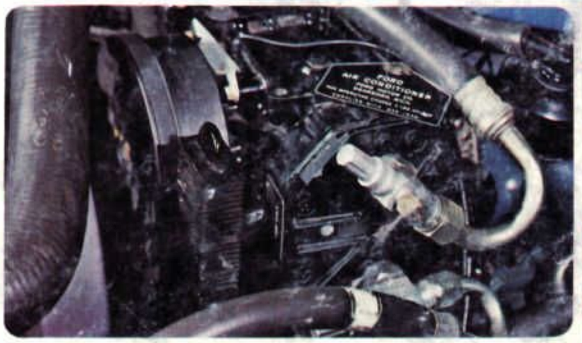
SHOP TIPS

Autolite Ford

VOL. 8, NO. 9 MAY, 1970

AIR • CONDITIONING

... Preparing System for Warm Weather



SEE CENTER INSERT FOR TIMELY PROMOTIONS!

AIR CONDITIONING

Technical parts and service information published by the Autolite-Ford Parts Division and distributed by Ford and Lincoln-Mercury dealers to assist servicemen in Service Stations, Independent Garages and Fleets.

IN THIS ISSUE

Be sure and file this and future bulletins for ready reference. If you have any suggestions for additional information that you would like to see included in this publication, please write to: Autolite-Ford Parts Division of Ford Motor Company, Merchandising Services Dept., P.O. Box 3000, Livonia, Michigan 48151.

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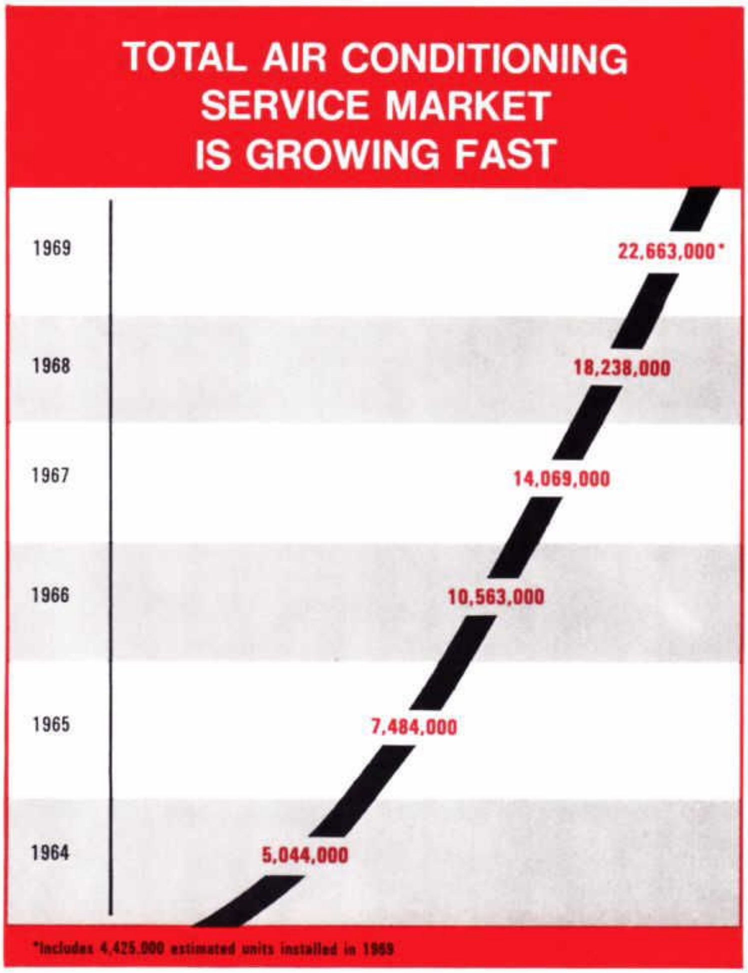


Figure 1—Service Potential Illustrated by Number of Cars with Air Conditioning Units

Air conditioning of automobiles can be traced back as far as the 1930's. However, the modern age of development is considered to be the early 1950's. This was the beginning era . . . on a serious scale . . . of factory installed air conditioners.

Today, we know that between 1960-70 car makers have produced more than 19,000,000 cars and trucks equipped with factory air conditioning units.

Add to that more than 3,250,000 vehicles with the instrument panel (hang-on) type and you have a total service market potential of at least 22,500,000. When we talk about "service market" we mean that all air conditioning units require periodic maintenance service at least once a year to help protect the owner's large investment and to maintain the proper cooling performance for hot weather months.

With these thoughts in mind, there should be no need to emphasize any further that YOU SERVICEMEN should be promoting this clean, specialized service in your own place of business. This issue of *Shop Tips* is designed to help you get going in this profitable direction or . . . if you are already doing air conditioning work, to act as a review of known and accepted service practices.

...Preparing the System for Warm Weather

SIMPLIFIED EXPLANATION OF AIR CONDITIONING FUNCTION

Essentially, all automotive and truck air conditioning systems are made up of five major units . . . a condenser, evaporator, compressor, expansion valve and a receiver-dehydrator.

Two radiator-like finned coil units (the condenser and evaporator) are connected together by leak-proof tubing or flexible hoses. See figure 2.

One of these radiator-like units, called an *Evaporator,* is located inside the car. Its function is to soak up heat from the car's interior by means of refrigerant 12, (R-12) flowing through the finned coils, thus providing the desired cooling effect. We'll describe the complete refrigerant cycle later on in this article.

The other radiator-like unit, called the *Condenser,* is located at the front of the car just behind the front grille. It transfers the heat taken from the car's interior and gets rid of this heat to the flow of outside air.

Between these two "radiators" is a pump called a *Compressor.* Its functions are to force the R-12 to travel from the condenser to the evaporator within the closed system and to squeeze the pressure of the refrigerant gas.

Two additional devices are needed to make this simple system work properly.

A metering device, called an *Expansion Valve,* acts much the same as a carburetor does. Its function is to meter (regulate) the correct amount and pressure of R-12 entering into the evaporator coils . . . not too much or too little.

A cylindrical device, called a *Receiver-Dehydrator,* acts as a storage tank for the R-12 as it waits to be metered into the evaporator. Inside this tank is a special drying agent that "swallows" the slightest trace of moisture that may have gotten into the refrigerant system and prevents this moisture from attacking internal parts.

Naturally, an air conditioning system functions in a more refined and sophisticated way than what we've described here. But, in the main, this simple explanation should help you in your understanding of the more complete principles of operation which will be described later on.

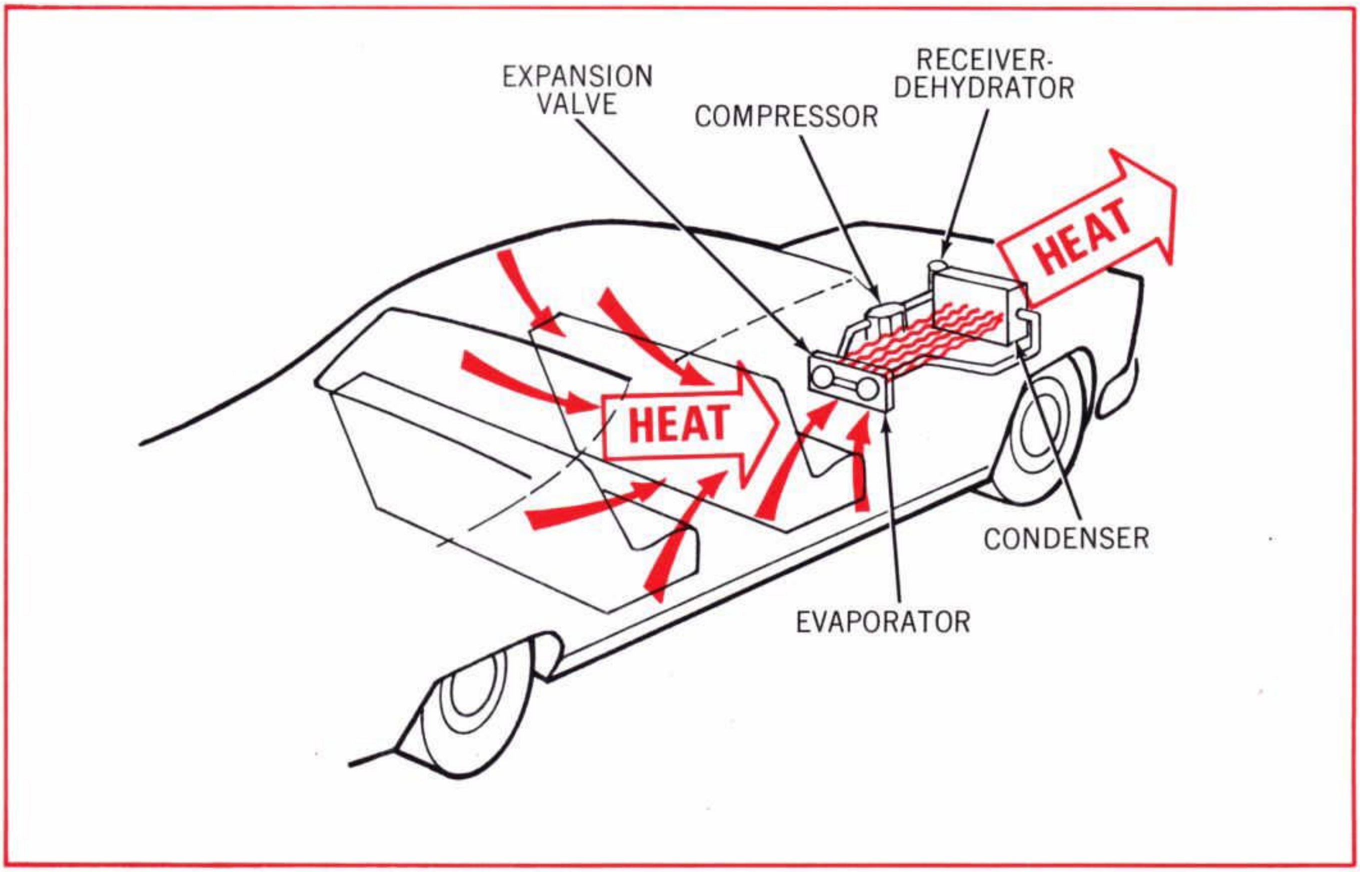
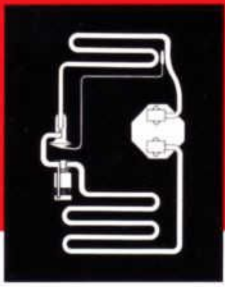


