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Road vehicles — Refrigerant systems used in mobile air conditioning systems (MAC) — Safety requirements

Véhicules routiers — Systèmes réfrigérants utilisés dans les systèmes d'air conditionné embarqués (MAC) — Exigences de sécurité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13043 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

Introduction

For many years, R-134a has been the refrigerant of choice for refrigerant systems for mobile air conditioning (MAC) due to its thermodynamic properties, worldwide availability and relative low cost. However, its contribution to global warming is now considered to be unacceptable. Additionally, it has been documented that the rate of growth in atmospheric loading of R-134a is of growing concern.

In 2006, the EU formulated legislation 2006/40/EC to ban the use of greenhouse gases having a global warming potential (GWP) of more than 150. Since R-134a has a GWP >1300, the European Directive has banned the use of R-134a for new model types since 1 January 2011 and for all new vehicles starting on 1 January 2017.

The automotive industry has responded by identifying two materials that would comply with the European Union GWP requirement and offer acceptable refrigeration performance. These products are R-744 (carbon dioxide, GWP of 1) and R-1234yf (2,3,3,3-Tetrafluoroprop-1-ene, GWP of 4).

In certain concentrations, both products could lead to a safety hazard to the vehicle occupants and to technicians who service the vehicle. This International Standard aims to identify refrigerant system safety requirements, to be met through robust engineering solutions and applied to the vehicle design, to maintain a comparable level of safety as that of MAC systems using R-134a.

Road vehicles — Refrigerant systems used in mobile air conditioning systems (MAC) — Safety requirements

1 Scope

This International Standard is restricted to refrigerant systems providing cooling or heating of passenger compartment, battery, etc., in passenger motor vehicles. It provides minimum design requirements for refrigerant containment and safety requirements of these systems.

This International Standard addresses the use of only R-134a, R-1234yf and R-744 refrigerants in vehicle original equipment manufacturer (OEM) and aftermarket (non-OEM) supplied components and systems.

The relevant risks associated with these refrigerant systems are:

— projection of fragments or fluid due to high pressure systems;

— inhalation of toxic substances, including potential decomposition products;

— flame propagation.

Consequently, this International Standard will address the component and system design requirements related to any of these hazards where the refrigerant system is involved.

Any scenario involving other components from the heating, ventilation and air conditioning (HVAC) system (heater, blower, air mixing and distribution) or any other component of the vehicle not related to the refrigerant system will not be covered in this International Standard.

The purpose of this International Standard is to ensure that end-users or service technicians are not exposed to hazards during normal usage, maintenance and repair, and end-of-life disposal of the car. Therefore, manufacturing, storage and transportation of the refrigerant, as well as refrigerant distribution and filling machines in the assembly plant will not be covered in this International Standard. For these situations, the safety of qualified personnel will be addressed by existing standards commonly used among the industry and relevant regulations.

Entire vehicle lifetime has been considered to address durability issues.

For the R-134a system, this International Standard applies to any new model type launched one year after the document is published.

For the R-1234yf and R-744 systems, this International Standard applies from first application of these refrigerants to any vehicle.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASHRAE 34-2007, *Designation and Safety Classification of Refrigerants*

SAE J639, *Safety Standards for Motor Vehicle Refrigerant Vapor Compressions Systems*

SAE J2064 - R-134a and R-1234yf, *Refrigerant Automotive Air-Conditioning Hose and Assemblies*

SAE J2670, *Stability and Compatibility Criteria for Additives and Flushing Materials Intended for Use in R-134a and R-1234yf Vehicle Air-Conditioning Systems*

SAE J2771 - CO2 (R-744), *Refrigerant Removal and Charging Equipment for Mobile Refrigerant Systems*

SAE J2772, *Measurement of Passenger Compartment Refrigerant Concentrations Uunder Ssystem Rrefrigerant Lleakage Cconditions*

SAE J2788 - HFC-134a (R-134a), *Recovery/Recycling Equipment and Recovery/Recycling/Recharging for Mobile Air-Conditioning Systems*

