

**State of California**  
**California Air Resources Board**

**Manufacturers Advisory Correspondence (MAC) 2022-01**

- Subject:** Clarifications on California Phase 2 Greenhouse Gas (GHG) Air Conditioning (A/C) Leakage Requirements
- Applicability:** New 2022 and subsequent model year (MY) medium- and heavy-duty vehicles, except medium-duty passenger vehicles.
- References:** Title 17, California Code of Regulations (CCR) Section 95663 and “California Greenhouse Gas Exhaust Emission Standards and Test Procedures for 2014 and Subsequent Model Heavy-Duty Vehicles,” as last amended on June 27, 2019 (Phase 2 GHG Procedures).  
  
Section 86.1819-14, section 1037.115, section 1037.621, and section 1037.801 in the Phase 2 GHG Procedures.
- Background:** The California Air Resources Board (the Board or CARB) adopted the California Phase 2 GHG regulation on December 19, 2018. That regulation established, among other provisions, requirements to minimize the leakage of air conditioning (A/C) system refrigerant from 2021 and subsequent model year heavy-duty vehicles. This MAC clarifies two subjects related to those requirements.
1. California’s Phase 2 GHG regulation specifies that the A/C refrigerant leak rate, as calculated using SAE International’s Surface Vehicle Standard J2727 (SAE J2727), must not exceed 11.0 grams per year or 1.50 percent of the refrigerant capacity per year, whichever is greater. To demonstrate compliance with this A/C leakage standard, the regulation requires manufacturers to provide to CARB a list of detailed A/C system information, including an A/C leakage compliance cover letter and summary table, A/C system schematics, and the corresponding SAE J2727 calculation spreadsheets. Manufacturers are exempt in a few cases from providing the detailed A/C system information, including when the system uses a refrigerant with a global warming potential (GWP)

value of 150 or less, when the projected volume of vehicles that are produced and delivered for sale in California in a given A/C platform is less than 20, or when the A/C system is designed such that a compliance demonstration using SAE J2727 standard is impossible or impractical.

Via this MAC, CARB is providing clarification on the A/C leakage requirement certification responsibilities for manufacturers of vehicles whose A/C installation involves both a certifying vehicle manufacturer and a non-certifying secondary vehicle manufacturer.

2. CARB's Phase 2 GHG regulation requires manufacturers to demonstrate that a vehicle A/C system achieves an equivalent level of refrigerant leakage control in cases where the system is designed such that a compliance demonstration using SAE J2727 is impossible or impractical. This provision was included in the regulation in response to a concern raised by manufacturers of transit buses. The concern was that some of the A/C systems for those vehicles may include components not adequately represented by those listed in SAE J2727 (e.g., hoses, fittings, or seals), and that the realistic leak rates of these components may not be correctly captured by SAE J2727.

As implementation of the Phase 2 GHG regulation has progressed, CARB has continued to evaluate compliance demonstration methods for such A/C systems. During this process, CARB received data and evidence from a transit bus manufacturer showing that the A/C component technologies pertaining to refrigerant leakage for the A/C systems in its transit buses, including the types of hoses, fittings, and seals, are in fact listed in SAE J2727. The data further suggest that SAE J2727 can be appropriately used for such systems to demonstrate compliance with the system leak rate limit requirement of 1.50% per year. CARB notes that such an application of SAE J2727 to A/C systems of transit buses is consistent with application of the standard to other vehicle types subject to the Phase 2 A/C leakage requirements. For those other vehicle types, SAE J2727 serves as a standard test procedure without regard to the leak rate variations attributable to factors external to the A/C system, such as the vocation's work cycle and the vehicle's operating conditions. Therefore, via this MAC, CARB is providing clarification that SAE

J2727 should be used to demonstrate A/C system compliance with the A/C leakage requirements in cases where the refrigerant type is covered by SAE J2727 and the A/C component technologies pertaining to refrigerant leakage are listed in SAE J2727.

If all the pertinent A/C component technologies of an A/C system are not listed in SAE J2727 (for example, compressor housings that are weld-shut as opposed to sealed by compressor housing seals), the manufacturer must use alternative means to demonstrate equivalent refrigerant leakage control. As one potential alternative, it may be possible to adapt the SAE J2727 method by modifying the SAE J2727 calculation to account for the refrigerant leakage attributable to the unlisted A/C component technologies. For example, for an A/C system with weld-shut compressor housings, the manufacturer may opt to add to the SAE J2727 calculation the weld-shut housings' leakage rates as justified by data or evidence.