Figure 2—An Air Conditioner System Removes Heat from the Interior of a Car by a Simple Mechanical Process



AIR CONDITIONING

BASIC PRINCIPLES OF AIR CONDITIONING (REFRIGERATION)

THE NATURE OF HEAT

Accurate troubleshooting and performing specialized maintenance services on vehicle fuel systems, electrical systems or hydraulic systems requires a thorough knowledge of their principles of operation. This is especially true with air conditioning systems. For that important reason, we must first have a complete understanding of the *Nature of Heat.* From this knowledge, you will be better able to diagnose and correct "cooling" complaints as a professional service repairman. It may seem unusual to talk about heat in an article about air conditioning, but basically, in such a system we are *handling heat exclusively.*

In other words, an air conditioner unit *does not* make air cold. What it does do is to take heat away from the car's interior and transfer that heat to the outside of the vehicle.

A simple question then is . . . when is heat considered "hot" and when is it considered "cold"?

Briefly, when the temperature gets to the *absolute cold* point (believed to be 459.6°F. BELOW ZERO) every bit of heat will have been removed from any substance. Thus, it stands to reason that every known substance ABOVE that temperature contains SOME HEAT. Note: In this *Shop Tips* article, all temperature references are keyed to the Fahrenheit (F.) scale. See figure 3.

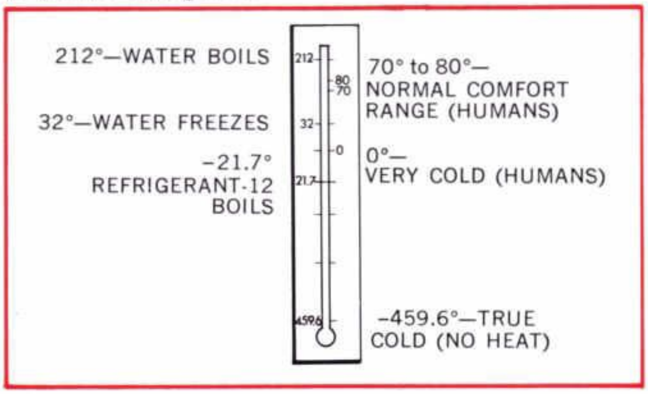


Figure 3—All Substances Contain Some Heat

To be more specific . . . temperature readings, using a thermometer, tell us only what the Heat Intensity (Sensible Heat) of the substance is and *does not* tell us the quantity or amount of heat the particular substance contains. To illustrate this further, pressure gauges on a large air tank and a smaller one may show exactly the same pressure reading, yet the larger tank may contain almost twice as much air as the smaller one.

To measure the amount of heat in a substance (object) we use a term known as BTU . . . *B*ritish *T*hermal *U*nits. ONE (1) BTU is the amount of heat needed to raise the temperature of ONE POUND of water ONE (1) DEGREE at sea level.

This is particularly important to remember when measuring heat movement in an air conditioning system, especially so in considering a *Change of State* that takes place within the closed refrigerant system. Remember . . . cold is NOT something that is produced, rather it is what remains when the heat has been taken away.

Now, let's talk about a *Natural Law of Heat.* Heat always moves from a *warmer* object to a *cooler* one and *never* from a *cooler* to a *warmer* object. Heat will follow this natural law whenever there is a TEMPERATURE DIFFERENCE between two objects or things.

We can easily observe this when we place a cup of hot water on a table and let it stand for awhile. In time it becomes "cold" . . . in other words, it loses some of its "heat." See figure 4 which illustrates this fact.

When the hot water reaches the room temperature, the cooling effect stops and thus both the surrounding air (called Ambient air) and the water will arrive at the same temperature.

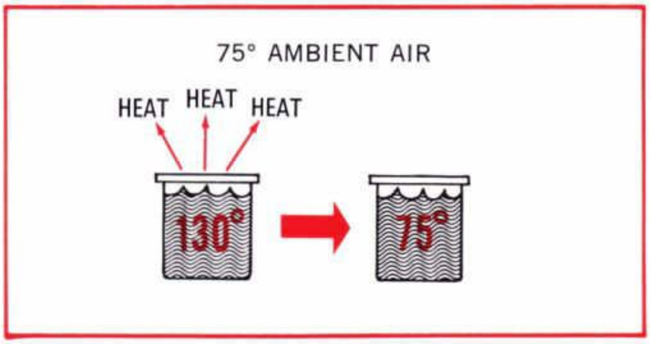


Figure 4—Heat Moving Out of Hot Water into Cooler Air

Another example to illustrate this natural law is shown in figure 5. If you leave your home on a cold wintry morning with the outside temperature 10°F. below zero, you will naturally feel the sub-zero cold for the simple fact that your body heat (normally about 98°F.) moves into the colder (−10°F.) ambient air. Looking at this from the opposite viewpoint . . . you feel "hot" when the surrounding air (110°F.) moves into your cooler (98°F.) body.

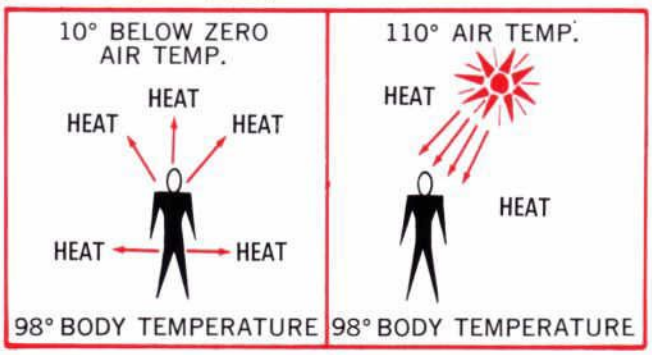


Figure 5—Heat Always Moves from a Warmer Object to a Colder One

EVAPORATION AND CONDENSATION

Now to go one step further in our understanding of how an air conditioning system functions, it is vital to know about *Evaporation* and *Condensation.*

Changing the state of a substance from a liquid to a vapor is known as *evaporation* (this occurs in the *Evaporator*), while changing a substance from a vapor state to a liquid is known as *condensation* (this occurs in the *Condenser*).

A liquid can refrigerate or absorb heat effectively only when it is changing from a liquid to a vapor. So . . . to be effective, a refrigerant must be able to absorb heat readily. Refrigerant 12 has this quality. It is the real secret of refrigeration and thus forms the basis for air conditioning systems.

When we place a container of water over a flame, heat from the flame is added to the water (again the principle of hot to cooler object). When the boiling point of the water is reached, the water turns rapidly into a vapor (steam) state as the water boils away. This is *evaporation.*

Now, if we remove the heat from the water vapor, the vapor will cool and return to its water (liquid) state. This is condensation (vapor to liquid). See figure 6.

