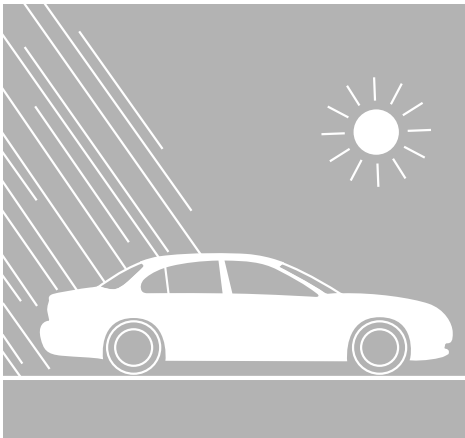


# ***SERVICE TRAINING COURSE 703 JAGUAR CLIMATE CONTROL SYSTEMS***



<b>ISSUE ONE</b>
<b>DATE OF ISSUE: 07/01/2002</b>

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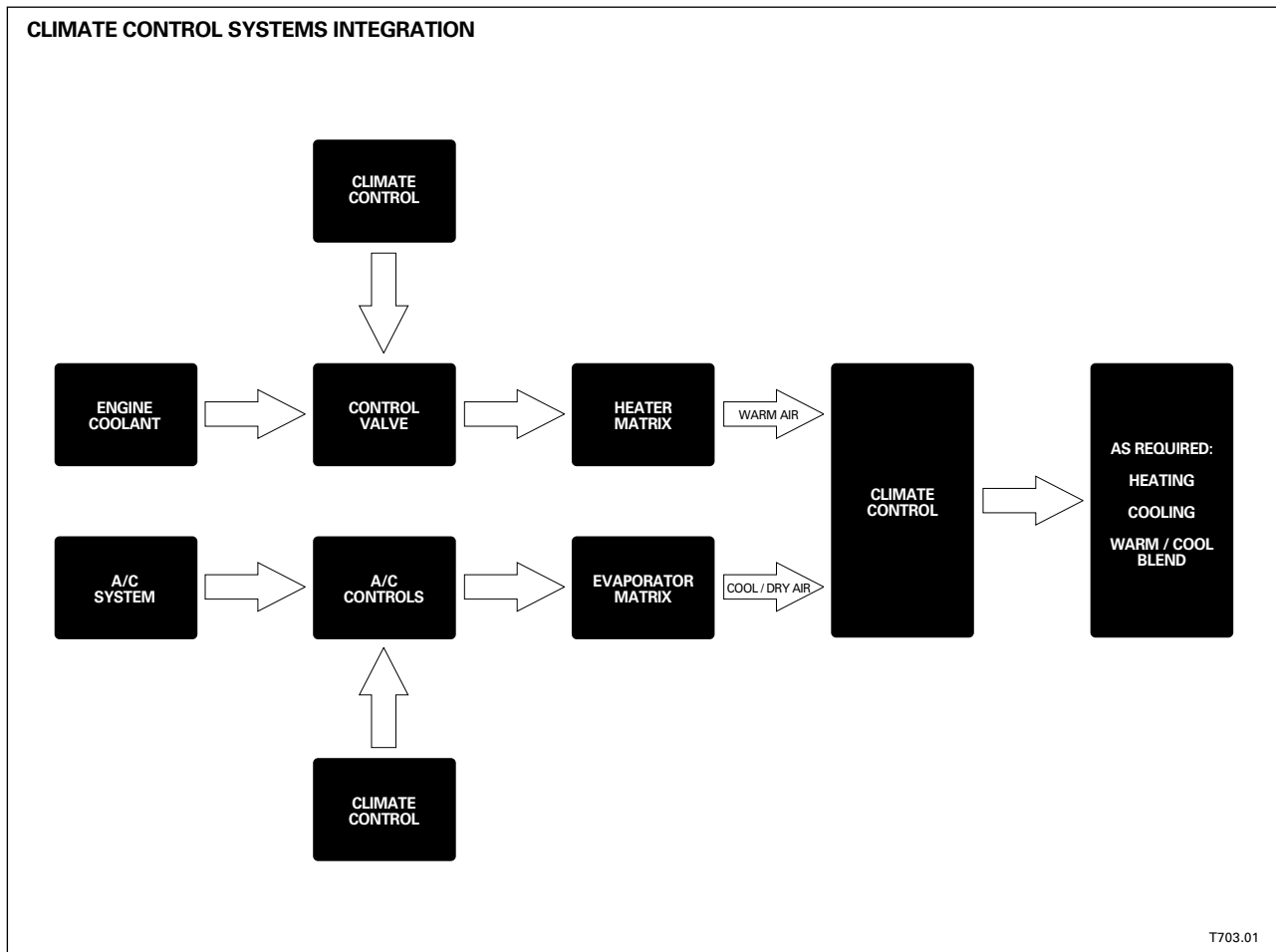
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## INTRODUCTION

Jaguar Climate Control Systems provide vehicle occupants with year-round automatic temperature and humidity control as selected on the control panel. The vehicle heating and air-conditioning systems are the foundation for providing the warm, cool or combined warm/cool air necessary to meet the desired conditions. Using advanced electronic components and a microprocessor-based control module, the Climate Control Systems produce a continuously comfortable environment over a wide range of ambient conditions.



## NOTES

## ACRONYMS AND ABBREVIATIONS

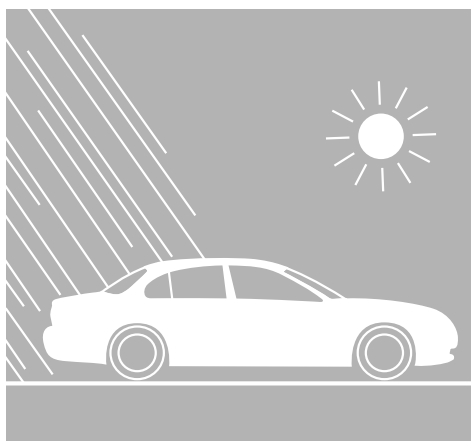
The following abbreviations and acronyms are used throughout the Jaguar Service Training Student Guides:

A/C	Air Conditioning
A/CCM	Air Conditioning Control Module
APP SENSOR	Accelerator Pedal Position Sensor
APP1	Accelerator Pedal Position Sensor Element 1
APP2	Accelerator Pedal Position Sensor Element 2
AUTO	Automatic Transmission
B+	Battery Voltage
BANK 1	RH Cylinder Bank (Cylinders 1, 3, 5, 7)
BANK 2	LH Cylinder Bank (Cylinders 2, 4, 6, 8)
CAN	Controller Area Network
CKP SENSOR	Crankshaft Position Sensor
CM	Control Module
CMP SENSOR / 1	Camshaft Position Sensor / RH Bank
CMP SENSOR / 2	Camshaft Position Sensor / LH Bank
D2B	D2B Network
DATC	Dual Automatic Temperature Control
DLC	Data Link Connector
DSC	Dynamic Stability Control
ECM	Engine Control Module
ECT SENSOR	Engine Coolant Temperature Sensor
EFT SENSOR	Engine Fuel Temperature Sensor
EGR	Exhaust Gas Recirculation
EGT SENSOR	Exhaust Gas Temperature Sensor
EOT SENSOR	Engine Oil Temperature Sensor
EVAP CANISTER CLOSE VALVE	Evaporative Emission Canister Close Valve
EVAP CANISTER PURGE VALVE	Evaporative Emission Canister Purge Valve
FTP SENSOR	Fuel Tank Pressure Sensor
GECM	General Electronic Control Module
GPS	Global Positioning System
HID	High Intensity Discharge
HO2 SENSOR 1 / 1	Heated Oxygen Sensor – RH Bank / Upstream
HO2 SENSOR 1 / 2	Heated Oxygen Sensor – RH Bank / Downstream
HO2 SENSOR 2 / 1	Heated Oxygen Sensor – LH Bank / Upstream
HO2 SENSOR 2 / 2	Heated Oxygen Sensor – LH Bank / Downstream
IAT SENSOR	Intake Air Temperature Sensor
IC	Instrument Cluster
ICE	In-Car Entertainment System
IMT VALVE / 1	Intake Manifold Tuning Valve / Top
IMT VALVE / 2	Intake Manifold Tuning Valve / Bottom
IP SENSOR	Injection Pressure Sensor
KS / 1	Knock Sensor / RH Bank
KS / 2	Knock Sensor / LH Bank
LH	Left Hand
LHD	Left Hand Drive
MAF SENSOR	Mass Air Flow Sensor
MAN	Manual Transmission
MAP SENSOR	Manifold Absolute Pressure Sensor
N/A	Normally Aspirated
NAS	North American Specification
NTC	Negative Temperature Coefficient
OAT	Organic Acid Technology
PATS	Passive Anti-Theft System
PCM	Powertrain Control Module

PTEC	Powertrain Electronic Control
PWM	Pulse Width Modulated
RECM	Rear Electronic Control Module
RH	Right Hand
RHD	Right Hand Drive
ROW	Rest of World
SCP	Standard Corporate Protocol Network
TCM	Transmission Control Module
TP SENSOR	Throttle Position Sensor
TP1	Throttle Position Sensor Element 1
TP2	Throttle Position Sensor Element 2
TURN	Turn Signal
TV	Television
V6	V6 Engine
V8	V8 Engine
VICS	Vehicle Information Control System
VVT VALVE / 1	Variable Valve Timing Valve / Bank 1
VVT VALVE / 2	Variable Valve Timing Valve / Bank 2
+ve	Positive
-ve	Negative



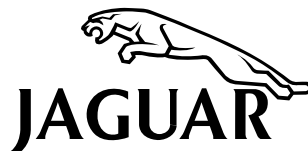
# *JAGUAR CLIMATE CONTROL SYSTEMS*



## **1 CLIMATE CONTROL**

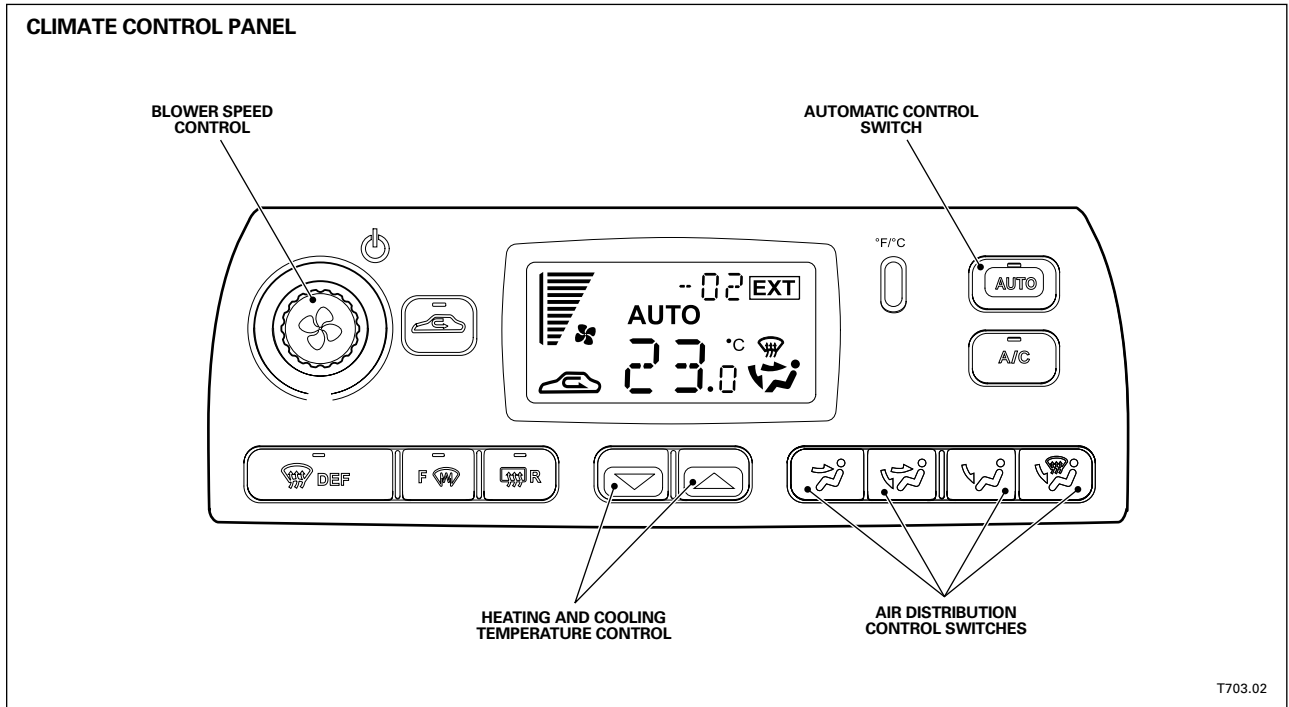
### **1.1 Climate Control Overview**

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## CLIMATE CONTROL OVERVIEW

The climate control system is designed to provide comfort for the driver and passengers. The climate control system maintains in-car air temperature and humidity within a range that is comfortable for the people inside and provides fresh clean air for ventilation. A comfortable temperature inside the vehicle helps keep the driver alert and attentive.

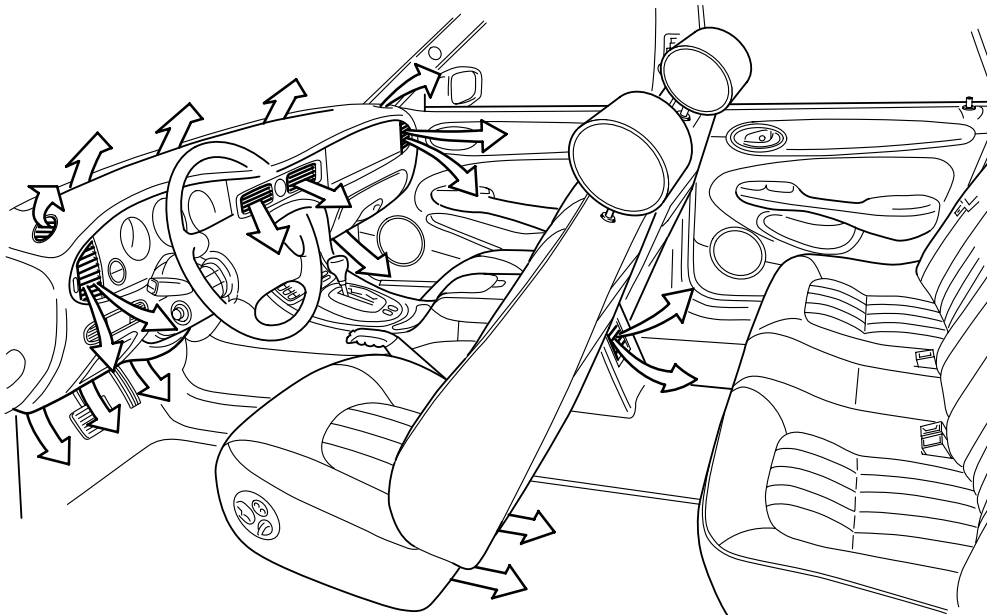


### NOTES



The air conditioning (A/C) system and the heating system comprise heating, ventilation and air conditioning systems. The climate control system controls heat, temperature, air distribution, and the removal of humidity. The climate control system uses an air distribution system of ducts, vents and doors to direct outside air or climate controlled air into the vehicle passenger compartment.

## AIR DISTRIBUTION



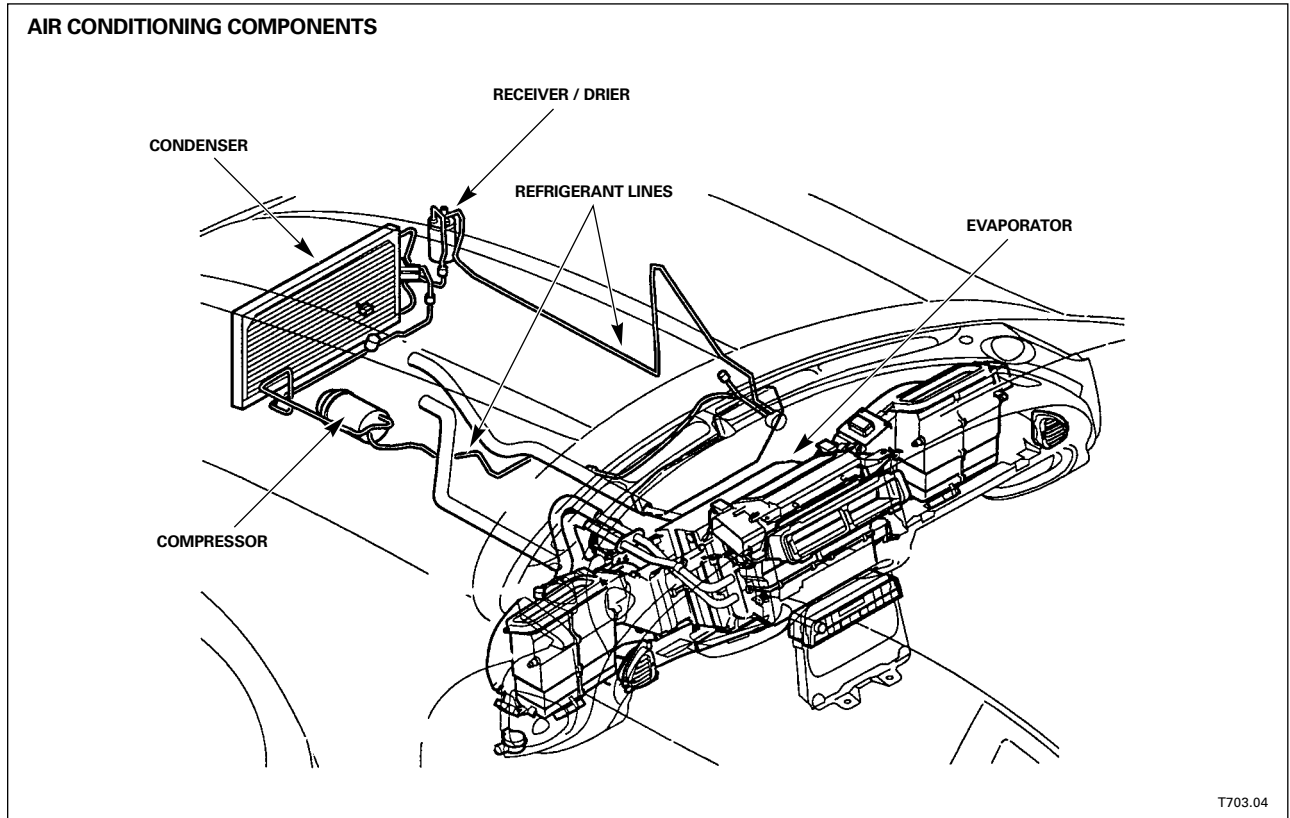
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## NOTES

## CLIMATE CONTROL OVERVIEW

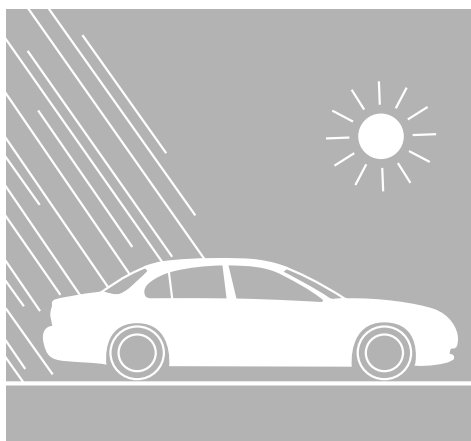
The climate control system in a vehicle is divided into four closely related subsystems:

- Refrigeration, A/C system
- Heating system
- Air distribution and ventilation system
- Electrical system



### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*



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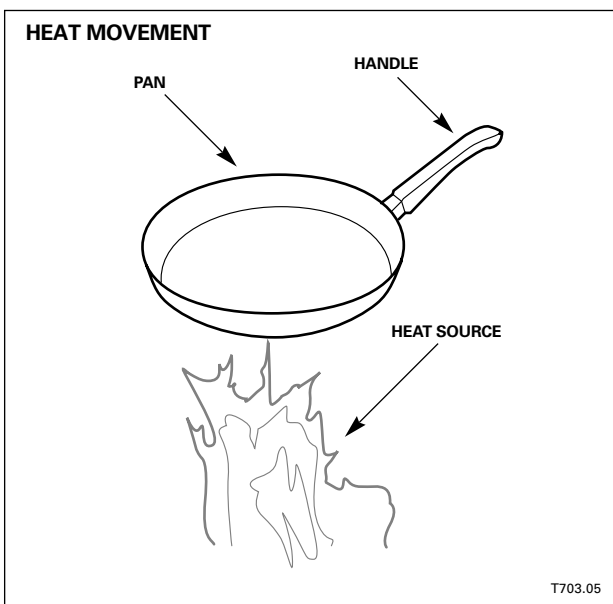
## CLIMATE CONTROL FUNDAMENTALS

### Heat Energy

Air conditioning is the control of heat. Heat is a form of energy. Energy cannot be destroyed, but can be converted into another form of energy. Air conditioning systems use heat and energy from the vehicle's engine to remove unwanted heat from the interior of the vehicle.

An example of energy conversion is a flame under a container of water. The heat from the flame raises the temperature of the water causing the water to boil. The expanding gases or steam from the boiling water can be used to create mechanical motion, another form of energy.

Along with the concept of heat and heat energy comes the concept of cold.



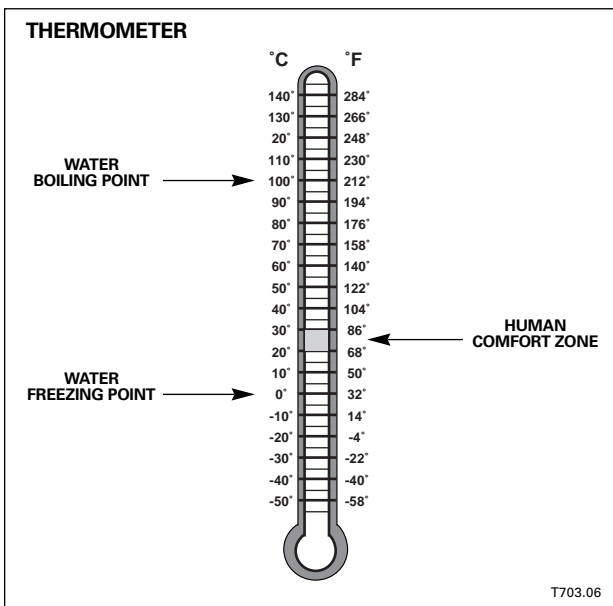
### Heat Measurement

Cold is merely the absence of heat. Cold is what is left if all heat is removed. Heat will always travel to cold. An example of this is a cooling pan on a hot stove. The heat on the bottom of the pan will travel toward the cold handle. Heat is relatively easy to measure and its methods of movement are very predictable and controllable.

Vehicle air conditioning systems create a cold spot in the interior of the vehicle, giving the heat a cold area to transfer to.

### Temperature

Temperature or heat intensity is measured using a thermometer. Heat intensity is important because the human comfort zone is 21 – 27 °C (65 – 80 °F). If the temperatures fall above or below this comfort zone the passengers may become uncomfortable.



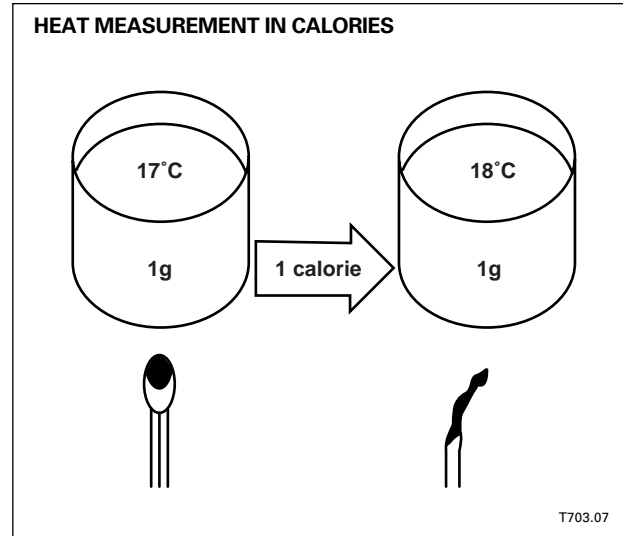
### NOTES

**Heat Quantity**

Heat quantity is measured in joules (J) or British thermal units (BTU). A typical wooden match produced 1,051 joules of heat. 4.2 joules is the amount of energy required to raise the temperature of 1 g of water one degree Celsius. A liter of gasoline has approximately 117 million joules of heat energy. Heat energy can be converted into mechanical energy by the engine to move the vehicle.

HVAC systems must also transfer heat to energy to and from the interior of the vehicle.

HVAC systems are rated in calories. Vehicle designers must take into account the size of the vehicle, number of passengers and possible sources of heat when designing a HVAC system.



**Metric to English conversion table**

Metric	English
1 gram	0.0022 pound
251 cal	1 BTU
1,055 J	1 BTU
17 °C	62.6 °F
18 °C	64.4 °F

**NOTES**

## CLIMATE CONTROL FUNDAMENTALS

### Humidity

Humidity is the amount of water or water vapor in the air. The humidity of the air may vary from a dry 0% up to a very damp 100%. Humid cold air feels much colder than air that is dry and at the same temperature. Humid hot air slows down the human body's ability to cool itself by evaporation and perspiration.

As with temperature, excessive humidity makes humans uncomfortable. Excessive humidity also puts added strain on the air conditioning system. A car's air conditioner not only cools the interior of the vehicle, it also removes the moisture from the air flowing into the passenger compartment as the air conditioning system operates.

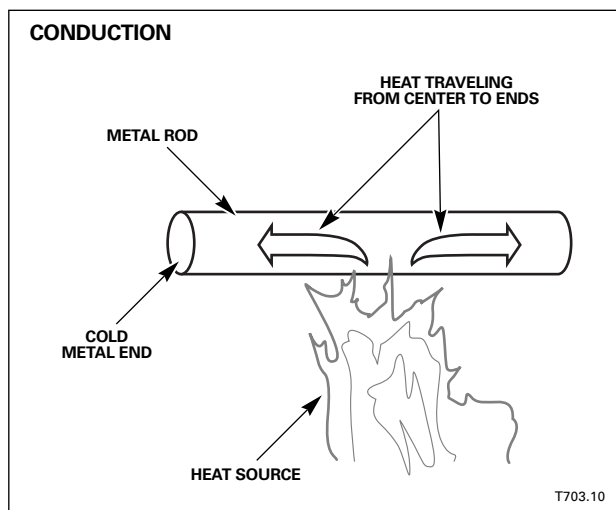
### Heat Movement

HVAC systems can transfer heat out of a place where it is not wanted and move the heat into a place where it is wanted. Several physical principles are involved in this transfer of heat.

Heat is energy that moves from hot to cold. Cold is a lack of energy. The rate that heat moves is a factor of the difference in the temperature between hot and cold areas. A large temperature difference moves heat much faster than if two areas are almost the same temperature. The heat flow tends to make the hot item cooler and the cooler item warmer. If left alone, the two areas will become the same temperature.

To cool a hot vehicle, the evaporator creates a cold place inside the vehicle for the unwanted heat to transfer to. Once the heat moves to this cool area, the heat is then removed and transferred to the air outside of the vehicle. The vehicle's engine and HVAC make this a fairly simple process.

Heat can travel on one or more of three paths: conduction, convection and radiation.



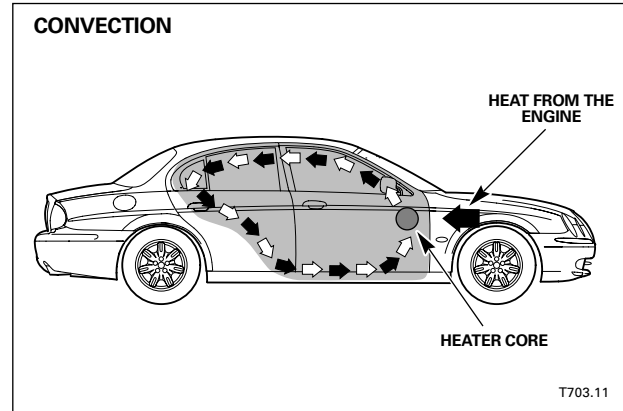
### Heat Conduction

Conduction is the simplest way heat travels. An example of conduction would be heating one end of a metal wire. Heat applied to one end of the wire would be conducted through the wire to the opposite end until both ends of the wire become hot. Some materials such as steel, copper and aluminum are good heat conductors. Materials such as wood or plastic are poor conductors of heat and are called insulators.

#### NOTES

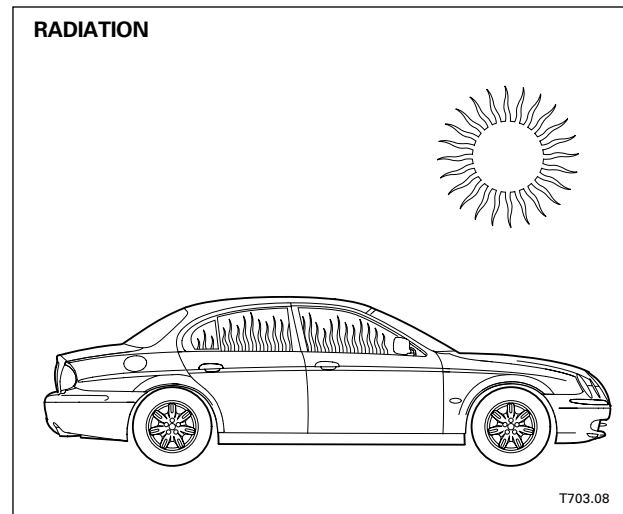
## Heat Convection

Convection is another type of heat transfer. Convection occurs when material, such as an engine, passes heat to the cooling system of the vehicle. As the potential energy of the fuel is converted to mechanical and heat energy by the engine combustion process, the heat of the engine must be removed. The liquid in the cooling system is pumped through the engine, and the convection process transfers engine heat to the liquid. The cooling system liquid then takes this heated coolant to the radiator. The metal radiator uses the conduction process to remove the heat from the liquid coolant and to the radiator fins. The radiator fins then pass the heat of the radiator to the passing airflow through the radiator.



## Heat Radiation

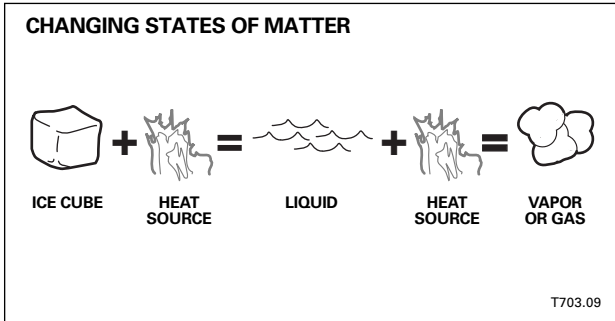
Radiation is another example of how heat can move. Radiation occurs when heat rays pass from one location to another without warming the air or material that the rays are passing through. An example of radiation is a vehicle on a cold sunny day. If the vehicle's interior is closed off from the outside air temperature, the interior of the vehicle becomes warmer than the outside air. This happens because the sunlight is passing through the air, and light rays are striking the exterior and interior of the vehicle. When the light rays strike the interior and exterior of the vehicle surface, the light energy is changed into heat energy warming the vehicle. The cold outside air that the light rays pass through is not heated.



## NOTES

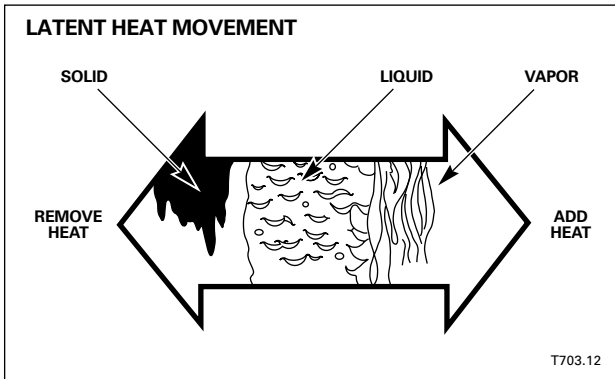
CLIMATE CONTROL FUNDAMENTALS

Heat Movement (continued)



**States of Matter**

The states of matter are solids, liquids, and gases. A solid may be a cube of ice, and when heat is added to the ice the solid ice cube will change state into a liquid. If additional heat is added (to 100 °C [212 °F]) the liquid will change state into a gas. The air conditioning system works through a fluid called a refrigerant. The refrigerant in an A/C system that is functioning is always changing state from a liquid to a gas and back to a liquid.



**Latent Heat**

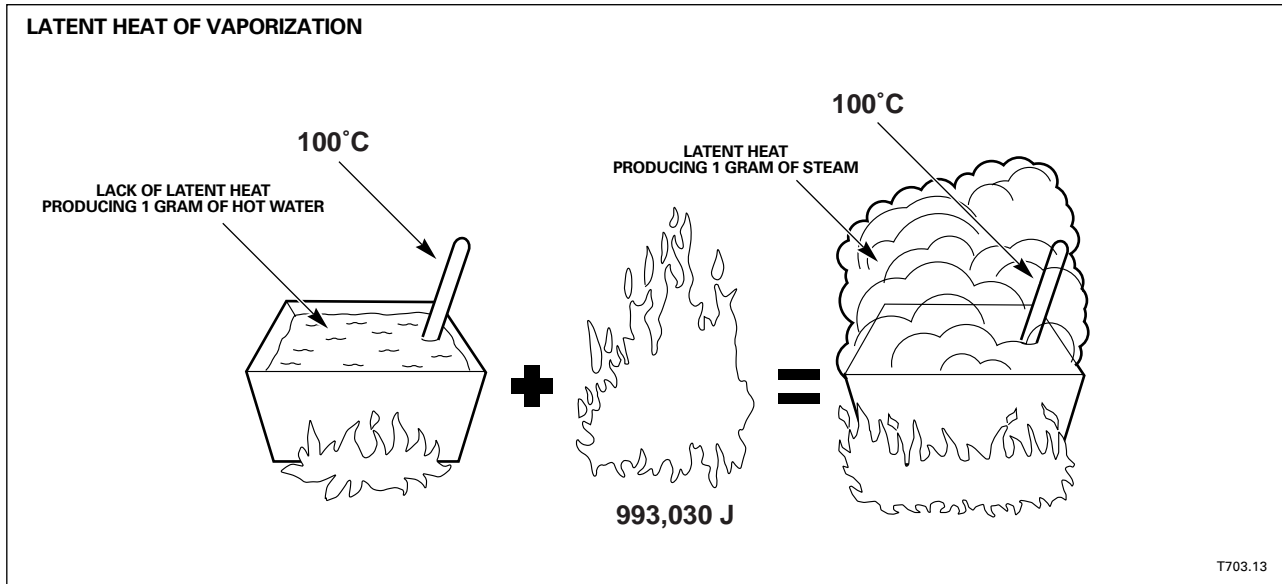
Latent heat is the amount of heat that must be added or removed from a liquid to make it change state. It is called latent heat because you cannot measure it with a thermometer. For example, if you heat 453 grams of water at sea level to 100 °C (212 °F) you must continue to apply at least 993,030 joules of heat energy to convert it to steam. As you add these additional joules to the water the temperature remains unchanged. The additional heat, called latent heat or hidden heat, is the heat needed to change a substance from a liquid to a vapor.

NOTES



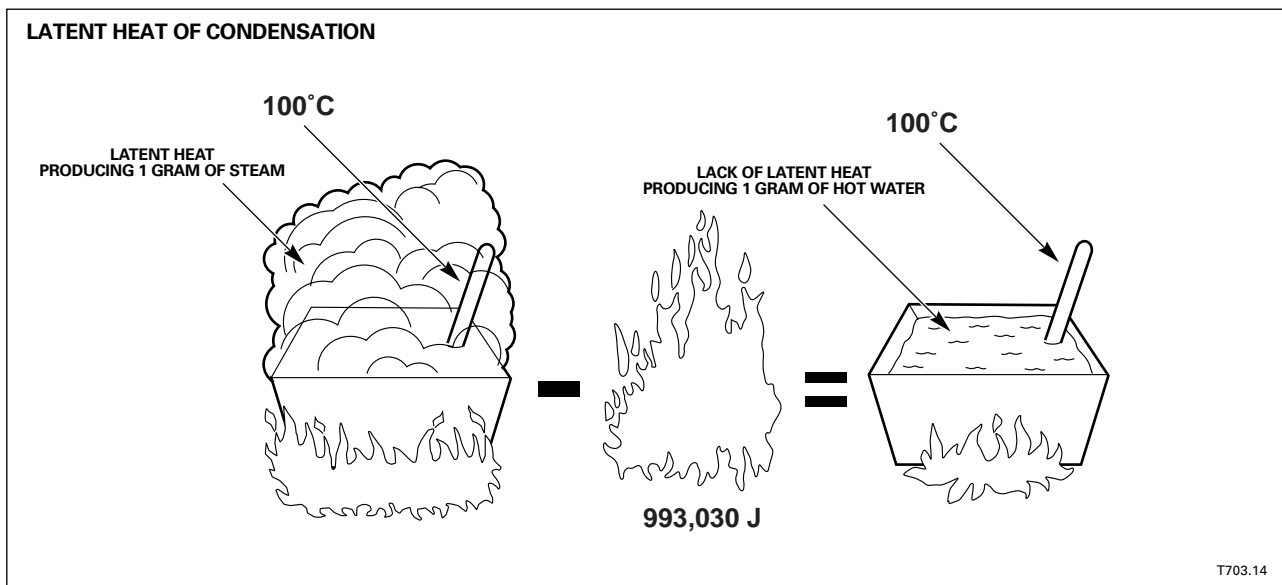
**Latent heat of vaporization**

In an A/C system, latent heat of vaporization occurs within the evaporator. When the refrigerant passes through the evaporator, it absorbs heat from inside the vehicle and begins to boil. As heat continues to be absorbed, the refrigerant changes from a low-pressure liquid into a low-pressure vapor.



**Latent heat of condensation**

In an A/C system, latent heat of condensation occurs within the condenser. The condenser discharges heat from the refrigerant into the outside air. As the refrigerant cools, it condenses from a vapor to a liquid.



### **CLIMATE CONTROL FUNDAMENTALS**

#### **Heat Movement (continued)**

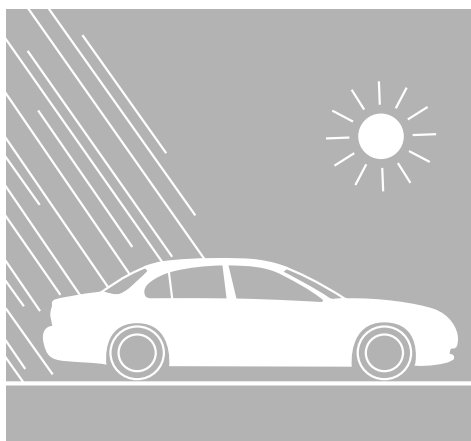
##### **Pressure and Boiling Points**

Changing the pressure of a liquid changes its boiling point. Higher pressure increases the boiling point, while lower pressure decreases the boiling point. An air conditioning system also uses this principle to remove heat from the interior of the vehicle. At sea level, water boils at 100 °C (212 °F). The lower atmospheric pressure at the top of a high mountain may allow water to boil at only 86 °C (187 °F). Refrigerants must have a very low boiling point. Some refrigerants under pressure in an air conditioning system may have boiling points as low as -22 °C (-7.6 °F).

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#### **NOTES**

# *JAGUAR CLIMATE CONTROL SYSTEMS*



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- 1.1 Climate Control Overview
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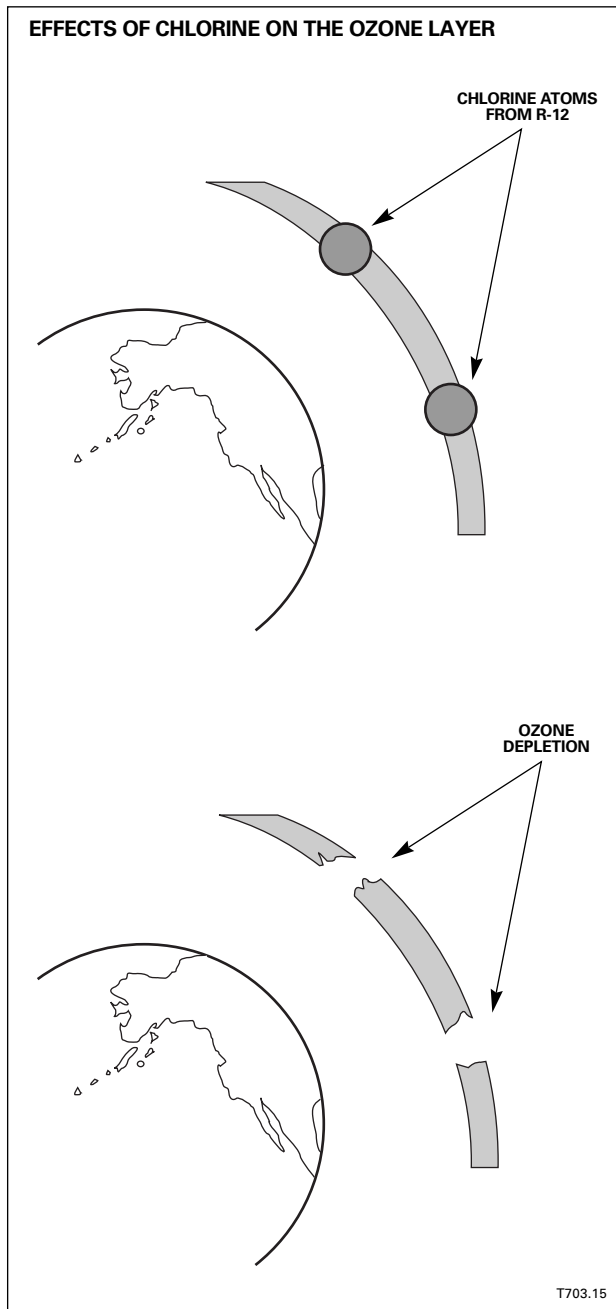
### **1.3 Refrigerants**

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## REFRIGERANTS

**R-12**

Automotive air conditioning systems typically use one type of refrigerant, R-134a. Older vehicles used a refrigerant called R-12, but this type of refrigerant is no longer in production. The R stands for refrigerant. Both chemicals are suitable A/C refrigerants because they have very low boiling points. Though similar in many respects, R-12 and R-134a affect the environment differently.

R-12 is the common name for Dichlorodifluoromethane-12 (CFC-12), a chemical used in many types of refrigeration systems up until about 1990. R-12 contains a single carbon atom, surrounded by two fluorine atoms and two chlorine atoms. The chemical formula for CFC-12 is  $\text{CCl}_2\text{F}_2$ . R-12 is a suitable refrigerant because of its excellent ability to absorb large quantities of heat.

In the mid-1980s, scientists discovered that chemicals called chloro-fluorocarbons (CFC) were destroying the ozone in the atmosphere. Ozone protects the earth from harmful ultraviolet rays released by the sun. One of the major contributors to CFCs in the atmosphere was R-12, which often leaked into the atmosphere during servicing of A/C systems. In 1987, many countries signed an international agreement calling for the gradual phase-out of CFCs. As a result, R-12 was phased out of all new automotive A/C systems. Many countries also have laws mandating that A/C technicians must be properly trained on refrigerant extracting and reclaiming before working on an A/C system.

**NOTES**

### HFC134a or R-134a

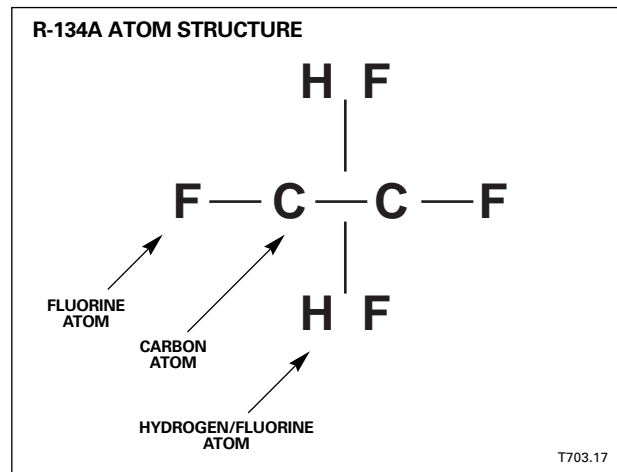
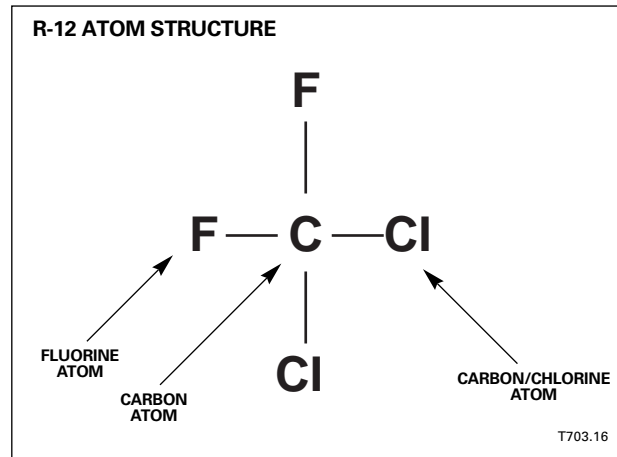
Because of the environmental damage caused by R-12, scientists developed an alternative refrigerant called R-134a. Most vehicles manufactured from 1990 to the present use R-134a as an A/C refrigerant. Unlike R-12, R-134a does not contain CFCs. Instead, it contains hydrofluorocarbons (HFCs), which do not damage the ozone layer. Like R-12, R-134a has chemical properties that make it ideal for use as a refrigerant. These include:

- Low boiling point of -26 ° (15 °F) at sea level
- Ability to change temperature readily in response to changes in pressure

R-134a provides most of the benefits of R-12 without the harmful atmospheric effects. The absence of chlorine in R-134a makes it environmentally “friendly,” but R-134a can be flammable at certain pressures and concentrations.

### Refrigerant Mixing

A/C systems that use one type of refrigerant cannot use the other type. For example, you cannot use R-134a to charge an older A/C system designed to use R-12. Under no circumstances should R-12 and R-134a be mixed in the same system. Mixing refrigerants is called cross-contamination, and it can seriously damage the A/C system. In addition, identifying contaminated refrigerant during normal diagnosis is difficult.

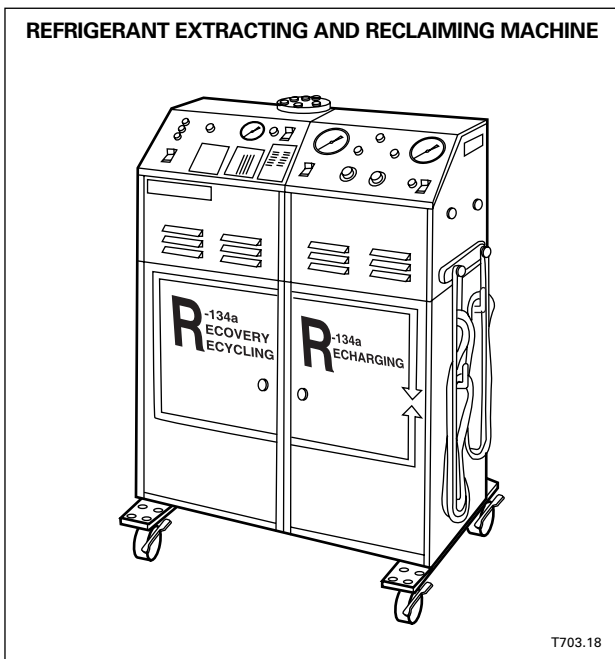


	R-12	R-134a
Container color	White	Light blue
Container marking	R-12	R-134a
Container fitting size	7/16" – 20	1/4" flare 1/2" – 16 ACME
Chemical name	Dichlorodifluoromethane	Tetrafluoroethane
Boiling point	-29.70 °C (-21.62 °F)	-25.15 °C (-15.07 °F)
Latent heat of evaporation at 0 °C (32 °F)	9,071 calories or 38,007 J or 36 BTUs	11,843 calories or 49,622 J or 47.19 BTUs

### Refrigerant Identification Tool

A tool that identifies the type of refrigerant is available from tool manufacturer Snap On. This tool verifies the refrigerant purity and identifies “air diluted” refrigerant problems. It also analyzes and identifies R134a, R12 and R22, known refrigerant blends and other hydrocarbons to protect against cross-contamination problems in vehicles, recovery/recycling machines and storage cylinders.

## REFRIGERANTS



### Handling refrigerant

Technicians often remove or discharge refrigerants from an A/C system during service. Depending on how these refrigerants are processed after removal, they can be classified as recycled, reclaimed or extracted.

### Recycled refrigerant

Recycled refrigerant is cleaned to remove contaminants produced during normal operation of the A/C system. Mixing recycled refrigerant from a non-vehicle mobile system or a building type A/C system, for example, contaminates recycled mobile vehicle refrigerant.

### Reclaimed refrigerant

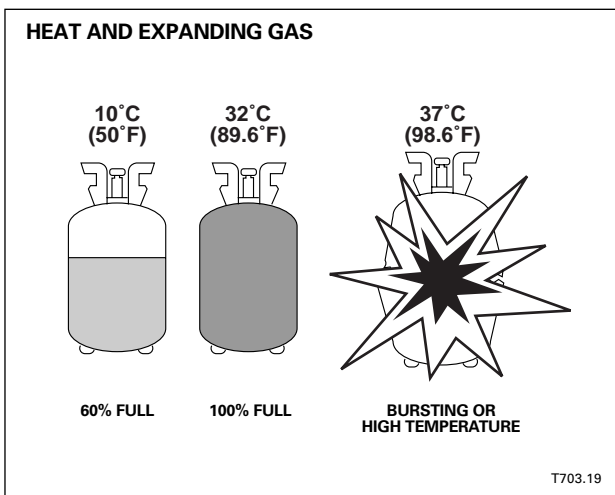
Reclaimed refrigerant is processed to the same standards and purity as new refrigerant. This process requires expensive equipment not ordinarily found in dealership service departments. Reclaimed and recycled refrigerant will perform equally well in all mobile A/C systems.

### Extracted refrigerant

Extracted refrigerant is simply removed and stored in an approved container. This process is used when servicing the refrigeration system and the refrigerant must be removed and stored from the A/C system.

### Storing refrigerant

Both R-12 and R-134a are gases at normal room temperature, and they can be hazardous if stored improperly. New refrigerant stored in its original, properly filled container usually poses no safety hazard. However, recycled refrigerant can be dangerous if it is stored in the wrong type of container or in an overfilled container.



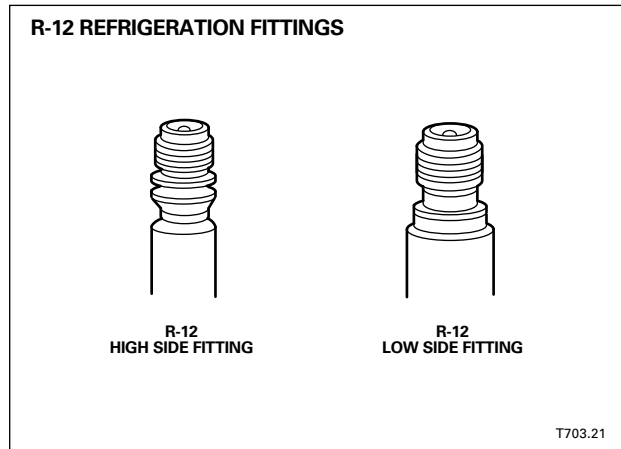
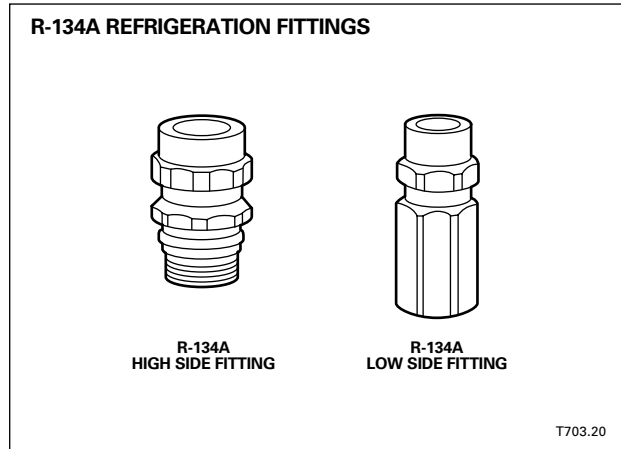
To prevent accidents when handling recycled refrigerant, always follow the rules below:

- Never save disposable refrigerant containers for reuse. Remove all refrigerant and dispose of the containers properly.
- Use only containers approved for refrigerant.
- Never fill a container to more than 60% of container capacity.
- Never store refrigerant containers in direct sun or heat. High temperature causes the gas to expand, which increases the pressure in the container and may cause the container to burst.

## NOTES

## Refrigerant Fittings

Refrigeration fittings allow the system to be checked for proper operating pressures and to empty or fill the system as needed. To prevent cross contamination of different types of refrigerants such as R-134a and R-12, refrigeration systems use different styles of fittings. There are several differences between R-134a and R-12 refrigeration fittings. The most significant difference is that R-134a uses a special coupler that cannot be used on R-12 systems. The new fittings on the R134a prevent excessive loss of refrigerant to the atmosphere.

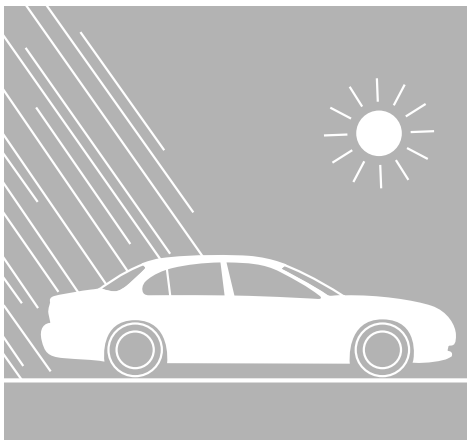


## NOTES





# *JAGUAR CLIMATE CONTROL SYSTEMS*



## **1 CLIMATE CONTROL**

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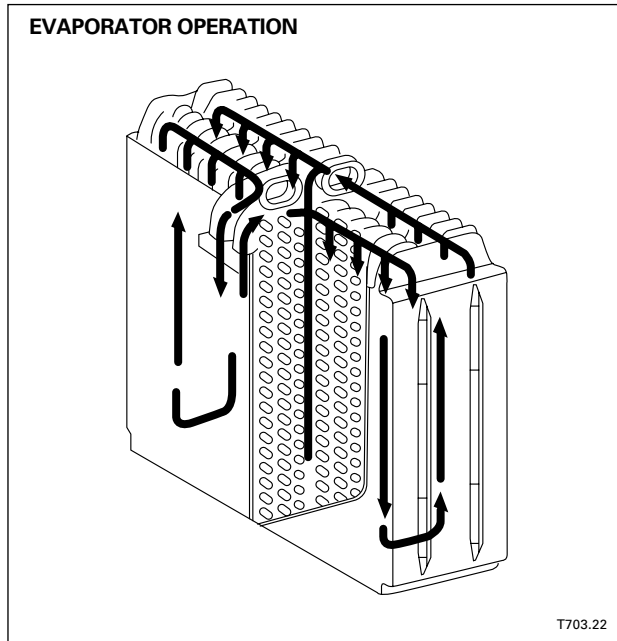
### **1.4 Refrigeration System Components**

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## REFRIGERATION SYSTEM COMPONENTS

Like the liquid in the engine cooling system, the refrigerant in an air conditioning system absorbs, carries, and releases heat. To do this, the A/C system utilizes many components to move heat.



### Evaporator

The evaporator is located near the interior of the vehicle. The evaporator removes heat from the passenger compartment and transfers the heat to the refrigerant. Refrigerant enters the evaporator as a cool, low-pressure liquid mist, which circulates through the evaporator's tubes and fins much like coolant circulates through an engine's radiator. An electric blower fan forces warm air from the vehicle's interior over the surface of the evaporator. The refrigerant absorbs heat as it changes from a liquid to a gas. The refrigerant then exits the evaporator, carrying the heat with the refrigerant as a warm, low-pressure gas.

### NOTES

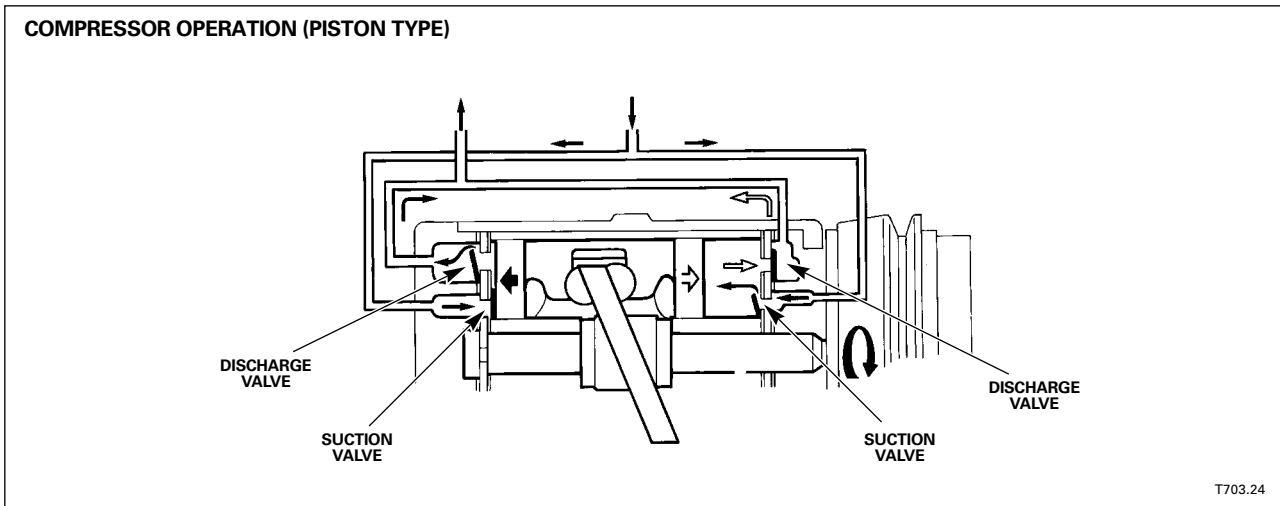
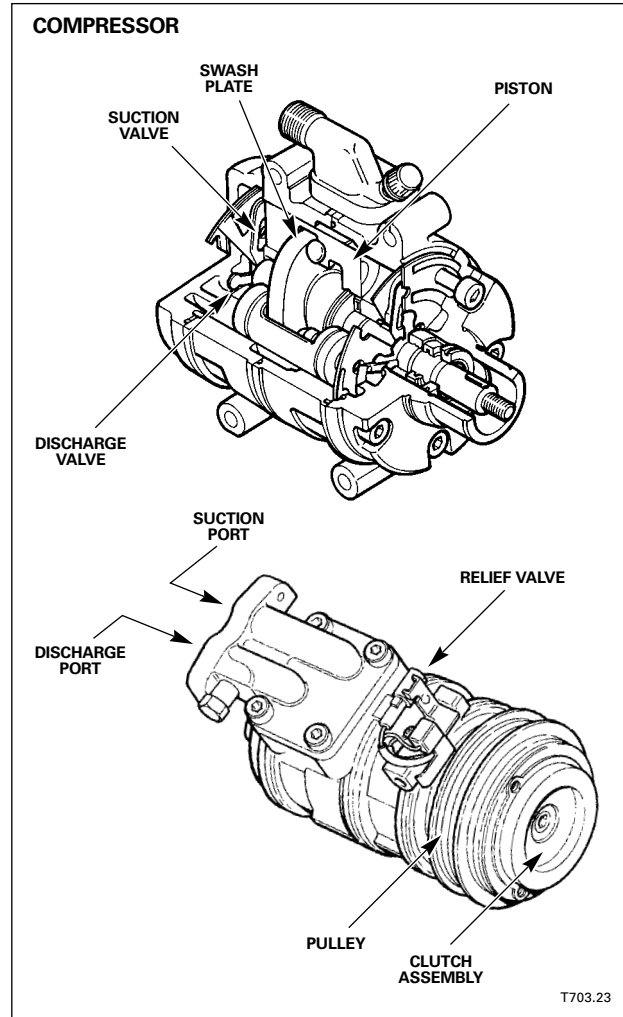
## Compressor

The compressor is the refrigerant pump for the A/C system. A drive belt and pulley connect the compressor to the engine crankshaft, which provides the power to operate the compressor. The compressor draws in warm, low-pressure gas from the evaporator, which drastically raises the pressure and temperature of the gas. The gas is passed on to the condenser. The compressor operates only with refrigerant in its gaseous state. Liquid refrigerant in the compressor will damage the compressor. Compressors create suction and pressure. Pistons or other forms of internal compressor components create pressure and suction, moving the refrigerant.

