

640 Heating and Air-conditioning

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GENERAL

This repair group covers heating and air-conditioning operation and component replacement.

If the air-conditioning system requires evacuation and recharging of refrigerant, use equipment specially designed for A/C system service and follow the equipment manufacturer's instructions.

See also:

- **020 Maintenance** for cabin microfilter service
- **170 Radiator and Cooling System** for cooling system service and electric cooling fan removal and installation
- **600 Electrical System-General**

A/C system fluids

The air-conditioning refrigerant used in modern automobiles is R134a, known chemically as *tetrafluoroethane*. Strict regulations govern the handling and disposal of automotive refrigerant. Be sure to read **Warnings and Cautions** in this repair group if working with A/C and heating components.

- A sticker in the engine compartment gives the manufacturer's recommendation for refrigerant capacity.

Table a. A/C system refrigerant capacity

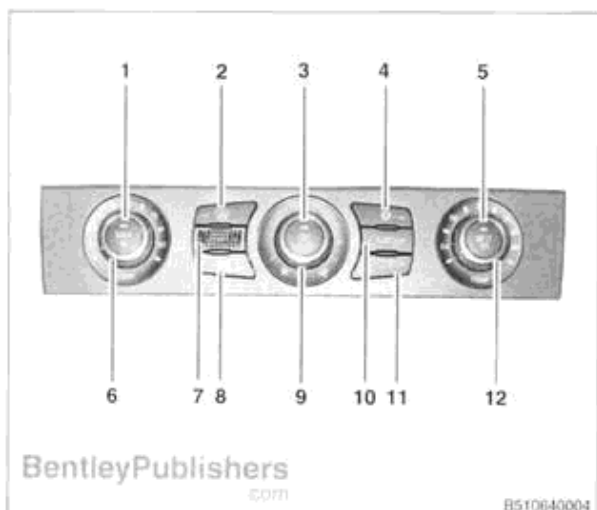
R134a	810 ± 10 grams (28.5 ± 0.3 oz)
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A synthetic oil, *polyalkylene glycol* (PAG), is used to lubricate the A/C compressor. This type of oil is highly hygroscopic (absorbs water). Be sure to immediately reseal an opened container after use.



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IHKA basics



IHKA basics

5 Series models come equipped with an integrated automatic climate control system (IHKA). The dashboard mounted control panel shares functions with iDrive.

IHKA includes the following features:

- Dual zone control system allows driver and passenger to control temperature settings separately.
- Residual heat (REST) function allows brief periods of cabin heating with the engine OFF.
- Condensation sensor at base of interior rear view mirror.
- Nine air control flap stepper motors (seven are identical).
- Stepper motors control via LIN-bus.
- Seat heater control.
- Rear window defogger control.
- Clutchless A/C compressor.

IHKA control panel

1. Maximum A/C setting
2. Windshield air distribution
3. OFF button
4. A/C button
5. Residual heat (REST) button
6. Driver temperature setting display
7. Interior air temperature sensor intake vent
8. Rear window defogger button
9. Blower speed
10. Automatic program button
11. Recirculation control button
12. Passenger temperature setting

IHKA control panel functions

Climate control sensor data is processed in the IHKA control panel. Driver and passenger climate control settings and requests are also entered in the panel. However, the panel does not directly control all functions and components but rather makes use of other control modules for this purpose. The IHKA control panel directly monitors the following:

- Central information display (CID) and iDrive controls.
- Solar sensor input.
- Condensation sensor.
- Rear air distribution knob (rheostat) signal.
- Ventilation, footwell, and evaporator temperature sensor signals.
- Condensation sensor signal.



IHKA CID control

- Extended HVAC functions such as air stratification are controlled with the iDrive controller and CID.

Car communication computer (CCC) processes IHKA menu and submenu signals and displays them in the dashboard mounted central information display (CID).

Central information display (CID). Use iDrive controller to activate the following functions and display selections in CID:

- Air distribution setting. Positions for defrost flaps, ventilation flaps and footwell flaps may be individually set in air distribution submenu.
- Automatic IHKA mode. Climate control intensity (low, medium or high) may be set in automatic mode submenu.

IHKA additional controls

Engine control module (ECM) climate control functions are:

- Actuates engine cooling fan for cooling of A/C condenser.
- Interfaces with IHKA control panel via bus network for compressor ON signal.
- Interfaces with IHKA control panel for operation of electric coolant pump for residual heat feature, (N52, N54 engine).

