

(B) The uniformity of radiant energy intensity is measured at each point of a 0.5 meter grid over the entire footprint of the test vehicle at the elevation of one meter including the footprint edges.

(C) Radiant energy uniformity must be checked at least every 500 hours of emitter usage or every six months depending on which covers the shorter time period; and every time major changes in the solar simulation hardware occur.

(vi) The radiant energy intensity measurement instrument specifications (minimum) are:

(A) Sensitivity of 9 microvolts per watt/square meter;

(B) Response time of 1 second;

(C) Linearity of ± 0.5 percent; and

(D) Cosine of ± 1 percent from normalization 0-70 degree zenith angle.

(e) *Vehicle frontal air flow.* The Administrator will approve frontal air flow based on "blower in box" technology as an acceptable simulation of environmental air flow cooling for the air conditioning compressor and engine, provided the following requirements are satisfied.

(1) The minimum air flow nozzle discharge area must be equal or exceed the vehicle frontal inlet area. Optimum discharge area is 18 square feet (4.25x4.25), however, other sizes can be used.

(2) Air flow volumes must be proportional to vehicle speed. With the above optimum discharge size, the fan volume would vary from 0 cubic feet/minute (cfm) at 0 mph to approximately 95,000 cfm at 60 mph. If this fan is also the only source of cell air circulation or if fan operational mechanics make the 0 mph air flow requirement impractical, air flow of 2 mph or less will be allowed at 0 mph vehicle speed.

(3) The fan air flow velocity vector perpendicular to the axial flow velocity vector shall be less than 10 percent of the mean velocity measured at fan speeds corresponding to vehicle speeds of 20 and 40 mph.

(4)(i) Fan axial air flow velocity is measured two feet from nozzle outlet at each point of a one foot grid over the entire discharge area.

(ii) The uniformity of axial flow tolerance is 20 percent of the fan speeds corresponding to vehicle speeds of 20 and 40 mph.

(5) The instrument used to verify the air velocity must have an accuracy of 2 percent of the measured air flow speed.

(6) The fan discharge nozzle must be located 2 to 3 feet from the vehicle and 0 to 6 inches above the test cell floor during air conditioning testing. This applies to non-wind tunnel environmental test cells only.

(7) The design specifications discussed in paragraphs (e)(1) through (e)(5) of this section must be verified by the manufacturer prior to conducting certification air conditioning tests.

[61 FR 54897, Oct. 22, 1996]

§ 86.162-00 Approval of alternative air conditioning test simulations and descriptions of AC1 and AC2.

The alternative air conditioning test procedures AC1 and AC2 are approved by the Administrator for all light-duty vehicles and light-duty trucks only for the model years of 2000, 2001, and 2002. To obtain Administrator approval of other simulation test procedures a manufacturer must satisfy the requirements of paragraph (a) of this section and meet the requirements of § 86.163-00. Air conditioning tests AC1 and AC2 are simulations of the environmental test cell air conditioning test discussed in § 86.160-00. AC1 simulates, in standard test cell ambient conditions and with the air conditioning off, the exhaust emission results of air conditioning operation in an environmental test cell by adding additional power requirements to roadload dynamometer requirements. AC2 simulates, in standard test cell ambient conditions and with the air conditioning controls in the heat position, the exhaust emission results of air conditioning operation in an environmental test cell by adding a heat load to the passenger compartment. The only differences between the test activities described in § 86.160-00 and those for AC1 and AC2 occur as the result of how the effect of the environmental cell ambient test conditions, defined in § 86.160-00(c)(5)(i), are simulated in a standard test cell nominal ambient conditions of 76 °F and 50

grains of water/pound of dry air. Paragraph (a) of this section discusses the procedure by which a manufacturer can obtain Administrator approval of other air conditioning test simulation procedures. Paragraph (b) of this section describes the AC1 test procedure and paragraph (c) of this section describes the AC2 test procedure.

(a) Upon petition from a manufacturer or upon the Agency's own initiative, the Administrator will approve a simulation of the environmental cell for air conditioning test (SC03) described in §86.160-00 providing that the procedure can be run by the Administrator for SEA and in-use enforcement testing and providing that the criteria of paragraphs (a)(1)(2), and (3) of this section are satisfied.

(1) In deciding whether approvals will be granted, the Administrator may consider data showing how well the simulation matches environmental cell test data for the range of vehicles to be covered by the simulation including items such as the tailpipe emissions, air conditioning compressor load, and fuel economy.

(2) The Administrator has approved test procedures AC1 and AC2 for only the model years of 2000, 2001, and 2002.

(3) Excluding the AC1 and AC2 procedures described in paragraphs (b) and (c) of this section for model years 2000, 2001, and 2002, for any simulation approved under paragraph (a) of this section, the manufacturer must agree to be subject to an ongoing yearly correlation spot check as described in §86.163-00.