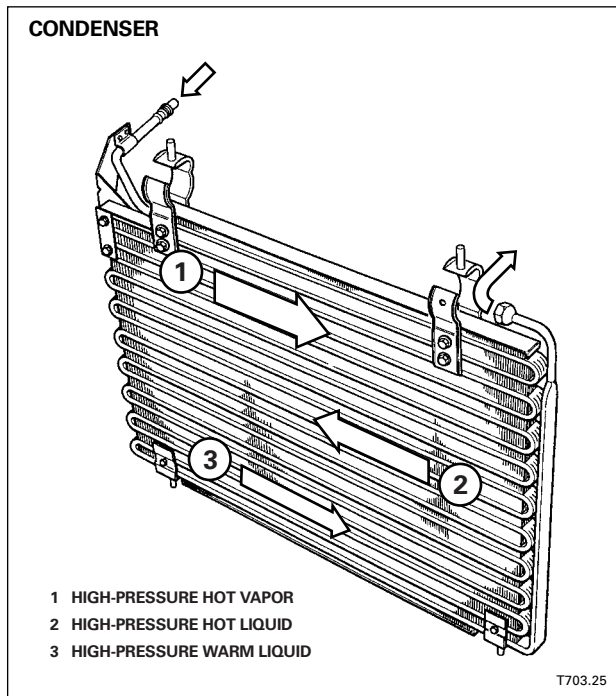
The suction port allows the compressor to draw in gas from the evaporator. The compressor then compresses the gas and discharges the gas out of the discharge port to the refrigeration lines and to the condenser.

The clutch assembly allows the compressor to cycle on and off using the HVAC electrical controls.

The relief valve protects the system from excessive refrigerant pressures. If system pressure becomes too high the valve opens and refrigerant is vented to the outside air.



## REFRIGERATION SYSTEM COMPONENTS



### Condenser

The condenser is located in front of the radiator. The condenser receives hot, high-pressure refrigerant gas from the compressor and transfers the heat to the outside air. Like the evaporator, the condenser circulates refrigerant through a series of tubes and fins. A fan draws outside air over the condenser's surface area, allowing the hot refrigerant to pass its heat to the air. As the refrigerant cools, it changes from a high-pressure gas to a high-pressure liquid. The efficiency of the condenser is critical to A/C operation. The outside air must absorb the stored heat from the vehicle interior plus the additional heat that results from compressing the gas. The more heat transferred by the condenser, the more cooling the evaporator can provide. A larger capacity condenser and a more efficient fan will reduce the interior temperature significantly.

### NOTES

## Receiver/Drier

Located near the outlet of the condenser on the high pressure side of the A/C system, the receiver/drier, used in conjunction with an expansion valve, filters moisture and foreign matter from the liquid refrigerant and serves as a storage area for refrigerant. The receiver/drier may also have electrical controls and service ports for system operation and servicing.

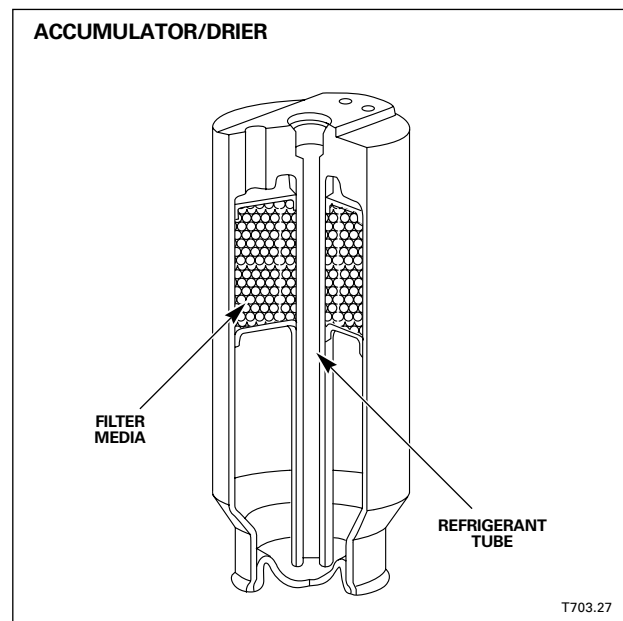
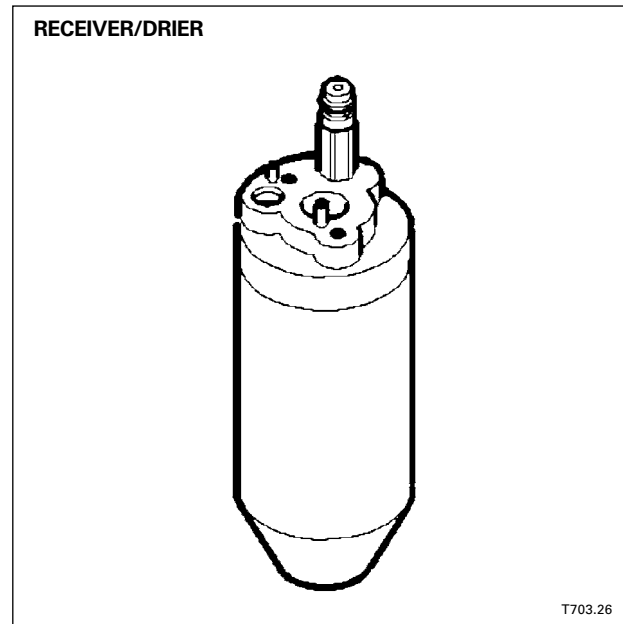
## Accumulator/Drier

The accumulator is used in A/C systems with an orifice tube. The accumulator is located after the evaporator and before the compressor, on the low pressure side of the A/C system. The accumulator functions very much like the receiver/drier in an expansion valve system.

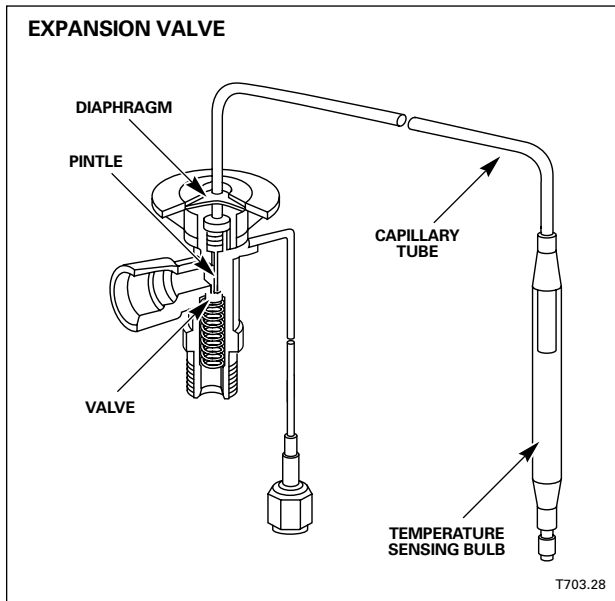
**NOTE:** Starting with the 1997 MY XK, all Jaguar receiver/driers and accumulators contain black die to aid in detecting refrigerant system leaks.

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## NOTES

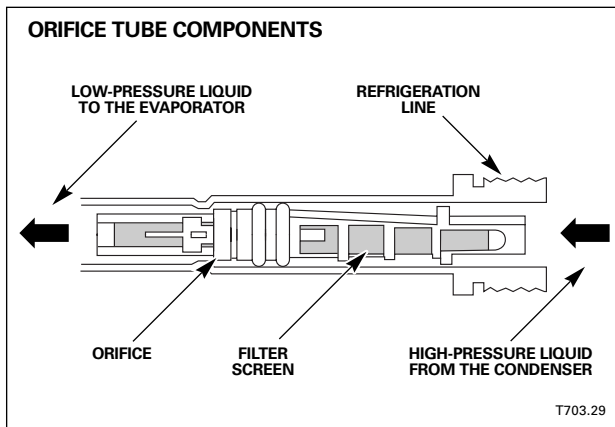


## REFRIGERATION SYSTEM COMPONENTS



### Expansion Valve

The expansion valve regulates the flow of refrigerant to the evaporator. To get maximum cooling potential, the pressure of the liquid refrigerant must be lowered before it enters the evaporator. At lower pressure, the refrigerant's temperature and boiling point drop, allowing it to absorb more heat as it passes through the evaporator. A bulb on the evaporator sends information about evaporator temperature through a capillary tube. This tube is attached to the diaphragm on the expansion valve. If the evaporator becomes too cold, the diaphragm pulls the needle-shaped pintle up, closing the valve and restricting refrigerant flow. As the evaporator temperature rises, the diaphragm presses down on the pintle, opening the valve and letting more refrigerant through.



### Orifice Tube

Like an expansion valve, an orifice tube divides the high and low-pressure parts of the A/C system. The orifice tube has a fixed opening. The flow rate of the refrigerant through the opening is determined by the cycling of the compressor.

### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*



## **1 CLIMATE CONTROL**

- 1.1 Climate Control Overview
- 1.2 Climate Control Fundamentals
- 1.3 Refrigerants
- 1.4 Refrigeration System Components

### **1.5 Lubricants**

- 1.6 Refrigeration Cycles
- 1.7 Heating System
- 1.8 Air Ventilation System

- 2 XJ/ XK CLIMATE CONTROL SYSTEM
- 3 S-TYPE CLIMATE CONTROL SYSTEM
- 4 X-TYPE CLIMATE CONTROL SYSTEM
- 5 CLIMATE CONTROL REFERENCE



### LUBRICANTS

Refrigeration oil lubricates the moving parts and seals of an A/C system. The oil flows with the refrigerant throughout the system. Refrigeration oil and motor oil are different. Never use motor oil in an A/C system.

#### Mineral Oil and PAG Oil

The type of refrigeration oil used in an A/C system depends on the type of refrigerant. When engineers develop a refrigerant, they simultaneously develop the lubrication oil used with it.

R-12 A/C systems use mineral oil as a lubricant. R-134a systems use an oil made of polyalkylene glycols, commonly called PAG oil. PAG oil and mineral oil are completely incompatible and should never be mixed.

#### Characteristics of Refrigeration Oil

Refrigeration oil, either mineral or PAG oil, is highly refined and free of the additives and detergents found in conventional motor oil. Refrigeration oil flows freely at temperatures well below freezing, and it includes an additive to prevent foaming in the A/C system. Refrigeration oil readily absorbs moisture. If stored improperly, the oil becomes unusable. For example, an unsealed container of PAG oil becomes saturated with two percent water if left in a humid climate for five days. If you use saturated oil in an A/C system, acids form, damaging seals and other components. Always seal refrigerant oil properly after use, and never reuse oil removed from an operating A/C system.

In an A/C system, the components hold the refrigerant oil. The compressor helps to mix the oil with the refrigerant and circulates it throughout the system. When replacing an A/C component, the oil that is trapped in the component that is being replaced must also be replaced. Service manuals contain charts describing how much oil to add for various component replacements.

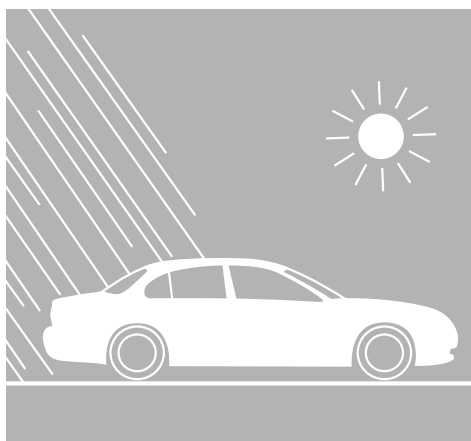
If an A/C system develops a leak, refrigeration oil will appear at the site of the leak. Any leaking refrigerant evaporates immediately. The amount of oil lost depends on the size of the leak and the length of time it was leaking. After you repair a leak, replace the amount of lost oil. Carefully measure the oil removed during evacuation and replace it with a slightly greater amount. If lost oil is not replenished severe damage may occur.

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### NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



## **1 CLIMATE CONTROL**

- 1.1 Climate Control Overview
- 1.2 Climate Control Fundamentals
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- 1.4 Refrigeration System Components
- 1.5 Lubricants

## **1.6 Refrigeration Cycles**

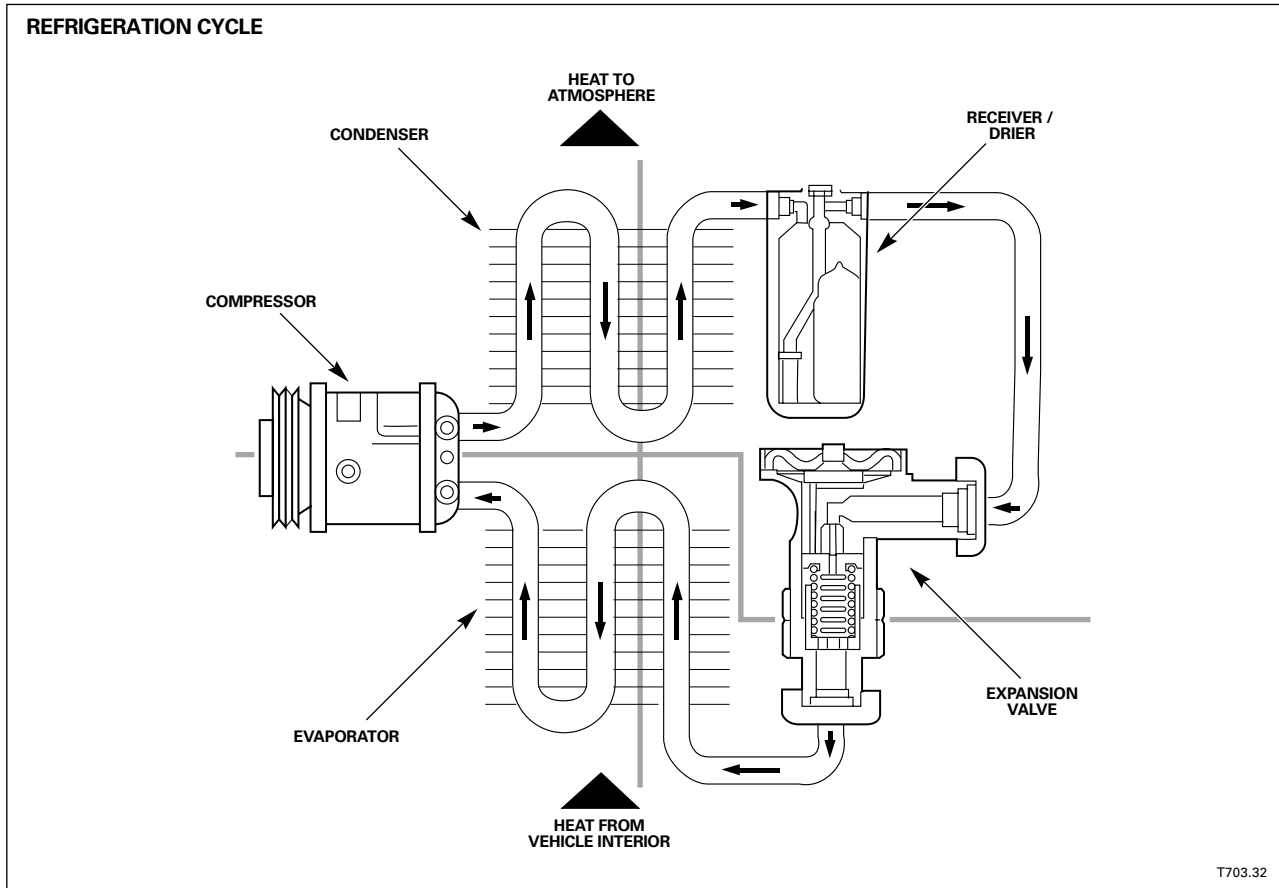
- 1.7 Heating System
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## REFRIGERATION CYCLES

### Refrigeration Cycle in an Expansion Valve System



Vehicle A/C systems use the physical principles of heat transfer and movement. Vehicle A/C systems are either orifice tube or expansion valve type systems. The A/C system is divided into two parts: a low-pressure side and a high-pressure side. Refrigerant boils or evaporates in the low side and condenses in the high side.

As the refrigerant flows through a complete cycle, the refrigerant undergoes two changes in pressure and changes of state. The A/C system can be divided into four sections. The horizontal line in the graphic divides the cycle into a “high-pressure side” on top and a “low-pressure side” on the bottom. The high-pressure side starts at the compressor outlet, extends through the condenser and receiver/drier, and ends at the expansion valve.

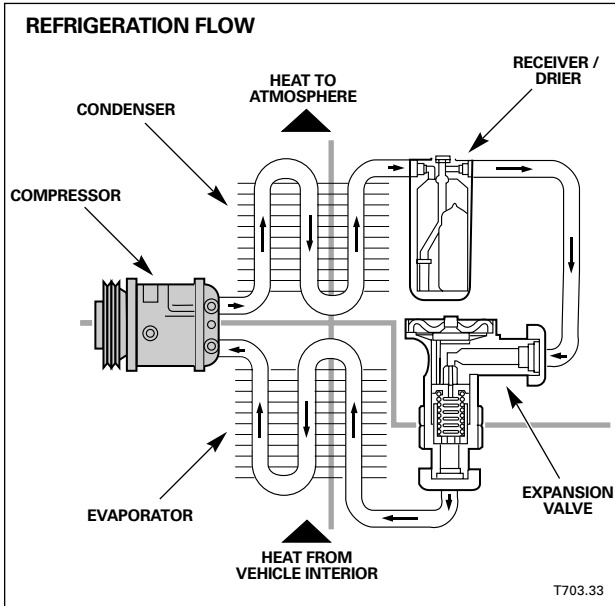
When refrigerant leaves the expansion valve, its pressure drops and it enters the low-pressure side. The low-pressure side extends through the evaporator and into the compressor’s inlet.

The vertical line in the illustration marks the points where the refrigerant changes state. On the left side of the circuit the refrigerant is a vapor; on the right side it is a liquid.

#### NOTES

## REFRIGERATION CYCLES

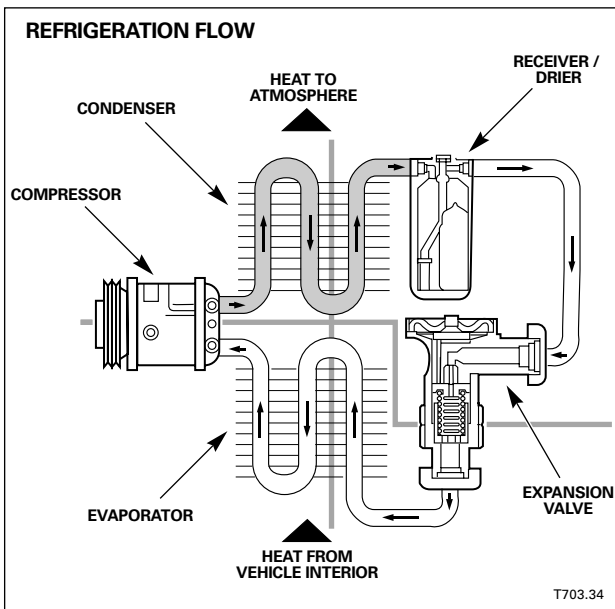
### Refrigeration Cycle in an Expansion Valve System (continued)



#### Refrigeration Cycle: Compressor

The refrigeration cycle begins at the compressor. The compressor draws in low-pressure vapor (about 206 kPa [30 psi] from the evaporator and compresses it to about 1,207 kPa [175 psi]. A drive belt on the engine turns the compressor pulley, which spins the compressor when the compressor's magnetic clutch is engaged. The system monitors refrigerant pressure and activates the compressor only when needed.

The compressor pushes vapor through the outlet to the condenser. The expansion valve is like a plug in the circuit that allows pressure to build on the high-pressure side of the system. This hot, high-pressure vapor carries heat picked up in the evaporator, as well as additional heat from the increased pressure provided by the compressor. At this point, the refrigerant may be as hot as 54 °C (130 °F).



#### Refrigeration Cycle: Condenser

Hot, high pressure refrigerant gas or vapor from the compressor enters the condenser under high pressure of about 1,206 kPa (175psi), making the refrigerant boiling point also higher. In addition, the difference between the temperature of the outside air and the refrigerant is great, so the refrigerant will quickly release heat to the air flowing over the surface of the condenser. The hot gas at approximately 54 °C (130 °F) quickly cools below its high boiling point. As the vapor condenses to a liquid, it releases large amounts of heat or latent heat of condensation. Airflow across the condenser decreases when the vehicle is not moving or in stop-and-go traffic. To compensate, most A/C systems include an electric fan to supply additional airflow when needed.

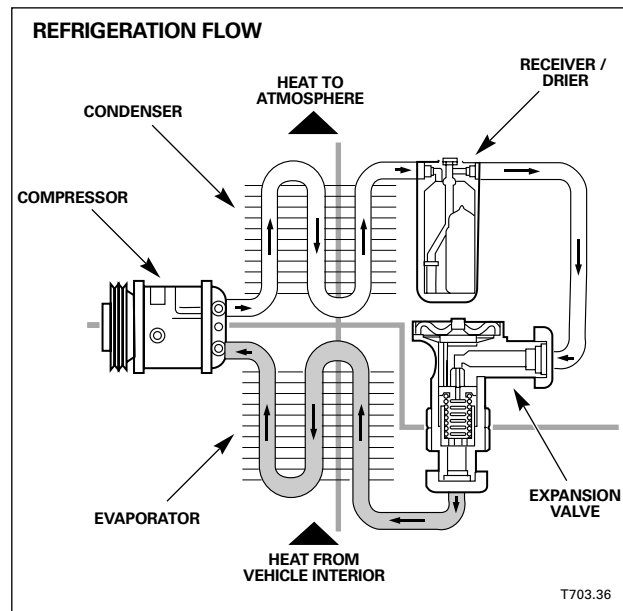
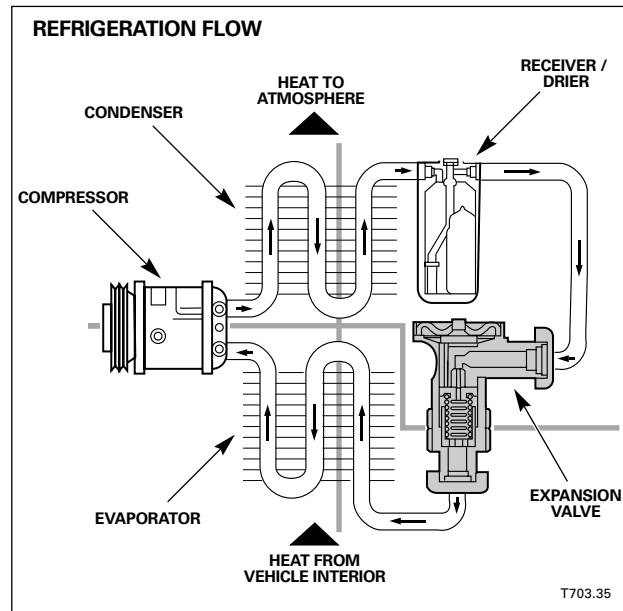
#### NOTES

**Refrigerant Cycle: Receiver/drier**

After flowing through the receiver/drier, which removes moisture and contaminants, the refrigerant next enters the expansion valve. The expansion valve restricts the flow of refrigerant, allowing only a small amount to pass through on its way to the evaporator. Refrigerant pressure on the high side of the expansion valve can be as high as 1,723 kPa (250 psi) or more. The expansion valve reduces that pressure to about 206 kPa (30 psi) on the low side. At this low pressure, the temperature of the liquid refrigerant drops from about 54 °C (130 °F) to about -1 °C (30 °F) and its boiling point decreases. As the refrigerant passes through the expansion valve, it is atomized, or turned into a fine, liquid mist. This process increases the surface area of the refrigerant so it easily absorbs heat when it passes through the evaporator.

**Refrigerant Cycle: Evaporator**

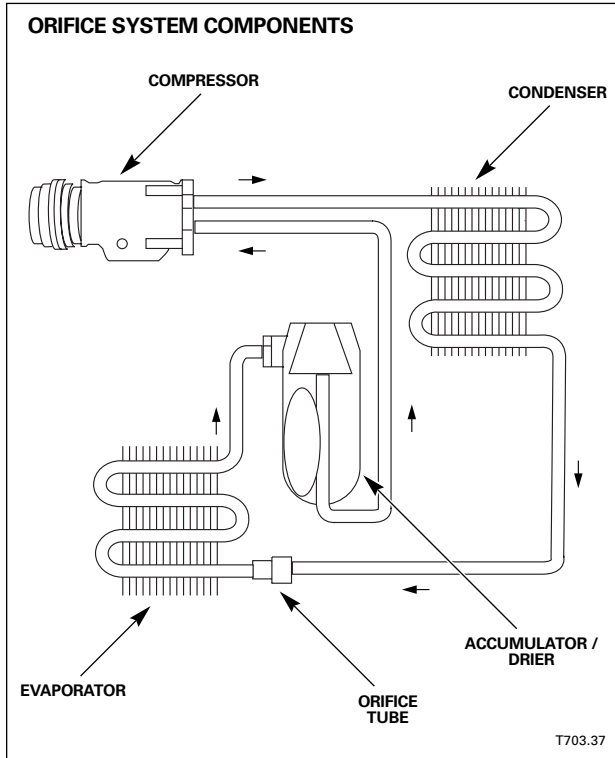
As the refrigerant flows into the evaporator, the refrigerant is a cold, low-pressure liquid mist. At this low temperature, (about -1 °C [30 °F]) the refrigerant readily picks heat from the passenger compartment. An electric blower fan pushes warm interior air over the evaporator, where it gives up its heat and returns to the passenger compartment as cool air. Since the refrigerant's boiling point is lower, it quickly changes into a gas, allowing it to store large amounts of heat as latent heat of vaporization. After picking up heat in the evaporator, the refrigerant gas is drawn into the inlet side of the compressor, where it begins another refrigeration cycle.



NOTES

## REFRIGERATION CYCLES

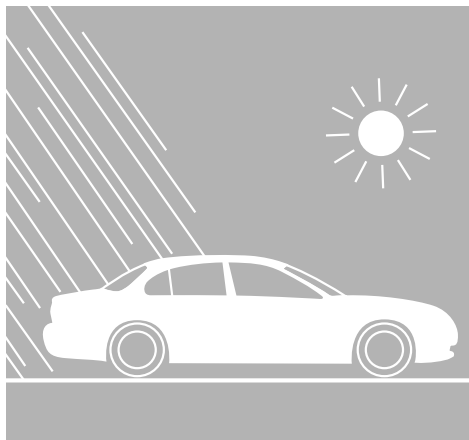
### Refrigeration Cycle in an Orifice Tube System



An orifice tube system is similar to an expansion valve system. However, since the orifice tube is a fixed size, the tube must flood the evaporator to work properly under all conditions. As the refrigerant passes through the evaporator, most of it changes into gas and then travels to the accumulator. The accumulator replaces the receiver/drier in the system. The accumulator/drier separates the liquid refrigerant from the refrigerant gas and also removes moisture and contaminants. This prevents liquid refrigerant from getting back into the compressor, and allows higher heat loads by keeping the remaining liquid on hand.

#### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*

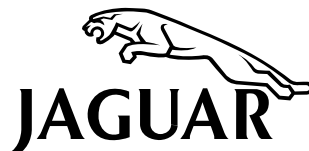


## **1 CLIMATE CONTROL**

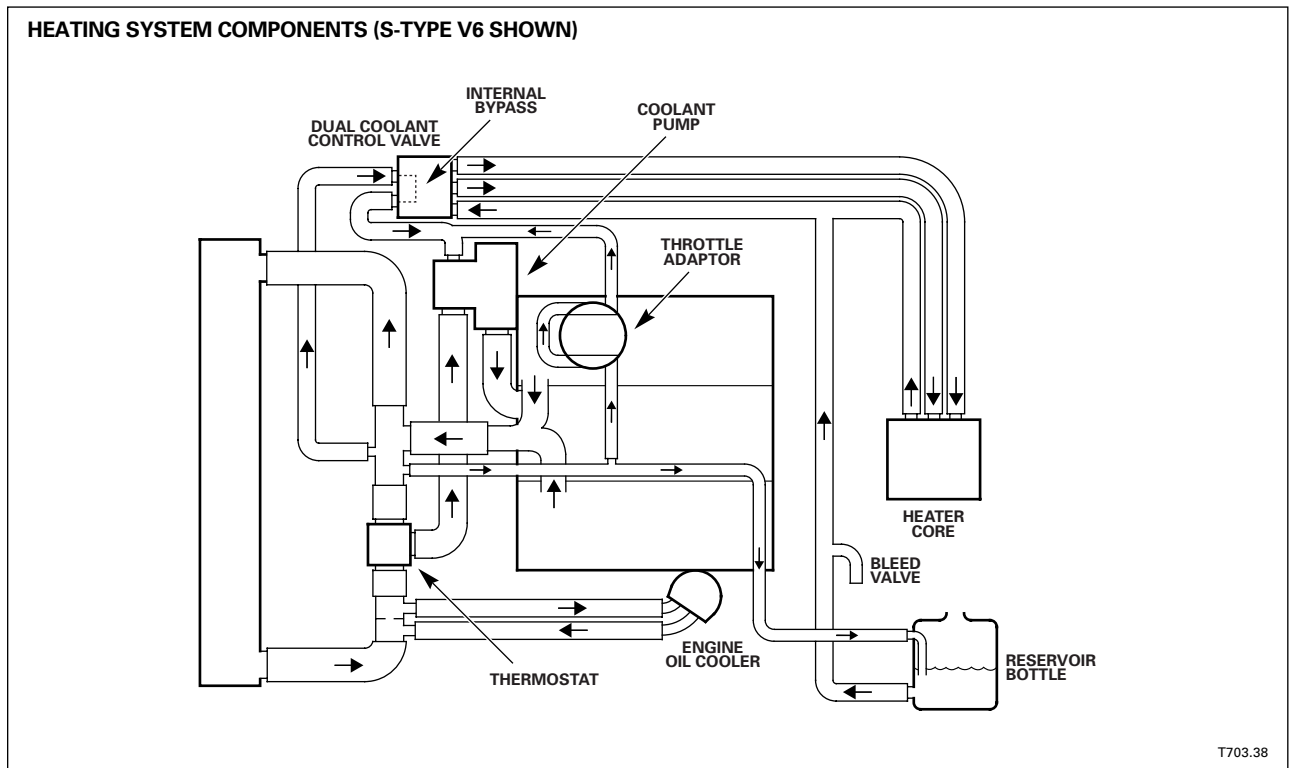
- 1.1 Climate Control Overview
- 1.2 Climate Control Fundamentals
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- 1.4 Refrigeration System Components
- 1.5 Lubricants
- 1.6 Refrigeration Cycles

## **1.7 Heating System**

- 1.8 Air Ventilation System
- 2 XJ/ XK CLIMATE CONTROL SYSTEM
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- 4 X-TYPE CLIMATE CONTROL SYSTEM
- 5 CLIMATE CONTROL REFERENCE



## HEATING SYSTEM

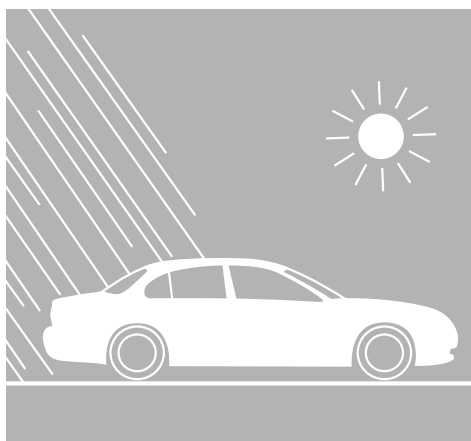


The heating system works in conjunction with the engine coolant system to transfer engine heat to the vehicle interior. The main components of the heating system are the engine, heater hoses, heater core, electric blower motor fan and a heat shutoff device. Hot engine coolant is moved by the coolant pump through the heater hoses to the heater core. The heater core is like the radiator of the engine. The heater core has tubes with fins also like the A/C evaporator. Heater cores are normally mounted in tandem next to A/C evaporators and use the same blower motor and air distribution system. The heat from the coolant is transferred to the air passing through it by the blower motor. The heated air is then moved through the vehicle by the air distribution system.

### NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



## **1 CLIMATE CONTROL**

- 1.1 Climate Control Overview
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- 1.4 Refrigeration System Components
- 1.5 Lubricants
- 1.6 Refrigeration Cycles
- 1.7 Heating System

## **1.8 Air Ventilation System**

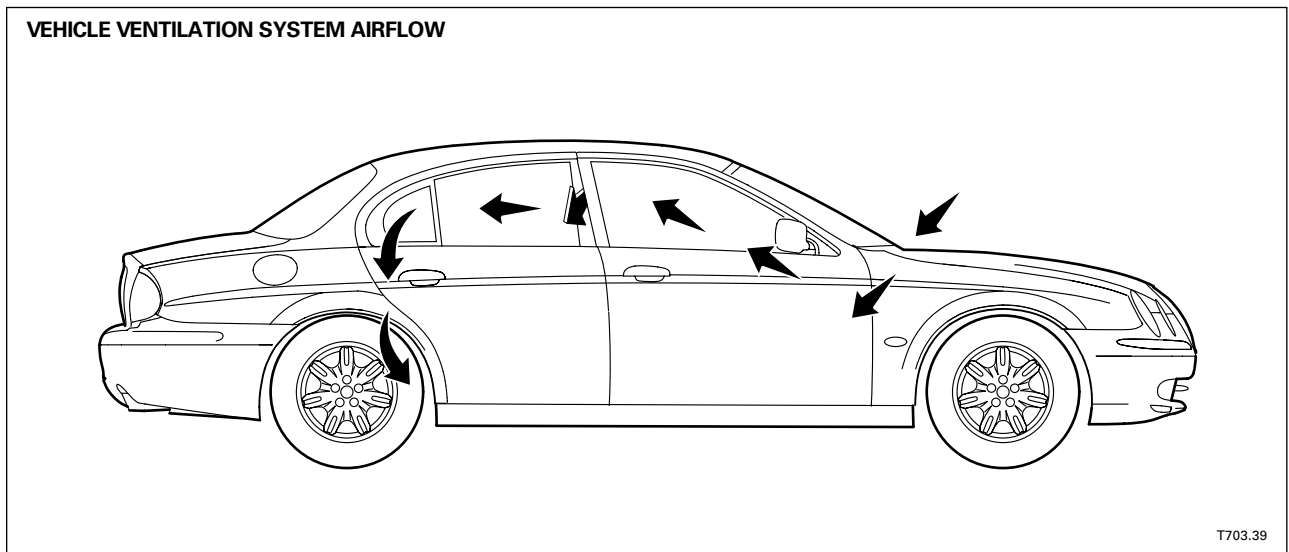
- 2 XJ/ XK CLIMATE CONTROL SYSTEM
- 3 S-TYPE CLIMATE CONTROL SYSTEM
- 4 X-TYPE CLIMATE CONTROL SYSTEM
- 5 CLIMATE CONTROL REFERENCE



## AIR VENTILATION SYSTEM

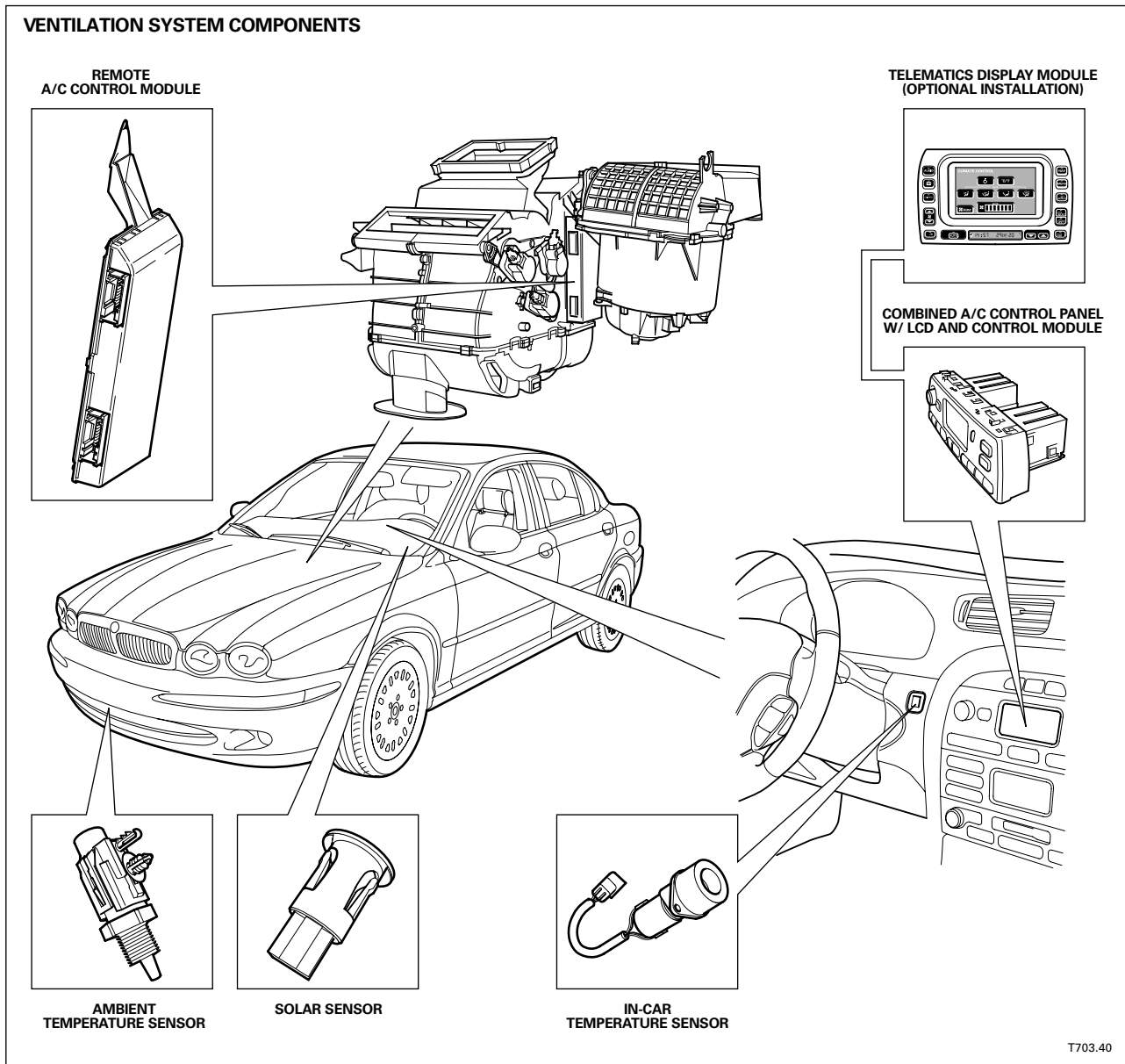
### Vehicle Ventilation System Airflow

The ventilation system provides fresh air into the interior of the vehicle. Air entering a point at the front of a vehicle is allowed to flow through the interior of the vehicle and exits at vents or openings in the door jambs or exit points to the outside air. The ventilation system has some form of control to allow air to flow or not flow through a vehicle depending on the setting of the air distribution system. The ventilation system uses the HVAC system to provide ventilated air to the interior of the vehicle. Some vehicles use an air filter to remove dust and pollen from the inlet air side of the ventilation system.



### NOTES

The electrical control system provides the operator control of blower motor speeds, discharge air temperature, air-flow distribution and HVAC system controls and protection devices.

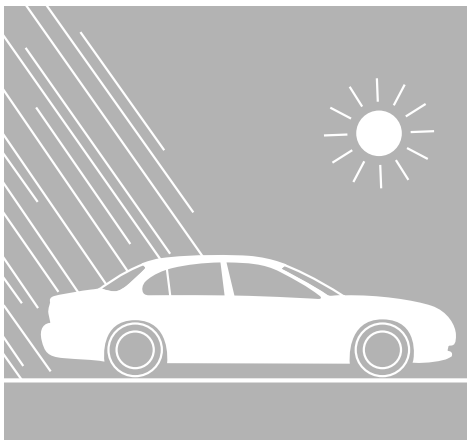


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## NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



## 1 CLIMATE CONTROL

## 2 XJ / XK CLIMATE CONTROL SYSTEM

### 2.1 Overview

- 2.2 Refrigeration System
- 2.3 Cooling Fan Control
- 2.4 Heating / Cooling System
- 2.5 Air Conditioning / Heater Unit
- 2.6 System Logic
- 2.7 Component Location
- 2.8 Control Module
- 2.9 Climate Control Panel
- 2.10 Temperature Control Sensors
- 2.11 Vehicle Systems Interfaces
- 2.12 Control Panel Diagnostics
- 2.13 Task Sheets

## 3 S-TYPE CLIMATE CONTROL SYSTEM

## 4 X-TYPE CLIMATE CONTROL SYSTEM

## 5 CLIMATE CONTROL REFERENCE



### OVERVIEW

The Jaguar Denso Climate Control System, introduced in the 1995 Model Year XJ, is standard equipment on XJ and XK models. The system is controlled through a microprocessor-based electronic control module and a microprocessor-based control panel. The system produces the driver selected comfort level by controlling air flow volume and distribution using cooling from the air conditioning system and heat from the engine cooling system. To control cabin temperature, the system uses a heater valve to regulate the heater matrix temperature. The Denso system differs from previous Jaguar systems that controlled cabin temperature with flaps in the air conditioning heater unit to blend cooled air with the heated air from an unregulated heater matrix. The windshield, rear window, and mirror heater circuits are integral with the Denso climate control system.

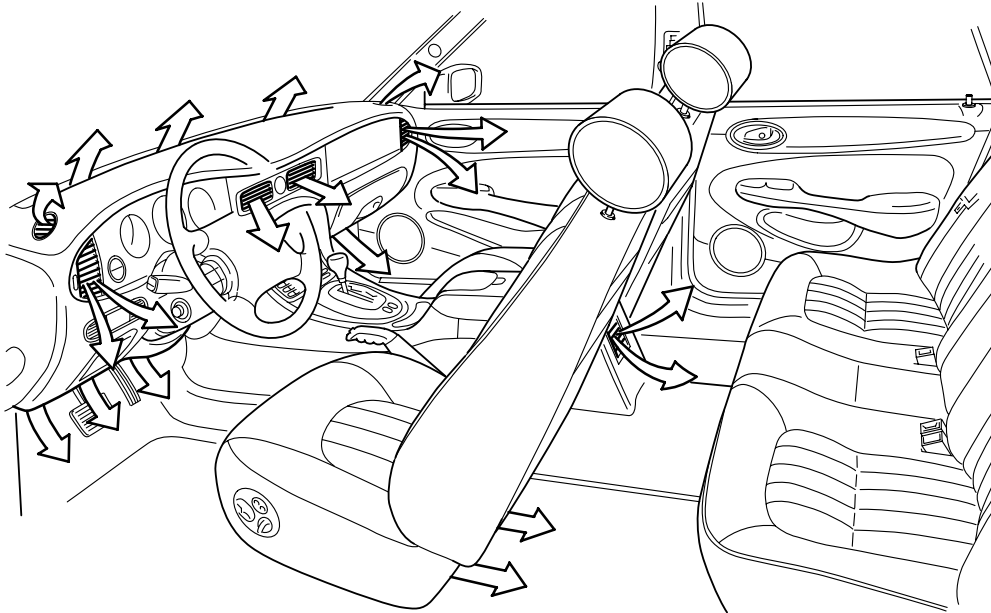
Diagnostic trouble codes (DTCs) and a panel display warn of system faults. In the case of most faults, a default value is substituted for the faulty signal allowing the climate control system to continue to function. Both the DTC and the panel display fault code information is supplied in this textbook with the description of each applicable component.

**PLEASE NOTE: For aid in understanding the climate control system, refer to the applicable Jaguar Electrical Guide for electrical circuit details, component information and pin-out data.**

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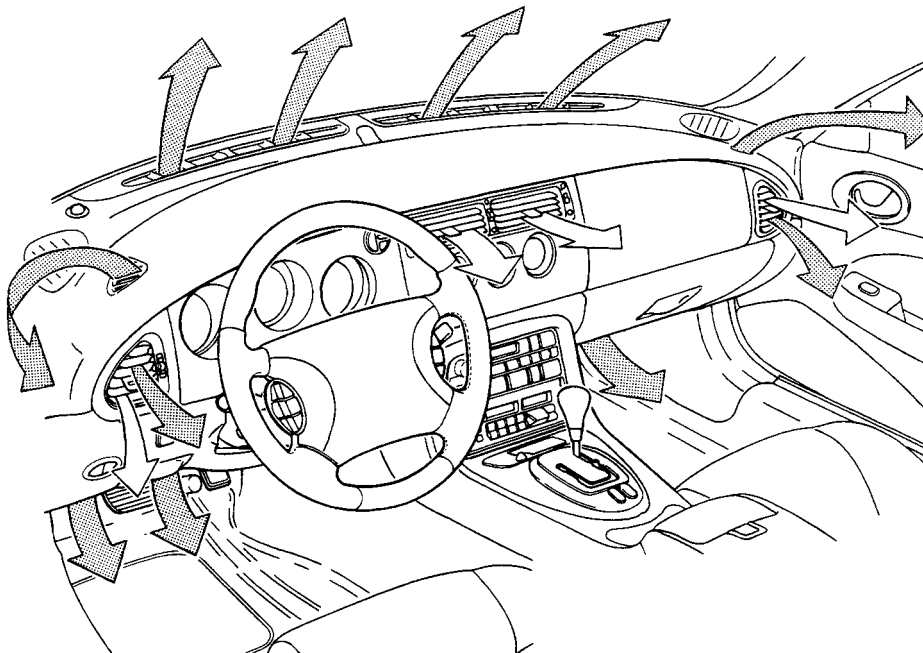
### NOTES

**XJ CLIMATE CONTROL AIR FLOW**



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**XK CLIMATE CONTROL AIR FLOW**

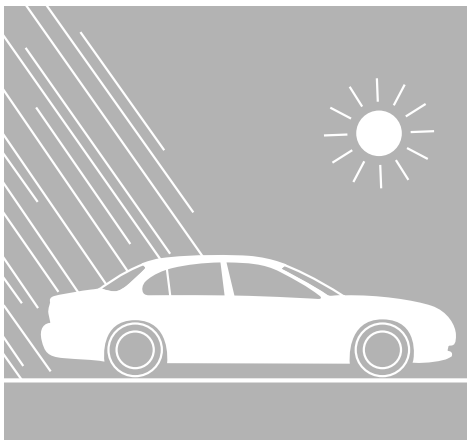


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# *JAGUAR CLIMATE CONTROL SYSTEMS*



## 1 CLIMATE CONTROL

## 2 XJ / XK CLIMATE CONTROL SYSTEM

### 2.1 Overview

### 2.2 Refrigeration System

### 2.3 Cooling Fan Control

### 2.4 Heating / Cooling System

### 2.5 Air Conditioning / Heater Unit

### 2.6 System Logic

### 2.7 Component Location

### 2.8 Control Module

### 2.9 Climate Control Panel

### 2.10 Temperature Control Sensors

### 2.11 Vehicle Systems Interfaces

### 2.12 Control Panel Diagnostics

### 2.13 Task Sheets

## 3 S-TYPE CLIMATE CONTROL SYSTEM

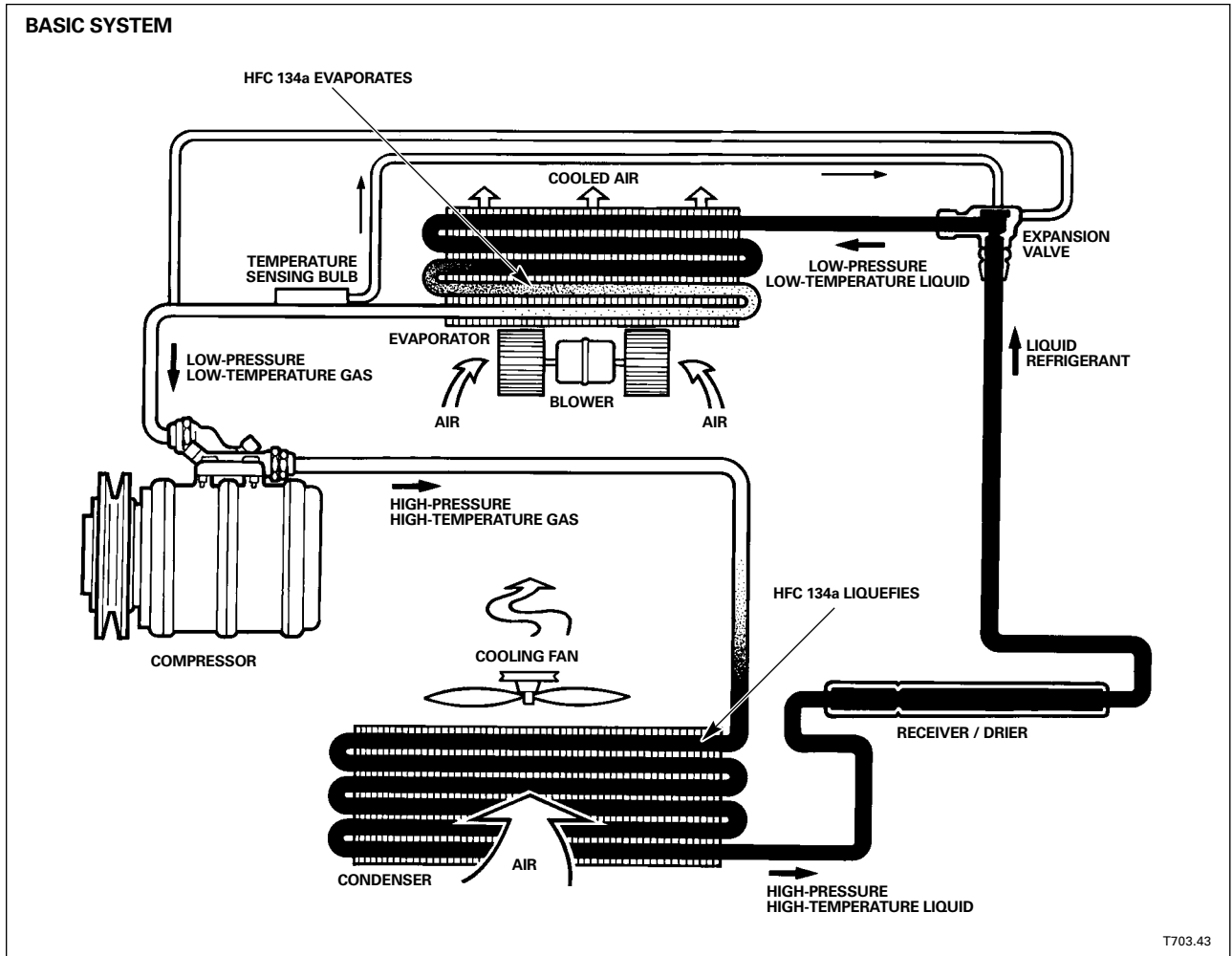
## 4 X-TYPE CLIMATE CONTROL SYSTEM

## 5 CLIMATE CONTROL REFERENCE



## AIR CONDITIONING / REFRIGERATION SYSTEM

The Jaguar air conditioning system employs environmentally friendly R134a refrigerant. The layout of the system is conventional; however, there are minor differences between the Sedan and XK8 installations.

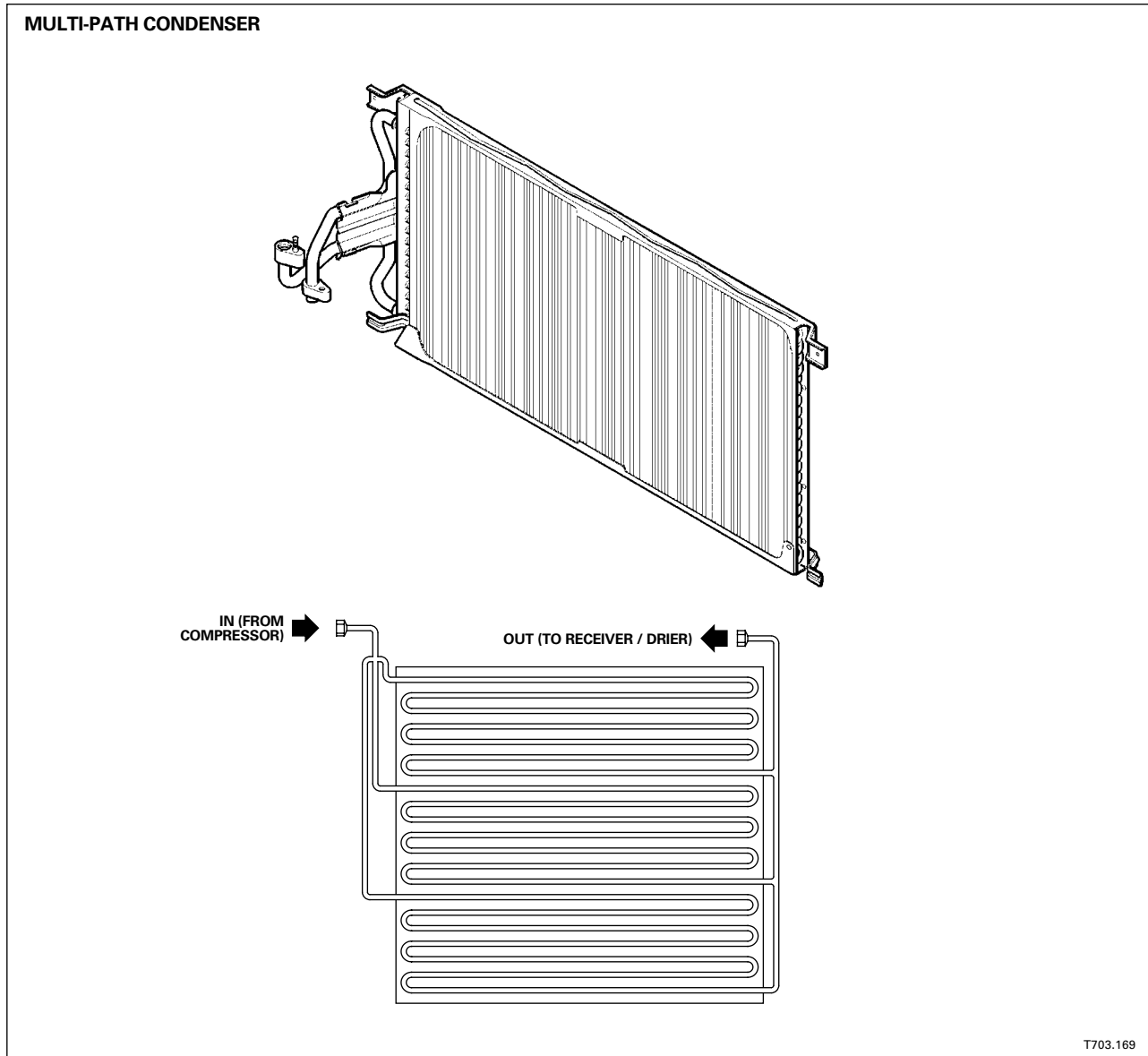


### NOTES

## Condenser

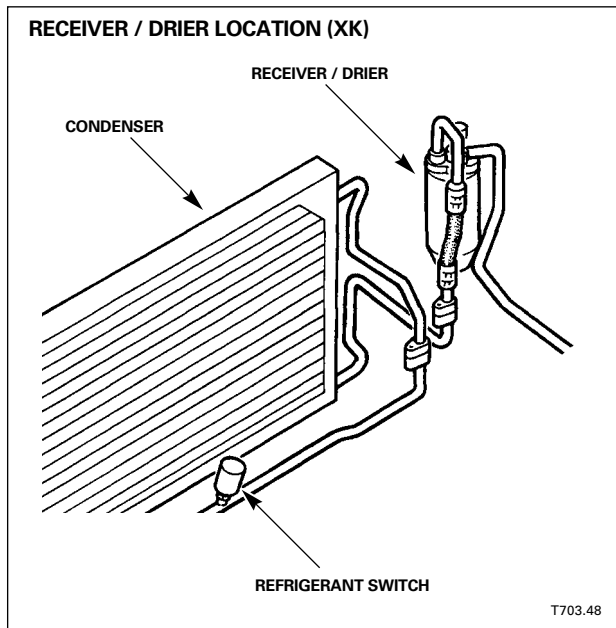
The condenser is part of the vehicle cooling pack. Located in front of the radiator, the condenser is the system high-side heat exchanger. The condenser is constructed as a tube and fin unit similar to the radiator.

Refrigerant flows through the condenser in separate paths starting at one side and exiting at the other.



## NOTES

## AIR CONDITIONING / REFRIGERATION SYSTEM



### Receiver / Drier

The vertically mounted receiver / drier is located near the radiator on the right side of the engine compartment. The high side charge port is on top of the receiver / drier. No sight glass is provided.

### NOTES

## Expansion Valve

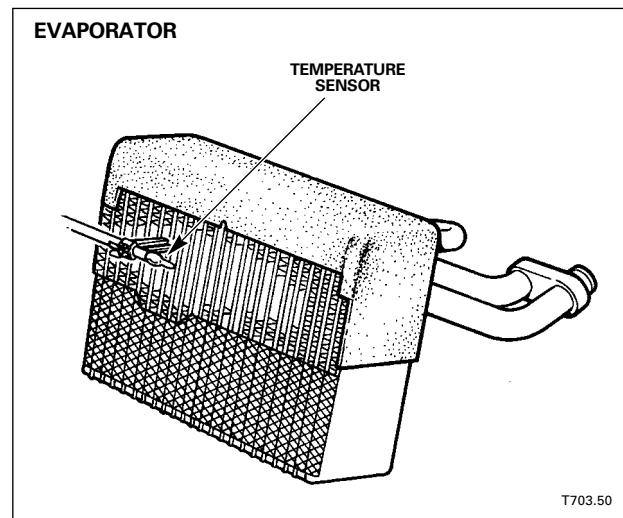
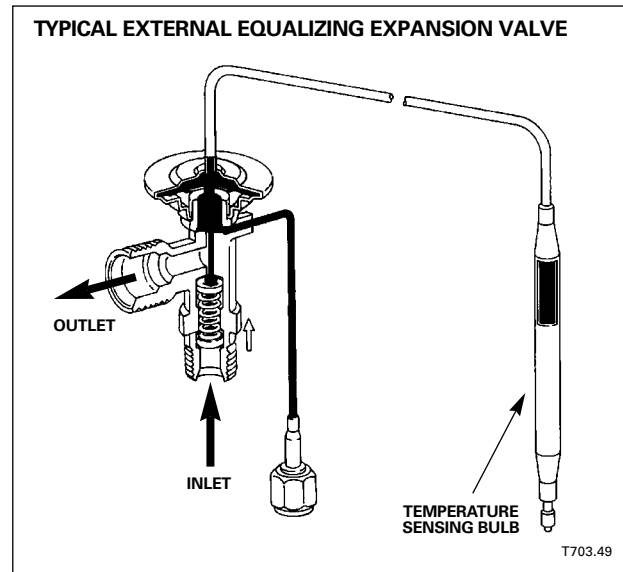
The expansion valve is located within the air conditioning / heater unit on the evaporator inlet.

## Evaporator

The evaporator is located within the air conditioning / heater unit behind the center console. It is the system low side heat exchanger.

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### NOTES



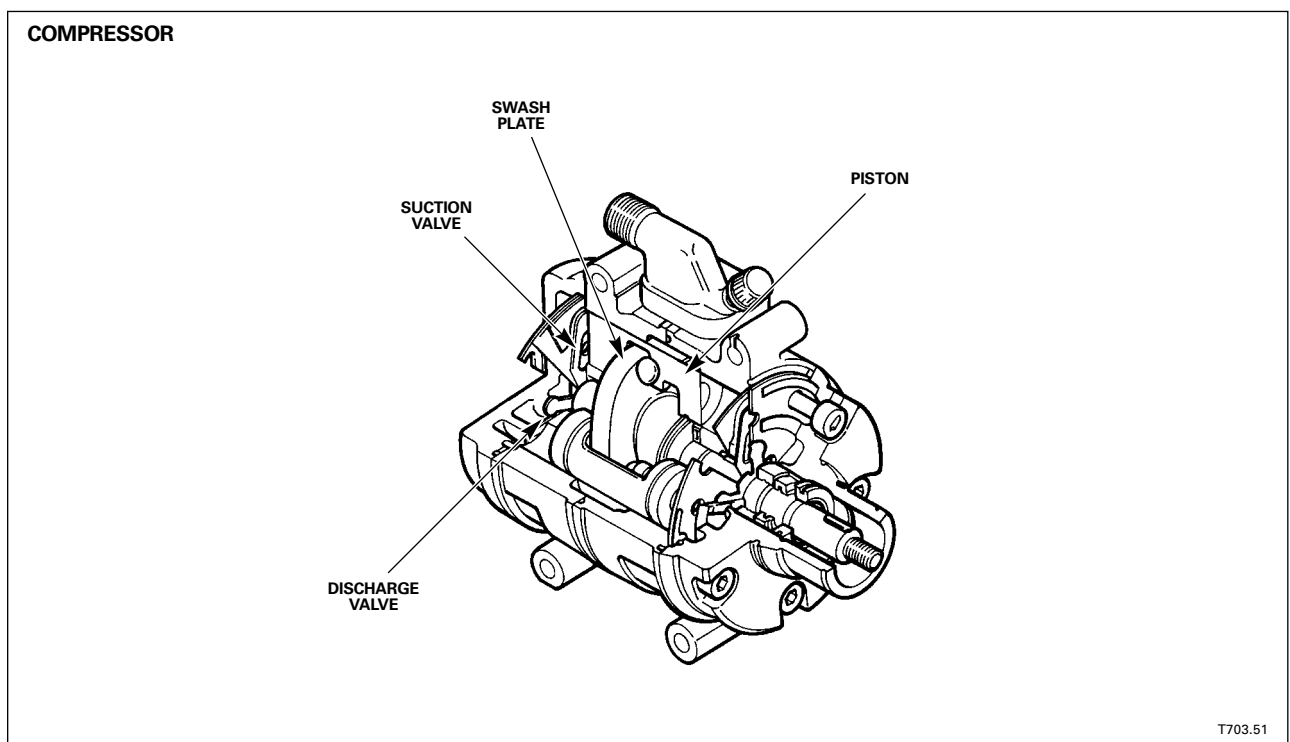
## AIR CONDITIONING / REFRIGERATION SYSTEM

### Compressor

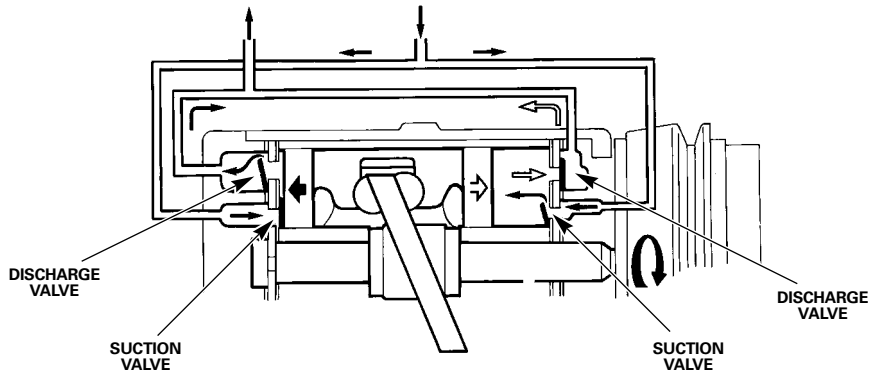
The refrigerant is compressed and circulated by a ten-cylinder swash-plate type compressor.

