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Choosing and Using Your Refrigerator

Michigan State University Extension Service

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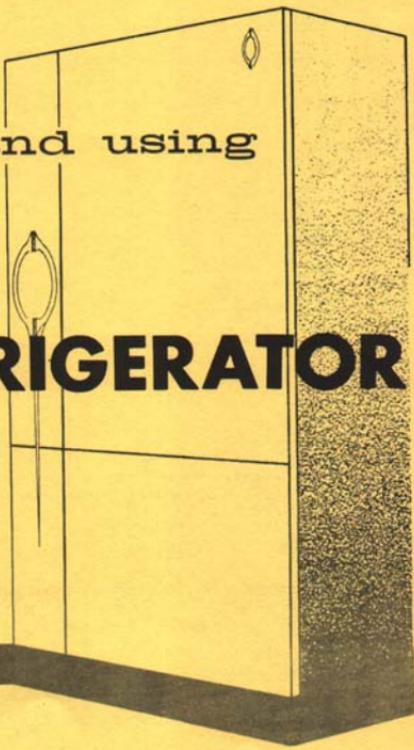
Extension Bulletin E-390
HOME AND FAMILY SERIES



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Choosing and using

● **YOUR**
REFRIGERATOR



Cooperative Extension Service
Michigan State University

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A REFRIGERATOR DOES MORE THAN KEEP YOUR FOOD COLD. IT:

- helps guard the health of your family by retarding food spoilage.
- offers temperatures from cool to cold to below freezing.
- protects your pocketbook—you can buy in larger quantities, save leftovers, cut down waste.
- requires little of you—weekly cleaning, defrosting (depending on the model) and electricity

Recent developments in refrigerators are exciting. New sizes, new features, new methods of defrosting all add up to new prices, but not necessarily to higher prices. You can buy a good refrigerator, adequate in size, for less than \$200. Or you can pay up to \$800. The average retail price paid for refrigerators in 1962 was \$287.¹

On the following pages are descriptions of the major types of refrigerators. When you find the one that suits you best, study it carefully so you'll know what to look for when you go shopping.

HOW DOES A REFRIGERATOR WORK?

A refrigerator is designed to cool the food placed in it and the air that surrounds this food inside the compartment. Whether or not your refrigerator will also provide long-term storage of frozen food depends upon the model you select.

To function properly, regardless of model, your refrigerator must have some means of removing the warm air that is brought in by the food, or that enters through the door and walls. In an electric refrigerator, the heat is absorbed by a liquid refrigerant (Freon). Gas refrigerators are cooled with ammonia. The refrigerant is held in evaporator coils. The location of this freezer section is a key factor in determining the model of your refrigerator.

Refrigerators differ chiefly in (a) the temperatures maintained in the two compartments and (b) their provision for eliminating frost. The wide range of choices offered makes it difficult to decide which model will meet your needs. There are about 25 manufacturers of electric refrigerators alone, and some of these offer as many as 14 different units.

Gas refrigerators are produced by only a few manufacturers. These refrigerators operate more quietly than electric models, but the features are about the same. Purchase price will likely be somewhat higher than for electric models, but operating costs may be lower. Information in the major portion of this leaflet refers to electric units, although much of it applies to gas models also.

REFRIGERATOR MODELS

There are two main groups of refrigerators: standard or "conventional" models and refrigerator-freezers or "combinations." It is well to distinguish between these quickly before we discuss the details of each.

"Standard" models provide fresh food storage and and short-term preservation of a limited amount of frozen food. The freezer section is an integral part of the total refrigeration space. Constant air movement takes place naturally between the two compartments, creating temperature fluctuations in the freezer section that are not conducive to proper freezing of foods or storage of frozen food. Air temperature in the fresh food compartment is usually more than adequate.

¹ See References on page 11

In the combination refrigerator-freezers, the two compartments are insulated (sealed off) from each other, hence there is no air movement between them. The freezer section maintains approximately zero degrees. This zero temperature permits freezing of foods and long-term storage of frozen foods. Temperature in the fresh food compartment is often several degrees lower than in a standard model.

