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**Road vehicles - Refrigerant systems used in mobile air
conditioning systems - Safety requirements**

道路车辆 汽车空调系统用制冷剂系统 安全要求

(English Translation)

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1 Scope

This Document specifies the safety requirements for refrigerant systems and components used in automobile air conditioning systems.

This Document applies to automobile air conditioning refrigerant systems for M1 and N1 vehicles using HFC-134a, HFO-1234yf, and R744 refrigerants.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 7778 Number designation and safety classification of refrigerants

GB/T 30512 Requirements for Prohibited Substances on Automobiles

QC/T 664 Automotive air-conditioning refrigerant hose

QC/T 665 Charging valve for automotive air conditioning

QC/T 669 Automotive Air-Condition Pipe-Fittings and Pipes

QC/T 720 Auto air condition vocabulary

QC/T 1176 Evaporator for automotive air conditioning

QC/T 1177 Condenser for automotive air conditioning

3 Terms and Definitions

For the purposes of this Document, the terms and definitions given in GB/T 7778 and QC/T 720, and the following apply.

3.12 Hazard

An event that could result in harm to people or the environment.

3.13 Risk

A quantitative assessment of the probability or likelihood of a specified hazard occurring.

3.14 Time-weighted average; TWA

The average mass concentration of harmful substances in the air during a specified period of time.

3.15 Exposure

The contact of one or more biological, chemical or physical factors with the human body in time and space.

3.16 Lowest observed effect level; LOEL

The lowest concentration or amount of a substance that is likely to cause any detectable change in the morphology, function, growth, development or lifespan of the target organism.

3.17 No observed effect level; NOEL

The highest concentration or amount of a substance that does not cause any detectable change in the morphology, functional growth, development or lifespan of the target organism under specified exposure conditions.

4.1 General

4.1.1

This Document aims to minimize the hazards to personnel, vehicles, property, and the environment caused by failure of mobile air conditioning (MAC) refrigerant systems and the used refrigerants, and to ensure that the safety level of MAC refrigerant systems using other refrigerants is equivalent to that of systems using HFC-134a refrigerant. The potential hazards resulting from failure of the refrigerant system and the used refrigerant may be related to the following factors.

- a) the physical and chemical properties of the refrigerant (such as pressure, toxicity, and flammability), as well as the refrigerant charge, pressure, and temperature in the refrigerant system;
- b) the passenger compartment volume, air exchange rate, and refrigerant system components located within the passenger compartment;
- c) elevated refrigerant concentrations in the passenger compartment or engine compartment, which could lead to direct inhalation of refrigerant or its decomposition products, potentially posing a health hazard to personnel;
- d) ignition of refrigerant at sufficient concentrations in the air by an accidental open flame;
- e) accidental entry of decomposition products of refrigerant leaking from the engine compartment into the passenger compartment due to ignition or thermal decomposition;
- f) noise release resulting in startling, irritation, or other disturbances to the driver, potentially posing a hazard to passengers or pedestrians;
- g) the quality and durability of risk-level refrigerant system components over the vehicle's lifecycle;
- h) refrigerant system leaks caused by improper repairs or serious maintenance errors. The risk of the refrigerant quality and charge in the system failing to meet design requirements;
- i) Vehicle accidents and failures that increase the refrigerant system risk level;

j) Increased refrigerant concentration in the passenger compartment due to increased refrigerant charge or increased pipe connections (e.g., battery cooling systems, dual evaporator systems, etc.);

k) Risks arising from increased external surface temperatures of engine components in vehicles using HFO-1234yf refrigerant in MAC systems. This risk shall be identified through a systematic risk analysis process, including a detailed analysis of the system and components, the system environment, and the intended use. Historical failure data (if available) and the severity and likelihood of each identified risk shall also be included in the risk analysis.

4.1.2

Risk assessment methods for MAC systems are described in 4.2. Risk assessment information for MAC systems using each refrigerant is described in 4.3.

4.1.3

Safety requirements for refrigerant systems are described in Clause 5; and safety requirements for refrigerant system components are described in Clause 6.

4.2 Risk assessment

Risk assessment for MAC systems is a multi-step process that requires reviewing various types of data and summarizing them to form a quantitative assessment of potential risks. The risk assessment methodology is as follows.

a) Assess refrigerant toxicity data. This data can be sourced from professionally reviewed scientific literature or newly initiated studies. For newly initiated studies, the study report must be reviewed to ensure the accuracy of the study protocol, report of results, any

Refrigerant toxicity limits are expressed as a time-weighted average (TWA) representing the toxicity limit requirement over a specified timeframe.

b) Scenarios to be assessed in the risk assessment.

1) Leakage in the passenger compartment of a MAC system, resulting in R744 exposure concentrations exceeding health limits;

NOTE: Smaller leaks (corrosion leaks) are associated with leaks during normal operation of the MAC system, while larger leaks are associated with refrigerant line ruptures caused by vehicle collisions.

2) R744 exposure concentrations exceeding health limits during vehicle maintenance;

3) Liquid or debris splashing due to a high-pressure system rupture;

4) Driver shock due to a high-pressure system rupture, resulting in an accident.