

Uniform Procedures For Collision Repair

AC01–Air Conditioning

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v.2.3



1. Description

This procedure describes methods for repairing, recharging, testing, and inspecting air conditioning (AC) systems that use **R-12** or **R-134a refrigerant**. A method for **retrofitting** systems from R-12 to R-134a refrigerant is also included.



2. Purpose

The purpose of this procedure is to provide industry-accepted requirements for performing high-quality repair of AC systems. This procedure is intended for use by professionals who are qualified through training, experience, and proper certification.



3. Referenced Documents

The following documents are considered part of this procedure by reference.

3.1 Procedures

HM01 Hazardous Materials

PS01 Personnel Safety

3.2 Other Information

Equipment-specific information

Recycled parts information

SAE recommended practices

Vehicle-specific repair information



4. Equipment And Material Requirements

4.1 Equipment

The use of this equipment is included in this procedure:

- refrigerant recovery and recycling equipment
- refrigerant recharging equipment
- manifold gauge set
- electronic, halogen, or dye-type leak detector
- flushing equipment

Use only service equipment that meets **SAE** requirements and is designed for use with the type of refrigerant being serviced. Cross-contaminating of equipment or AC systems must be avoided to prevent damage.

Recovery, recycling, and recharging equipment must be certified in accordance with Section 609 of the Clean Air Act Amendments of 1990. A copy of the certification must be filed with the Environmental Protection Agency by each company performing AC service.

4.2 Materials

Use only a refrigerant that is stored in an approved container and meets SAE requirements for the type of refrigerant in the system.

Use only a lubricant that is designated for use with the type of refrigerant in the system.

4.3 R-134a Retrofit Kits

Use only a retrofit kit that is approved by the vehicle maker, and meets SAE requirements. Use the proper kit for the year, make, and model of the vehicle being retrofitted.





5. Damage Analysis

5.1 General Damage

Inspect all AC system parts for these conditions:

- damage that allows any opening to the atmosphere
- kinks or bends
- excessive oil on external surfaces
- loose or worn belts
- damaged wiring
- signs of leakage

5.2 Condenser

Inspect the **condenser** for these conditions:

- visible damage
- movement from the original mounting position
- twisted or bent core
- bent, kinked, or cracked input or output tubes
- oil on the cooling fins
- damaged cooling fins
- damaged fittings



5.3 Compressor

Inspect the compressor for these conditions:

- damage to the housing
- damage to the clutch
- damage to the mounting brackets or fasteners
- damage to the pulley or fasteners
- cut or worn drive belt
- misalignment to the engine drive-belt system
- pulley noises when the engine is running
- unusual noises when the AC system is running

5.4 Lines And Hoses

Inspect all connectors for signs of leakage or oil. Look for kinks, bends, or weather cracking.



6. Personnel Safety

6.1 General Safety

General safety information is in **PS01**.

6.2 Safety With Refrigerants

To prevent injury when working with refrigerants:

- Protect eyes and exposed skin from any unexpected release of refrigerant.
- Work in a well-ventilated area. If accidental discharge occurs, ventilate the work area before resuming service. Exposure to refrigerant and lubricant vapors can irritate eyes, nose, and throat.
- Ensure that the AC system has been depressurized before loosening fittings or removing parts.
- Do not store refrigerant containers in areas over 50° C (120° F) or in direct sunlight.
- Do not transport refrigerant containers in the passenger compartment of a vehicle. Follow government regulations for transporting refrigerant containers.
- Do not puncture or incinerate refrigerant containers.
- Avoid heat sources and open flames when working with refrigerants.



7. Environmental Safety

7.1 Refrigerant And Lubricant

To protect the environment during AC repairs:

- Recover and recycle all refrigerant.
- Recover all refrigerant lubricant and properly dispose of it as hazardous waste.

Hazardous material safety information is in **HM01**.

Section 609 of the Clean Air Act Amendments of 1990 requires each person performing service on a motor vehicle air conditioning system be certified by a recognized testing agency.