(4) Once a simulation is approved and used by a manufacturer for testing for a given vehicle, EPA agrees to use the simulation test procedure for all official testing conducted on that vehicle by the Agency for certification, SEA, and recall purposes, excluding spot check testing and vehicles which fail the spot check criteria as described in §86.163-00.

(5) EPA will monitor the aggregate results of spot check testing and full environmental test cells. If EPA determines, based on such aggregate results, that any simulation (other than the AC1 and AC2 procedures described in paragraphs (b) and (c) of this section for the 2000, 2001, and 2002 model years)

is producing test results consistently below those from a full environmental test cell, EPA may review its approval of the simulation.

(b) *AC1 test procedure.* (1) Section 86.160-00(a) is applicable to the AC1 test procedure except for the discussion of the environmental test requirements. The AC1 test procedure simulates the effect of air conditioning operation in the environmental cell test conditions by adding the measured horsepower of the air conditioning system compressor, converted to an equivalent roadload component, to the normal dynamometer roadload horsepower.

(2) Section 86.160-00(b) is applicable to the AC1 test procedure except that the dynamometer horsepower settings procedure of §86.160-00(b)(4) is expanded to include a horsepower increase adjustment.

(i) The following describes one acceptable method of obtaining the required compressor horsepower and the corresponding roadload equivalent horsepower adjustment. Air compressor horsepower is measured during a SC03 air conditioning test cycle while operating in an environmental test cell as described in §86.160-00.

(A) Install an air conditioning (A/C) compressor with a strain-gauged input shaft that measures shaft torque in foot pounds. Other measurement techniques that produce data that can be shown will estimate A/C compressor horsepower are also acceptable.

(B) Obtain the engine crankshaft to A/C compressor pulley diameter (D) ratio (ACPR) as:

$$\text{ACPR} = \frac{D(\text{crankshaft pulley})}{D(\text{A/C pulley})}$$

(C) Record the following parameters, as a function of accumulated time (t), at least once per second from second 0 to second 600 while driving the SC03 cycle with the air conditioning system operating.

(1) Engine revolutions/minute (ERPM_i).

(2) Compressor input torque in foot pounds (CT_i).

(D) For each second of data recorded from paragraph (b)(2)(i)(C) of this section, calculate compressor horsepower (CHP_i) as:

$$\text{CHP}_i = \frac{\text{CT}_i (\text{ERPM}_i) (\text{ACPR})}{5252}$$

(E) For each second of accumulated time and the data of paragraph (b)(2)(i) (B) and (D) of this section, determine a value of air conditioning compressor roadload force (ACRF_i) that is equivalent to the air conditioning compressor force on the engine as:

$$\text{ACRF}_i = (\text{CHP}_i) (375) / V_i$$

where:

V_i equals vehicle SC03 cycle speed in miles per hour for each accumulated second of time, and 375 is a units constant to convert (ACRF_i) to foot pounds of force.

(F) Values of (ACRF_i) at each second of time are added to the corresponding roadload dynamometer force requirements of § 86.129-00(e) to obtain an approximation of the force generated by the vehicle engine during a SC03 test in an environmental test cell.

(ii) The method by which the values of (ACRF_i) additional dynamometer load is applied by the dynamometer to the vehicle tire surface will vary with dynamometer design and its force simulation capabilities. If the dynamometer has grade simulation capabilities, increasing load by simulating varying grades is one acceptable method of applying (ACRF_i) values.

(iii) For those calculated values of (ACRF_i) which exceed the force capacity of the dynamometer being used for simulation test, replace the calculated values with the maximum road force capacity of the dynamometer. The Administrator would normally not expect (ACRF_i) values to exceed dynamometer capability for time periods of more than a second.

(iv) Values of (ACRF_i) for application to AC1 testing should be an average of at least two runs unless the manufacturer can demonstrate to the Administrator that one run repeatability is acceptable.

(v) Values of (ACRF_i) for application to AC1 testing are to be obtained for each vehicle and engine family combination. If only one vehicle configuration is selected to represent an engine family, the selected configuration is the vehicle expected to produce the highest air conditioning load requirements. A manufacturer may petition the Administrator to reduce the number of (ACRF_i) test vehicles for their product line, if they can show that the highest air conditioning loads are cov-

ered with a lesser number than one per family.

(vi) Test results, calculations, and dynamometer setting values associated with making these roadload determinations are to be retained by the manufacturer as part of their certification records.

(3) Perform the SC03 air conditioning test sequence as described in § 86.160-00(c) with the following exceptions:

(i) The variable speed cooling fan of § 86.160-00(c)(2)(ii) is replaced with the fixed speed cooling fan requirements of § 86.159-00(b).

(ii) The position of vehicle windows is optional.