There are three general types of refrigerator-freezers, each with its own advantages, as described later in this leaflet.

One out of five families now owns a separate freezer. As a result, many families see no need for having a freezer section take up part of the space in their refrigerator.

Two newcomers to the refrigerator market are the manufacturers' answer to the growing demand for a refrigerator with little or no freezer space.

THE ALL-REFRIGERATOR

Contrary to its name, the new all-refrigerator does have a small freezer compartment. This space provides a minimum of freezer space, generally just enough for a few (2-3) ice-cube trays and a few packages of frozen food. This means that there is additional fresh food storage space available.

On the disadvantage side, purchase price is higher and operation costs are apt to be considerably higher than standard models. One reason for this—the freezer section is most often found at the bottom. Therefore, a fan is needed to circulate the cold air up into the fresh food area.

COMPACTS

One of the new words in refrigerators is compacts. Most of these small, one-compartment refrigerators have less than 5 cubic feet of storage area, although a few have 6 cubic feet. Manufacturers point out that compacts can be moved around, loaded into cars, taken to camps or wherever electricity is

available. The future trend in refrigerators may be toward separate units of this sort located all over the house—a compact for ice cubes and beverages in the living room, one on the patio, another in the dining room for desserts and table use. Most compacts are operated by electricity, although a few gas models are available. Manual defrosting is most common. The compacts are likely to cost more per cubic foot to buy and operate than small (10-11 cubic feet) standard refrigerators.

STANDARD (OR CONVENTIONAL) REFRIGERATORS

Special pointers:

- Generally the lowest priced models of each manufacturer's line (except compacts).
- Operating costs will be less than those of combination refrigerator-freezers.
- Have a single exterior door.

There are 2 compartments—not sealed off from each other. This model is sometimes called the "uninsulated" refrigerator.

- The fresh food compartment has above freezing temperatures, ranging from 37° - 45° F. This section is always located below the frozen food compartment. Since it is cooled by a descending flow of cold air, food placed on the defrost or chiller tray often freezes.
- The frozen food storage area has below freezing temperature, averaging 10° - 15° F. This is not a true freezer and should not be used as such.

Research at USDA² showed a top-compartment temperature range from 10° to 28° F. in the models tested at standard cold-control settings. At the coldest settings, the temperature went even below 0° F. in some cases. In all cases, temperature in the fresh food storage area went below freezing at the coldest settings because of additional cold air dropping from the freezer compartment. Proper adjustment of the airflow (described below) might lessen this control problem.

² See References on page 11

Evaporator coils—One set of freezing (cooling) coils serves both compartments. These coils are located in or around the cold storage space, placed across the top of the refrigerator. In this type it is desirable to have some method of controlling the amount of airflow between the freezing section and the fresh food compartment. Some models have an adjustable narrow crosswise flap or baffle at the rear of the compartment, often attached to the back of the defrost pan or to the back of the food compartment.³ When closed (flat) the baffle keeps more of the cold air in the upper section. When opened it allows more cold air to drop into the fresh food compartment, especially important in the summer when room temperatures are warmer. Sometimes the baffle is operated automatically in connection with the cold control.

In other models the flow of cold air may be controlled by adjusting the position of the defrost tray. Whatever method of control is provided, it should be easy to regulate. The easier it is to adjust the airflow, the more control you will have over temperatures.

Defrost method—manual. Few standard refrigerators have automatic defrost. Most have a temperature control with a defrost position—you turn the dial off by hand and turn it back on after defrosting

is completed. Some have a push button that provides for faster defrosting by introducing heat. In this case, after defrosting, the refrigeration cycle starts automatically. It is easiest to defrost the cold compartment when cleaning the refrigerator compartment.

