

PUBLISHED: 10-OCT-2019  
2020.0 DEFENDER (LE), 412-01

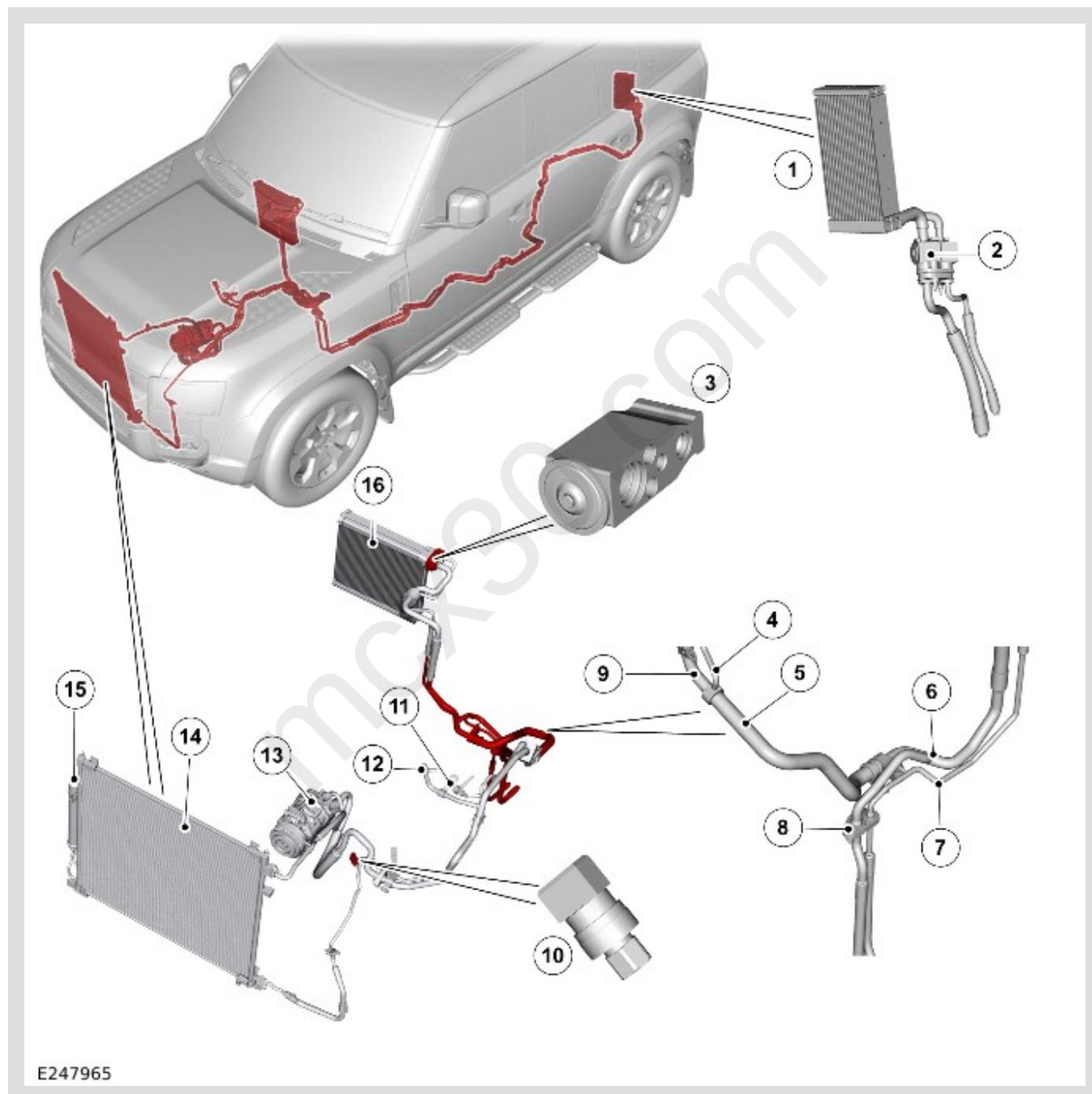
CLIMATE CONTROL

# AIR CONDITIONING (G2342522)

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## COMPONENT LOCATION

## COMPONENT LOCATION - 1 OF 2 - VEHICLES WITH AUXILIARY CLIMATE CONTROL

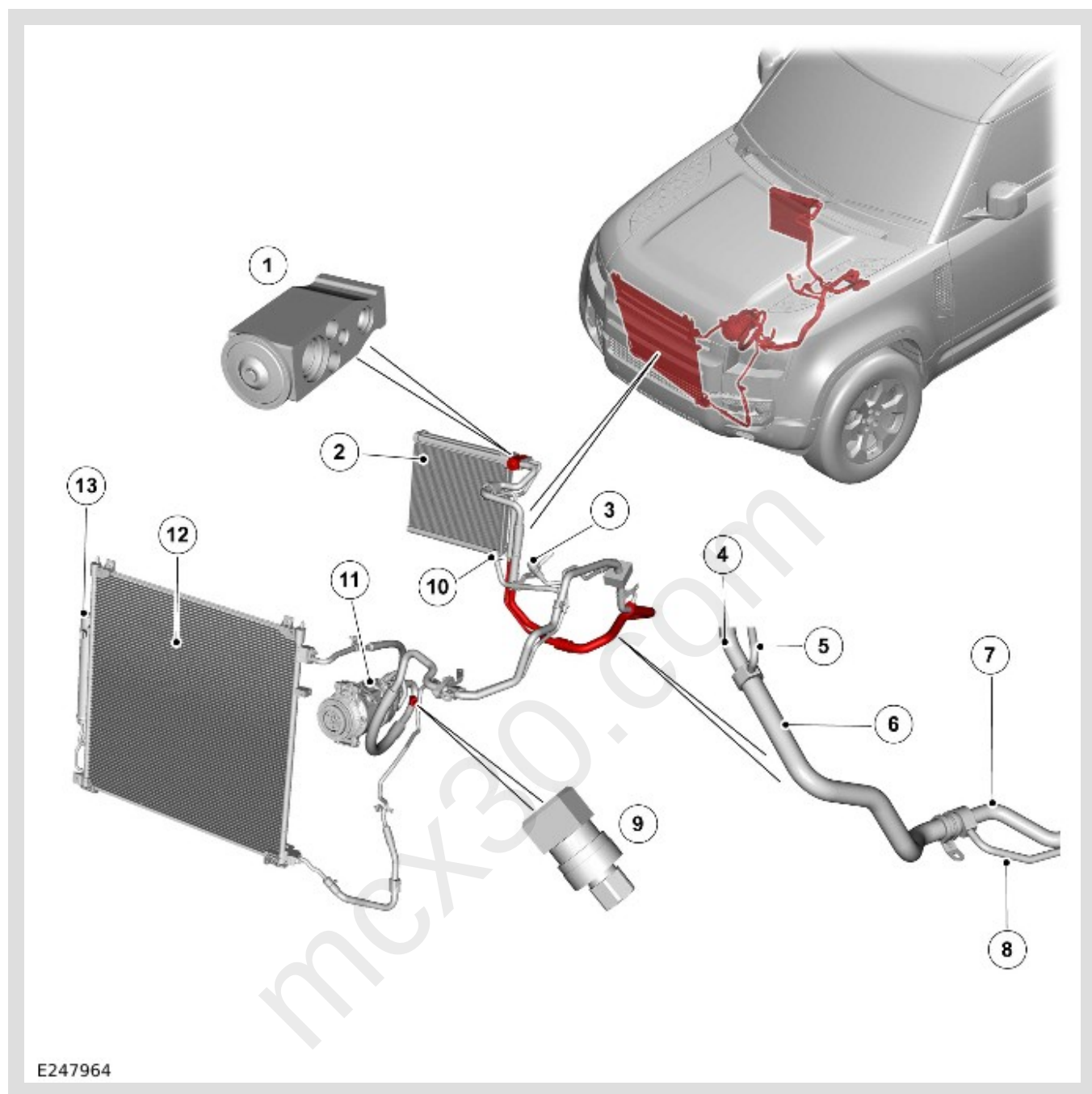


E247965

| ITEM | DESCRIPTION                                                                      |
|------|----------------------------------------------------------------------------------|
| 1    | Auxiliary evaporator                                                             |
| 2    | Auxiliary climate control isolation valve and Thermostatic Expansion Valve (TXV) |

| ITEM | DESCRIPTION                                                                  |
|------|------------------------------------------------------------------------------|
| 3    | TXV                                                                          |
| 4    | High Pressure (HP) pipe                                                      |
| 5    | Internal Heat Exchanger (IHX)                                                |
| 6    | Low Pressure (LP) pipe                                                       |
| 7    | HP pipe                                                                      |
| 8    | Connections for the rear refrigerant pipes for the auxiliary climate control |
| 9    | LP pipe                                                                      |
| 10   | Refrigerant pressure sensor                                                  |
| 11   | HP servicing connection                                                      |
| 12   | LP servicing connection                                                      |
| 13   | Air Conditioning (A/C) compressor                                            |
| 14   | A/C condenser                                                                |
| 15   | A/C receiver dryer                                                           |
| 16   | Evaporator                                                                   |

# COMPONENT LOCATION - 2 OF 2 - VEHICLES WITHOUT AUXILIARY CLIMATE CONTROL



E247964