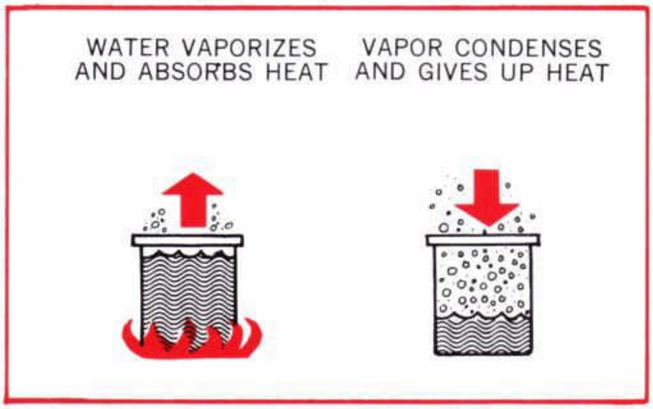


Figure 6—Principle of Evaporation and Condensation

CHANGE OF STATE

It might be well to note here that the greatest quantity of HEAT MOVEMENT occurs during a change of state. This is known as LATENT (hidden) HEAT and is a quantity that cannot be read on a thermometer.

Whenever heat is added to a container holding one (1) pound of water which is at 212°F. (at sea level) the water will absorb 970 BTU's of heat without any change in the thermometer reading. This is known as LATENT HEAT OF EVAPORATION. See figure 7.

As the change of state occurs . . . water from a liquid at 212°F. to a vapor at 212°F. . . . the vapor carries away the 970 BTU's along with it because of the fact that this amount of heat was needed to change the water from a *liquid* to a *vapor.*

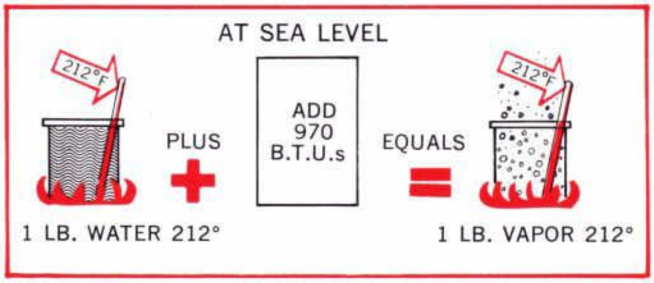


Figure 7—The Principles of Latent Heat of Evaporation

Now let's reverse this process and remove the heat from one pound of water *vapor* at 212°F. (sea level). This vapor will give off 970 BTU's of heat without any change in the thermometer reading. This is known as LATENT (hidden) HEAT OF CONDENSATION and will cause a change of state of the water from a *vapor* at 212°F. to a *liquid* at 212°F. See figure 8.

To establish a clear understanding, we know that any liquid will condense at the *same* temperature at which it is boiled. This temperature level is a clear-cut separation . . . much like a dividing line. On one side a *liquid* . . . the other side a *vapor.*

The basic reason for this review of "change of state" is to emphasize the fact that when a substance changes from a liquid to a vapor, it gains a large amount of heat *without* rising in temperature. Therefore, when related to an air conditioning unit, complete vaporization of the refrigerant within the evaporator coils is vitally important if the maximum amount of heat is to be soaked up from the warm air in the car's interior.

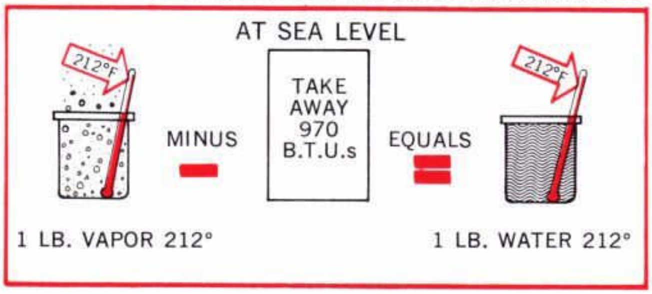


Figure 8—The Principles of Latent Heat of Condensation

If you have followed our explanation up to this point and understand it, the next step is to review how HEAT moves *into* and *out* of a car by means of *Conduction . . . Convection* and *Radiation.* It can be considered safe to say that heat transfer seldom takes place by conduction, convection or radiation alone, but rather by a combination of two or more of these processes.

CONDUCTION

Conduction is essentially the movement of heat from one substance to another part of the same substance. A simple demonstration of heat transfer by conduction is illustrated in figure 9. When we heat one end of a metal rod, the opposite end soon becomes warm. In an air conditioning system, hot air (heat) within the car's interior passes through finned coils of the evaporator into the refrigerant 12 contained within the evaporator coils. Then, this same heat is passed from the R-12 into the coils of the condenser by *conduction*.

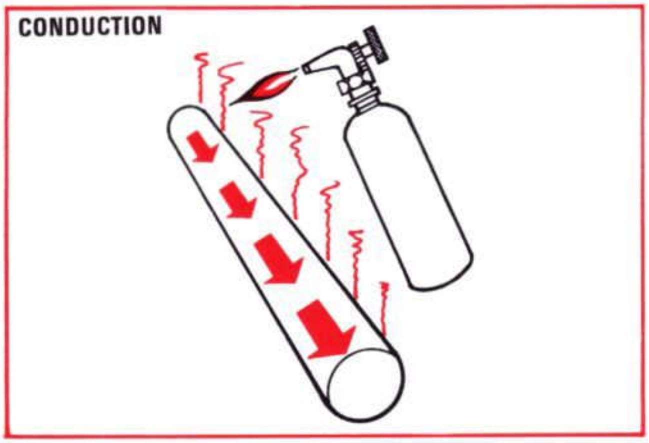


Figure 9—The Principles of Conduction

CONVECTION

Heat is also transferred from one place to another by the movement of the heated substance. This is known as *convection*. For example, in a home hot water system, the water is heated some distance away from the faucets. Yet, when we turn on the faucet handle, hot water is transferred from the hot water tank to the tap by *convection*. Another example of this is shown in figure 10, where the air heated by the hot charcoal rises and cooks the chicken. In an air conditioning system, heat entering the refrigerant 12 at the evaporator is transferred by the refrigerant flow to condenser by convection. At the condenser location air flow caused by the car's movement plus cooling fan action picks up the heat from the condenser and carries it away to the surrounding air by this same principle of convection.

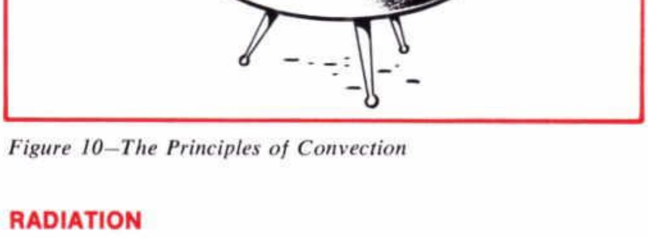


Figure 10—The Principles of Convection

RADIATION

Heat is also moved out of the condenser by *radiation*. You can say that radiation is the transfer of heat by HEAT RAYS. Some examples are heat from a home radiator, see figure 11, or heat from the sun's rays.

It may be well to also note here that heat also moves out of the condenser by *convection* as described earlier.

In summing up, *conduction* can be improved by using good conducting materials such as copper or aluminum. *Convection* can be improved by speeding-up the flow of the conveying medium while *radiation* can be improved by making the radiating surfaces of a material known to have good radiating qualities.

Figure 11—Principles of Radiation

TEMPERATURE/PRESSURE RELATIONSHIP

Before we get into the refrigeration cycle, there is one more thing that we must understand and that is temperature-pressure relationships.

We know that water boils at 212°F. at sea level. But, let us, for example, pressurize the boiling water as it is done in the engine's cooling system. By using a pressurized radiator cap the water can be heated far above 212°F. without causing the coolant to boil. However, if we suddenly lower the pressure, it will cause the liquid (coolant) to boil . . . as anyone can vouch for if they have ever removed the radiator cap from a hot cooling system.

In an air conditioning system, we can compress (pressurize) the refrigerant 12 vapor and in doing so, concentrate the heat it contains. When we concentrate the heat in a vapor into a smaller space, we increase the heat intensity (sensible heat) or, saying it another way . . . we increase the temperature because temperature is merely a measurement of this heat intensity. The amazing part of all this is the fact that the vapor has become hotter without actually adding any additional quantities of heat. See figure 12.

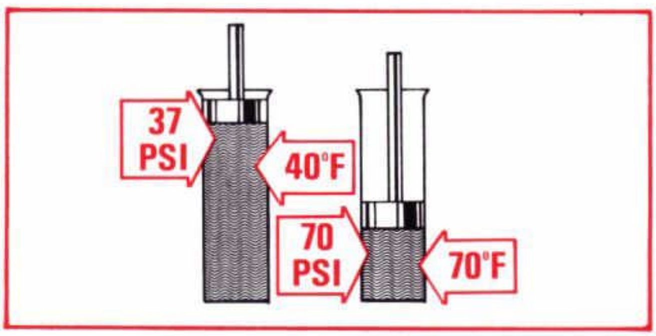


Figure 12—Compressing a Vapor Concentrates its Heat

REFRIGERATION CYCLE

Now that we've reviewed the nature of heat, let's review what goes on INSIDE the closed refrigeration system when it is operating. This is vitally important because a thorough knowledge of this cycle will help you to accurately trouble-shoot system problems and understand test gauge readings.