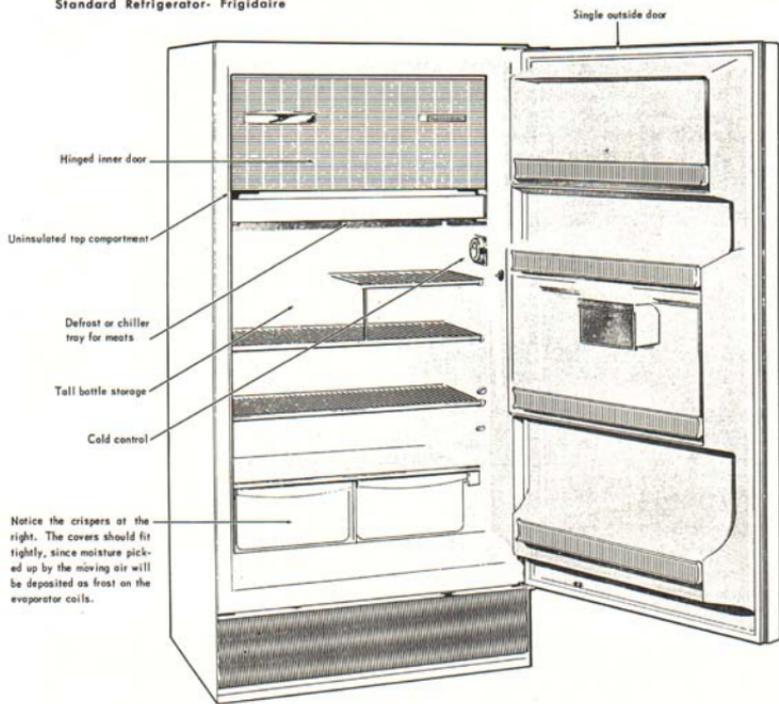
General information—Cool air falls naturally and warm air rises. Therefore, a standard refrigerator has a good fresh food storage compartment because cold air is always moving down from the uninsulated top section. But this type has a poor frozen food storage area because the warmer air can move up into the top compartment. Food kept for more than 2-3 weeks in the frozen food storage area will rapidly deteriorate in quality and lose food value.

Usually, an inside door covers the front of the colder storage area. If this is hinged on the side rather than at the bottom, it is more convenient to reach into the compartment without having to open fully the outside door.

The defrost tray, directly below the evaporator coils, serves as a storage space for fresh meats, except during defrosting. The meat may freeze in this location unless it is protected by heavy insulating paper. Before you buy, it would be wise to check the ease with which this tray is removed and replaced, since you'll be using it often.

³ See References on page 11

Standard Refrigerator- Frigidaire



Combination Refrigerator-Freezers

1. Most models have two exterior doors. All have an insulated door to freezer section.
2. All have two separate compartments, insulated from each other.
3. Freezer at the bottom is gaining in popularity, due to larger freezer capacity.
4. In comparing the three types, (*) indicates important differences.

Refrigerator - automatic defrost
Freezer - manual defrost

<p>Refrigerator compartment</p> <p>Defrost cycle method Temperature in compartment 38°-44° F.</p> <p>Air circulation natural</p> <p>Coils on freezer plate, visible inside food compartment, usually at upper back or at the top</p>	<p>Freezer compartment</p> <p>Defrost manual</p> <p>Temperature 0° F., true freezer</p> <p>Air circulation natural</p> <p>Coils inside compartment, may not be visible on freezer plate</p> <p>*Contact freezing</p>
<p>Purchase price moderate</p> <p>Cost of operation moderate</p>	

Refrigerator - frostless
Freezer - manual defrost

<p>Refrigerator compartment</p> <p>Defrost cycle method *Temperature 33° - 38° F.</p> <p>Air circulation forced; fan may not be visible</p> <p>*Coils outside the compartment liner, not visible</p>	<p>Freezer compartment</p> <p>Defrost manual</p> <p>Temperature 0° F., true freezer</p> <p>Air circulation natural</p> <p>Coils inside the compartment, may not be visible on freezer plate</p> <p>*Contact freezing</p>
<p>Purchase price moderate to high</p> <p>Cost of operation moderate to high</p>	