The compressor drive shaft connects to a swash plate that operates five double-ended pistons. This compressor design allows one end of each piston to be on the suction stroke while the other end is on the compression stroke, resulting in smooth, quiet operation.

As a safety feature, a pressure relief valve in the compressor vents refrigerant at 41 bar (594 psi) and resets at approximately 28 bar (406 psi).

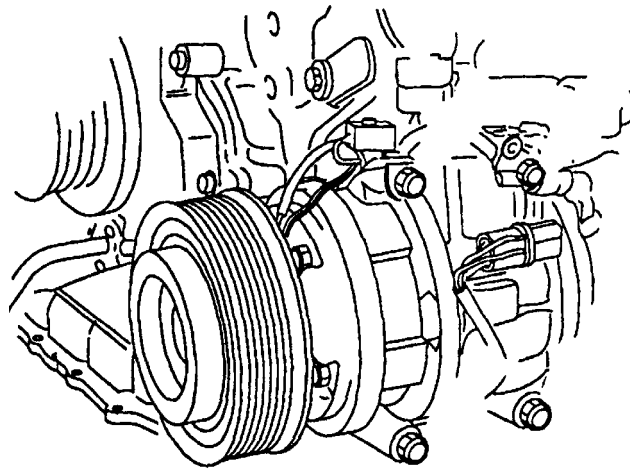


**COMPRESSOR OPERATION**



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**COMPRESSOR LOCATION**



T703.53

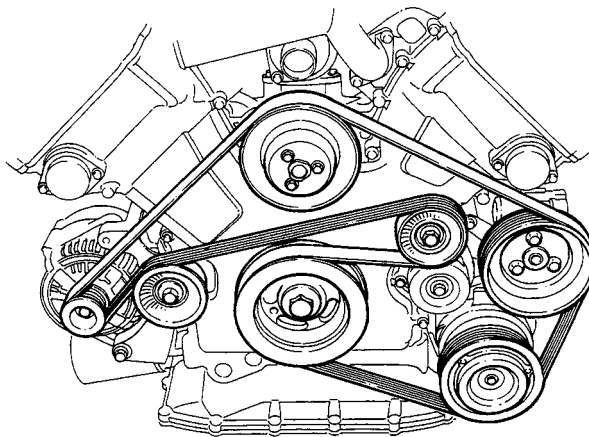
## AIR CONDITIONING / REFRIGERATION SYSTEM

### Compressor (continued)

#### Compressor Drive Belt Adjustment

AJV8 engine applications use a multi-ribbed serpentine belt with an automatic belt tensioner. A belt wear indicator on the tensioner indicates the need for belt replacement. Refer to the Service Manual for inspection and belt replacement procedures.

**COMPRESSOR DRIVE**



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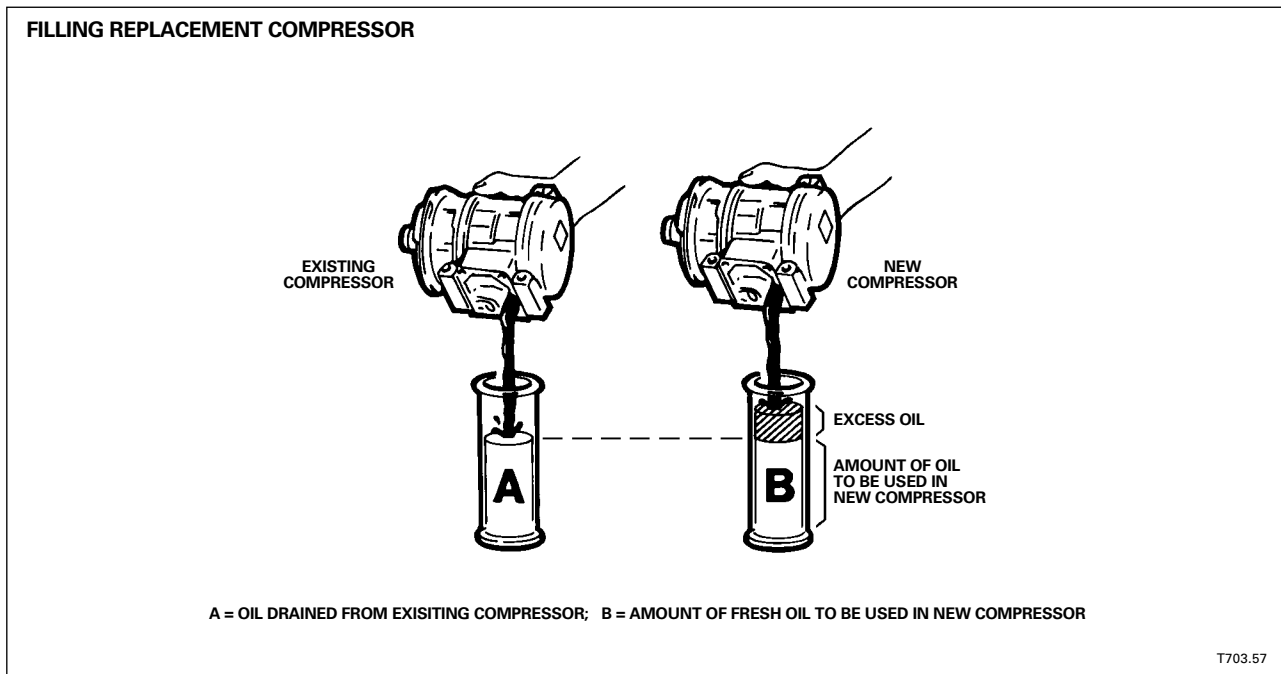
#### NOTES



## Compressor Lubricating Oil

The compressor requires a special PAG lubricating oil. Refer to the Service Manual and / or Technical Bulletins for the correct part number and capacities.

**CAUTION:** Replacement compressors are supplied filled with the amount of lubricating oil specified for the entire air conditioning system. When replacing a compressor, completely drain and measure the oil from the existing compressor. Then, completely drain the oil from the replacement compressor. Refill the replacement compressor with an amount of fresh oil equal to that removed from the existing compressor.



## NOTES

## AIR CONDITIONING / REFRIGERATION SYSTEM

### Compressor Clutch Control

The compressor is switched on or off depending on the evaporator temperature and the operating demands of the climate control system and the engine. When the climate control system is switched on, the A/CCM “requests” that the engine control module (ECM) switch on the compressor clutch. If engine operating parameters are within an acceptable range, the ECM applies a ground to the compressor clutch relay coil to switch on the compressor.

The ECM inhibits compressor operation under the following conditions:

- Engine coolant temperatures above 119 °C (246 °F)
- At idle speed the compressor is momentarily inhibited (50 ms) to allow the ECM to increase the idle speed to compensate for the compressor load.
- At high engine load (WOT), the compressor is inhibited.

If the compressor clutch is engaged and one of the above conditions occurs, the ECM disengages the clutch until the inhibiting condition is corrected.

### Compressor Clutch Diagnostic Monitoring

The A/CCM uses the B+ “compressor on” input to monitor the integrity of the compressor clutch drive circuit. If all compressor operating conditions are met and a request signal has been sent to the ECM, the A/CCM should receive the B+ signal. If the B+ signal is not received, a fault condition is assumed and a DTC will be flagged, however; the A/CCM will continue to request the ECM for compressor operation.

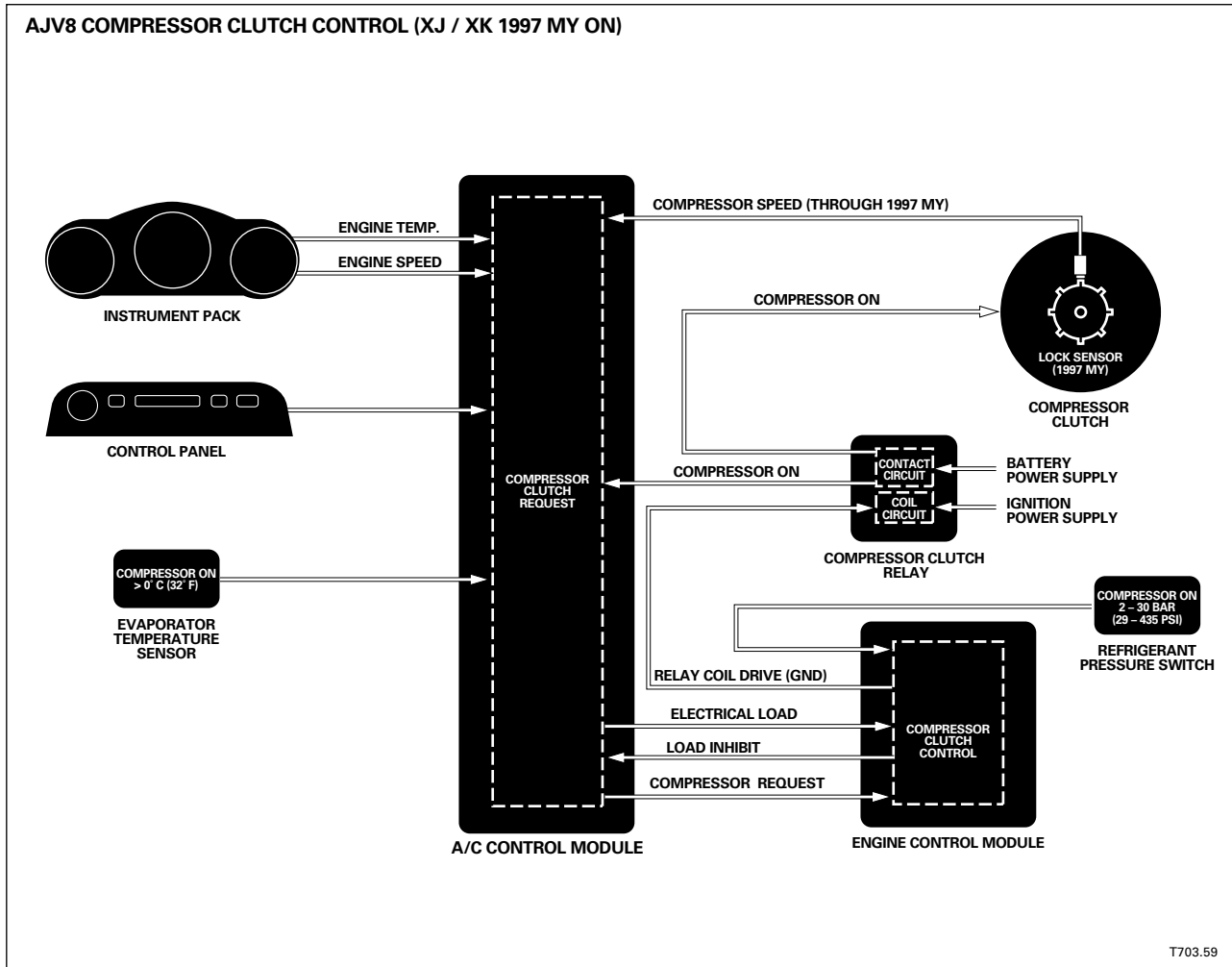
On early 1997 MY XK vehicles, the A/CCM monitors for compressor lock conditions when the B+ signal is present. No default value is used for this signal.

DTCs	
WDS	Control Panel
B1969	none

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### NOTES

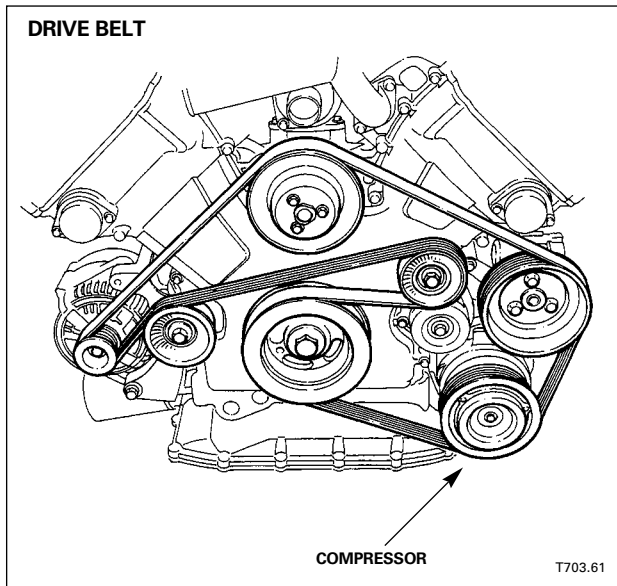
AJV8 COMPRESSOR CLUTCH CONTROL (XJ / XK 1997 MY ON)



T703.59

NOTES

**AIR CONDITIONING / REFRIGERATION SYSTEM**



**Compressor Lock Sensor  
(early 1997 MY Xk vehicles only)**

Because the power steering pump and air conditioning compressor are driven by the same belt, a compressor lock sensor is installed to provide the A/CCM with an input to verify correct operation. The compressor lock sensor, similar to an ABS wheel speed sensor, provides a pulsed signal indicating compressor pulley speed. The A/CCM compares the pulley speed to the engine speed input received from the ECM. If the pulley speed indicates belt slippage, the A/CCM cancels the A/C request to the ECM to protect against drive belt failure. The A/CCM also flashes the control panel A/C switch LED as an immediate warning and flags DTC B1862.

The compressor lock sensor is deleted on AJV8 applications after the 1997 MY.

**Compressor Lock Sensor Diagnostic Monitoring**

The A/CCM monitors the compressor lock sensing circuit for open circuit and short circuit conditions. If a fault is present, a DTC will be flagged. No default value is used for this signal.

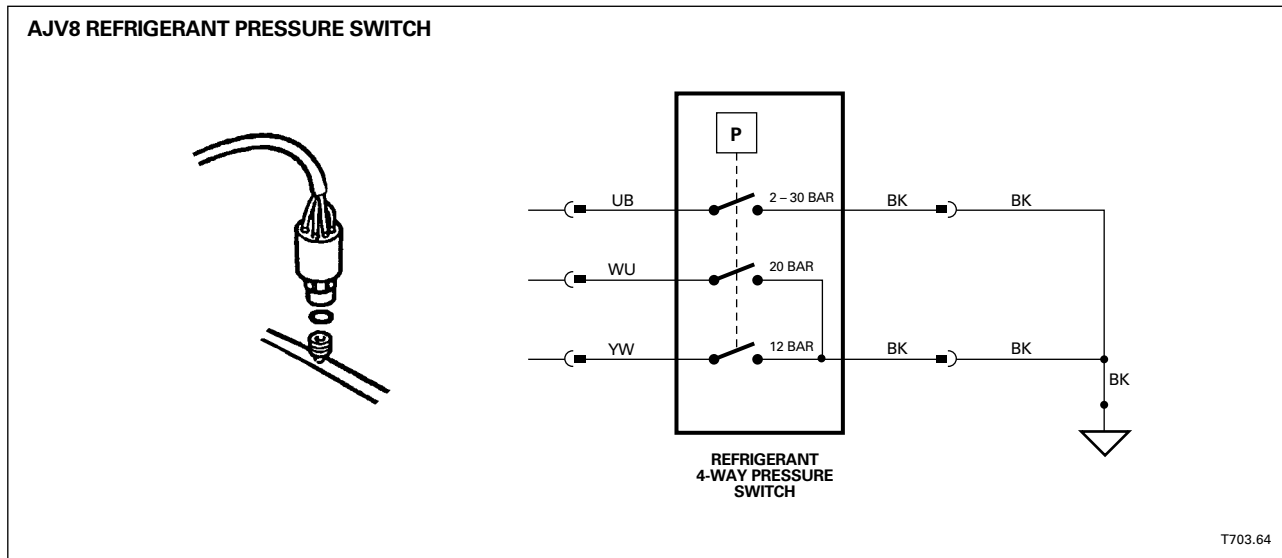
DTCs	
WDS	Control Panel
B1862	22

**NOTES**

## Refrigerant Pressure Switches

A single 4-way pressure switch is located on the high pressure line between the compressor and condenser to monitor refrigerant pressure. The three contact sets in the switch work with the A/CCM and ECM to control compressor clutch engagement and radiator cooling fan speed. Refer to AJV8 Cooling Fan Control, page 2.3.4.

The refrigerant pressure must be between 2 – 30 bar (29 – 435 psi) for the switch contacts to remain closed and provide a signal to the A/CCM allowing the A/C request signal to the ECM.



## Refrigerant Pressure Switch Diagnostic Monitoring

The A/CCM monitors pressure switch operation by comparing the ambient temperature to the switch contact position. During normal ambient temperature conditions the switch contacts should be closed. If the switch circuit is open during normal conditions, DTC B1858 is flagged.

At ambient temperatures below -10 °C (14 °F), refrigerant pressure should drop below 2 bar (29 psi) and open the switch contacts. If the contacts are closed or there is a short circuit to ground, DTC B1861 is flagged. No default value is used for this signal.

DTCs		
WDS	Control Panel	Condition
B1858	23	Open circuit
B1861	23	Closed circuit

## NOTES

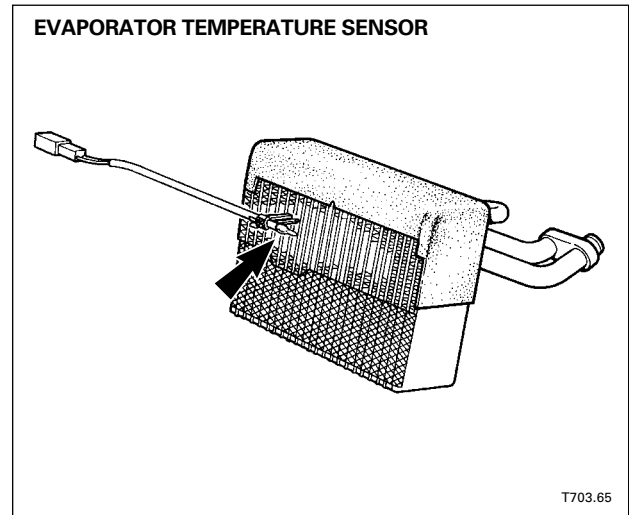
**AIR CONDITIONING / REFRIGERATION SYSTEM**

**Evaporator Temperature Sensor**

The evaporator temperature sensor, located on the left side of the evaporator, is an NTC (negative temperature coefficient) sensor that provides a voltage signal to the A/CCM. If the evaporator temperature falls to 0 °C (32 °F), the A/CCM will cancel the A/C request to the ECM and switch off the compressor to prevent the evaporator matrix from freezing. When the evaporator temperature rises to approximately 3 °C (37.5 °F), the A/CCM will again request A/C from the ECM.

**Approximate Temperature Versus Voltage**

Temperature		Voltage
°C	°F	
32 – 37	90 – 100	1.50
26 – 31	79 – 89	1.75
21 – 25	70 – 78	2.00
17 – 21	63 – 70	2.25
13 – 18	56 – 65	2.50
08 – 13	47 – 56	2.75
05 – 09	42 – 49	3.00
01 – 04	35 – 40	3.25
-05 – 0	23 – 32	3.50



**Evaporator Temperature Sensor Diagnostic Monitoring**

The A/CCM monitors the evaporator temperature sensing circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 0 °C (32 °F) is substituted by the A/CCM if an evaporator temperature sensor fault is present. The compressor will not run when an evaporator temperature sensor fault is flagged.

DTCs	
WDS	Control Panel
B1946	13
B1947	13

**NOTES**

# *JAGUAR CLIMATE CONTROL SYSTEMS*



## 1 CLIMATE CONTROL

## 2 XJ / XK CLIMATE CONTROL SYSTEM

### 2.1 Overview

### 2.2 Refrigeration System

### 2.3 Cooling Fan Control

### 2.4 Heating / Cooling System

### 2.5 Air Conditioning / Heater Unit

### 2.6 System Logic

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### 2.8 Control Module

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### 2.10 Temperature Control Sensors

### 2.11 Vehicle Systems Interfaces

### 2.12 Control Panel Diagnostics

### 2.13 Task Sheets

## 3 S-TYPE CLIMATE CONTROL SYSTEM

## 4 X-TYPE CLIMATE CONTROL SYSTEM

## 5 CLIMATE CONTROL REFERENCE



## COOLING FAN CONTROL

### Cooling Fan Control

The radiator / condenser cooling fans are controlled by the ECM via the fan control relay module using inputs from the engine coolant temperature sensor (ECT) and the 4-way refrigerant pressure switch 12 bar (174 psi) and 20 bar (290 psi) switch elements. At lower coolant temperatures / refrigerant pressures the fans operate at low speed (series). At high coolant temperatures / refrigerant pressures the fans operate at high speed (parallel). As the ECM switches the fan speeds, an overlap between switch on / switch off points prevents “hunting” between the fan modes

#### XJ Radiator Fan Switching Points

Fan Speed	Engine coolant temperature		Refrigerant pressure	
	ON	OFF	ON	OFF
Low	90 °C (194 °F)	86 °C (187 °F)	12 bar (174 psi)	8 bar (116 psi)
Fast	97.5 °C (207.5 °F)	93.5 °C (200.5 °F)	22 bar (319 psi)	17.5 bar (254 psi)

#### XK Radiator Fan Switching Points

Fan Speed	Engine coolant temperature		Refrigerant pressure	
	ON	OFF	ON	OFF
Low	90 °C (194 °F)	86 °C (187 °F)	12 bar (174 psi)	8 bar (116 psi)
Fast	97.5 °C (207.5 °F)	93.5 °C (200.5 °F)	20 bar (290 psi)	17.5 bar (254 psi)

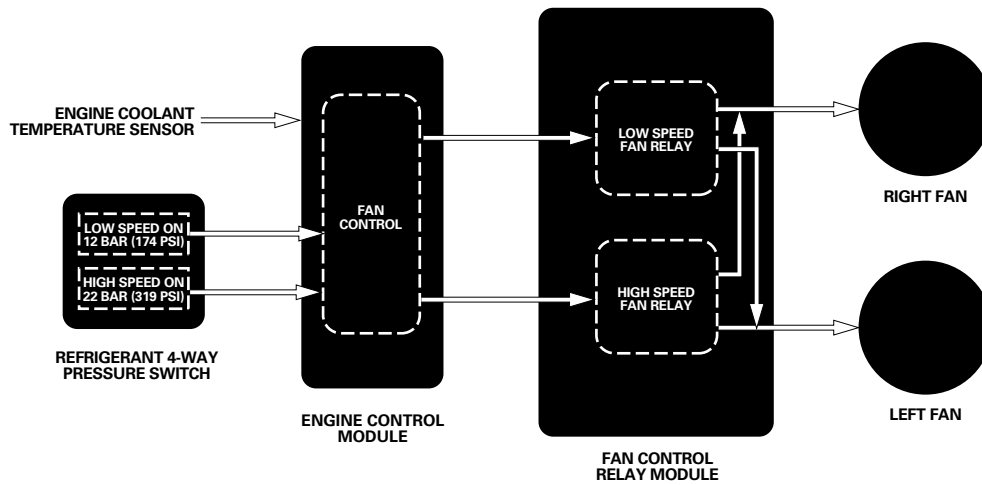
On all vehicles, when the engine is switched off, the ECM remains powered up for a few seconds to complete EMS adaptations. If the fans are operating when the engine is switched off, the ECM continues to drive the fans for 5 minutes or until the coolant temperature decreases to a preset value. If the fans are off when the engine is switched off and the coolant temperature rises to the switch-on point during the time the ECM is still powered, it will switch the fans on. The fans will operate for five minutes or until the coolant temperature decreases to a preset value.

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#### NOTES



COOLING FAN CONTROL

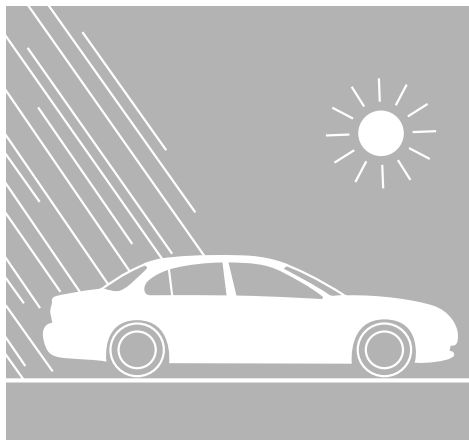


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NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



## 1 CLIMATE CONTROL

## 2 XJ / XK CLIMATE CONTROL SYSTEM

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### 2.13 Task Sheets

## 3 S-TYPE CLIMATE CONTROL SYSTEM

## 4 X-TYPE CLIMATE CONTROL SYSTEM

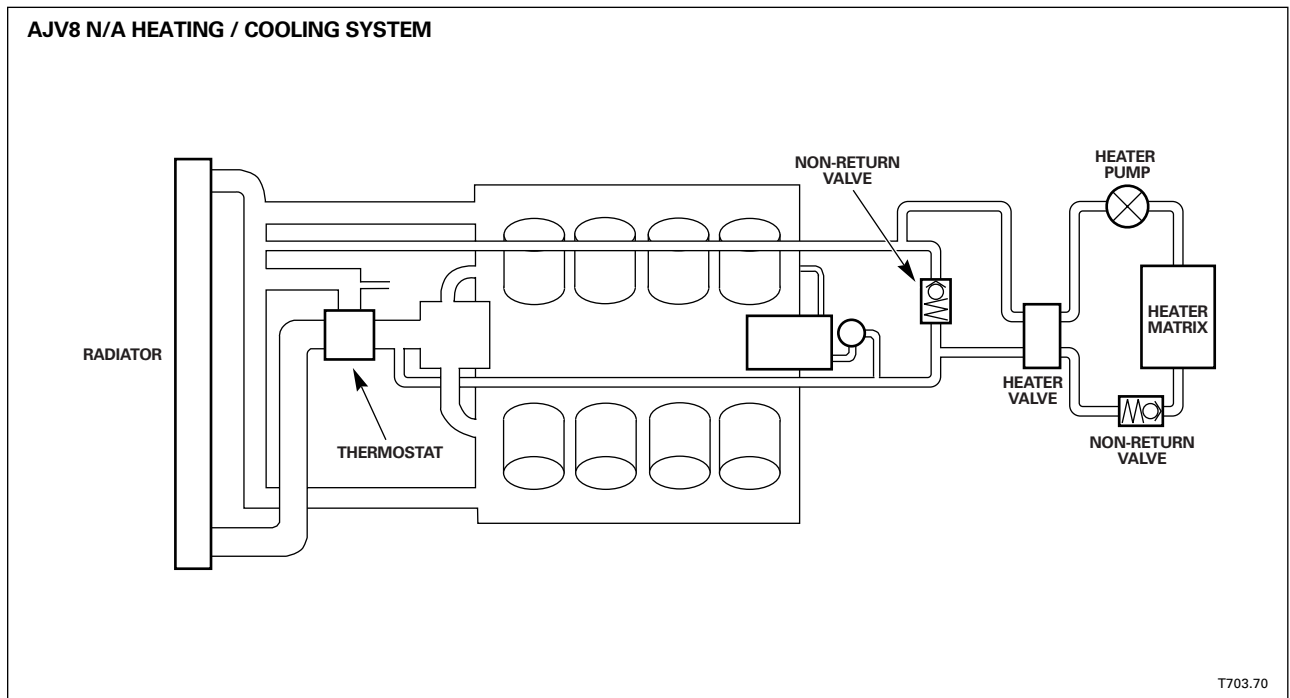
## 5 CLIMATE CONTROL REFERENCE



## HEATING / COOLING SYSTEM

The Jaguar Climate Control System employs engine coolant to provide cabin heat. An electric pump constantly circulates engine coolant through the heater matrix when the engine is running. An A/CCM controlled heater valve maintains the heater matrix at the optimum temperature required to achieve the selected cabin temperature.

The AJV8 low volume cooling system design requires two non-return valves to maintain correct coolant flow under all engine operating conditions. At low engine speeds, engine coolant flow pressure is less than heater pump pressure. The non-return valve in the engine cooling system prevents the heater pump from recirculating coolant against the normal flow of engine coolant. The heater circuit non-return valve prevents hot engine coolant from flowing back into the heater matrix after the engine is switched off.

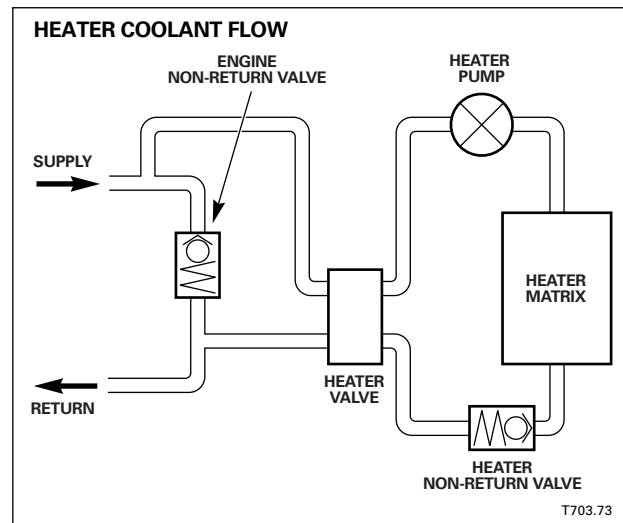
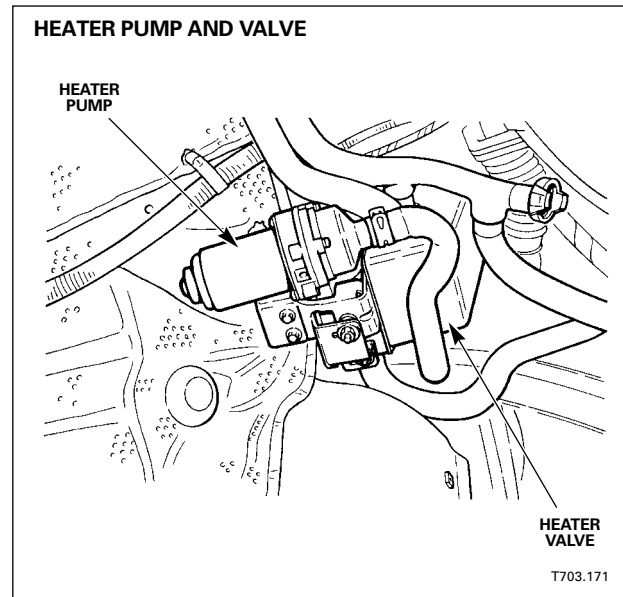


### NOTES

## Heater Pump

The pump is operated continuously by the A/CCM when the A/CCM receives an engine speed signal and the engine coolant temperature is above  $30\text{ }^{\circ}\text{C}$  ( $86\text{ }^{\circ}\text{F}$ )  $\pm 10\text{ }^{\circ}\text{C}$  ( $18\text{ }^{\circ}\text{F}$ ). The A/CCM grounds the heater pump relay coil circuit to activate the pump. If the ignition is switched on and the engine is not running, the pump is switched off.

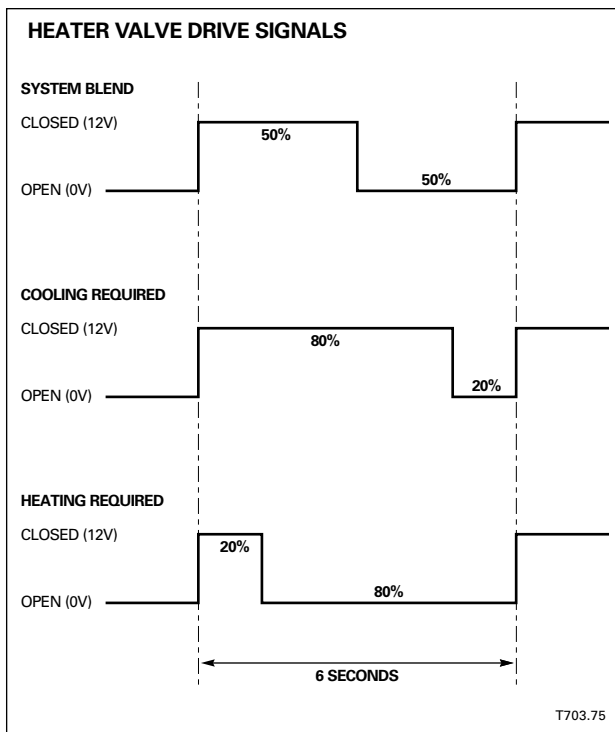
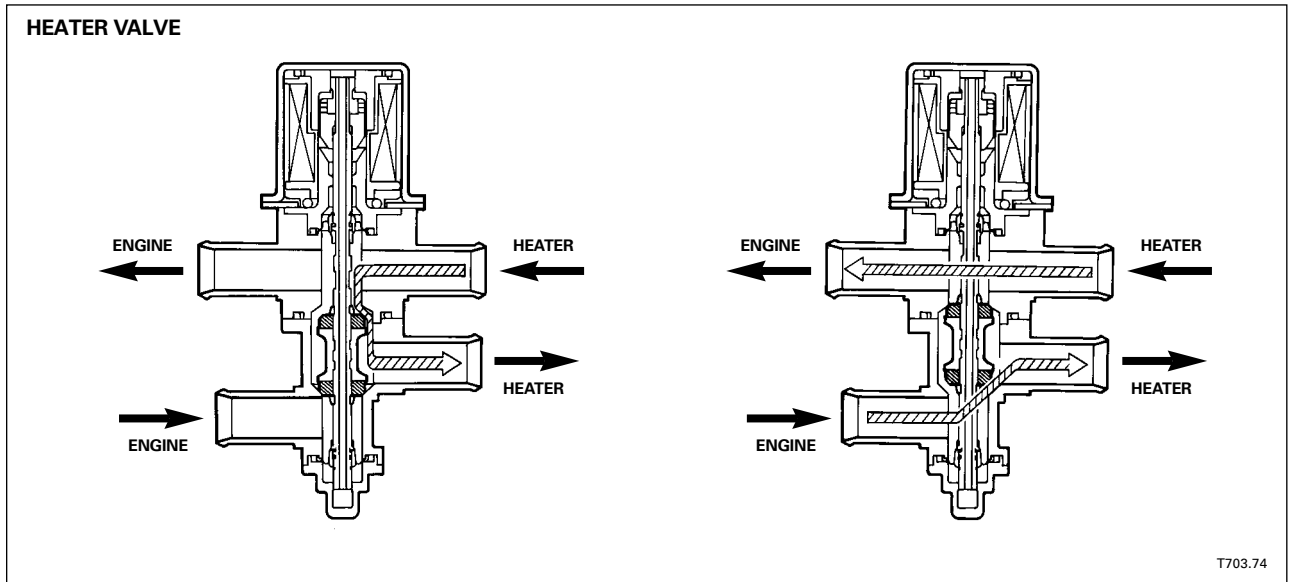
### NOTES



## HEATING / COOLING SYSTEM

### Heater Valve

Coolant circulation to the heater matrix is controlled through a variable duty cycle valve. The A/CCM drives the valve to fully open or closed to control the heater matrix temperature.



The A/CCM drives the valve with a 12 volt, six second duty cycle signal. The A/CCM increases or decreases the length of the 12 volt signal within the duty cycle to achieve the required heater matrix temperature. If the drive circuit fails (open circuit), the valve defaults to the open position to allow full engine coolant flow to the heater matrix.

The A/CCM uses the control panel settings and the heater matrix temperature sensor input signals to achieve the optimum heater matrix temperature. To prevent the circulation of cool engine coolant through the heater matrix, the heater valve is driven closed during the following conditions:

- Engine coolant temperature below 86 °F (30 °C) ± 18 °F (10 °C)
- No engine speed signal present

The A/CCM does not monitor the heater valve circuit for diagnostics.

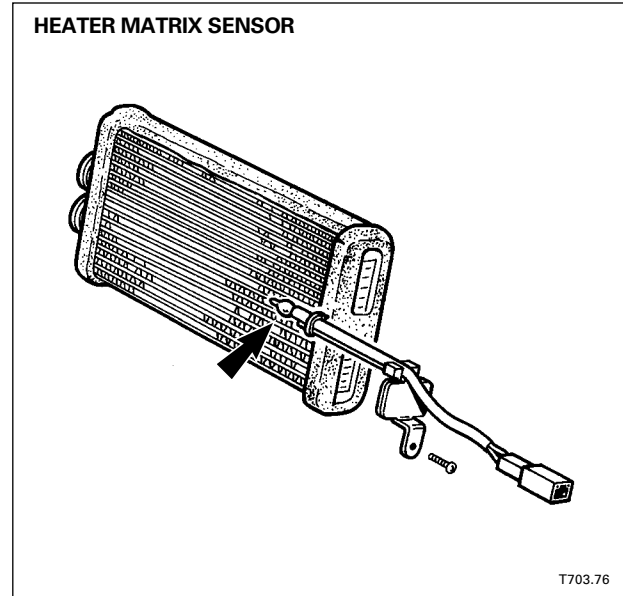
#### NOTES

## Heater Matrix Sensor

The NTC (negative temperature coefficient) heater matrix sensor, located on the right side of the heater matrix in the air conditioning / heater unit, provides the A/CCM with a voltage signal representing the heater matrix outlet air temperature. The heater matrix air temperature is one of the inputs used by the A/CCM to control the operation of the heater valve.

### Approximate Air Temperature Versus Voltage

Temperature		Voltage
°C	°F	
67 – 73	152 – 163	0.75
57 – 64	136 – 147	1.00
50 – 56	123 – 133	1.25
43 – 48	109 – 118	1.50
37 – 42	98 – 108	1.75
32 – 36	89 – 97	2.00
27 – 31	81 – 88	2.25
23 – 26	74 – 79	2.50
18 – 22	66 – 72	2.75
14 – 17	57 – 64	3.00
10 – 13	50 – 56	3.25



### Heater Matrix Sensor Diagnostic Monitoring

The A/CCM monitors the heater matrix sensing circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 45 °C (113 °F) is substituted by the A/CCM if a heater matrix air temperature sensor fault is present.

DTCs	
WDS	Control Panel
B1966	15
B1967	15

### NOTES





# *JAGUAR CLIMATE CONTROL SYSTEMS*



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## 4 X-TYPE CLIMATE CONTROL SYSTEM

## 5 CLIMATE CONTROL REFERENCE



### AIR CONDITIONING / HEATER UNIT

#### Blowers

The blower assemblies each contain a motor, fan, servo and fresh air / recirculation flap. They connect to either side of the air conditioning / heater unit with ducts. Each blower incorporates a power transistor assembly to regulate air flow output volume. The A/CCM varies the voltage applied to the base of the power transistor to vary the blower motor speed and thus the air flow output volume. During normal operation, power is supplied to the blower motors via the blower motor relay. The motor ground is completed by the power transistor circuit to provide varying blower motor speed. When maximum blower output is required, the A/CCM activates the high speed relay, which switches the blower motor ground circuit directly to ground and the motor runs at maximum speed.

In AUTO mode, blower motor variable speed is controlled automatically by the A/CCM. In manual control, 11 speed steps are available. Through the 1997 MY, to compensate for the effect of ram air on the air intakes, the A/CCM adjusts blower speed at vehicle speed above 25 mph (40 km/h). Blower speed compensation is canceled during the following conditions:

- Maximum blower speed required
- Fresh / recirc flaps positioned to recirculation
- DEFROST selected
- AUTO – full cooling required (fresh / recirc flaps positioned to recirculation)

In the heating mode, blower operation is canceled by the A/CCM until the engine coolant temperature reaches 30 °C (86 °F) to prevent cold air distribution. The blowers operate at all times in the cooling and defrost modes.

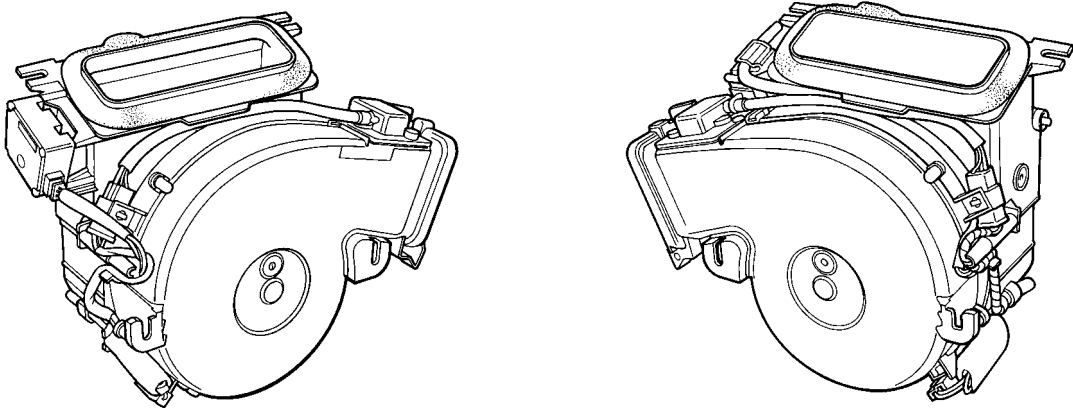
The A/CCM does not monitor the blower motor circuits for diagnostics, however; the A/CCM receives a feedback signal from the power transistor circuit that indicates blower motor speed. This signal is used to adjust blower speed. If a fault occurs in the blower speed feedback circuit, the A/CCM uses a default speed that depends on the speed selected when the fault occurred. If the equivalent speed was above 7/8 bar segments, the A/CCM drives the blower motors at maximum speed; if the equivalent speed was below 7/8 bar segments, the blower motors are switched off.

The electrical load placed on the vehicle charging system by high speed blower operation is compensated for by the ECM (engine control module).

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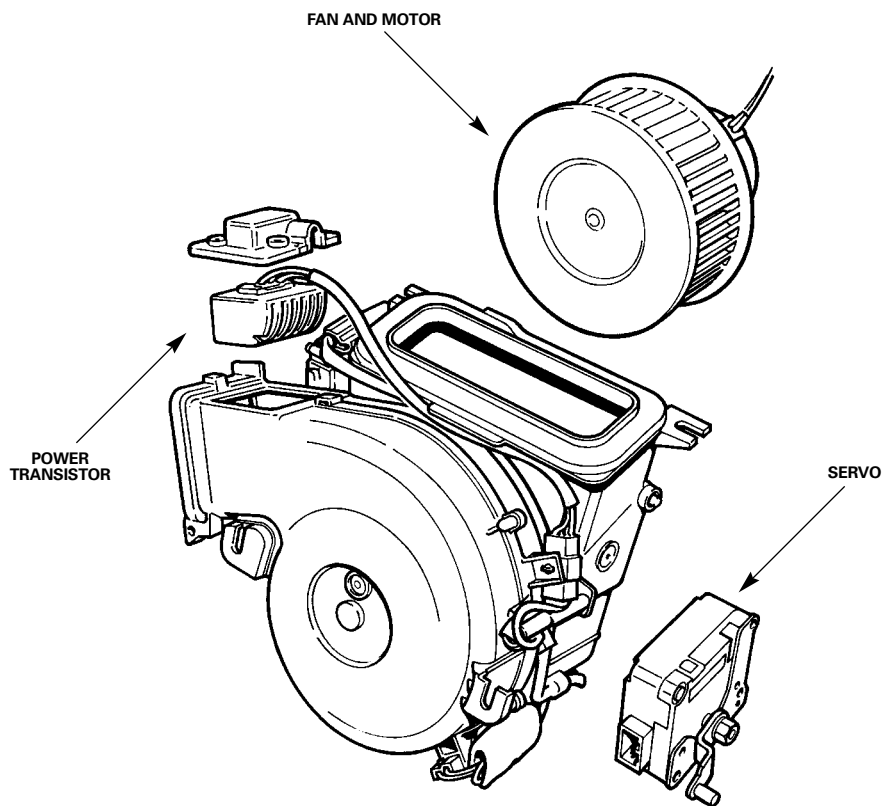
#### NOTES

**BLOWERS**



T703.80

**BLOWER COMPONENTS**

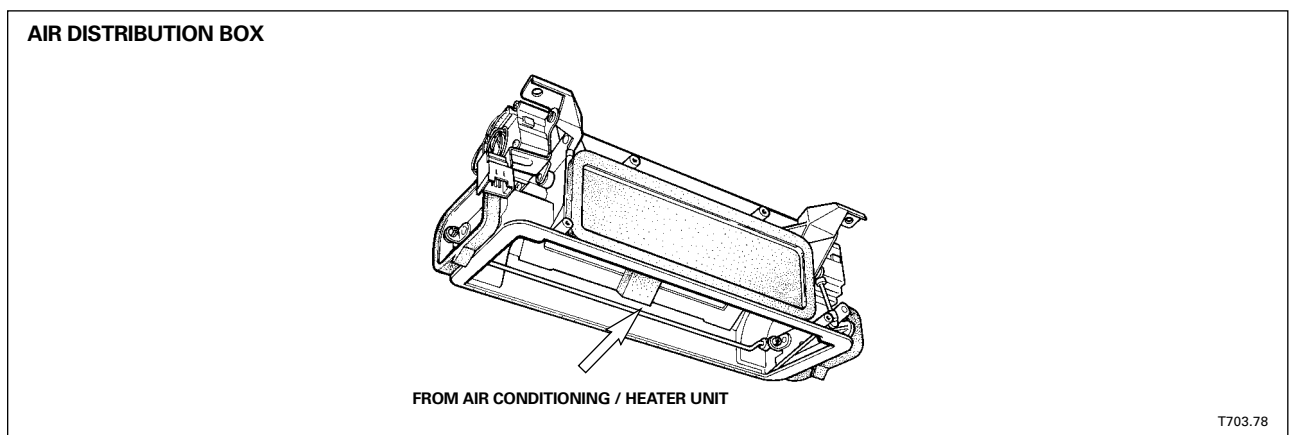
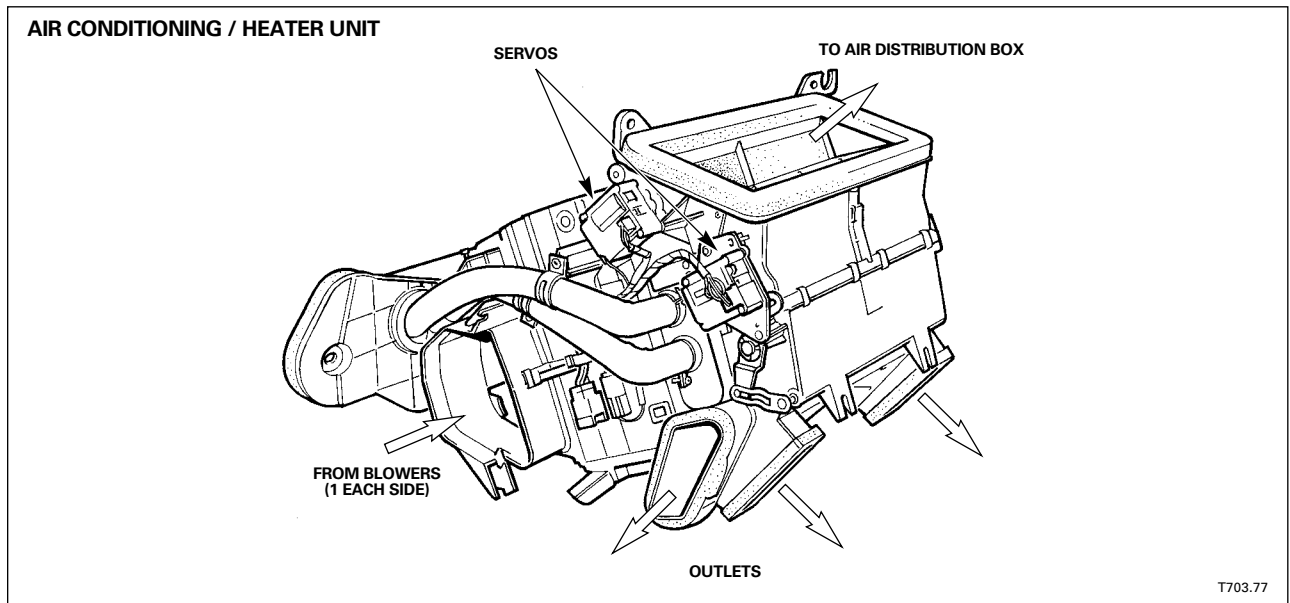


T703.81

## AIR CONDITIONING / HEATER UNIT

### Air Distribution

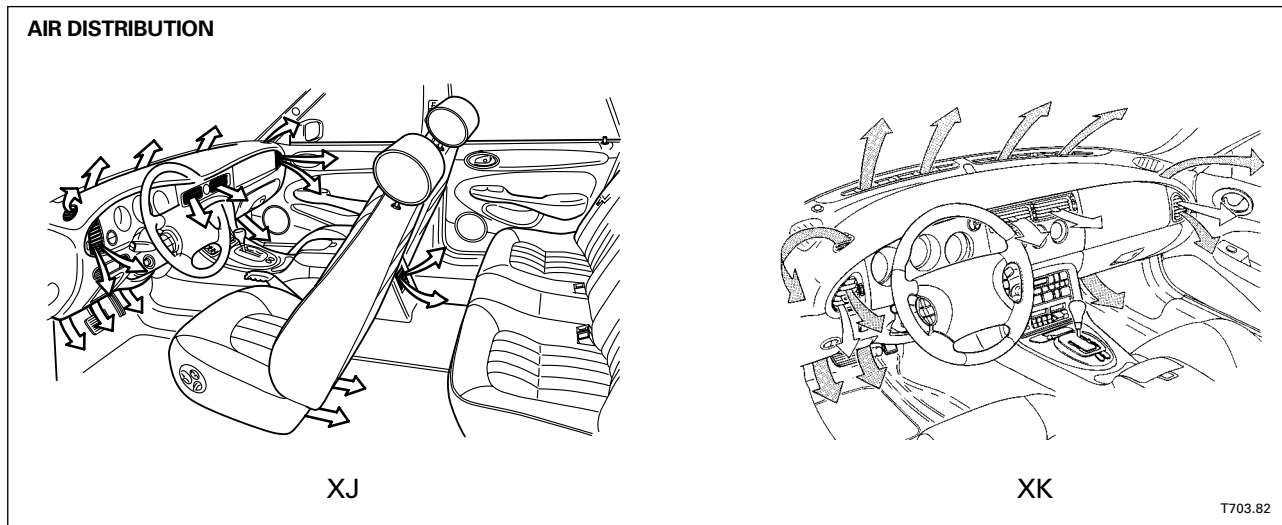
The air conditioning / heater unit is located behind the fascia and is connected by ducts to the right and left blowers. The unit directs air into the cabin at the desired temperature via a series of servo motor operated flaps. The position of the flaps is fed back to the A/CCM by non adjustable potentiometers integrated with the servo motors. The air conditioning / heater unit directs outlet air to the various cabin vents. The air distribution box, located on top of the air conditioning / heater unit, directs air to the windshield, side vents and face vents.



### NOTES

## Cabin Air Distribution

Air is distributed to the cabin from multiple vents located at the face level, foot level, windshield, side windows, rear foot wells and rear center console.



## Face Vent Differential Temperature Control (through 1997 MY only)

The face vent differential control is a potentiometer that provides the A/CCM with a feedback voltage to indicate the face level differential air temperature selected by the driver. The A/CCM adjusts the position of the upper cool air bypass flap to meet the desired selection. The resistance range of the potentiometer is nominally 2 – 8 k $\Omega$ :

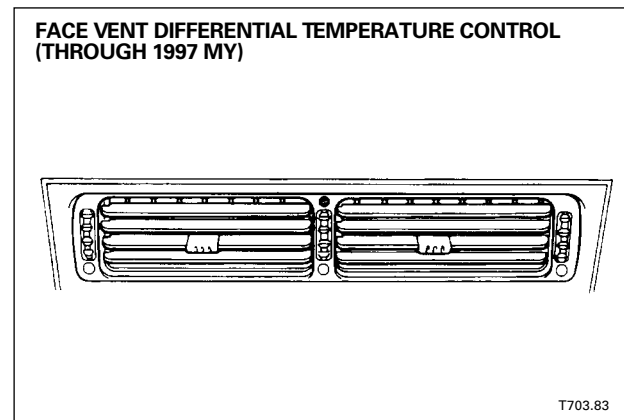
- Minimum differential (RED) 8 k $\Omega$   $\pm$  10% = 1 volt (wiper feedback voltage)
- Maximum differential (BLUE) 2 k $\Omega$   $\pm$  10% = 4 volt (wiper feedback voltage)

## Face Vent Differential Temperature Control Diagnostic Monitoring

The A/CCM monitors the face vent differential temperature control circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

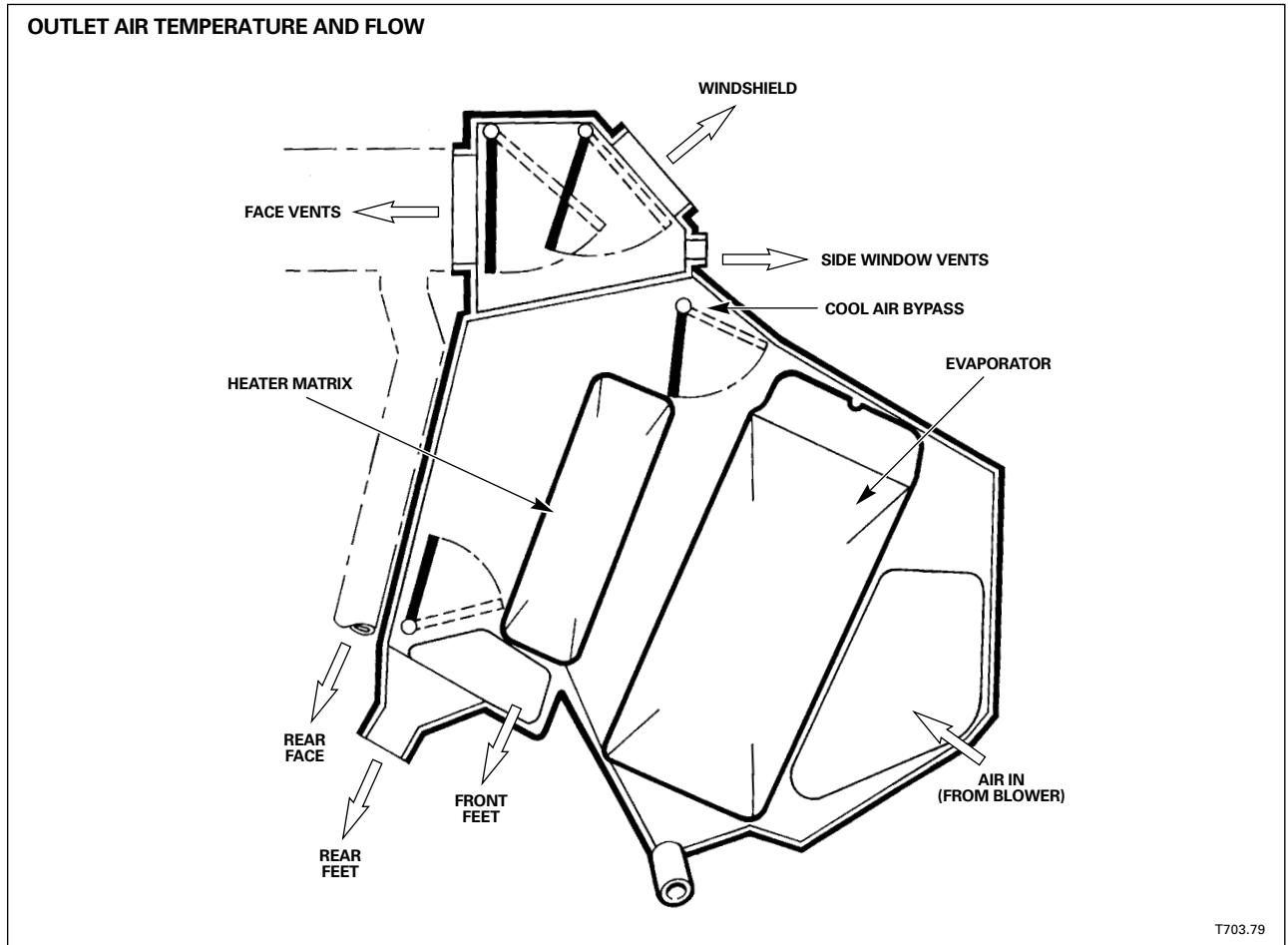
No default value is used for face vent differential control circuit failure.