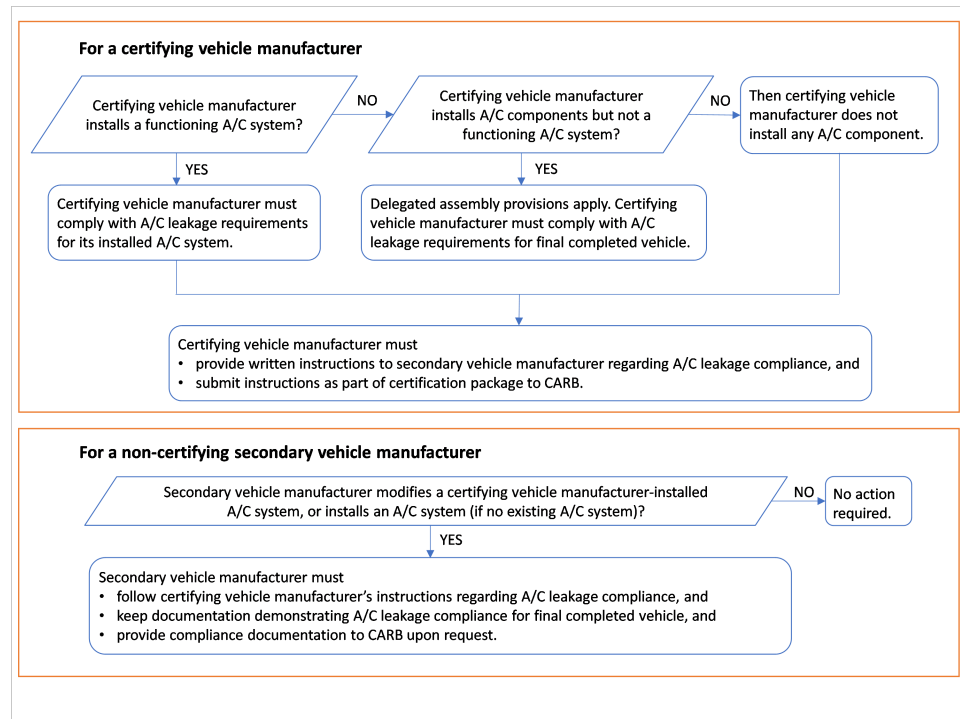
Some A/C systems use refrigerant types not covered by SAE J2727, for example, R-407C. This is another circumstance under which the use of alternative means is needed to demonstrate equivalent refrigerant leakage control. As an alternative compliance demonstration method for these systems, manufacturers may use SAE J2727 for the benchmark refrigerant of HFC-134a, as a proxy to evaluate the leak rates for the uncovered refrigerant types. CARB believes that this proxy would account for the refrigerant containment effectiveness of different A/C component technologies, even though it does not account for the leakage impact of different refrigerants' thermodynamic properties such as vapor pressure and dynamic viscosity.

Note that a refrigerant circuit that is dedicated to the thermal management for battery packs or other vehicular systems or components and that is separate from the refrigerant circuit used for cabin driver/passenger comfort cooling is not subject to the Phase 2 GHG A/C leakage requirements.

**Process:**

1. A/C Leakage Certification Responsibilities for Manufacturers of Vehicles whose A/C Installation Involves both a Certifying Vehicle Manufacturer and a Non-Certifying Secondary Vehicle Manufacturer

This section delineates the A/C leakage certification responsibilities where A/C system installation involves both certifying vehicle manufacturers and non-certifying secondary vehicle manufacturers. Subsections 1.1 through 1.3 discuss three scenarios depending on the certifying vehicle manufacturer's role in A/C system installation. Figure 1 below provides an overview of the process.



**Figure 1.** A/C leakage certification responsibilities for manufacturers of vehicles whose A/C installation involves both a certifying vehicle manufacturer and a non-certifying secondary vehicle manufacturer.

- 1.1. If the certifying vehicle manufacturer installs a functioning A/C system prior to selling or shipping the vehicle to a non-certifying secondary vehicle manufacturer:
  - 1.1.1. The certifying vehicle manufacturer must comply with the Phase 2 GHG A/C leakage requirements as specified in the Phase 2 GHG Procedures for the A/C systems it installs prior to selling or shipping the vehicle to a non-certifying secondary vehicle manufacturer.

- 1.1.2. The certifying vehicle manufacturer must provide instructions, via an Incomplete Vehicle Documentation (IVD) or similar written document, regarding compliance with the A/C leakage standard to the non-certifying secondary vehicle manufacturer, and a copy of the instructions shall be submitted to CARB as part of the certification application.
- 1.1.3. The aforementioned instructions must include the following statements:
- *The state of California limits the air conditioning refrigerant leak rate to 11.0 grams per year or 1.50 percent of the nominal refrigerant charge per year, whichever is greater, per 17 CCR § 95663.*
  - *This vehicle, when completed, will meet the leakage standard in 17 CCR § 95663 if no alterations are made to the vehicle air conditioning system as delivered and no additional air conditioning components are added.*
  - *If additional air conditioning components are added by a secondary vehicle manufacturer, or if the air conditioning system is otherwise modified by the secondary vehicle manufacturer, the final completed system must meet the leakage standard in 17 CCR 95663.*
- 1.1.4. If the non-certifying secondary vehicle manufacturer adds additional air conditioning components to, or otherwise modifies, the air conditioning system installed by the certifying vehicle manufacturer, the non-certifying secondary vehicle manufacturer must follow the certifying vehicle manufacturer's instructions regarding compliance with the A/C leakage standard and must keep documentation demonstrating that the final completed vehicle meets the A/C leakage standard. Such documentation must be compliant with the CARB A/C leakage requirements (section 86.1819-14 or section 1037.115 in the Phase 2 GHG Procedures, depending on which section the manufacturer certifies the vehicle to), and include, with a few exceptions explicitly specified in the Phase 2 GHG Procedures, A/C cover letter and summary table, A/C system

schematics, and the corresponding SAE J2727 spreadsheets.

