

Subpart E—In-use Testing

§ 1036.401 In-use testing.

We may perform in-use testing of any engine family subject to the standards of this part, consistent with the provisions of § 1036.235. Note that this provision does not affect your obligation to test your in-use engines as described in 40 CFR part 86, subpart T.

Subpart F—Test Procedures

§ 1036.501 How do I run a valid emission test?

(a) Use the equipment and procedures specified in 40 CFR 86.1305 to determine whether engines meet the emission standards in § 1036.108.

(b) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.

(c) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.

(d) For engines that use aftertreatment technology with infrequent regeneration events, invalidate any test interval in which such a regeneration event occurs with respect to CO₂, N₂O, and CH₄ measurements.

(e) Test hybrid engines as described in 40 CFR part 1065 and § 1036.525.

(f) [Reserved]

(g) If your engine requires special components for proper testing, you must provide any such components to us if we ask for them.

§ 1036.525 Hybrid engines.

(a) If your engine system includes features that recover and store energy during engine motoring operation test the engine as described in paragraph (d) of this section. See § 1036.615(a)(2) for engine systems intended to include features that recover and store energy from braking unrelated to engine motoring operation. For purposes of this section, features that recover energy between the engine and transmission are considered “related to engine motoring”.

(b) If you produce a hybrid engine designed with power take-off capability and sell the engine coupled with a

transmission, you may calculate a reduction in CO₂ emissions resulting from the power take-off operation as described in 40 CFR 1037.525. Use good engineering judgment to use the vehicle-based procedures to quantify the CO₂ reduction for your engines.

(c) The hardware that must be included in these tests is the engine, the hybrid electric motor, the rechargeable energy storage system (RESS) and the power electronics between the hybrid electric motor and the RESS. You may ask us to modify the provisions of this section to allow testing non-electric hybrid vehicles, consistent with good engineering judgment.

(d) Measure emissions using the same procedures that apply for testing non-hybrid engines under this part, except as specified otherwise in this part and/or 40 CFR part 1065. If you test hybrid engines using the SET, deactivate the hybrid features unless we have specified otherwise. The five differences that apply under this section are related to engine mapping, engine shutdown during the test cycle, calculating work, limits on braking energy, and state of charge constraints.

(1) Map the engine as specified in 40 CFR 1065.510. This requires separate torque maps for the engine with and without the hybrid features active. For transient testing, denormalize the test cycle using the map generated with the hybrid feature active. For steady-state testing, denormalize the test cycle using the map generated with the hybrid feature inactive.

(2) If the engine will be configured in actual use to shut down automatically during idle operation, you may let the engine shut down during the idle portions of the test cycle.

(3) Follow 40 CFR 1065.650(d) to calculate the work done over the cycle except as specified in this paragraph (d)(3). For the positive work over the cycle set negative power from hybrid to zero. For the negative work over the cycle set the positive power to zero and set the non-hybrid power to zero.

(4)(i) Calculate brake energy fraction, x_b , as the integrated negative work over the cycle divided by the integrated positive work over the cycle according to Equation 1036.525-1. Calculate the brake energy limit for the

engine, x_{bl} , according to Equation 1036.525-2. If x_b is less than x_{bl} , use the integrated positive work for your emission calculations. If the x_b is greater than x_{bl} use Equation 1036.525-3 to calculate the positive work done over the cycle. Use W_{cycle} as the integrated posi-

tive work when calculating brake-specific emissions. To avoid the need to delete extra brake work from positive work you may set an instantaneous brake target that will prevent x_b from being larger than x_{bl} .

$$x_b = \left| \frac{W_{neg}}{W_{pos}} \right|$$

Eq. 1036.525-1

$$x_{bl} = 4.158 \cdot 10^{-4} \cdot P_{max} + 0.2247$$

Eq. 1036.525-2

$$W_{cycle} = W_{pos} - \left(\left| W_{neg} \right| - x_{bl} \cdot W_{pos} \right)$$

Eq. 1036.525-3

(ii) The following definitions of terms apply for this paragraph (d)(4):

x_b = the brake energy fraction.

W_{neg} = the negative work over the cycle.

W_{pos} = the positive work over the cycle.

x_{bl} = the brake energy fraction limit.

P_{max} = the maximum power of the engine with the hybrid system engaged (kW).

W_{cycle} = the work over the cycle when x_b is greater than x_{bl} .

(iii) Note that these calculations are specified with SI units (such as kW), consistent with 40 CFR part 1065. Emission results are converted to g/hp-hr at the end of the calculations.

(5) Correct for the net energy change of the energy storage device as described in 40 CFR 1066.501.

§ 1036.530 Calculating greenhouse gas emission rates.

This section describes how to calculate official emission results for CO₂, CH₄, and N₂O.

(a) Calculate brake-specific emission rates for each applicable duty cycle as specified in 40 CFR 1065.650. Do not apply infrequent regeneration adjustment factors to your results.

(b) Adjust CO₂ emission rates calculated under paragraph (a) of this section for measured test fuel properties as specified in this paragraph (b) to obtain the official emission results. You are not required to apply this adjustment for fuels containing at least 75 percent pure alcohol, such as E85. The purpose of this adjustment is to make official emission results independent of differences in test fuels within a fuel type. Use good engineering judgment to develop and apply testing protocols to minimize the impact of variations in test fuels.