As shown in figure 13, refrigerant 12 gas under LOW PRESSURE is drawn into the compressor where it is compressed to a HIGH PRESSURE. During the compression, the R-12 gas becomes HEATED. The greater the pressure, the higher the vapor temperature. When sufficient pressure is built up, the hot R-12 gas travels into the condenser where it COOLS by giving off its heat to the air passing over the finned condenser surfaces. As the hot R-12 gas is COOLED it condenses into a LIQUID at HIGH PRESSURE and accumulates in the receiver-dehydrator. This HIGH PRESSURE LIQUID R-12 then continues on to the expansion valve where it flows through this valve into the evaporator under a much LOWER PRESSURE.

When the liquid R-12 is exposed to the LOWER PRESSURE it begins to boil, thus changing to a VAPOR state. As the R-12 then passes through the evaporator coils it continues to boil by absorbing heat from the air passing over the evaporator finned surfaces until it returns to a completely VAPORIZED state. From the evaporator the COOL LOW PRESSURE R-12 gas is drawn back to the compressor . . . and the cycle is repeated once again.

Thus, the air passing over the evaporator finned surfaces is COOLED by simply giving up its heat to the R-12 during the boiling process.

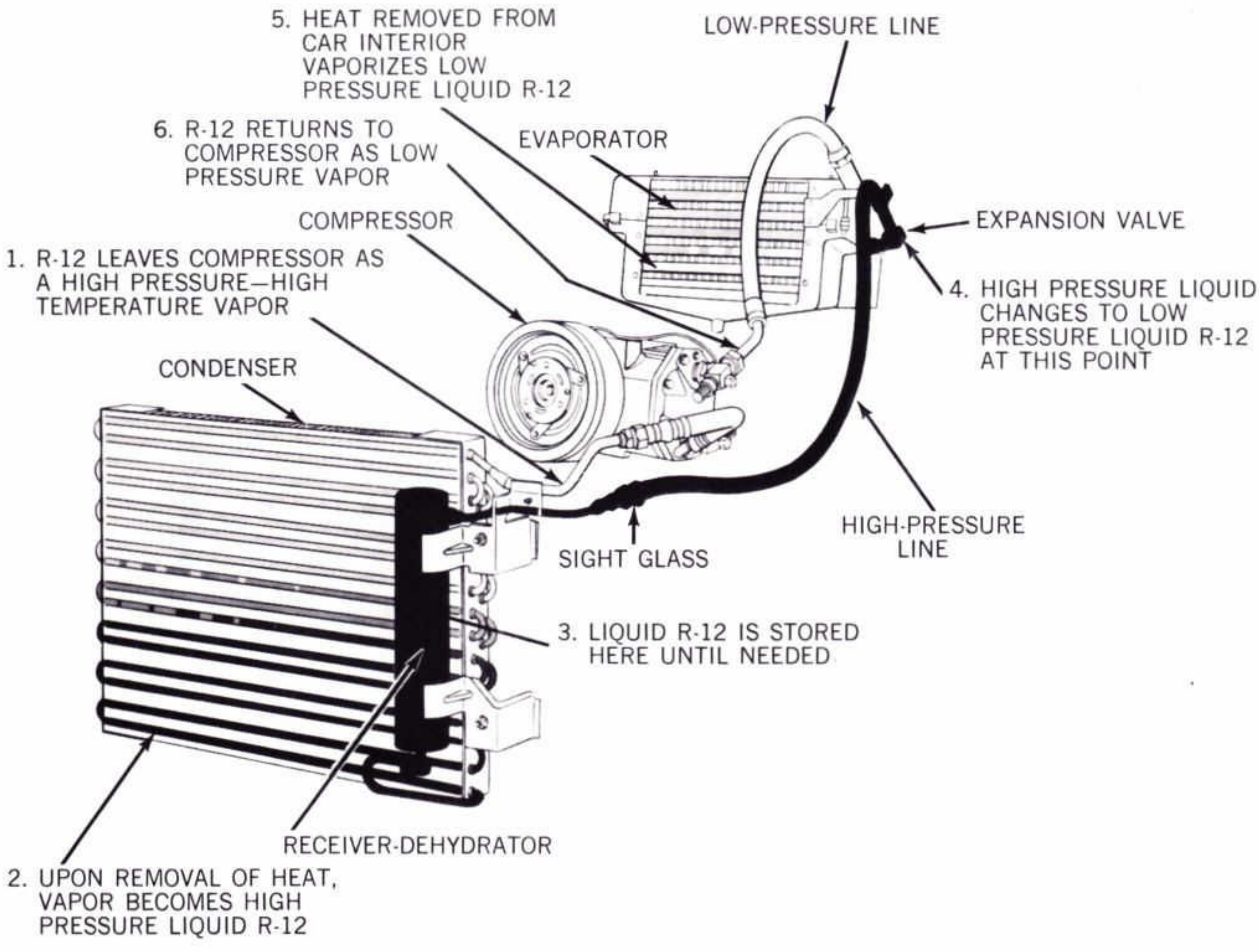


Figure 13—Basic Refrigeration Cycle

TOOLS AND EQUIPMENT

Generally, the cost outlay for air conditioning tools and equipment is considered small in comparison with other service work such as tune-up.

As you become more familiar with servicing air conditioning systems and your volume of service work increases, you can then add to the total specialized equipment.

First, you'll need a good belt tension gauge to accurately measure belt deflection between two pulley sheaves. One of the obvious advantages is that a reading can be made while the belt is being adjusted. You'll also need a Manifold Gauge Set and a Leak Detector.

All of the common service operations performed on the refrigeration section of the air conditioning system involve the use of a Manifold Gauge set as shown in figure 14.

The low pressure side of the gauge set usually reads from 0 to 60 psi (some are 0 to 150 psi), and a vacuum reading of 0 to 30 inches. This side is connected to the low pressure or inlet side of the compressor.

The high pressure side is usually calibrated to read from 0 to as high as 600 psi. The hose from this side of the gauge set is connected to the discharge or high pressure side of the compressor.

One of the two center section hoses (some gauge sets only come equipped with one) is used for connecting to a vacuum pump while the other is used to connect with a supply of R-12 when the system is to be charged.

Never use wrenches or pliers of any kind to tighten these knurled fittings since they use Neoprene O-ring seals to provide a hand-tight, vapor-tight seal.

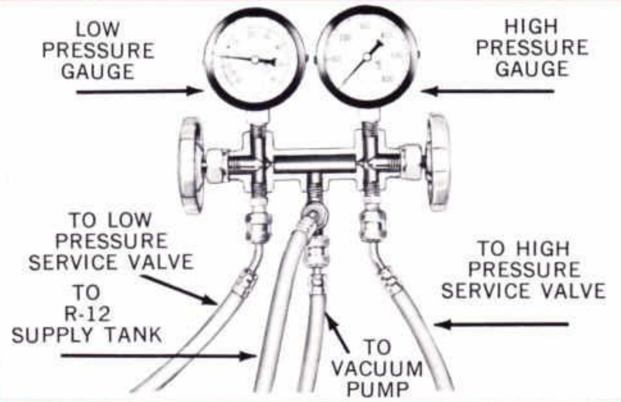


Figure 14—Cutaway View of a Typical Gauge Set

An accurate Leak Detector is an absolute must. There are three most common types.

The one most often used today is the gas torch, see figure 15, which can detect a refrigerant leak of *One Pound in 10 Years.* The electronic type is the most sensitive of all. It can detect a loss of *One Pound in 40 Years.* Another type called a "bubble detector" uses a solution applied externally at the various connection points. It will cause foam or bubbles to appear if there is a leak present.

The gas operated type uses a copper disc "reaction plate" heated by a flame from a propane bottle and a "sniffer" tube which is attached in such a way that gases are drawn up and directed to the flame. If these gases contain R-12, the flame color will change to a bright yellow (greenish) appearance if a small leak is present. A larger leakage condition will turn the flame to a brilliant blue or purple.

Since R-12 is heavier than air the search hose (sniffer) must be placed below the suspected leak point during the checking.

It will be well to note that the smaller the flame, the more sensitive it is to leaks. Remember, the copper element must be red hot during the testing period, Once the reaction plate is cherry red, adjust the flame just high enough to maintain the red color.

A good thermometer is also a necessity. Almost any type can be used but special ones are available for this purpose. A vacuum pump is another *must* piece of equipment. It is used to evacuate (remove) air from the closed refrigerant system. See note below.