DTCs	
WDS	Control Panel
B1849	24
B1852	24



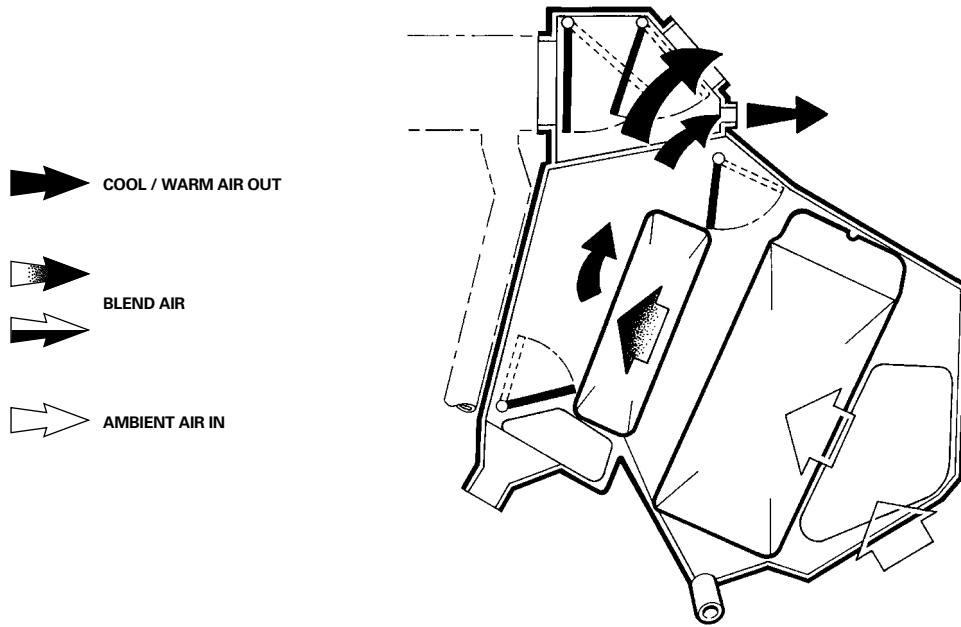
**AIR CONDITIONING / HEATER UNIT**

**Air Distribution (continued)**



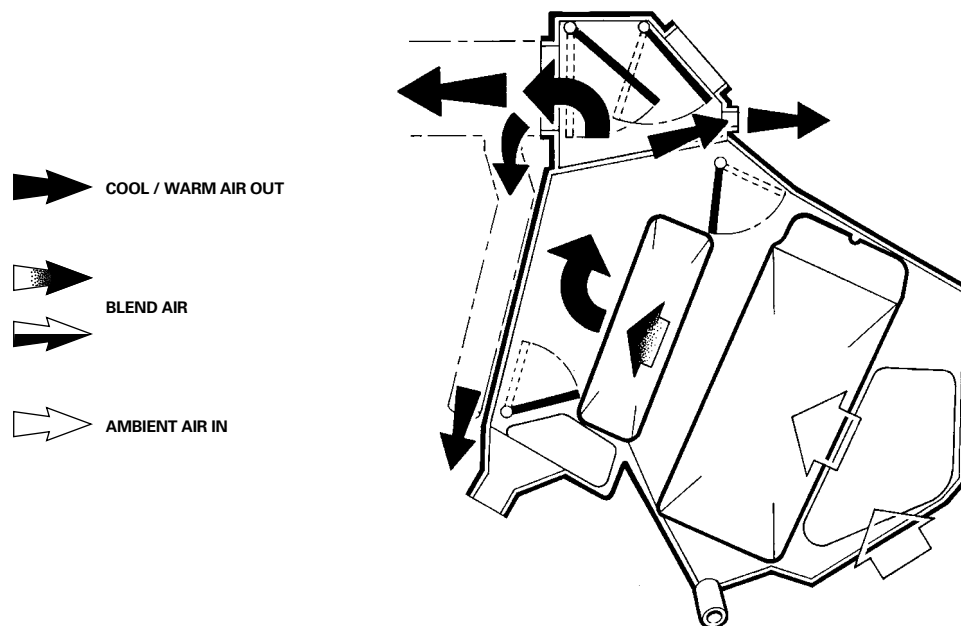
**NOTES**

DEFROST SELECTED



T703.84

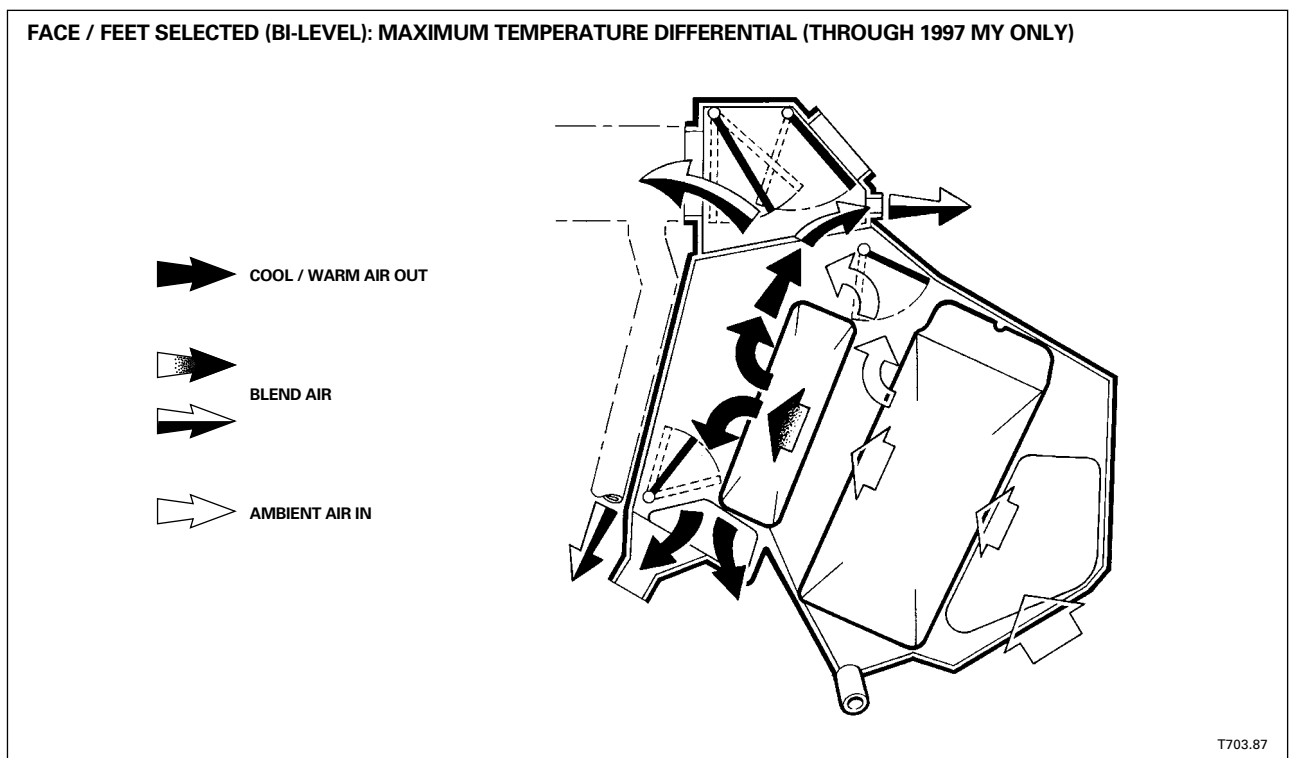
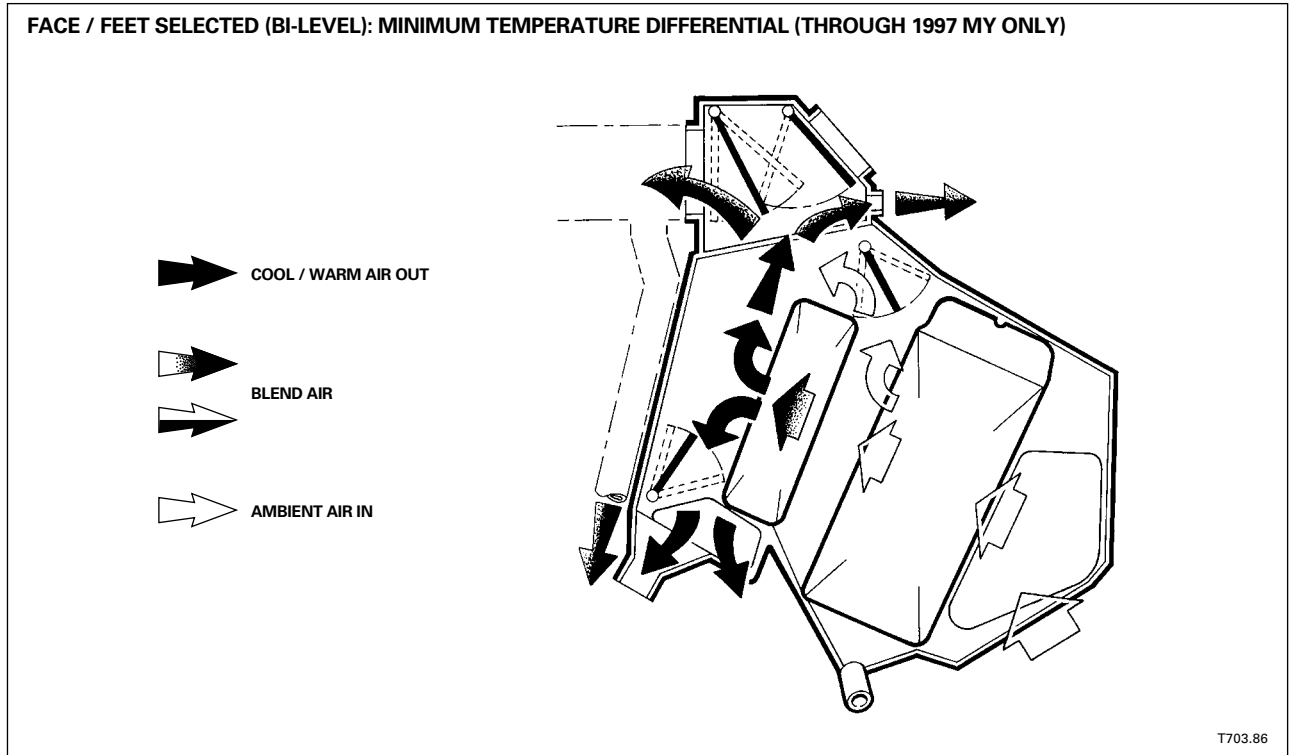
FACE SELECTED



T703.85





## AIR CONDITIONING / HEATER UNIT

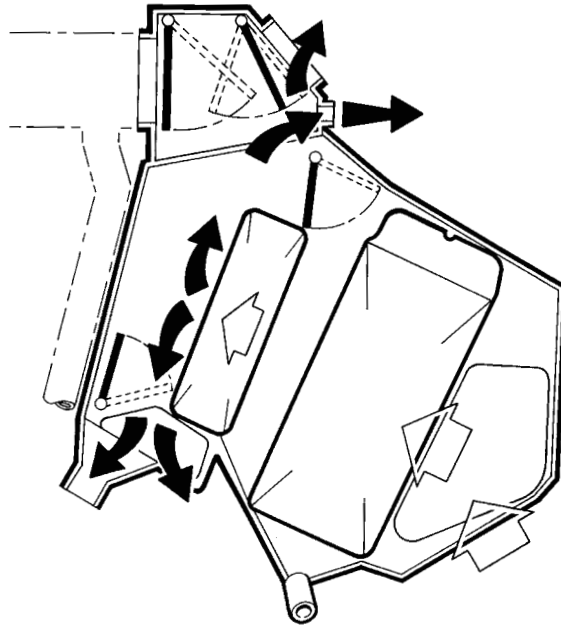
### Air Distribution (continued)









FEET SELECTED

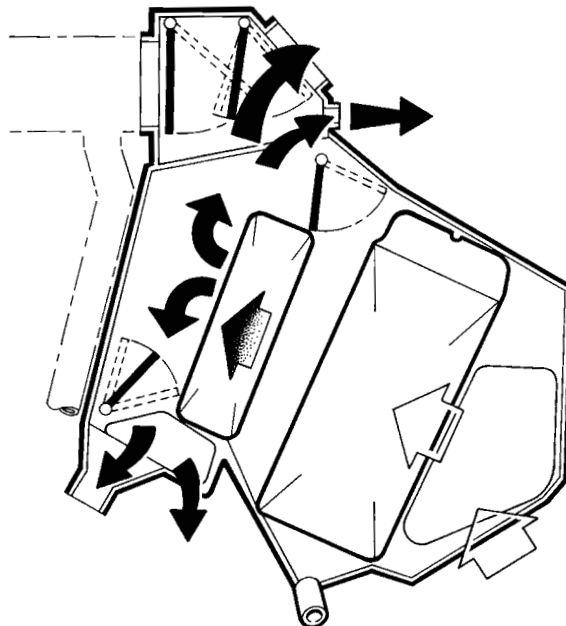
-  COOL / WARM AIR OUT
-  BLEND AIR
-  BLEND AIR
-  AMBIENT AIR IN



T703.88

DEMIST SELECTED

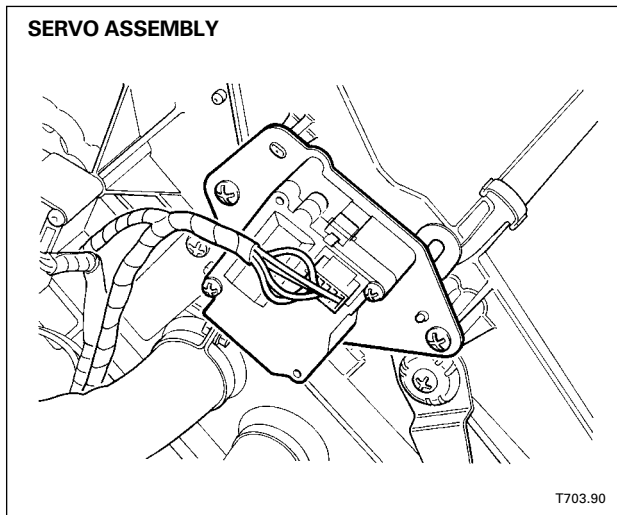
-  COOL / WARM AIR OUT
-  BLEND AIR
-  BLEND AIR
-  AMBIENT AIR IN



T703.89

**AIR CONDITIONING / HEATER UNIT**

**Servos and Feedback Potentiometers**



Six air flow control flap servo assemblies are used in the system:

- Defrost vent
- Center vent
- Left fresh / recirc flap (blower intake)
- Right fresh / recirc flap (blower intake)
- Cool air bypass
- Footwell vent

Each servo incorporates a feedback potentiometer that provides the A/CCM with a feedback voltage that indicates the position of the air flow flap. The resistance range of the potentiometers is nominally 2 – 5 kΩ:

- Flap closed**      5 kΩ ± 10% = 1 volt (wiper feedback voltage)
- Flap open**        2 kΩ ± 10% = 4 volt (wiper feedback voltage)

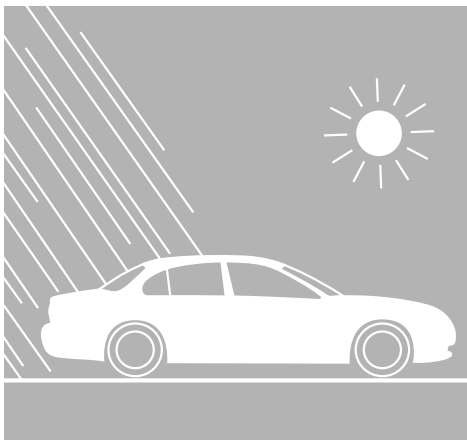
**Servos and Feedback Potentiometers Diagnostic Monitoring**

The A/CCM monitors the feedback potentiometer sensing (wiper) circuits for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged. In addition, the A/CCM monitors the time required for each servo to position its flap. If the flap does not reach the required position within 30 seconds, a DTC is flagged.

No default values are used for servo / potentiometer circuit failures.

DTCs		
WDS	Control Panel	Component
B1262	44	Defrost vent position
B1268	34	Defrost feedback potentiometer
B1271	34	Defrost feedback potentiometer
B1263	45	Center vent position
B1272	35	Center feedback potentiometer
B1275	35	Center feedback potentiometer
B1264	46	Footwell vent position
B1276	36	Footwell feedback potentiometer
B1279	36	Footwell feedback potentiometer
B1265	43	Cool air bypass position
B1280	33	Cool air bypass feedback potentiometer
B1283	33	Cool air bypass feedback potentiometer
B1266	41	Left fresh / recirculation position
B1287	31	Left fresh / recirculation feedback potentiometer
B1287	31	Left fresh / recirculation feedback potentiometer
B1267	42	Right fresh / recirculation position
B1288	32	Right fresh / recirculation feedback potentiometer
B1291	32	Right fresh / recirculation feedback potentiometer

# *JAGUAR CLIMATE CONTROL SYSTEMS*



## 1 CLIMATE CONTROL

## 2 XJ / XK CLIMATE CONTROL SYSTEM

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- 2.8 Control Module
- 2.9 Climate Control Panel
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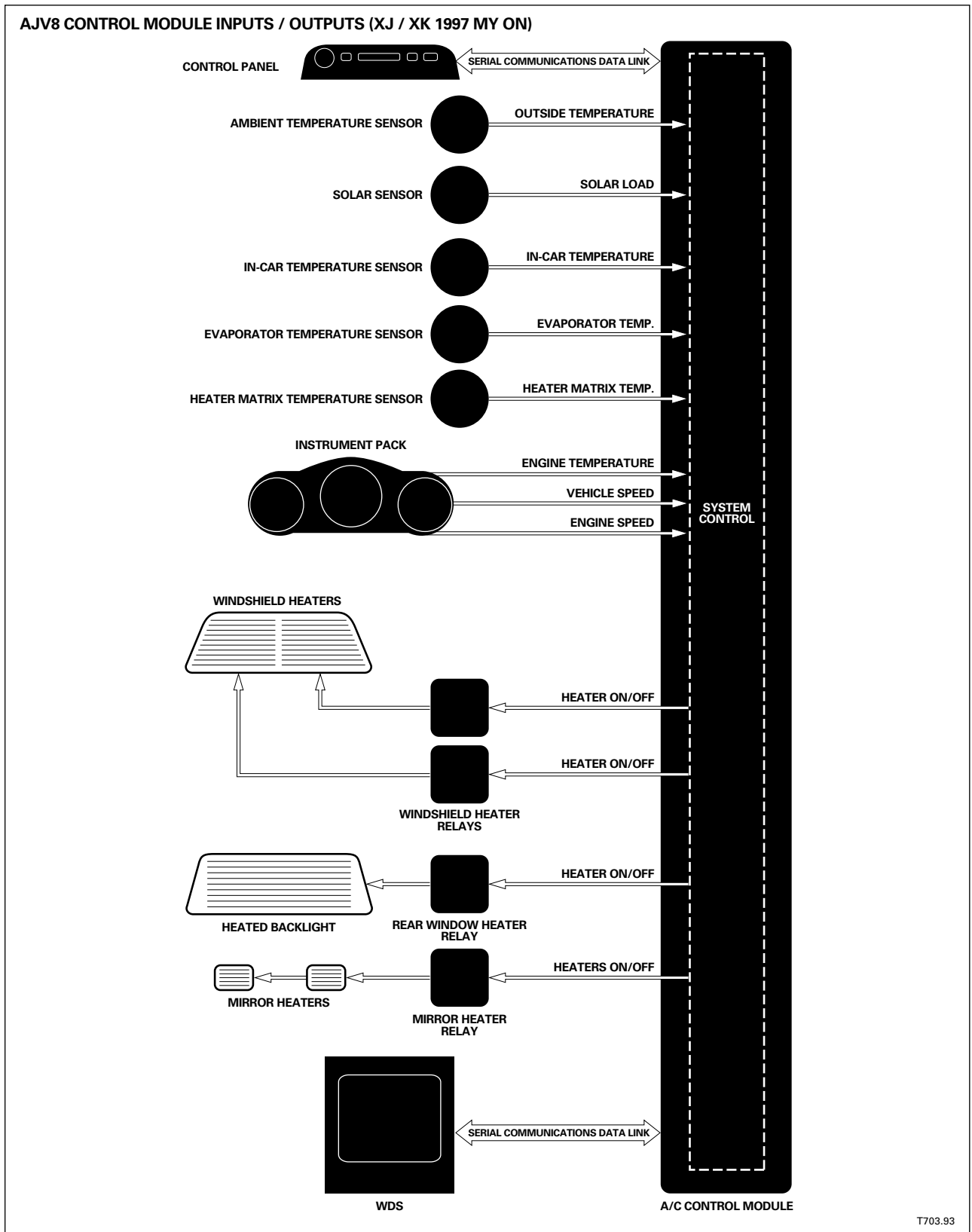
## 3 S-TYPE CLIMATE CONTROL SYSTEM

## 4 X-TYPE CLIMATE CONTROL SYSTEM

## 5 CLIMATE CONTROL REFERENCE

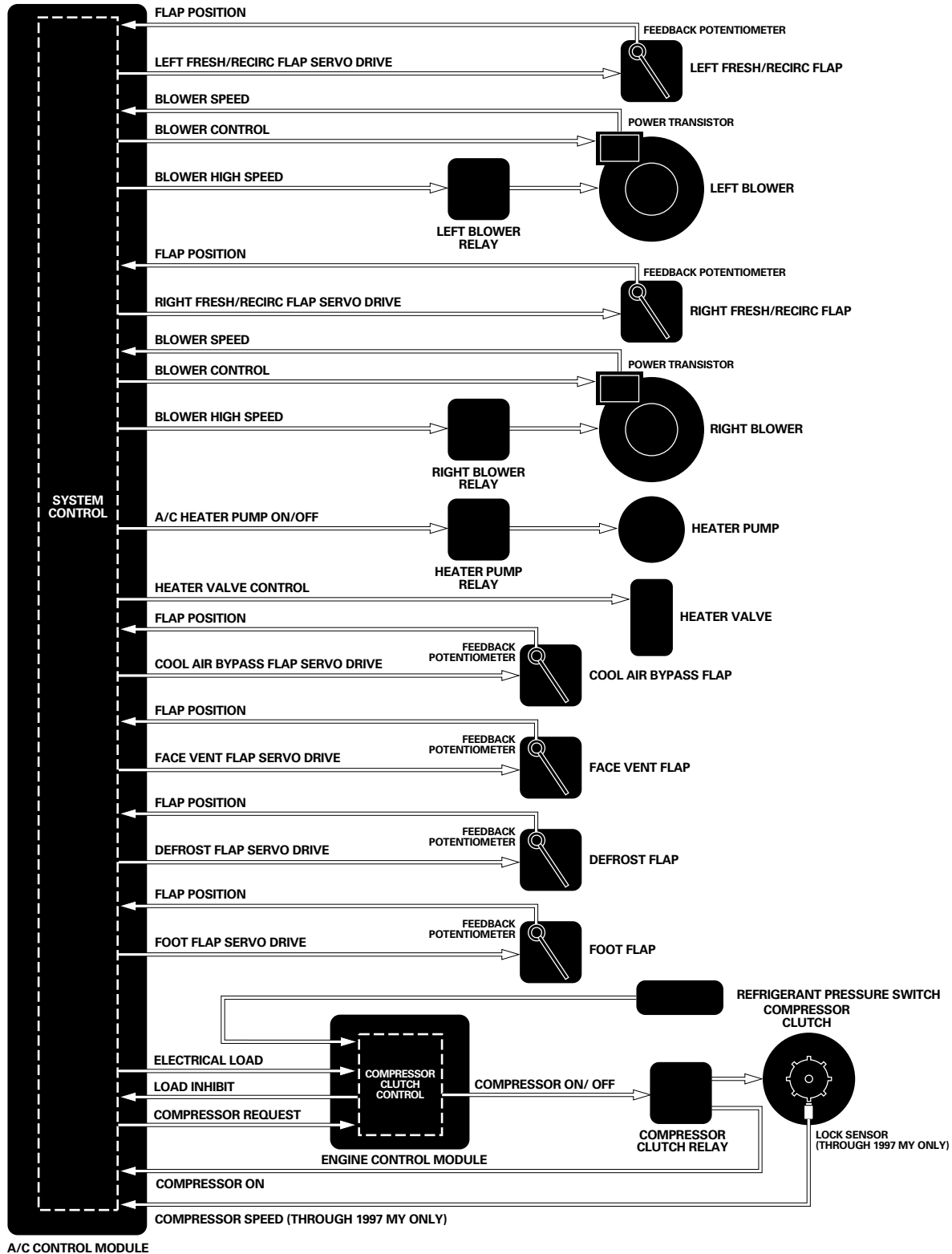


SYSTEM LOGIC



T703.93

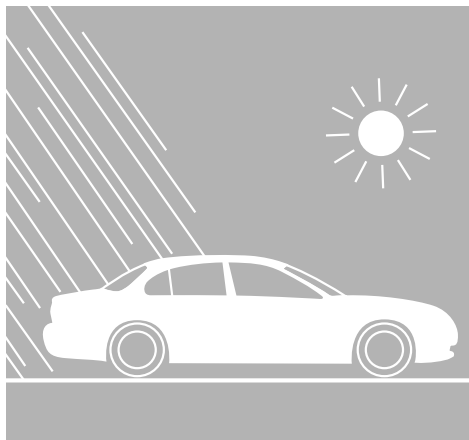
## AJV8 CONTROL MODULE INPUTS / OUTPUTS (XJ / XK 1997 MY ON)



T703.94



# *JAGUAR CLIMATE CONTROL SYSTEMS*



1 CLIMATE CONTROL

**2 XJ / XK CLIMATE CONTROL SYSTEM**

- 2.1 Overview
- 2.2 Refrigeration System
- 2.3 Cooling Fan Control
- 2.4 Heating / Cooling System
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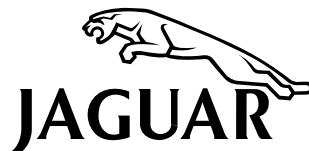
**2.7 Control Module**

- 2.8 Climate Control Panel
- 2.9 Temperature Control Sensors
- 2.10 Vehicle Systems Interfaces
- 2.11 Control Panel Diagnostics
- 2.12 Task Sheets

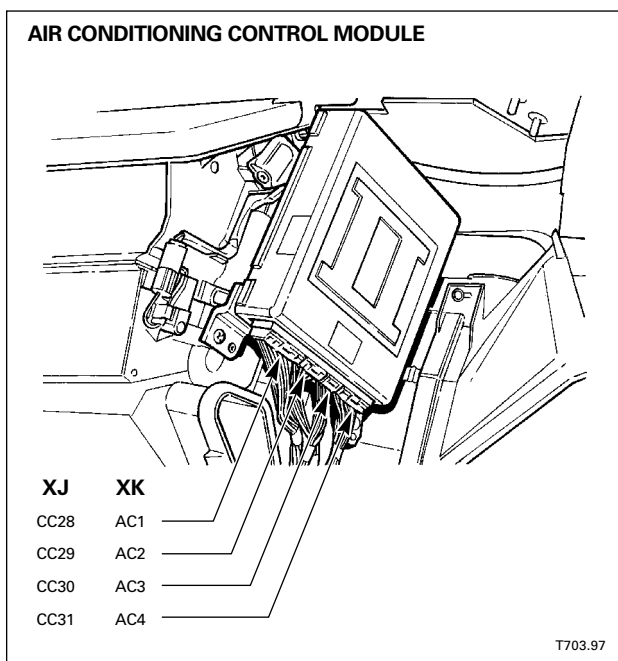
3 S-TYPE CLIMATE CONTROL SYSTEM

4 X-TYPE CLIMATE CONTROL SYSTEM

5 CLIMATE CONTROL REFERENCE



## CONTROL MODULE



The air conditioning control module (A/CCM), located on the right side of the air conditioning / heater unit, controls all system sensing and drive functions.

The A/CCM has two microprocessors: one 8-bit and one 4-bit. The 8-bit microprocessor controls the overall system strategy and stores input / output information. The 4-bit microprocessor “conditions” the system signals and processes information.

The A/CCM uses discrete components plus analog-to-digital circuits to interface between the microprocessors, input sensors and output devices. Software programmed into an EPROM is used for control, data and diagnostics.

Ignition switched power activates the A/CCM when the ignition is switched to position II. Quiescent current from a battery power supply is used to keep the A/CCM random access memory (RAM) active so that diagnostic information is maintained.

The A/CCM contains four connector sockets. A rough guide to the connector function grouping is as follows:

Connector		Description	Function
XJ	XK		
CC28	AC1	26-way	system component drives; compressor clutch status
CC29	AC2	16-way	sensor inputs; feedback inputs; vehicle interface
CC30	AC3	12-way	sensor inputs; control panel communication; grounds; vehicle interface
CC31	AC4	22-way	power supplies; grounds; signal grounds; vehicle interface

### Isolate Relay

The A/C isolate relay remains energized by the A/CCM for 30 seconds after the ignition is switched off to provide battery power for the A/CCM to “park” the system servos and also supplies power to the aspirator motor.

### NOTES



## System Sensors and Potentiometers: Power Supply and Signal Ground

The climate control system uses multiple sensors to measure and report temperatures on 1997 MY XK only, compressor rotation. Feedback potentiometers are used to report the position of air flow flaps and the desired face level differential position (through 1997 MY only). All of the sensors and potentiometers use a common five volt power supply (reference voltage) from the A/CCM and a common signal ground at the A/CCM.

### Sensor and Potentiometer Power Supply and Signal Ground Diagnostic Monitoring

The A/CCM monitors the sensor 5 volt power supply circuit for open circuit, high resistance and short circuit conditions. The signal ground circuit is monitored for open circuit conditions. If a fault is present, a DTC will be flagged.

DTCs	
WDS	Control Panel
B1297	None
B1298	None
B1299	None
B1863	None

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### NOTES

# XJ / XK CLIMATE CONTROL SYSTEM

## CONTROL MODULE

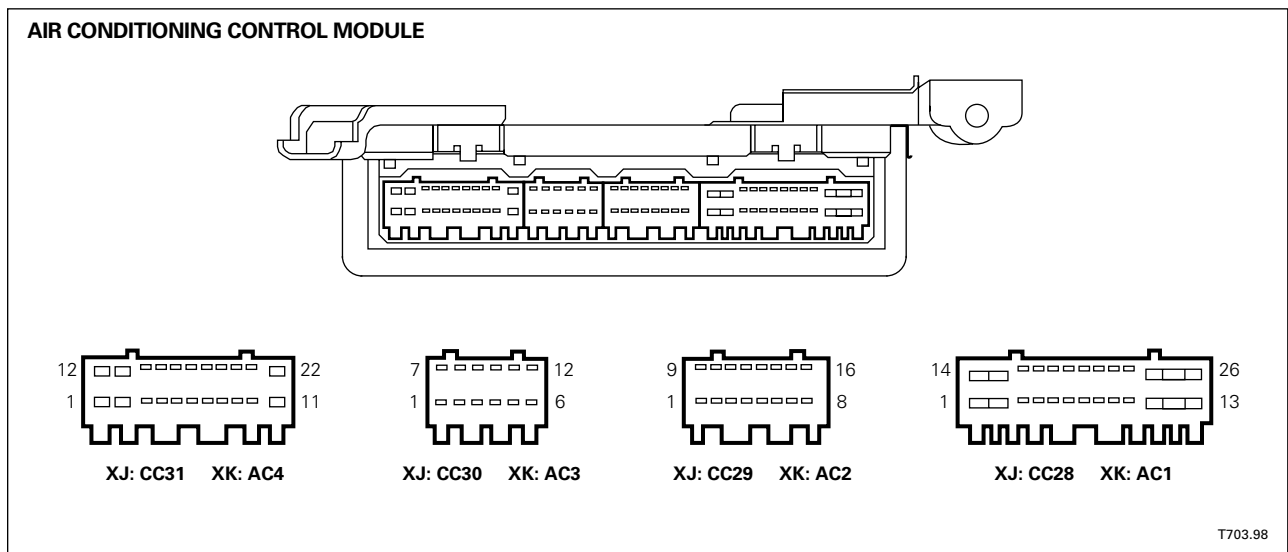
### System Diagnostics

The A/CCM continuously monitors the climate control system for faults. If a fault is detected the A/CCM flags a diagnostic trouble code (DTC) corresponding to the fault. All DTCs can be retrieved using WDS. In addition, some fault codes can be displayed on the control panel screen. The WDS DTCs consist of 5 characters; the codes displayed on the control panel are two digit numbers. WDS and panel display fault code information is supplied with the description of the applicable component in this textbook.

### A/CCM Power Supplies and Auxiliary Ground Diagnostic Monitoring

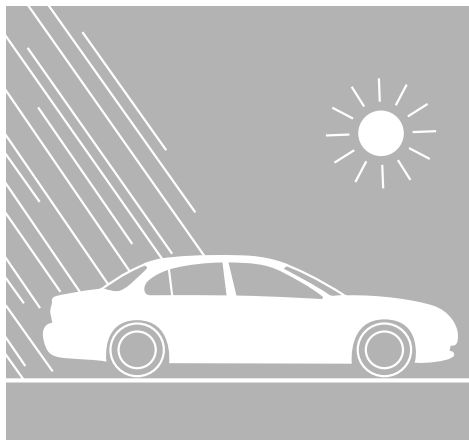
The A/CCM monitors the system power supplies for open circuit, high resistance, and short circuit conditions. The ignition switched ground input signal is monitored for open circuit or high resistance conditions. If a fault is present, a DTC will be flagged.

DTCs	
WDS	Control Panel
B1292	None
B1294	None
B1355	None
B1857	None



### NOTES

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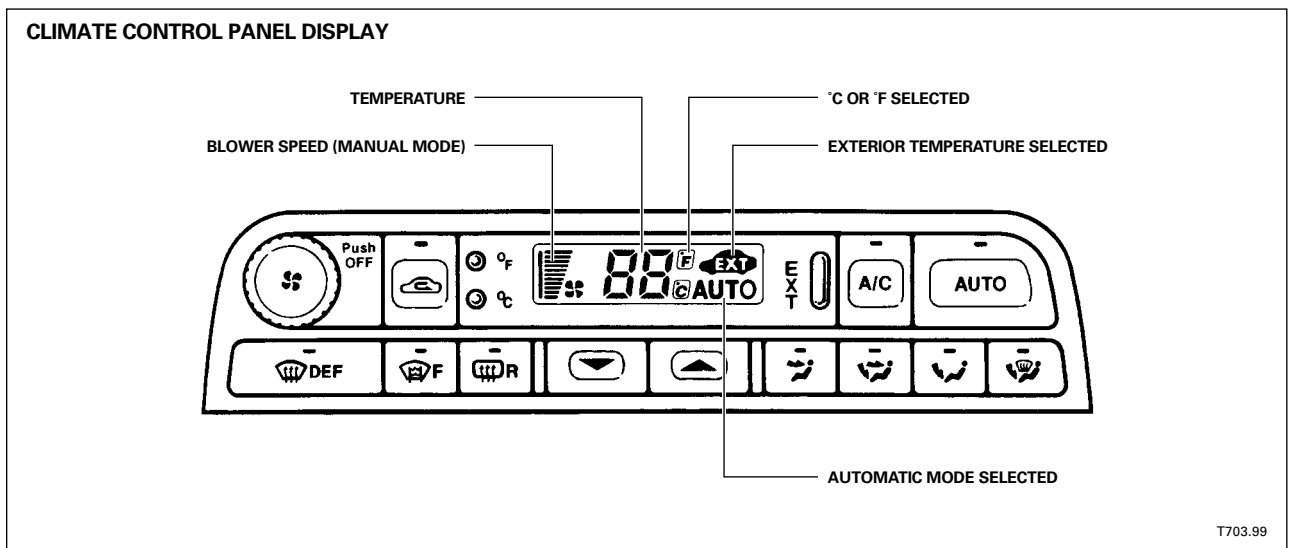
5 CLIMATE CONTROL REFERENCE



## CLIMATE CONTROL PANEL

The control panel is the interface between the driver and the air conditioning control module (A/CCM). It has a 4-bit microprocessor that processes information and converts the selected switch positions and settings into digital data that is communicated to the A/CCM over a serial data link.

Data transfer between the control panel and the A/CCM occurs in cycles when the “START” signal is received from the A/CCM. The total communication contains 29 “CLOCK” pulses. In order to avoid errors, the A/CCM must receive two identical data transfers before any action is taken. Power supply to the control panel is provided via the A/CCM when the ignition switch is in position I (auxiliary) or II (ignition).



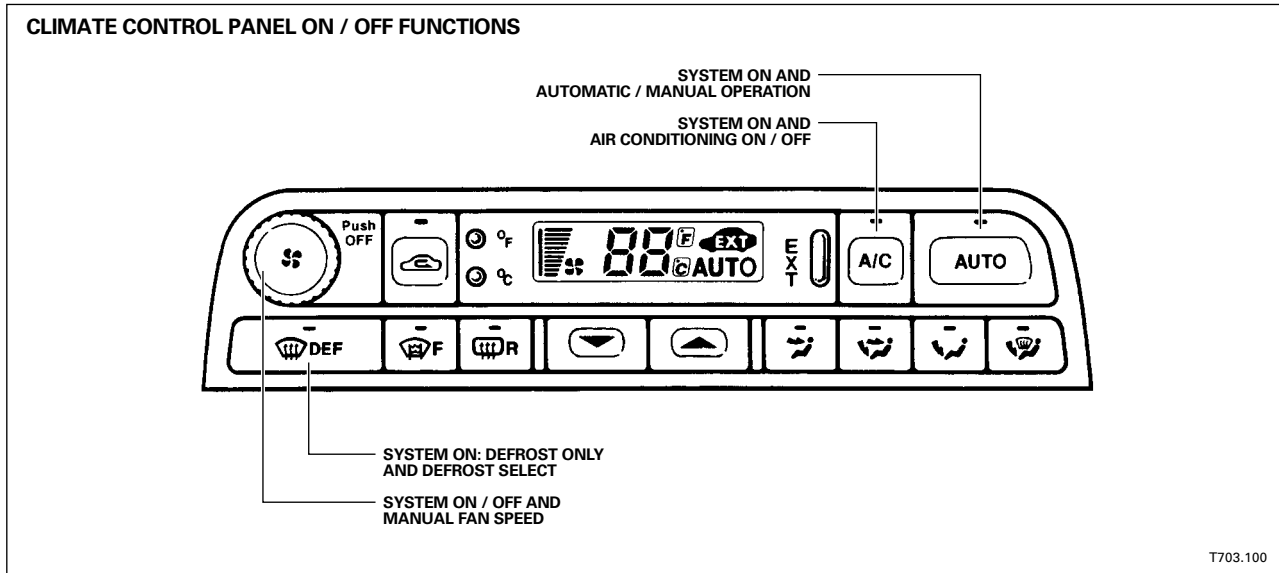
### Control Panel Display

The display gives the driver a visual presentation of the system's current selections and operation:

- Blower speed** A bar graph displays the blower speed during manual control.
- Temperature** The interior or exterior temperature is displayed numerically. Exterior temperature is selected by pressing the EXT button:
  - Momentary press (one beep) – four second display
  - Long duration press (two beeps) – continuous display
- Temperature scale** °F (Fahrenheit) or °C (Celsius) is displayed by pressing the °F or °C button.
- Exterior temp. option** EXT is displayed when the exterior temperature is selected. The exterior temperature will continue to be displayed if the system is switched off.
- Automatic mode** AUTO is displayed when the system is in automatic mode. Any manual overrides will switch off the AUTO indicator.
- Displayed exterior temperature** To compensate for heat soak conditions, the displayed exterior temperature is stored in memory for one hour after the ignition is switched OFF.

If the ignition is switched ON before one hour has elapsed, and the ambient temperature has risen, the stored temperature is displayed; if the ambient temperature has dropped, the lower temperature is displayed. When the ignition is switched ON after one hour, the current ambient temperature is displayed.

## Climate Control System ON / OFF



The climate control panel is switched ON by pressing one of the following panel controls:

- AUTO** AUTO switches the system ON in the automatic mode; AUTO appears on the panel display. Temperature, blower speed and air distribution are automatically controlled. If heat is required, the blowers will not operate until the engine temperature has risen above 30 °C (87 °F), unless defrost is selected. The blowers operate any time cooling is required. Except in recirculation mode, blower speed is linked to vehicle speed to adjust for the ram air effect at higher vehicle speeds.
- A/C** A/C switches the system ON in air conditioning mode only. The system uses the air conditioning settings in effect the last time air conditioning was used.
- DEF** DEF switches the system ON in the defrost mode only. Air is directed to the windshield only. The blowers operate at maximum speed. Temperature is automatically controlled by the A/CCM.
- Push OFF** Push OFF switches the system ON in the AUTO mode. AUTO appears on the panel display.

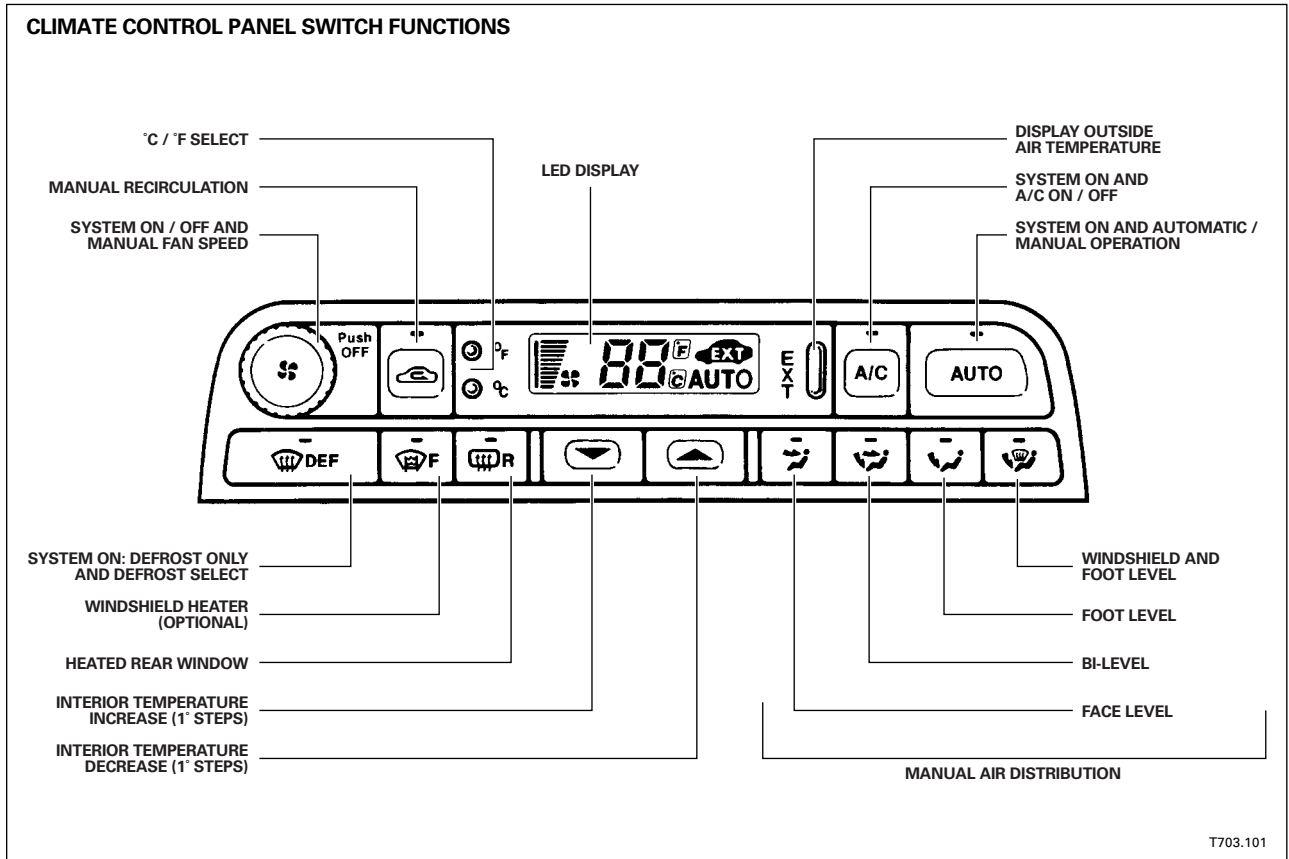
The climate control system is switched OFF as follows:

- Push OFF** Push OFF is the only method for switching the system OFF. When push OFF is pressed, the system is switched off and the fresh air or recirculation blower flaps are set to recirculation, shutting off outside air intake.

### NOTES

## CLIMATE CONTROL PANEL

### Climate Control Panel Switch Functions



**Push OFF** This switch is a combination switch for manual blower speed control and system ON / OFF. Pushing the rotary switch provides system ON or OFF. Turning the switch provides manual blower control and overrides the AUTO control blower speed functions.

**Recirculation** Pressing this switch closes off the outside air intake and recirculates cabin air. The LED indicates the status.

Momentary press (one beep) – five minute operation

Long duration press (two beeps) – continuous operation

**A/C** This switch signals the A/CCM to request air conditioning compressor operation from the engine control module. The LED indicates when compressor operation is requested.

**AUTO** When AUTO is selected (LED on), control of air distribution, blower speed, and interior temperature is fully automatic. Manual overrides, such as pressing one of the air distribution buttons, turning the blower speed control, or selecting A/C, will disengage the automatic function. The AUTO LED will go out to indicate that a manual override has been selected. When AUTO is pressed again, manual overrides are canceled and full automatic system control is restored.

#### NOTES

- DEF** This switch selects defrost. Maximum blower speed occurs and all air is directed to the windshield. Blower speed can be reduced by turning the blower speed control rotary switch. Temperature is controlled by the A/CCM; however, the temperature can be adjusted by using the temperature select UP / DOWN switches. The optional heated windshield will also be switched on for six minutes. If DEF is switched off or the system is switched off before the six minutes has elapsed, the heated windshield will remain on for the six minute timed period. The LED indicates the status.
- Heated windshield** This switch selects the optional windshield electric heater. The heater will operate for six minutes, then time-out. The LED indicates the status. The windshield heater operates only when the engine is running.
- Heated backlight** This switch selects the backlight and door mirror heaters. The backlight will operate for 20 minutes and the door mirror heaters will operate for 11 minutes, then time-out. The LED indicates the status. The heated backlight and mirror heaters operate only when the engine is running.
- Interior temperature** The temperature select buttons increase or decrease the desired interior temperature in 1° increments, °C or °F, as selected.
- Manual air** Four air distribution manual override buttons are used to override the automatic function and distribution override distribute air as the driver selects: FACE, FACE AND FEET (bi-level), FEET ONLY and WINDSHIELD AND FEET. The LED indicates the status.

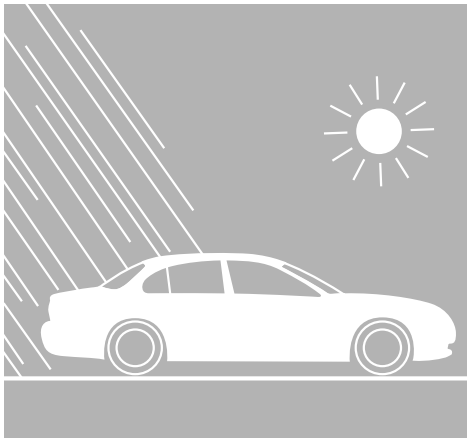
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### NOTES





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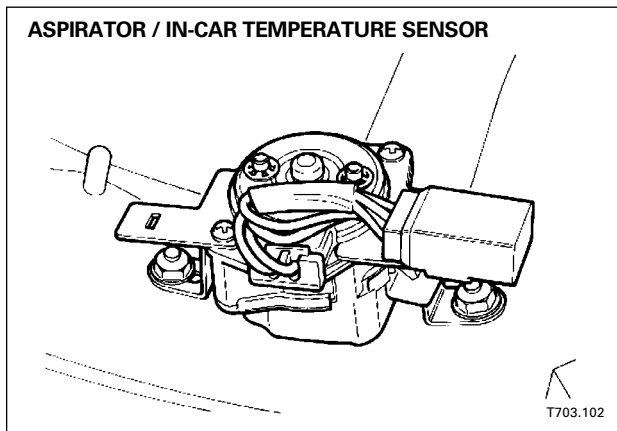


**TEMPERATURE CONTROL SENSORS**

The A/CCM uses the temperature control sensor inputs to determine the temperature and volume of air required to maintain the selected interior temperature of the passenger compartment

**In-Car Temperature Sensor**

The NTC (negative temperature coefficient) in-car temperature sensor is part of the aspirator assembly, located on the driver’s side dash liner. The sensor provides the A/CCM with a voltage signal representing the average in-car air temperature. The A/CCM uses the signal to correct the outlet air temperature and distribution to reach the target in-car temperature selected by the driver.



**Approx. In-Car Temperature Versus Voltage**

Temperature		Voltage
°C	°F	
33 – 37	92 – 99	2.00
28 – 32	84 – 90	2.25
24 – 27	75 – 81	2.50
19 – 22	67 – 72	2.75
15 – 18	59 – 66	3.00
11 – 14	52 – 57	3.25
06 – 10	43 – 50	3.50

**In-car temperature diagnostic monitoring**

The A/CCM monitors the in-car temperature sensing circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 25 °C (77 °F) is substituted by the A/CCM if an in-car temperature sensor fault is present.

DTCs	
WDS	Control Panel
B1250	11
B1253	11

**NOTES**

## Aspirator Motor

The motorized aspirator provides a constant flow of interior air over the in-car temperature sensor. The motor operates only when the control panel is switched ON. Operation is momentarily stopped when the ignition is turned to position III.

### Aspirator Motor Diagnostic Monitoring

The A/CCM monitors the aspirator motor circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

No default value is used for aspirator motor failure. The in-car temperature sensor will continue to be used by the A/CCM, but temperature stability will be lost.

DTCs	
WDS	Control Panel
B1853	None
B1856	None

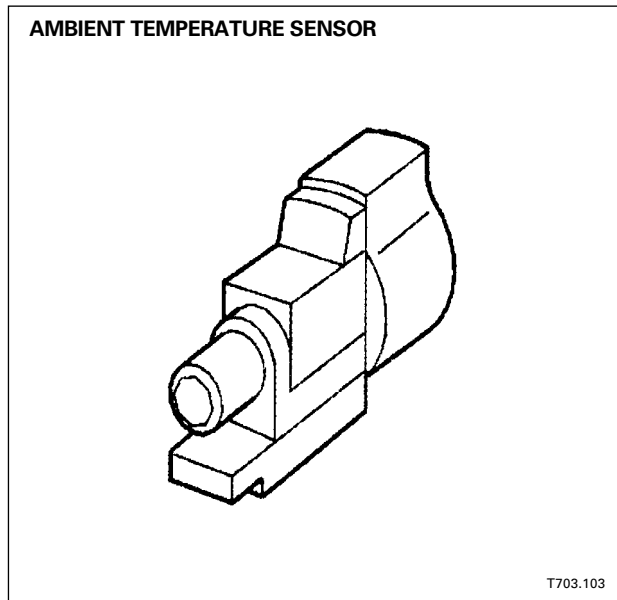
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## NOTES

**TEMPERATURE CONTROL SENSORS**

**Ambient Temperature Sensor**

The NTC (negative temperature coefficient) ambient temperature sensor, located on the lower left radiator mount (XJ) or the right side horn bracket behind the front bumper (XK), provides the A/CCM with a voltage signal representing the ambient air temperature. The A/CCM uses the signal to compensate for ambient air temperature conditions and for the exterior air temperature panel display. To prevent an incorrect temperature signal during “heat soak” conditions (stationary vehicle with the engine running), a rising temperature signal is ignored by the A/CCM at vehicle speeds below 9 mph (15 km/h). Falling temperature signals are always used by the A/CCM.



**Approx. Ambient Temperature Versus Voltage**

Temperature		Voltage
°C	°F	
44 – 49	111 – 121	1.25
38 – 42	101 – 108	1.50
32 – 36	90 – 97	1.75
27 – 31	81 – 88	2.00
23 – 26	74 – 79	2.25
18 – 22	65 – 71	2.50
13 – 17	56 – 63	2.75
9 – 12	48 – 54	3.00
5 – 8	41 – 47	3.25
0 – 4	32 – 39	3.50
-5 – -1	24 – 30	3.75

**Ambient Temperature Diagnostic Monitoring**

The A/CCM monitors the ambient temperature sensing circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 10 °C (50 °F) is substituted by the A/CCM if an ambient temperature sensor fault is present.

DTCs	
WDS	Control Panel
B1254	12
B1257	12

**NOTES**

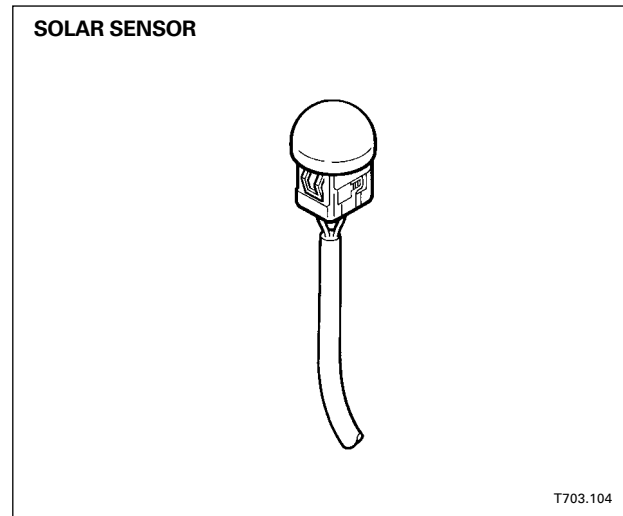
## Solar Sensor

The light sensitive solar sensor, located at the top of the fascia panel, provides the A/CCM with a voltage signal representing the “solar (sun) load” being placed on the vehicle. The sensor uses a light sensitive diode so that as the brightness of the sun brightness increases, the sensor voltage signal to the A/CCM increases. The range of the sensor is 0.75 – 4.75 volts.

### Solar Load Diagnostic Monitoring

The A/CCM monitors the solar sensor circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 0 kW/m is substituted by the A/CCM if a solar sensor fault is present.



DTCs	
WDS	Control Panel
B1258	21
B1260	21

## NOTES



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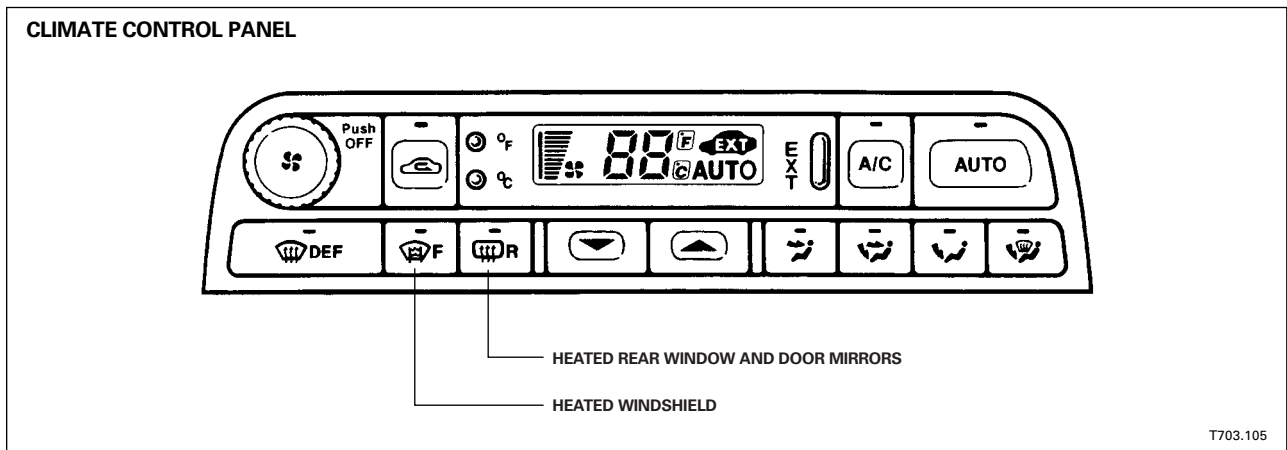


## VEHICLE SYSTEMS INTERFACES

### Windshield, Rear Window and Mirror Heaters

Control of the windshield, rear window and mirror heaters is integrated with the climate control system. The engine must be running for the heaters to operate.

The A/CCM will not switch on the heaters until it receives an engine speed signal from the ECM. In V12 systems, the A/CCM will not switch on the heaters if it receives an engine load signal from the ECM. To compensate for the electrical load placed on the vehicle charging system when the heaters operate, the ECM acts to maintain the target idle speed.



The heated rear window and door mirrors are activated by pressing the “R” button on the climate control panel. The heated windshield can be activated manually by pressing the panel “F” button.

When the heaters are requested, the A/CCM signals the ECM for permission to switch ON the heaters via the electrical load request hard wire circuit. Depending on the engine operating condition, the ECM inhibits heater operation by outputting a load inhibit signal to the A/CCM via the load inhibit hard wire circuit.

Engine conditions for heaters ON:

- Engine not at idle \*
- Engine coolant temperature below 119 °C (246 °F)
- Throttle valve less than full load (WOT)

Engine conditions for heaters inhibited:

- Engine coolant temperature above 119 °C (246 °F)
- Throttle valve at full load (WOT)

\* Engine at idle – Heaters inhibited for (approximately 50 ms) as the ECM adjusts the idle speed to compensate for the increased electrical load.

**The heaters are timed as follows:**

Heated rear window	20 ± 1 minutes
Heated door mirrors	11 ± 1 minutes
Heated windshield	6 ± 1 minutes



### Heated Windshield

If a heated windshield is fitted, it can be activated manually or automatically. The heated windshield is inhibited by the ECM as described on the previous page.

#### **Automatic activation**

The heated windshield and door mirror heaters can activate automatically during certain driving conditions. No LEDs illuminate when the heaters are activated automatically, therefore the driver cannot easily tell when they switch on or off.

The windshield and door mirror heaters activate independently depending on ambient temperature and vehicle speed. Automatic activation points vary slightly depending on the A/CCM software. Activation occurs when all of the following conditions are met.

#### **Automatic heated windshield activation:**

Ambient temperature below approximately  $-10 - 0^{\circ}\text{C}$  ( $14 - 32^{\circ}\text{F}$ ) and vehicle speed greater than 30 – 40 mph (48 – 64 km/h) for longer than 2 minutes. The windshield switches off immediately when the conditions are no longer valid.

#### **Automatic door mirror activation:**

Ambient temperature below  $0 - 10^{\circ}\text{C}$  ( $32 - 50^{\circ}\text{F}$ ) and vehicle speed greater than 30 mph (48 km/h). The mirrors switch off immediately if the temperature rises above the switch on point or after 2 minutes if the vehicle speed drops to below 30 mph (48 km/h).

The A/CCM does not monitor the window and mirror circuits for diagnostics.

---

### NOTES

## VEHICLE SYSTEMS INTERFACES

### Climate Control Electrical Load

When the blowers operate at high speed and / or the window and mirror heaters operate, additional electrical load is placed on the vehicle charging system. When one or more of these components operate, the A/CCM provides the ECM with a B+ voltage signal. The ECM adjusts the engine idle speed to compensate for the increased load.

The A/CCM does not monitor the electrical load circuit for diagnostics.

### Engine Speed

The A/CCM receives an engine speed signal from the instrument pack . The A/CCM uses the engine speed signal for the following functions:

- Heater pump control
- Heater valve control
- Windshield, backlight and mirror heaters operation
- Compressor lock sensing (through 1997 MY only)
- Diagnostics

### Engine speed diagnostic monitoring

The A/CCM compares engine speed to vehicle speed. If the engine speed is 0 and the vehicle speed is above 50 mph (81 km/h), a DTC is flagged.

No default value is used for engine speed circuit failure.

DTCs	
WDS	Control Panel
P0335	None

### Engine Cranking

During engine cranking, the ignition switched ground signal is removed from the A/CCM (ignition switch position III) to signal the A/CCM to momentarily inhibit the operation of current consuming components.

The A/CCM does not monitor the engine cranking circuit for diagnostics.

---

## NOTES

## Engine Coolant Temperature

The A/CCM receives an engine coolant temperature voltage signal from the instrument pack.

### Heating Mode

When the system is in the heating mode and the engine coolant temperature is below 30 °C (86 °F), the A/CCM inhibits operation of the heater valve, heater pump, and the blowers. Once the coolant temperature has risen above this temperature, the heater pump and valve operation returns to normal; the blower speed will be lower than selected until the coolant temperature reaches 60 °C (140 °F).

### Coolant Temperature Diagnostic Monitoring

The A/CCM monitors the engine coolant temperature circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

If a circuit fault occurs between the coolant temperature sensor and the instrument pack, the instrument pack output will default to a voltage equal to 20 °C (68 °F).

If a circuit fault occurs between the instrument pack and the A/CCM, the A/CCM will substitute a default value of 76 °C (169 °F).

DTCs	
WDS	Control Panel
B1948	14
B1949	14

## Vehicle Speed

The A/CCM receives a pulsed signal from the instrument pack to indicate vehicle speed. The instrument pack receives its signal from the ABS control module. The A/CCM uses the vehicle speed signal for the following functions:

- Blower speed control
- Ambient temperature signal recognition
- Diagnostics

The A/CCM does not monitor the vehicle speed circuit for diagnostics.

---

## NOTES



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## CONTROL PANEL DIAGNOSTICS

### System Self-Test

Some system generated fault codes can be displayed on the control panel screen. When a fault is flagged, an audible “beep” will sound and the message “Er” will be displayed for five seconds, after the ignition is switched to position II. To display stored “panel fault codes”, follow this procedure:

- **Switch off the ignition**  
 Press and hold the AUTO and FRESH / RECIRC buttons simultaneously while switching the ignition to position II. All of the panel LEDs and all LCD segments will flash ON and OFF. Any function LED indicator or LCD segment that does not flash suggests a fault condition within that area of the panel, or with the LED or LCD.
- **Press AUTO**  
 The control panel display will flash and scroll through the list of flagged fault codes. A maximum of five codes will be stored and displayed. If 0 is displayed, no fault codes are flagged.
- **Press FACE to manually scroll through the fault codes**  
 When a fault code is displayed, an accompanying beep will indicate if the fault is present. If the code is not accompanied by a beep, the fault occurred previously.  
**NOTE:** Faults that are present can not be cleared until the cause of the fault is repaired.  
 To clear fault codes, press HRW and FACE simultaneously. Wait 30 seconds for the A/CCM to retest the system and reflag any current faults.
- **Press PUSH OFF to return the system to normal operation (default panel settings)**

### Panel Communication Check

The data link, power, and lighting circuits between the A/CCM and the control panel can be checked by simultaneously holding AUTO and FAN while the ignition is switched to position II. Panel control LEDs will illuminate to indicate that each circuit is OK, as follows:

Circuit	LED
Ignition switched power supply (pos. II) circuit	Defrost button LED
Ignition switched power supply (pos. I, Aux.) circuit	Face button LED
Clock circuit	Bi-level button LED
Start circuit	Foot button LED
Data circuits	Defrost / foot button LED
Panel lighting	Recirc. button LED (Headlights ON!)

## EXERCISE

Perform the System Self-Test above on the assigned vehicle. Record any faults below.

OBD II DTCs	Control Panel Code

## Actuator Check

The control panel, system actuators and certain components can be checked by simultaneously holding AUTO and FRESH / RECIRC while the vehicle is being started.

### Control Panel

All of the panel control LEDs and LCD segments will flash on and off to indicate that each panel circuit is OK. If a LED does not flash, a fault condition in that area of the panel is indicated, or the LED has failed. If a LCD segment does not flash, a fault condition in that area of the panel is indicated, or the LCD segment has failed.

### Actuators and Components

Check the actuators by selecting AUTO, then FRESH / RECIRC. Select FACE to cycle through the actuator mode conditions 20 – 27 as shown in the following table. After the check is complete, select PUSH OFF to restore normal system operation.

### Actuator Check Chart

Mode	Blower level	Face	Outlet: Foot	Defrost	Cool Air bypass	Fresh / recirc	Compressor	Heater valve	Heater pump
20	0	open	closed	closed	closed	fresh	OFF	closed	OFF
21	1	open	closed	closed	closed	fresh	OFF	closed	ON
22	10	open	closed	closed	open	1/2 open	A/C ON	closed	ON
23	17	bleed	1/2 open	closed	1/2 open	1/2 open	A/C ON	6 sec. pulse*	ON
24	17	bleed	1/2 open	closed	closed	recirc	A/C ON	6 sec. pulse*	ON
25	23	closed	open	bleed	closed	recirc	A/C ON	open	ON
26	23	closed	1/2 open	1/2 open	closed	recirc	A/C ON	open	ON
27	31	closed	closed	open	closed	open	A/C ON	open	ON

\* The heater valve operates on a 6 second pulse (3 seconds ON, 3 seconds OFF)

### Control Panel Diagnostic Monitoring

The A/CCM can determine incorrect data by the absence of a minimum number of “high” and “low” bits in each data “block” received or sent. The A/CCM continuously checks the data flow between the A/CCM and the control panel. If consistent incorrect data is detected, a DTC is flagged.

## EXERCISE

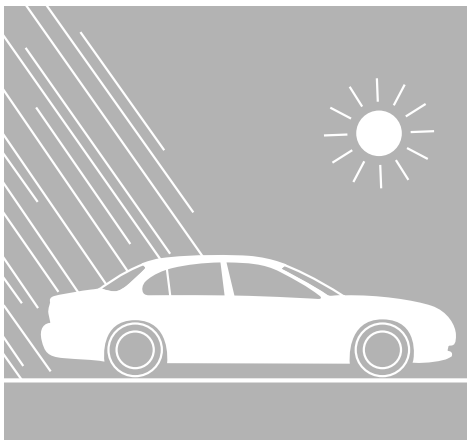
Perform the Actuator Check above on the assigned vehicle. Record any faults below.

