

surface must be smooth, continuous, and free from any local transitions greater than four degrees. An example

of a fastback shape is presented in Figure 1.

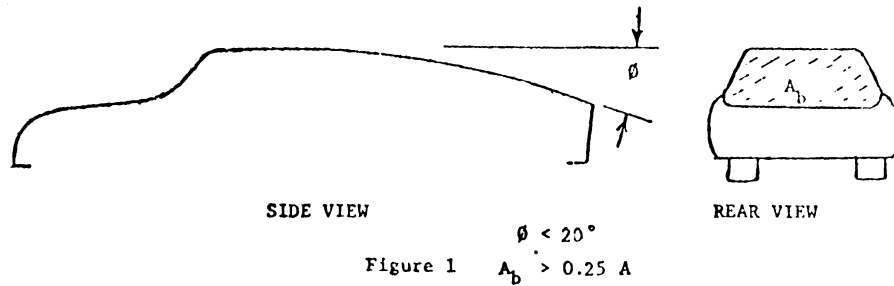


Figure 1

TABLE I—PROTUBERANCE POWER, P, VERSUS TOTAL PROTUBERANCE FRONTAL AREA, A_p

A _p (square foot)	P (horsepower)
A _p <0.30	0.0
0.30 A _p <0.60	.40
0.60 A _p <0.90	.70
0.90 A _p <1.20	1.00
1.20 A _p <1.50	1.30
1.50 A _p <1.80	1.60
1.80 A _p <2.10	1.90
2.10 A _p <2.40	2.20
2.40 A _p <2.70	2.50
2.70 A _p <3.00	2.80
3.00 A _p	3.10

The protuberance frontal area, A_p, is defined in a manner analogous to the definition of the vehicle reference frontal area, i.e., the total area of the orthogonal projections of the vehicle mirrors, hood ornaments, roof racks, and other protuberance onto a plane(s) perpendicular to both the longitudinal plane of the vehicle and the surface upon which the vehicle is positioned. A protuberance is defined as any fixture attached to the vehicle protruding more than 1 inch from the vehicle surface and having a projected area greater than 0.01 ft² with the area calculated by a method approved in advance by the Administrator. Included in the total protuberance frontal area shall be all fixtures which occur as standard equipment. The area of any optional equipment shall also be included if it is expected that more than 33 percent of the car line sold will be equipped with this option.

(ii) The dynamometer power absorber setting for light-duty vehicles shall be rounded to the nearest 0.1 horsepower.

(iii) For light-duty vehicles to be tested on a single, large roll dynamometer.

$$Hp = aA + P + (5.0 \times 10^{-4} + 0.33t)W$$

All symbols in the above equation are defined in paragraph (c)(2)(i) of this section. The rounding criteria of paragraph (c)(2)(i) also apply to this paragraph.

(3) The road load power calculated above shall be used or the vehicle manufacturer may determine the road load power by an alternate procedure requested by the manufacturer and approved in advance by the Administrator.

(4) Where it is expected that more than 33 percent of a car line within an engine-system combination will be equipped with air conditioning, per §86.080-24(g)(2), the road load power as determined in paragraph (c)(2) or (3) of this section shall be increased by 10 percent up to a maximum increment of 1.4 horsepower, for testing all test vehicles of that car line within that engine-system combination if those vehicles are intended to be offered with air conditioning in production. This power increment shall be added to the indicated dynamometer power absorption setting prior to rounding off this value.

[42 FR 45653, Sept. 12, 1977, as amended at 43 FR 52921, Nov. 14, 1978]

§ 86.129-94 Road load power, test weight, inertia weight class determination, and fuel temperature profile.

Section 86.129-94 includes text that specifies requirements that differ from §86.129-80. Where a paragraph in §86.129-80 is identical and applicable to §86.129-94, this may be indicated by specifying the corresponding paragraph and the statement “[Reserved]. For

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guidance see § 86.129-80.” Where a corresponding paragraph of § 86.129-80 is not applicable, this is indicated by the statement “[Reserved].”

