

or vehicles that may not be susceptible to satisfactory testing by the procedures and methods in this section. For example, the Administrator may prescribe alternative air conditioning system settings for systems with controls that are not able to meet the requirements in this section.

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86.166–12 [Reserved]

§86.167–17 AC17 Air Conditioning Emissions Test Procedure.

(a) *Overview.* The AC17 test procedure consists of four elements: a pre-conditioning cycle, a 30-minute soak period under simulated solar heat, followed by measurement of emissions over an SC03 drive cycle and a Highway Fuel Economy Driving Schedule (HFET) drive cycle. The vehicle is preconditioned with a single UDDS to bring the vehicle to a warmed-up stabilized condition. This preconditioning is followed by a 30 minute vehicle soak (engine off) that proceeds directly into the SC03 driving schedule, during which continuous proportional samples of gaseous emissions are collected for analysis. The SC03 driving schedule is followed immediately by the HFET cycle, during which continuous proportional samples of gaseous emissions are collected for analysis. This entire sequence is conducted in an environmental test facility. Vehicles are tested for any or all of the following emissions, depending upon the specific test requirements and the vehicle fuel type: gaseous exhaust THC, NMHC, NMOG, CO, NO_x, CO₂, N₂O, CH₄, CH₃OH, C₂H₅OH, C₂H₄O, and HCHO. For purposes of measuring the impact of air conditioning systems on CO₂ emissions, this sequence is run twice: once with air conditioning on and once with air conditioning off. The following figure shows the basic sequence of the test procedure.

(b) *Equipment requirements.* Equipment requirements are specified in subpart B of part 86 of this chapter.

(c) *Fuel specifications.* The test fuel specifications are given in §86.113. Test fuels representing fuel types for which there are no specifications provided in

§86.113 may be used if approved in advance by the Administrator.

(d) *Analytical gases.* The analytical gases must meet the criteria given in §86.114.

(e) *Driving cycles.* (1) The driving schedules for the EPA Urban Dynamometer Driving Schedule (UDDS) and the SC03 cycle are contained in appendix I of this part. The driving schedule for the Highway Fuel Economy Driving Schedule (HFET) is set forth in appendix I of part 600 of this chapter.

(2) The speed tolerance at any given time on the driving schedules is defined by upper and lower limits. The upper limit is 2 mph higher than the highest point on trace within 1 second of the given time. The lower limit is 2 mph lower than the lowest point on the trace within 1 second of the given time. Speed variations greater than the tolerances (such as may occur during gear changes) are acceptable provided they occur for less than 2 seconds on any occasion. Speeds lower than those prescribed are acceptable provided the vehicle is operated at maximum available power during such occurrences.

(f) *Equipment calibration.* The equipment used for fuel economy testing must be calibrated according to the provisions of §86.116.

(g) *Vehicle preparation.* The vehicle shall be prepared for testing according to §86.132(a) through (g), concluding with a 12–36 hour soak.

(h) *Dynamometer procedures.* (1) The AC17 test procedure consists of a pre-conditioning UDDS, a 30-minute soak period under simulated solar heat, followed by measurement of emissions over an SC03 drive cycle and a Highway Fuel Economy Driving Schedule (HFET) drive cycle.

(2) Except in cases of component malfunction or failure, all emission control systems installed on or incorporated in a new motor vehicle must be functioning during all procedures in this subpart. The Administrator may authorize maintenance to correct component malfunction or failure.

(3) Use §86.129 to determine road load power and test weight. The dynamometer's horsepower adjustment settings shall be set such that the force

imposed during dynamometer operation matches actual road load force at all speeds.

(4) Tests shall be run on a large single roll electric dynamometer or an equivalent dynamometer configuration that satisfies the requirements of § 86.108-00.

(5) The vehicle speed as measured from the dynamometer rolls shall be used. A speed vs. time recording, as evidence of dynamometer test validity, shall be supplied at request of the Administrator.

(6) The drive wheel tires may be inflated up to a gauge pressure of 45 psi (310 kPa), or the manufacturer's recommended pressure if higher than 45 psi, in order to prevent tire damage. The drive wheel tire pressure shall be reported with the test results.

(7) The driving distance, as measured by counting the number of dynamometer roll or shaft revolutions, shall be determined separately for each driving schedule over which emissions are measured (SC03, and HFET).