Refrigerator - frostless
Freezer - frostless

<p>Refrigerator compartment</p> <p>Defrost cycle method *Temperature 33° - 38° F.</p> <p>Air circulation forced; fan may not be visible</p> <p>*Coils outside food compartment</p>	<p>Freezer compartment</p> <p>Defrost automatic once a day or every 20th door opening</p> <p>Temperature moving air 0° F. or below</p> <p>Air circulation forced by means of a fan, may not be visible</p> <p>*Coils not visible, located inside freezer liner</p> <p>May have a small refrigerated plate for frost-freezing of ice cubes</p>
<p>Purchase price high to very high</p> <p>Cost of operation high, due in part to extra fans, more loss of cold air when door is opened, and to outside location of evaporator coils.</p>	

REFRIGERATOR-FREEZER COMBINATIONS

The chart on page 5 gives details of the three types of combination models.

The price range of refrigerator-freezers is from moderate to high, depending upon the number of automatic features and the extra conveniences included. Combinations usually have more deluxe features than standard refrigerators.

Costs of operating combination models range from moderate to high, in some cases more than 50 per cent above that of standard models. Colder temperatures in the freezer section are one reason for this.

Evaporator Coils— The location of the coils determines whether air circulation will be natural or must be forced. When the coils are inside the compartments, the air can circulate naturally. If the coils are outside the compartments, a fan is needed to force the cold air into each compartment and to pull the warm air back to the coils. Since cold air falls naturally, it is usually forced into the compartment through vent openings at the top. However, moving cold air may be admitted at several locations to keep foods at desired temperatures. Moving cold air keeps the frost formation down and prevents packages in the freezer section from sticking together.

Coils on the outside are generally not visible, because they are located between the food liner and the insulation; some may be at the bottom, others at the back.

Defrost methods— Frost forms regardless of the location of evaporator coils, since moisture vapor condenses when it touches a cold surface and freezes if the surface is cold enough. Frost may be removed manually (see page 3) or automatically depending on the type of refrigerator-freezer.

"Automatic defrost" usually refers to models that have their evaporator coils on the inside. In this type the refrigerator section usually defrosts automatically every time the cycle goes off. It is not

generally desirable to have the freezer section of this type defrost automatically, however. Since the coils are inside, the defrost water would freeze again when the cycle started. This would cause packages to freeze to each other and to the freezer liner. The freezer section, therefore, is usually manually defrosted, normally about 2 or 3 times a year. Since the freezer compartment is insulated from the refrigerator section, it is slow to collect frost if used properly. By scraping off light frost occasionally you can cut defrosting time to a minimum.

"Frostless" models are known by such terms as no-frost, frost-off, frost-guard, frost-free. These terms should indicate that forced cold air moves through both the refrigerator and freezer sections. Coils are on the outside.

The refrigerator section of frostless models defrosts automatically by the cycle method. However, since there are no coils inside, there will be no defrost water inside. The defrost water drains to a tray below and is evaporated. Some models have a 15-watt bulb below the tray to hasten evaporation.

The freezer section of frostless models collects very little frost. Provision for defrosting can be automatic, since the coils are not inside the compartment. Defrosting occurs once every 24 hours, once every 20th door opening, or with every cycle change. In some cases defrosting is speeded up by an electric element next to the coils that comes on for several (6-10) minutes. Other manufacturers use a "reverse refrigeration" method that sends the warm refrigerant temporarily back into the coils. During defrosting the forced air is halted, which may result in a 5° - 15° warmup in the freezer at this time.

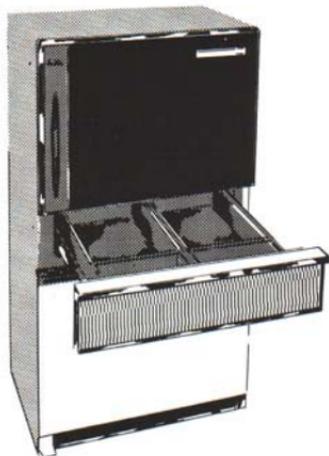
Contact freezing occurs when packages of unfrozen food are placed in direct contact with evaporator coils. Manufacturers generally use the term true freezer to denote freezers NOT of the frostless type. A true freezer makes "contact freezing" possible with walls or shelves. Since the coils of a frostless model are located outside the food liner, food to be frozen will have contact only with moving zero cold air.