(a) Flywheels, electrical, or other means of simulating test weight as shown in the following table shall be used. If the equivalent test weight specified is not available on the dynamometer being used, the next higher equivalent test weight (not to exceed 250 pounds) available shall be used:

Road load power at 50 mi/hour—light duty trucks ^{1,2,3}	Test weight basis ^{4,5}	Test equivalent test weight (pounds)	Inertia weight class (pounds)
.....	Up to 1062	1,000	1,000
.....	1063 to 1187	1,125	1,000
.....	1188 to 1312	1,250	1,250
.....	1313 to 1437	1,375	1,250
.....	1438 to 1562	1,500	1,500
.....	1563 to 1687	1,625	1,500
.....	1688 to 1812	1,750	1,750
.....	1813 to 1937	1,875	1,750
.....	1938 to 2062	2,000	2,000
.....	2063 to 2187	2,125	2,000
.....	2188 to 2312	2,250	2,250
.....	2313 to 2437	2,375	2,250
.....	2438 to 2562	2,500	2,500
.....	2563 to 2687	2,625	2,500
.....	2688 to 2812	2,750	2,750
.....	2813 to 2937	2,875	2,750
.....	2938 to 3062	3,000	3,000
.....	3063 to 3187	3,125	3,000
.....	3188 to 3312	3,250	3,000
.....	3313 to 3437	3,375	3,500
.....	3438 to 3562	3,500	3,500
.....	3563 to 3687	3,625	3,500
.....	3688 to 3812	3,750	3,500
.....	3813 to 3937	3,875	4,000
.....	3938 to 4125	4,000	4,000
.....	4126 to 4375	4,250	4,000
.....	4376 to 4625	4,500	4,500
.....	4626 to 4875	4,750	4,500
.....	4876 to 5125	5,000	5,000
.....	5126 to 5375	5,250	5,000
.....	5376 to 5750	5,500	5,500
.....	5751 to 6250	6,000	6,000
.....	6251 to 6750	6,500	6,500
.....	6751 to 7250	7,000	7,000
.....	7251 to 7750	7,500	7,500
.....	7751 to 8250	8,000	8,000
.....	8251 to 8750	8,500	8,500
.....	8751 to 9250	9,000	9,000
.....	9251 to 9750	9,500	9,500
.....	9751 to 10250	10,000	10,000
.....	10251 to 10750	10,500	10,500
.....	10751 to 11250	11,000	11,000
.....	11251 to 11750	11,500	11,500
.....	11751 to 12250	12,000	12,000
.....	12251 to 12750	12,500	12,500
.....	12751 to 13250	13,000	13,000
.....	13251 to 13750	13,500	13,500
.....	13751 to 14000	14,000	14,000

¹For all light-duty trucks except vans, and for heavy-duty vehicles optionally certified as light-duty trucks, and for complete heavy-duty vehicles, the road load power (horsepower) at 50 mi/h shall be 0.58 times B (defined in footnote 3 of this table) rounded to the nearest ½ horsepower.

²For vans, the road load power at 50 mi/h (horsepower) shall be 0.50 times B (defined in footnote 3 of this table) rounded to the nearest ½ horsepower.

³B is the basic vehicle frontal area (square foot) plus the additional frontal area (square foot) of mirrors and optional equipment exceeding 0.1 ft² which are anticipated to be sold on more than 33 percent of the car line. Frontal area measurements shall be computed to the nearest 10th of a square foot using a method approved in advance by the Administrator.

⁴For model year 1994 and later heavy light-duty trucks not subject to the Tier 0 standards of § 86.094-9, test weight basis is as follows: for emissions tests, the basis shall be adjusted loaded vehicle weight, as defined in § 86.094-2; and for fuel economy tests, the basis shall be loaded vehicle weight, as defined in § 86.082-2, or, at the manufacturer's option, adjusted loaded vehicle weight as defined in § 86.094-2. For all other vehicles, test weight basis shall be loaded vehicle weight, as defined in § 86.082-2.

⁵Light-duty vehicles over 5,750 lb. loaded vehicle weight shall be tested at a 5,500 lb. equivalent test weight.

(b)-(c) [Reserved]. For guidance see § 86.129-80.