(8) Four-wheel drive and all-wheel drive vehicles may be tested either in a four-wheel drive or a two-wheel drive mode of operation. In order to test in the two-wheel drive mode, four-wheel drive and all-wheel drive vehicles may have one set of drive wheels disengaged; four-wheel and all-wheel drive vehicles which can be shifted to a two-wheel mode by the driver may be tested in a two-wheel drive mode of operation.

(i) *Testing facility requirements.* (1) *Ambient air temperature.* (i) Ambient air temperature shall be controlled within the test cell during all emission sampling phases of the test sequence to 77 ± 2 °F on average and 77 ± 5 °F as an instantaneous measurement. During phases of the test where emissions are not being sampled, ambient air temperature shall be controlled to these same tolerances, except that periods outside the specified ranges are allowed to occur as long as the total cumulative time outside the specified ranges does not exceed three minutes.

(ii) Record air temperature continuously at intervals of not more than 30 seconds. Alternatively, you may use a moving average over intervals of not more than 30 seconds to record and re-

port air temperature. You must maintain records of test cell air temperatures and values of average test temperatures.

(2) *Ambient humidity.* (i) Ambient humidity shall be controlled, within the test cell, during all emission sampling phases of the test sequence to an average of 69 ± 5 grains of water/pound of dry air and an instantaneous measurement of 69 ± 10 grains of water/pound of dry air. During phases of the test where emissions are not being sampled, ambient humidity shall be controlled to these same tolerances, except that periods outside the specified ranges are allowed to occur as long as the total cumulative time outside the specified ranges does not exceed three minutes.

(ii) Humidity shall be recorded continuously at intervals of not more than 30 seconds. Records of cell humidity and values of average test humidity shall be maintained by the manufacturer.

(3) *Solar heat loading.* The requirements of § 86.161-00(d) regarding solar heat loading specifications shall apply. The solar load of 850 W/m² is applied only during specified portions of the test sequence.

(4) *Minimum test cell size.* The requirements of § 86.161-00(c) regarding test cell size requirements shall apply.

(5) *Test cell air flow requirements.* The requirements of § 86.161-00(e) regarding air flow supplied to the vehicle shall apply. Air flow at a maximum of 4 miles/hour may be provided during periods of idle and key-off soak if required for maintenance of ambient requirements.

(j) *Interior temperature measurement.* The interior temperature of the vehicle shall be measured during all the emission sampling phases of the test.

(1) Interior temperatures shall be measured by placement of thermocouples at the following locations:

(i) The outlet of the center duct on the dash.

(ii) Behind the driver and passenger seat headrests. The location of the temperature measuring devices shall be 30 mm behind each headrest.

(2) The temperature at each location shall be recorded a minimum of every 5 seconds.

(k) *Air conditioning system settings.* For tests being conducted to measure emissions with the air conditioning operating, the air conditioner settings shall be as follows:

(1) Automatic systems shall be set to automatic and the temperature control set to 72 deg F, with blower or fan speed and vent location controlled by the automatic mode.

(2) Manual systems shall be set at the start of the SC03 drive cycle to full cool with the fan on the highest setting and the airflow setting to "recirculation." Within the first idle period of the SC03 drive cycle (186 to 204 seconds) the fan speed shall be reduced to the setting closest to 6 volts at the motor, the temperature setting shall be adjusted to provide 55 deg F at the center dash air outlet, and the airflow setting changed to "outside air."

(1) *Test procedure.* The AC17 air conditioning test is composed of the following sequence of activities.

(1) Position the test vehicle on the dynamometer (vehicle may be driven) and restrain.

(2)(i) Position the variable speed cooling fan in front of the test vehicle with the vehicle's hood down. This air flow should provide representative cooling at the front of the test vehicle (air conditioning condenser and engine) during the driving cycles. See §86.161-00(e) for a discussion of cooling fan specifications.

(ii) In the case of vehicles with rear engine compartments (or if this front location provides inadequate engine cooling), an additional cooling fan shall be placed in a position to provide sufficient air to maintain vehicle cooling. The fan capacity shall normally not exceed 5300 cfm (2.50 m³/s). If, however, it can be demonstrated that during road operation the vehicle receives additional cooling, and that such additional cooling is needed to provide a representative test, the fan capacity may be increased or additional fans used if approved in advance by the Administrator.

(3) Open all vehicle windows.

(4) Connect the emission test sampling system to the vehicle's exhaust tail pipe(s).

(5) Set the environmental test cell ambient test conditions to the condi-

tions defined in paragraph (c) of this section, except that the solar heat shall be off.

(6) Set the air conditioning system controls to off.

(7) Start the vehicle (with air conditioning system off) and conduct a preconditioning EPA urban dynamometer driving cycle (§86.115).