OBD II DTCs	Control Panel Code





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**TASK SHEET 1 – XJ / XK TEMPERATURE DEMAND**

Complete the following exercise using WDS.

**Manual Mode: Full Cold Temperature Demand**

Datalogger Selection: Potentiometer (flap)	Control Panel Selections				
	Face	Face/Foot	Foot	Defrost/Foot	Defrost
Defrost					
Center vent					
Cool air					
Foot					
Water valve duty cycle %					

**Manual Mode: Full Hot Temperature Demand**

Datalogger Selection: Potentiometer (flap)	Control Panel Selections				
	Face	Face/Foot	Foot	Defrost/Foot	Defrost
Defrost					
Center vent					
Cool air					
Foot					
Water valve duty cycle %					

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 2 – XJ / XK TEMPERATURE SENSORS**

Use the Wiring Diagrams and the Student Guide to fill in the table below. When the table is complete, go to the assigned vehicle and locate the sensors.

Sensor Name	Temperature / Voltage Range (Wiring Data Page)	Pin / Wire Data (at A/CCM)	Default Temperature (Student Guide)	Location on Vehicle

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_



# *JAGUAR CLIMATE CONTROL SYSTEMS*



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  - 3.3 Heating / Cooling System
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### **OVERVIEW**

The Jaguar S-TYPE uses a Visteon-made climate control system introduced in the 2000 model year. A microprocessor-based electronic control module and a microprocessor control panel control the system. This system has one unique feature, which is the Dual Automatic Temperature Control (DATC) system, in which both driver and front passenger have independent control of the air temperature for their individual comfort.

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### **NOTES**

# *JAGUAR CLIMATE CONTROL SYSTEMS*



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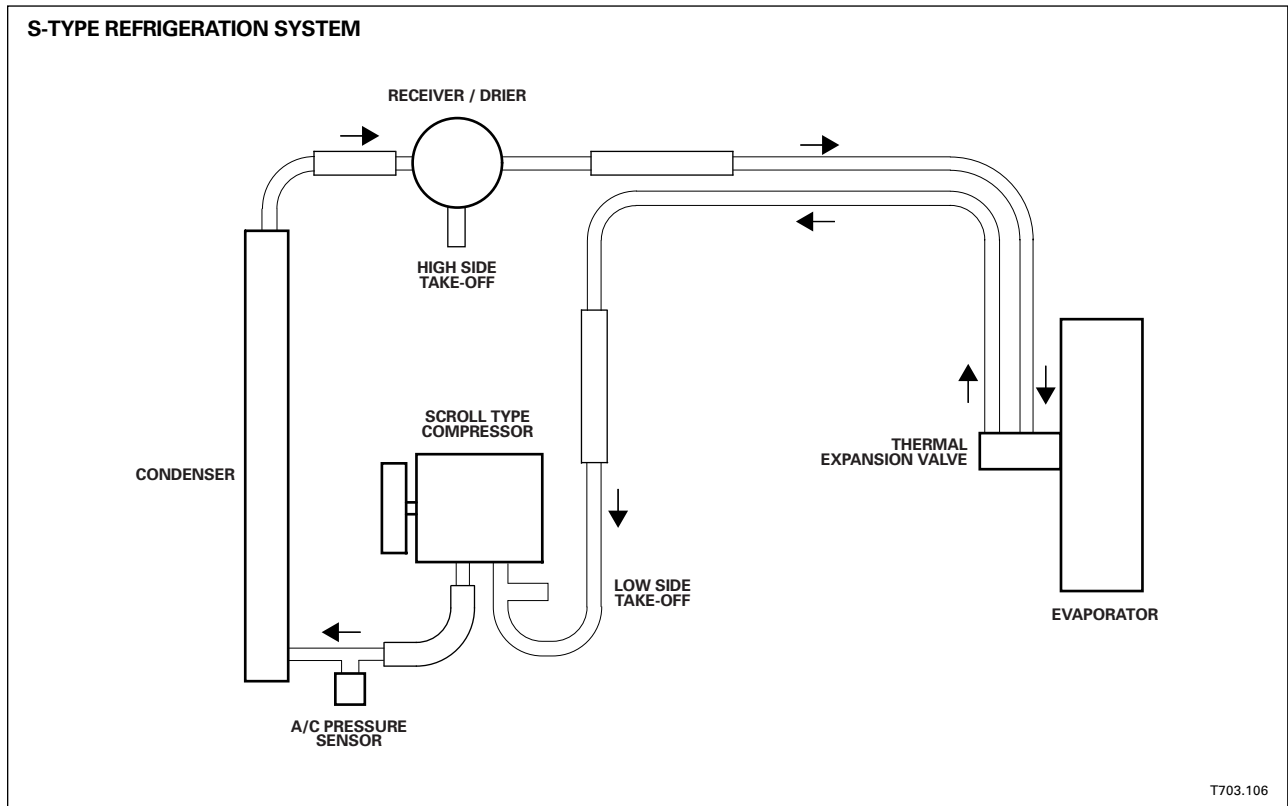




## S-TYPE CLIMATE CONTROL SYSTEM

### REFRIGERATION SYSTEM

Jaguar S-TYPE has a conventional R134a air conditioning refrigeration system. The installation of a variable displacement scroll type compressor and the use of an air conditioning pressure sensor are components new to Jaguar. The system does not require the installation of mufflers.



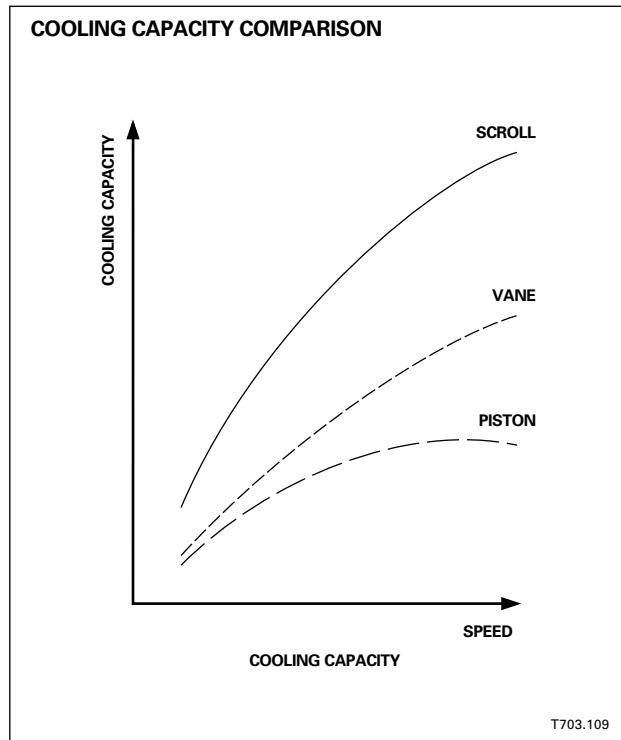
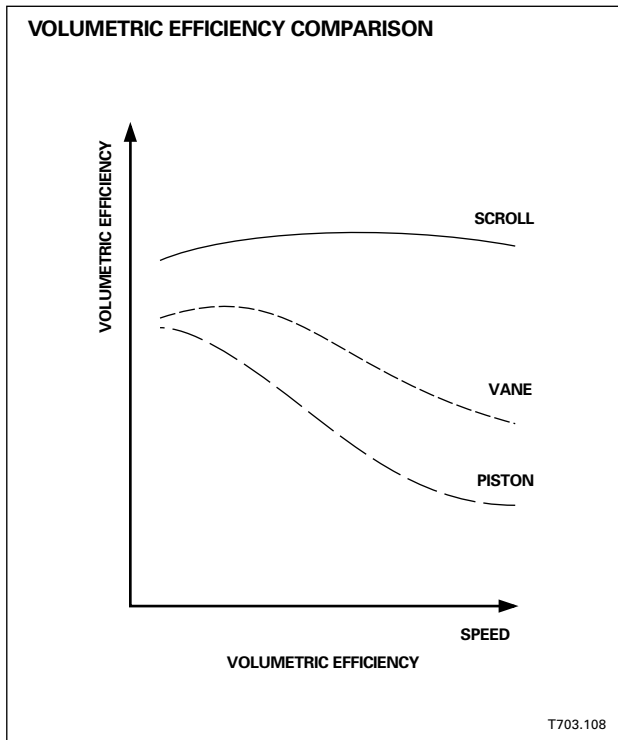
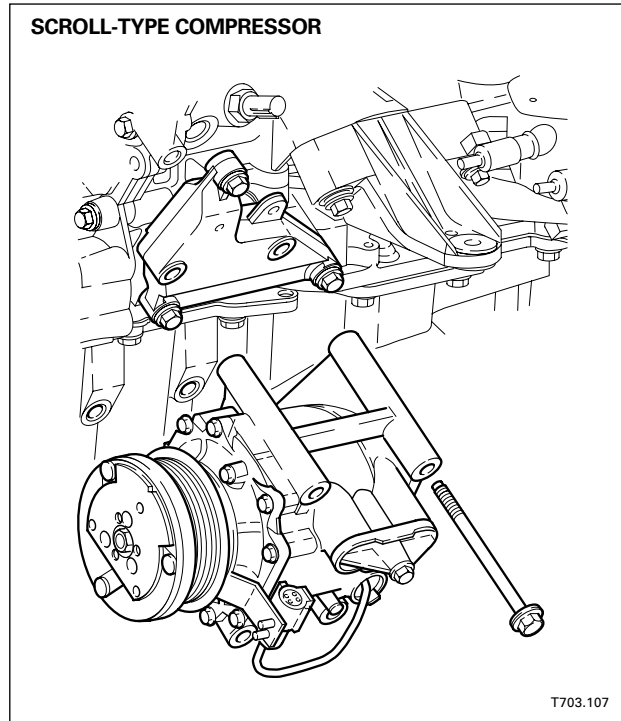
#### NOTES



### Scroll Type Compressor

The nominal displacement of the scroll type compressor is 90 cc. This displacement can be reduced to an effective displacement of 27 cc by an internal bypass valve that is positioned from open (full bypass – 27 cc) to closed (no bypass – 90 cc) by sensing suction pressure. At low air conditioning load, the suction pressure is low and the bypass valve is moved toward open; at high air conditioning load, the suction pressure is high and the bypass valve is moved toward closed. To protect the compressor from extreme high pressure damage, a pressure relief valve is incorporated in the compressor manifold. The relief valve opens only long enough to release sufficient refrigerant to bring the pressure down to a safe level. In addition, the compressor incorporates a thermal switch in the clutch drive circuit that trips to disengage the clutch and protect the compressor if extreme high compressor body temperature occurs. The thermal switch will reset automatically.

The graphs show the improvements in volumetric efficiency and cooling capacity over other types of compressors.



### REFRIGERATION SYSTEM

#### Compressor Clutch Control

The A/CCM broadcasts a SCP compressor ON request message to maintain optimum evaporator temperature. When the compressor ON request message is present on the SCP network, the PCM receives the message and cycles the compressor clutch ON / OFF as long as the message remains. The PCM will disengage the compressor clutch during the following engine operating conditions:

- During engine cranking
- At wide-open throttle, with vehicle speed below 95 mph (153 km/h) (maximum 10 seconds clutch disengage)
- At engine speed above 5882 rpm
- At very low engine speed – V8 <400 disengage, > 550 engage; V6 <450 disengage, > 650 engage.
- During “fail safe cooling” (V6 only)

The A/CCM requests compressor ON at evaporator discharge air temperature above 2.2 °C (36 °F) and compressor OFF at evaporator discharge air temperature below 1.1 °C (34 °F). The A/CCM will not request compressor ON at ambient temperatures below -3 °C (27 °F).

#### Air Conditioning Pressure Sensor

The A/C pressure sensor is a component of the powertrain control system. The sensor, located on the high side compressor discharge pipe, is a pressure transducer that monitors compressor discharge pressure. The sensor is mounted on a Schrader type valve to allow service replacement without the need for discharging the refrigeration system.

The PCM receives a feedback voltage signal from the sensor that is used to calculate a equivalent refrigerant pressure. The PCM will cycle the compressor clutch ON / OFF as necessary based on the refrigerant pressure calculation. In addition, the PCM uses the calculation for control of the radiator fan speed and operation.

The PCM engages the compressor after determining if there is adequate refrigerant pressure as compared to the calculated (displayed) ambient temperature (DATC ambient temperature SCP message).

The compressor clutch is disengaged by the PCM if the discharge pressure rises to 29 Bar (420 psi) and above. Once disengaged by high pressure, the PCM re-engages the compressor at 24.1 Bar (350 psi) After normal system disengagement, the compressor clutch is re-engaged by the PCM if the discharge pressure drops to 20.7 Bar (300 psi) and below.

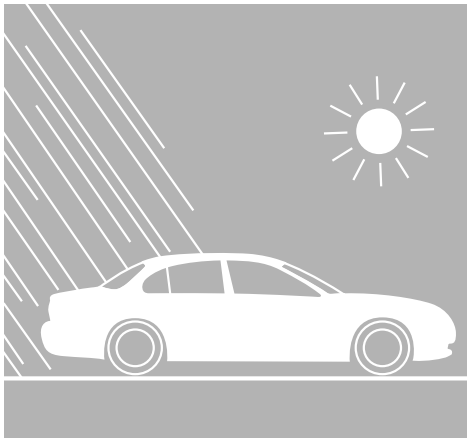
Compressor clutch engagement is momentarily interrupted or delayed by the PCM as follows:

- Momentary disengage during transmission shift (automatic)
- 0.2-second engagement delay at idle to allow idle speed response
- 5-second engagement delay at idle with power steering pressure switch activated

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#### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*



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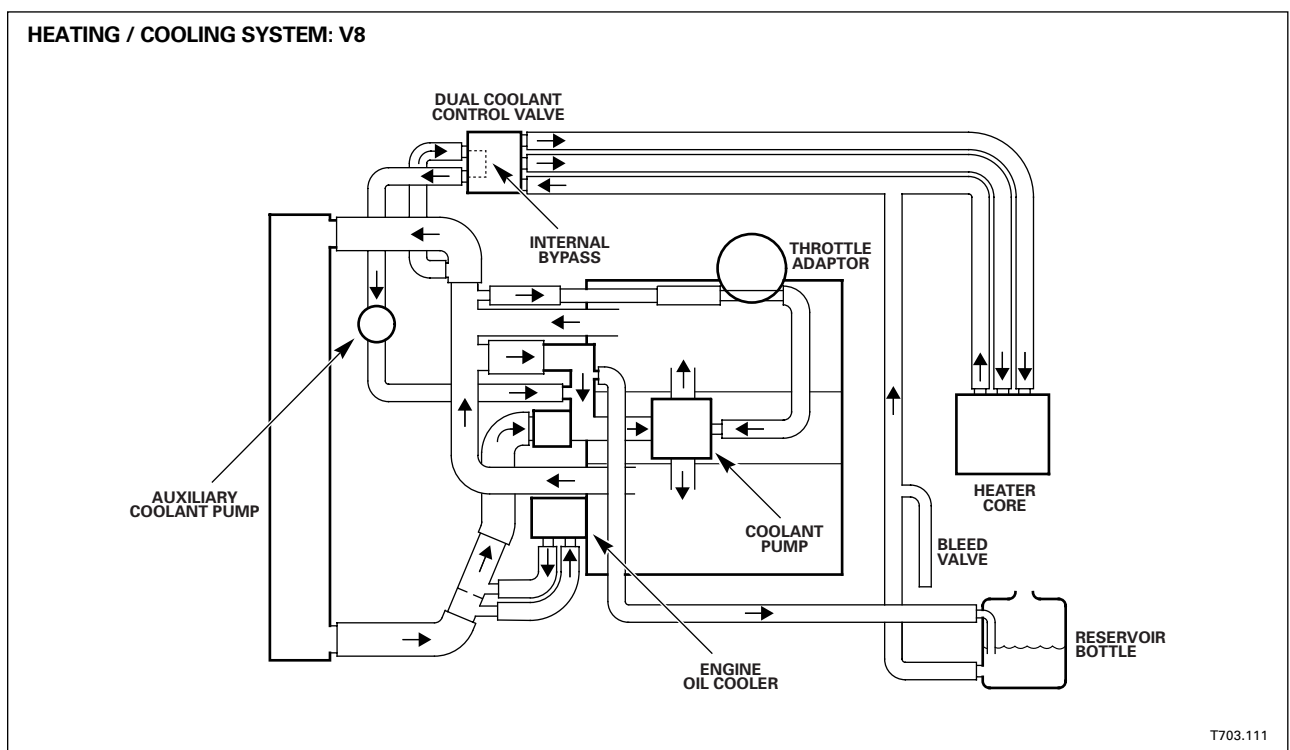
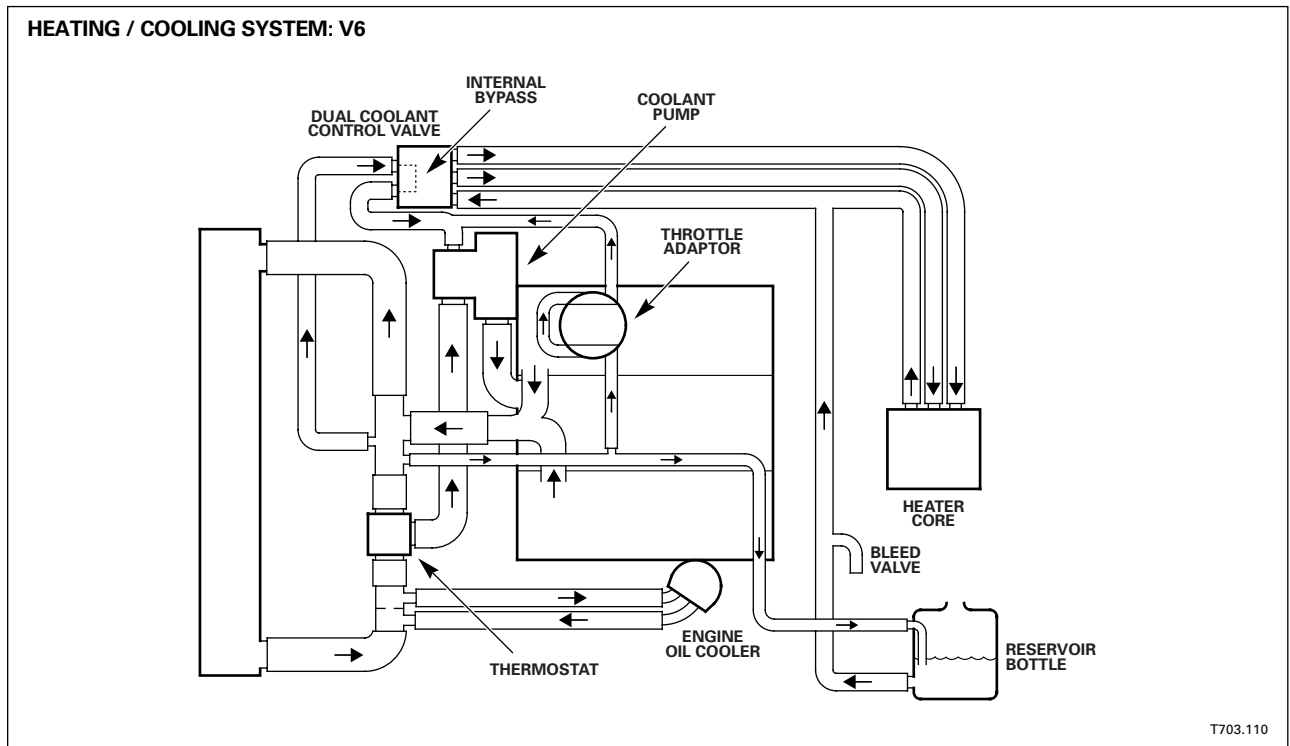




## S-TYPE CLIMATE CONTROL SYSTEM

### HEATING / COOLING SYSTEM

The V6 and V8 engines have similar cooling systems. During engine running, cooling fan control is provided by the PCM. After the ignition is switched off, the PCM is deactivated; however, the need for cooling fan operation can still exist.



## S-TYPE CLIMATE CONTROL SYSTEM

After the engine is switched off, the A/CCM notes the last engine coolant (V8) or cylinder head (V6) temperature (SCP MESSAGE) and provides a control signal to the cooling fan module for a period of four minutes to operate the fan motor. Engine off fan operation is determined by the A/CCM based on the SCP temperature message.

On V8 vehicles, if the coolant temperature rises above 105 °C (221 °F) for a period of one minute after ignition OFF, the A/CCM operates the auxiliary coolant pump for nine minutes, in addition to the radiator cooling fan. The increased coolant flow reduces the risk of boiling.

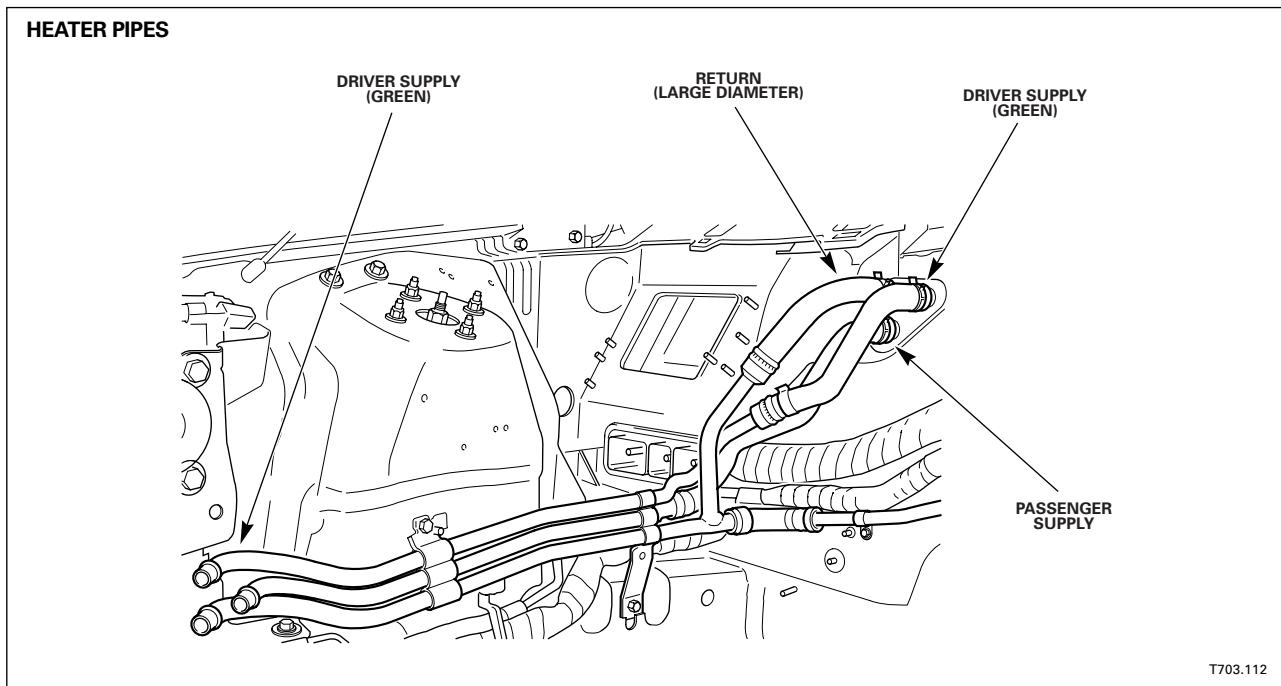
### Service Note

If air is trapped in the heater core, the following symptoms will appear:

- **V6:** Large temperature changes between engine idle and 2000 rpm at the Defrost air discharge and the Foot / Defrost air discharge.
- **V8:** “Gurgle” in heater core during engine OFF / auxiliary coolant pump ON period.

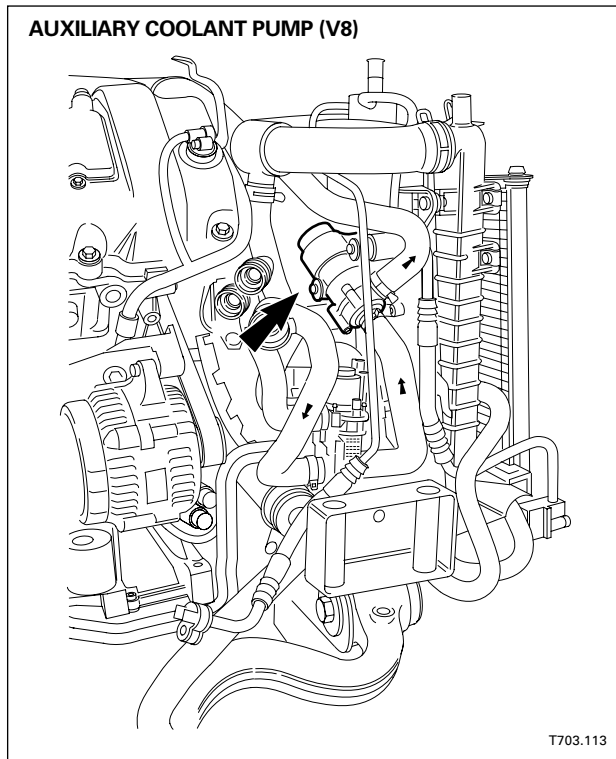
### Heater Pipes

The heater pipe connections at the bulkhead remain the same for driver and passenger regardless of LHD or RHD vehicles. The driver supply pipe is color coded white at the dual coolant control valve and green at the intermediate junction and at the bulkhead. The passenger supply pipe is not color coded.



### NOTES

## HEATING / COOLING SYSTEM



### Auxiliary Coolant Pump (V8)

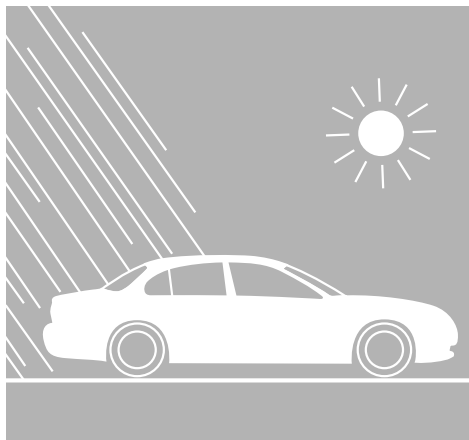
As with existing V8 engines, an auxiliary coolant pump, situated in the return side, is used to increase coolant flow to the heater core as necessary. The A/CCM controls pump operation via a relay located in the front power distribution box.

The A/CCM operates the V8 auxiliary coolant pump as follows:

- Pump ON when selected temperature (control panel) is moderate to high.
- Pump OFF when selected temperature (control panel) is low.
- One minute pump ON delay after engine start.
- Pump ON with radiator cooling fan drive ON, after ignition OFF, engine hot.

### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*



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## **S-TYPE CLIMATE CONTROL SYSTEM**

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### **DATC SYSTEM**

The Dual Automatic Temperature Control (DATC) climate control system is a compact system that provides a complete selection of driver controlled functions and additional automatic functions. The DATC climate control system was designed by Visteon for the Jaguar S-TYPE. Most of the DATC functions and controls are similar to the existing Jaguar systems.

The DATC system has several features that are completely new:

#### **Dual Zone Temperature Control**

The driver and passenger have independent temperature control selection.

#### **SCP Network**

The A/CCM operates on the SCP (Standard Corporate Protocol) multiplex network. Certain control functions are carried out via SCP.

#### **Voice Control**

An optional Voice Activation Control system allows the driver to adjust temperature control without touching the DATC controls.

#### **Heated windshield wiper park**

All vehicles not equipped with heated windshield are fitted with heated wiper park that operates both automatically and under driver control.

Other DATC construction and operational features are different than those in existing Jaguar climate control systems:

#### **Single blower and housing**

A compact heater, evaporator and blower unit provides all vehicle air flow volume requirements.

#### **Single control module**

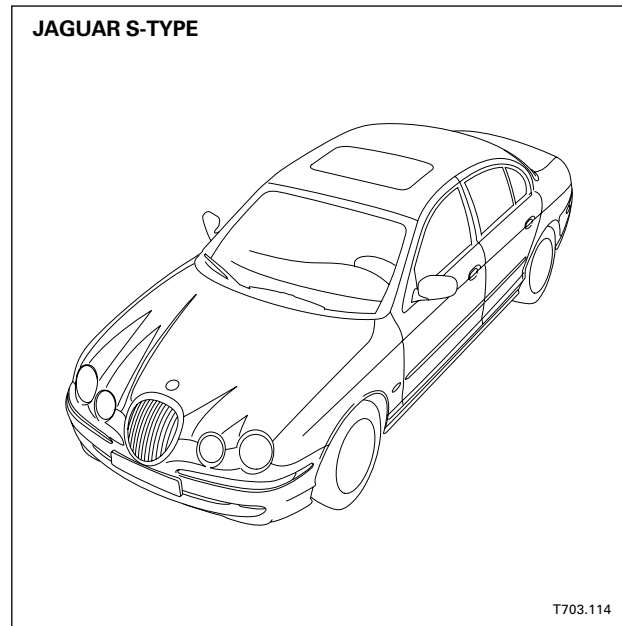
Unlike previous Jaguar systems, the A/CCM and the control panel are combined into one panel mounted control module.

#### **Diagnostics**

All diagnostics are carried out using WDS. No separate "panel diagnostics" are provided.

#### **Scroll type compressor**

A new variable displacement scroll type A/C compressor replaces the previous swash plate type compressor.



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### **NOTES**

### **DATC SYSTEM**

#### **System Components**

- Temperature sensors:
  - Ambient air temperature sensor
  - In-car air temperature sensor
  - Evaporator discharge air temperature
  - LH discharge air temperature
  - RH discharge air temperature
- Blower and blower motor controller
- Evaporator / heater assembly
- Air flow / distribution flaps and actuators:
  - Cold air bypass
  - Fresh / recirculation
  - Defrost
  - Panel
  - Floor
- Dual coolant control valve
- Auxiliary coolant pump (V8)
- Air intake screen and filter
- Air conditioning refrigeration system
  - Scroll type compressor
  - A/C pressure sensor
- Engine cooling system
- Windshield and mirror heaters



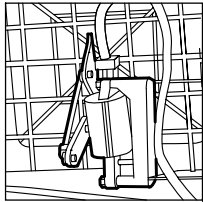
**JAGUAR**

Service Training

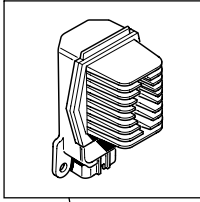
# S-TYPE CLIMATE CONTROL SYSTEM

## DATC SYSTEM COMPONENTS (LHD SHOWN)

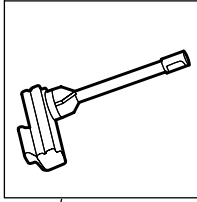
FRESH / RECIRCULATION ACTUATOR



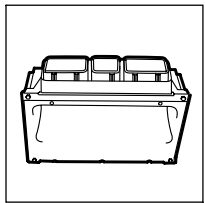
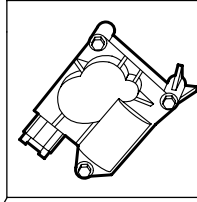
BLOWER MOTOR CONTROLLER



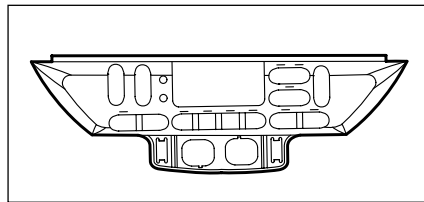
EVAPORATOR DISCHARGE AIR TEMPERATURE SENSOR



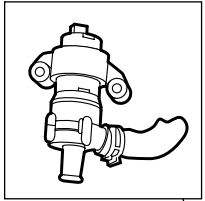
COLD AIR BYPASS ACTUATOR



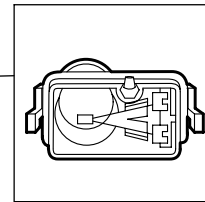
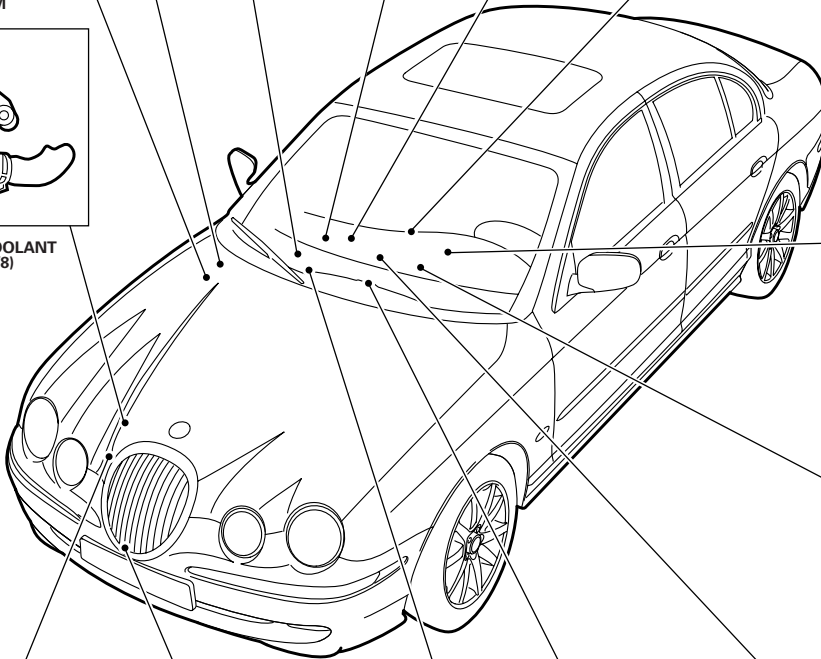
PCM



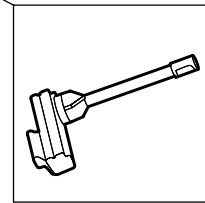
AIR CONDITIONING CONTROL MODULE



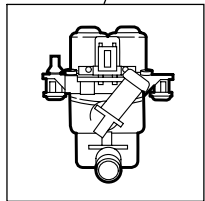
AUXILIARY COOLANT PUMP (V8)



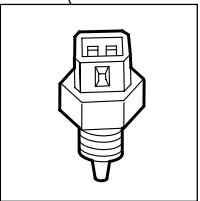
IN-CAR TEMPERATURE SENSOR



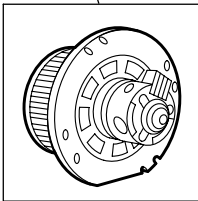
LH DISCHARGE AIR TEMPERATURE SENSOR



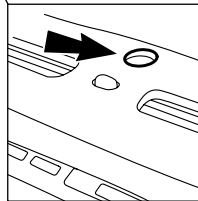
DUAL COOLANT CONTROL VALVE



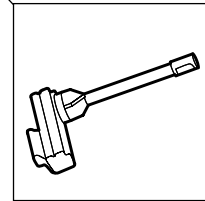
AMBIENT TEMPERATURE SENSOR



BLOWER



DUAL SOLAR SENSOR



RH DISCHARGE AIR TEMPERATURE SENSOR

T703.115

### DATC SYSTEM

#### Air Conditioning Control Module (A/CCM)

The DATC A/CCM is a single module packaged in the center of the fascia. The control module is microprocessor-based, consisting of a bezel assembly (including all buttons and switches), a main control board and a housing for the assembly. Battery direct and ignition switched B+ power is supplied from the primary junction box.

The A/CCM control panel provides the following driver interface controls:

- AUTO mode
- OFF
- Driver and passenger individual temperature adjustment
- Manual fan speed
- Manual A/C control
- RECIRCULATE AIR mode
- DEFROST mode
- Four manual air distribution modes
- Exterior temperature display
- °F / °C selection
- Heated windshield wiper park or optional (standard fit certain markets) heated windshield
- Heated backlight (includes exterior rear view mirrors)

A confirmation chime is emitted from the A/CCM when any control is operated.

#### A/CCM Memory

The A/CCM stores all panel settings and flagged DTCs in volatile memory. If the vehicle battery is disconnected or B+ power is interrupted by fuse removal or disconnection, all panel settings and flagged DTCs will be lost. After B+ reconnection, the panel will be set to OFF. When next switched ON, the panel will assume an average automatic setting (24 °C, 75 °F).

If appropriate, the customer's settings should be recorded before power disconnection and reset before the vehicle is returned to service.

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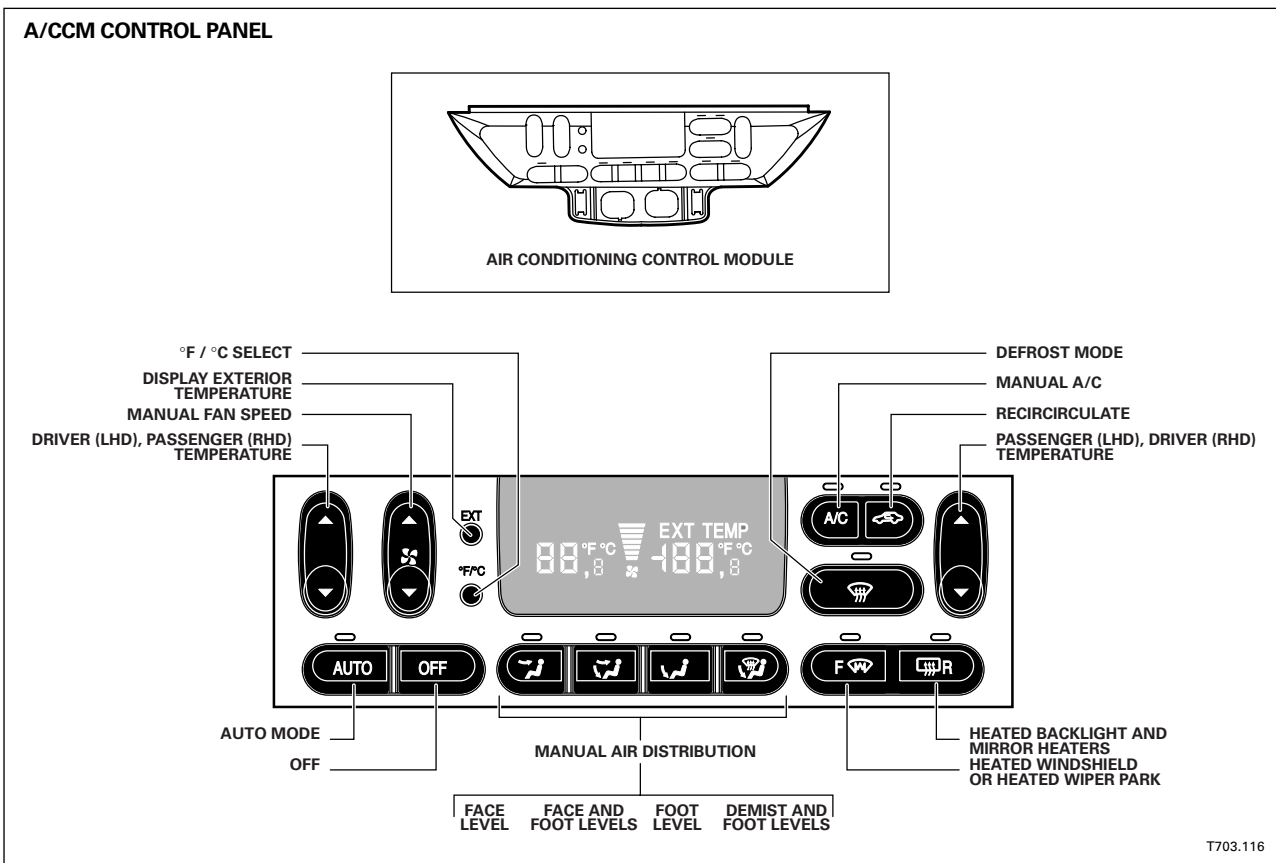
#### NOTES

## A/CCM Replacement

After installation, all replacement A/CCMs must be programmed using WDS, before they are put into service. The absence of the audible chime when the control panel buttons are pressed will alert the technician that the A/CCM requires programming.

The programmable attributes are:

- Heated windshield
- Heated wiper park



## NOTES

### DATC SYSTEM

#### Control Summary

The A/CCM automatically maintains the selected driver and passenger interior temperatures and regulates the volume of airflow between the various system outlets. Separate driver and passenger discharge temperatures are made possible by the heater system that incorporates a partitioned dual zone heater core and dual coolant flow control valve.

#### Air Intake

Depending on the interior temperature when the system is activated, the A/CCM automatically selects between fresh intake air and recirculated cabin air; however, the driver has the option for manually selecting RECIRCULATION / FRESH. If the manual recirculation button is pressed for a short period (one chime), “timed recirculation” is enabled.

Timed recirculation varies with air conditioning compressor status and ambient temperature. If the compressor is off (A/C LED OFF), recirculation will be enabled for 1 to 6 minutes by the A/CCM. If the compressor is on (A/C LED ON), recirculation will be enabled for 1 to 12 minutes by the A/CCM. If the manual recirculation button is pressed for a long period (two chimes), “latched recirculation” is enabled.

All manual recirculation settings are canceled at the next ignition switch cycle.

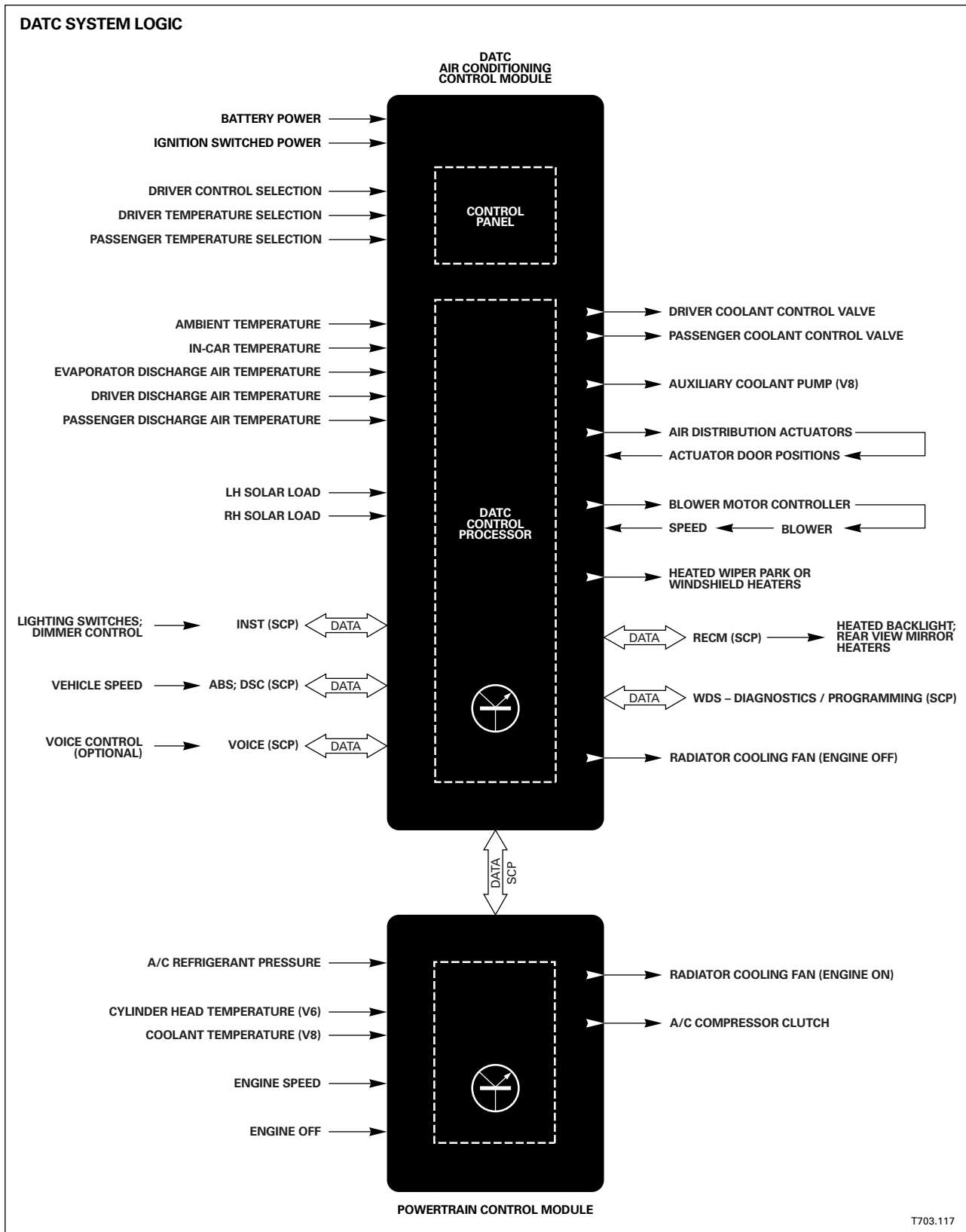
#### Discharge Air Temperature

The A/CCM attempts to provide both the driver and the passenger with their selected air temperature. If both of the selected temperatures cannot be achieved, the system is biased in favor of the driver. The rear seat passengers receive the air temperature selected for the person seated directly in front. Fan speed and air distribution are centrally controlled. Pressing and holding the AUTO button for two seconds equalizes the driver and passenger temperature selections.

A feature unique to V8 vehicles allows interior heating to be continued after the engine has been switched off. With the ignition switch in position II, the climate control system will continue to provide interior heating until the engine cools to a predetermined level (maximum 20 minutes).

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#### NOTES

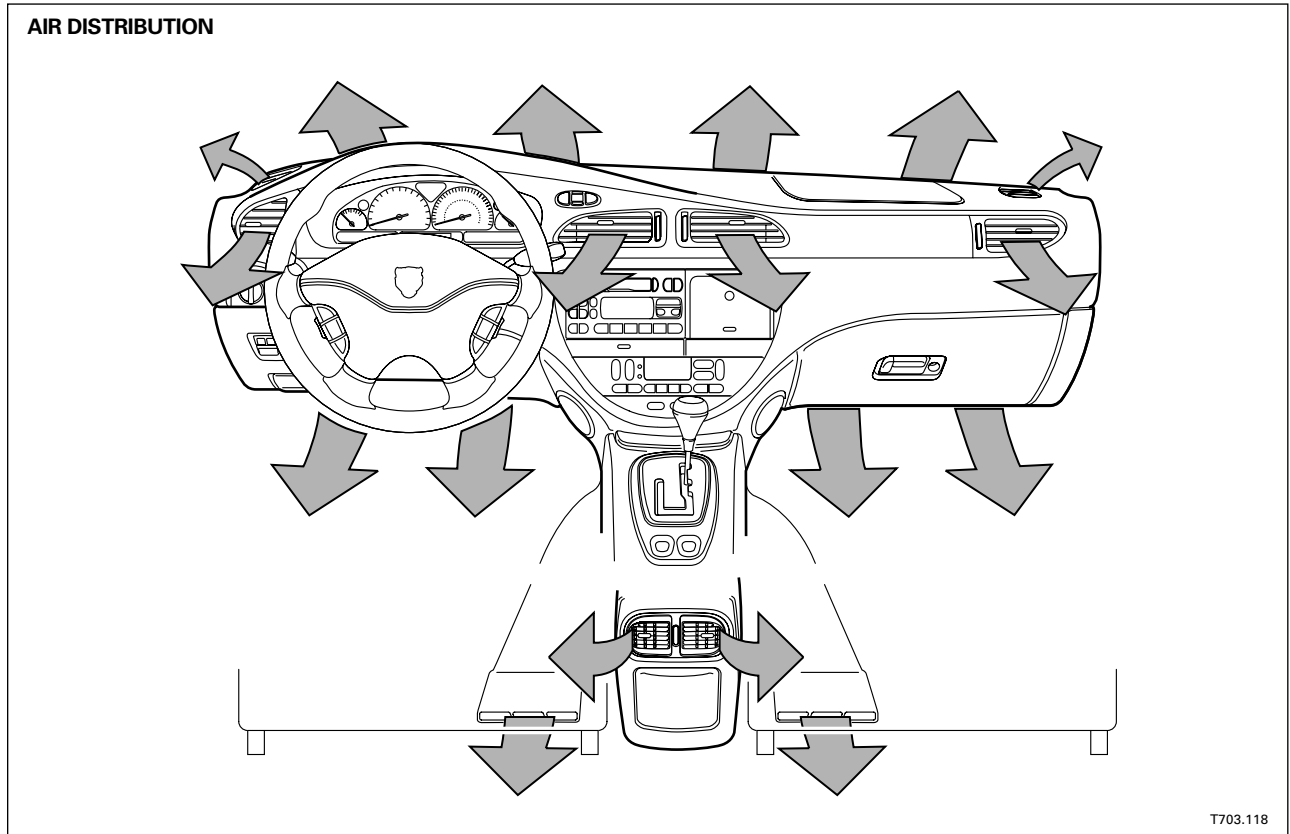


## DATC SYSTEM

### Control Summary (continued)

#### Air Distribution

Air distribution can be controlled automatically or manually. If AUTO is selected, the A/CCM will automatically determine the appropriate air distribution. If the driver wishes to manually control air distribution, the four manual air distributions buttons allow the desired setting.



#### NOTES



## System Details

### Blower Control

The single high output variable speed blower is driven by a Blower Motor Controller located within the blower housing. The controller has an integral high speed relay. The driver has the option of manually selecting one of seven preset blower speeds from the control panel or selecting AUTO to allow the A/CCM to determine the appropriate blower speed.

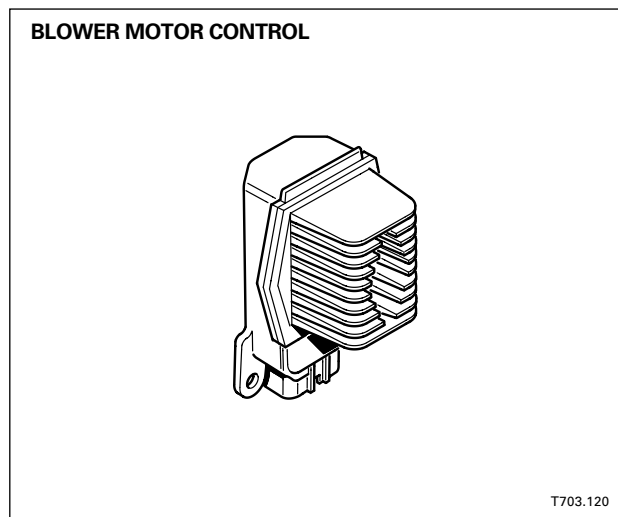
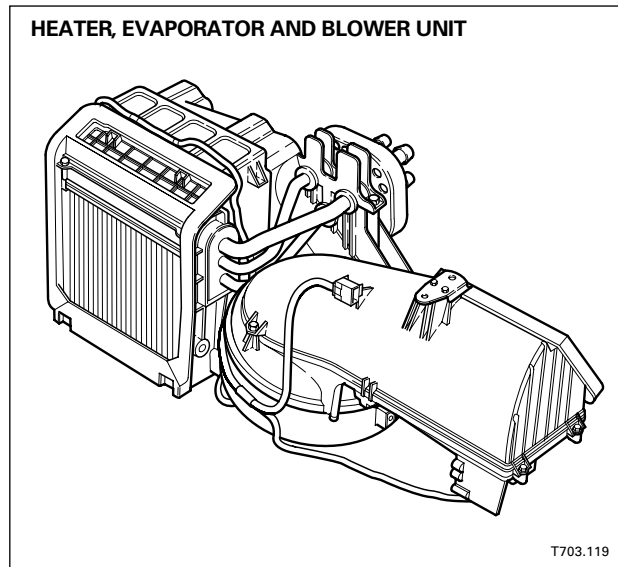
In automatic mode, blower speed is determined as a function of many input variables. Based on the selected in-vehicle temperature, the A/CCM calculates the blower speed from input signals received from system sensors. These include:

- Ambient temperature
- Discharge air temperatures (Driver and Passenger)
- In-car temperature
- LH and RH solar loads

The A/CCM controls the blower motor controller with a pulse width modulated signal. Blower speed is represented by the bar graph on the panel display. One bar is the minimum speed; seven bars is the maximum blower speed.

There are two vehicle conditions that alter normal blower speed control in automatic mode:

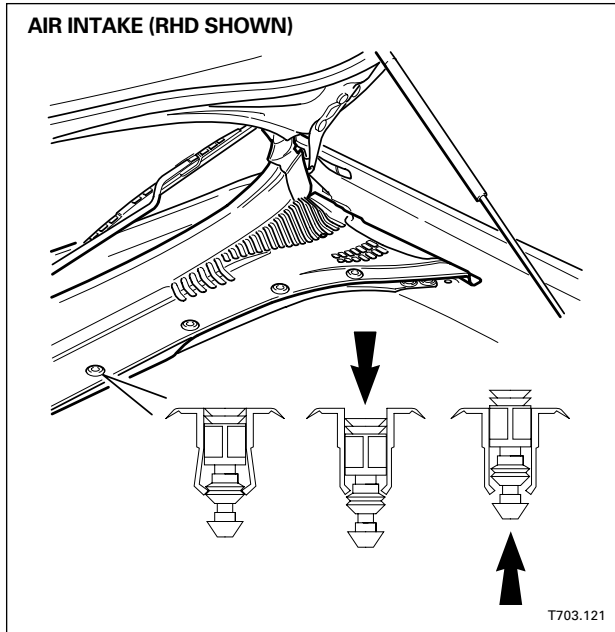
1. Cold ambient temperature; cold engine coolant temperature; cold in-car temperature If the three temperatures occur simultaneously, the DATC system will operate in a special low blower speed / defrost mode until the engine temperature reaches a predetermined level. Once the engine has warmed-up, the blower motor control will revert to the normal automatic mode.
2. At very high vehicle speed, where high “ram air” would normally increase the air flow into the vehicle interior, the A/CCM adjusts the blower speed to maintain the desired air flow.



## NOTES

## DATC SYSTEM

### System Details (continued)



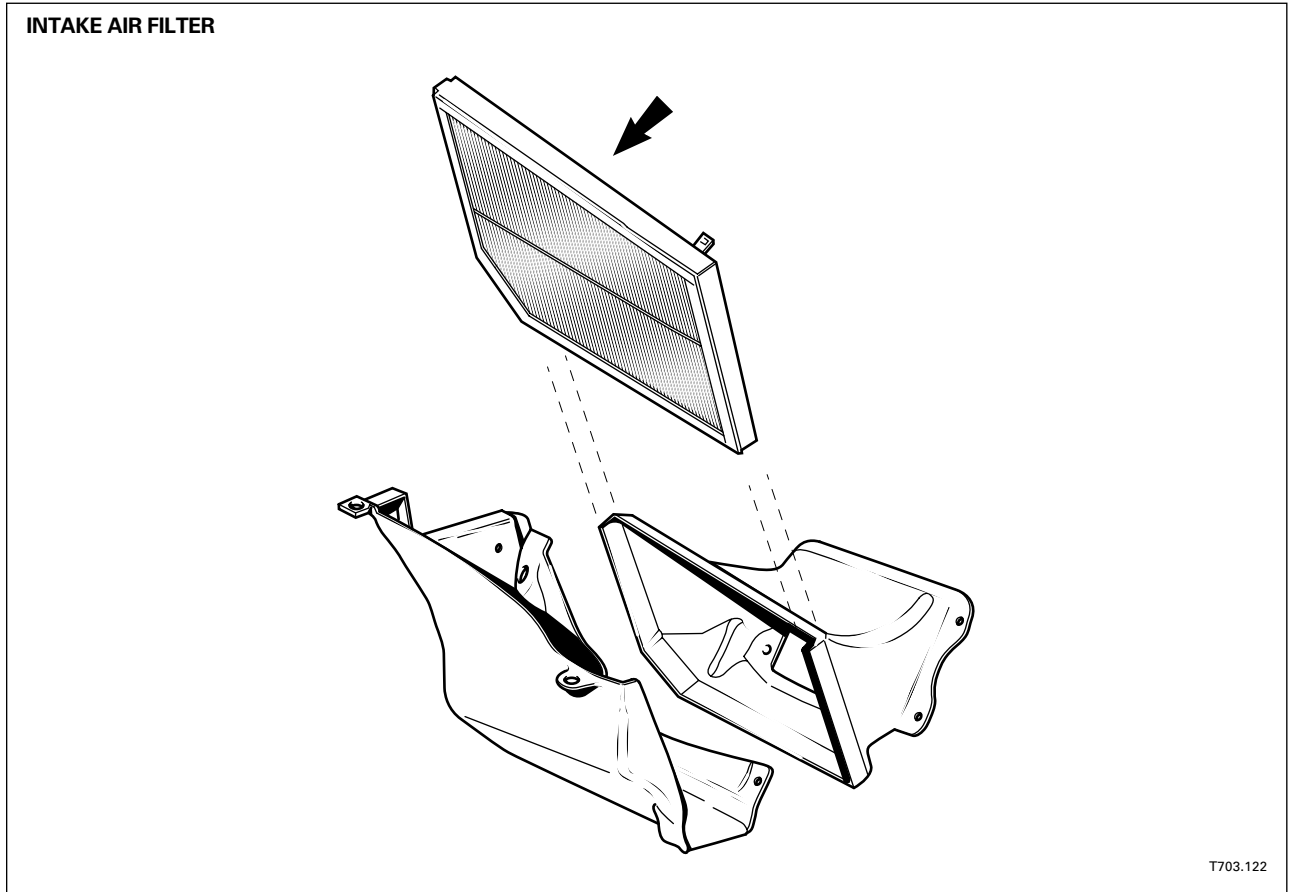
### Climate Control Intake Air

Exterior air enters the system via the grille located at the base of the windshield on the passengers side of the vehicle. The grille can be removed by releasing the integral fasteners.

A serviceable air filter is located in the duct connecting the air intake to the blower housing. On NAS vehicles, the filter should be changed at the 10,000 mile service interval.

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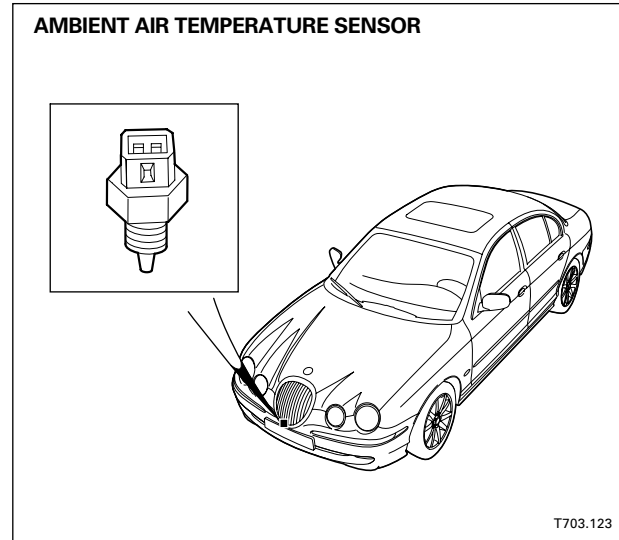
### NOTES



## Ambient Air Temperature Sensor

The ambient air temperature sensor, located at the right hand side of the lower front air intake, is a thermistor, which has a negative temperature coefficient (NTC). Ambient air temperature is determined by the A/CCM by the change in the sensor resistance. The A/CCM applies a fixed voltage (<5 v) to the sensor and monitors the voltage across the pins to detect the varying resistance.

Due to the sensor location and effects of vehicle speed, below 48 km/h (30 mph), the A/CCM modifies the calculated ambient temperature. The displayed panel exterior temperature is derived from the ambient temperature sensor signal. This displayed value only matches the true exterior ambient temperature when the ignition is switched ON while the engine is cold and the vehicle is stationary.

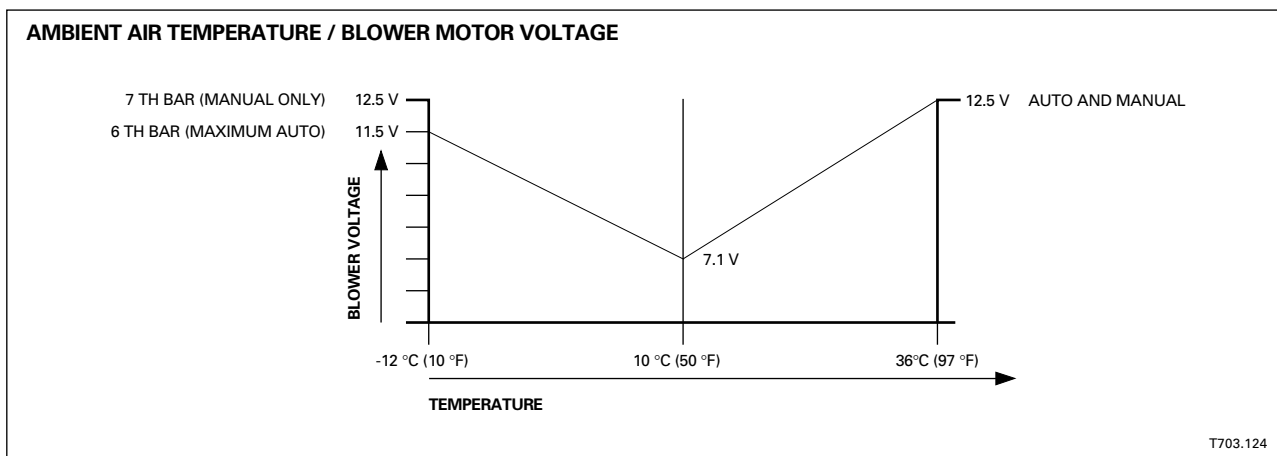


The displayed ambient temperature responds rapidly to lowering ambient temperature, regardless of vehicle speed. The displayed ambient temperature responds slower to increasing ambient temperature at vehicle speed greater than 48 km/h (30 mph). At vehicle speed 48 km/h (30 mph) and less, the displayed ambient temperature response is slowed further. If the ambient temperature sensor signal is lost, the displayed temperature defaults to 10 °C (50 °F).