Car access system (CAS) assigns a personal identification code to each remote control key. Personal identification codes are transmitted to IHKA control panel via K-CAN. When vehicle enters sleep mode, current climate control settings are stored in IHKA control panel for remote control key in use at that time.

When vehicle is unlocked via remote control key, settings for this key are called up and executed.

- Center console switch cluster (SZM).** Seat heater switches in SZM are connected directly to CID and both seat control modules.



- Central information display (CID).** Use iDrive controller to choose seat cushion and backrest heat distribution.



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IHKA sensors

IHKA sensors

Interior temperature sensor, mounted on IHKA control panel, samples cabin air by using a small electrical fan (non-replaceable) to suck air through the grill on the front face of the control panel. Sensor output is used by the IHKA panel to modulate interior temperature.

Evaporator temperature sensor, mounted close to the evaporator, transfers data directly via cable to IHKA control panel.

Two heater core temperature sensors, mounted close to the heater core, transfer data directly via cable to IHKA control panel.

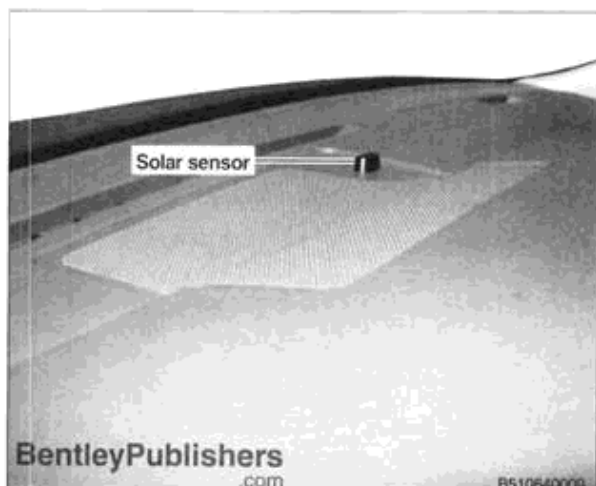
Outside temperature sensor is hard wired to the instrument cluster which then sends a signal via K-CAN to the IHKA control panel.

Vent flap temperature sensors are 3 NTC type sensors wired directly to the IHKA control panel:

- Stratified temperature sensor
- Ventilation temperature sensor
- Footwell temperature sensor

➤ **Solar sensor**, located at the front of the dashboard under the windshield, is hard wired to the IHKA control panel

Refrigerant pressure sensor is in the pressure line between the A/C condenser and the evaporator. In case of excessively high or low refrigerant pressure, A/C compressor output is reduced via signal from IHKA control panel to ECM. Sensor power is provided by IHKA.

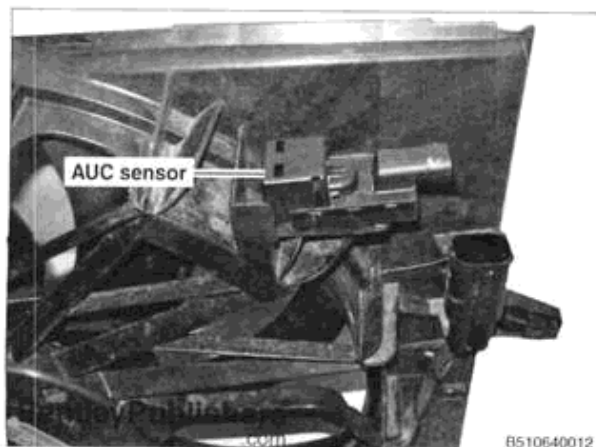


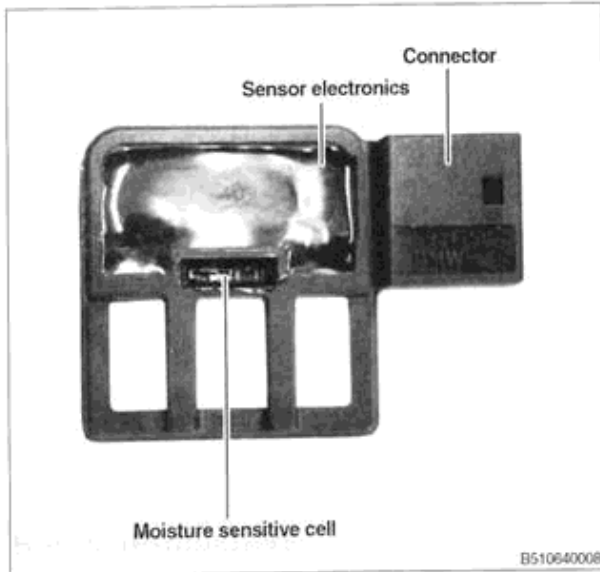
➤ **Air quality (AUC) sensor:**

- To 2006: mounted to the engine cooling fan housing,
- From 2006: mounted to cabin microfilter housing,

is controlled and powered by IHKA. AUC sensor detects the following:

- Carbon monoxide (CO)
- Hydrocarbons (HC)
- Oxides of nitrogen (NO_x).