(d) *Fuel temperature profile*—(1) *General requirements.* (i) To be tested for running losses, as specified in § 86.134, a vehicle must have a fuel temperature profile. The following procedure is used to generate the fuel temperature profile, which serves as a target for controlling fuel temperatures during the running loss test. This profile represents the fuel temperature change that occurs during on-road driving. If a vehicle has more than one fuel tank, a profile shall be established for each tank. Manufacturers may also simultaneously generate a profile for vapor temperatures.

(ii) If a manufacturer uses a vehicle model to develop a profile to represent multiple models, the vehicle model selected must have the greatest expected fuel temperature increase during driving of all those models it represents. Also, manufacturers must select test vehicles with any available vehicle options that increase fuel temperatures during driving (for example, any feature that limits underbody airflow).

(iii) Manufacturers may conduct testing to develop fuel temperature profiles in a laboratory setting, subject to approval by the Administrator. The laboratory facility should simulate outdoor testing to reproduce fuel and vapor temperature behavior over the specified driving schedule. The design of the laboratory facility should include consideration of any parameters that may affect fuel temperatures, such as solar loading, pavement heat, and relative wind velocities around and underneath the test vehicle. Indoor testing to develop the fuel temperature profiles must be conducted with little or no vehicle-specific adjustment of laboratory parameters. Manufacturers

would need to maintain an ongoing demonstration of correlation between laboratory and outdoor measurement of fuel temperatures. Specifically, fuel temperatures and pressures from in-door driving should be at least as high as measured when driving outdoors according to the procedures described in this section.

(iv) Small-volume manufacturers, as defined in § 86.094-14(b)(1), may use an alternate method for generating fuel temperature profiles, subject to the approval of the Administrator.

(v) The Administrator may conduct testing to establish any vehicle's temperature profiles or to verify compliance with fuel tank pressure requirements.

(2) *Vehicle instrumentation.* (i) The vehicle must be equipped with temperature sensors and pressure transducers, as described in § 86.107-96 (e) and (f), and a driver's aid, which shall be configured to provide the test driver with the desired vehicle speed vs. time trace and the actual vehicle speed.

(ii) A computer, data logger, or strip chart data recorder shall record the following parameters at a minimum during the test run:

- (A) Desired speed;
- (B) Actual speed;
- (C) Instantaneous average liquid fuel temperature (T_{liq}); and
- (D) Vapor space pressure (the Administrator may omit measurement of fuel tank pressure).

(iii) The data recording system described in paragraph (d)(2)(ii) of this section shall be capable of resolving time to ± 1 s, capable of resolving temperature to ± 2 °F, capable of resolving pressure to ± 1.0 inch of water, and capable of resolving speed to ± 1 mph. The temperature and pressure signals shall be recorded at intervals of up to 1 minute; speed signals shall be recorded at intervals of up to 1 second.

(3) *Ambient conditions.* The procedure shall be run under the following ambient conditions. Conditions should be representative of sunny summer days.

(i) Starting ambient temperature ($T_{amb,o}$) shall be at least 95 °F, steady or increasing (no more than 2 °F drop) during the procedure. Ambient temperature shall be measured and recorded in regular intervals of at least

once every 5 minutes. Measure ambient temperature with the following requirements (based on *Federal Standard for Siting Meteorological Sensors at Airports*, FCM-S4-1987). The sensors shall be mounted 5 ± 1 feet (1.5 ± 0.3 meters) above ground level. The sensors shall be protected from radiation from the sun, sky, earth, and any other surrounding objects, but at the same time be adequately ventilated. The sensors shall be installed in such a position as to ensure that measurements are representative of the free air circulation in the locality and not influenced by artificial conditions such as large buildings, cooling towers, and expanses of concrete and tarmac. Keep any grass and vegetation within 100 feet (30 meters) of the sensor clipped to a height of about 10 inches (25 centimeters) or less.