The A/CCM uses the ambient temperature calculation for a number of control functions:

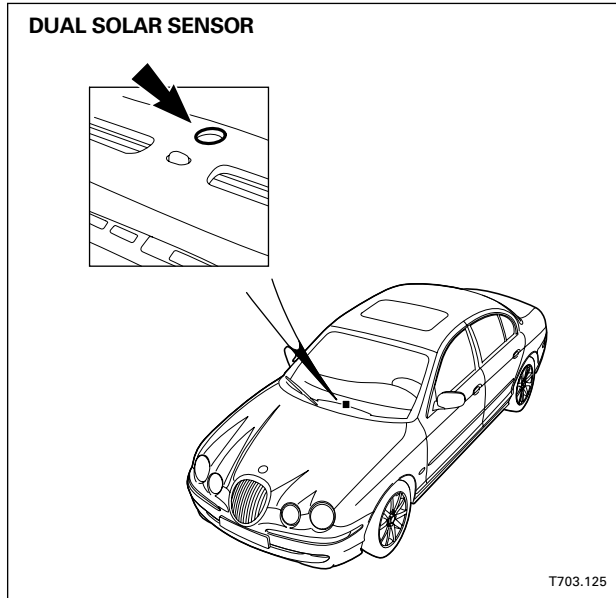
- System control configuration to compensate for intake air temperature
- Panel outside air temperature display
- A/C compressor cancel at temperatures where compressor damage may occur
- Automatic control of windshield, backlight and mirror heaters
- SCP ambient temperature message
- Blower speed adjusted to ambient temperature

The chart shows the relationship of ambient temperature and blower speed.



## DATC SYSTEM

### System Details (continued)



### Dual Solar Sensor

The dual solar sensor, located on the top center of the fascia, contains two light sensitive photodiodes. Each photodiode is positioned to sense solar load only from one side of the vehicle – LH or RH. LH and RH solar load is determined by the A/CCM by the change in sensor circuit voltage. The A/CCM applies a fixed voltage to each sensor photodiode and monitors the voltage to a common sensor reference ground.

The separate LH and RH solar load signals allow the A/CCM to independently trim driver and passenger discharge air temperature to compensate for LH and RH solar load.

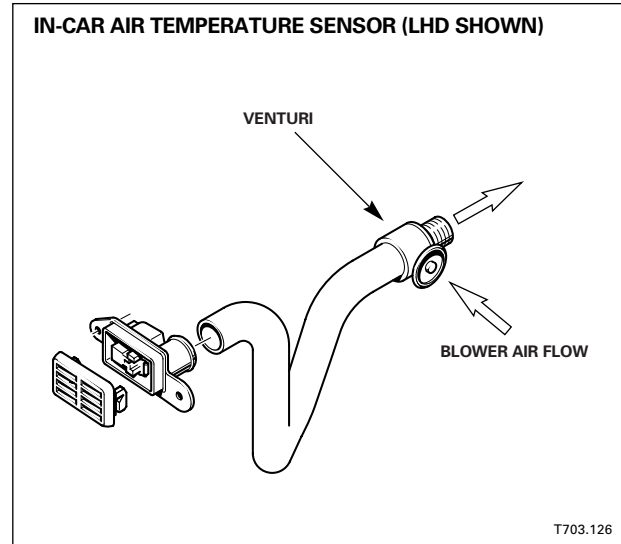
### NOTES

### In-Car Air Temperature Sensor

The in-car air temperature sensor, located in the duct on the fascia, is a thermistor, which has a negative temperature coefficient (NTC). A venturi connected to the plenum chamber causes interior air flow through the duct and over the sensor. In-car air temperature is determined by the A/CCM by the change in the sensor resistance. The A/CCM applies a fixed voltage (<5 v) to the sensor and monitors the voltage across the pins to detect the varying resistance.

The A/CCM uses the in-car temperature calculation for system control configuration to compensate for in-car temperature.

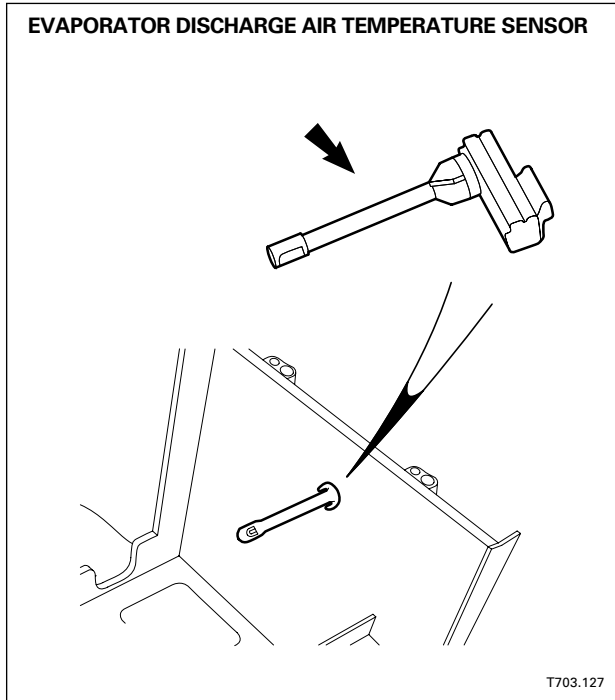
If the A/CCM loses the in-car temperature signal, a default value of 24 °C (75 °F) is substituted.



### NOTES

## DATC SYSTEM

### System Details (continued)



### Evaporator Discharge Air Temperature Sensor

The DATC does not use a direct contact evaporator temperature sensor. Instead, the sensor measures the evaporator discharge air temperature. The evaporator discharge air temperature sensor, located in the left hand side of the central evaporator / heater core matrix, is a thermistor, which has a negative temperature coefficient (NTC). Evaporator discharge air temperature is determined by the A/CCM by the change in the sensor resistance. The A/CCM applies a fixed voltage ( $<5\text{ v}$ ) to the sensor and monitors the voltage across the pins to detect the varying resistance.

The A/CCM uses the evaporator discharge air temperature calculation to cycle the air conditioning compressor to maintain the evaporator discharge temperature at just over  $0\text{ }^{\circ}\text{C}$  ( $32\text{ }^{\circ}\text{F}$ ). Actual compressor clutch control is provided by the PCM.

If the A/CCM loses the evaporator discharge air temperature signal, a default value of  $-4\text{ }^{\circ}\text{C}$  ( $25\text{ }^{\circ}\text{F}$ ) is substituted and air conditioning compressor operation is canceled.

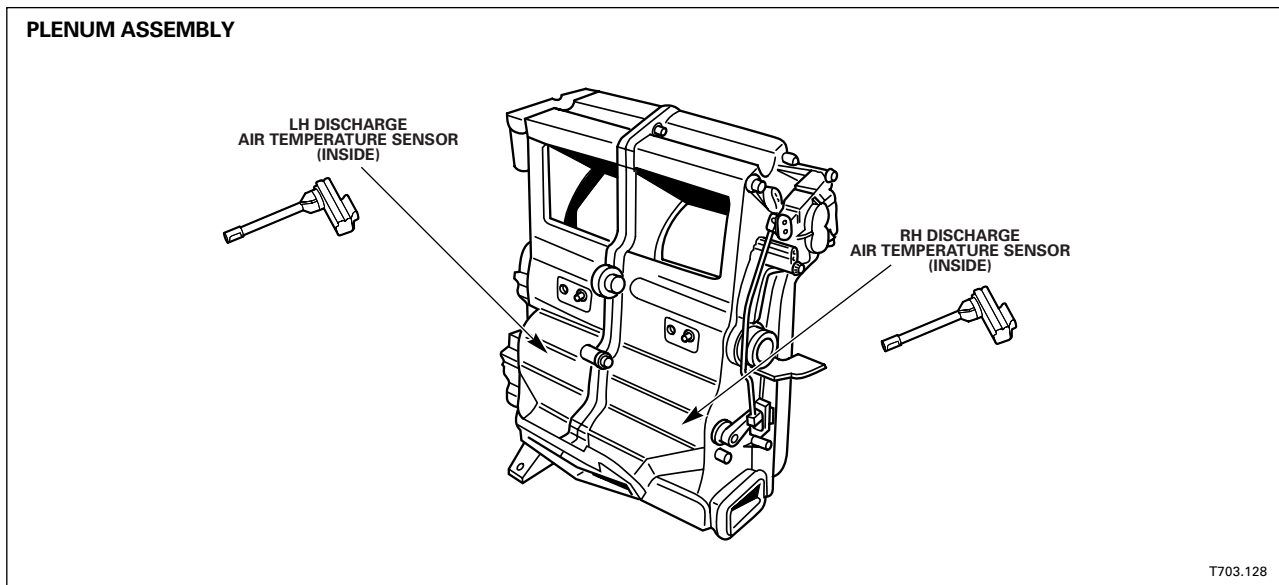
## NOTES

## Discharge Air Temperature Sensors

The left and right hand discharge air temperature sensors, located within the LH and RH air discharge ducts in the central air distribution plenum, are thermistors, which have a negative temperature coefficient (NTC). Discharge air temperature is determined by the A/CCM by the change in the sensor resistance. The A/CCM applies a fixed voltage (<5v) to the sensor and monitors the voltage across the pins to detect the varying resistance.

The A/CCM uses the LH and RH discharge air temperature calculations to determine control of the dual coolant control valve. Control of this valve allows the system to provide individual discharge air temperature to the driver and front passenger.

If the A/CCM loses a discharge air temperature signal, a default value of 24 °C (75 °F) is substituted.



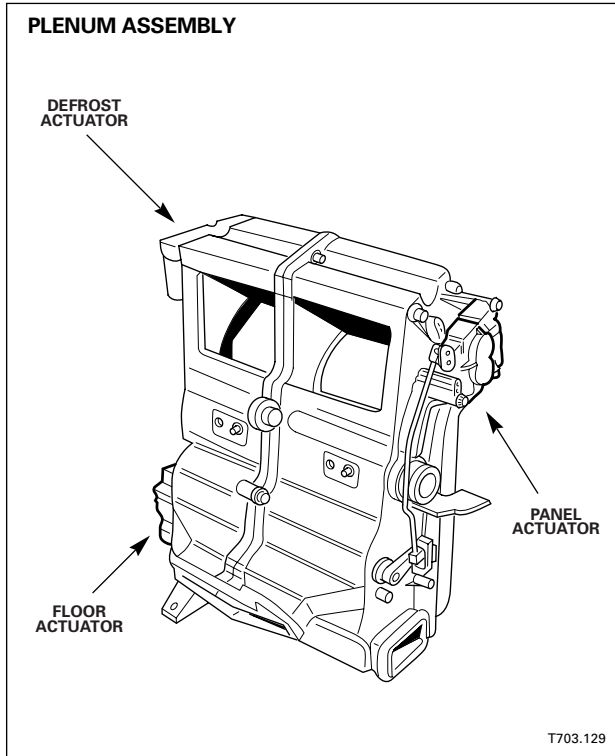
## NOTES



## S-TYPE CLIMATE CONTROL SYSTEM

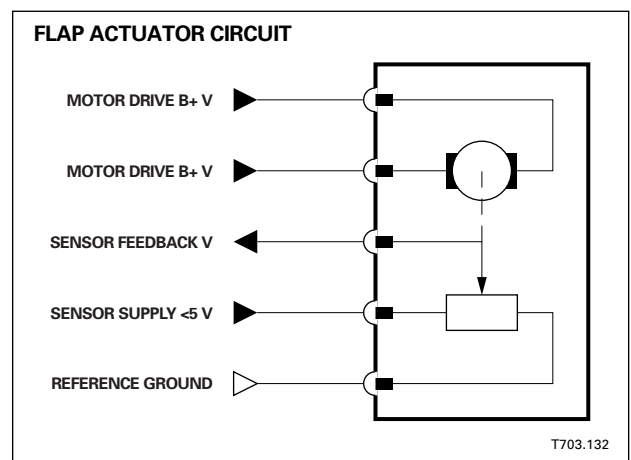
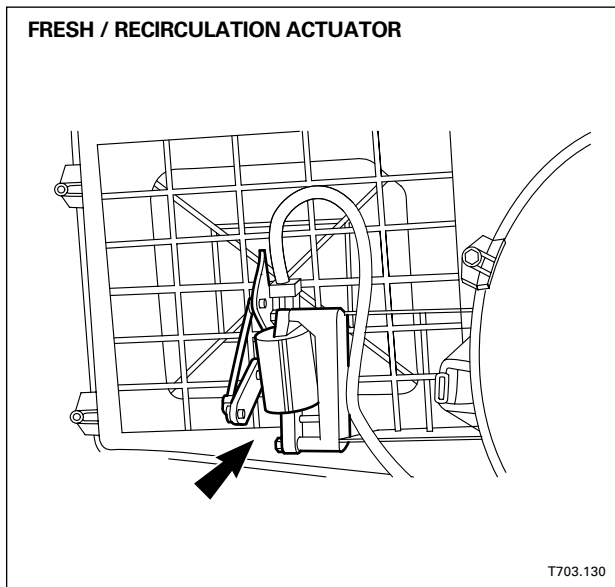
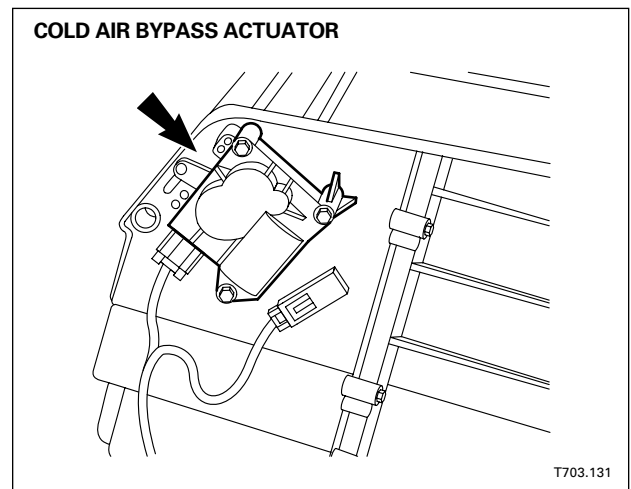
### DATC SYSTEM

#### System Details (continued)



#### Flap Actuators

There are five flap actuators, which are positioned by the A/CCM to achieve the desired discharge air flow for the selected DATC operating mode. The actuators have flap positioning motors driven by the A/CCM with integral position feedback potentiometers. The A/CCM uses the position feedback potentiometer signal to calculate actual flap position. The flaps move between open and close in approximately 5 to 6 seconds. Two minutes after the ignition is switched off, the flaps are moved to their parked positions.



#### NOTES



## Dual Coolant Control Valve

The dual coolant control valve, located behind the right hand headlamp, contains two solenoid operated valves that are actuated by the A/CCM to achieve the driver and passenger selected temperatures. The A/CCM, using pulse width modulated (PWM) low (ground) side drives, positions the valves to control engine coolant flow through the partitioned dual zone (driver / passenger) heater core. Battery voltage (12 v minimum) is required to close the valves so that if electrical circuit failure occurs, the valves will remain open and allow full coolant flow to the heater core.

Control of the two valves of the dual coolant control valve is phased 180° apart to reduce the risk of “water hammer” being generated in the supply of coolant to the valve, and to reduce the chance of the valves internal mechanical movement being heard within the cabin.

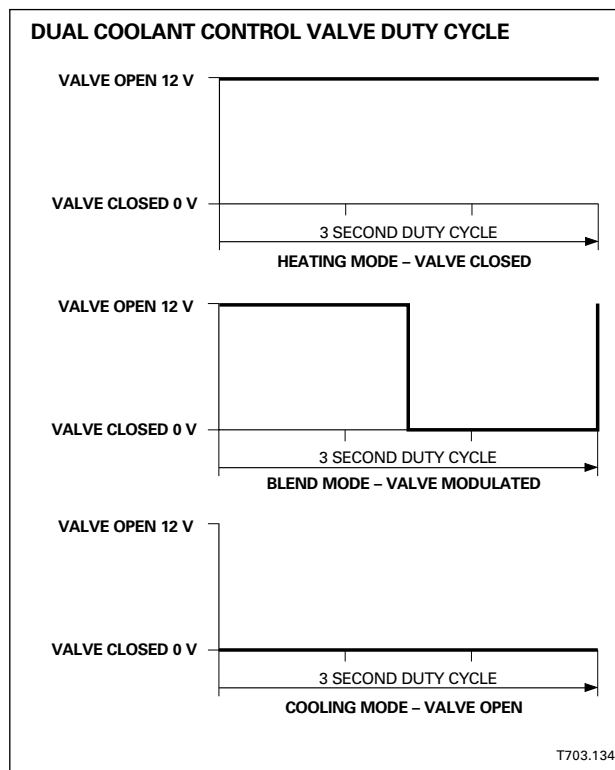
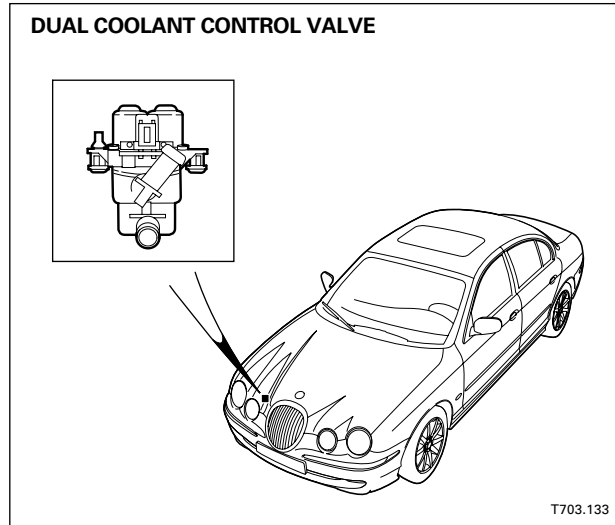
After the ignition is switched OFF, the valves are driven to the closed position for 5 minutes to prevent “hot flush” in the heater core if the vehicle is switched back on.

The hose connections to the dual coolant control valve are color coded to prevent incorrect assembly.

The valve coil resistance is 15 Ω at 20 °C (68 °F).

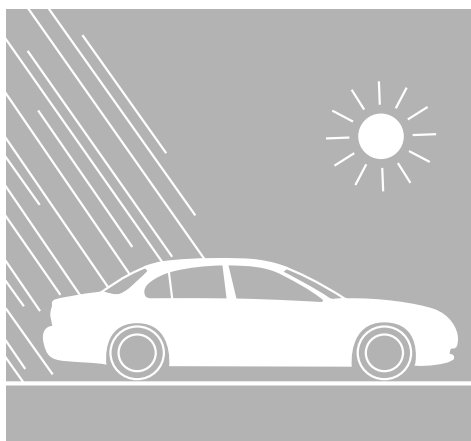
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### NOTES

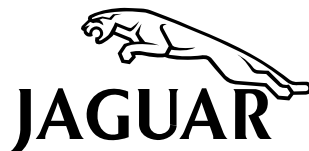




# *JAGUAR CLIMATE CONTROL SYSTEMS*



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### WINDSHIELD, BACKLIGHT AND REAR VIEW MIRROR HEATERS

**NOTE:** All glass heaters operate only while the engine is running. System (battery) voltage must be above a predetermined level for heater operation

#### Heated Windshield; Heated Windshield Wiper Park

Vehicles are fitted with either heated windshield wiper park or heated windshields. Heated windshields have two (LH and RH) heating elements with two control and activation circuits. Heated wiper park windshields have one heating element in the wiper park area. The heated wiper control and activation circuit is the same circuit used for the RH windshield heater. The circuits incorporate relays located in the front power distribution box.

#### Heated Windshield Control

The A/CCM activates the windshield heaters for a four-minute time period when either heated windshield or defrost is selected on the control panel. If low battery voltage is sensed by the A/CCM, the windshield heaters will be disabled. If defrost is selected, then the ignition switched OFF / ON, heated windshield will be disabled.

#### Heated Wiper Park Control

The A/CCM activates heated wiper park either automatically or manually.

- If the ambient temperature is below 4 °C (40 °F) at engine start, the A/CCM will automatically activate heated wiper park.
- If while engine operating, the ambient temperature falls below 1 °C (34 °F), the A/CCM will automatically activate heated wiper park, provided it did not activate previously during the ignition cycle.
- As long as the ambient temperature remains at or below 5 °C (41 °F), heated wiper park operates; however, the voltage threshold for disengagement moves up after the first ten minute period.
- If while heater operating, the ambient temperature rises above 5 °C (41 °F), the A/CCM will automatically disengage heated wiper park.
- If heated wiper park is disengaged manually, automatic engagement is disabled until the next ignition cycle.
- If heated wiper park is manually engaged or disengaged, then the ignition switched OFF, the selection will be stored in memory for ten minutes in case of restart.

#### Heated Backlight and Rear View Mirrors

The heated backlight and mirror heaters operate simultaneously and are directly controlled by the rear electronic control module (RECM) upon receipt of a SCP heaters ON request from the A/CCM. The heater circuit incorporates a relay located in the rear power distribution box.

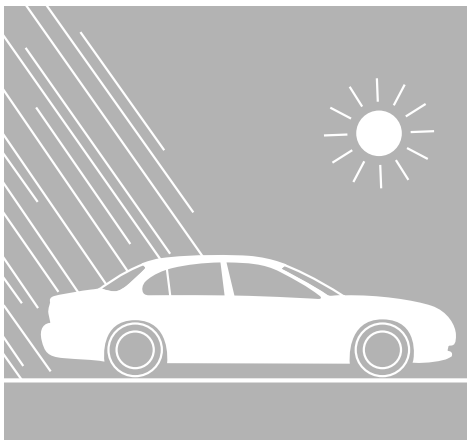
#### Heated Backlight and Rear View Mirrors Control

The A/CCM activates the heaters either automatically or manually using the same inputs and control as the heated wiper park.

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#### NOTES

# *JAGUAR CLIMATE CONTROL SYSTEMS*



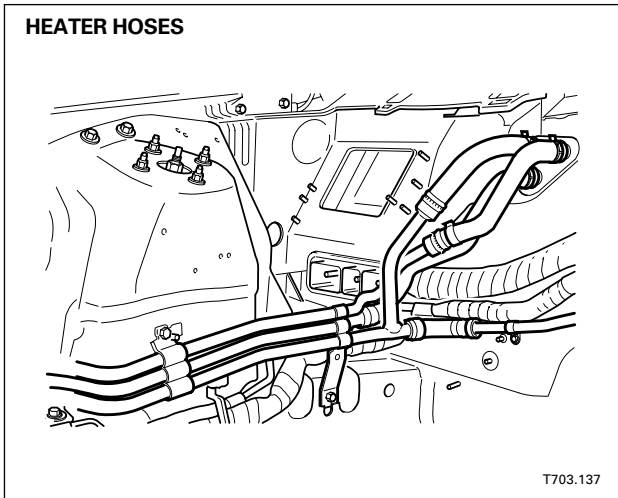
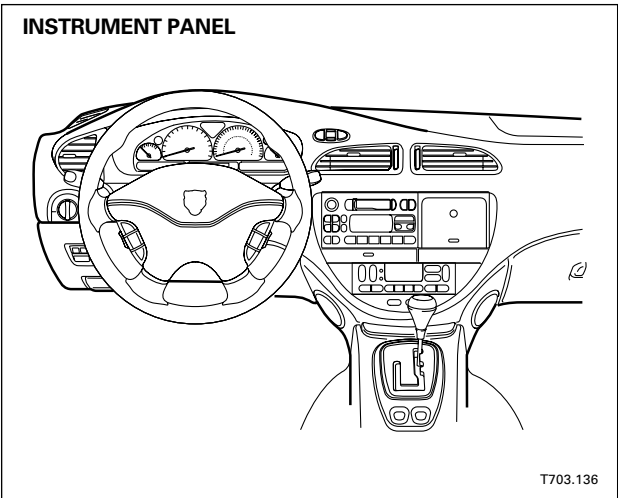
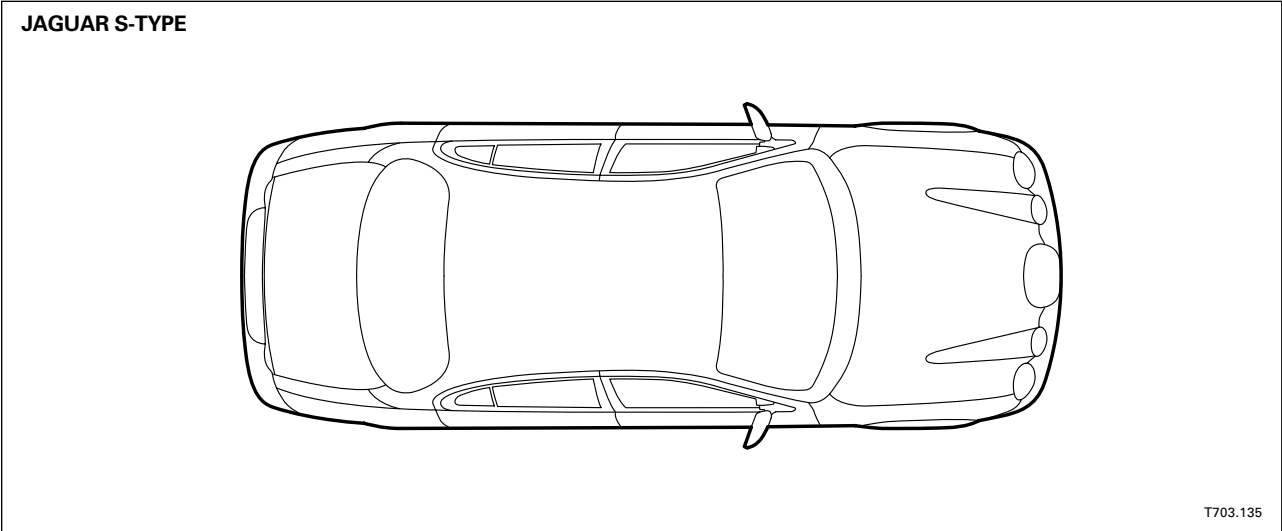
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## TASK SHEET 1 – DATC COMPONENT LOCATION

Find the following components on the vehicle. Write the component number on the appropriate illustration to record its location.

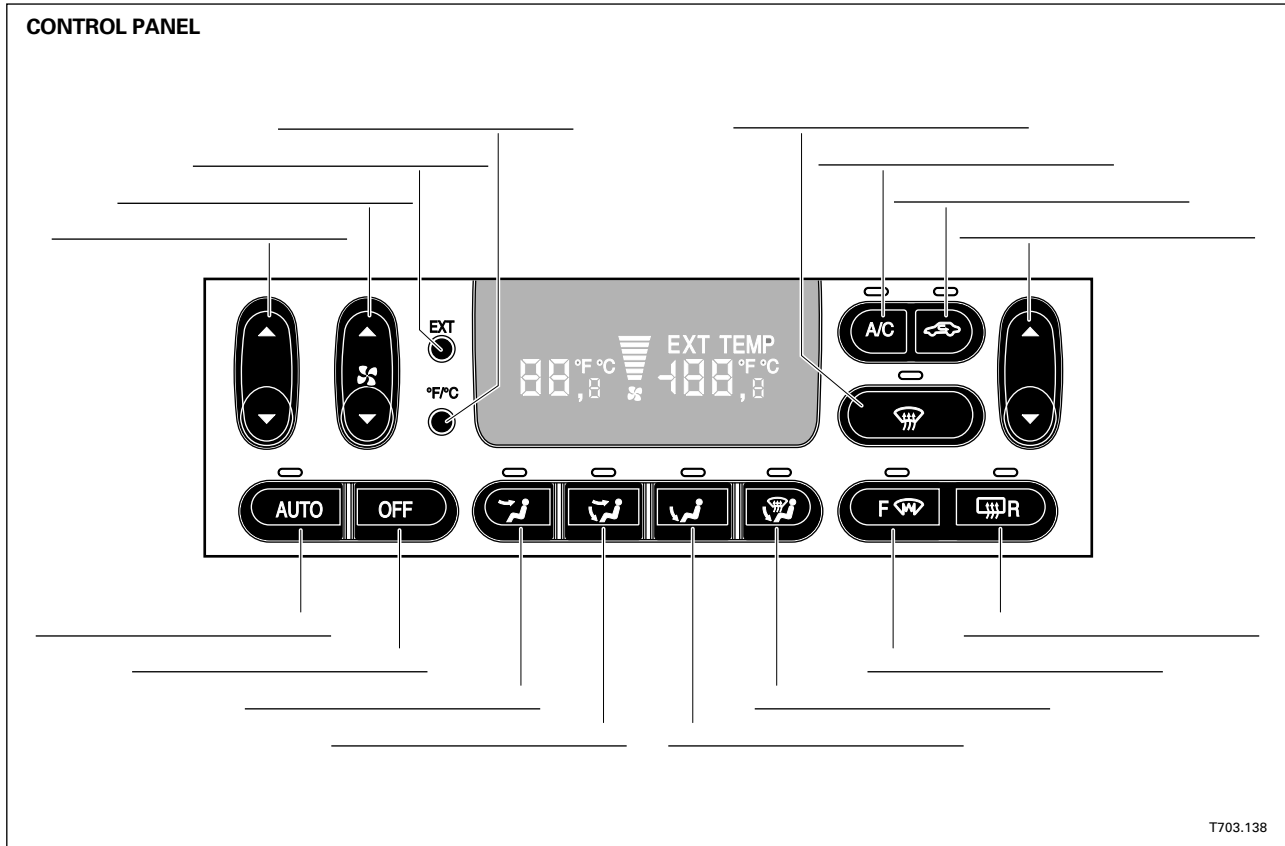
1. A/CCM control module
2. In-car temperature sensor
3. Dual solar sensor
4. Auxiliary coolant pump (V8)
5. Dual coolant control valve.  
How many hoses attach to this valve?  
\_\_\_\_\_
6. Return heater hose
7. High side refrigerant service port. What must be removed to access the high side port?  
\_\_\_\_\_



Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

TASK SHEET 2 – CONTROL PANEL FUNCTIONS

1. Indicate the functions performed by each of the panel controls



2. List two ways to achieve system balance between the passenger and driver side temperatures

\_\_\_\_\_

\_\_\_\_\_

3. What is the maximum temperature differential between the driver and passenger temperature selections?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 3 – WDS DATALOGGER EXERCISE**

1. Use the WDS Datalogger function to monitor 5 different signals from the A/CCM. Record the acronym, description, and value of each signal.

Acronym	Description	Signal

2. Identify the location of the refrigeration high side service port:

\_\_\_\_\_

3. Why must the refrigeration system be charged only through the high side service port?

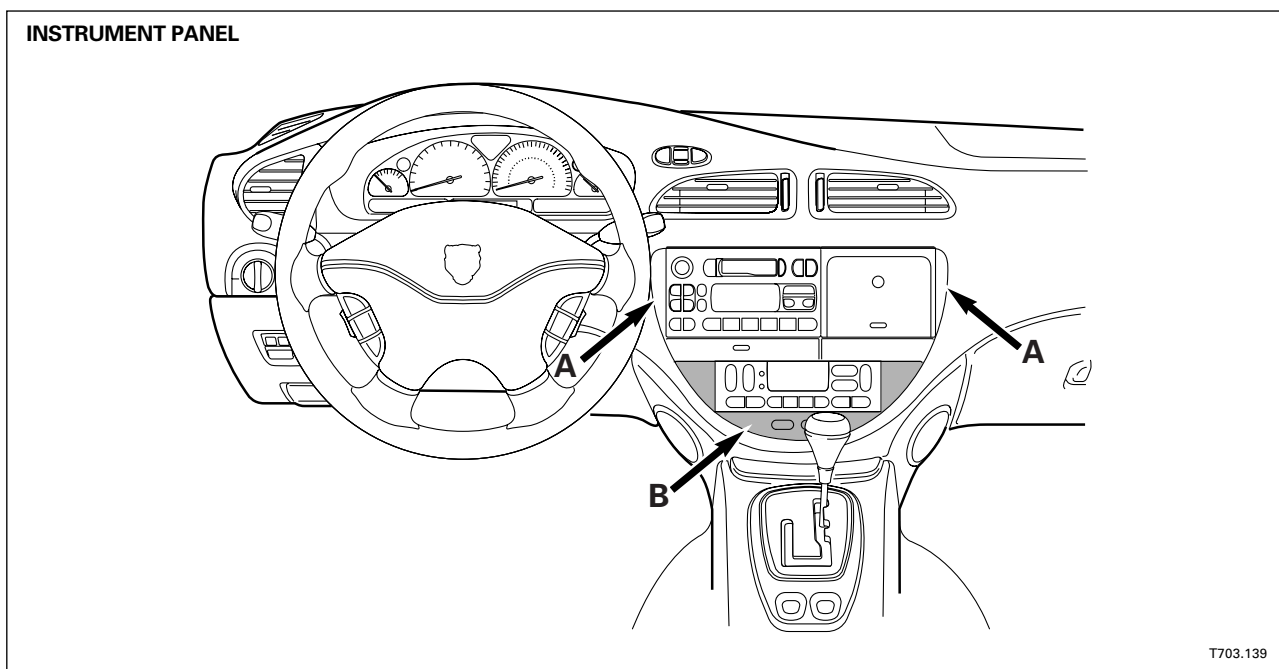
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Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_



## TASK SHEET 4 – REMOVE AND INSTALL A/CCM / CONTROL PANEL ASSEMBLY

1. Apply the parking brake
2. Move the gear selector lever to position D
3. Close the cup holder
4. Disconnect the battery ground cable
5. Cover and protect the console and gear selector assembly



6. Carefully snap out the triangular shaped trim pieces (A) at each side of the control panel
7. Carefully snap out the 'half moon' shaped trim piece (B) at the bottom of the control panel
8. Remove the four 8 mm bolts
9. Remove the harness connectors from the A/CCM / control panel assembly
10. Have your Instructor inspect the removed assembly

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 5 – S-TYPE TEMPERATURE DEMAND**

Complete the following exercise using WDS.

**Manual Mode: Full Cold Temperature Demand**

Datalogger Selection: Potentiometer (flap)	Control Panel Selections				
	Face	Face/Foot	Foot	Defrost/Foot	Defrost
Defrost					
Floor					
Panel					
Fresh Recirc					
Cold Air Bypass					

**Manual Mode: Full Hot Temperature Demand**

Datalogger Selection: Potentiometer (flap)	Control Panel Selections				
	Face	Face/Foot	Foot	Defrost/Foot	Defrost
Defrost					
Floor					
Panel					
Fresh Recirc					
Cold Air Bypass					

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 6 – S-TYPE TEMPERATURE SENSORS**

Use the Wiring Diagrams and the Student Guide to fill in the table below. When the table is complete, go to the assigned vehicle and locate the sensors.

Sensor Name	Temperature / Voltage Range (Wiring Data Page)	Pin / Wire Data (at A/CCM)	Default Temperature (Student Guide)	Location on Vehicle

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

## TASK SHEET 7 – S-TYPE AMBIENT TEMPERATURE SENSOR

Using WDS Datalogger and the assigned vehicle, perform the following task and record the results.

Materials: S-TYPE; hair dryer or heat gun

1. Run the Datalogger while observing the selections.
2. Apply heat with the hair dryer or heat gun to the ambient sensor. If using a heat gun, use care not to melt anything.
3. Record and compare the readings to the actual control panel changes.

Datalogger Selections	Readings without heat applied to sensor	Readings with heat applied to sensor
External temperature sensor Unfiltered data 2		
External temperature sensor Filtered data 2		
<b>Control Panel Displayed Temperature</b>		

Which reading matches the control panel displayed temperature?

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How is the ambient temperature calculated in relation to wheel speed?

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Why?

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Under what driving conditions will the ambient temperature displayed not match the actual outside temperature?

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Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 8 – S-TYPE COOLANT CONTROL VALVE**

Use WDS to complete this Task Sheet.

- 1. From the “Content Model” screen, open “Climate Control System” to the second level menu. Highlight, but do not open, “Air Conditioning”.
- 2. Select “Guided Diagnostics” from the top of the screen.
- 3. From the menu displayed, highlight “Heating System” and press the tick.
- 4. From the menu displayed, highlight “Coolant Control Valves” and press the tick. Follow the instructions displayed on the screen.
- 5. When the test is completed, press the “Vehicle Selector” tab at the top of the screen.
- 6. Press the “Log Viewer” tab at the bottom left of the screen.

How did WDS determine the status of the Coolant Control Valve operation?

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Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_



# *JAGUAR CLIMATE CONTROL SYSTEMS*



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### **OVERVIEW**

As on the S-TYPE, the air conditioning system fitted to the X-TYPE uses mostly Visteon-made electrical components. For the North American market, there are two versions of the electronic automatic temperature control (EATC) system:

- EATC – Telematics version
- EATC – Non-Telematics version

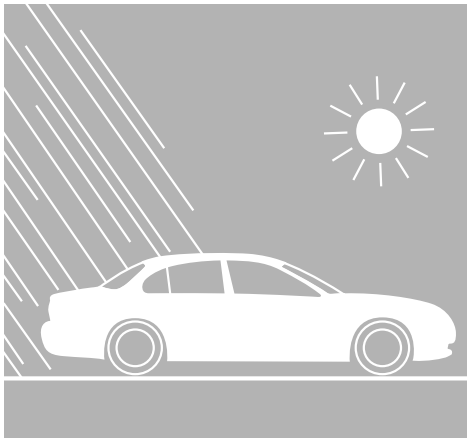
The basics of the refrigeration system remain the same as on previous systems except for the refrigerant control, which is handled by an orifice tube and a suction accumulator, which are used instead of the expansion valve and receiver/drier as on XJ/ XK and S-TYPE models.

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### **NOTES**



# *JAGUAR CLIMATE CONTROL SYSTEMS*



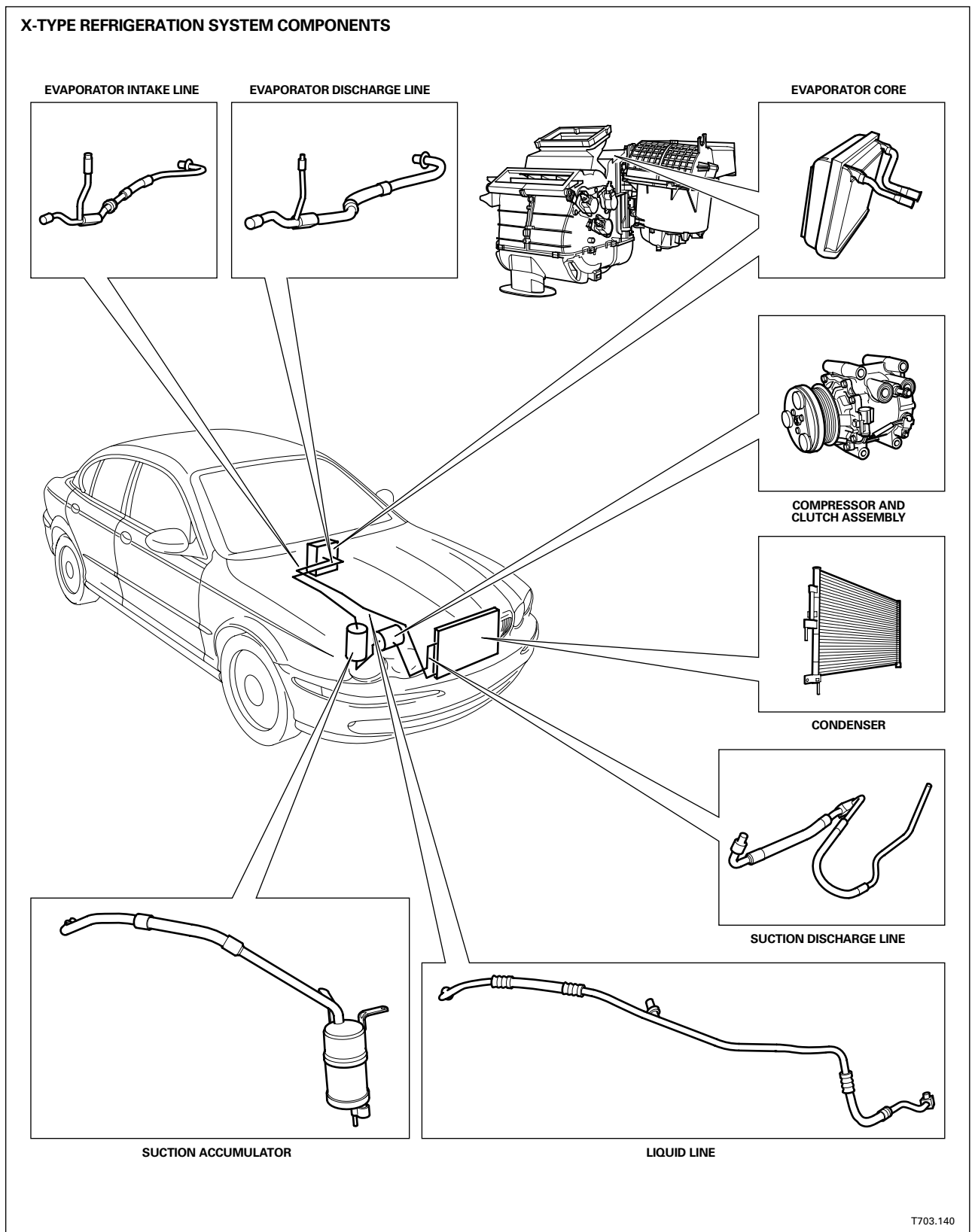
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## X-TYPE CLIMATE CONTROL SYSTEM

### REFRIGERATION SYSTEM



T703.140

## Compressor

To raise the pressure of the R134a refrigerant gas, a 90 cc scroll-type variable capacity compressor is employed. This compressor is a carry-over unit from the S-TYPE system.

The compressor is controlled by the engine management system (EMS); it is mounted to the lower RHS of the engine bay and rigidly mounted to the engine.

The unit has a variable capacity via an internal valve, which can bypass volume through the compressor when required. The compressor output varies from 100% to 30% depending on refrigerant demand; the variation is governed by the internal valve within the compressor housing.

The compressor clutch air gap is adjustable.

The compressor has protection in the form of a pressure relief valve and a sensing element for over-temperature conditions.

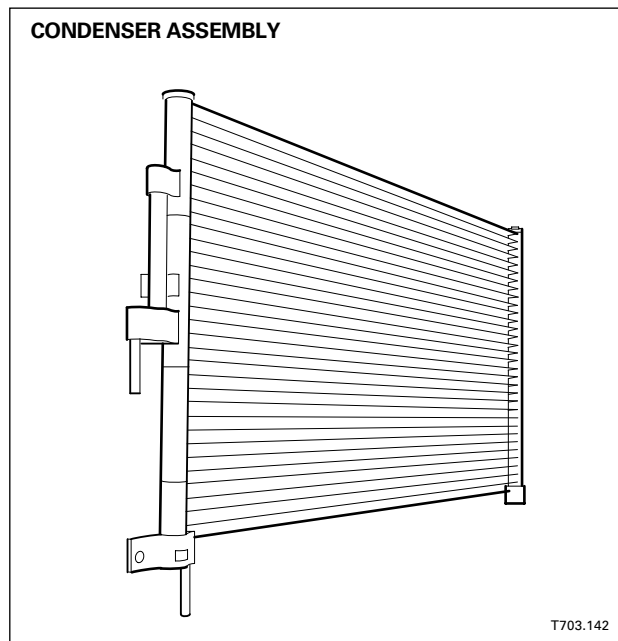
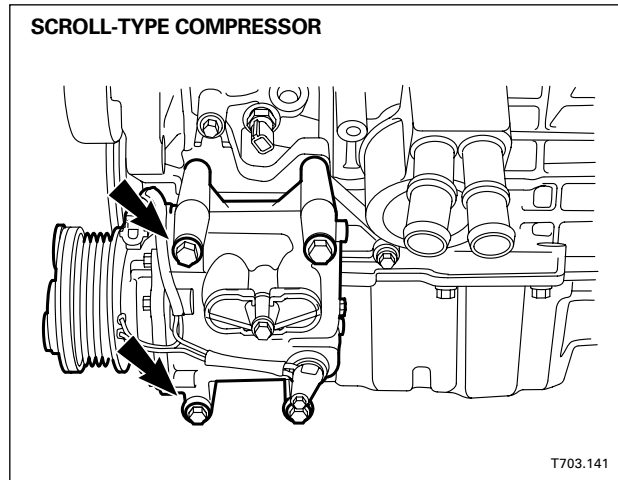
The compressor oil fill quantity is 220 cc; however, the system quantity is 290 cc.

## Condenser

The 16 mm multipass condenser is used to change the state of the refrigerant from gas to liquid, and it is mounted in front of the radiator cooling pack module. A multipass condenser was chosen because it has a much higher performance capacity than a single pass unit.

Two top slots locate the upper part of the condenser, while the lower part is secured by two fixings. Removal of the condenser is from below the front of the vehicle, once the two fixings and connection hoses have been removed.

Automatic transmission models will require that the transmission fluid cooler be moved to one side to allow the condenser to drop down.

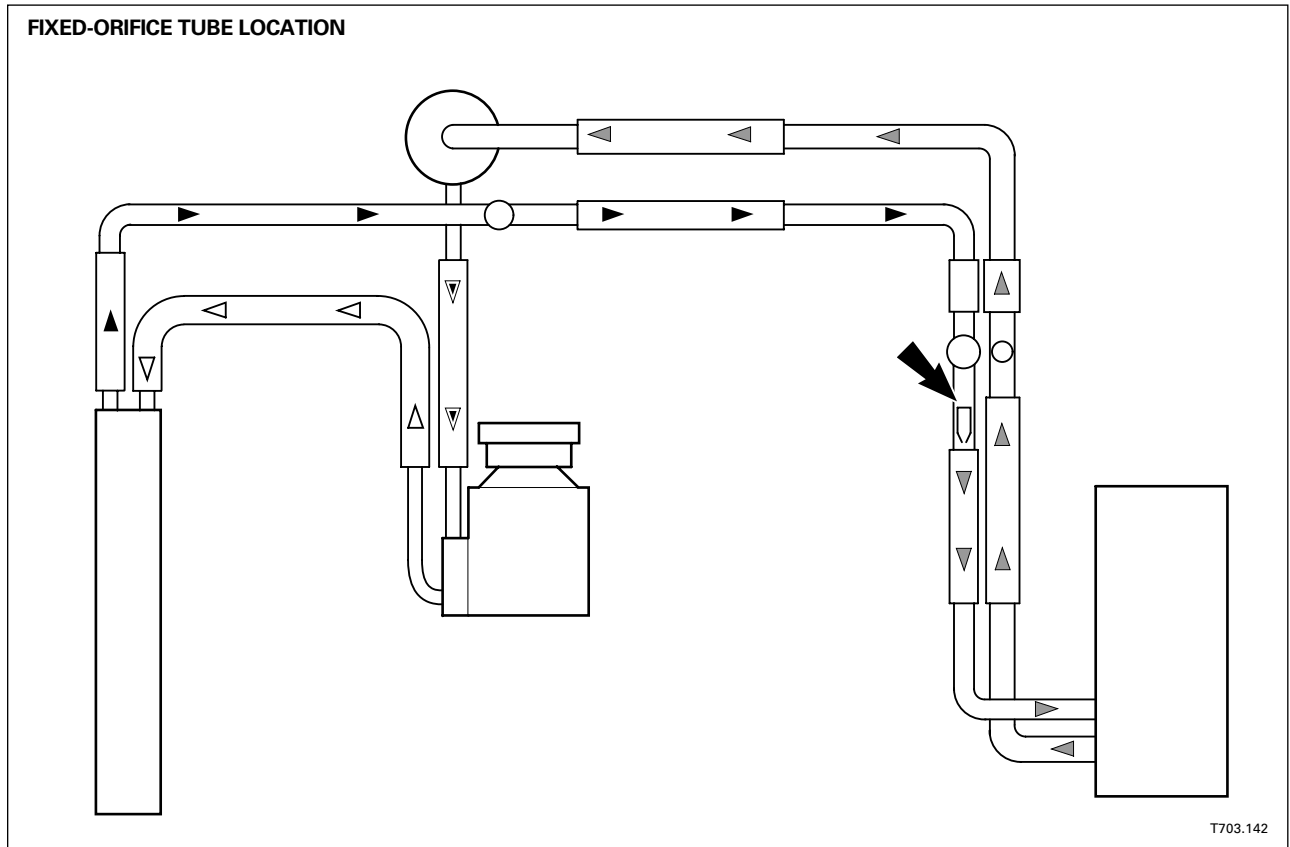


## NOTES

## REFRIGERATION SYSTEM

### Fixed-Orifice Tube

The unit is located inside the evaporator inlet pipe and mounted towards the right-hand side of the engine bay bulk-head, as viewed from the driver's seat position. The unit is color coded to identify the flow rate; the X-TYPE uses an orange color coded unit for this climate control system. The fixed-orifice tube is a simplified device which replaces the thermostatic expansion valve.



For vehicles in service, a special tool is required for the removal and installation of the fixed-orifice tube to the evaporator inlet pipe. For installation purposes, there is an arrow to show the direction of refrigerant flow. This indication is important to the operation of the system, as the device has different filter elements; the long filter is used for debris collection. However, the second shorter filter of the two is used to atomize the refrigerant as it enters the evaporator.

The special tool, 412-034\*, ensures the correct installation of the unit, and it is also used for extracting the tube assembly. If the tube breaks during extraction, then a second special tool, 412-035\*, is used for the removal of the remaining broken piece.

\* This tool allocation may change, as it is easy enough to extract the fixed-orifice tube using a pair of pointed-nose pliers.

A tool can be purchased from Snap On should one be required.

### Refrigerant Flow Control

The refrigerant is metered by sending the evaporator sensor signal to the climate control module and then on to the engine management system. This signal allows the engine control module (ECM) to cycle the compressor clutch in and out as dictated by the evaporator temperature. The overall effect is control of refrigerant flow through the evaporator.

Refrigeration system behavior is, in principle at least, the same as it would be for an expansion valve system.

### Fixed-Orifice Tube Operation

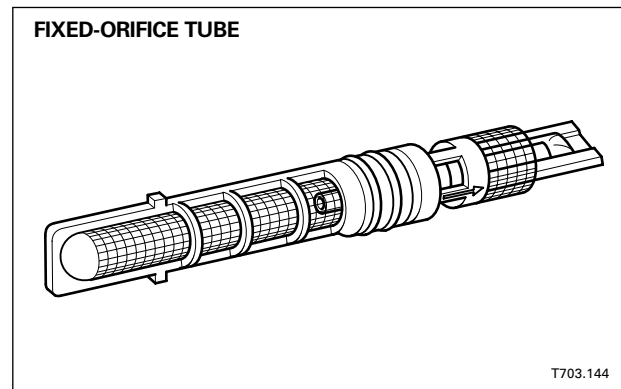
The clutch-cycling fixed-orifice tube system allows the compressed liquid to expand by metering the liquid into the low pressure area of the evaporator.

The low pressure is created by the restriction of the fixed-orifice tube and the suction of the scroll type compressor.

The liquid begins to change state by transferring from a high pressure liquid into a low pressure gas more or less immediately after it leaves the fixed-orifice tube.

Converted vapor now in this lower pressure environment continues to flow through the evaporator matrix, taking on the heat from the surrounding air flowing over the matrix fins. Heat from the incoming air is absorbed into the liquid, causing the liquid to boil.

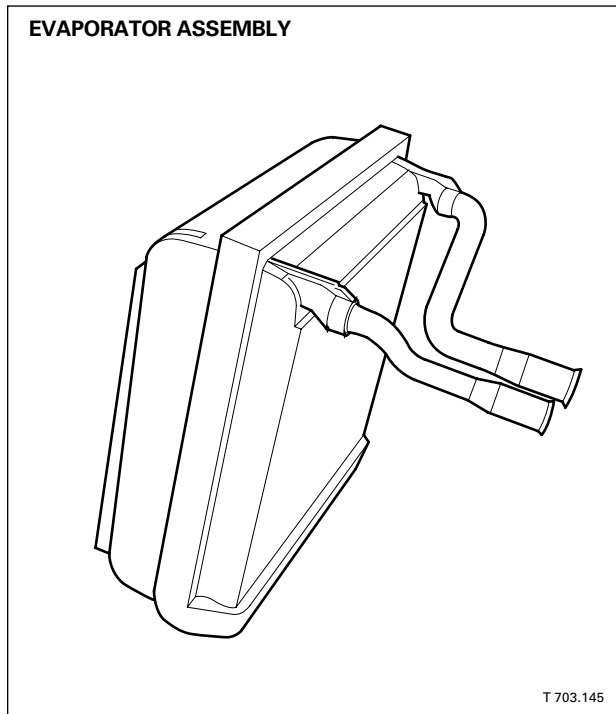
The liquid gradually changes its state into a vapor. Because the process has used the heat from the surrounding incoming air, cold air is left to enter the cabin area for cooling requirements.



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### NOTES

## REFRIGERATION SYSTEM



### Evaporator Assembly

The evaporator is mounted within the passenger compartment and is combined with the heater matrix unit into a single housing. The housing also contains the blend control flaps. The outer RHS panel of the housing is the location where the stepper motor servo actuators are fitted to drive the flaps to the desired positions.

Removal of the evaporator requires removal of the fascia; however, the heater unit can be removed with the housing and fascia left in position.

Items such as the stepper servo motors, which control the panel / floor, defrost, and temperature blend flaps, can be accessed via removal of the glove box.

The functionality of the evaporator remains the same as in previous refrigeration systems; that is, it uses the incoming air temperature to vaporize the refrigerant. The heat used during the conversion process boils the liquid refrigerant to a gas state and allows the air with the heat removed to enter the passenger cell.

Because the evaporator also removes moisture from the incoming air, this moisture is drained away via a tube that leads out beneath the vehicle. Therefore, while the air conditioning system is functioning, water may be seen emitting from the drain tube and forming a puddle beneath the vehicle.

If any moisture remains held on the evaporator matrix fins and the evaporator is cooled down too much, the evaporator matrix will freeze over, causing an air passage problem. To overcome this eventuality, an evaporator temperature sensor is employed, which terminates the compressor clutch action at a given threshold.

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### NOTES

## Suction Accumulator

The suction accumulator is located under the right-hand front wheel arch liner and secured by two fixings.

The purpose of the suction accumulator is to ensure that only refrigerant gas, and not liquid, is passed to the compressor.

The suction accumulator is connected to the low pressure side of the refrigeration system.

The functions of suction accumulators are similar to those of the receiver drier unit; they include:

- Moisture removal
- Storage (larger volume)
- Filtration system

The operation of the suction accumulator is as follows:

The scroll type compressor draws the refrigerant through the outlet pipe of the accumulator.

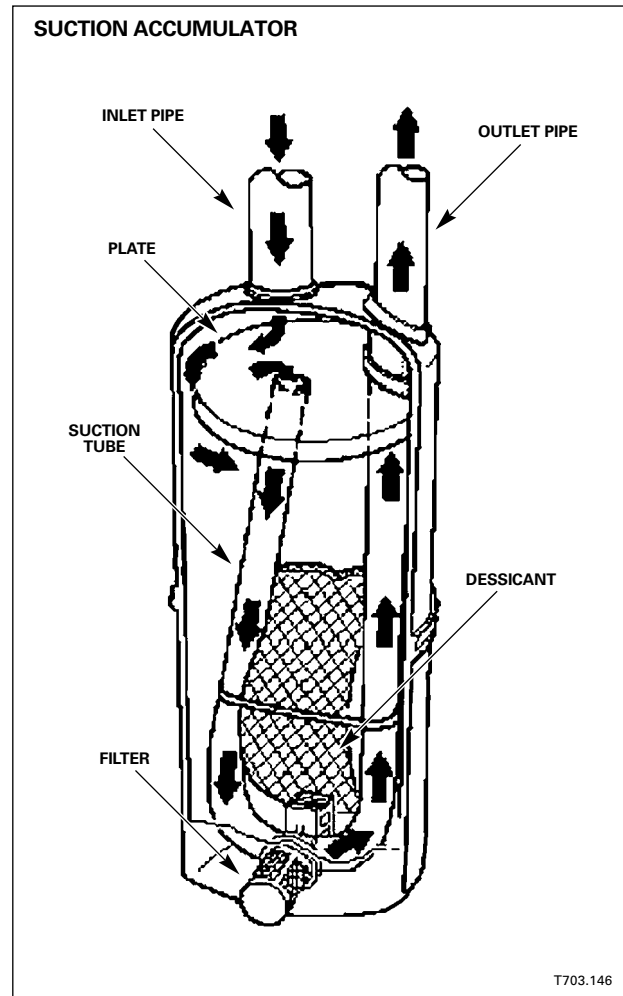
Returning refrigerant from the evaporator is drawn into the suction accumulator via the inlet pipe and flows over a plate inside the accumulator.

The accumulator volume ensures that the refrigerant is fully vaporized before the gas rises to the top of the assembly and that it is drawn through a tube by the suction action of the compressor via the outlet pipe.

At the lower point of the tube is a filter that allows a small amount of oil to enter from the lowest point of the suction accumulator and mix with the returning gas for compressor lubrication.

Moisture is removed from the refrigerant by a sachet of desiccant.

The accumulator is larger than its expansion valve counterpart to counteract refrigeration overcharging and to provide the area for oil separation.



## NOTES

### REFRIGERATION SYSTEM

#### Pipes and Hoses

Four main hose assemblies connect the refrigeration system together:

1. Suction and discharge – This assembly connects the compressor to the suction accumulator and the condenser.
2. Liquid line – This assembly connects the condenser to the evaporator. This pipe runs under the RHS wheel arch behind the plastic trim and can be identified by the inclusion of a pressure transducer fitted to the high pressure pipe.
  - The pressure transducer is used to control over pressure in the high side of the refrigeration system.
  - This control is achieved by the engine management control module (ECM) disengaging the compressor clutch at a given pressure threshold.
  - The transducer signal is hardwired to the ECM and then passed on to the climate control module using the CAN bus for the final control of the cooling fan speed.
  - The final requested demand speed of the cooling fans is then sent back to the ECM over the CAN bus so that the ECM can forward the processed signal to the cooling fan's speed regulator. The cooling fan regulator then PWM the two cooling fan motors.
3. Evaporator inlet – This assembly connects to the liquid line and runs along the engine bay bulkhead.
  - The fixed-orifice tube is fitted into this pipe; the short end of the fixed-orifice tube butts up against a shoulder swaged in the pipe towards the evaporator.
4. Evaporator outlet – This assembly runs parallel to the evaporator inlet pipe along the engine bay bulkhead and connects to the suction accumulator assembly under the RHS wheel arch.

#### Refrigerant Charging

System charging occurs via the two pipes that run along the engine bay bulkhead – the evaporator inlet and outlet. Both of these pipes have service ports that can be utilized when recharging the system. Both pipes are secured with quick-fit connectors at the evaporator inlet and outlet ports, with both connections having a secondary slip or collar for added security.

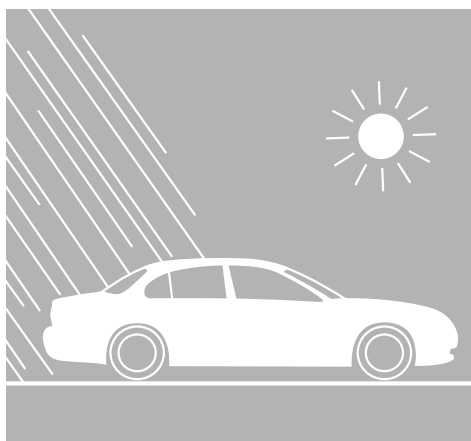
Service tools are available to decouple the spring-locked connections. These tools are common to the S-TYPE refrigeration system.