SAE J2842 - R-1234yf and R-744, *Design Criteria and Certification for OEM Mobile Air Conditioning Evaporator and Service Replacements*

SAE J2843 - R-1234yf, *Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems*

SAE J2845, *Technician Training for Safe Service and Containment of Refrigerants Used in Mobile A/C Systems (R-744, and R-1234yf)*

3 Terms and definitions

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

3.1
vehicle
vehicle with a combustion engine and/or electric driving motor, intended for use on the road, with or without external body components added, having a permissible maximum mass of at least 400 kg and a maximum design speed equal to or exceeding 50 km/h

NOTE Passenger cars and light commercial vehicles (including light-duty trucks) are covered, with the exception of heavy trucks and road tractors, minibuses, buses and coaches, agriculture tractors and public work vehicles.

3.1.1
air exchange rate
AER
number of times that the air in the passenger compartment is replaced per hour

3.1.2
air inlet plenum
chamber located in front of the passenger compartment where the air is collected before entering into the vehicle, usually separating water, snow, and debris from the air prior to its entry into the HVAC module

3.1.3
engine bay
space for a combustion engine and/or an electric driving motor

NOTE 1 In a front-engined vehicle, it is the space between the front grille, the front side fenders, the front of dash (or firewall) in front of the passenger compartment, closed by the engine bonnet.

NOTE 2 In a rear-engined vehicle, it is the space between rear end and vehicle compartment rear bulkhead, embedded between engine compartment side panels (fender apron), closed by the hatchback and underneath closed out to various degrees by an underbonnet shield.

NOTE 3 In a mid-engined vehicle, it is the space between rear end and passenger compartment rear bulkhead, embedded between engine compartment side panels (fender apron), closed by an engine compartment cover and underneath closed out to various degrees by an underbonnet shield.

3.1.4
underhood
space in the engine bay where the components of the refrigerant system are located

NOTE 1 In a front-engined vehicle, it contains mechanical or electric compressor, condenser/gas cooler, refrigerant sensor, accumulator or receiver/drier, at least one expansion device, piping, assemblies, charge and/or service ports, and an optional internal heat-exchanger.

NOTE 2 In a rear-engined and mid-engined vehicle, it contains mechanical or electric compressor and piping.

3.1.5
vehicle lifetime
design life of the vehicle as specified by the vehicle manufacturer in terms of mileage and years of life

3.1.6
vehicle interior
passenger compartment
vehicle space occupied by the driver and passengers while driving

NOTE This space is normally sealed from the exterior environment, but has a certain air exchange rate.

3.1.7
original equipment manufacturer
OEM
vehicle manufacturer

3.2
mobile air conditioning
MAC
system used to provide occupant comfort by heating or cooling and dehumidifying the air that is delivered into the passenger compartment, by an electric blower and/or ram air from various air distribution ducts and outlets in the interior of the vehicle

NOTE The heating phase may include the use of waste engine heat and/or electric heating elements. The cooling phase is provided by a refrigerant system. The MAC also provides the ability to deliver conditioned airflow to clear vision (glazing/window) areas during inclement weather conditions. Air filtering devices with a sufficient degree of separation protect the HVAC units and occupants of the vehicle from the entry of water, snow, and other airborne debris.

3.2.1
battery chiller cooling system

refrigerant system with circuit extension consisting of an evaporator in a brine (water/anti-freeze mixture) loop with the intention to chill the circulating brine

3.2.2
battery direct cooling system
refrigerant system with circuit extension consisting of integrated evaporator in the battery assembly

3.2.3
double (dual) evaporator system
air conditioning system with a refrigerant loop with one compressor, one condenser and two evaporators and expansion devices, usually in parallel and usually both placed in or adjacent to the passenger compartment

3.2.4
high pressure side
refrigerant system from the compressor discharge chamber to the expansion device inlet chamber

3.2.5
low pressure side
refrigerant system from the expansion device discharge chamber to the compressor inlet chamber, including the compressor crankcase

3.2.6
refrigerant system
system consisting of refrigerant components, e.g. compressor, condenser/gas cooler, accumulator or receiver/drier, refrigerant sensor, at least one expansion device and one evaporator, piping assemblies, charge and/or service ports and an optional internal heat exchanger

NOTE The various parts of a refrigerant system fulfil design intent leak tightness and form a closed refrigerant cycle, in which the refrigerant can circulate at different pressures. The refrigerant lines make a connection between the components. Pressure and temperature sensors sense the refrigerant condition. For performance enhancements, an internal heat exchanger can be integrated between a high and low pressure side. The refrigerant cycle is built up during the assembly of the refrigerant system components in the vehicle, connecting the components to the vehicle body, and filling the designated refrigerant charge.