General information about combinations —

- Remember that a frostless combination model may be free of frost in both compartments or in only compartment. If coils are on the inside in either section, this is not a fully frostless refrigerator-freezer.
- In the refrigerator section of "automatic defrost" models, it is difficult to maintain temperatures sufficiently low for some foods. For example, highly perishable foods, such as fresh meats, may not keep more than a few days. This is due in part to the small cooling area provided by the evaporator coils inside the refrigerator section. Defrosting occurs during every cycle change.
- One manufacturer (Philco) features an "Air Wrap" section within the fresh food area. The section is so designed that foods are stored in very still, humid air, just above freezing temperature. According to the manufacturer, fresh meat and vegetables will keep up to 14 days without wrapping. Several manufacturers offer an air-wrap principle, although they do not use this term.
- At least one manufacturer (Westinghouse) features a center drawer with a separate opening in the top-of-the-line model. This is located at easy-reach height between the freezer and fresh food compartments. The drawer is divided into two sections, a colder one for meats, a less cold one for vegetables and fruits.

Frostless models keep fresh meat as long as 1 week, since the meat compartment is located where it gets the first blast of cold air that is forced into the refrigerator. In some cases the entire meat compartment is "wrapped" by constantly moving cold air. The compartment should have a tight cover to prevent the meat from losing moisture. During the defrost period of "frostless" models, the freezer temperature may rise enough to permit softening of ice cream.

- The fan-forced circulating air in frostless models keeps the air dry; in the general storage compartment this may cause more drying of foods unless they are covered tightly. This does not affect the frozen food compartment if packages are properly wrapped and stored.
- Operating costs are higher because forced cold air in refrigerator and/or freezer compartment causes more loss of cold air when doors are opened than with other models—even though the fan stops while the door is open. Also, it is necessary to keep the coils colder.
- Several manufacturers (including Admiral and Kelvinator) are offering vertical or "side by side" refrigerator-freezers.⁴



Center-drawer type — Westinghouse

⁴ See References on page 11

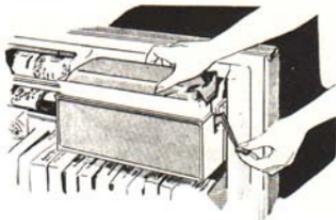
ITEMS TO CONSIDER IN SELECTION

Features vary from year to year; some are improvements, others may not be. Consider carefully the features that are important to you, and decide whether they are worth the extra cost they may add to the price tag. Frequently, new features that appear only on the top-of-the-line one year may appear a year or two later on models further down the price line.

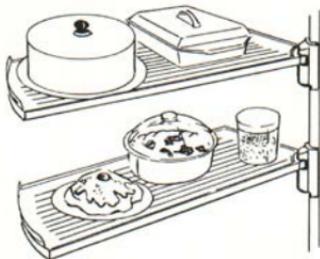
Trays, shelves, special compartments — Look for good quality materials, good construction, easy-to-manipulate and easy-to-clean features.

Metal meat trays and vegetable crispers, rather than plastic, are well worth the extra cost. They are easier to clean, will not break, and generally cool foods more quickly. Swing-out shelves, butter and cheese compartments, even egg racks are examples of cost-adding features. Any feature that will be handled frequently, such as trays or shelves that slide, need to be sturdy and free of sharp edges. All pull-out shelves should have a positive lock position to prevent them from coming all the way out. Ice-cube ejectors and automatic ice-making equipment may be high priced for the use you'll make of them.

Tall bottles require special storage space. Some models have a two-level shelf for this purpose. For greater convenience, look for shelves that will permit removing and replacing bottles without tipping them.



Ice cube ejector.