- 1.1.5. CARB reserves the right to request the non-certifying secondary vehicle manufacturer to provide the aforementioned A/C leakage compliance documentation. Documentation must be provided upon request.
- 1.2. If the certifying vehicle manufacturer installs A/C components that do not result in a functioning A/C system prior to selling or shipping the vehicle to a non-certifying secondary vehicle manufacturer,  
Section 1037.621 (Delegated assembly) of the Phase 2 GHG Procedures applies. The certifying vehicle manufacturer must comply with the CARB A/C leakage requirements (section 86.1819-14 or section 1037.115 in the Phase 2 GHG Procedures, depending on which section the manufacturer certifies the vehicle to) for the final vehicle as completed by the delegated assembly work.
- 1.3. If the certifying vehicle manufacturer does not install any A/C components prior to selling or shipping the vehicle to a non-certifying secondary vehicle manufacturer:
  - 1.3.1. The certifying vehicle manufacturer must provide instructions, via an Incomplete Vehicle Documentation (IVD) or similar written document, regarding compliance with the A/C leakage standard to the non-certifying secondary vehicle manufacturer, and a copy of the instructions shall be submitted to CARB as part of the certification application.
  - 1.3.2. The aforementioned instructions must contain the following statements:
    - *The state of California limits the air conditioning refrigerant leak rate to 11.0 grams per year or 1.50 percent of the nominal refrigerant charge per year, whichever is greater, per 17 CCR § 95663.*
    - *This vehicle has been produced without any air conditioning components.*
    - *If an air conditioning system is added by a secondary vehicle manufacturer, the final*

*completed system must meet the leakage standard in 17 CCR 95663.*

- 1.3.3. If the non-certifying secondary vehicle manufacturer adds an air conditioning system, the non-certifying secondary vehicle manufacturer must follow the certifying vehicle manufacturer's instructions regarding compliance with the A/C leakage standard, and keep documentation demonstrating that the final completed vehicle meets the A/C leakage standard. Such documentation must show compliance with the CARB A/C leakage requirements (section 86.1819-14 or section 1037.115 in the Phase 2 GHG Procedures, depending on which section the manufacturer certifies the vehicle to), and include, with a few exceptions explicitly specified in the Phase 2 GHG Procedures, A/C cover letter and summary table, A/C system schematics, and the corresponding SAE J2727 spreadsheets.
- 1.3.4. CARB reserves the right to request the non-certifying secondary vehicle manufacturer to provide the aforementioned A/C leakage compliance documentation. Documentation must be provided upon request.

## 2. Clarification on Refrigerant Leakage Control Demonstration Method

- 2.1. Manufacturers may follow one of the following three paths to compliance for each A/C system with a refrigerant capacity greater than 3,000 grams. As part of the certification application, the manufacturer must state which compliance path it plans to follow.
  - 2.1.1. If the A/C system uses a refrigerant type covered by SAE J2727, and if all the A/C component technologies pertaining to refrigerant leakage are listed in SAE J2727, then 1037.115.B.1.1 through B.1.3 in the Phase 2 GHG Procedures apply.
  - 2.1.2. If all the A/C component technologies pertaining to refrigerant leakage are not listed in SAE J2727, then section 1037.115 B.1.4 in the Phase 2 GHG Procedures applies. When applicable, if the manufacturer opts to

demonstrate A/C leakage compliance by modifying the SAE J2727 calculation to account for the refrigerant leakage attributable to the unlisted A/C component technologies, the manufacturer must provide documentation as required by 1037.115.B.1.1 through B.1.3 in the Phase 2 GHG Procedures, and must also provide data or other evidence justifying the modification to the SAE J2727 calculation.

2.1.3. If the A/C system uses a refrigerant type not covered by SAE J2727, then section 1037.115 B.1.4 in the Phase 2 GHG Procedures applies. If, however, all the A/C component technologies pertaining to refrigerant leakage of the A/C system are listed in SAE J2727, the manufacturer may still use the SAE J2727 calculation for HFC-134a as a proxy for evaluating the A/C system leak rate for the uncovered refrigerant.

2.2. If an A/C system has a refrigerant capacity equal to or less than 3,000 grams and is designed such that a compliance demonstration using SAE J2727 standard is impossible or impractical, the manufacturer must use alternative means to demonstrate compliance. In doing so, the manufacturer must use an engineering evaluation to show its air conditioning system achieves an equivalent level of refrigerant leakage control. The engineering evaluation must quantify or estimate the refrigerant leak rate for new-production air conditioning systems and must take into account the probability of incorrect assembly of various fitting technologies and joints. To demonstrate leakage compliance, the manufacturer may follow similar paths to the aforementioned paths 2.1.2 and 2.1.3 for A/C systems with refrigerant capacities greater than 3,000 grams. As part of the certification application, the manufacturer must state its compliance path.