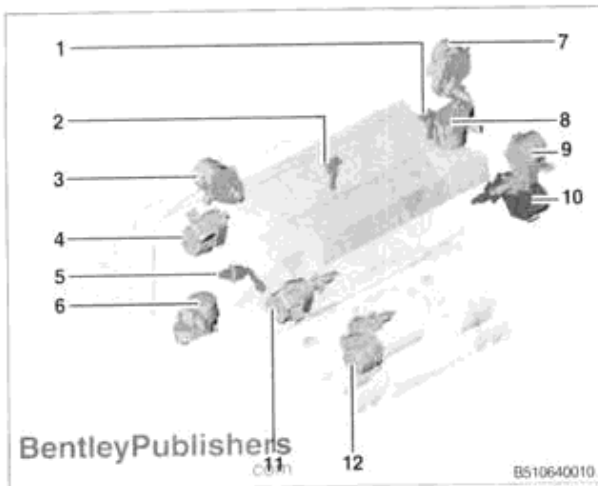
➤ **Condensation sensor**, mounted under the rain and light sensor (RLS) on interior mirror base at top of windshield.

When moisture is detected on the windshield by the condensation sensor, the following occurs if IHKA system is set on automatic operation:

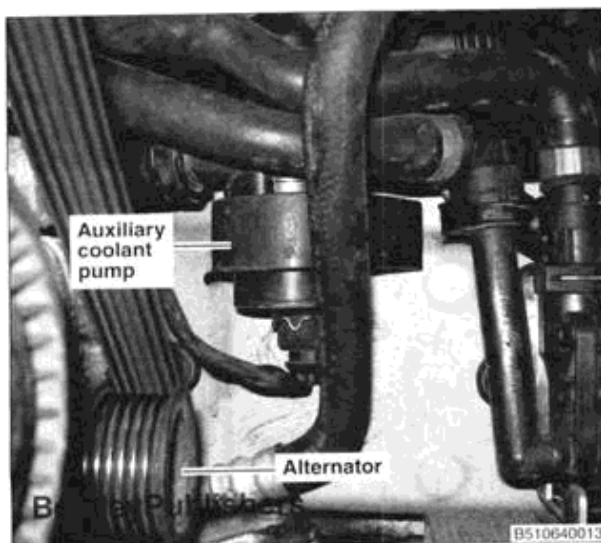
- Defroster flaps open further.
- Fresh air flaps open 100%.
- Blower speed is increased.
- Footwell flaps are closed.
- Temperature setting increases.
- Evaporator temperature threshold goes to minimum.

IHKA outputs

➤ **Stepper motors** in climate control housing under the dashboard:



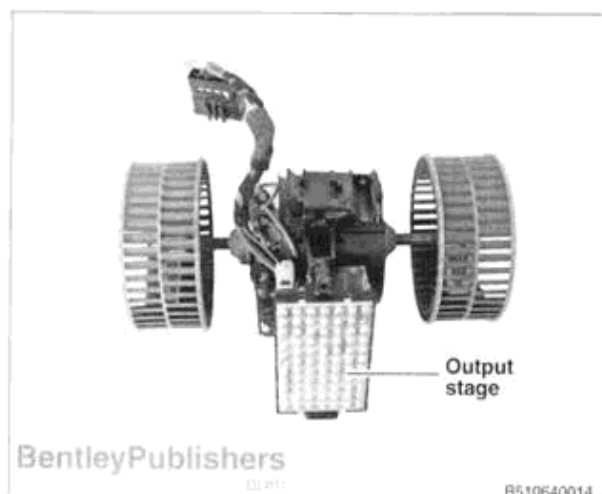
1. Right heater core temperature sensor
2. Left heater core temperature sensor
3. Left footwell flap stepper motor
4. Defroster flaps stepper motor
5. Evaporator temperature sensor
6. Left fresh air - recirculation flap stepper motor
7. Right footwell flap stepper motor
8. Right fresh air - recirculation flap stepper motor
9. Right dashboard ventilation flaps stepper motor
10. Front air distribution flap stepper motor
11. Left dashboard ventilation flaps stepper motor
12. Center compartment stepper motor



➤ **Auxiliary coolant pump** is mounted to the driver side frame rail near the alternator. It supplies hot coolant to heater core when engine is idling.

