

Automotive parts – Air conditioner – Test method for measuring refrigerant (R134a) leakage

1 Scope

This Standard specifies test procedures for measuring the amount of refrigerant that has leaked from an air conditioner of a vehicle (hereinafter referred to as "car air conditioner") using R134a as refrigerant. This Standard applies to both a single air conditioner and a dual air conditioner for a passenger vehicle. Although refrigerant leakage can be calculated by subtracting the amount of the refrigerant remaining in an air conditioner cycle at the end of testing from the amount of the initially charged refrigerant, it is necessary to measure the amount of the initially charged refrigerant and the amount of the remaining refrigerant accurately in order to achieve the accurate measurements of the refrigerant leakage. For this reason, this Standard specifies the work instructions and methods for the accurate measurements since operations for charging and recovering refrigerant which differ from the operations for conventional air conditioning systems using chlorofluorocarbon are required.

NOTE 1 It is recommended that the test should be conducted for 2 years or longer with vehicles that have been used for 1 year or longer since the refrigerant leakage is defined as average annual leakage during the use.

NOTE 2 Although this Standard is considered to be applicable to trucks and buses, the refrigerant recovery accuracy for them has not been verified yet.

2 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

2.1 refrigerant leakage

average annual amount of refrigerant that has leaked during the test period (grams per year)

2.2 air conditioner cycle

all of the components, such as a compressor, a condenser, an expansion valve, an evaporator, pipes and hoses, that constitute the refrigerant passage and that are in the connected state

2.3 recovery error

difference between the mass of the refrigerant that is charged into a vehicle and the mass of the refrigerant that is recovered from the vehicle immediately after the charging

NOTE After being charged with the specified amount of the refrigerant, the car air conditioner is set at the internal circulation and heater mode (at fully hot temperature for a manual air conditioner and at the highest temperature for an auto air conditioner), the air flow rate of the fan is set at the maximum rate, and the car air conditioner switch is turned on. Then the engine is driven in idling condition for 30 min, and then stopped. The refrigerant is recovered after the engine stops. The recovery error is obtained based on the difference between the charged refrigerant and the recovered refrigerant. In this Standard, the allowable recovery error is 3 g or less.

3 Test devices

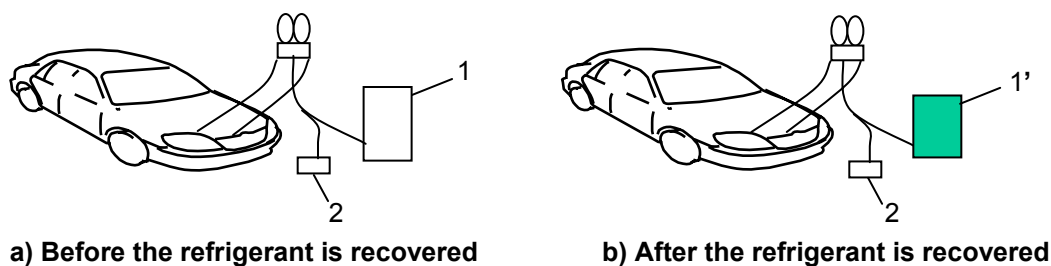
The devices used for measuring refrigerant leakage from an actual vehicle air conditioner system shall be capable of measuring accurately the amount of the refrigerant charged to the car air conditioner before the test and the amount of the refrigerant recovered from the car air conditioner after the test. The devices shall be as follows.

- a) **Gauge manifold system** A gauge manifold system consists of pressure gauges, charge hoses and quick couplers, and it has the functions to make transit connection between the car air conditioner and the following devices (a vacuum pump, refrigerant recovery tank, etc.) and to monitor the pressure while the refrigerant is charged and recovered. A low-pressure valve shall be normally kept open, and the quick couplers shall be equipped with a stop valve in order to prevent the careless outflow of the refrigerant at the recovery operation.
- b) **Vacuum pump** A vacuum pump is used to vacuumize the air conditioner cycle before the initial charging of the refrigerant. The vacuum pump should have the flow rate capacity of 20 L/min to 30 L/min.
- c) **Refrigerant recovery tank** A refrigerant recovery tank is used for the initial charging and recovery of the refrigerant. The inner volume of the tank shall be approximately 1.0 L. The tank opening shall be connected with an opening/shut-off valve. Two refrigerant recovery tanks (including a spare) should be prepared when the refrigerant is recovered and the measurement is performed.
- d) **Needle valve** A needle valve is in the refrigerant recovery circuit and is used to adjust the flow rate of the recovered refrigerant.
- e) **Sight glass** A sight glass is in the refrigerant recovery circuit and is used to observe the flow condition of the recovered refrigerant (whether or not oil is present).
- f) **Insulating container** A container with the insulating structure that allows the refrigerant recovery tank to be immersed in liquified nitrogen when the refrigerant is recovered. A stainless container with the structure of vacuum insulation (such as a thermos bottle) is used normally.
- g) **Balance** A balance used for the test shall be capable of measuring the mass of the charged or recovered refrigerant as contained in the refrigerant recovery tank. The measurement accuracy shall be ± 0.1 g or less.
- h) **Liquified nitrogen** Liquified nitrogen is used, when the refrigerant is recovered, to cool the refrigerant recovery tank down to the extremely low temperature in order to lower the pressure in the tank to a high vacuum condition so as to draw the refrigerant from the air conditioner cycle.