| ITEM | DESCRIPTION                             |
|------|-----------------------------------------|
| 1    | Thermostatic Expansion Valve (TXV)      |
| 2    | Evaporator                              |
| 3    | High Pressure (HP) servicing connection |
| 4    | Low Pressure (LP) pipe                  |
| 5    | HP pipe                                 |
| 6    | Internal Heat Exchanger (IHX)           |
| 7    | LP pipe                                 |

| ITEM | DESCRIPTION                       |
|------|-----------------------------------|
| 8    | HP pipe                           |
| 9    | Refrigerant pressure sensor       |
| 10   | LP servicing connection           |
| 11   | Air Conditioning (A/C) compressor |
| 12   | A/C condenser                     |
| 13   | A/C receiver dryer                |

## OVERVIEW

The Air Conditioning (A/C) system transfers heat from the passenger compartment to the outside atmosphere to provide the climate control assembly with dehumidified cool air.

The A/C system is a sealed closed loop system, filled with refrigerant as the heat transfer medium. Refrigerant oil is added to the refrigerant to lubricate the internal components of the A/C compressor.

Depending on the market specification, 2 different types of refrigerant used in the A/C system:

- R1234yf refrigerant is used in North American Specification (NAS) and European markets.
- R134a refrigerant is used in the Rest Of World (ROW) markets.

For additional information, refer to: [Specifications](#) (412-01 Climate Control, Specifications).

The A/C compressor is a variable displacement unit, where the displacement (flow of refrigerant) is controlled to match the thermal load of the evaporator.

The operation of the A/C system is controlled by the HVAC control module.

For additional information, refer to: [Control Components](#) (412-01 Climate Control, Description and Operation).

The auxiliary climate control assembly is available as:

- Optional equipment on vehicles with 2 rows of seats.
- Standard equipment on vehicles with third row seats.

The auxiliary climate control assembly is used to enhance the A/C system performance for second and third row seat passengers.