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IHKA outputs



➤ **Blower and blower output stage** are mounted in the climate control housing center dashboard, behind IHKA control panel.

Blower output stage is activated via pulse-width modulation by IHKA control panel. Operating power for the blower motor is supplied by fuse 3 (40A), located in the front fuse panel.

Heater valve controls amount of heated engine coolant sent to the heater core. Blend flaps are used to control the temperature settings on the two sides of the dual zone climate control system.

Heater valve is opened via a spring. It is operated via band pulse width modulated signal from IHKA.

A/C compressor is clutchless. A swash plate in the compressor housing varies the amount of compression on the refrigerant. The compressor valve is controlled and powered by IHKA.

Seat heating is controlled and powered by seat control module of the respective seat. Request for seat heating activation is initiated from center console switch cluster (SZM) directly to the seat control module via K-CAN.

Rear window defogger is controlled by IHKA. Defogging request activates a relay in the rear fuse panel.



➤ **N52, N54 engine: Electric coolant pump** is electronically controlled by the engine control module (ECM). When residual heat (REST) function is activated, IHKA control panel interfaces with ECM to activate the coolant pump, circulating hot or warm coolant through the heater core to warm up the passenger cabin.

IHKA non-electrical components

Refrigerant circuit consists of A/C compressor, expansion valve, evaporator and condenser. The system features:

- Aluminum refrigerant lines.
- Receiver-drier (with replaceable desiccant) integrated in the condenser.
- Clutchless compressor controlled by IHKA logic.
- Expansion valve accessible from engine compartment.

Heating circuit. Heated engine coolant is pumped by coolant pump(s) through heater valve to heater core (heat exchanger). From here, coolant is routed back to engine and coolant thermostat.

◀ **Cabin microfilters.** The microfilter with activated carbon is accessible from the engine compartment. For microfilter replacement, see **020 Maintenance**.

To 2008: Filter service is indicated by condition based service (CBS) system. Microfilter condition is monitored by the IHKA control panel using a calculation model (algorithm) based on the following factors:

- Outside temperature.
- Signal from rain and light sensor.
- Signal from solar sensor.
- Blower voltage.
- Air quality, recognized from frequency of recirculation mode usage.
- Average vehicle road speed.
- Service interval display (SIA) timer.

IHKA panel communicates with instrument cluster via K-CAN to detect and report the following:

- Odometer reading.
- Microfilter remaining life in percent.
- Time remaining until next microfilter service.

From 2008: Microfilter replacement is recommended every second oil service.



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Warnings and Cautions

Warnings and Cautions

WARNING—

- Do not discharge or charge the A/C system without proper equipment and training. Damage to the vehicle and personal injury may result.
- Wear hand and eye protection (gloves and goggles) when working around the A/C system.
- If refrigerant comes in contact with your skin or eyes:
 - Do not rub skin or eyes.
 - Immediately flush skin or eyes with cool water for 15 minutes.
 - Rush to a doctor or hospital.
 - Do not attempt to treat yourself.
- Work in a well ventilated area. Switch on exhaust / ventilation systems when working on the refrigerant system.
- Do not expose any component of the A/C system to high temperatures (above 80°C or 176°F) or open flames. Excessive heat causes a pressure increase which could burst the system.
- Keep refrigerant away from open flames. Poisonous gas is produced if it burns. Do not smoke near refrigerant gases for the same reason.
- The A/C system is filled with refrigerant gas which is under pressure. Pressurized refrigerant in the presence of oxygen may form a combustible mixture. Do not introduce compressed air into any refrigerant container (full or empty).
- Electric welding near refrigerant hoses causes R-134a to decompose. Discharge system before welding.
- At normal operating temperature the cooling system is pressurized. Allow the system to cool as long as possible before opening (a minimum of one hour), then release the cap slowly to allow safe release of pressure.

