§ 86.165–12 Air conditioning idle test procedure.

(a) Applicability. This section describes procedures for determining air conditioning-related CO₂ emissions from light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. The results of this test are used to qualify for air conditioning efficiency CO₂ credits according to §86.1866–12(c).

(b) Overview. The test consists of a brief period to stabilize the vehicle at idle, followed by a ten-minute period at idle when CO₂ emissions are measured without any air conditioning systems operating, followed by a ten-minute period at idle when CO₂ emissions are measured with the air conditioning system operating. This test is designed to determine the air conditioning-related CO₂ emission value, in grams per minute. If engine stalling occurs during cycle operation, follow the provisions of §86.136–90 to restart the test. Measurement instruments must meet the specifications described in this subpart.

(c) Test cell ambient conditions.

(1) Ambient humidity within the test cell during all phases of the test sequence shall be controlled to an average of 50 ± 5 grains of water/pound of dry air.

(2) Ambient air temperature within the test cell during all phases of the test sequence shall be controlled to 75 ± 2 °F on average and 75 ± 5 °F as an instantaneous measurement. Air temperature shall be recorded continuously at a minimum of 30 second intervals.

(d) Test sequence.

(1) Connect the vehicle exhaust system to the raw sampling location or dilution stage according to the provisions of this subpart. For dilution systems, dilute the exhaust as described in this subpart. Continuous sampling systems must meet the specifications provided in this subpart.

(2) Test the vehicle in a fully warmed-up condition. If the vehicle has soaked for two hours or less since the last exhaust test element, preconditioning may consist of a 505 Cycle, 866 Cycle, US06, or SC03, as these terms are defined in §86.1803–01, or a highway fuel economy test procedure, as defined
in §600.002–08 of this chapter. For soak periods longer than two hours, pre-condition the vehicle using one full Urban Dynamometer Driving Schedule. Ensure that the vehicle has stabilized at test cell ambient conditions such that the vehicle interior temperature is not substantially different from the external test cell temperature. Windows may be opened during preconditioning to achieve this stabilization.

(3) Immediately after the preconditioning, turn off any cooling fans, if present, close the vehicle’s hood, fully close all the vehicle’s windows, ensure that all the vehicle’s air conditioning systems are set to full off, start the CO₂ sampling system, and then idle the vehicle for not less than 1 minute and not more than 5 minutes to achieve normal and stable idle operation.

(4) Measure and record the continuous CO₂ concentration for 600 seconds. Measure the CO₂ concentration continuously using raw or dilute sampling procedures. Multiply this concentration by the continuous (raw or dilute) flow rate at the emission sampling location to determine the CO₂ flow rate. Calculate the CO₂ cumulative flow rate continuously over the test interval. This cumulative value is the total mass of the emitted CO₂.

(5) Within 60 seconds after completing the measurement described in paragraph (d)(4) of this section, turn on the vehicle’s air conditioning system. Set automatic air conditioning systems to a temperature 9 °F (5 °C) below the ambient temperature of the test cell. Set manual air conditioning systems to maximum cooling with recirculation turned off, except that recirculation shall be enabled if the air conditioning system automatically defaults to a recirculation mode when set to maximum cooling and maintains recirculation with the low fan speed, then recirculation shall continue to be enabled. After the fan speed has been set, continue idling the vehicle while measuring and recording the continuous CO₂ concentration for a total of 600 seconds as described in paragraph (d)(4) of this section.

(e) Calculations. (1) For the measurement with no air conditioning operation, calculate the CO₂ emissions (in grams per minute) by dividing the total mass of CO₂ from paragraph (d)(4) of this section by 10.0 (the duration in minutes for which CO₂ is measured). Round this result to the nearest tenth of a gram per minute.

(2)(i) For the measurement with air conditioning in operation for automatic air conditioning systems, calculate the CO₂ emissions (in grams per minute) by dividing the total mass of CO₂ from paragraph (d)(5) of this section by 10.0. Round this result to the nearest tenth of a gram per minute.

(ii) For the measurement with air conditioning in operation for manually controlled air conditioning systems, calculate the CO₂ emissions (in grams per minute) by summing the total mass of CO₂ from paragraphs (d)(5) and (d)(6) of this section and dividing by 20.0. Round this result to the nearest tenth of a gram per minute.

(3) Calculate the increased CO₂ emissions due to air conditioning (in grams per minute) by subtracting the results of paragraph (e)(1) of this section from the results of paragraph (e)(2)(i) or (ii) of this section, whichever is applicable.

(f) The Administrator may prescribe procedures other than those in this section for air conditioning systems and/or vehicles that may not be susceptible
§ 86.166–12  
Method for calculating emissions due to air conditioning leakage.