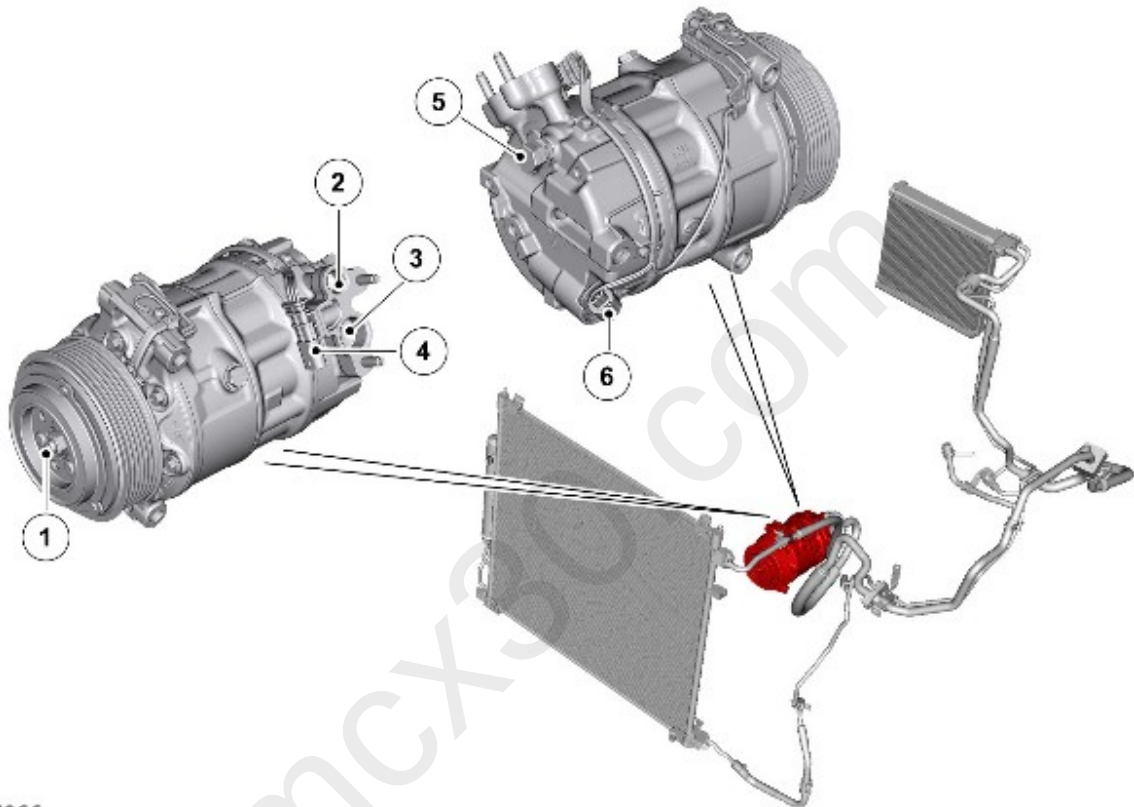
For additional information, refer to: [Auxiliary Climate Control](#) (412-02 Auxiliary Climate Control, Description and Operation).

## DESCRIPTION

### AIR CONDITIONING COMPRESSOR

#### NOTE:

Vehicles without auxiliary climate control are shown, vehicles with auxiliary climate control are similar.



| ITEM | DESCRIPTION                 |
|------|-----------------------------|
| 1    | Pulley                      |
| 2    | Outlet connection           |
| 3    | Inlet connection            |
| 4    | Electrical connector        |
| 5    | Pressure Relief Valve (PRV) |
| 6    | Electrical connector        |

The Air Conditioning (A/C) compressor is a variable displacement unit, attached to the front left of the engine with 3 bolts. The A/C compressor circulates the refrigerant around the A/C system by compressing Low Pressure (LP) vapor

from the evaporator. The A/C compressor then discharges the resultant High Pressure (HP) vapor to the A/C condenser.

To protect the A/C system from excessive pressure, a Pressure Relief Valve (PRV) is installed in the outlet of the A/C compressor. The PRV vents excess pressure into the engine compartment.

The A/C compressor is driven by the accessory drive belt through an electro-magnetic clutch in the compressor pulley. The HVAC control module controls the operation of the electro-magnetic clutch. The HVAC control module controls an integral electronic control valve within the A/C compressor to control the displacement of the A/C compressor. The HVAC control module changes the displacement of the A/C compressor, between the minimum and maximum, to match the thermal load of the evaporator.

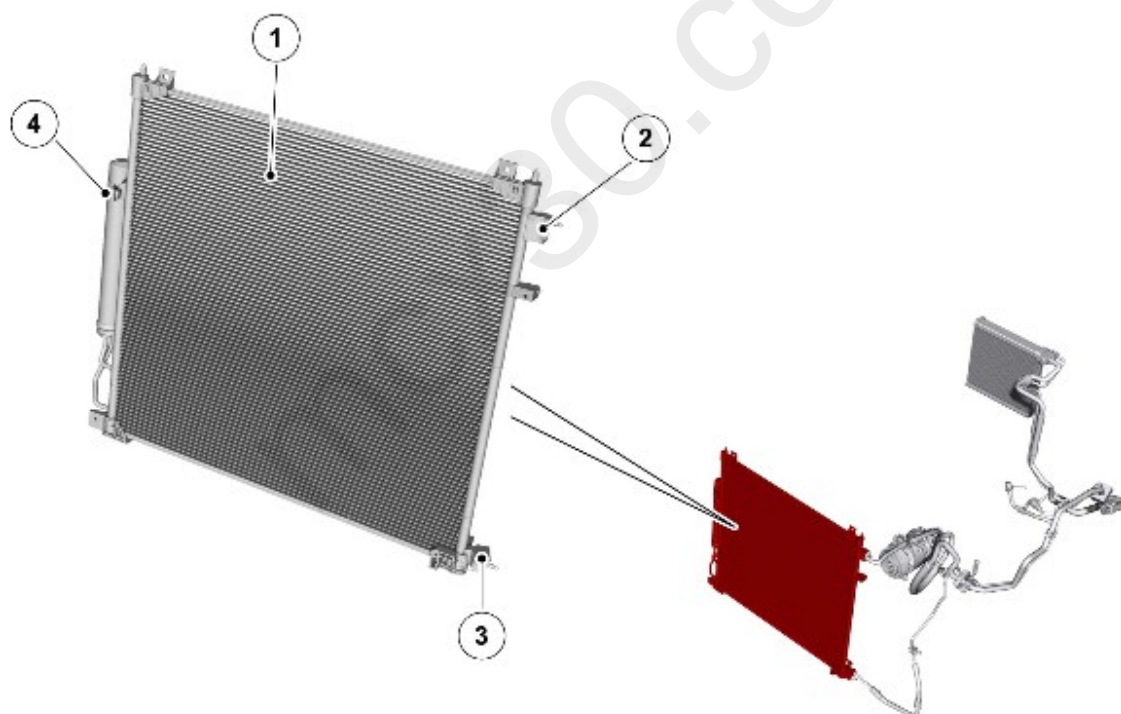
For additional information, refer to: [Control Components](#) (412-01 Climate Control, Description and Operation).