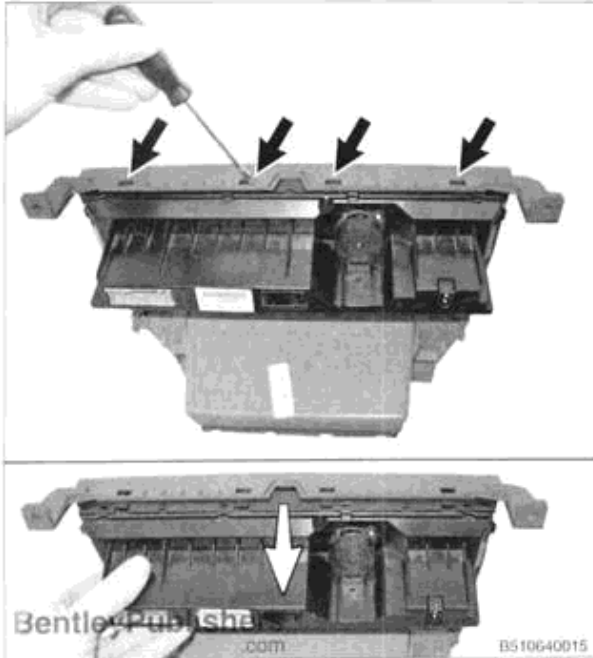
CAUTION—

- In the United States, any person who services a motor vehicle air-conditioner must, by law, be properly trained and certified, and use approved refrigerant recycling equipment. Technicians must complete an EPA-approved recycling course to be certified.
- Comply with state and local governments which may have additional requirements regarding air-conditioning servicing.
- It is recommended that all A/C service be left to an authorized BMW dealer or other qualified A/C service facility.
- Do not top off a partially charged refrigerant system. Discharge system, evacuate and then recharge system.
- The mixture of refrigerant oil (PAG oil) and refrigerant R-134a attacks some metals and alloys (for example, copper) and breaks down certain hose materials. Use only hoses and lines that are identified with a green mark (stripe) or marked with R-134a.
- Immediately plug open connections on A/C components and lines to prevent dirt and moisture contamination.
- Do not steam clean the A/C condenser or evaporator. Use only cold water or compressed air.
- To avoid damaging plastic interior trim, use a plastic prying tool or a screwdriver with the tip wrapped with masking tape.

IHKA COMPONENT REPLACEMENT

IHKA control panel, removing and installing

- Remove center dashboard trim panel. See **513 Interior Trim**.
- Release control panel retaining tabs (**arrows**) and remove control panel from center dashboard trim.
- Installation is reverse of removal. Use BMW scan tool to program and code new panel. See **600 Electrical System-General**.

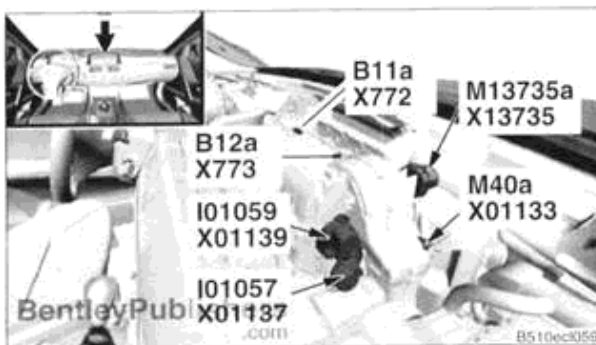


Stepper motors

The IHKA system utilizes nine stepper motors that are wired in series for climate control operation. IHKA control panel operates stepper motors via LIN-bus.

Stepper motors can be replaced without removing the dashboard or climate control housing.

- Top of IHKA housing:
 - **B11a** Heater core temperature sensor, left side
 - **B12a** Heater core temperature sensor, right side
 - **I01057** Fresh air flap stepper motor
 - **I01059** Right ventilation flap stepper motor
 - **M40a** Right fresh-recirculated air flap stepper motor
 - **M13735a** Right footwell flap stepper motor
 - **X772** Connector
 - **X773** Connector
 - **X01133** Connector
 - **X01137** Connector
 - **X01139** Connector



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Stepper motor, removing and installing



Top of IHKA housing:

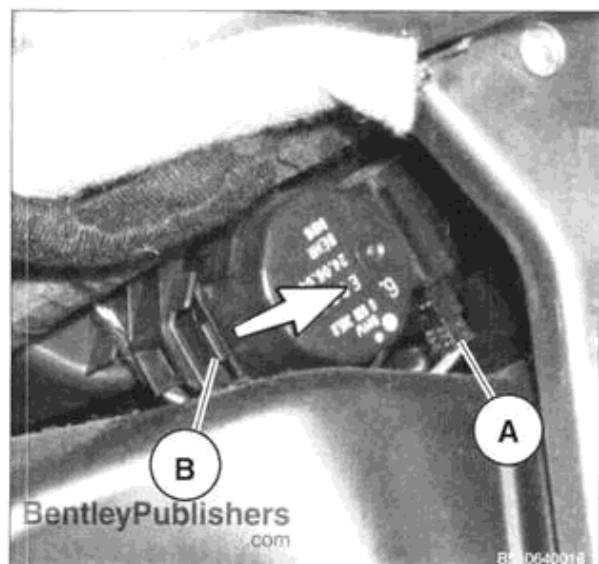
- B14a Evaporator temperature sensor
- I01058 Left ventilation flap stepper motor
- I01060 Rear compartment mixing flap stepper motor
- I01062 Electric auxiliary heater
- M35a Defroster flap stepper motor
- M36a Left fresh-recirculated air flap stepper motor
- M13734a Left footwell flap stepper motor
- X771 Connector
- X01132 Connector
- X01134 Connector
- X01138 Connector
- X01140 Connector
- X13734 Connector
- X14052 Connector

Stepper motor, removing and installing

- To gain access to left side stepper motors, remove left lower dashboard trim (pedal cluster trim). See **513 Interior Trim**.
- To gain access to right side stepper motors:
 - Remove right lower dashboard trim. See **513 Interior Trim**.
 - Remove glove compartment. See **513 Interior Trim**.

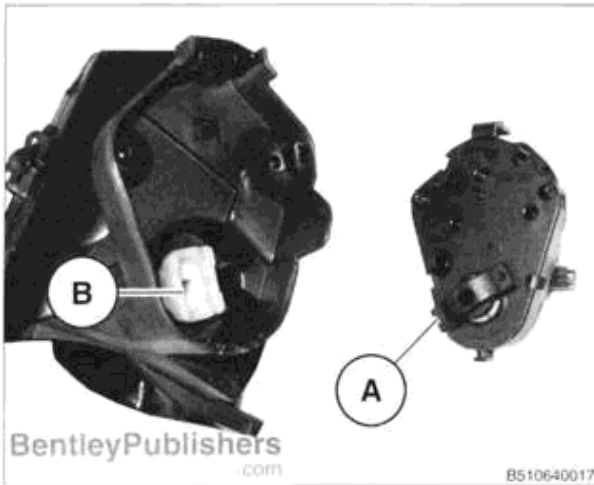
To remove stepper motor:

- Detach electrical connector (A).
- Press locking tab (B) and remove motor from housing in direction of arrow.



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Blower, removing and installing

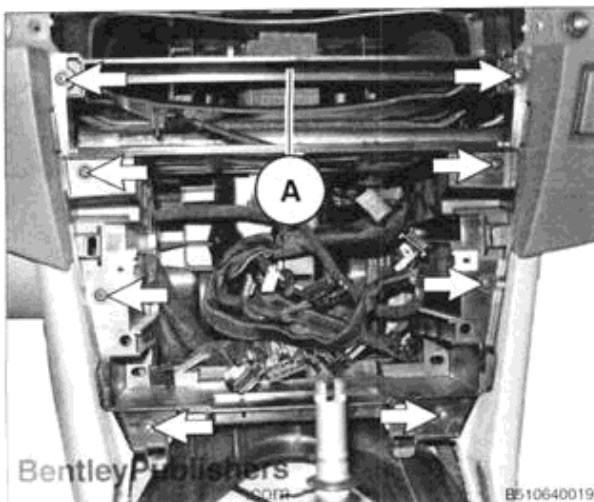
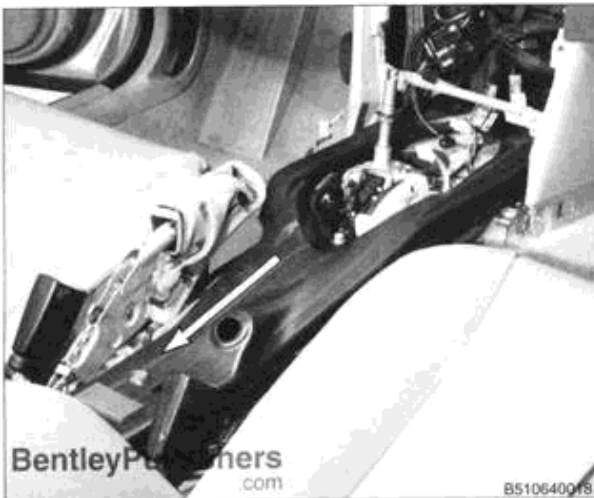


During installation:

- Do not twist motor drive (A). Instead align shaft of flap (B) with stepper motor.
 - Listen for stepper motor to snap into place.
- Reassemble vehicle. Check operation of stepper motor.