This section describes procedures used to determine a refrigerant leakage rate in grams per year from vehicle-based air conditioning units. The results of this test are used to determine air conditioning leakage credits according to §86.1866–12(b).

(a) Emission totals. Calculate an annual rate of refrigerant leakage from an air conditioning system using the following equation:

\[
\frac{\text{Grams/YR}_{\text{TOT}}}{\text{Grams/YR}_{\text{RP}}} = \frac{\text{Grams/YR}_{\text{SP}}}{} + \frac{\text{Grams/YR}_{\text{FH}}}{} + \frac{\text{Grams/YR}_{\text{MC}}}{} + \frac{\text{Grams/YR}_{\text{C}}}{}.
\]

Where:

- \(\frac{\text{Grams/YR}_{\text{TOT}}}{\text{Grams/YR}_{\text{TOT}}}\) = Total air conditioning system emission rate in grams per year and rounded to the nearest tenth of a gram per year.
- \(\frac{\text{Grams/YR}_{\text{RP}}}{\text{Grams/YR}_{\text{RP}}}\) = Emission rate for rigid pipe connections as described in paragraph (b) of this section.
- \(\frac{\text{Grams/YR}_{\text{SP}}}{\text{Grams/YR}_{\text{SP}}}\) = Emission rate for service ports and refrigerant control devices as described in paragraph (c) of this section.
- \(\frac{\text{Grams/YR}_{\text{FH}}}{\text{Grams/YR}_{\text{FH}}}\) = Emission rate for flexible hoses as described in paragraph (d) of this section.
- \(\frac{\text{Grams/YR}_{\text{MC}}}{\text{Grams/YR}_{\text{MC}}}\) = Emission rate for heat exchangers, mufflers, receiver/driers, and accumulators as described in paragraph (e) of this section.
- \(\frac{\text{Grams/YR}_{\text{C}}}{\text{Grams/YR}_{\text{C}}}\) = Emission rate for compressors as described in paragraph (f) of this section.

(b) Rigid pipe connections. Determine the grams per year emission rate for rigid pipe connections using the following equation:

\[
\frac{\text{Grams/YR}_{\text{RP}}}{\text{Grams/YR}_{\text{RP}}} = 0.00522 \times (125 \times \text{SO}) + (75 \times \text{SCO}) + (50 \times \text{MO}) + (10 \times \text{SW}) + (5 \times \text{SWO}) + (\text{MG})
\]

Where:

- \(\frac{\text{SO}}{\text{SO}}\) = The number of single O-ring connections.
- \(\frac{\text{SCO}}{\text{SCO}}\) = The number of single captured O-ring connections.
- \(\frac{\text{MO}}{\text{MO}}\) = The number of multiple O-ring connections.
- \(\frac{\text{SW}}{\text{SW}}\) = The number of seal washer connections.
- \(\frac{\text{SWO}}{\text{SWO}}\) = The number of seal washer with O-ring connections.
- \(\frac{\text{MG}}{\text{MG}}\) = The number of metal gasket connections.

(c) Service ports and refrigerant control devices. Determine the grams per year emission rate for service ports and refrigerant control devices using the following equation:

\[
\frac{\text{Grams/YR}_{\text{SP}}}{\text{Grams/YR}_{\text{SP}}} = 0.522 \times (0.3 \times \text{HSSP}) + 0.2 \times \text{LSSP} + 0.2 \times \text{STV} + 0.2 \times \text{TXV})
\]

Where:

- \(\frac{\text{HSSP}}{\text{HSSP}}\) = The number of high side service ports.
- \(\frac{\text{LSSP}}{\text{LSSP}}\) = The number of low side service ports.
- \(\frac{\text{STV}}{\text{STV}}\) = The total number of switches, transducers, and pressure relief valves.
- \(\frac{\text{TXV}}{\text{TXV}}\) = The number of refrigerant control devices.

(d) Flexible hoses. Determine the permeation emission rate in grams per year for each segment of flexible hose using the following equation, and then sum the values for all hoses in the system to calculate a total flexible hose emission rate for the system. Hose end connections shall be included in the calculations in paragraph (b) of this section.

\[
\frac{\text{Grams/YR}_{\text{FH}}}{\text{Grams/YR}_{\text{FH}}} = 0.00522 \times (3.14159 \times \text{ID} \times \text{L} \times \text{ER})
\]

Where:

- \(\frac{\text{ID}}{\text{ID}}\) = Inner diameter of hose, in millimeters.
- \(\frac{\text{L}}{\text{L}}\) = Length of hose, in millimeters.
- \(\frac{\text{ER}}{\text{ER}}\) = Emission rate per unit internal surface area of the hose, in g/mm². Select the appropriate value for ER from the following table.