(ii) Wind conditions shall be calm to light with maximum wind speed of 15 mph. In the case of temporary gusting, wind speeds between 15 and 25 mph may occur for up to 5 percent of the total driving time without invalidating the data collection. Wind speed shall be measured and recorded in regular intervals of at least once per minute. Measure wind speed with the following requirements (based on *Federal Standard for Siting Meteorological Sensors at Airports*, FCM-S4-1987). The site should be relatively level, but small gradual slopes are acceptable. The sensor shall be mounted 30 to 33 feet (9 to 10 meters) above the average ground height within a radius of 500 feet (150 meters). The sensor height shall not exceed 33 feet, except as necessary to be at least 15 feet (5 meters) above the height of any obstruction (e.g. vegetation, buildings, etc.) within a 500 foot (150 meter) radius. An object is considered to be an obstruction if the included lateral angle from the sensor to the ends of the object is 10 degrees or more.

(iii) Road surface temperature shall be at least 125 °F throughout the driving period. Pavement temperature shall be measured and recorded in regular intervals of at least once per minute. The track temperature may be measured with an embedded sensor, a portable temperature probe, or an infrared pyrometer that can provide an accuracy of ± 2 °F. Temperatures must

be measured on a surface representative of the surface where the vehicle is driven.

(iv) Conditions shall be sunny or mostly sunny with a maximum cloud cover of 25 percent.

(v) Reported cloud cover, wind speed, and ambient temperature should be consistent with that reported by the nearest weather station; the Administrator may request justification of any discrepancy.

(4) *Profile determination procedure.* (i) Drain the fuel tank(s) and fill with test fuel to the "tank fuel volume" defined in § 86.082-2. The test fuel should meet the specifications of § 86.113, except that fuel with a lower volatility may be used, subject to Administrator approval. Manufacturers using a lower volatility fuel must generate a vapor temperature profile for demonstrating compliance with the limit on fuel tank pressure during the running loss test (see § 86.134-96).

(ii) The vehicle shall be moved to the location where the data is to be collected. It may be driven a maximum distance of 5 miles and may also be transported by other means. The vehicle shall be stabilized by one of the following methods:

(A) The vehicle shall be parked for a minimum of 12 hours in an open area on a surface that is representative of the test road, without any artificial heating or cooling of the fuel. The orientation of the front of the vehicle during parking (e.g., N, SW, etc.) shall be documented.

(B) The vehicle may be soaked in a temperature-controlled environment to stabilize fuel temperatures. Before starting the drive, the vehicle shall be stabilized with fuel temperatures 95 ± 3 °F for at least one hour. The fuel temperature may not exceed 98 °F at any time before the beginning of the driving schedule, during which only whole-vehicle heating and cooling may be used to control fuel temperatures. If a manufacturer uses the provisions of paragraph (d)(7)(v) of this section to establish a lower initial fuel temperature for the running loss test, the fuel in the test vehicle may not be stabilized at a temperature higher than the newly established initial fuel temperature.

(iii) Once the ambient conditions specified in paragraph (d)(3) of this section are met and the vehicle has been stabilized according to paragraph (d)(4)(ii) of this section, the vehicle's engine may be started. The vehicle's air conditioning system (if so equipped) shall be set to the "normal" air conditioning mode and adjusted to the minimum discharge air temperature and high fan speed. Vehicles equipped with automatic temperature controlled air conditioning systems shall be set to operate in "automatic" temperature and fan modes with the system set at 72 °F.

(iv) The vehicle may be operated at minimum throttle for a period up to 60 seconds prior to the start of the driving schedule, as necessary to move from the parking location onto the road surface. The driver's aid shall be started and the vehicle operated over the driving cycle specified in § 86.134-96(b) with the transmission operated in the same manner as specified in § 86.128-79. The data recording system shall provide a record of the required parameters over the entire period of driving.

(5) *Records required.* In addition to the vehicle data recording, the following parameters shall be documented for the determination of the fuel temperature profile:

- (i) Date and time of vehicle fueling;
- (ii) Odometer reading at vehicle fueling;
- (iii) Date and time vehicle was parked, parking location and orientation;
- (iv) Odometer reading at parking;
- (v) Date and time engine was started;
- (vi) Time of initiation of first UDDS;
- (vii) Time of completion of the driving cycle;
- (viii) Ambient temperatures throughout the period of driving (T_{amb});
- (ix) Wind speed throughout the period of driving;
- (x) Track surface temperatures throughout the period of driving cycle (T_{sur});
- (xi) Percent cloud cover during the period of driving; and
- (xii) Ambient temperature, wind speed, and percent cloud cover reported by the nearest weather station for the time corresponding most closely to the period of driving.