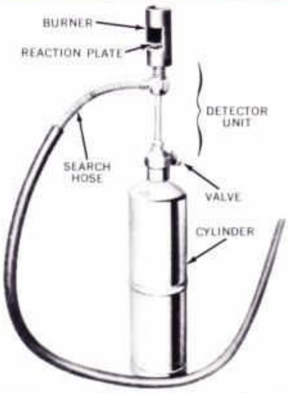


Figure 15—The Torch Type of Leak Detector

NOTE: *The compressor should never be used as a vacuum pump since the system oil circulates along with the R-12. Thus, if there is a lack of R-12 (which carries the oil for lubrication throughout the system) the compressor more than likely will become damaged.*

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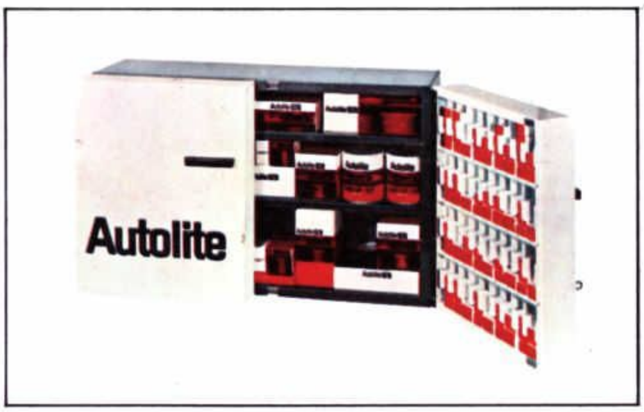

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MAINTENANCE CHECKS AND LIGHT SERVICE

During any check-up of the air conditioning system, a thorough and searching visual inspection should be made to help determine the condition of the compressor, mounting brackets, compressor clutch, drive belts, and electrical wiring. Also check refrigerant hoses, all clamps and hose connections. Look carefully for any sign of an oily condition at all refrigerant connections.

CONDENSER (Figure 16)

Check to make sure the condenser finned passages are not obstructed with dust, dried leaves or mud, paper, bugs and so forth.

Any obstruction reduces the heat transfer and will cause excessively high system temperatures and pressures, plus a drastic loss in the overall cooling efficiency.

To clean the condenser air passages, use a stiff bristle brush and compressed air. *Never* steam clean (or weld) at or near any of the system components or refrigerant lines. The heat could build up DANGEROUS and highly damaging internal pressures in the system.

The space between the condenser and the cooling system radiator should also be free and clean.

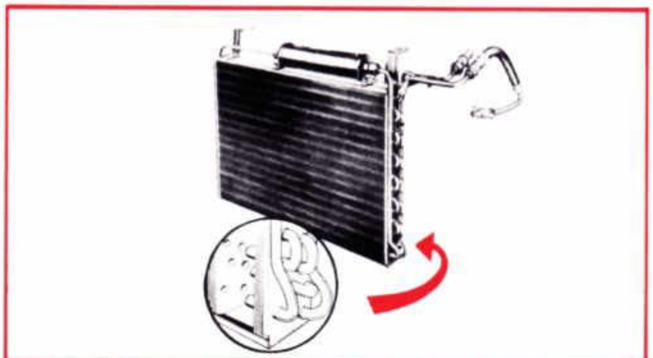


Figure 16—A Typical Condenser Showing Construction Details

DRIVE BELT

The compressor drive belt should be in good condition and have the proper belt tension. A loose drive belt will slip and the compressor will not operate at the correct speed. Too tight a drive belt will reduce belt life and damage the compressor, water pump or alternator bearings.

If it's a high mileage belt, remove and examine the inner surfaces for cracks or other damage that may have started. A new drive belt at the beginning of the hot weather season is considered cheap insurance.

COMPRESSOR/CLUTCH (Figure 17)

The air conditioning compressors used in the Ford product line are the two-cylinder, reciprocating type units.

The inlet side of the compressor is known as the "low-pressure" or "suction side." This side of the compressor is connected to the evaporator outlet with a specially designed, flexible, nonporus line.

The other side of the compressor is referred to as the "discharge" or "high-pressure" side. This side is connected to the top of the condenser coil with the same type of line material.

A special oil that will mix well with the refrigerant is used to lubricate the compressor. This oil is as free of moisture as it can be made.

Make sure the compressor is attached firmly to the mounting brackets and that the magnetic compressor clutch is operating correctly.

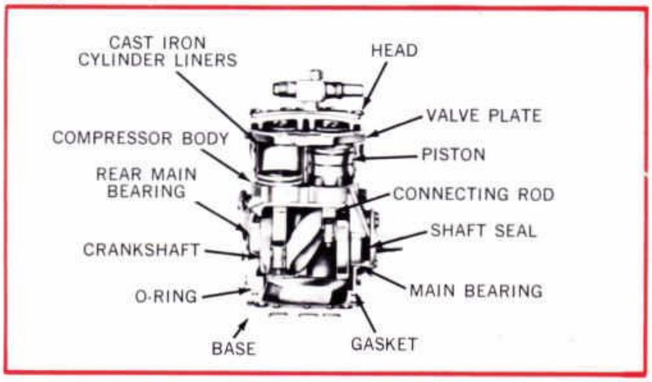


Figure 17—A Cutaway View of a Typical Compressor Used with Ford Products

MAGNETIC CLUTCH (Figure 18)

This clutch is designed to connect and disconnect the compressor from the engine. Whenever the engine is operating the clutch pulley is also turning (free-wheeling) since it is driven by the drive belt. However, the compressor does not operate until the clutch is energized.

The clutch is engaged by a magnetic field and disengaged by flat springs when this magnetic field is broken.

When the controls call for compressor operation, the electrical circuit to the clutch is completed, the magnetic field is energized and the clutch then engages the compressor.

To check clutch operation, set the air conditioning controls for maximum cooling. You should hear a sharp "click" each time the ignition switch is turned to the "on" position.

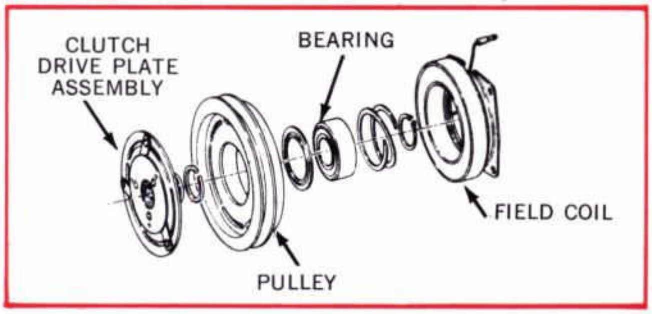


Figure 18—An Exploded View of a Typical Compressor Clutch

SIGHT GLASS

Check the sight glass which is usually located in the liquid line leading to the evaporator from the receiver-dehydrator.

"Reading" the sight glass at ambient temperatures above 70°F. when the system is operating will help to determine whether the refrigerant charge is sufficient. After about 5 to 10 minutes of compressor operation, the appearance of slow moving bubbles (vapor) indicates a *slight shortage* of R-12. Foam or a heavy stream of bubbles indicates the system is *very low* on refrigerant. Oily streaks on the sight glass indicate a *complete lack* of refrigerant.

No bubbles in the sight glass may also indicate either a *full charge* of refrigerant or a *complete loss* of refrigerant. While looking at the sight glass, cycle the magnetic clutch on and off with the engine running at about 1500 rpm. During the time the clutch is off (not engaged) bubbles will appear if refrigerant is in the system and will disappear when the clutch is on (energized). If *no bubbles* appear during the on and off cycle of the magnetic clutch, it indicates there is *no refrigerant* in the system.

However, if the sight glass is generally clear and cooling performance of the system is satisfactory, occasional bubbles do not indicate a refrigerant shortage.

NOTE: Under conditions of extremely high temperatures, occasional foam or bubbles may appear in the sight glass.

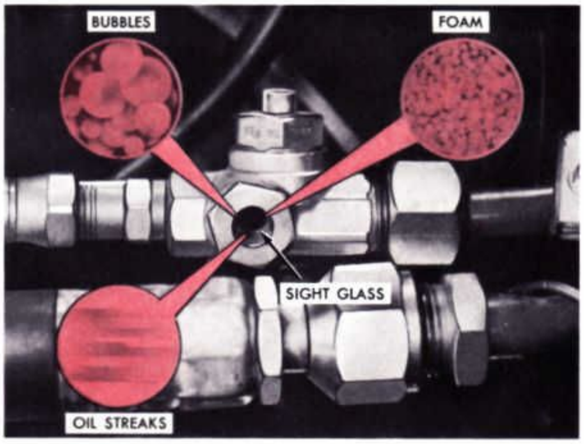


Figure 19—A Typical Sight Glass Showing Various Refrigerant Conditions

EXPANSION VALVE

During the seasonal maintenance check-up make sure the temperature sensing bulb, part of the expansion valve assembly, is fastened tightly. Both the bulb and the evaporator outlet pipe where it is attached must be completely covered with insulation material to protect it from high temperatures within the engine compartment. If the material is loose or missing, wrong signals will be sent to the expansion valve resulting in improper cooling performance. Also make sure there are no kinks or sharp bends in the temperature sensing (capillary) tube. If this condition is present, a new expansion valve assembly must be installed.

The expansion valve should not be taken apart or the factory preset adjustments changed. If the valve is malfunctioning, a new valve assembly should be installed.