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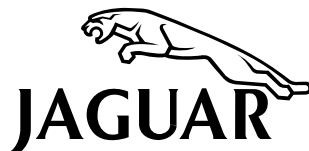
#### NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



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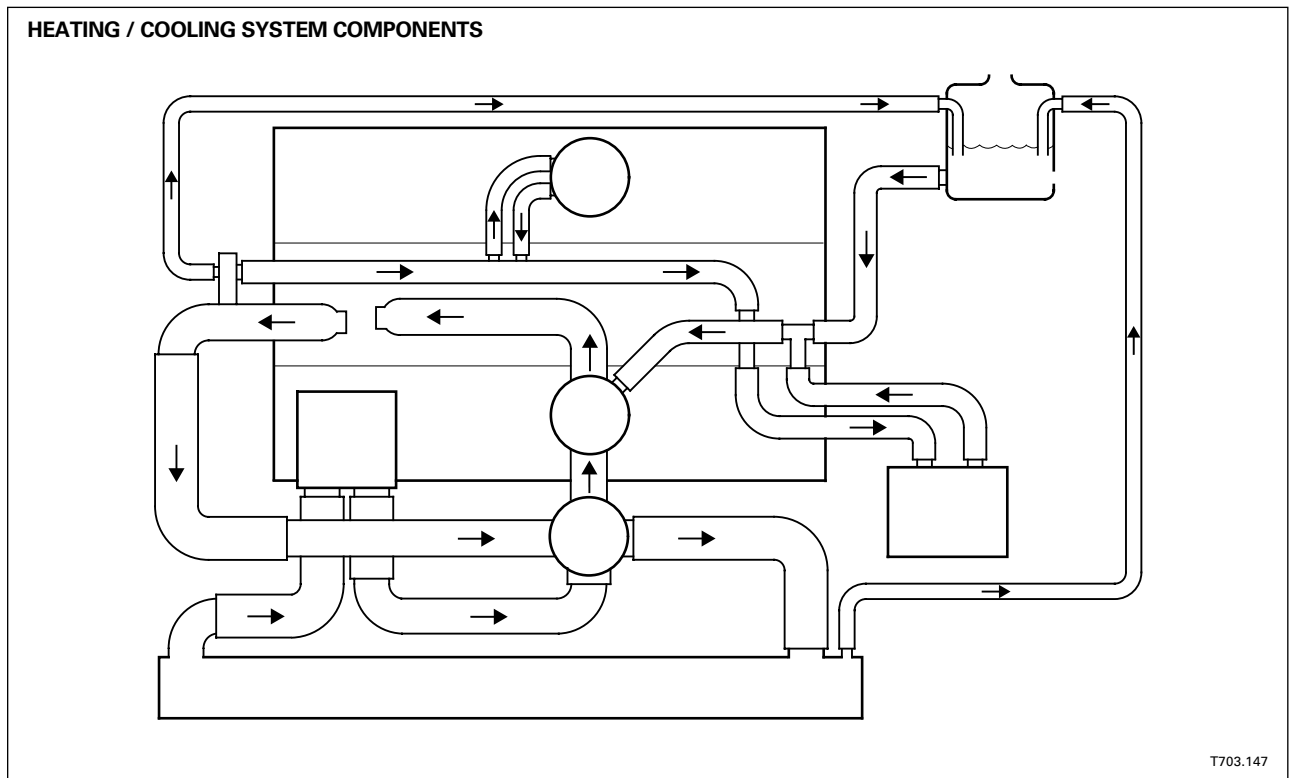


## HEATING / COOLING SYSTEM

### Overview

The system includes the following components:

- Water pump
- Hoses
- Radiator
- Cooling fans
- Thermostat
- Reservoir
- Antifreeze
- Distilled water



### NOTES

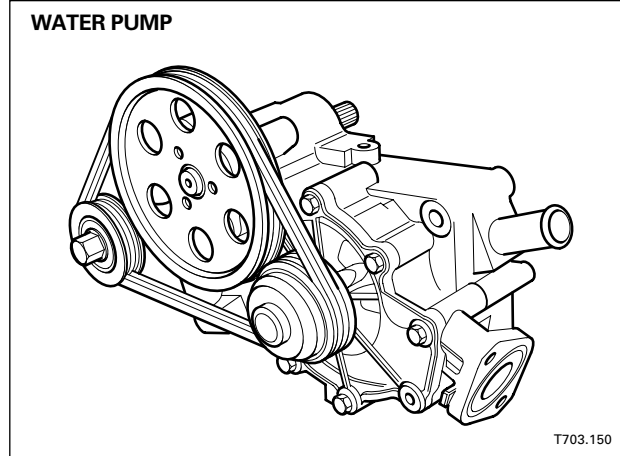
## Components

### Water Pump

The water pump is mounted on the rear of the left-hand bank cylinder head and is driven off the exhaust camshaft.

The drive belt is not adjustable. It has a service change schedule at 112,000 km (70,000 miles).

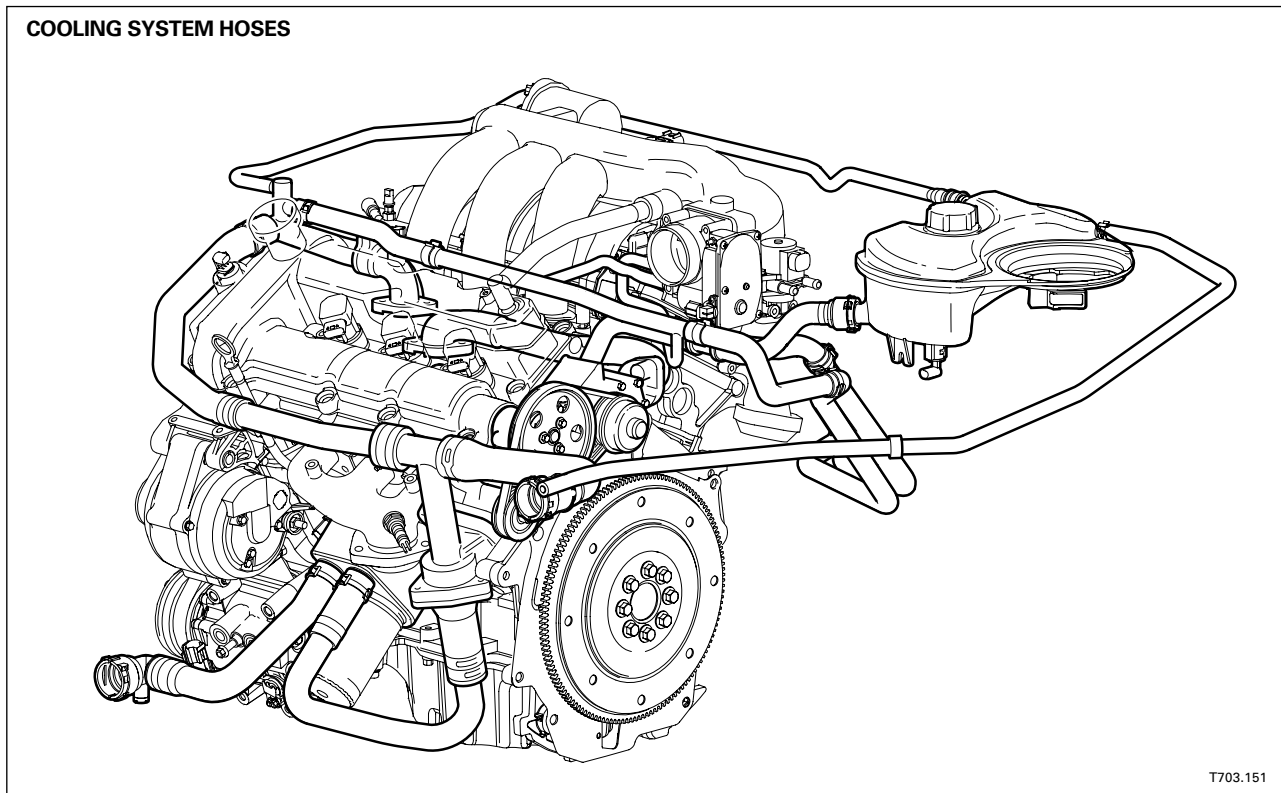
The exhaust camshaft is used to ensure that no interference occurs with the VVT operation.



### Hoses

Most hoses have a quick-fit connector of one type or another; that is, spring clip or spring clamp. The spring clamp has a special tool for easy release of the clamp type clip, which can be purchased separately if required.

A drain plug is fitted in the bottom hose for coolant drainage. Filling is via the reservoir, which has self-venting hoses from the engine and radiator.



## HEATING / COOLING SYSTEM

### Components (continued)

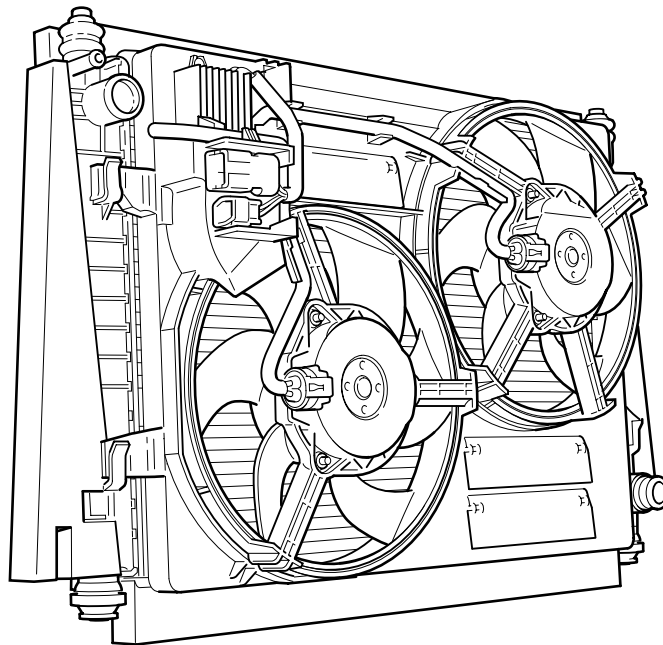
#### Radiator

The radiator consists of a 32 mm matrix core with plastic end tanks. The assembly is mounted using four rubber isolators – two top and two bottom – which are located on the plastic end tanks.

The radiator is mounted on a lower cross member. This cross beam requires removing to gain access to the radiator for servicing requirements. The radiator removal direction is out from below; that is, downwards once the cross member is removed.

Fitted on both sides of the radiator end tanks are foam side seals to prevent air bypassing the radiator core. These seals should not be missing or damaged; cooling performance will be affected and will result in reduced efficiency of the engine cooling and refrigeration systems.

**RADIATOR AND COOLING FANS**



T703.148

#### NOTES

## ***X-TYPE CLIMATE CONTROL SYSTEM***

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### **Cooling Fans**

The cooling fans are mounted to the rear of the radiator by two slots and two quick-fit connecting clips. There are no retaining bolt type fixings securing the assembly. The assembly consists of two 300 watt motors and fan units housed within a polypropylene cowling. To distinguish between the motors, each motor is secured to the fan cowling with a different number of spokes.

The fan motors are controlled via a speed regulator using PWM. Control of the motors is via the ECM. The signal is used by the speed regulator located in the top LHS of the fan cowling. A small air duct passage allows a stream of air to flow over the fins of the regulator to aid cooling.

The cooling fan speed regulator has an internal temperature sensor that will power the cooling fans at full speed if the temperature threshold rises above a given value. The fans only operate if the coolant temperature is 95 °C (203 °F) or above. It will cease to operate when the temperature falls below 95 °C (203 °F), thus allowing for hysteresis.

The cooling fan strategy is controlled by two control modules, the ECM and the A/CCM; the ECM uses the A/C pressure transducer as its input and passes the signal on to the A/CCM. The A/CCM then requests the actual cooling fan speed from the ECM; the ECM in turn passes this request to the cooling fan speed regulator. In general terms, the highest temperature signal will always be given the highest priority.

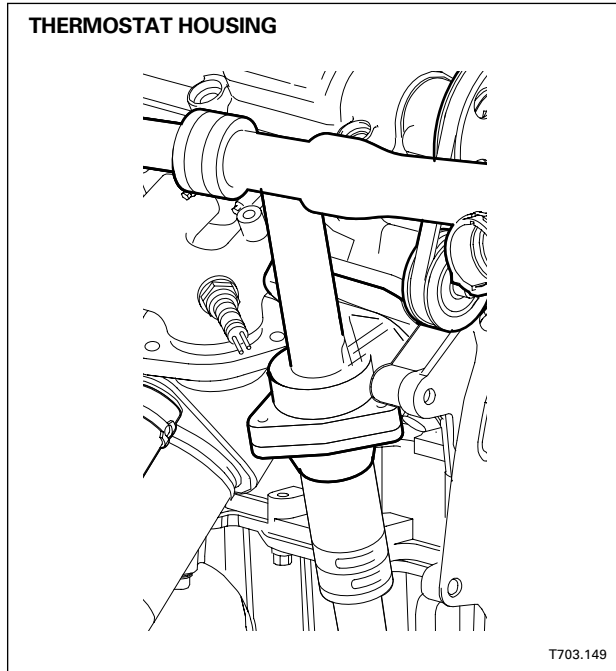
The blades of the fans are highly balanced units and should be handled carefully. If they are mishandled, vibration may result.

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### **NOTES**

## HEATING / COOLING SYSTEM

### Components (continued)



#### Thermostat

The thermostat is located in a housing fitted between the engine oil cooler housing and the water pump rail. Access is via quick-fit connectors. The thermostat is changed along with the lower housing as a service part.

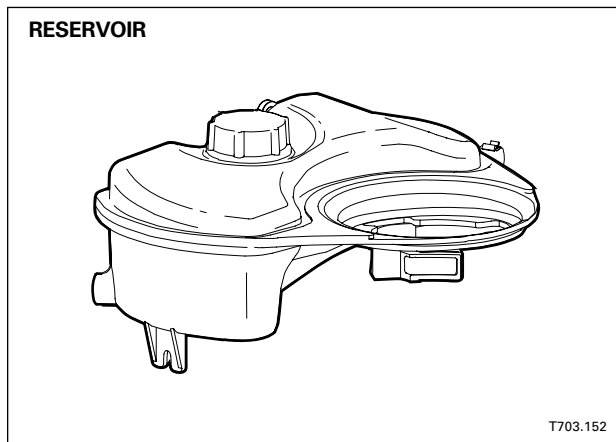
- The thermostat is an 88 °C (190.4 °F) unit
- The thermostat starts to open at 75 °C (167 °F)
- The thermostat is fully open at 95 °C (203 °F)

#### Reservoir

The cooling system reservoir is appropriately sized to allow expansion and contraction of the coolant without expelling any fluid.

Level marking showing the minimum and maximum fill levels are clearly visible; this visibility allows coolant checks to be made very easily via the translucent reservoir molding.

There is no level sensing on the reservoir. Always fill the reservoir at ambient temperature to the maximum fill level to ensure the maximum fill volume possible.



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#### NOTES

### Coolant Filling Procedure

The system fill is 8.25 liters of 50 / 50  $\pm$ 5% with OAT (organic acid technology coolant) / distilled water mix. This system fill is common with the S-TYPE; that is, it utilizes the orange Extended Life antifreeze (five years or 156,000 miles / 250,000 km).

1. Fill with coolant when the engine is cold.
2. Ensure that the thermostat is closed.
3. Add the 50 / 50 OAT/distilled water mix until it reaches the maximum level indicator on the reservoir (approximately 4 liters for a radiator change).
4. Ensure that the 50 / 50 mix is achieved for correct cooling efficiency. Too much antifreeze reduces cooling capacity, while too little results in freezing problems.
5. Allow around two minutes to fill the cooling system. Do not try to rush the procedure; completing the fill slowly will avoid the creation of air locks.
6. Run the engine at idle for ten minutes. The level will drop to below the maximum level shown on the reservoir.
7. Switch off the engine and allow the system to cool down to the ambient temperature (in order to achieve maximum coolant volume).
8. It is important to top up the system to the maximum level indicated on the reservoir housing.

This is not a quick operation, but the procedure described here should be followed in order to ensure the correct operation of the cooling system.

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#### NOTES





# *JAGUAR CLIMATE CONTROL SYSTEMS*



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## EATC SYSTEM

There are two versions of the electronic automatic temperature control (EATC) system:

- EATC – Non-Telematics version
- EATC – Telematics version

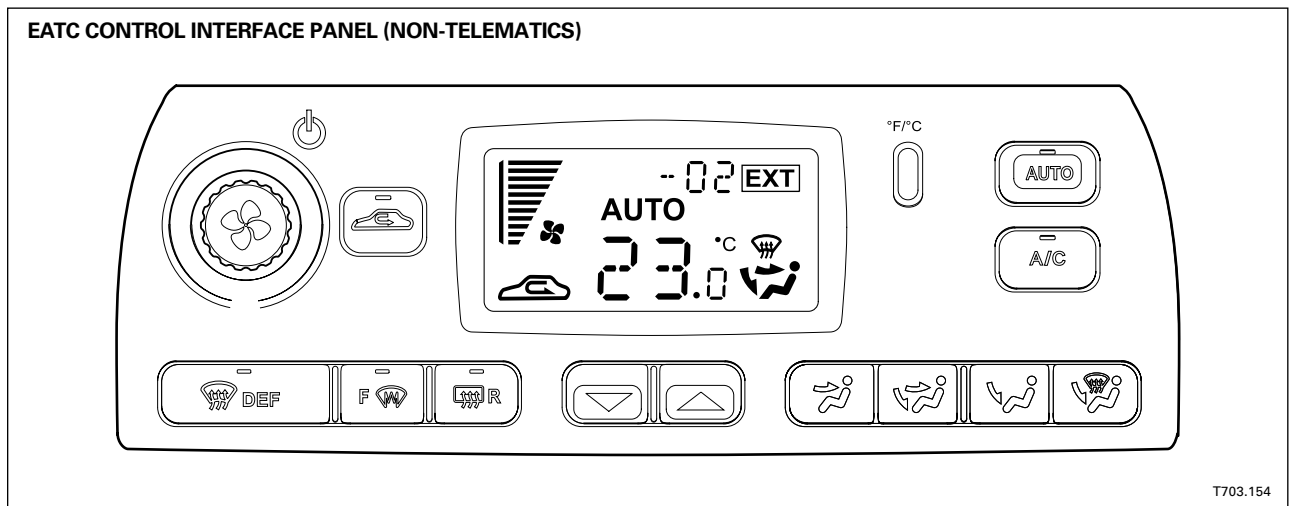
## EATC Control System

### EATC Control Panel (Non-telematics)

This interface panel is equipped with a digital display and in many cases operates on a logic similar to that of previous Jaguar climate control systems. The information shown on the panel consists of the following items:

- External temperature (permanently displayed, when system is operational)
- Blower motor speed chaplets and axis line
- Recirculation operation symbol
- Selected temperature demand
- Auto symbol
- Air distribution symbol

The EATC panel can have up to a total of fourteen push buttons. The system On/Off button is combined with a rotary control for manual blower speed operation.



### Push Button Features

- Fresh / Recirculation
- Temperature demand control
- °C or °F scale
- Heated rear window (R); heated door mirrors
- A/C On / Off switch
- Heated windshield (F) (optional fitment)
- Auto mode
- Defrost control
- Air distribution mode (four buttons)
- System On / Off (rotary control switch)

### System Operation

The EATC system maintains the interior of the vehicle at the temperature selected by occupant. The heat input, air conditioning, fan speed, and air intake and distribution are adjusted automatically to maintain the desired set temperature. Automatic control (AUTO) may be overridden at any time by the use of the various control buttons, such as the blower speed control.

The following features are available on this system:

- Digital display
- Auto mode
- Temperature scales for °C or °F decided by user preference
- Heated rear window with heated windshield as an optional addition. If heated windshield is not ordered, the heated rear window button is double in size.
- Occupant temperature control
- 360° manual control over the blowers available, using an eleven-step motor, which is PWM-driven by the CM
- Fresh / recirculation operation governed by various sensors, such as the ambient sensor; therefore no pre-defined time is quoted for the duration of operation. If you press and hold the recirculation button for longer than two seconds, the recirculation flap is latched; latched operation is confirmed by a double beep.
- Permanent display of external temperature. The ambient sensor must be in the air stream to operate effectively; that is, not blocked off by any aftermarket accessories.

### Ambient Sensor Logic

The logic is similar to that of previous Jaguar climate control systems and follows the strategy as follows:

- If the vehicle has cooled down since the ignition was on last, then the digital display reading is updated immediately on the next ignition cycle.
- Should the ambient sensor detect a temperature rise on the next ignition on cycle, indicating a possible heat soak condition, then the system must be driven at 35 km/h (22 mph) and above for 30 seconds before a stabilized reading will be shown.

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### NOTES

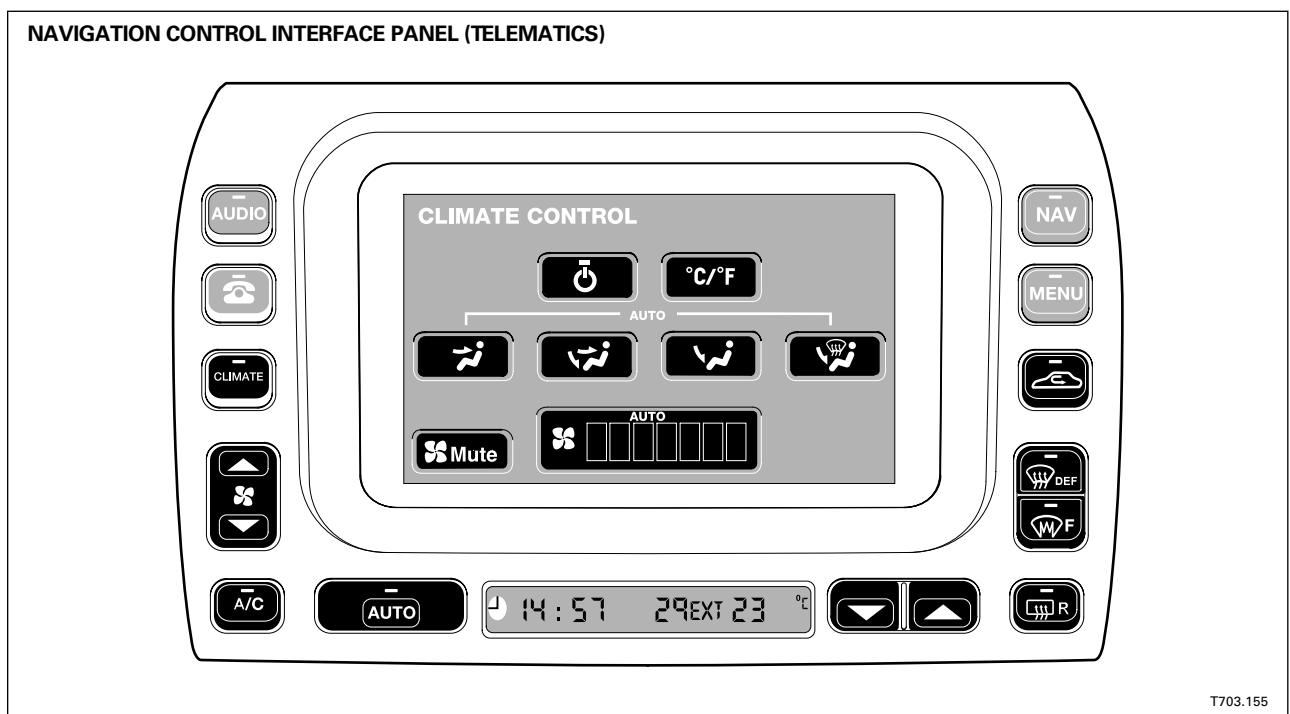
## EATC SYSTEM

### EATC Control System (continued)

#### Navigation Control Panel (Telematics)

This panel contains a 178 mm (7 in.) touch-sensitive screen-display control system, with eleven climate control buttons, while the remaining features are selected via the navigation touch-screen display.

All the operating features for the EATC mid-line system apply to the navigation system. The main distinguishing element that differentiates the two systems is the location of the CM. On the EATC mid-line system, the CM is located in the control panel assembly. However, the navigation system utilizes a remote CM because Denso, not Visteon, produces the navigation display unit.



## NOTES

## **X-TYPE CLIMATE CONTROL SYSTEM**

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### **Navigation Keys**

Three levels of soft key functionality exist.

- A grayed out soft key indicates that the function is inhibited.
- A soft key with a red ring circling the circumference indicates that the feature is active.
- A soft key, not grayed out, with no red ring, indicates that the soft key is available but not active.

Pressing the OFF soft key activates the RAM air feature in lieu of the MUTE feature and enables the air distribution soft keys.

The Mute function reduces the blower speed to two chaplets, thereby lowering background noise when a mobile phone is used or a conversation is taking place in the vehicle.

If the system is fitted with a fixed phone, the Mute facility will automatically engage when the phone is being used, and will revert back to the previous condition upon call termination.

### **Keys Available**

#### **Climate Control Hard Keys**

- Climate menu
- Blower speed control
- A/C ON / OFF
- Temperature demand
- Heated rear window (R)
- Heated windshield (F) (optional fitment)
- Defrost
- Recirculation
- Auto mode

#### **Climate Control Soft Keys**

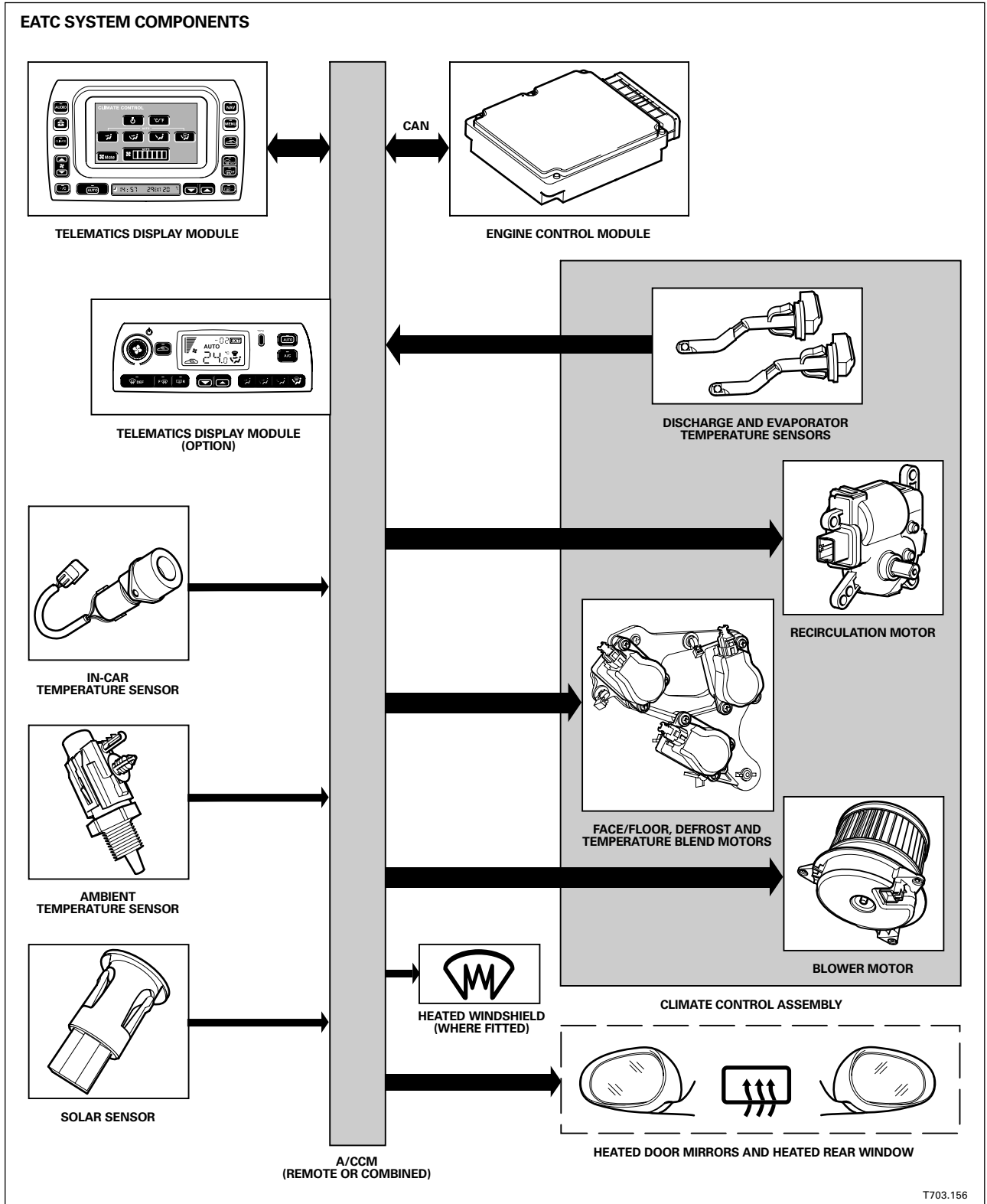
- Manual fan speed indicator chaplets
- Manual air distribution selection
- System ON/OFF
- External temperature scales °C and °F
- RAM air mode
- Mute feature

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### **NOTES**

## EATC SYSTEM

### Components



## **X-TYPE CLIMATE CONTROL SYSTEM**

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### **Control Module Supply Voltage**

- Connector IP101
- White 26-way AMP
- Pin 14
- Wire U
- CJB 10 amp fuse, F75
- However, fuse F75 in the CJB is supplied by fuse F7 located in the BJB.

The minimum and maximum battery voltages are between 9 – 16v. Without this power supply voltage, control module memory is lost and, with it, the panel setting position.

The ignition input is provided for wake-up and shut-down strategies in the form of anti-misting control, DTC storage and temperature display logic. The system also uses ignition to power certain other functions, such as the motorized aspirator.

The main battery supply is used to keep the panel settings in memory.

The normally accepted battery supply voltage range is between 9 – 16v. Should this supply be lost, then the CM defaults to Auto 23°C when the battery is re-connected.

The control module will enter a protection mode to prevent damage to electronics and LEDs should the voltage rise above 16v.

If the battery level falls to below 7.5 volts, then the control module will drive the door to a near open or close position. Normal operation will be resumed when the supply voltage returns.

The system will recalibrate the stepper motors upon battery reconnection; this relearns the flap end-to-end stop positions.

Stepper motor calibration can take up to 30 seconds. It is advised not to operate any of the panel controls while this takes place, as it interrupts the learning sequence.

The reason for stepper motor calibration is that there are no feedback pots for door position.

### **Control Module Ground**

- Connector IP101
- White 26-way AMP
- Pin 15
- Wire B
- G37BR ground eyelet, located on the cross-car beam left-hand side.

This is the main climate control module ground point. This ground stud is shared with other components, such as:

- Turn indicators
- Indicator audible warning
- Master light switch (not all models)
- Not-in-park switch
- Instrument cluster

Therefore, look for clues in other components not operating correctly, but don't disregard a broken, corroded eyelet or leg.

### **Control Module Ignition Supply**

- Connector IP101
- White 26-way AMP
- Pin 2
- Wire WR
- CJB 10 amp fuse, F80

The ignition supply is used to invoke the climate control module wake-up and shut-down strategies. These would be in the form of anti-misting, temperature display logic, system monitoring and storing of DTCs.

This supply is also used by other components or systems, such as:

- In-Car aspirator
- J-gate supply
- J1962 connector power

Quick checks can be made on the motorized aspirator and J-gate if this voltage supply is in doubt.

## EATC SYSTEM

### Components (continued)

#### Battery Saver Relay

- Connector IP101
- White 26-way AMP
- Pin 1
- Wire OY
- CJB

The battery saver relay is controlled by the GEM for 20 minutes after the ignition has been turned off.

During this period, the battery saver relay supplies 12v to pin IP101-1, then internally through the control module to the stepper motor drive circuits. This allows the control module to carry out the anti-misting strategy. This is achieved by operating certain flaps to prevent warm moist air reaching the cold glass surface, which can cause fogging of the windscreen in certain climatic conditions.

#### Anti-Misting Control

Two minutes after ignition is switched off, the control module controls the system to prevent moisture condensation forming on the windscreen. This is achieved by:

- Closing off the defrost flap
- Driving the recirculation flap to fresh

NOTE: The defrost flap is not driven closed if the previous condition for the climate control system was full defrost.

The battery saver relay serves many other areas on the vehicle:

- EATC A/CCM
- LH & RH footwell lamps
- LH & RH vanity mirror lamps
- Map lights
- Front interior lights
- LH & RH door courtesy lamps
- Trunk lamp

Therefore, any concerns with the battery saver relay functionality will show up by the lamps listed above not operating.

The customer complaint will be no air flow where he/she would expect it, due to no door/flap control.

The battery saver relay is located in the CJB and listed as R21 on the fuse and relay schematic.

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## NOTES



## Sensors

### Sensor Inputs

X-TYPE climate control systems use five sensors as feedback to the control module.

### Sensor Grounds

All sensors have a ground connection via the control module.

The ground return is completed on two separate connectors.

#### The first connector is:

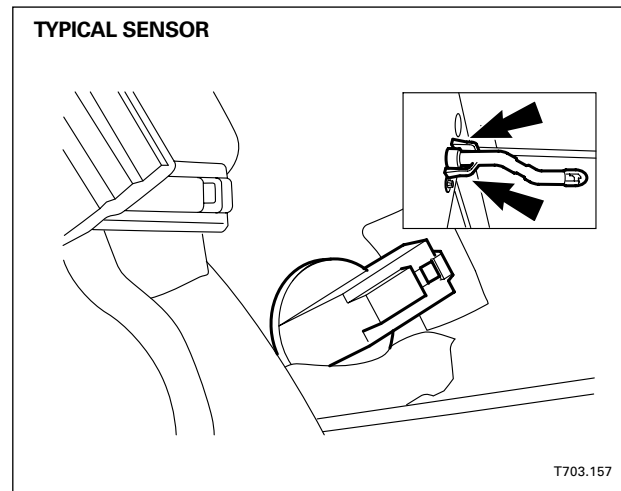
- AC001
- Black 26-way AMP
- Pin 16
- Wire B
- Evaporator and discharge sensors

#### The second connector is:

- IP101
- White 26-way AMP
- Pin 17
- Wire B
- Solar, ambient and in-car sensors

### Sensor Operation

All the sensors except the solar sensor are of the NTC variety. As the temperature rises, the resistance falls, and vice versa.



The individual reference voltage from the control module to each sensor is 5v.

As the resistance changes from high to low, so does the reference voltage at the relevant control module pin, thus indicating to the control module precise temperature data.

High ohms = high volts

Low ohms = low volts

The solar sensor operates using ambient light; the brighter the solar output, the higher the voltage at the control module.

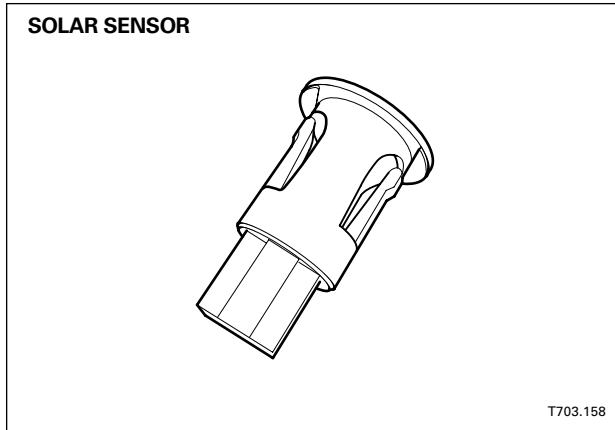
Low light = low volts

Bright light = high volts

## NOTES

## EATC SYSTEM

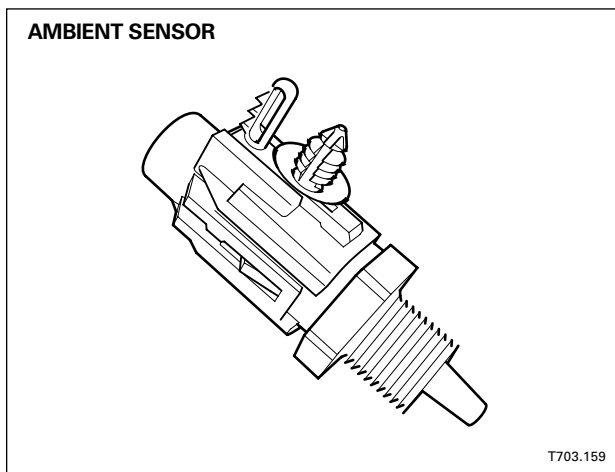
### Components (continued)



#### Solar Sensor

The solar sensor is positioned on the drivers side of the vehicle and mounted close to the defrost vent on top of the fascia.

The purpose of the solar sensor is to prevent the need for the driver having to react to changes in sunlight and continually having to raise or lower the temperature demand request. This is an automatic function of the control module, moving the required flaps towards cooling when the light becomes brighter as indicated by the rise in voltage. The operation is damped so as not to be too overreactive to a quick rise-then-fall type of change.



#### Ambient Sensor

The ambient sensor is located at the front of the vehicle and is mounted on the left hand side PAS cooler bracket.

The role of the ambient sensor is to display the external temperature for the driver display panel. On the mid-line system, this is constantly displayed in the climate control panel.

The navigation system takes the hardwired input and converts the signal into a CAN message. The CAN message is used by the smaller LCD display screen below the navigation screen and also by the instrument cluster for low temperature warnings.

Both panel readouts can be changed from degrees Centigrade to degrees Fahrenheit by using the appropriate button or soft key.

**NOTE:** The ambient sensor defaults to 10 °C (50 °F). If the battery supply is lost and the ambient temperature is high, this is the reading the driver will see. A system reset will occur at 35 km/h (22mph) when the fault is corrected; this may take a few minutes to fully recalibrate.

However, if the surrounding ambient temperature is cold then the control module will display the ambient sensor reading immediately.

The ambient sensor signal is also utilized by other areas of the system, such as automatic control of the heated rear window, heated door mirrors and heated windshield at -1° C (30 °F). It assists the evaporator sensor with control of the compressor by extending the compressor clutch switching points; e.g., high ambient will result in a longer compressor clutch on time.

### **In-Car Sensor**

The in-car sensor is combined with the motorized aspirator assembly and is mounted behind a small grille in the fascia. The location is next to the steering wheel, towards the center line of the vehicle.

The motorized aspirator has a voltage supply when in Key Position II. The 12v feed is from the ignition relay located in the CJB; the relay is listed as R18 on the fuse and relay schematic. This may change to the battery saver relay supplying the motorized aspirator 12v feed.

The in-car sensor has a 5v reference voltage applied, which is used as a feedback signal. This input is used to control the air temperature blend flap in conjunction with the temperature demand input for controlling the cabin temperature to the desired level.

A simple test to check for motorized aspirator operation is to place a light piece of tissue against the intake grille and switch on the ignition. If the motor is running, then it should draw the tissue towards the grille.

Do not use the cigar lighter to test for in-car sensor operation; the unit has a damped operation so results do not show too readily and secondly you risk damaging the fascia as you move the heat source closer.

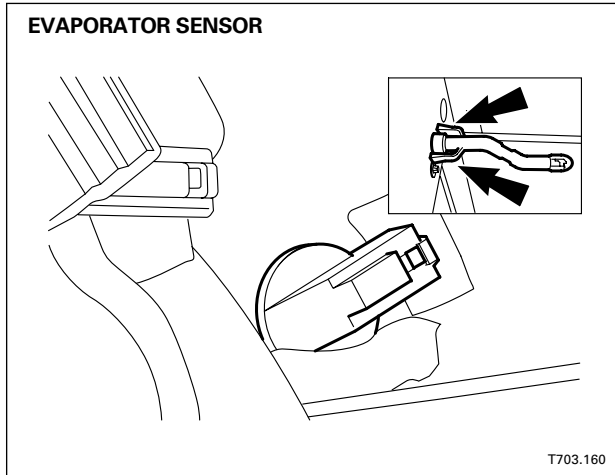
Concerns with the in-car temperature sensor will show as erratic in-car temperature stability. If a fault occurs, a DTC will be provided and the system will not have automatic control.

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### **NOTES**

## EATC SYSTEM

### Components (continued)



#### Evaporator Sensor

The evaporator sensor is used to control the compressor clutch cycling, and with it, refrigerant flow through the system.

At 0 °C (32 °F) the evaporator temperature signal is used by the control module to switch off the compressor clutch, thus preventing the evaporator from icing and reducing system performance.

At 3 °C (37 °F) and above, compressor clutch operation is permitted. The compressor clutch should cycle around three times in any one minute (4 = Maximum). This is taken at 50km/h (30mph) with the engine at approximately 2000 rpm.

The sensor is located in the climate control housing on the right-hand side of the unit. It is easily removed from the housing by way of a trim/fork type removal tool.

Because the sensor is situated very close to the evaporator, the sensor is coated to prevent moisture affecting the performance of the unit.

#### Low Refrigerant

The evaporator sensor also serves as a low-pressure refrigeration charge sensor and controls the compressor clutch cutoff should the refrigeration charge be low.

The reason why the evaporator sensor can achieve this is due to the way refrigerant behaves in an enclosed environment, volume, temperature and pressure are all interrelated, e.g.:

- 600 grams @ 0 °C (32 °F) = 3 bar
- 100 grams @ 40 °C (104 °F) = 3 bar
- 3 bar absolute, 2 bar gauge pressure

Using a look-up chart with any one of the known values will provide an indication of what is happening inside the system. This look-up chart has been built into the control strategy of the control module.

From the evaporator core temperature, the system knows the volume and pressure inside the refrigeration system and controls the compressor clutch request accordingly.

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#### NOTES

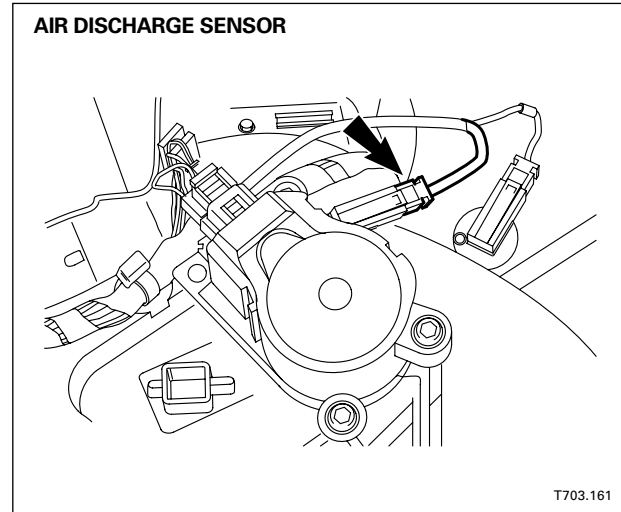
## Air Discharge Sensor

The air discharge sensor is placed in the air stream from the air temperature blend flap.

Air flowing into the cabin is checked against what the driver has requested and against what the in-car temperature sensor is reading.

The sensor is in fact the same unit as the evaporator sensor. However, it is not coated and would not stand up to the moist environment if placed in the evaporator position.

Should the driver change the temperature demand setting higher or lower, then the blend flap will move to allow more evaporator air or more heater matrix air through the required distribution flap. If the requested temperature demand is set to Hi or Lo, then the air discharge sensor enters an open loop condition; the result is that the sensor signal is then disregarded.

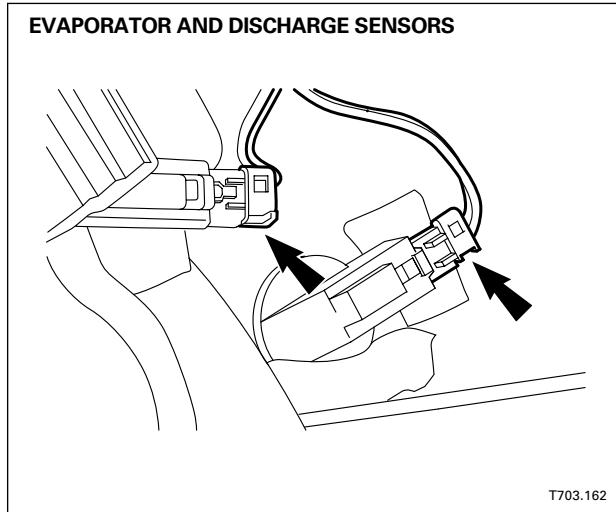


## Sensor Resistance

Temperature °C	Ambient	Discharge	Evaporator	In-Car
-20	276959	96358	96358	95890
-15	209816	72500	72500	72220
-10	160312	55046	55046	54890
-5	123485	42157	42157	42070
0	95851	32554	32554	32500
5	74914	26339	26339	25310
10	58987	19872	19872	19860
15	46774	15698	15698	12690
20	37340	12488	12488	12490
25	30000	10000	10000	10000
30	24253	8059	8059	8060
35	19716	6535	6535	6536
40	16113	5330	5330	5331
45	13236	4372	4372	4372
50	10926	3605	3605	3606

## EATC SYSTEM

### Components (continued)



#### Incorrect Sensor Fitment

The identification of the evaporator and discharge sensors is very easy using their color coding:

Black = discharge sensor

White = evaporator sensor

However, the two harness connectors are both black and it is possible to connect them to the wrong sensor. Should this occur, the control module will read exactly the opposite of what it expected:

The control module evaporator feedback would register a heat signal; i.e., low resistance, therefore low volts.

While the air discharge pin would register cold; i.e., high resistance, therefore high volts.

The result will be full heating as the temperature blend flap will close off the evaporator side and open the heater matrix side as far as possible.

#### NOTES

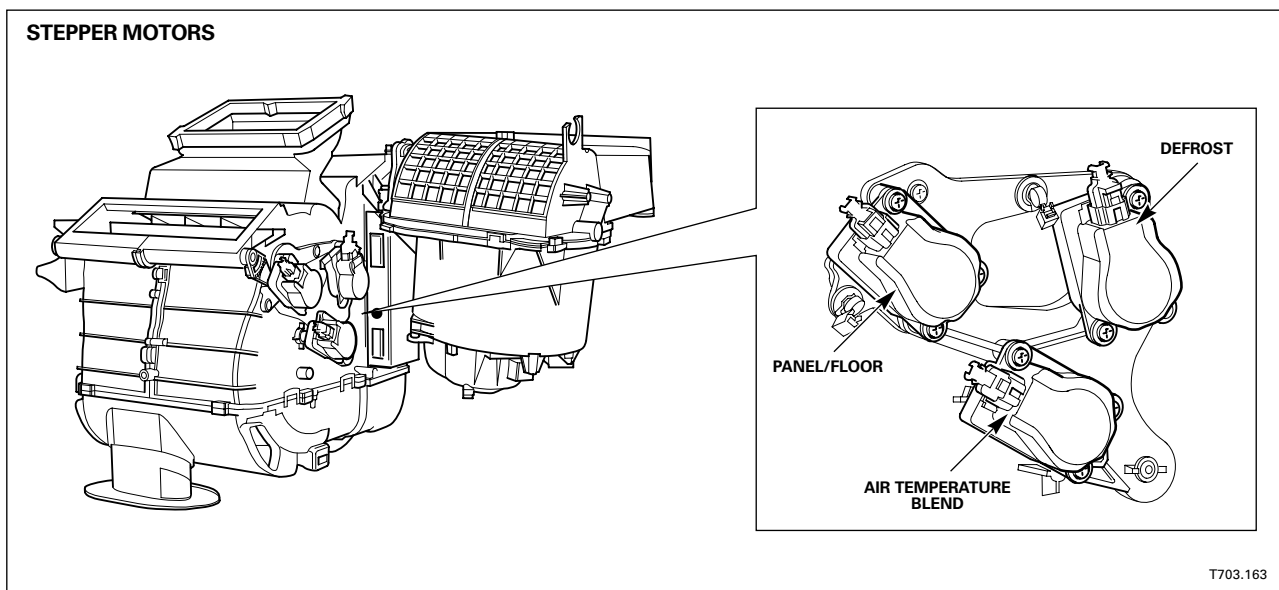
## Stepper Motors

Three stepper motors are used for controlling the door positions:

- Defrost
- Panel/floor
- Air temperature blend

Each stepper motor has five wires:

- One 12v supply from the CM
- Four wires pulsed in pairs



There are no feedback pots; position of the door is purely down to counting the steps of rotation.

Do not try to measure an output. Any fault concerns are covered by DTCs and are very effective.

Stepper motors will cease rotation on engine cranking and continue after the engine has started; this is to prevent any low battery voltage problems. The stepper motor can stall if the battery voltage is too low. Air flow force can interrupt door movements when current available to drive the stepper motor is low.

If, for some reason, a panel is disconnected without the battery being isolated, be sure to refit the black connector first, the white connector second. This enables power to be at the stepper motors prior to powering the climate control panel software.

The control module recalibrates stepper motors by driving the motors end-to-end when a battery reconnection occurs. After 85 ignition cycles, the stepper motors will recalibrate 2 minutes after ignition off.

### EATC SYSTEM

#### Components (continued)

##### Stepper Motors (continued)

###### Manual Reset

A panel / stepper motor manual reset method exists and is listed below:

- Select full cooling
- Select full heating
- Back to full cooling
- Select face followed by floor
- Then select face again
- Finally select defrost

If there is any doubt, then a battery reset should be completed; wait two minutes before reconnection.

The motors are mounted on an adjustable adaptor plate; do not disturb the setting.

Should there be a need to remove the adaptor plate, mark its position. Adaptor plate misalignment can cause a strain on the stepper motor drive gear.

###### Moisture Purge

To combat the fact that moisture is present in the evaporator matrix area, a number of innovations have been designed into the system to prevent windshield fogging and odors from the A/C system.

The doors, except the heater matrix, are made from plastic and are foamless; this prevents moisture being stored by the foam, which assists in reducing the chance of odors being generated.

The climate control system calculates the accumulative amount of time the A/C system has been engaged. If this time exceeds a period of one minute at 15 – 20°C, then the system qualifies for ignition-on moisture purge.

At the next ignition on signal, the defrost door is closed and the foot door is opened, air is blown through to the foot-wells at 30% blower speed for 30 seconds.

All positions will purge, except the defrost position, which can purge through panel/face vent if required.

---

#### NOTES



## Blower Motors

Blower motors are always located on the passenger side of the vehicle.

The blower motor 12v supply is fed from the blower relay labeled R20 on the fuse and relay location chart.

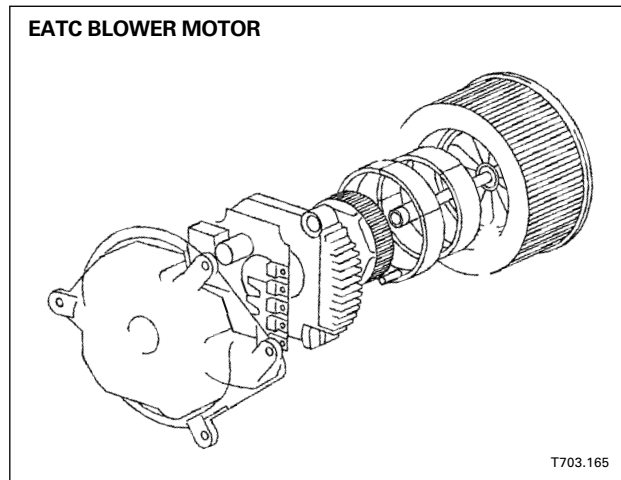
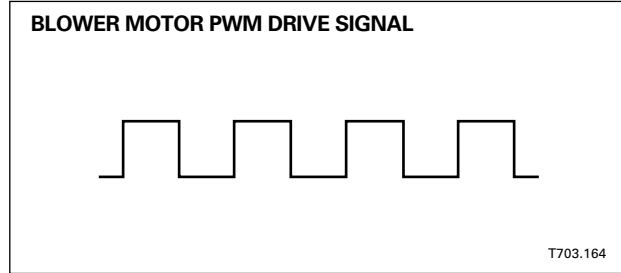
Relay control is via the climate control module with a 12v feed to the relay coil windings.

A blower sense wire is taken from the blower circuit back to the control module to indicate the blower is operational.

This signal is used to control the climate control compressor clutch circuit; therefore, no blower signal will result in no cooling.

Blower speed is also used as an aid for compressor clutch control; the faster the blower speed, the longer the compressor on time.

In the automatic mode, and with heat requested, the blower speed will be restricted until 80°C is reached; at this point, full blowers will then become available.



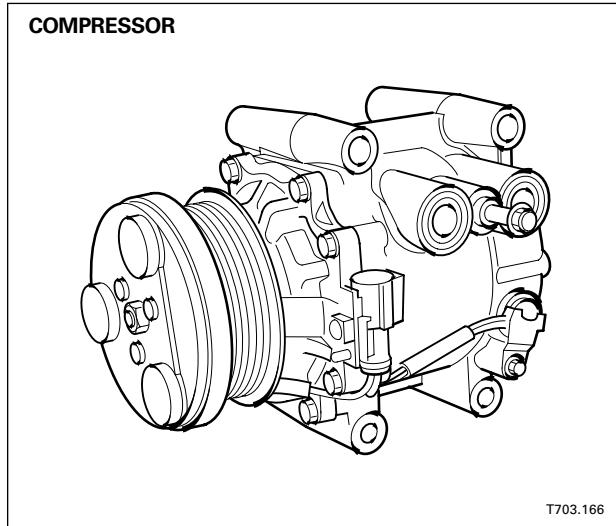
**NOTE:** Early X-TYPE vehicles were fitted with brushless blower motors.

---

## NOTES

## EATC SYSTEM

### Components (continued)



### Compressor Clutch

The compressor is the same scroll type unit that is used on the S-TYPE. The compressor clutch is supplied with power from the compressor clutch relay (R6), located in the BJB.

The compressor clutch will not operate if any of the following events occur:

- High refrigeration pressure
- No blower sensing
- W.O.T of 65° (100% = 86°)
- Engine speeds above 5980 rpm
- Low Idle speeds
- High coolant temperatures
- 0 °C (32 °F) ambient temperature

The clutch has power supplied from the air conditioning compressor clutch relay. This relay is located in the BJB and is labeled R6 on the fuse and relay schematic.

---

### NOTES

## X-TYPE CLIMATE CONTROL SYSTEM

---

### Pressure Transducer

This component is located under the right-hand inner wheel arch behind the wheel arch liner.

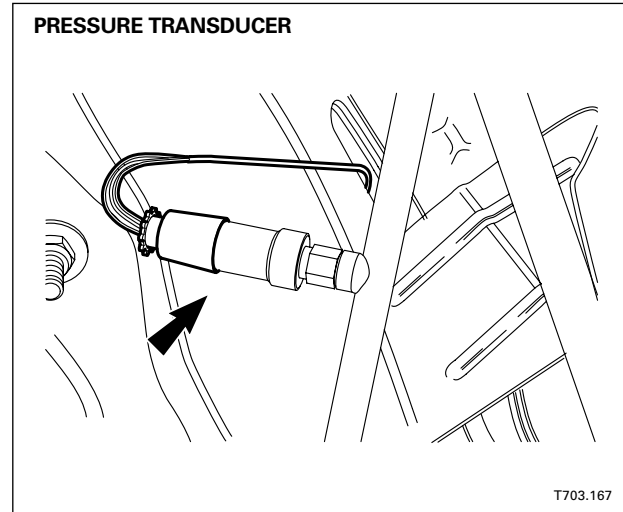
Because a Schraeder valve is fitted, the unit can be changed without depressurizing the refrigeration system.

The transducer controls two systems:

- Cooling fans
- Compressor clutch

The pressure transducer is hard-wired into the ECM by three wires:

- 5v supply
- Ground
- Feedback



The unit consists of a strain gauge device which outputs a voltage with reference to refrigerant pressure.

- 0 – 5v
- 0 – 35 bar (507 psi)

At 30 bar (435 psi) pressure, the ECM will cut off the compressor clutch; it will reengage at 16 bar (232 psi). The reengagement pressure is chosen for compressor clutch torque protection. The average time between 30 bar (435 psi) and 16 bar (232 psi) using a fixed-orifice tube is approximately 7 seconds.

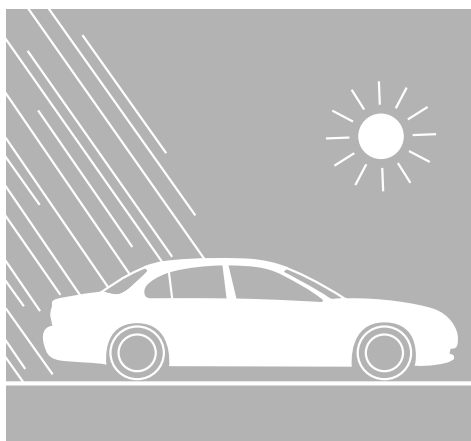
The signal from the pressure transducer is redirected by the ECM to the A/CCM to be used in the compressor clutch and cooling fan control strategy.

---

### NOTES



# *JAGUAR CLIMATE CONTROL SYSTEMS*



- 1 CLIMATE CONTROL
- 2 XJ/XK CLIMATE CONTROL SYSTEM
- 3 S-TYPE CLIMATE CONTROL SYSTEM
- 4 X-TYPE CLIMATE CONTROL SYSTEM**
  - 4.1 Overview
  - 4.2 Refrigeration System
  - 4.3 Heating / Cooling System
  - 4.4 EATC System
  - 4.5 Service Information**
  - 4.6 Task Sheets
- 5 CLIMATE CONTROL REFERENCE



## SERVICE INFORMATION

### Particle Filter

Particle filters arrest approximately 40% of particles in the 0.3 to 1 micron range. Pollen, for example, falls above this range because its molecule size is larger than 1 micron.

Particle filters will stop elements such as the following; however, this is not an exhaustive list and only serves to highlight a few examples:

- Spores: 4 – 45 microns
- Pollen: 8 microns plus
- Road dust: 1 – 100 microns
- Exhaust particles: 0.01 – 100 microns
- Bacteria: 0.7 – 20 microns

The particle filter should be changed at 40,000 km (24,000 mi.) intervals.

### Serviceable Items

#### Blower motor

#### Serviceable Sensors

- Evaporator
- Air discharge
- Ambient
- Solar
- In-car
- Refrigeration system pressure transducer

#### Other Serviceable Items

- Heater matrix
- Evaporator matrix
- Filter elements – particle or combination
- Ducting
- Fixed-orifice tube
- Display control panels
- Remote climate control module – navigation system only

#### Stepper Motors

- Face / floor
- Temperature blend
- Defrost

#### Recirculation

- Fresh / recirculation DC motor for recirculation flap control

---

## NOTES

### Service Care Information

Failure of any refrigeration component will require that the fixed-orifice tube be removed for cleaning or replacement.

If the refrigeration system is left open for any length of time, or if a major component failure where debris is circulated around the system occurs, the suction accumulator should be changed.

### Specifications

The PAG oil specification for the X-TYPE refrigeration system is the same as for the S-TYPE refrigeration system, but not the same specification as the Denso PAG oil; therefore, only the correct specified oil should be used.

Refrigerant	R134a
R134a quantity	0.810 kg
Lubricating oil	PAG
System oil quantity	290 cc
PAG oil part number	XR8 3680
Decoupler tool	310 D005
Fixed-orifice tube remove / install tool	412 034*
Fixed-orifice broken tube extractor tool	412 035*
System diagnosis	WDS

\*It may not be necessary to use these tools, since it is possible to remove the tubes with a pair of pointed-nose pliers.

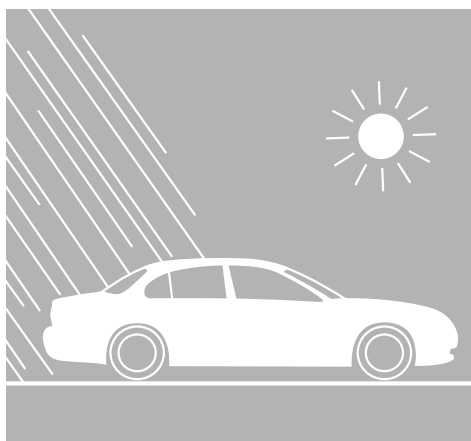
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### NOTES

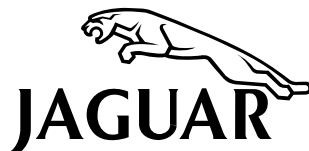




# *JAGUAR CLIMATE CONTROL SYSTEMS*



- 1 CLIMATE CONTROL
- 2 XJ/XK CLIMATE CONTROL SYSTEM
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**TASK SHEET 1 – X-TYPE AIR DISTRIBUTION STEPPER MOTORS**

Run engine. Select each air distribution in turn. Wait 10 seconds for each flap to get into position. Record results in the table below.

**Manual Mode: Full Cold Temperature Demand**

Datalogger Selection	Control Panel Selections				
	Panel	Foot	Panel/Foot	Defrost/Foot	Defrost
Air Blend Door					
Panel Vent					
Defrost Vent					
Recirculation Door					

**Manual Mode: Full Hot Temperature Demand**

Datalogger Selection	Control Panel Selections				
	Panel	Foot	Panel/Foot	Defrost/Foot	Defrost
Air Blend Door					
Panel Vent					
Defrost Vent					
Recirculation Door					

What does the recirculation door control?

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When the temperature demand is set to full cold, how does this system use the recirculation door to achieve colder cabin temperature?

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Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

**TASK SHEET 2 – X-TYPE TEMPERATURE SENSORS**

Use the Wiring Diagrams and the Student Guide to fill in the table below. When the table is complete, go to the assigned vehicle and locate the sensors.

Sensor Name	Temperature / Voltage Range (Wiring Data Page)	Pin / Wire Data (at A/CCM)	Default Temperature (Student Guide)	Location on Vehicle

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

## TASK SHEET 3 – X-TYPE AMBIENT TEMPERATURE SENSOR

Using WDS Datalogger and the assigned vehicle, perform the following task and record the results.

Materials: X-TYPE; hair dryer or heat gun

1. Run the Datalogger while observing the selections.
2. Apply heat with the hair dryer or heat gun to the ambient sensor. If using a heat gun, use care not to melt anything.
3. Record and compare the readings to the actual control panel changes.

Datalogger Selections	Readings without heat applied to sensor	Readings with heat applied to sensor
Measured external temperature		
Calculated external temperature		
<b>Control Panel Displayed Temperature</b>		

Which reading matches the control panel displayed temperature?

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How is the ambient temperature calculated in relation to wheel speed?

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Why?

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Under what driving conditions will the ambient temperature displayed not match the actual outside temperature?

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Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_

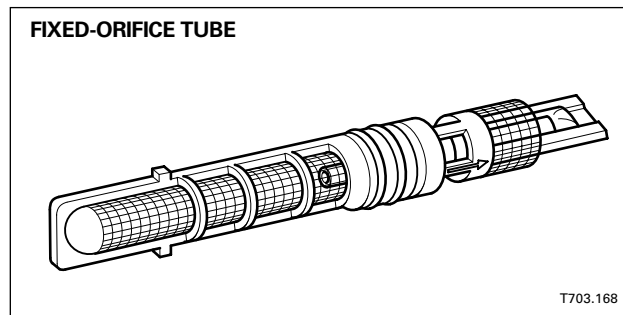
## TASK SHEET 4 – X-TYPE ORIFICE TUBE SERVICE

Using the proper tools and equipment, evacuate refrigerant; remove, inspect and reinstall the orifice tube; recharge the system on the assigned X-TYPE.