#### AIR CONDITIONING CONDENSER



#### NOTE:

Vehicles without auxiliary climate control are shown, vehicles with auxiliary climate control are similar.



E247967

| ITEM | DESCRIPTION                      |
|------|----------------------------------|
| 1    | Air Conditioning (A/C) condenser |
| 2    | High Pressure (HP) vapor inlet   |

| ITEM | DESCRIPTION        |
|------|--------------------|
| 3    | HP liquid outlet   |
| 4    | A/C receiver dryer |

The Air Conditioning (A/C) condenser is installed immediately in front of the radiator. The A/C condenser converts the High Pressure (HP) vapor from the compressor into a liquid.

The A/C condenser consists of a fin and pipe heat exchanger core. The heat exchanger separates into a 4-pass upper section and a 2-pass lower section.

### Air Conditioning Receiver Dryer

The Air Conditioning (A/C) receiver dryer is attached to the 2 stub pipes on the right end tank of the A/C condenser. The A/C receiver dryer removes solid impurities and moisture from the refrigerant. The A/C receiver dryer also acts as a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

Refrigerant entering the A/C receiver dryer passes through a filter and a desiccant bag. The refrigerant then collects in the base of the unit before flowing through the outlet pipe back to the A/C condenser.

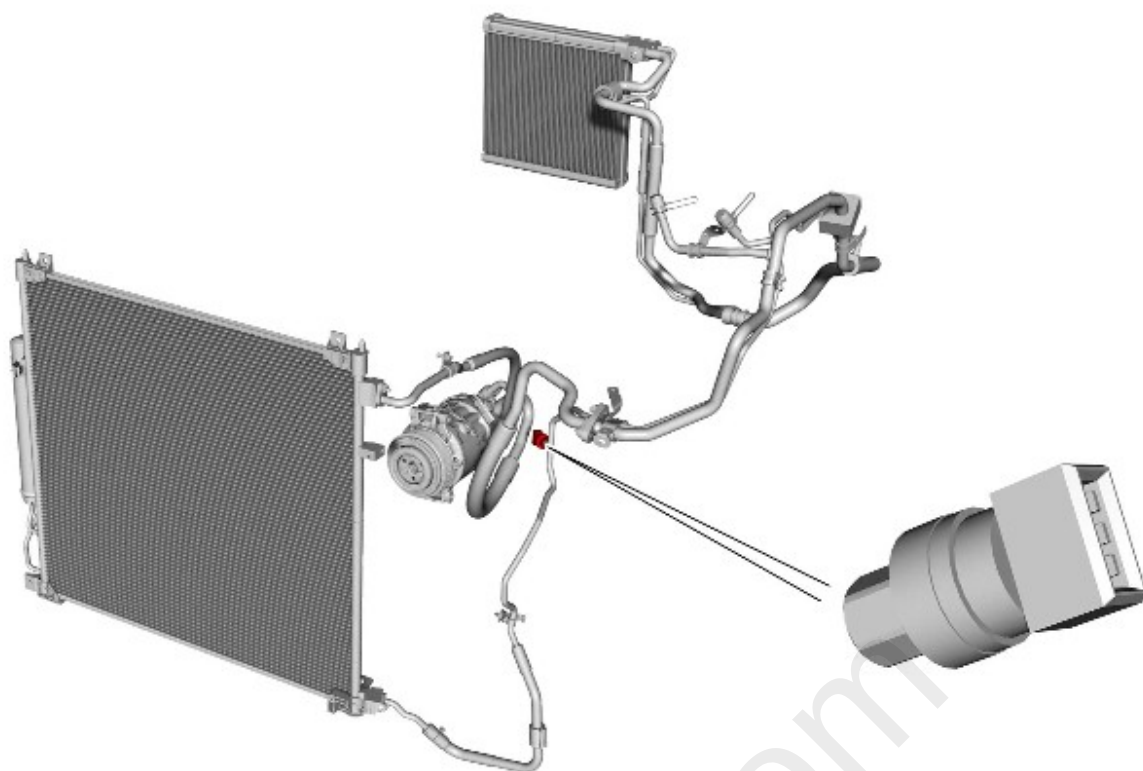
The filter and desiccant bag are non-serviceable. The filter and desiccant bag need to be replaced when a change of desiccant is required.

### REFRIGERANT PRESSURE SENSOR



#### NOTE:

Vehicles without auxiliary climate control are shown, vehicles with auxiliary climate control are similar.