NOTE: The expansion valve assembly on all models (except Falcon, Fairlane and Montego) employ a temperature sensing bulb and tube. The expansion valve assembly on Falcon, Fairlane and Montego models is connected in line with both the inlet and outlet evaporator refrigerant lines. In this design, the expansion valve diaphragm, connected by internal passages to and from the underside of the valve diaphragm senses the refrigerant temperature and pressure as it leaves the evaporator core.

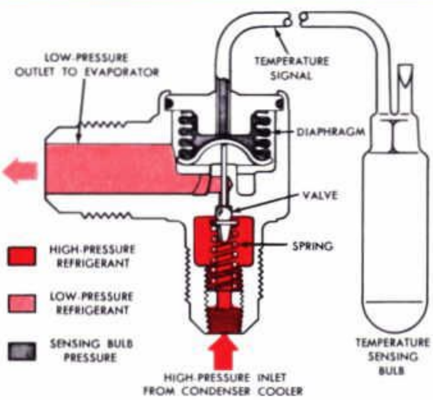


Figure 20—Typical Construction of Expansion Valve and Temperature Sensing Bulb

RECEIVER-DEHYDRATOR

A quick test of the receiver-dehydrator can be made by operating the air conditioner for about five (5) minutes. Then, slowly move your hand across the length of the unit from end to end. There should not be any noticeable difference in temperature. If cold spots are felt, it indicates that the unit is restricting refrigerant flow and the receiver-dehydrator must be replaced. If a new receiver-dehydrator is to be installed, do not remove the shipping caps from the new unit until you are ready for installation.

In operation, liquid refrigerant and some refrigerant vapor from the condenser enter the reservoir. Since liquid is heavier than vapor the liquid drops to the bottom of the unit where it passes through a screen and enters the outlet tube.

Moisture is a very dangerous agent in an air conditioning system. Moisture not absorbed by the desiccant (dryer) in the receiver-dehydrator unit will circulate with the refrigerant and droplets more than likely will collect and freeze in the expansion valve orifice, blocking refrigerant flow and stopping cooling performance of the system.

Moisture also reacts with the refrigerant to form an acid which causes corrosion of metal parts. It may be well to note that the attraction of the drying material is so great that if the receiver-dehydrator is left open, moisture will be drawn in from the outside air. Just one drop of water added to the refrigerant will start chemical changes that result in corrosion and eventual breakdown of the chemicals in the system.

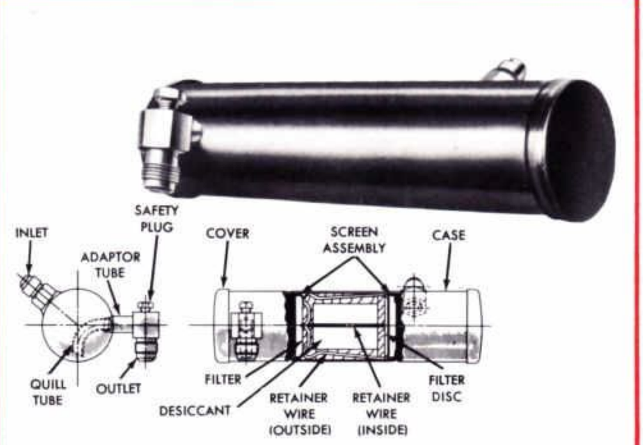


Figure 21—Typical Construction of a Receiver-Dehydrator Assembly. (Note the Safety Plug which is designed to open the system if temperatures rise above 232° F.)

LEAK TESTING

Leaks may occur anywhere in the system, such as at connections, fittings, sight glass, compressor, service valves, evaporator core, condenser core, receiver-dehydrator or at the expansion valve. Checking for a leak with a leak detector in good condition, is one of the most important of all service maintenance procedures.

When leak testing, all fittings and joints should be free of excess oil which may contain some refrigerant that has been absorbed into the oil film. Use a clean, dry wiping cloth. If a leak is located at a connection, attempt to correct the leak by tightening the joint or if necessary replace the seal O-ring. If you replace an O-ring, always use a small amount of fresh refrigerant oil on the O-ring surfaces and on all tube and hose joints.

When tightening joints ALWAYS use a second wrench to hold the stationary part to prevent twisting and kinking. It is also urged that you tighten the connections to the recommended torques. Overtightening may distort mating parts and thus cause a refrigerant leak condition.

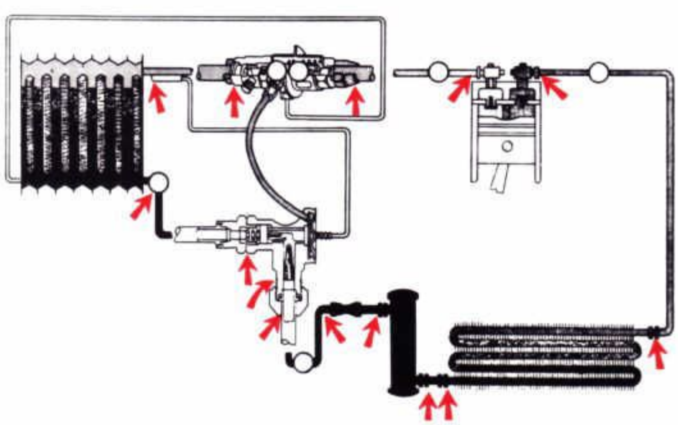


Figure 22—Check All Areas and System Connections as Indicated for Refrigerant Leakage

SERVICE VALVES

On all air conditioning systems, the compressor incorporates two *service valves*, one for the "high" side the other for the "low" side of the system. Ford-built air conditioner systems employ Stem Type service valves.

These service valves have protector caps installed at the service ports and also at the valve stems. See figure 23.

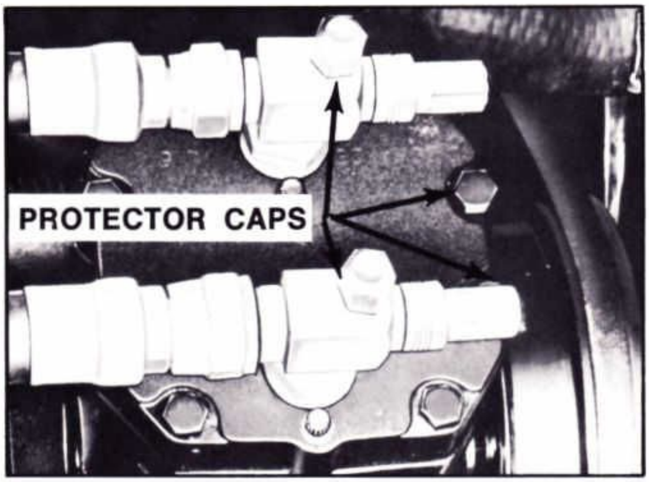


Figure 23—Remove These Caps for Test Gauge Connections and to be Able to Turn the Service Valve Stems. Replace Caps When Service is Completed.

Each of these valves has three (3) positions. See figure 24. When the valve stem is rotated fully inward (clockwise) it is in the shut-off position with the front valve face seated and the refrigeration system hose passage closed. This isolates the compressor from the balance of the system.

NOTE: Never operate the air conditioning system with the valves front-seated. To do so would damage the compressor as no refrigerant would flow through the compressor, resulting in excessive head pressures and more than likely causing seals to blow out.

The intermediate or mid-position is when the valve stem is turned about 1½ to 2 turns inward so that you can connect the service gauge port into the gauge heads, thus permitting you to take gauge readings when the system is operating. When the valve stem is turned fully outward (counterclockwise) it is back-seated. In this position the rear valve face seals off the service gauge port.

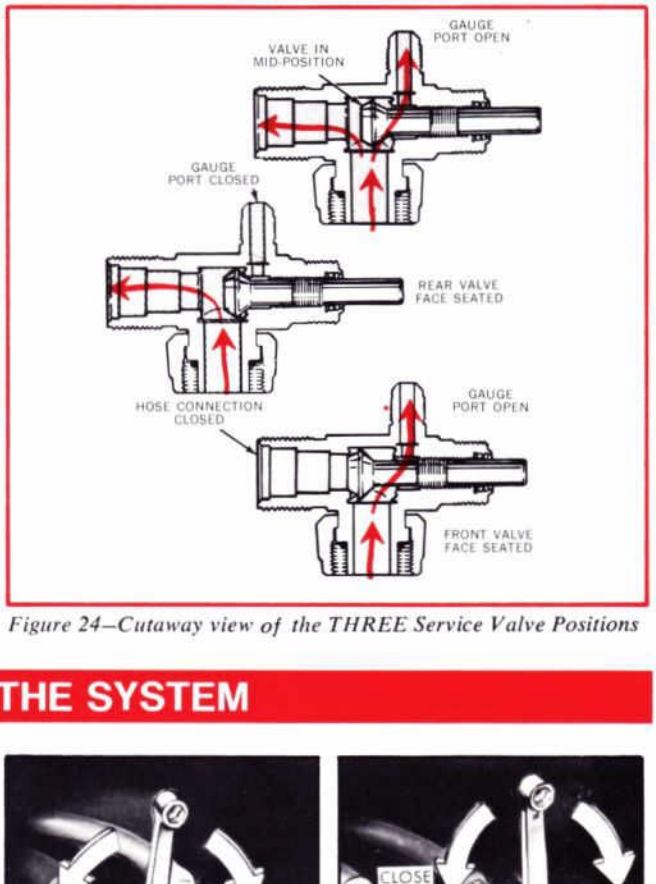


Figure 24—Cutaway view of the THREE Service Valve Positions

DISCHARGING THE SYSTEM

It will be necessary to discharge the refrigerant from the system before replacing any part or unit of the system (except the compressor). Whenever the compressor must be removed or an oil check made, the compressor can be isolated from the system without losing the refrigerant charge. However, to discharge the system connect the manifold gauge set to the compressor service ports.

