to run through the wall. These are more expensive, but do an excellent job.

Another type of seal for service pipe is made by sealing a tapered hole with emulsified asphalt. A tapered hole is made in a piece of wood about 1 1/2" thick with an auger. This wood block is fastened to the vapor seal securely. Service pipes are run through this hole. Then the hole is filled up with emulsified asphalt around the service pipes. Another block of wood with a hole in it is slipped on the end of the service pipes on to the wall and then fastened in place with screws. If slightly more emulsified asphalt is used than is necessary to fill the hole, the excess squeezes out when the block is screwed in place and makes a tight seal. See Figure 8.

Connecting Up and Starting Unit

The actual connections generally consist of a number of flared and sweated joints of copper tubing. This work should usually be given to a refrigeration man, as the average person cannot make satisfactory joints that will prevent leakage at a later date. Also, it takes a good deal of skill in knowing how to start up the unit. The actual placement of the compressor, securing it to the foundation and fastening blower coils in place, can usually be done by the individual, if care is used in making the supports strong enough and placing them in the right positions. To reduce vibration, condensor units can be placed upon cork bases. Some units, however, are built with springs to take up the vibration.

Next to the compressor or blower coil, the tubing should form a loop. This loop absorbs the shock of vibration and prevents leaks at a later date.

Fifty-fifty solder joints are satisfactory, provided the vibration is not severe, and, in this later case, it is well to use silver solder joints or brazing compounds purposely made for sweated fittings of refrigerating systems. A threaded fitting can be made tight by dipping the threads in solder before fastening them together.

Care During Use

In order to obtain satisfactory results, freezers and refrigerators should be defrosted at regular intervals. In the case of blower coils in 35° F. rooms, this is taken care of by the defrosting between cycles. To defrost pipes and plates placed along the ceiling many times is a disagreeable job. The usual way is to place large sections of canvas beneath the pipes or plates; then, warm up the refrigerator or freezing unit with fans and allow the water to drain off the canvas to some type of container. Usually this means stopping the unit for some length of time. Care should be used to store the food in packages that will keep them cool during this process. In order to hasten the job, many times small heaters are placed in the refrigerator. These should not be placed close to the pipes or plates as they are apt to break the evaporator from the heat. Small fans can also be used to bring outside air into the unit and circulate it within the refrigerator. This is usually the better thing to do.

It is necessary to defrost the blower coil in 0° F. rooms. This is usually done with water, hot gas, or electricity. The drain from the coil must be protected from freezing. Defrosting should be done at regular intervals if the efficiency of the system is to be maintained.

Check the motors at frequent intervals on the compressor and blower coil to be sure that they are lubricated at the proper intervals with the right type of lubricant recommended by the manufacturer. Do not overlubricate, as it is apt to run over on the inside of the motor and cause trouble.

Check the compressors and blower coils to see that they are adequately supported at all times. It may be that in time the bolts work loose. It is well to stop the compressors sometimes by shutting off the electricity and blowing out the fins on the condensor coils that sometimes become very dirty. This improves their operation.

On open-type compressor units, it is well to have extra fan belts ready, in case one of them should break. Watch the connections between the compressor, evaporator, thermal expansion valve, etc. A small collection of oil at a joint usually means that a leak is occurring at that point. Many times this is due either to a jar or to vibration. Forming the copper in loops prevents leaks by vibration, and protecting tubing by guards prevents breakage.

In the case of water-cooled compressors, be sure that water is being supplied continually. If the water is off for any length of time, the condensing unit should be shut off.

Following these instructions should make for continuous and satisfactory freezer and cold storage operation.

Table 3. Approximate Capacity of Freon 12 Condensing Units

(Individual condensing units may have either greater or lesser capacity, depending on their speed and the conditions under which they operate)

Size of motor or compressor	Aircooled, 90°F. air		Water cooled, 75°F. water	
	Room temp. 0°F. Suction temp. -20°F.	Room temp. 35°F. Suction temp. +20°F.	Room temp. 0°F. Suction temp. -20°F.	Room temp. 35°F. Suction temp. +20°F.
	<u>BTU/hour</u>	<u>BTU/hour</u>	<u>BTU/hour</u>	<u>BTU/hour</u>
1/4 hp.	1,000	2,000		
1/3 hp.	1,300	2,700	1,600	3,400
1/2 hp.	1,900	4,000	2,400	5,100
3/4 hp.	2,900	6,000	3,600	7,600
1 hp.	3,900	8,000	4,800	10,100
1 1/2 hp.	5,800	12,000	7,500	16,000