Materials:

- Safety glasses, fender covers and gloves
  - JTIS; record section # after printing a copy \_\_\_\_\_
  - Recycling / recovery equipment
  - Recommended special tool for orifice tube removal \_\_\_\_\_
1. Using industry standard procedures, evacuate the refrigerant from the assigned vehicle.
  2. Remove and inspect the orifice tube for any dirt or debris.

Actual tool used to remove orifice tube: \_\_\_\_\_

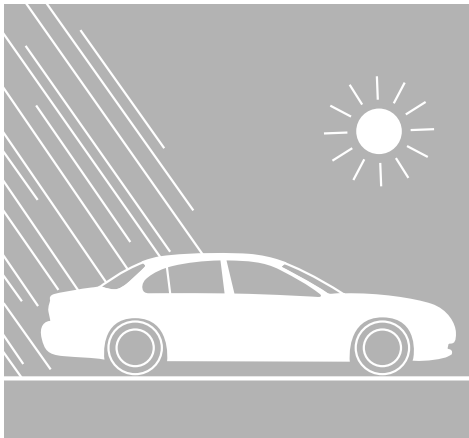


3. Using the graphic as a reference, which way should the arrow face when reinstalling the orifice tube?  
\_\_\_\_\_
4. Replace pipe 'O' rings and reinstall the orifice tube. **DO NOT OVER-TORQUE FITTINGS.**
5. Recharge vehicle with correct amount of refrigerant \_\_\_\_\_
6. Check system for proper operation and leaks.

Demonstrates Competence: Instructor Signature \_\_\_\_\_ Date \_\_\_\_\_



## ***JAGUAR CLIMATE CONTROL SYSTEMS***



AJ16/V12 CLIMATE CONTROL



Service Training Course T703  
DATE OF ISSUE: 07/01/2002

## **OVERVIEW**

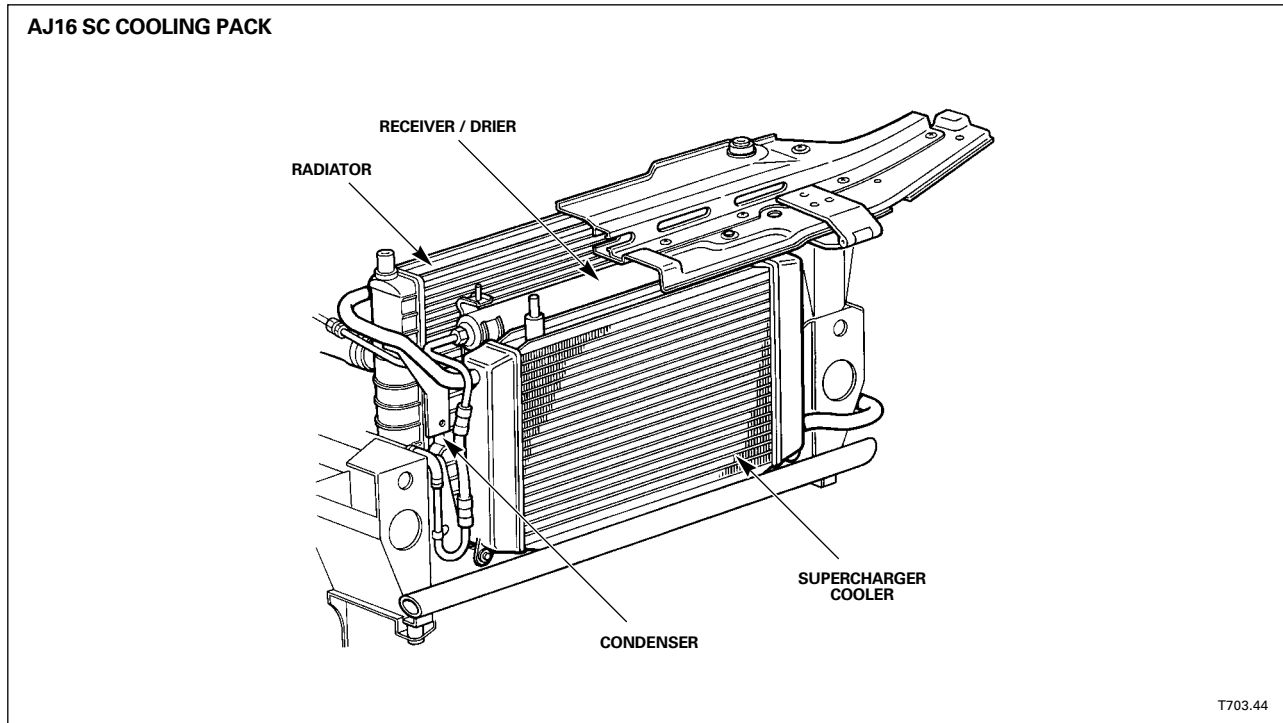
The climate control systems fitted to AJ16 and V12 engine XJ and XK8 vehicles operate in a similar fashion and share most components. Important differences between the systems are outlined in this book.



**AIR CONDITIONING / REFRIGERATION SYSTEM**

**Condenser**

Refrigerant flow through the condenser differs between the AJ16 and the V12 condensers.



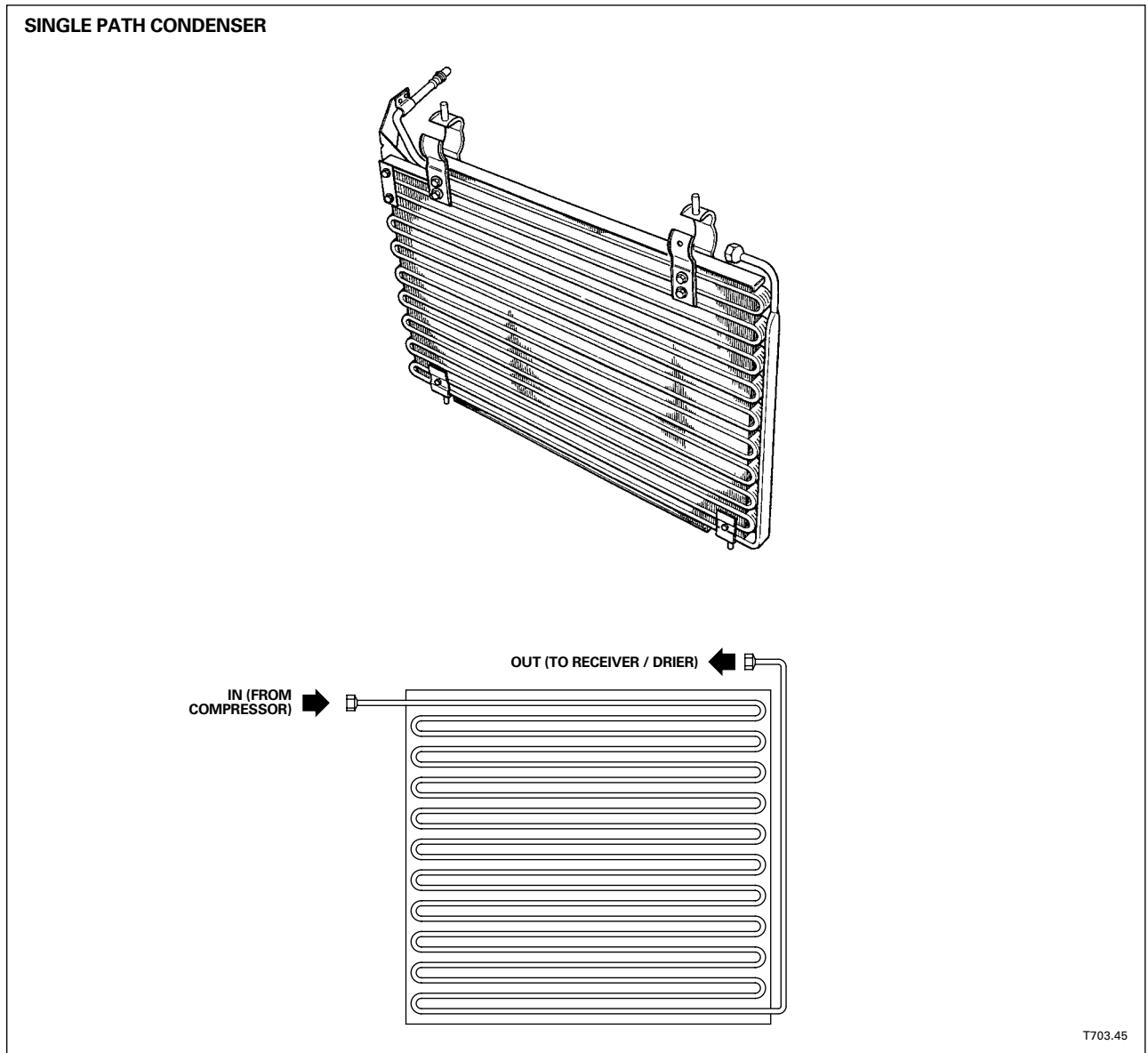
**NOTES**

## AIR CONDITIONING / REFRIGERATION SYSTEM

### Condenser (continued)

#### AJ16 Condenser (Single Path)

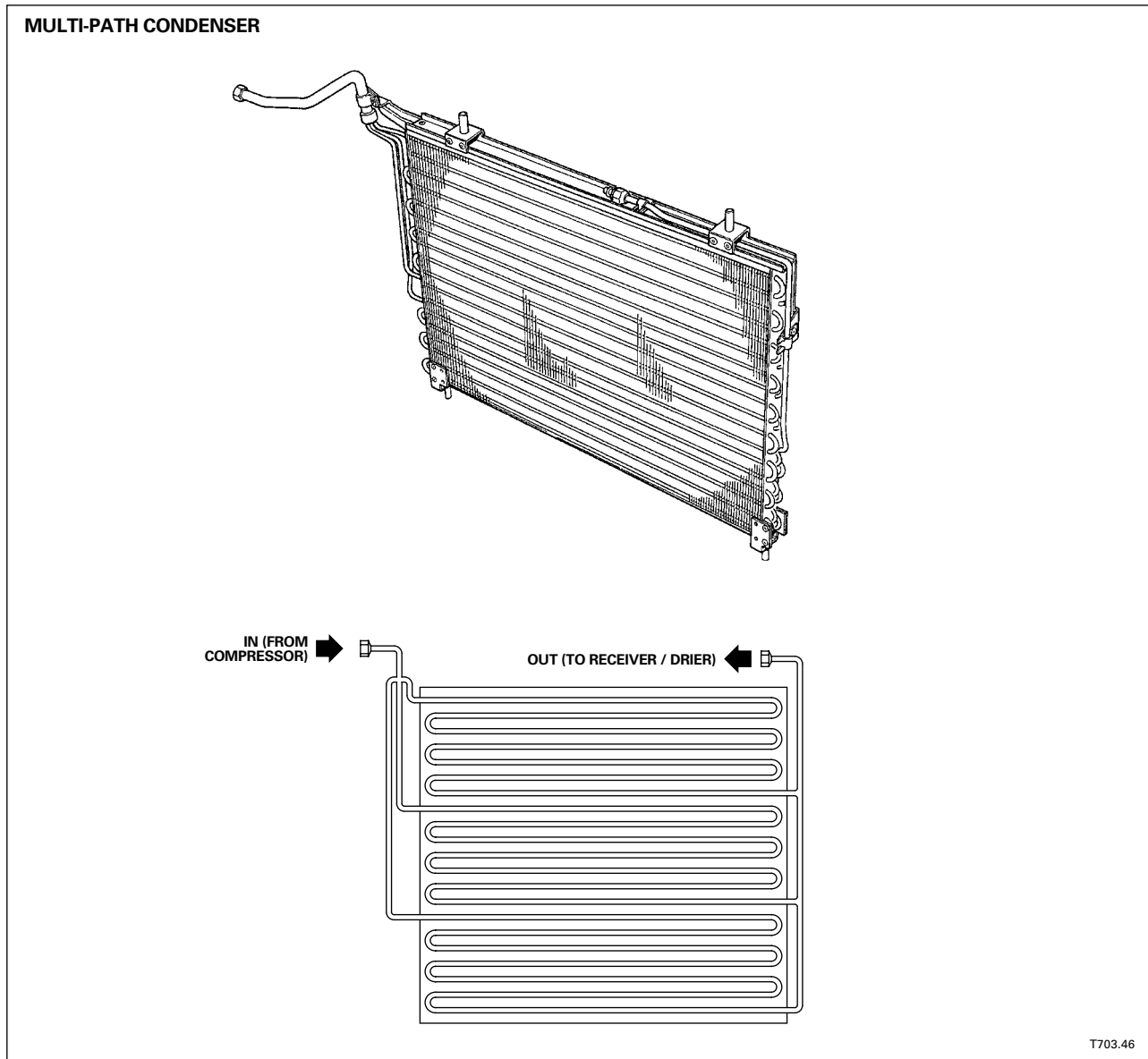
Refrigerant flows through the condenser in a single path from top to bottom.



### NOTES

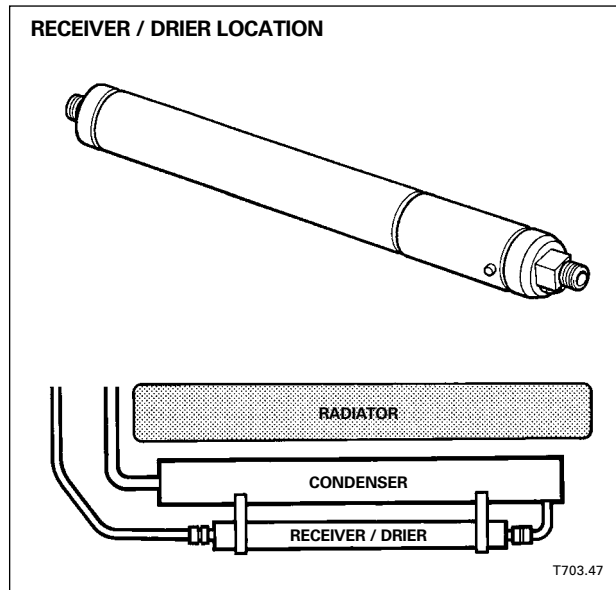
### V12 Condenser (Multi-Path)

Refrigerant flows through the condenser in separate paths starting at one side and exiting at the other.



### NOTES

## AIR CONDITIONING / REFRIGERATION SYSTEM



### Receiver / Drier

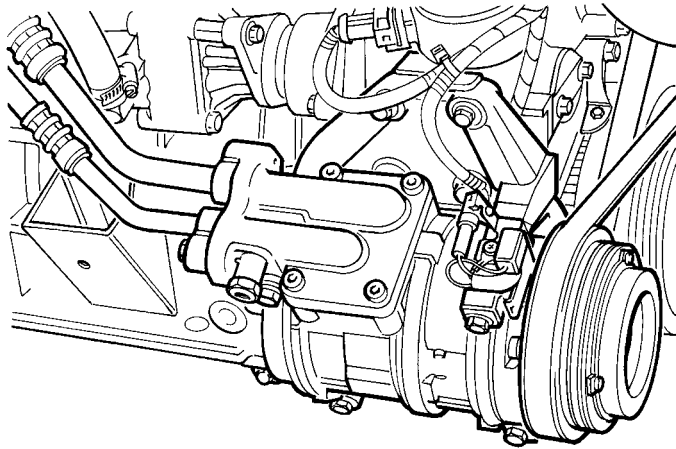
On AJ16 an V12 installations the receiver / drier is horizontally mounted at the top of the condenser.

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### NOTES

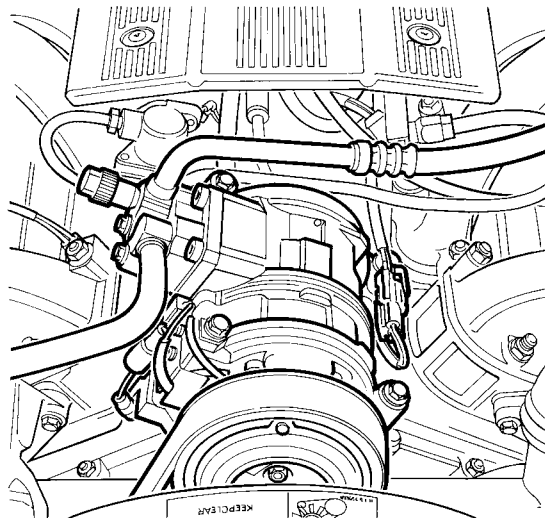
## Compressor

**AJ16 COMPRESSOR LOCATION**



T703.55

**XJ12 6.0L COMPRESSOR LOCATION**



T703.54

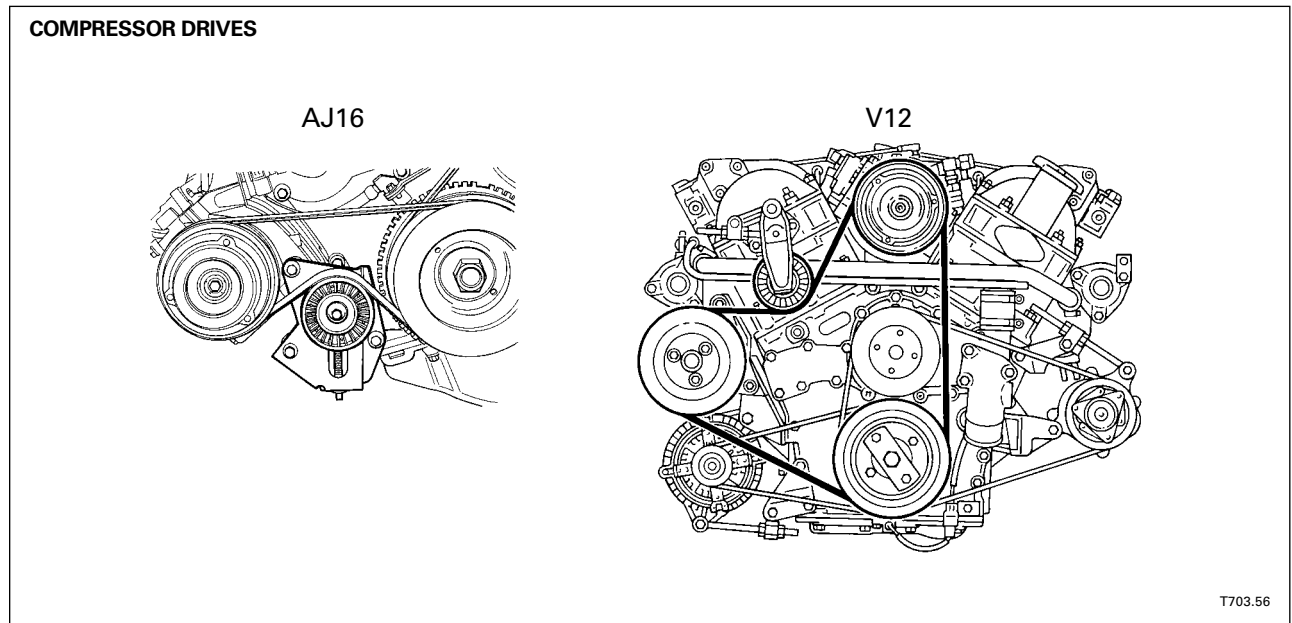
## NOTES

## AIR CONDITIONING / REFRIGERATION SYSTEM

### Compressor (continued)

#### Compressor Drive Belt Adjustment

Both AJ16 and V12 engine drive belts use adjustable idler pulleys for belt tensioning. The AJ16 tensioner operates in a slotted bracket. The V12 tensioner operates on a pivoting bracket.



#### NOTES

## Compressor Clutch Control

### AJ16

The ECM may delay compressor clutch engagement for four seconds depending on engine operating temperature.

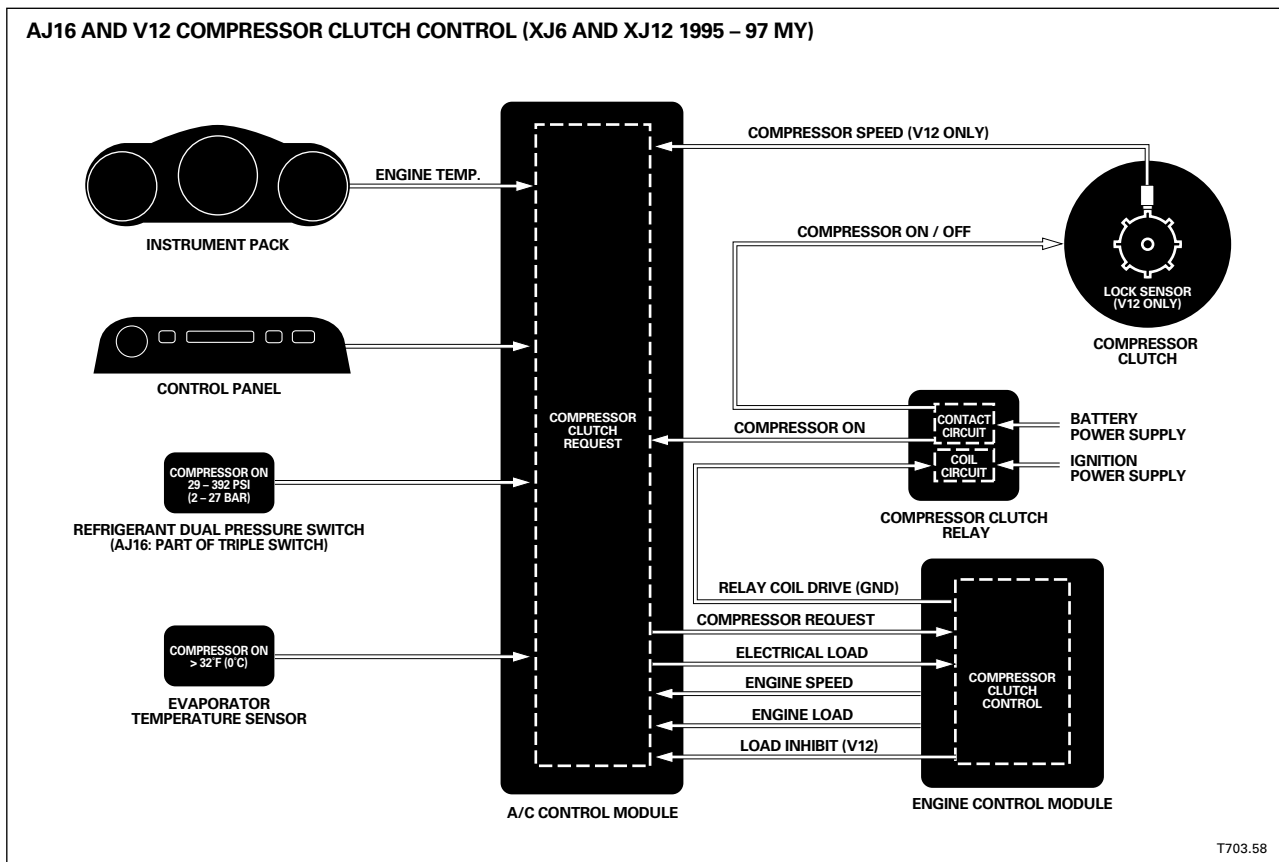
### V12

The ECM inhibits compressor operation under the following conditions:

- Engine coolant temperature above 120 °C (248 °F).
- Engine speed below 500 rpm – the compressor is switched on again 20 seconds after the engine speed reaches 566 rpm.
- Full throttle operation – the compressor is switched off for 15 seconds. It is switched on again after 15 seconds or when the ECM no longer “sees” full throttle.

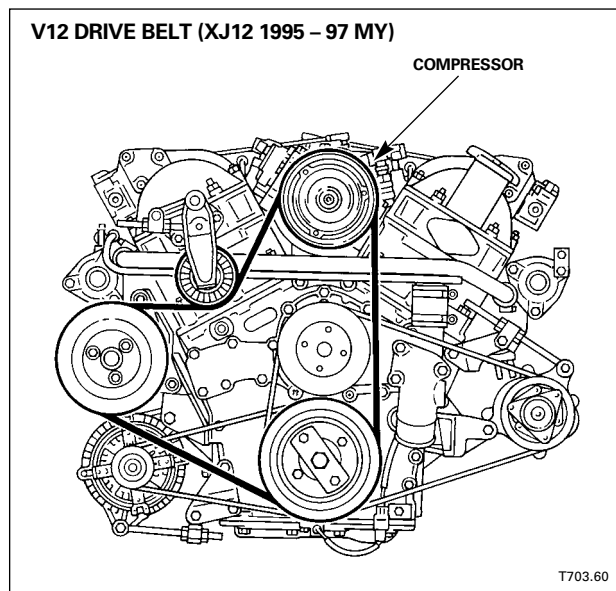
## Compressor Clutch Diagnostic Monitoring

In V12 systems, the A/CCM monitors for compressor lock conditions when the B+ signal is present. No default valve is used for this signal. There is no compressor lock sensor in AJ16 systems.



## NOTES

## AIR CONDITIONING / REFRIGERATION SYSTEM



### Compressor Lock Sensor (V12 only)

Because the power steering pump and air conditioning compressor are driven by the same belt on the V12, a compressor lock sensor is installed to provide the A/CCM with an input to verify correct operation.

### NOTES

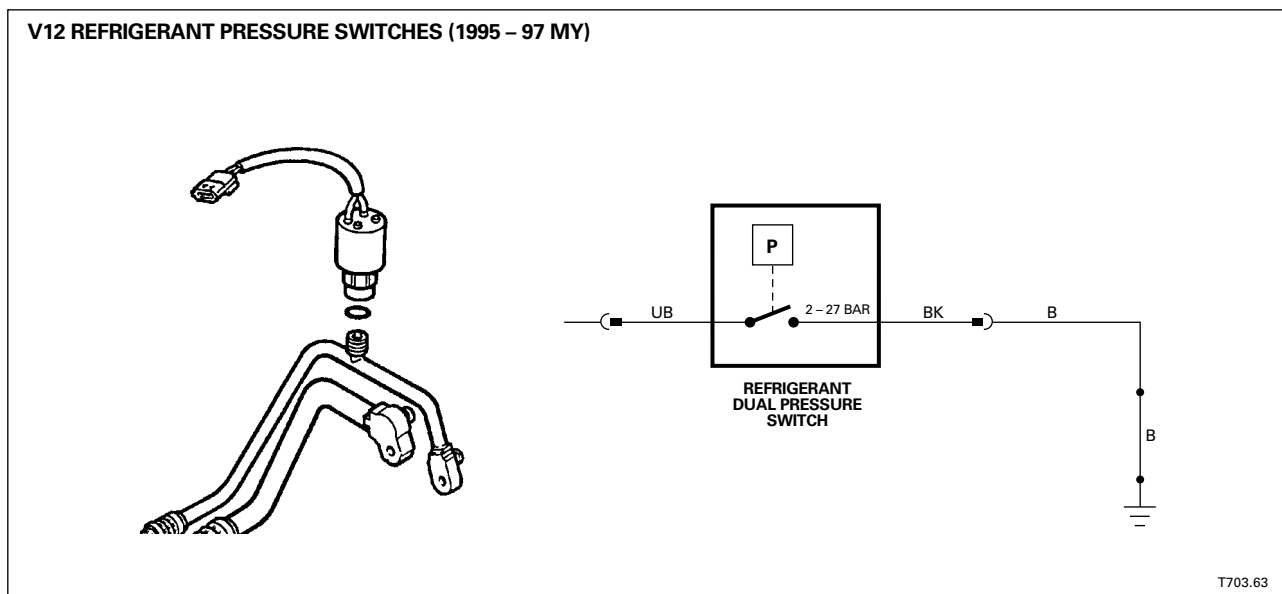
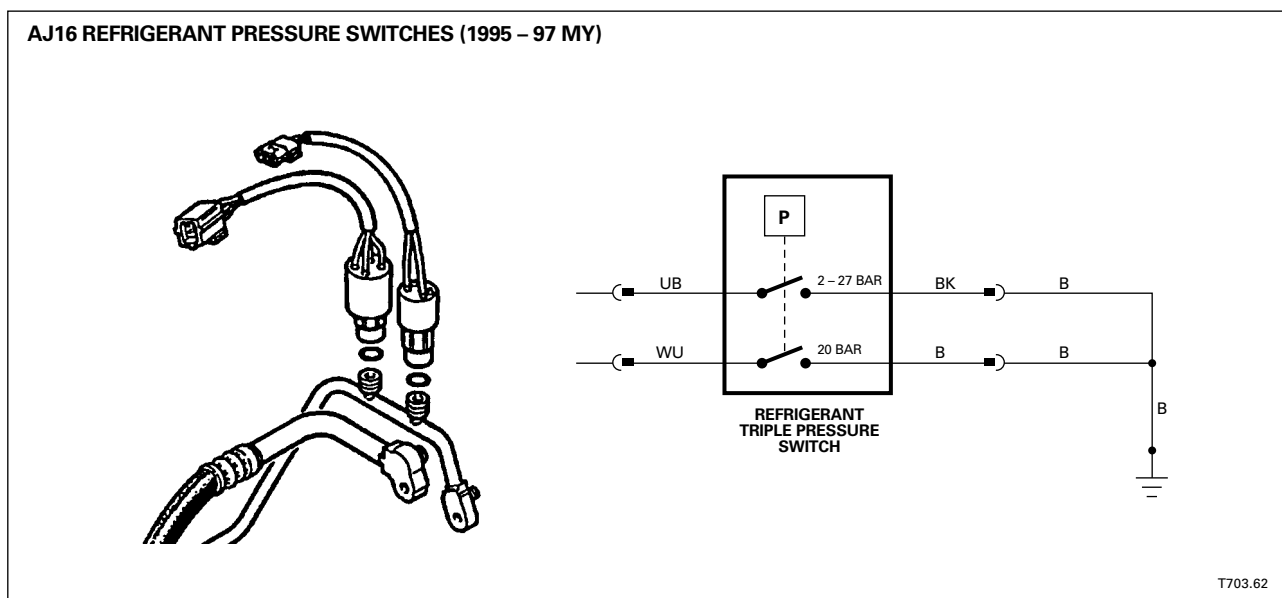


## Refrigerant Pressure Switches

If the refrigerant pressure is low or high, the refrigerant dual pressure switch contacts will open to signal the A/CCM to switch the compressor off. Low pressure can result from a system leak or low ambient temperature. High pressure can be caused by poor system performance, system blockage, or high ambient temperature.

On AJ16, the pressure switch is part of the triple pressure switch. Refrigerant pressure must be between 2 – 27 bar (29 – 392 psi) for the switch contacts to remain closed and provide a ground signal to the A/CCM. The radiator cooling fans are switched from low to high speed by the other set of contacts in the triple pressure switch.

The refrigerant pressure switch(es) are located close to the engine bulkhead on the right side.



### COOLING FAN CONTROL

#### Cooling Fan Control – AJ16

The radiator and condenser cooling fans are controlled by both radiator coolant temperature and air conditioning refrigerant pressure. Fan operation depends on the cooling air flow requirement. At lower coolant temperature / refrigerant pressure, both fans operate at low speed (in series); at high coolant temperature / refrigerant pressure, both fans operate at high speed (in parallel). The refrigerant triple pressure switch contains a pressure contact set for high speed fan drive. A separate refrigerant single pressure switch is used for low speed fan drive. Fan speed switching is accomplished through a fan control relay module. For engine coolant temperature, a radiator thermostatic switch with two sets of contacts – one for slow speed fan drive and one for high speed fan drive is used.

#### Low Speed Fan Operation

Both fans run at low speed (in series) when the radiator coolant temperature reaches 86 °C (187 °F) and / or the refrigerant pressure reaches 12 bar (174 psi).

#### High Speed Fan Operation

Both fans run at high speed (in parallel) when the radiator coolant temperature reaches 100 °C (212 °F) and / or the refrigerant pressure reaches 20 bar (290 psi).

Beginning with VIN 761570, the refrigerant single pressure switch has been deleted from AJ16 engine vehicles. The cooling fans run continuously when the ignition is switched to position II.

#### Cooling Fan Control – V12

The radiator and condenser cooling fans are controlled by radiator coolant temperature. The V12 uses the same dual temperature radiator thermostatic switch and fan control relay module as the AJ16.

#### Low Speed Fan Operation

Both fans run at low speed when the radiator coolant temperature reaches 86 °C (187 °F).

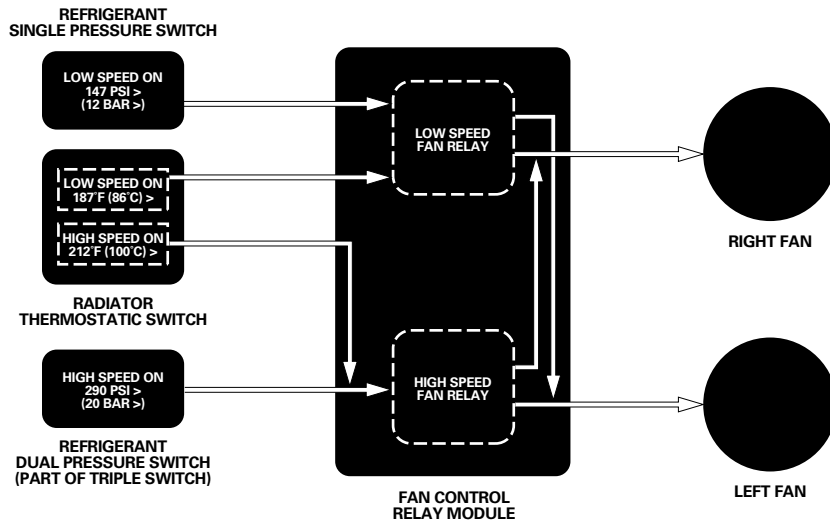
#### High Speed Fan Operation

Both fans run at high speed when the radiator coolant temperature reaches 100 °C (212 °F).

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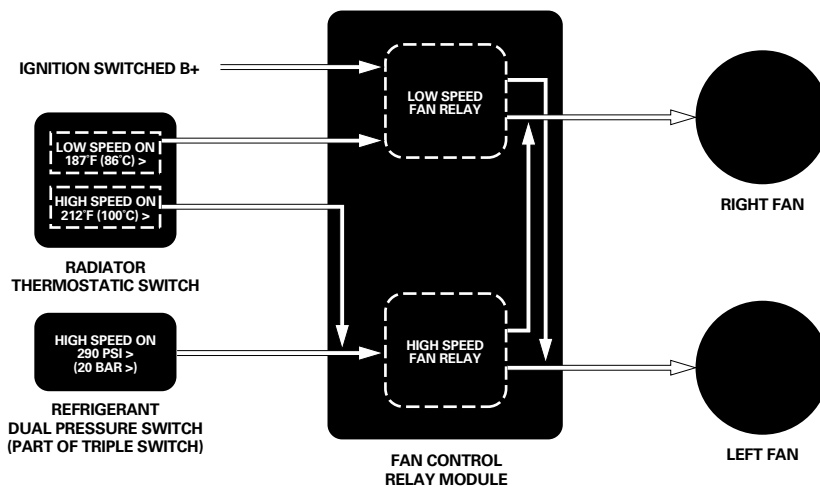
#### NOTES

## AJ16 COOLING FAN CONTROL UP TO VIN 761569 (XJ6 1995 – 97 MY)



T703.66

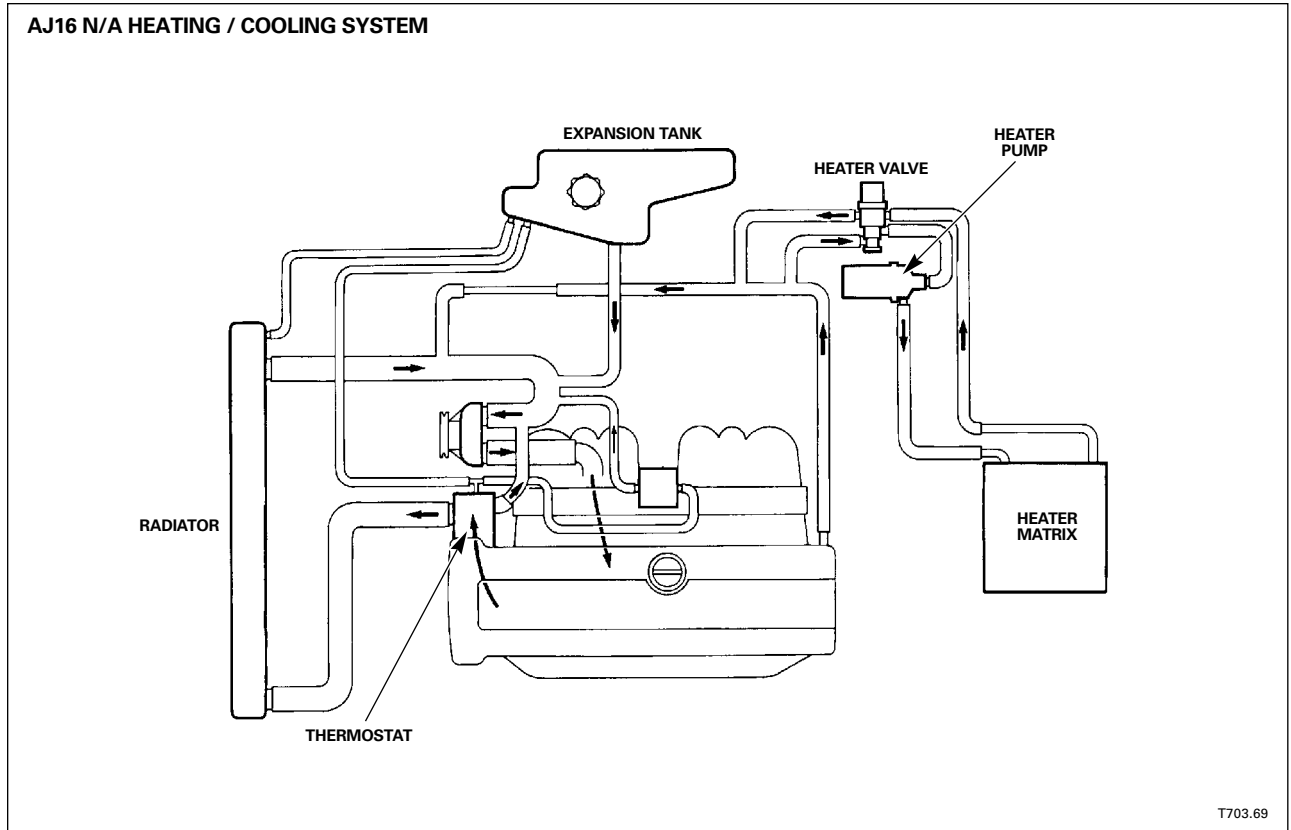
## AJ16 COOLING FAN CONTROL FROM VIN 761570 (XJ6 1995 – 97 MY)



T703.67

## HEATING / COOLING SYSTEM

The AJ16 and V12 heating systems function similarly to the AJV8 heating system.



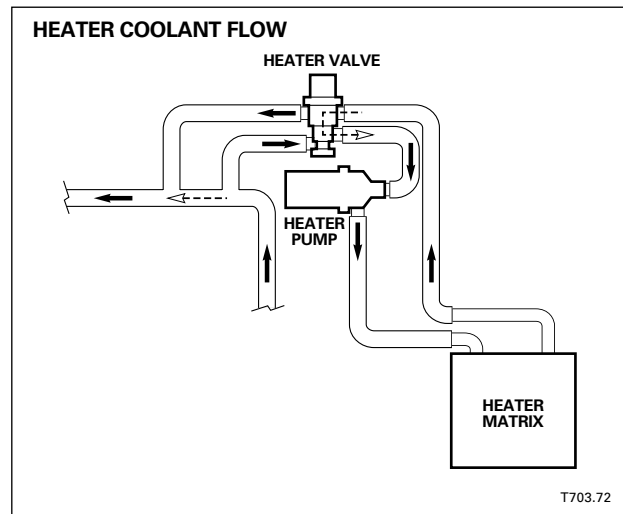
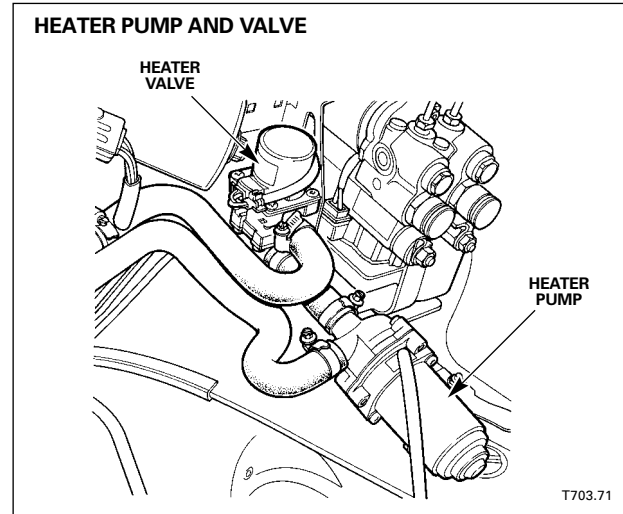
### NOTES

## Heater Pump Diagnostic Monitoring

Heater pump diagnostic monitoring occurs only on 1995 MY vehicles up to VIN 739425. These vehicles use a high current draw motor with the ground circuit completed through the A/CCM. By monitoring the ground voltage, the A/CCM can detect when a pump motor failure has occurred (pump locked or ground circuit open). Vehicles from VIN 739426 use a lower current draw motor and no A/CCM diagnostic monitoring. The pump motor ground circuit is completed directly to ground.

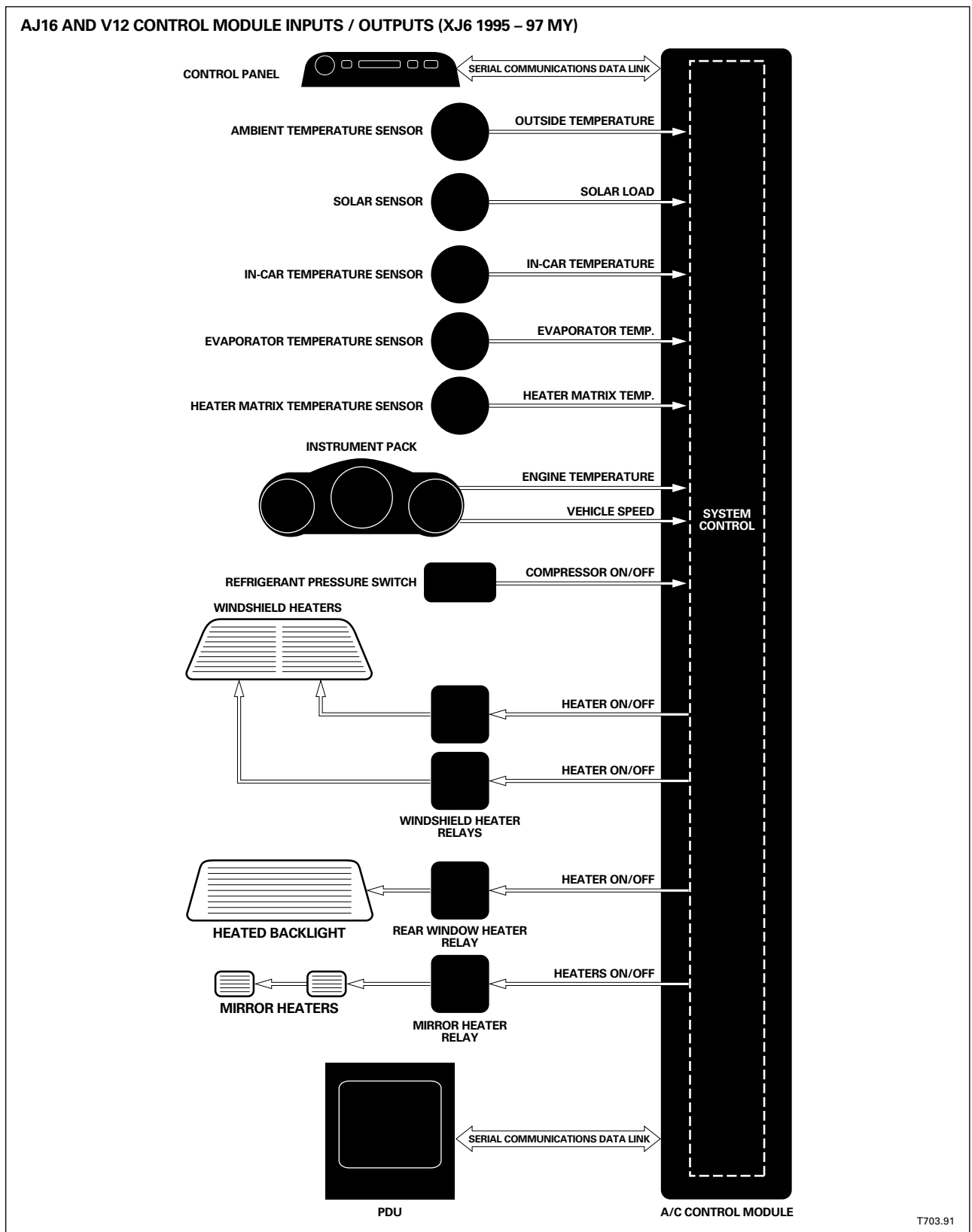
DTCs	
WDS	Control Panel
B1968	None

### NOTES

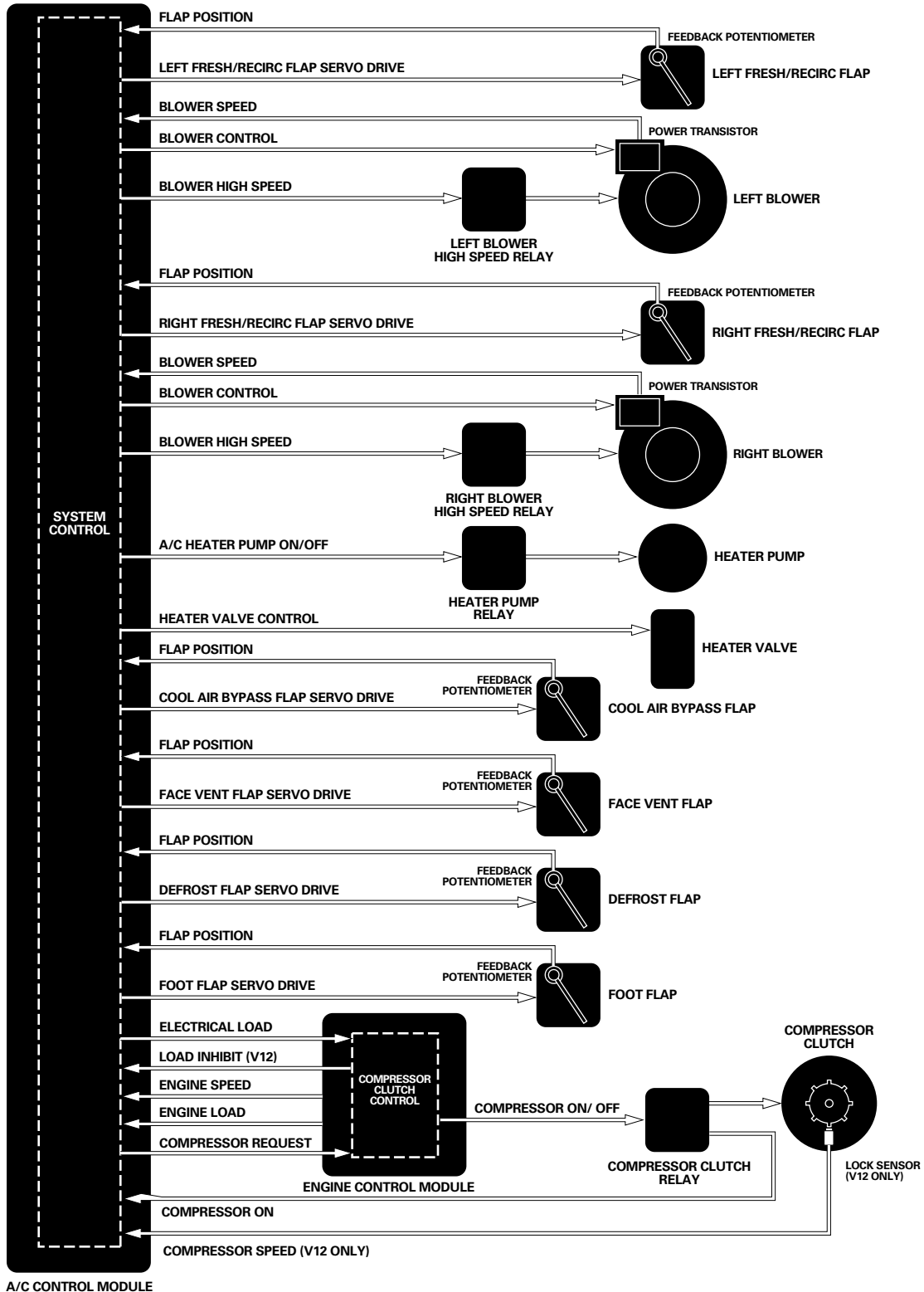


# AJ16/V12 CLIMATE CONTROL

## SYSTEM LOGIC



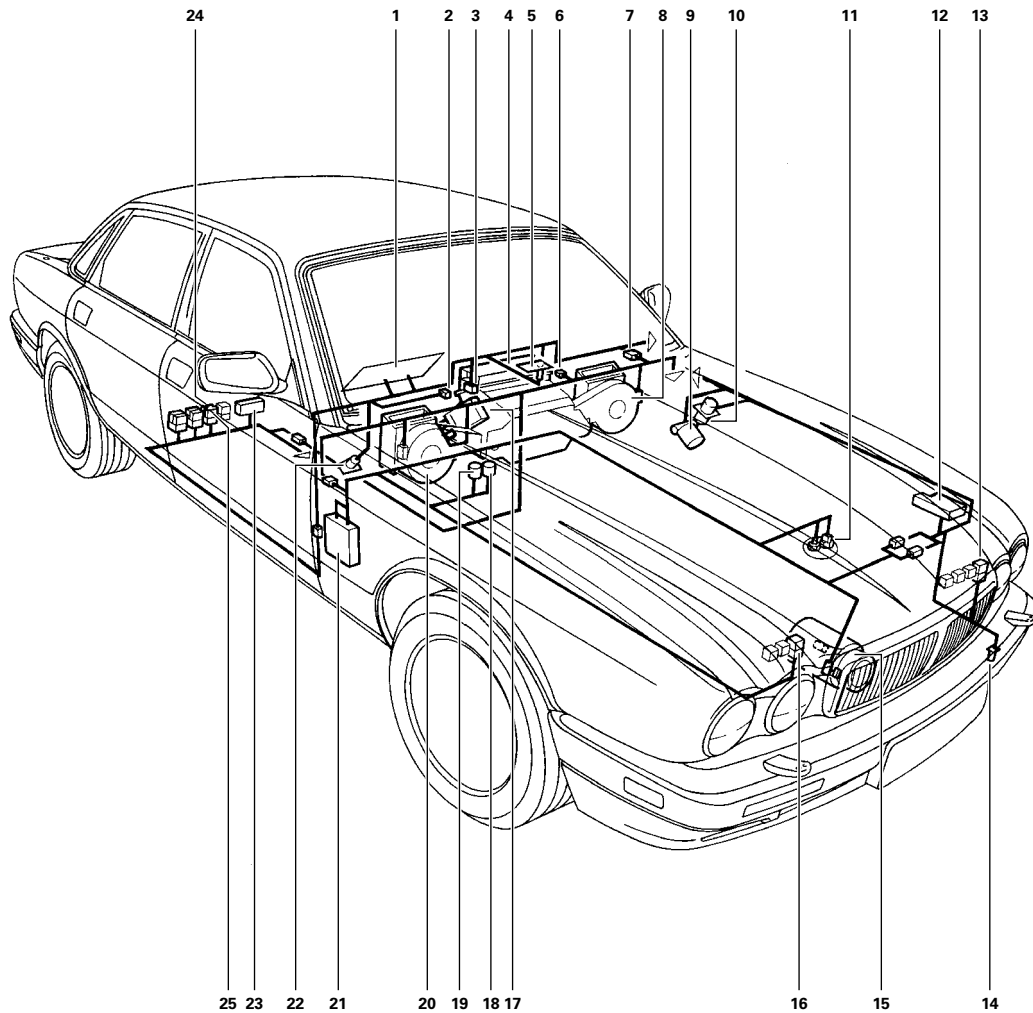
## AJ16 AND V12 CONTROL MODULE INPUTS / OUTPUTS (XJ6 1995 – 97 MY)



T703.92

## COMPONENT LOCATION

AJ16 AND V12 CLIMATE CONTROL COMPONENTS (XJ 1995 – 97 MY) (RIGHT-HAND DRIVE SHOWN)



- |                               |  |
|-------------------------------|--|
| 1 INSTRUMENT PACK             | 14 AMBIENT TEMPERATURE SENSOR                                  |
| 2 FASCIA SWITCHPACK CONNECTOR | 15 COMPRESSOR  |
| 3 DEFROST SERVO               | 16 COMPRESSOR CLUTCH RELAY                                     |
| 4 AIR DISTRIBUTION BOX        | 17 AIR CONDITIONING CONTROL MODULE                             |
| 5 SOLAR SENSOR                | 18 TRIPLE PRESSURE SWITCH (AJ16)<br>DUAL PRESSURE SWITCH (V12) |
| 6 CONTROL PANEL CONNECTOR     | 19 SINGLE PRESSURE SWITCH (AJ16)                               |
| 7 CENTER CONSOLE CONNECTOR    | 20 RIGHT SIDE BLOWER   |
| 8 LEFT SIDE BLOWER            | 21 ENGINE CONTROL MODULE                                       |
| 9 HEATER PUMP                 | 22 ASPIRATOR AND IN-CAR TEMPERATURE SENSOR                     |
| 10 HEATER VALVE               | 23 A/C ISOLATE RELAY   |
| 11 COOLANT TEMPERATURE SENSOR | 24 LEFT SIDE BLOWER RELAY                                      |
| 12 LEFT SIDE FRONT FUSE BOX   | 25 RIGHT SIDE BLOWER RELAY                                     |
| 13 HEATER PUMP RELAY          |  |

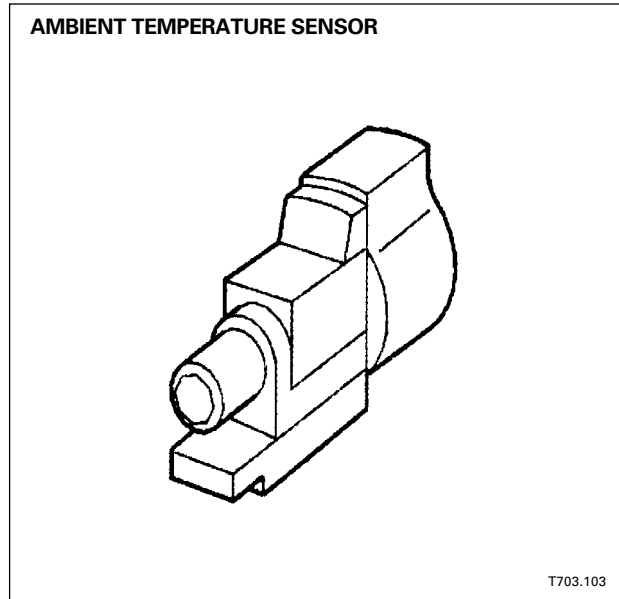
T703.95



## TEMPERATURE CONTROL SENSORS

### Ambient Temperature Sensor

The NTC (negative temperature coefficient) ambient temperature sensor, located in the left hand front brake air cooling duct, provides the A/CCM with a voltage signal representing the ambient air temperature.



### NOTES

### VEHICLE SYSTEMS INTERFACES

#### Engine Load (V12 only)

The ECM outputs an engine load ground signal to the A/CCM if it detects fluctuation in the idle speed or a high engine load. In response, the A/CCM inhibits operation of blower motor high speed and / or window and mirror heaters for a maximum of 15 seconds. No heater operation occurs during high engine load.

The A/CCM does not monitor the engine load circuit for diagnostics.

#### Engine Speed

The A/CCM receives an engine speed signal from the ECM. The A/CCM uses the engine speed signal for the following functions:

- Heater pump control
- Heater valve control
- Windshield, backlight and mirror heaters operation
- Compressor lock sensing (V12 only)
- Diagnostics

---

#### NOTES

## STUDENT PROFICIENCY POST-TEST

Name \_\_\_\_\_ Date \_\_\_\_\_

Dealer \_\_\_\_\_ Score \_\_\_\_\_

**Read each question carefully. Place an "X" in the space next to the correct answer. This is an open book test and all paper and electronic resources are allowed.**

- Concerning a 2000 XK8, Technician A states that the climate control panel can be used to access all the climate control related DTCs. Technician B states that the climate control module controls the heater matrix temperature by monitoring the heater matrix temperature sensor and controlling the speed of the heater pump. Who is correct?  
 A) Technician A only  
 B) Technician B only  
 C) Technician A and B are both correct  
 D) Neither technician A or B
- Concerning a 2001 XJ8, Technician A states that the ECM activates the compressor clutch relay ON. Technician B states that the compressor will operate if the evaporator sensor has an open circuit fault. Who is correct?  
 A) Technician A only  
 B) Technician B only  
 C) Neither technician A or B  
 D) Technician A and B are both correct
- Concerning an XJ8, Technician A states that the four way refrigerant pressure switch signals are used to control cooling fan speed. Technician B states that the four way pressure switch signals are used to inhibit compressor clutch activation for high and low-pressure conditions on an XK8. Who is correct?  
 A) Technician A only  
 B) Technician B only  
 C) Neither technician A or B  
 D) Technician A and B are both correct
- The water valve duty cycle on a 2000 XJ8 is 105%. This reading indicates:  
 A) The water valve is not allowing hot coolant into the heater core.  
 B) The water valve is allowing hot coolant into the heater core.  
 C) Full cold is selected on the control panel.  
 D) The vehicle is in fail-safe engine cooling mode.

## STUDENT PROFICIENCY POST-TEST

5. When using data logger on WDS to observe the flap actuators on a 2001 S-TYPE, the following readings were obtained. (Temperature demand full cold, FACE selected on the control panel, 95°F ambient temperature.)

Cold air bypass	185
Panel	167
Fresh/recirc	40
Defrost	60

What do these readings indicate?

- A) The panel flap is stuck closed.
- B) Cold air bypass flap is allowing air through the heater core.
- C) The cold air bypass flap is allowing air to go around the heater core.
- D) The defrost flap is allowing maximum de humidified air on to the window.
6. When replacing the A/CCM on a 2000-2002 S-TYPE, you should use WDS to configure it for:
- A) Navigation equipped or non navigation.
- B) Engine size, Heated Wiper Park or heated front windscreen.
- C) Heated rear glass, electrochromic rear view mirrors.
- D) Automatic or manual transmission.
- E) All the above.
7. Concerning a 2001 S-TYPE, Technician A states that the engine must be running before the glass heaters will operate. Technician B states that the engine must be running for the engine cooling fans to operate. Who is correct?
- A) Technician A only
- B) Technician B only
- C) Technician A and B are both correct
- D) Neither technician A or B
8. The Cool air bypass servo on an S-TYPE has failed open circuit. Which DTC will be stored?
- A) B1262
- B) B1318
- C) B1342
- D) B1265
9. What would the customer complaint be if the blower sense wire were open circuit on a 2001 X-TYPE?
- A) Lack of heating.
- B) In sufficient cooling.
- C) Control panel flashes ER when the vehicle is first started.
- D) In sufficient cooling in automatic mode only.

10. When using WDS data logger to monitor the RECIRCULATION motor on a 2002 X-TYPE, the digital display reading is 3. This indicates:
- A) The motor is in the process of moving the flap.
  - B) The motor has stopped moving the flap.
  - C) The flap is closed.
  - D) The flap motor has a fault, this is a DTC.
11. Which of the following is true, concerning an X-TYPE climate control system:
- A) The HSLP (high side low-pressure switch) is used to protect the compressor from low pressure.
  - B) The pressure transducer is used to protect the system from high pressure (above 30 Bar/441 PSI)
  - C) The orifice tube cannot be serviced separately from the evaporator jumper pipe.
  - D) The heater matrix sensor input is used for blower speed control, in automatic mode.
12. Which of the following sensors are not used on an X-TYPE:
- A) Solar sensor
  - B) Ambient sensor
  - C) Heater matrix sensor
  - D) In car temperature sensor
  - E) Air discharge temperature sensor
13. Concerning a replacement compressor on a 2000 MY Jaguar, Technician A states that one should always add 4 ounces of fresh oil to the system. Technician B states that additional oil is not necessary. Who is correct?
- A) Technician A only
  - B) Technician B only
  - C) Neither technician A or B
  - D) Technician A and B are both correct
14. Concerning an expansion valve system, Technician A states that the refrigerant leaving the receiver drier is a low temperature low pressure liquid. Technician B states the refrigerant leaving the receiver drier is a low-pressure low temperature gas/vapor. Who is correct?
- A) Technician A only
  - B) Technician B only
  - C) Technician A and B are both correct
  - D) Neither technician A or B
15. Concerning an orifice tube system, Technician A states that the refrigerant leaving the accumulator is a low temperature low-pressure vapor. Technician B states that the refrigerant leaving the accumulator is a low-pressure low temperature liquid. Who is correct?
- A) Technician A only
  - B) Technician B only
  - C) Technician A and B are both correct
  - D) Neither technician A or B