8. Vehicle Protection

8.1 Vehicle Finish

To protect the vehicle finish:

- Use fender covers.
- Carefully handle removed parts to avoid spilling any lubricant.
- Immediately clean up any spilled lubricant. Properly dispose of all cleaning materials.

8.2 Electrical And Vacuum Systems

To protect electrical and vacuum systems:

- Follow the vehicle maker's recommendations for recording and resetting **electronic memories**.
- Ensure that the ignition switch is in the LOCK position, and the key is removed.
- Disconnect and isolate the negative battery cable, and disarm the **passive restraint system**. Follow the vehicle maker's recommendations.
- Carefully remove computer modules when welding or heating within 300 mm (12"), or a greater distance when recommended by the vehicle maker.
- Protect computer modules, connectors, and wiring from dirt, heat, static electricity, and moisture.
- Loosen or remove any wiring harnesses or electrical parts that could be damaged during the repair process.

8.3 Opened AC System

To protect an opened AC system:

- Avoid contamination from the environment.
- Remove dirt and other contaminants from fittings before disconnecting.
- Seal refrigerant lines, hoses, or fittings immediately after opening or removal.



9. Repair Procedure

Before proceeding, determine which parts must be replaced because of damage, and which parts must be replaced because of exposure to the atmosphere. Follow the vehicle maker's recommendations for additional parts that must be replaced.

If no parts are being replaced, inspect and test the system. See **11.1** and **11.2**.

If parts are to be replaced, discharge the system while recovering the refrigerant, if necessary, as described in **9.1**. Replace the parts, as described in **9.2** through **9.5**. After the parts are installed, perform the leak test, described in **9.6**.

For retrofitting a system to use R-134a refrigerant, see **9.8**.

9.1 Refrigerant Recovery

To recover the refrigerant:

- 1. Check for tags or labels to identify the type of refrigerant.
- 2. Connect the refrigerant recovery equipment following the equipment maker's instructions. Use only an approved refrigerant recovery tank.
- 3. Check the recovery tank for the weight of the existing volume of refrigerant.
- 4. Make sure the addition of recovered refrigerant will not exceed 80% of the container's gross weight rating.
- 5. Remove the refrigerant from the vehicle's AC system, following the equipment maker's instructions.

9.2 Replacement Of The Condenser

To replace an AC condenser:

- 1. Recover the refrigerant. See **9.1**.
- 2. Disconnect and immediately seal the refrigerant inlet and outlet hoses. If the system has been open to the atmosphere, follow the vehicle maker's recommendations for additional parts that must be replaced.
- 3. Remove bolted parts such as deflectors, electric fan, radiator, and other parts required for access.
- 4. Remove the attaching brackets and fasteners.
- 5. Carefully lift out the condenser.
- 6. Drain and measure the refrigerant lubricant from the original condenser, if necessary.

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9. Repair Procedure (cont'd)

- 7. Set the replacement condenser in the vehicle. Be careful not to damage the fins on the condenser or radiator.
- 8. Align the condenser for proper attachment.
- 9. Install attaching brackets and fasteners.
- 10. Uncap the inlet and outlet tubes. Minimize the time the condenser is left open to the atmosphere.
- 11. Add the required refrigerant lubricant to the condenser. Follow the vehicle maker's specifications.
- 12. Replace all O-rings. Apply a small amount of the proper refrigerant lubricant to each O-ring before installation.
- 13. Connect the refrigerant inlet and outlet hoses.
- 14. Install the bolted parts previously removed.
- 15. Leak-test the system. See **9.6**.