(iii) The nominal ambient air test conditions of § 86.160-00(b)(5)(i) (A) and (B) are replaced with 76 °F and 50 grains of water/pound of dry air and the solar heat load of § 86.160-00(b)(5)(i)(C) is omitted.

(iv) The air conditioning system is not operated during the SC03 test cycle. Operation of the air conditioning during preconditioning test cycles is optional.

(4) Section 86.160-00(d) is applicable to the AC1 test procedure.

(5) *NO_x humidity correction.* Calculated NO_x exhaust emissions from air conditioning tests conducted in a standard test cell at a nominal 50 grains of water/pound of dry air are corrected for humidity to 75 grains of water/pound of dry air (see the relationship of § 86.144-94(c)(7)(iv)(B)).

(c) *AC2 test procedure.* (1) section 86.160-00(a) is applicable the AC2 test procedure except for the discussion of the environmental test requirements. The AC2 test procedure simulates the effect of air conditioning operation in the environmental cell test conditions by adding heat from the vehicle's heating system to the interior of the passenger compartment.

(2) Section 86.160-00(b) is applicable to the AC2 test procedure.

(3) Section 86.160-00(c) is applicable except for the following:

(i) Section 86.160-00(c)(3) is applicable except the drivers side front window is left open and all the others are closed.

(ii) The nominal ambient air test conditions of § 86.160-00(b)(5)(i) (A) and (B) are replaced with 76 °F and 50 grains of water/pound of dry air and

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the solar heat load of § 86.160-00(b)(5)(i)(C) is omitted.

(iii) The control position instruction of § 86.160-00(c)(6)(iv) is replaced with set the A/C temperature control to the highest warm position (maximum for automatic systems).

(4) Section 86.160-00(d) is applicable to the AC2 test procedure.

(5) *NO_x humidity correction.* Calculated NO_x exhaust emissions from air conditioning tests conducted in a standard test cell at a nominal 50 grains of water/pound of dry air are corrected for humidity to 75 grains of water/pound of dry air (see the relationship of § 86.144-94(c)(7)(iv)(B)).

[61 FR 54898, Oct. 22, 1996]

§ 86.162-03 Approval of alternative air conditioning test simulations.

(a) Upon petition from a manufacturer or upon the Agency's own initiative, the Administrator will approve a simulation of the environmental cell for air conditioning test (SC03) described in § 86.160-00 providing that the procedure can be run by the Administrator for SEA and in-use enforcement testing and providing that the following criteria are met:

(1) In deciding whether approvals will be granted, the Administrator will consider data showing how well the simulation matches environmental cell test data for the range of vehicles to be covered by the simulation including items such as the tailpipe emissions, air conditioning compressor load, and fuel economy.

(2) For any simulation approved under paragraph (a) of this section, the manufacturer must agree to be subject to an ongoing yearly correlation spot check as described in § 86.163-00.

(3) Once a simulation is approved and used by a manufacturer for testing for a given vehicle, EPA agrees to use the simulation test procedure for all official testing conducted on that vehicle by the Agency for certification, SEA, and recall purposes, excluding spot check testing and vehicles which fail the spot check criteria as described in § 86.163-00.

(4) EPA will monitor the aggregate results of spot check testing and full environmental test cells. If EPA determines, based on such aggregate results,

that any simulation is producing test results consistently below those from a full environmental test cell, EPA may review its approval of the simulation.

(b) [Reserved]

[61 FR 54899, Oct. 22, 1996]

§ 86.163-00 Spot check correlation procedures for vehicles tested using a simulation of the environmental test cell for air conditioning emission testing.

This section is applicable for vehicles which are tested using a simulation of the environmental test cell approved under the provisions of § 86.162-00(a).

(a) The Administrator may select up to five emission data vehicles (one emission data vehicle for small volume manufacturers), including vehicles submitted for running change approval, each model year for any manufacturer undergoing the spot checking procedures of this section.

(b) Testing conducted under this section (including testing performed in an environmental test cell) will be considered as official data as described in § 86.091-29 and used in determining compliance with the standards. Such testing must comply with all applicable emission standards of subpart A of this part. Retests for the purpose of emission compliance will be allowed using the procedures described in § 86.091-29.

(c) *Spot check procedures.* (1) Subject to the limitations of paragraphs (a) and (d)(2)(iii) of this section, the Administrator may require that one or more of the test vehicles which use a simulation rather than actual testing in an environmental test cell for air conditioning emission testing be submitted at a place the Administrator will designate for air conditioning emission testing in an environmental test cell as described in § 86.160-00. The Administrator may order this testing to be conducted at a manufacturer facility. All manufacturers which use a simulation instead of environmental cell testing must have access to an environment test cell meeting the requirements of § 86.161-00 to perform this testing.

(2) An air conditioning emission test will be performed as described in § 86.162-00 in a full environmental test cell.