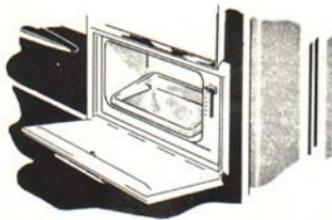


Swing-out shelves.

Many people like the convenience of a built-in shelf or compartment for ice-cube trays. Since water gives off heat when it freezes, it is better not to have the tray located directly below frozen packages of food.

Some of these features make cleaning more difficult. Remember that your refrigerator may last 15 years—you may not want to pay high prices for accessories that may wear out long before your refrigerator does.

Flush look — in part, this square built-in look is accomplished by the use of semiconcealed door hinges. These permit a closer fit to adjacent walls or cabinets. On the back of some refrigerator-freezers is a black gridlike construction. This is not the condenser coil. Its purpose is to prevent a too-close fit against the wall. Usually, a fan forces the warm air out the bottom where the condenser is located, thus allowing a closer fit.



Butter conditioner.

Doors— Look for construction which will permit you to open the door without having to leave extra swing space at the corner. Try removing crispers and other features when the door is partially opened. If door has to be swung more than a right angle (90 degrees), it will interfere with placing your refrigerator in a corner. A foot pedal is a convenience, particularly if you have limited counter space next to the door opening.

Some door handles may be more comfortable to reach and grasp than others.

Insulation— Insulation is of key importance in refrigerator construction. The greater the difference in temperature between hot and cold objects, the more rapid will be the heat transfer. So it is with a refrigerator. Traditional insulating materials have been primarily fiberglass and mineral or rock wool. Because of the low temperatures inside, this type of insulation should be about 3 inches thick if used alone.

Some of the newer, thinner insulations are made of these same basic materials. In some instances, spun glass fibersheets about 1-1/2 inches thick are sealed in plastic laminate bags. The sealing process protects the insulation from getting wet. Insulation that is wet has lost much of its insulating qualities.

Foam plastics also serve as good insulators. These rigid sheets are formed into permanent shapes from a liquid polyurethane or other plastic resin that is poured into a mold. As the liquid is processed, it foams up to fill the space. The outside layer forms a tight skinlike membrane that resists the entrance of vapor. These new types of insulation cost about 25 per cent more than the others, and they are available mostly on the top-of-the-line models.

Storage temperatures—Most fresh foods have a temperature at which they keep best⁵. Fresh meat, poultry, and fish need temperatures between 30° and 35° F. Milk, cream, and cheese should be kept at about 40° F. While a small amount of butter may be held at 50°-55° F. in a butter conditioner, the bulk of it needs about 40°-44° F.

Safety catches— Federal regulations now make it mandatory to provide door catches that can be opened from within by no more than 15 pounds pressure. Only one manufacturer makes a latch-type closure at present, all others use a magnetic closure. Magnets, held by the vinyl door gasket, are attracted to the metal cabinet as the door closes. Magnetic closure is easier and quieter, but may not be as positive as a latch-type closure, especially if the appliance is not level.

Capacity— The trend in buying continues to be to the larger sizes, 11-14 cubic feet capacity. More manufacturers are attempting to explain capacity in terms of useable storage space rather than overall gross size.

Seals of approval— Electric appliances should carry the Underwriters' Laboratory seal of approval. While not a guarantee of performance, this seal assures you that the appliance has passed certain tests for safety. If you buy a gas refrigerator, it should carry the seal of the American Gas Association.



Seals of approval.

⁵ See References on page 11

CARING FOR YOUR REFRIGERATOR

Defrosting is automatic with some models; with others it must be done manually. Methods vary according to the manufacturer and the model. Follow directions for your refrigerator. If you have an automatic defrost refrigerator, be sure to find out where the defrost pan is located, so it can be cleaned frequently.

If the freezer section of your refrigerator is manual defrost, you'll need to do this 2 or 3 times a year, or when the frost is 1/4 to 1/2 inch thick. Some manufacturers provide a plastic or wooden scraper to remove frost that is in the form of snow. This may save you from defrosting quite so often. Never use a sharp or pointed tool, such as a knife, screwdriver, or ice pick, for this job—you can puncture the evaporator coils with a sharp instrument. An electric fan may be used to hasten defrosting.