(i) If engine stalling should occur during any air conditioning test cycle operation, follow the provisions of §86.136-90 (Engine starting and restarting).

(ii) For manual transmission vehicles, the vehicle shall be shifted according to the provisions of §86.128-00.

(8) Following the preconditioning cycle, the test vehicle and cooling fan(s) are turned off, all windows are rolled up, and the vehicle is allowed to soak in the ambient conditions of paragraph (i) of this section for 30 ±1 minutes. If emissions are being measured with the air conditioner operating, the solar heat system must be turned on and generating 850 W/m² within 1 minute of turning the engine off. Otherwise the solar heat system shall be turned off.

(9) Initiate data logging, sampling of exhaust gases, and integrating measured values. Start the engine. If emissions are being measured with the air conditioner operating, you must start the engine with the air conditioning system running as specified in paragraph (k) of this section. Otherwise the air conditioning system should be completely off. Initiate the driver's trace when the engine starts. Fifteen seconds after the engine starts, place vehicle in gear.

(10) Eighteen seconds after the engine starts, begin the initial vehicle acceleration of the SC03 driving schedule.

(11) Operate the vehicle according to the SC03 driving schedule, as described in appendix I, paragraph (h), of this part.

(12) At the end of the deceleration which is scheduled to occur at 594 seconds, simultaneously stop all SC03 and start all HFET sampling, recording, and integrating; including background sampling. Record the measured roll or shaft revolutions.

(13) Allow the vehicle to idle for 14-16 seconds.

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(14) Operate the vehicle according to the HFET driving schedule, as described in appendix I to 40 CFR part 600.

(15) Turn the engine off 2 seconds after the end of the last deceleration, i.e., engine off at 765 seconds.

(16) Five seconds after the engine stops running, stop all HFET sampling, recording, and integrating (including background sampling), indicating the

end of the test cycle. Record the measured roll or shaft revolutions.

(17) Turn off the solar heat system, if applicable.

(m) *Calculations.* The final reported test results for each emission constituent being evaluated is the average of the SC03 and HFET gram per mile emissions, which shall be calculated using the following formula:

$$Y_{WM} = 0.5 \times \left(\frac{Y_{SC03}}{D_{SC03}} \right) + 0.5 \times \left(\frac{Y_{HFET}}{D_{HFET}} \right)$$

Where:

Y_{WM} = Weighted mass emissions of each pollutant, i.e., THC, CO, THCE, NMHC, NMHCE, CH₄, NO_x, or CO₂, in grams per vehicle mile.

Y_{SC03} = Mass emissions as calculated from the SC03 phase of the test, in grams per test phase.

D_{SC03} = The measured driving distance from the SC03 phase of the test, in miles.

Y_{HFET} = Mass emissions as calculated from the HFET phase of the test, in grams per test phase.

D_{HFET} = The measured driving distance from the HFET phase of the test, in miles.

(n) *Measuring the net impact of air conditioner operation.* This test may be used to determine the net impact of air conditioner operation as may be required under §86.1868, which requires that CO₂ be measured using the procedures in this section with both air conditioning on and off. To do this, you must follow these steps:

(1) Conduct the test procedure described in this section with the air conditioning system operating, being sure to follow the appropriate instructions regarding air conditioner operation and use of the solar heat system. Analyze the data and calculate the weighted CO₂ emissions in grams per mile according to paragraph (m) of this section.

(2) Allow the vehicle to remain on the dynamometer, with the engine shut off, for 10 to 15 minutes after emissions sampling has concluded. The solar heat system should be turned off.

(3) Conduct the test procedure described in paragraph (1) of this section with the air conditioning system

turned off, being sure to follow the appropriate instructions regarding air conditioner operation (off) and use of the solar heat system (off). Analyze the data and calculate the weighted CO₂ emissions in grams per mile according to paragraph (m) of this section.

(4) Calculate the incremental CO₂ emissions due to air conditioning operation by subtracting the CO₂ grams per mile determined in paragraph (n)(3) of this section from the CO₂ grams per mile determined in paragraph (n)(1) of this section.

(o) *Records required and reporting requirements.* For each test the manufacturer shall record the information specified in §86.142-90. Emission results and the results of all calculations must be reported for each phase of the test. The manufacturer must also report the following information for each vehicle tested: vehicle class, model type, carline, curb weight engine displacement, transmission class and configuration, interior volume, climate control system type and characteristics, refrigerant used, compressor type, and evaporator/condenser characteristics.

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