9.3 Replacement Of Hoses Or Lines

To replace the AC hoses or lines:

- 1. Recover the refrigerant. See **9.1**.
- 2. Disconnect and immediately seal the refrigerant system inlets and outlets. If the system has been open to the atmosphere, follow the vehicle maker's recommendations for additional parts that must be replaced.
- 3. Remove the attaching brackets and fasteners, and any other parts to allow access.
- 4. Remove the faulty part from the vehicle. Be careful not to damage the surrounding area or parts.
- 5. Drain and measure the refrigerant oil from the original hose or line, if necessary.
- 6. Route the replacement hose or line exactly as routed by the vehicle maker.
- 7. Install the attaching brackets and fasteners.
- 8. Uncap the inlet and outlet tubes of the replacement hose or line. Minimize the time the part is left open to the atmosphere.
- 9. Add the required refrigerant lubricant to the replacement hose or line, if needed. Follow the vehicle maker's specifications.
- 10. Replace all O-rings. Apply a small amount of the proper refrigerant lubricant to each O-ring before installation.
- 11. Connect the hose or line to the AC system.
- 12. Install any bolted parts previously removed.
- 13. Leak-test the system. See **9.6**.



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9. Repair Procedure (cont'd)

9.4 Replacement Of The Accumulator Or Receiver-Drier

To replace an AC **accumulator** or **receiver-drier**:



1. Recover the refrigerant. See **9.1**.
2. Disconnect and immediately seal the refrigerant system inlets and outlets. If the system has been open to the atmosphere, follow the vehicle maker's recommendations for additional parts that must be replaced.
3. Remove the attaching brackets and fasteners, and any other parts to allow access.
4. Remove the faulty part from the vehicle. Be careful not to damage the surrounding area or parts.
5. Drain and measure the refrigerant oil from the original accumulator or receiver-drier.
6. Install the replacement part exactly as specified by the vehicle maker.
7. Install the attaching brackets and fasteners.
8. Uncap the inlet and outlet tubes of the replacement accumulator or receiver-drier. Minimize the time the part is left open to the atmosphere.
9. Add the required refrigerant lubricant to the replacement accumulator or receiver-drier, if needed. Follow the vehicle maker's specifications.
10. Replace all O-rings. Apply a small amount of the proper refrigerant lubricant to each O-ring before installation.
11. Connect the accumulator or receiver-drier to the AC system.
12. Install any bolted parts previously removed.
13. Leak-test the system. See **9.6**.

9.5 Replacement Of The Compressor

To replace an AC compressor:

1. Recover the refrigerant. See **9.1**.
2. Disconnect the wiring, if necessary, and carefully set it aside.
3. Disconnect and immediately seal the refrigerant inlet and outlet hoses. If the system has been open to the atmosphere, follow the vehicle maker's recommendations for additional parts that must be replaced.
4. Loosen the adjusting bracket fasteners, as needed, to move the compressor and remove the drive belt.
5. Remove the attaching fasteners, as needed.

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9. Repair Procedure (cont'd)

- 6. Remove the compressor from the vehicle.
- 7. Measure the amount of refrigerant lubricant in the compressor. If the compressor has failed mechanically, it may be necessary to backflush debris from the orifice tube. If the lubricant is contaminated, flush the entire system. Use the proper refrigerant, and follow the equipment maker's procedure.
- 8. Install the replacement compressor onto the mounting brackets.
- 9. Install the attaching bolts and torque to the vehicle maker's recommendations.
- 10. Uncap the inlet and outlet tubes of the replacement compressor. Minimize the time the part is open to the atmosphere.
- 11. Add the proper refrigerant lubricant to the replacement compressor following the vehicle maker's specifications.
- 12. Replace all O-rings. Apply a small amount of the proper refrigerant lubricant to each O-ring before installation.
- 13. Connect the inlet and outlet hoses to the compressor.
- 14. Adjust the drive belt and torque all fasteners to the vehicle maker's specifications.
- 15. Leak-test the system. See 9.6.

9.6 Refrigerant Leak Test

To test for refrigerant leaks using an electronic, halogen, or dye-type leak detector:

- 1. Add a small amount of the proper refrigerant, if necessary, to produce a low-side pressure of about 345 **kPa** (50 **psi**).
- 2. Test for leaks around each fitting and connection, following the equipment maker's recommended procedure.
- 3. Test for leaks around all refrigerant line sensors and switches.
- 4. Test for leaks around the compressor.
- 5. Test for leaks near any oil deposits on the condenser.
- 6. Remove insulation or other parts, as necessary, to check for leaks at the bottom of the **evaporator** case.
Note: Oil deposits may be an indication of a leak.
- 7. Repair any leaks and retest, as necessary.
- 8. Evacuate and recharge the system.