Do not connect the center manifold hose to a container of R-12 or a vacuum pump. Place the open end of these hoses (or hose) in a garage exhaust system. Set both manifold gauge set valves at the *maximum counterclockwise* or *open position.*

Open both service valves at the compressor head a slight amount (see figures 25 and 26), and allow the refrigerant to discharge slowly from the system.

***NOTE:** Do not allow the refrigerant to rush out as the oil in the compressor will be forced out along with it.*

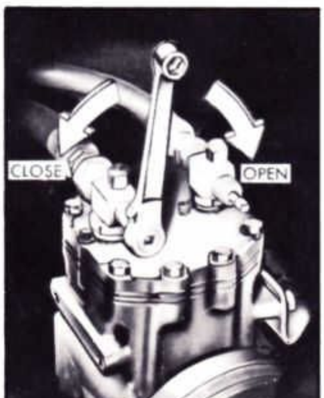


Figure 25—Location of Low Pressure Service Valve and Gauge Port at Compressor Head

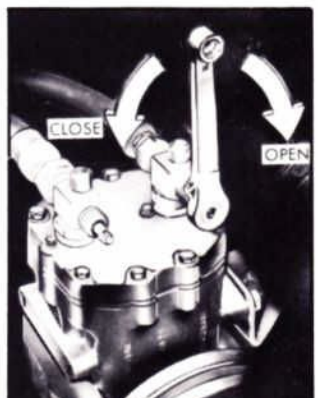


Figure 26—Location of High Pressure Service Valve and Gauge Port at Compressor Head

EVACUATING THE SYSTEM

This should be performed only after the system is discharged. Attach the manifold gauge set to the service valves as described earlier. Attach the center hose to a good vacuum pump. Then, set both service valves at the mid-position. Slowly open both of the manifold valves and release any pressure that may be in the system. Now, open the vacuum pump valve and run it until the low-pressure gauge reads at least 25 inches and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20 to 30 minutes to boil out any moisture in the system. Close the vacuum pump valve and turn off the pump.

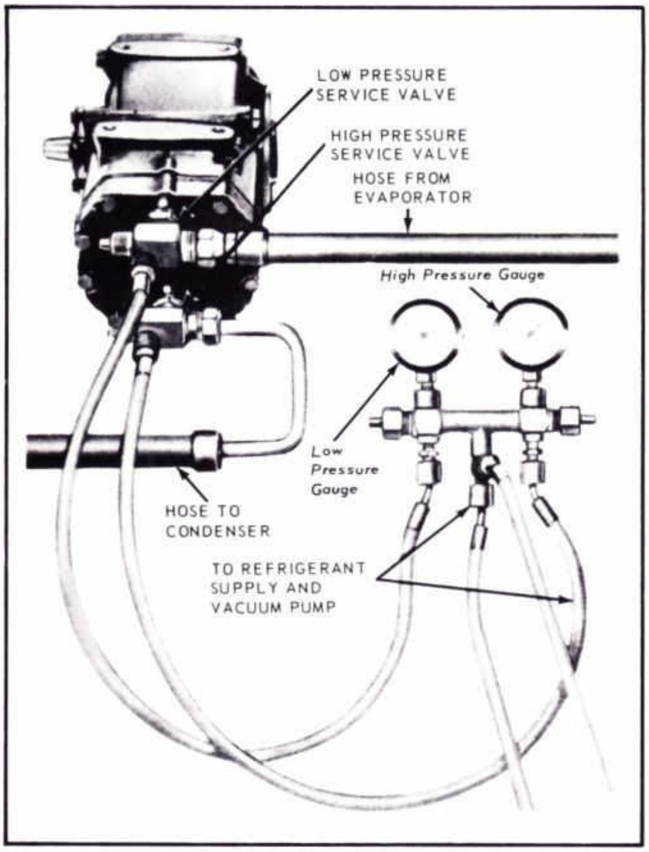


Figure 27—Gauge Set Connections for Evacuating or Charging the Air Conditioning System

CHARGING THE SYSTEM

Refrigerant-12 is available in small 15-ounce cans as well as larger size containers. For charging, attach a 15-ounce can of R-12 to a special valve, then open this valve. The gauge set must be connected to the service valves as described earlier. Both service valves at the compressor should be in the mid-position . . . the low pressure manifold gauge valve should be at the full (open) counterclockwise position and the high pressure manifold gauge valve at the fully closed (clockwise) position. Keep the can in an upright position. Briefly loosen slightly the center hose fitting at the gauge manifold for about 3 seconds to purge any air from the hose, then retighten this center hose fitting at the manifold gauge set.

With the car engine off, NOT RUNNING, open the low side manifold gauge valve to permit the R-12 to flow into the system. When the can is empty (no frost showing on can surface) close the valve and remove the empty can. Attach a new can and open the valve again. Allow only the specified amount of refrigerant to be pumped into the system. Check car maker's Shop Manual for correct amount required. The frost line on the can surface will indicate what portion of the R-12 in the can has entered the system. Then close the special valve at the can. The system will then have the correct amount of charge in pounds of refrigerant. Now, turn both service valves at the compressor head to their maximum counterclockwise (back-seated) position. Remove the gauge set, then reinstall the protective caps on the valve gauge ports and valve stems.

NOTE: If a complete charge cannot be installed as described, start the car engine to operate the air conditioner. With the refrigerant can in an upright position and the low side manifold gauge set valve open (fully counterclockwise) allow the refrigerant vapor to flow into the LOW SIDE ONLY until a complete charge has been installed. The HIGH SIDE MANIFOLD GAUGE SET VALVE must be CLOSED when operating the air conditioner during this charging procedure.

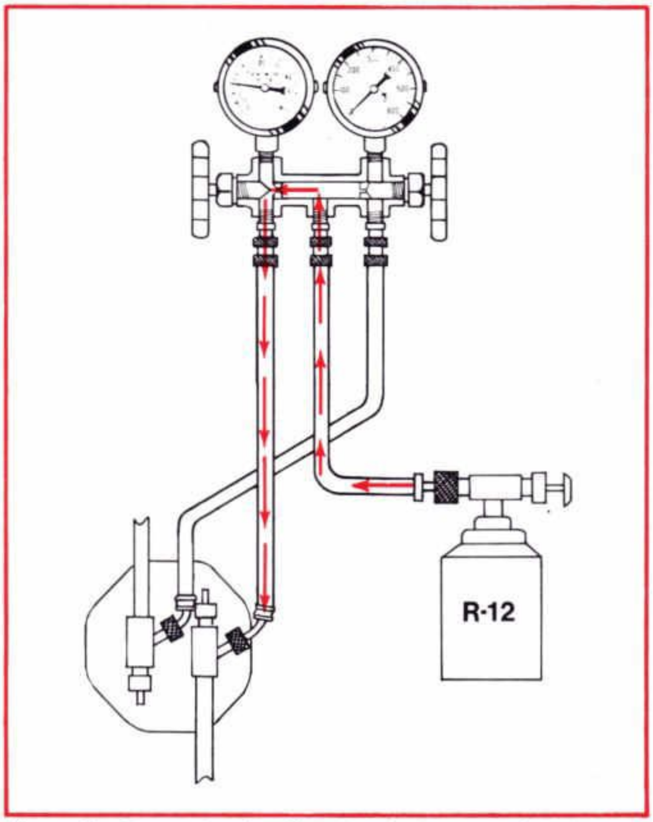


Figure 28—Connections for Charging the System with Refrigerant from Small Can of R-12

AIR CONDITIONING

...Preparing the System for Warm Weather

Continued

SAFETY PRECAUTIONS

Refrigerant-12 is a relatively safe refrigerant and is used in all Ford Motor Company air conditioning systems. It operates at low pressure and condenses easily in the temperature ranges found in automotive condensers. A list of advantages includes these qualities:

- Odorless
- Colorless
- Tasteless
- Non-Corrosive
- Non-Toxic
- Non-Inflammable
- Has a high affinity for oil
- Has the ability to absorb great quantities of heat
- Readily changes state
- Low boiling point

However, refrigerant-12 is used under pressure and its low boiling point (minus 21.7°F.) combined with its chemical change when exposed to flame requires certain handling precautions for personal safety.