Blower, removing and installing

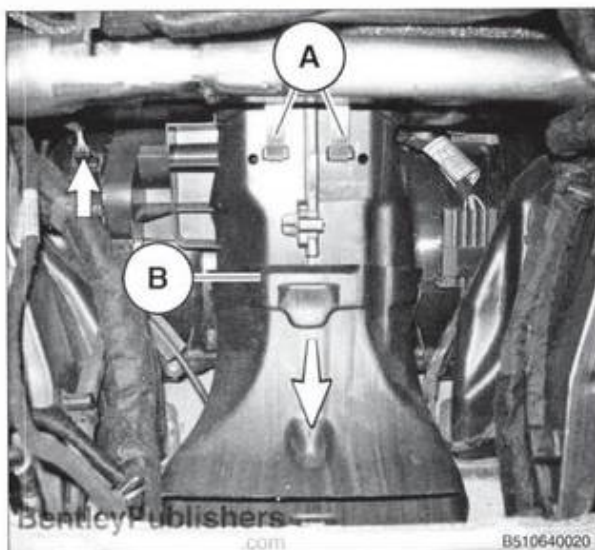
- Remove center console. See **513 Interior Trim**.
 - Remove left side lower dashboard trim. See **513 Interior Trim**.
 - Remove glove compartment. See **513 Interior Trim**.
 - Remove radio. See **650 Radio**.
 - Remove CID display. See **650 Radio**.
- Remove center air duct in direction of **arrow**.



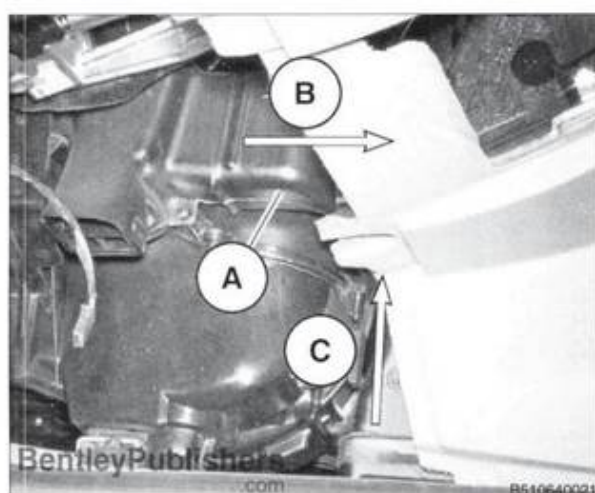
- Remove fasteners (**arrows**) then remove bracket (A) from dashboard.

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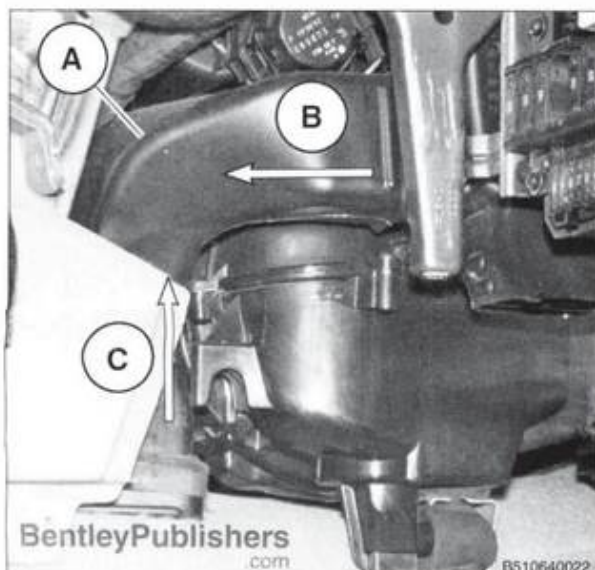
Blower, removing and installing



Disconnect electrical connectors (arrow). Remove clips (A) and remove air duct (B) toward rear of vehicle.