4 Procedures for refrigerant leakage measurement

4.1 Check of the error caused by charging and recovery of refrigerant

Confirm that the operational error in charging and recovering the refrigerant is 3 g or less before the measurement of the refrigerant leakage of test vehicles is performed. Take the following procedures to confirm the operational error.

**Key**

- 1 Refrigerant recovery tank (before the refrigerant is recovered from the vehicle)
- 1' Refrigerant recovery tank (after the refrigerant is recovered from the vehicle)
- 2 Vacuum pump

Figure 2 – Recovery of refrigerant from a test vehicle

c) Check of recovery error

Repeat the operation to charge and recover the refrigerant until the error between W_{ref} (the amount of the charged refrigerant) and W_{refrec} (the amount of the recovered refrigerant) reaches 3 g or less in order to improve the accuracy in the operation.

NOTE Total leakage of the refrigerant from a test vehicle during the test period of 2 years will be approximately 30 g (estimated annual refrigerant leakage 15 g x 2 years). Assuming that the allowable measurement error is 10 %, the required accuracy should be at most 3 g.

4.2 Measurement of refrigerant leakage in test vehicles

Measure the refrigerant leakage from test vehicles if the recovery error of 3 g or less has been confirmed in 4.1. The procedures to perform the measurement shall be as follows.

- a) Prepare vehicles that satisfy the following requirements as vehicles appropriate for the purpose of the refrigerant leakage measurement.
 - 1) Vehicles that have been in service for 1 year or longer instead of new vehicles should be used in consideration of the aged deterioration of packing, seal, etc.
 - 2) The car air conditioner shall be in good order. If for some reason, such as an accident, the car air conditioner parts were replaced in the past, the replacement parts shall be the specified ones (genuine parts) and the car air conditioner shall not have been modified.
 - 3) A vehicle with a clear sign of a large amount of refrigerant leakage (oil adherence) shall not be used as a test vehicle because such a vehicle will deliver inaccurate test results.
- b) An indoor workshop should be used as the work site. However, if the measurement is performed outdoors, the following places should be used:
 - 1) a flat place where there is no wind and no direct sunlight;
 - 2) place where vehicle exhaust gas can be treated appropriately;

3) a place where outside air temperature is 15 °C or higher.

c) Measurement of amount of the refrigerant charged into a test vehicle

The measurement of the refrigerant shall be performed in accordance with 4.1 a).

d) Test report

Make test reports according to **Table 1** and keep them until the monitoring of the refrigerant leakage from the test vehicles is completed.

e) Monitoring of test vehicles

Monitoring of the test vehicles in the market shall be continued for 2 years or longer.

f) Measurement of refrigerant recovered form test vehicles

Measurement of the recovered amount of the refrigerant shall be performed in accordance with 4.1 b).

g) Calculation of annual refrigerant leakage

Obtain the amount of the refrigerant leakage during the monitoring period (days), and calculate the annual refrigerant leakage by using the following equation.

$$W = \Delta W_{\text{ref}} \times \frac{365}{n}$$

where

- W is the annual refrigerant leakage (g)
- ΔW_{ref} is the refrigerant leaked during the monitoring period [Difference between the equations (1) and (2)] (g)
- n is the number of days monitored

5 Work instructions for charging and recovering refrigerant

5.1 General

The work instructions for charging and recovering the refrigerant specified in 4.1 and 4.2 are as follows.

Figure 3 shows the overall arrangement (example) of the devices for charging and recovering the refrigerant.

Figure 4 shows the schematic connections of charge hoses.

Figure 5 shows the main portion of the system for charging and recovering the refrigerant (example).

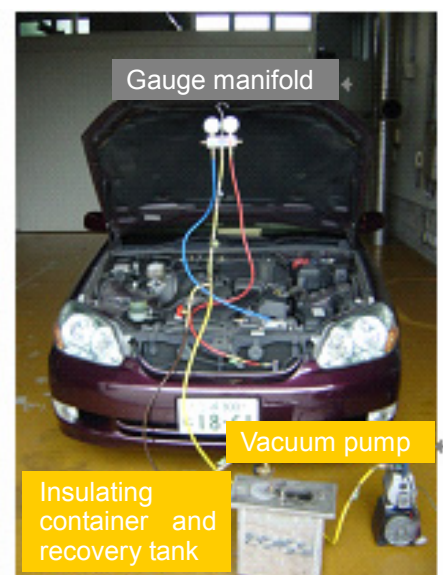


Figure 3 – Overall structure of device for charging and recovering refrigerant (example)