(6) *Fuel tank pressure.* Tank pressure shall not exceed 10 inches of water at any time during the temperature profile determination unless a pressurized system is used and the manufacturer demonstrates that vapor would not be vented to the atmosphere upon fuel cap removal.

(7) *Calculation of temperature profiles.*

(i) The traces from the driving schedule shall be verified to meet the speed tolerance requirements of §86.115. The following conditions shall be verified:

(A) $T_{amb,i} \geq T_{amb,o} - 2$ °F.

Where,

(1) *i*=instantaneous measurement throughout the drive; and

(2) *o*=initial measurement at the start of the specified driving schedule.

(B) $T_{amb,o} \geq 95$ °F.

(C) $T_{sur,i} - T_{amb,i} \geq 30$ °F.

(D) $W_{max} \leq 15$ mph.

(ii) Failure to comply with any of these requirements shall result in invalidation of the data and require that the procedure be repeated, beginning with the fuel drain at paragraph (d)(4)(i) of this section.

(iii) If all these requirements are met, the following calculations shall be performed to determine a profile for liquid fuel temperatures and, if applicable, for vapor temperatures:

$T_{i,profile} = T_i - T_o$.

Where:

(A) $T_{i,profile}$ =the series of temperatures that comprise the relative temperature profile.

(B) T_i =the series of observed liquid fuel or vapor temperatures during the drive.

(C) T_o =the liquid fuel or vapor temperature observed at the start of the specified driving schedule.

(iv) The relative temperature profile consists of the set of temperatures at each 1-minute interval. If temperatures are sampled more frequently than once per minute, the temperature data points may represent a rolling average of temperatures sampled for up to one-minute intervals. If multiple valid test runs are conducted for any model, then all the collected data shall be used to calculate a composite profile, based on the average temperatures at each point. The absolute temperature profile is determined by adding 95 °F (35 °C) to each point of the relative profile. Other

methodologies for developing corrected liquid fuel and vapor space temperature profiles may be used if demonstrated to yield equivalent results and approved in advance by the Administrator.

(v) Manufacturers may use a lower initial fuel temperature for the running loss test, if approved in advance by the Administrator. To demonstrate the need for such an adjustment, manufacturers would be expected to determine the maximum fuel temperature experienced by a vehicle during an extended park or after driving one UDDS cycle when exposed to the ambient conditions described in paragraph (d)(3) of this section. To use this provision, manufacturers would have to show maximum fuel temperatures no greater than 92 °F.

[56 FR 25775, June 5, 1991, as amended at 58 FR 16033, Mar. 24, 1993; 59 FR 39649, Aug. 3, 1994; 60 FR 43891, Aug. 23, 1995; 65 FR 59956, Oct. 6, 2000]

§ 86.130-00 Test sequence; general requirements.

Applicability. Section 86.130-96 (a) through (d) is applicable to vehicles tested for the FTP test. Paragraph (e) of this section is applicable to vehicles tested for the SFTP supplemental tests of air conditioning (SC03) and aggressive driving (US06). Paragraph (f) of this section is applicable to all emission testing. Section 86.130-00 includes text that specifies requirements that differ from §86.130-96. Where a paragraph in §86.130-96 is identical and applicable to §86.130-00, this may be indicated by specifying the corresponding paragraph and the statement “[Reserved]. For guidance see §86.130-96.”

(a)-(d) [Reserved]. For guidance see §86.130-96.

(e) The supplemental tests for exhaust emissions related to aggressive driving (US06) and air conditioning (SC03) use are conducted as stand-alone tests as described in §§86.158-00, 86.159-00, and 86.160-00. These tests may be performed in any sequence that maintains the appropriate preconditioning requirements for these tests as specified in §86.132-00.

(f) If tests are invalidated after collection of emission data from previous