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9. Repair Procedure (cont'd)

9.7 System Evacuation And Recharge

To evacuate and recharge the AC system:

- 1. Connect the proper AC service equipment, following the equipment maker's instructions.
- 2. Traces of refrigerant remaining in the AC system must be properly recovered. See **9.1**.
- 3. Pump the system to a vacuum of 980 mb (29" Hg) for 30–45 minutes, following the vehicle or equipment maker's instructions.
- 4. If 980 mb (29" Hg) cannot be reached after 15 minutes of pumping, or if the system does not hold 980 mb (29" Hg) for 10 minutes after pumping, there is a leak in the system. Repair any leaks and repeat steps 3 and 4 before continuing.
- 5. Determine the proper amount of refrigerant required to recharge the system. Refer to the vehicle AC label or service manual.
- 6. Add the same amount of refrigerant lubricant that was previously removed from the system. Ensure that the lubricant is compatible with the refrigerant.
- 7. Add the refrigerant, following the equipment maker's instructions.
- 8. Inspect and test the system. See **11.1** and **11.2**.

9.8 Retrofitting An R-12 System

To retrofit an R-12 system to use R-134a refrigerant:

- 1. Follow the vehicle maker's recommendations and all directions supplied with the retrofit kit.
- 2. Recover the R-12 refrigerant. See **9.1**.
- 3. Remove the R-12 refrigerant lubricant from the system.
- 4. Dispose of the R-12 refrigerant lubricant as hazardous waste.
- 5. Remove the R-12 parts, including the service ports, following the kit instructions.
- 6. Install the R-134a retrofit parts, following the kit instructions.
- 7. Install the high- and low-pressure service ports for R-134a refrigerant.
- 8. Add the proper type and amount of lubricant for the R-134a retrofit system, following the kit maker's recommendations.
- 9. Apply the proper R-134a retrofit labels.
- 10. Leak-test the system. See **9.6**.



10. Use Of Recycled (Salvage) Parts

10.1 Salvage Parts Requirements

A salvage condenser must meet these requirements:

- correct part for the vehicle year, make, model, and engine size
- designed for the proper type of refrigerant
- all openings sealed at the time the part was removed
- no **corrosion** damage
- no unreparable damage
- all refrigerant lubricant removed

A salvage compressor must meet these requirements:

- correct part for the vehicle year, make, model, and engine size
- designed for the proper type of refrigerant
- all openings sealed at the time the part was removed
- proper size clutch pulley
- no binding, improper clearance, corrosion, or damage
- no refrigerant lubricant contamination



11. Inspection And Testing

11.1 System Inspection

Inspect an AC system for these conditions:

- proper routing of lines and hoses
- proper routing and attachment of all electrical and vacuum connectors
- visible damage to any system parts
- bent or damaged condenser fins
- proper labels, including a retrofit label if the system has been retrofitted to R-134a
- proper belt routing and tension
- noise or vibrations from the compressor

Correct any defects.

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11. Inspection And Testing (cont'd)

11.2 System Performance Test

To test AC system performance:

1. Park the vehicle inside, and out of direct sunlight.
2. Open the vehicle doors or windows to vent the interior.
3. Connect high- and low-side pressure gauges to the service ports.
4. Record the **ambient temperature**.
5. Record the **relative humidity**.
6. Set the parking brake. Place the transmission in PARK or NEUTRAL and start the engine.
7. Place a thermometer in the air outlet nearest the center of the dash.
8. Turn the AC ON, at the coldest setting, with the blower fan speed at HIGH.
9. Place a portable electric fan in front of the vehicle's grille. Direct the air towards the condenser to simulate vehicle motion.
10. Hold the engine idle speed steady at 1500–2000 rpm, and close the windows.
11. Allow the AC to run for about 10 minutes at the coldest setting.
12. Record the high- and low-side refrigerant pressure readings.
13. Record the air temperature at the dash air outlet.
14. Compare all readings to the vehicle maker's performance chart. If the system has been retrofitted to use R-134a refrigerant, compare all readings to the kit maker's performance chart.
15. If the system performance is less than described on the performance chart, make the necessary repairs, perform the leak test in **9.6**, and repeat this test. It may be necessary to evacuate the system and recharge with pure refrigerant. See **9.7**.
16. Remove the gauges and re-cap the service ports.

Correct any defects.

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11. Inspection And Testing (cont'd)

Readings at 2000 rpm Engine Speed

Relative Humidity (%)	Ambient Air Temperature		Low Side Pressure				Discharge Air Temperature				High Side Pressure			
			R-12		R-134a		R-12		R-134a		R-12		R-134a	
	°C	°F	kPa	PSI	kPa	PSI	°C	°F	°C	°F	kPa	PSI	kPa	PSI
20	21	70	204	29.5	255	37.0	4	40	8	46	1034	150.0	1551	225.0
	27	80	204	29.5	255	37.0	7	44	8	47	1310	190.0	1896	275.0
	32	90	207	30.0	255	37.0	9	48	12	53	1689	245.0	2241	325.0
	38	100	214	31.0	262	38.0	14	57	12	54	2103	305.0	2241	325.0
30	21	70	204	29.5	255	37.0	6	42	9	48	1034	150.0	1655	240.0
	27	80	207	30.0	255	37.0	8	47	10	50	1414	205.0	1965	285.0
	32	90	214	31.0	269	39.0	11	51	14	57	1827	265.0	2344	340.0
	38	100	221	32.0	296	43.0	16	61	16	60	2241	325.0	2482	360.0
40	21	70	204	29.5	255	37.0	7	45	9	49	1138	165.0	1793	260.0
	27	80	207	30.0	255	37.0	9	49	12	53	1432	215.0	2103	305.0
	32	90	221	32.0	290	42.0	13	55	16	60	1931	280.0	3137	355.0
	38	100	269	39.0	338	49.0	18	65	19	66	2379	345.0	2724	395.0
50	21	70	207	30.0	255	37.0	8	47	11	51	1241	180.0	1896	275.0
	27	80	221	32.0	269	39.0	12	53	13	56	1620	235.0	2206	320.0
	32	90	235	34.0	317	46.0	15	59	17	63	2034	295.0	2586	375.0
	38	100	276	40.0	379	55.0	21	69	22	72	2413	350.0	2965	430.0
60	21	70	207	30.0	255	37.0	9	48	12	53	1241	180.0	2000	290.0
	27	80	228	33.0	290	42.0	13	56	15	59	1655	240.0	2344	340.0
	32	90	248	36.0	338	49.0	17	63	19	66	2069	300.0	2689	390.0
	38	100	297	43.0	414	60.0	23	73	26	78	2482	360.0	3068	445.0
70	21	70	207	30.0	255	37.0	10	50	13	55	1276	185.0	2103	305.0
	27	80	235	34.0	310	45.0	14	58	17	62	1689	245.0	2448	355.0
	32	90	262	38.0	365	53.0	18	65	21	70	2103	305.0	2792	405.0
	38	100	290	44.0	420	61.0	24	75	25	78	2515	365.0	3135	455.0
80	21	70	207	30.0	283	41.0	10	50	13	56	1310	190.0	2206	320.0
	27	80	235	34.0	331	48.0	15	59	18	65	1723	250.0	2551	370.0
	32	90	269	39.0	393	57.0	19	67	23	73	2138	310.0	2896	420.0
90	21	70	207	30.0	310	45.0	10	50	14	58	1379	200.0	2310	335.0
	27	80	248	36.0	359	52.0	17	62	20	68	1827	265.0	2655	385.0