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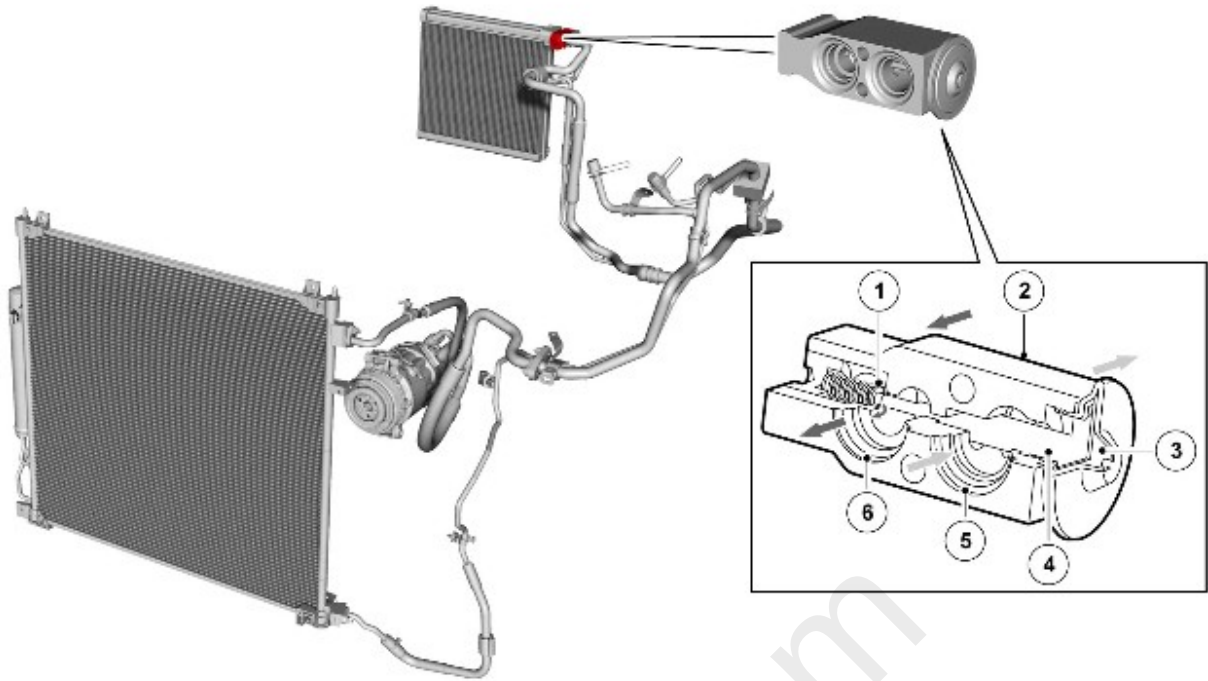
The refrigerant pressure sensor is located in the High Pressure (HP) pipe between the Air Conditioning (A/C) condenser and the Thermostatic Expansion Valve (TXV).

The refrigerant pressure sensor provides the HVAC control module with a pressure input from the HP side of the refrigerant system. The refrigerant pressure sensor is hardwired to the HVAC control module, the signal is used to control operation of the A/C compressor.

#### THERMOSTATIC EXPANSION VALVE

##### NOTE:

Vehicles without auxiliary climate control are shown, vehicles with auxiliary climate control are similar.



E247969

| ITEM | DESCRIPTION                       |
|------|-----------------------------------|
| 1    | Metering valve                    |
| 2    | Housing                           |
| 3    | Diaphragm                         |
| 4    | Temperature sensor                |
| 5    | Outlet connection from evaporator |
| 6    | Inlet connection to evaporator    |

The Thermostatic Expansion Valve (TXV) is a block type valve located behind the climate control assembly. The TXV attaches to the inlet and outlet connections of the evaporator. The TXV meters the flow of refrigerant to match the flow with the heat load of the air passing through the evaporator.

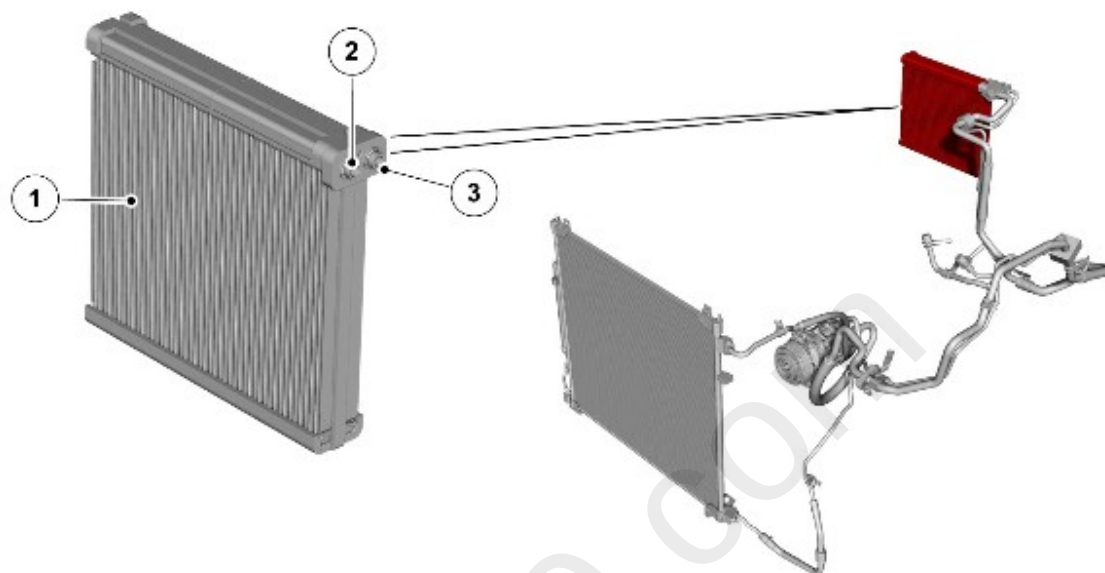
The TXV consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive pipe connected to a diaphragm. The bottom end of the temperature sensitive pipe acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by the evaporator outlet temperature conducted through the temperature sensitive pipe. The bottom of the diaphragm senses evaporator outlet pressure.

## EVAPORATOR



### NOTE:

Vehicles without auxiliary climate control are shown, vehicles with auxiliary climate control are similar.