NEVER TOUCH LIQUID

Liquid refrigerant-12 vaporizes so quickly and takes on so much latent heat in the process that even a drop on your skin will cause severe and painful frostbite. Therefore, open fittings carefully and slowly to release pressure inside the system.

If skin areas are exposed to refrigerant-12, treat as you would for frostbite or consult a physician.

ALWAYS WEAR SAFETY GOGGLES

When performing any type of service around an air conditioning system, it is vital that you wear safety goggles. Liquid refrigerant in your eyes could cause blindness. If you should get any near your eyes, rinse them immediately with mineral oil to absorb the refrigerant. Follow by flooding your eyes with a weak solution of boric acid and contact a doctor immediately.

AVOID HEAT

Store refrigerant containers upright out of the sun and away from building heat outlets. Pressure in a container will rise with heat.

Always discharge the refrigerant from the system if the car is going into a paint drying oven, or if welding or steam cleaning jobs are to be done near the system. Also, watch the temperature and pressure when testing the system. It may be necessary to direct the flow of air from a large fan through the front grille to avoid overheating.

It is common practice to put a refrigerant container (can or drum) in a pan of warm water to raise the pressure and thus speed-up the charging operation . . . but never heat the containers with an open flame or exceed 125°F. to make charging occur faster. *The pressure rise may happen so fast that the containers may just explode.*

VENTILATION

Proper ventilation in the area of air conditioning work is essential. Although R-12 is non-toxic, too much in a confined space can be suffocating as it doesn't contain the oxygen we need to breathe. Therefore, always discharge the refrigeration system into an exhaust fan or through an open window or doorway.

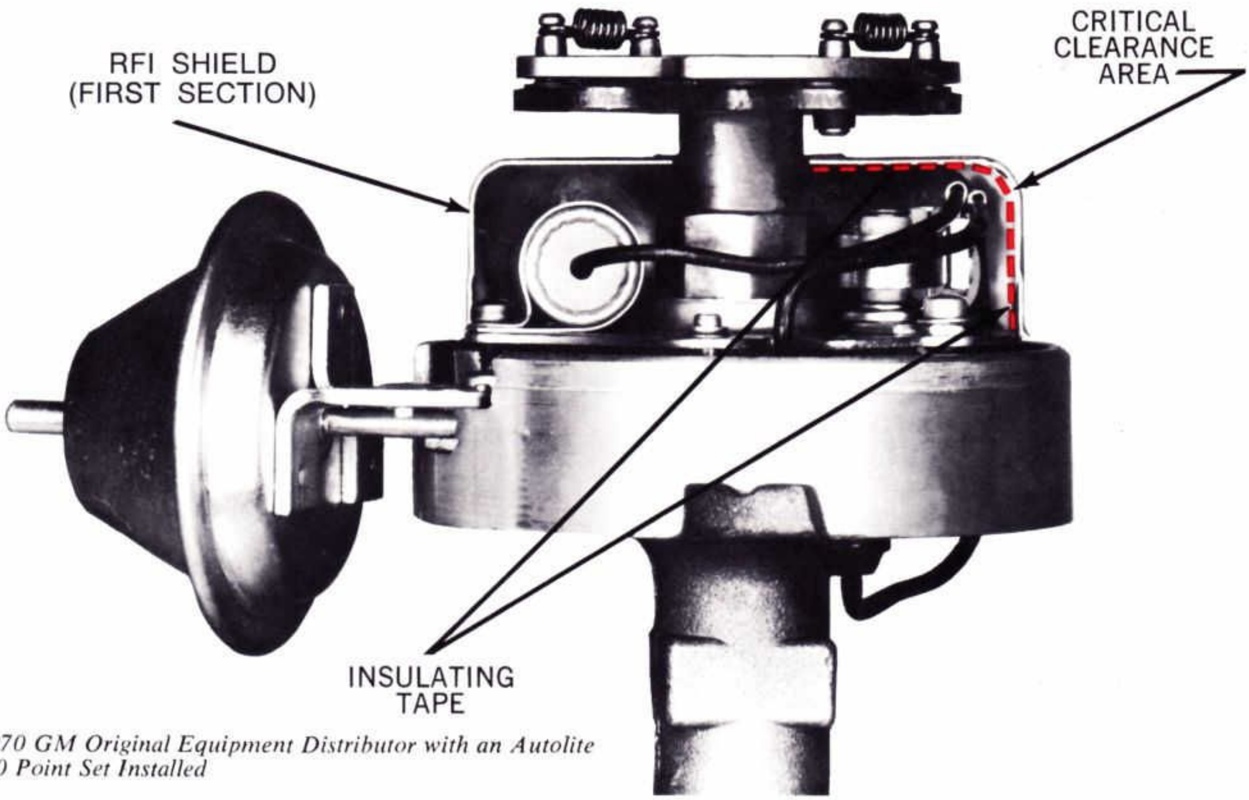
AVOID FLAME

At all normal temperatures R-12 is non-toxic. But, in contact with an open flame, it forms phosgene gas, which can be extremely harmful. Never discharge a system near an open flame. When the flame type leak detector is used to check for leaks, never breathe the fumes.

THINGS YOU SHOULD KNOW

- Leakage of refrigerant-12 can be so silent that the complete charge in the system can be lost without warning.
- Refrigerant gas (vapor) is heavier than air and will settle to the floor as it flows from a point of leakage or controlled discharge.
- Pressure in the system may momentarily get as high as 400 psi and under such pressure, the refrigerant is forced out through the smallest opening or needlepoint size pore.
- The compressor is continually giving up some lubricating oil to the refrigerant as it circulates and depends upon oil in the returning refrigerant for a continuous supply. Any stoppage or major loss of refrigerant will therefore be fatal to the moving parts of the compressor.
- All parts of the refrigerant system are under pressure at all times whether the compressor is operating or not operating and thus any leakage point is losing refrigerant-12 continuously.
- The refrigerant system is a completely sealed assembly. This sealed condition is absolutely necessary to retain the chemicals and keep them in a pure and proper condition.
- The extreme internal dryness of a properly prepared system is a truly desert-like condition.

TECHNICAL SERVICE BRIEFS



A 1970 GM Original Equipment Distributor with an Autolite 1-210 Point Set Installed

Most of the 1970 GM passenger car ignition distributors for V-8 engines are equipped with a metal, two-piece Radio Frequency Interference (RFI) Shield. This shield completely covers the ignition points and movable breaker plate and is designed to prevent radio interference in the owner's automobile.

Therefore, when it is necessary to inspect or replace the distributor points and/or condenser, both parts of this shield must be removed.

To answer any questions that may arise regarding the use of Autolite's Heavy-Duty, Ventilated Point Set, Part No. 1-210, on 1970 GM V-8 distributors equipped with an RFI shield, note the photograph above. Here you see a 1970 GM original equipment distributor with an Autolite 1-210 point set correctly installed. No interference problem exists in the critical clearance area (as clearly shown in the photograph). During point set installation, it is extremely important to make sure the primary lead and condenser terminals *do not touch the shield or its insulating tape*. Proper clearance should be *no less than 1/16"*.

If the points or terminals touch this shield, a short circuit or grounding condition will result, causing erratic engine operation or a total loss of ignition.

NOTE: When replacing the original GM point set with a new Autolite 1-210 point set . . . which covers the majority of GM V-8 engines from 1959 to 1970 . . . make sure the terminals are pressed down all the way and the terminal screw tightened securely. Then, install the first section of the RFI shield, as shown, before installing the second section of the shield.

THE AUTOLITE 1-210 DISTRIBUTOR POINT SET OFFERS MANY ADVANTAGES

- Ventilated contacts for cooler operation with less pitting and burning
- Contacts constructed of over 99% pure tungsten for longer life
- Pre-assembled to provide easy installation and cut replacement time
- Terminal lead screw assures tight electrical connections
- Lightweight breaker arm construction assures outstanding high speed performance
- High quality stainless steel breaker point springs provide proper tension for minimum rubbing block wear and less point bounce at higher engine RPM

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The best place in the world to buy replacement suspension parts is at our Dealership. With today's complex front ends, it pays to use high quality and durable original equipment suspension parts. As an example, the Ford ball joint provides longer life and increased safety because its design includes a special air-tight boot seal. Ford ball joints like all Ford parts, are manufactured to exacting original equipment specifications—they fit right—and because they do, they are easy to install and last longer. This means fewer comebacks—more profitable service business.

We must be prepared at all times to service the vehicles we sell; we carry—or can get—every part needed from bumper to bumper, including nuts and bolts. You can load up at one stop. No chasing around town to get *everything you need.* At today's labor prices, trip-time savings alone can save you a sockfull. See us the next time you need suspension parts for Ford Family vehicles, whether it be shock absorbers, springs, spindles, ball joints or whatever!

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