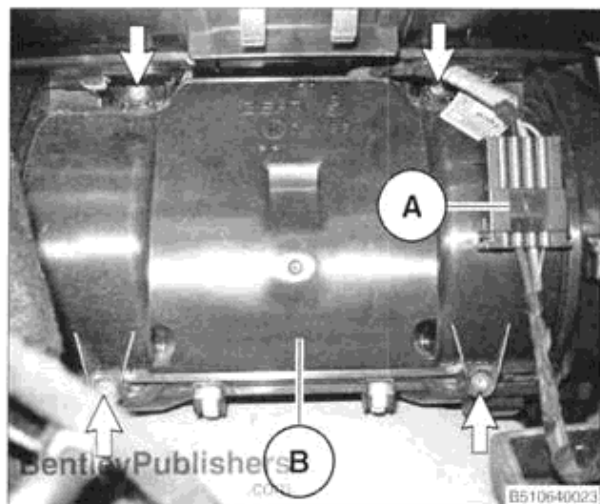
Disconnect left side air duct (A) in area B then in area C.



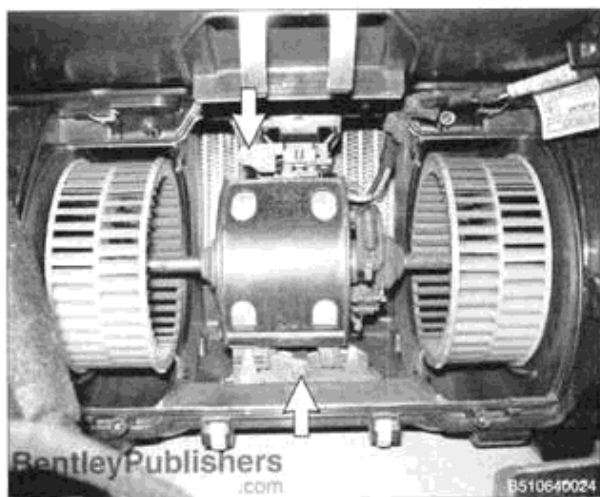
Disconnect right side air duct (A) in area B then in area C.

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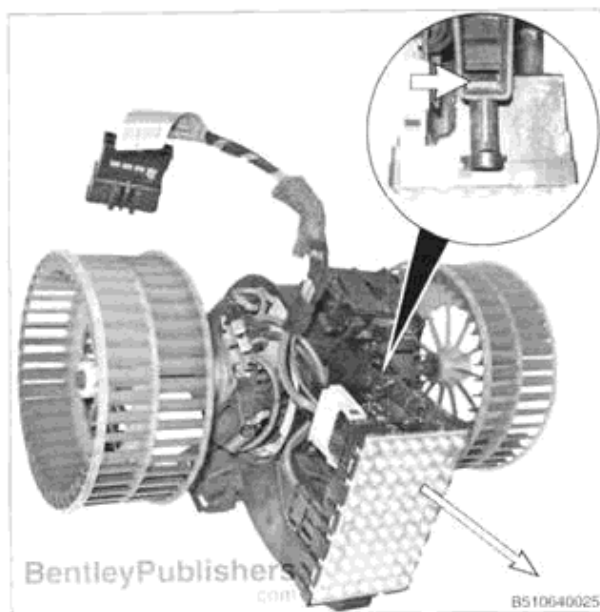
Blower, removing and installing



- Disconnect electrical connector (A) and remove from blow motor cover. Remove fasteners (arrows) and remove blow motor cover (B).



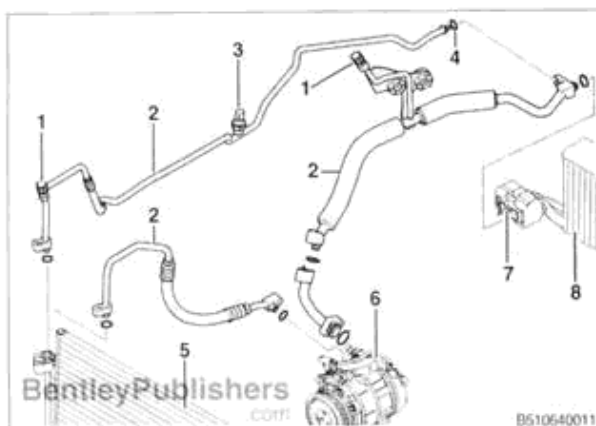
- Remove blower motor fasteners (arrows) and remove blower motor from heater housing.



- If necessary, separate blower final stage using a flat blade screwdriver.
- Installation is reverse of removal. Remember to:
- Properly seat final stage.
 - Check that blower motor cages do not rub on heater housing.
 - Properly install all housing covers.
 - Seat air ducts correctly.

640-14 Heating and Air-conditioning

Air-conditioning components



Air-conditioning components

1. Refrigerant service port
2. A/C line
3. Pressure sensor
4. O-ring
5. Condenser
6. A/C compressor
7. Expansion valve
8. Evaporator