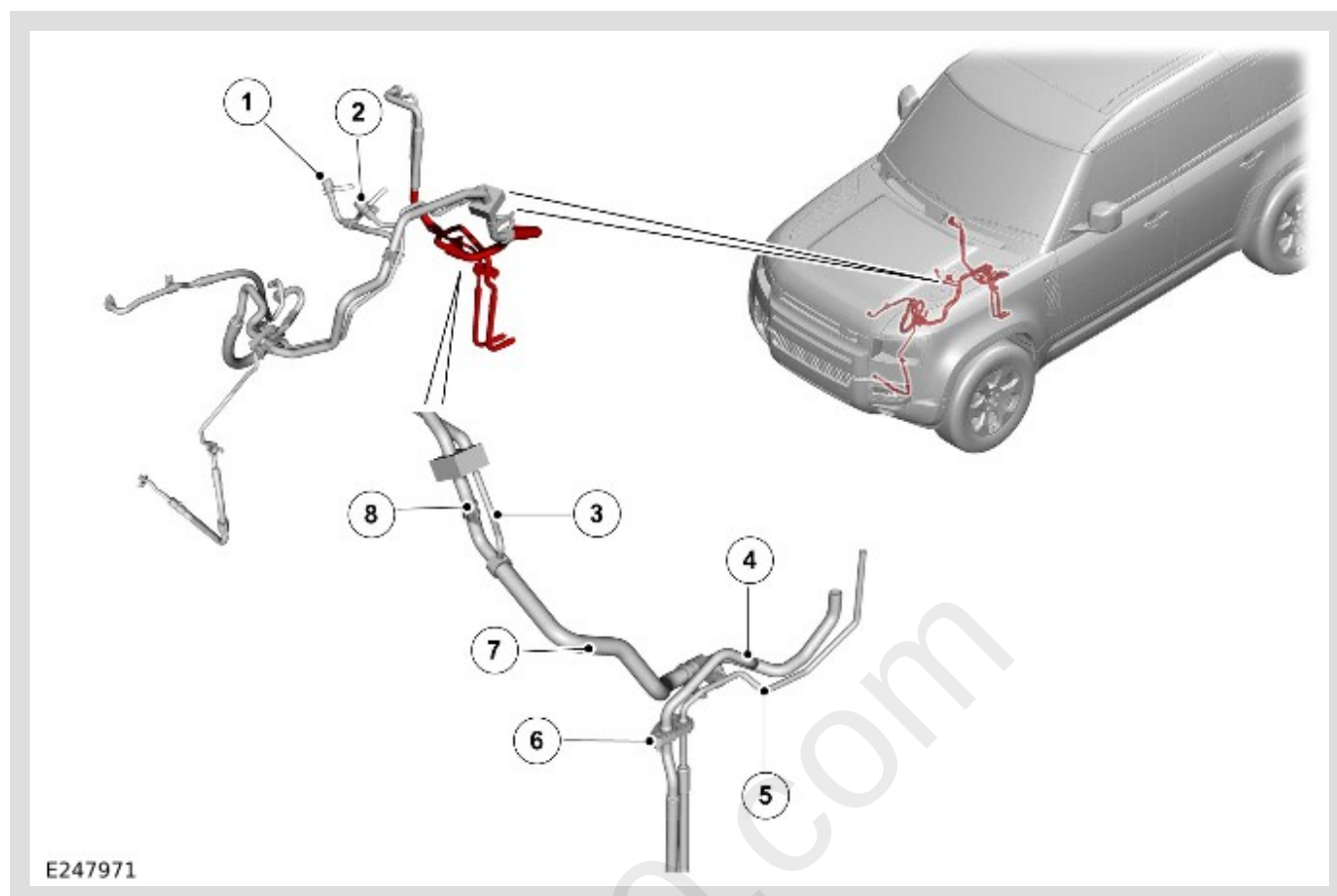


E247970

| ITEM | DESCRIPTION       |
|------|-------------------|
| 1    | Evaporator        |
| 2    | Outlet connection |
| 3    | Inlet connection  |

The evaporator is installed in the climate control assembly, immediately in front of the heater core. The purpose of the evaporator is to absorb heat from the exterior or recirculated air. The High Pressure (HP) refrigerant changes from liquid to vapor in the evaporator, absorbing heat as it changes state.

## REFRIGERANT PIPES



| ITEM | DESCRIPTION                                                                          |
|------|--------------------------------------------------------------------------------------|
| 1    | Low Pressure (LP) servicing connection                                               |
| 2    | High Pressure (HP) servicing connection                                              |
| 3    | HP pipe                                                                              |
| 4    | LP pipe                                                                              |
| 5    | HP pipe                                                                              |
| 6    | Connections for the rear refrigerant pipes - Vehicles with auxiliary climate control |
| 7    | Internal Heat Exchanger (IHX)                                                        |
| 8    | LP pipe                                                                              |

To maintain similar flow velocities around the Air Conditioning (A/C) system, the diameter of the refrigerant pipes varies to suit the 2 pressure areas. The larger diameter pipes are installed in the Low Pressure (LP) area. The smaller diameter pipes are installed in the High Pressure (HP) area.

Nylon lined, low permeability rubber hoses are used in:

- The LP pipe into the A/C compressor.

- The HP pipe from the A/C condenser.

The refrigerant pipes are manufactured from aluminum. The refrigerant pipes incorporate a LP and a HP servicing connection for the A/C system.

On vehicles with auxiliary climate control, the following connections are incorporated into the refrigerant pipes:

- Auxiliary evaporator.
- Auxiliary climate control isolation valve and Thermostatic Expansion Valve (TXV).

For additional information, refer to: [Auxiliary Climate Control](#) (412-02 Auxiliary Climate Control, Description and Operation).

### Internal Heat Exchanger

The Internal Heat Exchanger (IHX) is incorporated within the refrigerant pipes. The IHX is part of the Air Conditioning (A/C) system and increases the cooling capacity of the A/C system. The IHX combines a section of the system's pipework before and after the evaporator into 1 pipe.

The IHX gives the following benefits:

- Helps reduce exhaust tail pipe CO2 emissions, due to less engine load.
- Improved fuel economy, due to reduced A/C compressor power requirements.

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## OPERATION

### AIR CONDITIONING SYSTEM

The Air Conditioning (A/C) compressor circulates the refrigerant around the system by compressing Low Pressure (LP) vapor from the evaporator. The resultant High Pressure (HP) vapor is discharged to the A/C condenser. In the A/C condenser the vapor condenses to a liquid. Then the liquid passes through the A/C receiver dryer and out of the A/C condenser to the Thermostatic Expansion Valve (TXV).

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process.