Once you get used to a true freezer, you will notice that most of the frost first appears at the top of the compartment. If you remove the frost frequently with the scraper, there will be less buildup of frost elsewhere. Thus the job of complete defrosting can be done less frequently.

Check your door gaskets to be sure of a tight seal. On some models you can do this by closing the door on a piece of paper towel or a dollar bill. The paper should not pull out easily. A worn gasket allows warm air to enter the box, and your refrigerator becomes less efficient. Replace the gasket when necessary. The door gasket should be kept

free of grease; avoid handling it when closing the door. Clean by wiping with a cloth wrung out of detergent water. Rinse and dry.

Clean the refrigerator section regularly, — even though your model requires no defrosting. A disadvantage of automatic defrosting is that the need for regular cleaning is sometimes overlooked. Once a week is a good average, but this varies with the season and frequency of use.

- Wipe up spills immediately; this may be your signal for cleaning ahead of schedule.
- When cleaning, remove all food and removable interior parts. Wipe inside the cabinet with a cloth or sponge wrung out of warm detergent water, or use 1-2 tablespoons of baking soda to 1 quart of warm water. You can wash most glass shelves and plastic parts in detergent water. Remember that cold plastic may crack under sudden temperature change. Rinse and dry.

Clean freezer section periodically. Consult your instruction book for the method of cleaning the freezer section of your refrigerator.

Wipe the outside of the cabinet with a damp cloth.

Wax the outside of your refrigerator about twice a year. If the exterior finish is synthetic enamel (as most are), it might be wise to use a specially formulated white cream wax to protect the surface. Since these waxes are naphtha-based, they may be used successfully to clean the surface as well as protect it.

IT'S UP TO YOU

A refrigerator or combination refrigerator-freezer is a long-time investment. Under normal use and with proper care your appliance will last you for many years. Many refrigerators are traded in because a family wants a new model, not because the appliance is worn out.⁴ In 1962, for example, only 25 per cent of the refrigerators reported as trade-ins had to be discarded by dealers. This compares with 48 per cent of the washers, 74 per cent of the dishwashers and 92 per cent of the electric water heaters that could not be resold.

So, it's up to you to select your refrigerator carefully. Then use it to best advantage. Operating costs of any type will be greatly increased if you are careless about opening the doors too often or leaving them open long. Food storage will be more satisfactory, if you follow the directions for placement within the refrigerator and for cleaning. Most manufacturers try to give you a good product. From then on its up to you.

REFERENCES

1. **Electrical Merchandising Week**
 - 1962 Annual Statistical and Marketing Section, January 1, 1962
 - 1963 Annual Statistical and Marketing Section, January 21, 1963
 - 1962 and 1963 Specifications for Refrigerator-Freezer Combinations
 - 1961 Specifications for Standard Refrigerators, Upright Freezers and the New Compacts
 - 1963 Specifications for Standard Refrigerators, Freezers and Compacts
2. **Today's Household Refrigerators**, by Earl C. McCracken, Physicist, Agricultural Research Service, USDA.
3. **Equipment in the Home**, Ehrenkranz and Inman, Harper and Bros., New York, 1958.
4. **Consumer Bulletin**, July 1962 (See also August, 1958; July and August, 1960).
5. **Storing Perishable Foods in the Home**, Home and Garden Bulletin No. 78, USDA, October, 1961.
6. **Household Equipment**, Peet and Thye, John Wiley and Sons, Inc., 5th Edition, 1961.
7. **Consumer Reports**, September, 1962.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.





OTHER LEAFLETS IN THIS SERIES INCLUDE:

- Choosing and Using Your Automatic Dishwasher, E-388
- Choosing and Using Your Automatic Clothes Dryer, E-389
- Choosing and Using Your Food Freezer, E-391
- Choosing and Using Your Automatic Washer, E-392
- Choosing and Using Your Household Range, E-393

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