3.3
refrigerant system components
parts and subassemblies constituting the refrigerant system

3.3.1
accumulator
vessel capable of holding liquid refrigerant which is connected between the evaporator exit and inlet of compressor or internal heat exchanger

NOTE 1 The accumulator may contain the desiccant for removing moisture from the refrigerant. The accumulator may contain an integrated internal heat exchanger.

NOTE 2 An accumulator is used where the expansion device is an orifice or where the system is a transcritical R-744 system.

3.3.2
compressor
component that mechanically increases the pressure of the refrigerant vapour by sucking it in as low temperature and low pressure refrigerant from the evaporator or internal heat exchanger outlet and compressing it to high temperature and high pressure refrigerant for supply to the condenser or gas cooler inlet

3.3.3
condenser
device (heat exchanger) in which vaporized refrigerant is liquefied by removal of heat and the heat is released to the ambient air flowing through it

3.3.4
connecting technology
serviceable fitting technology used between components and piping assemblies in the refrigerant cycle

3.3.5
crimping
area of the refrigerant piping in which the pipe is permanently connected with the hose

3.3.6
desiccant
hygroscopic substance that absorbs or bonds free water from the enclosed refrigerant system until it becomes saturated

NOTE Commonly encountered desiccants are solids, and work through absorption or adsorption of water, or a combination of the two. Desiccants may work through physical or chemical bonding of water molecules.

3.3.7
evaporator
device (heat exchanger) absorbing heat from vehicle compartment air flow prior to entering the vehicle compartment or from other sources (battery, secondary loop fluid, etc.)

NOTE The refrigerant is converted from a predominately liquid state to a predominately vapour or superheated vapour state in the evaporator.

3.3.8
expansion device
orifice or regulating valve through which the refrigerant expands to a saturated low pressure vapour prior to entering the evaporator

NOTE The refrigerant is throttled from the high pressure side to the low pressure side.

3.3.9
flexible hose
flexible part of the refrigerant piping assembly, which allows relative movement between components in the vehicle

3.3.10
gascooler
device (heat exchanger) which is used for heat removal from the refrigerant in the supercritical refrigerant in a transcritical system

3.3.11
heating, ventilation and air conditioning unit
HVAC
part of the vehicle interior, which essentially consists of housings, blower, air filter, evaporator, heater core and/or electrical heater, air damper, motors, cable controls, air ducts, etc.

NOTE The system boundaries for interior components are the air inlet openings for outside air or recirculation air and the outlet openings to the passenger compartment.

3.3.12
internal heat exchanger
device which is used for defined heat transport from high pressure liquid side to low pressure suction side of the refrigerant system

3.3.13
liquid receiver/dryer
vessel which is permanently connected to the high pressure side of the system by inlet and outlet connections for accumulation of liquid refrigerant before the expansion device

NOTE The receiver contains the desiccant for moisture removal. The receiver is often an integrated element of the condenser.

3.3.14
lubricant
fluid partly circulating in the refrigerant system together with the refrigerant for reducing friction between surfaces in relative motion essentially by use of a fluid film

3.3.15
tubing
rigid refrigerant line including reinforcing and connecting pieces and connection seals

3.3.16
piping assembly
tubing or hoses (including bellows, connection technology) that interconnect the various parts of a refrigerating system

NOTE The piping assembly is fitted on both ends with connection technology to the component.

3.3.17
pressure relief device
mechanical device designed to automatically relieve pressure from the refrigerant system in order not to exceed the maximum pressure