As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The decrease in pressure, the fine spray and the heat from the evaporator cause the refrigerant to change to a gas. The temperature and pressure of the refrigerant leaving the evaporator acts on the diaphragm and temperature sensitive pipe, which regulate the metering valve opening. This controls the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat to evaporate refrigerant and the greater volume of refrigerant allowed through the metering valve. For more information, see the 'Thermostatic Expansion Valve' in the 'Description' section.

As the refrigerant passes through the TXV, the liquid refrigerant changes to a fine, LP spray, which is directed into the evaporator. In the evaporator the refrigerant changes back to a LP vapor, as it absorbs heat from the air in the passenger compartment. The refrigerant returns to the A/C compressor to begin the cycle again.

**NOTE:**

Most of the moisture in the air passing through the evaporator condenses into water. The water drains out of the vehicle by passing through a drain pipe underneath the vehicle.

Operation of the Air Conditioning (A/C) system is controlled by the HVAC control module. The HVAC control module adjusts the electronic control valve in the A/C compressor to match the refrigerant flow to the thermal load of the evaporator. By controlling the refrigerant flow, the HVAC control module maintains the required temperature in the passenger compartment while maximizing fuel economy.

The HVAC control module sends the data from the refrigerant pressure sensor to the Body Control Module/Gateway Module (BCM/GWM). The HVAC control module communicates with the BCM/GWM through the High Speed (HS) Controller Area Network (CAN) Human Machine Interface (HMI) systems bus. The BCM/GWM sends the data to the Powertrain Control Module (PCM) through the FlexRay. The PCM calculates the additional load on the engine when the A/C compressor is in operation.

For additional information, refer to: [Control Components](#) (412-01 Climate Control, Description and Operation).

The refrigerant is also used for the auxiliary climate control (if equipped).

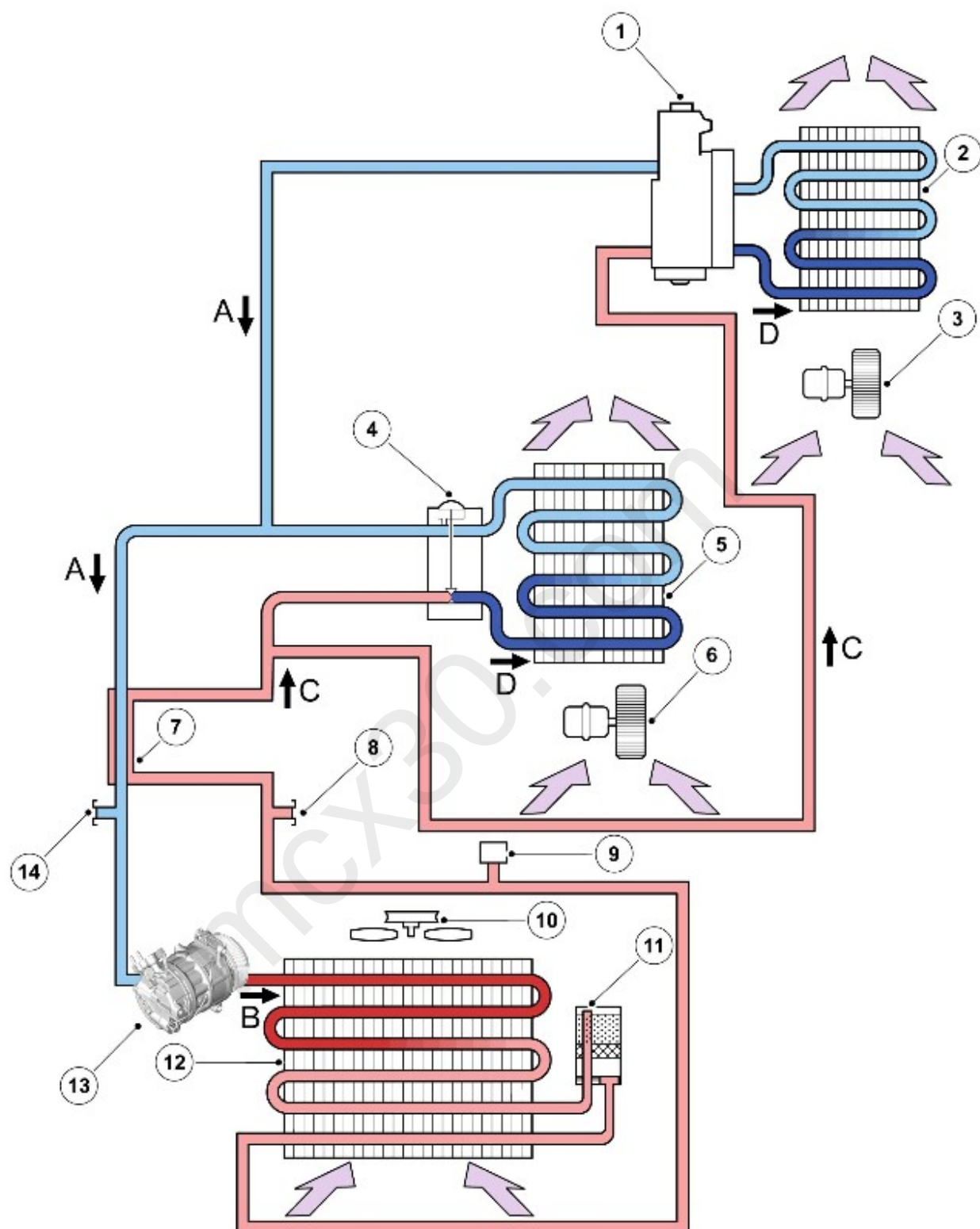
For additional information, refer to: [Auxiliary Climate Control](#) (412-02 Auxiliary Climate Control, Description and Operation).

**Internal Heat Exchanger**

The Internal Heat Exchanger (IHX) is positioned before and after the Thermostatic Expansion Valve (TXV) and the evaporator.

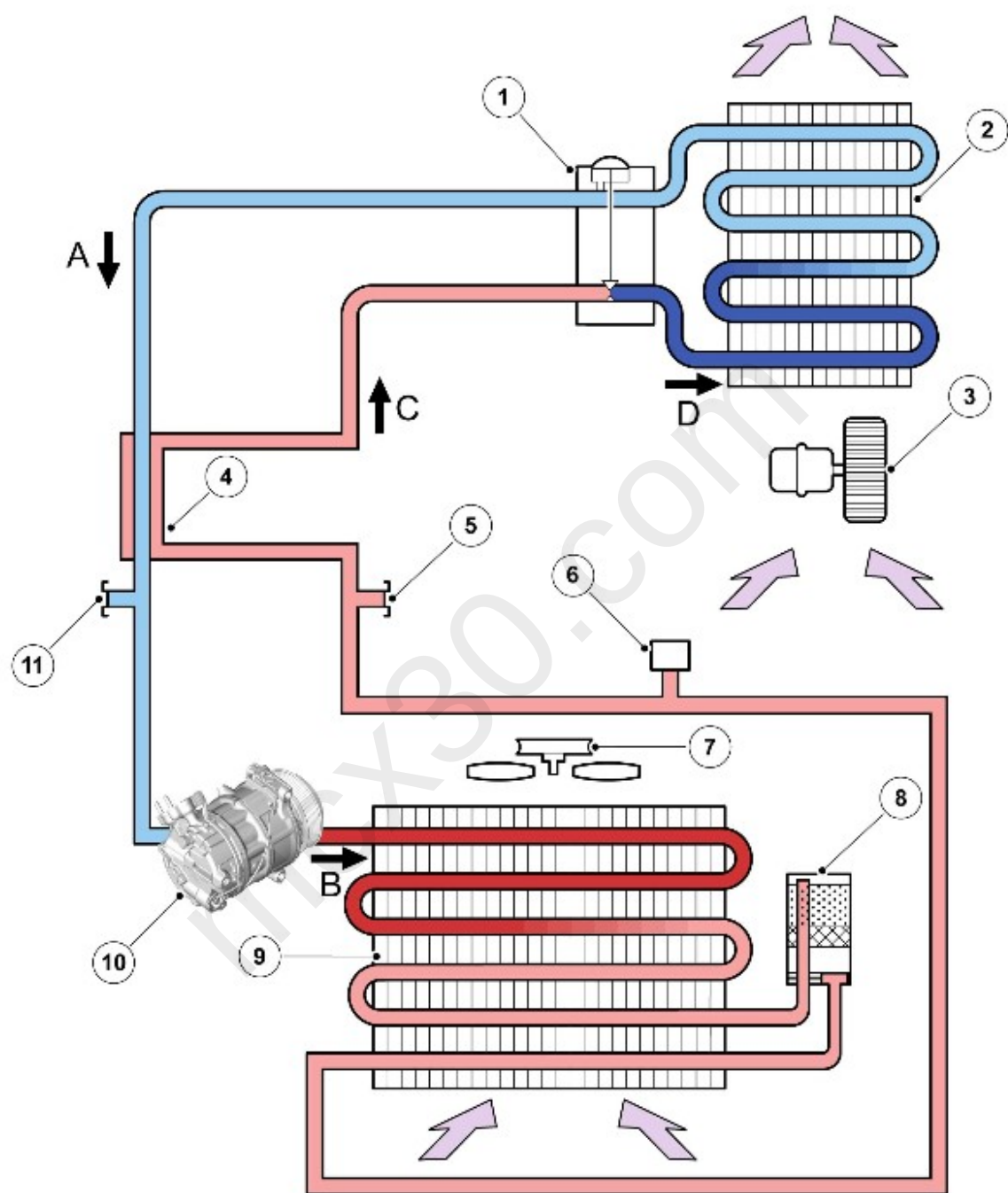
The IHX uses the colder Low Pressure (LP) refrigerant vapor that exits the evaporator to cool the hot refrigerant liquid before it enters the TXV. This increases the density of the High Pressure (HP) liquid refrigerant, which improves cooling.

The IHX uses the heat from the HP refrigerant to increase the temperature of the LP refrigerant before it enters the Air Conditioning (A/C) condenser. This decreases the energy used by the A/C system to cool the passenger compartment.



A = LOW PRESSURE (LP) VAPOR: B = HIGH PRESSURE (HP) VAPOR: C = HP LIQUID: D = LP LIQUID.

| ITEM | DESCRIPTION                                                                      |
|------|----------------------------------------------------------------------------------|
| 1    | Auxiliary climate control isolation valve and Thermostatic Expansion Valve (TXV) |
| 2    | Auxiliary evaporator                                                             |
| 3    | Auxiliary blower                                                                 |
| 4    | TXV                                                                              |
| 5    | Evaporator                                                                       |
| 6    | Front blower                                                                     |
| 7    | Internal Heat Exchanger (IHX)                                                    |
| 8    | High Pressure (HP) servicing connection                                          |
| 9    | Refrigerant pressure sensor                                                      |
| 10   | Electric cooling fan                                                             |
| 11   | Air Conditioning (A/C) receiver dryer                                            |
| 12   | A/C condenser                                                                    |
| 13   | A/C compressor                                                                   |
| 14   | Low Pressure (LP) servicing connection                                           |



A = LOW PRESSURE (LP) VAPOR: B = HIGH PRESSURE (HP) VAPOR: C = HP LIQUID: D = LP LIQUID.

| ITEM | DESCRIPTION                             |
|------|-----------------------------------------|
| 1    | Thermostatic Expansion Valve (TXV)      |
| 2    | Evaporator                              |
| 3    | Blower                                  |
| 4    | Internal Heat Exchanger (IHX)           |
| 5    | High Pressure (HP) servicing connection |
| 6    | Refrigerant pressure sensor             |
| 7    | Electric cooling fan                    |
| 8    | Air Conditioning (A/C) receiver dryer   |
| 9    | A/C condenser                           |
| 10   | A/C compressor                          |
| 11   | Low Pressure (LP) servicing connection  |

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