

2013 Ram 1500 HFE Bi-Fuel CNG Conversion¹

Advanced Vehicle Testing – Baseline Vehicle Testing Results



VEHICLE SPECIFICATIONS²

Vehicle Features

VIN: 3C63R6RG0DG561319

Class: Standard Pickup Truck

Seatbelt Positions: 3

Type: ICE with start/stop; Conversion to CNG
Gasoline Bi-Fuel

Emissions Rating³: Tier 2, Bin 4

Engine

Model: Pentastar, V6, 24-Valve VVT

Displacement: 3.6 l

Cycle: Otto

Peak Power: 227 kW @ 6400 rpm

Peak Torque: 365 Nm @ 4175 rpm

Configuration: V6

Transmission

TorqueFlite 8-Speed Automatic 845RE

Tires

Manufacturer: Goodyear

Model: Wrangler

Size: P265/70 R17

Pressure F/R: 40 psi/40 psi

Spare Installed: Full Size

Gasoline Fuel Tank

Fuel Tank Capacity: 26 gal

Fuel Type: Regular Unleaded Gasoline

CNG Fuel Tank

Fuel Tank Capacity: 24 GGE (IA)⁴

Fuel Type: CNG

Tank Type/Pressure Rating: Type IV Composite/3600 psi

Weights

Design Pre-Conversion Curb Weight: 4,572 lb

Delivered Pre-Conversion Curb Weight: 4,621 lb

Pre-Conversion Distribution F/R (%): 55/45

Delivered Post-Conversion Curb Weight: 4,918 lb

Post-Conversion Distribution F/R (%): 53/47

GVWR: 6,010 lb

GAWR F/R: 3,700 lb/3,900 lb

Max. Pre-Conversion Payload: 1,438 lb

Max. Post-Conversion Payload: 1,092 lb

Dimensions

Wheelbase: 119.2 in

Track F/R: 67.5 in/67.8 in

Length/Width: 209 in/79.4 in

Height: 74.6 in

NOTES:

1. The vehicle was converted into a bi-fuel (gasoline and compressed natural gas (CNG)) vehicle by NatGasCar, LLC.
2. Vehicle specifications were supplied by the manufacturer, measured, or derived from a literature review.
3. The vehicle (pre-conversion) was designated as a Tier 2, Bin 4 vehicle by the U.S. Environmental Protection Agency.
4. IA stands for "Industry Average", and is a method for calculating the gallons of gasoline equivalent: At 24.8 MPa (3,600 psi) and 21 °C, IA is 4.82 lb/GGE.

PRE-CONVERSION PERFORMANCE STATISTICS¹

TRACK TESTING ²	DYNAMOMETER TESTING ⁵																																																																											
<p><u>Acceleration 0-60 mph³</u> Measured Time: 8.2 s</p> <p><u>Maximum Speed</u> At ¼ Mile: 87.1 mph Maximum Speed⁴: 106.1 mph</p>	<p><u>Cycle Results⁶</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">72 °F</th> <th style="text-align: center;">20 °F</th> <th style="text-align: center;">95 °F + 850 W/m²</th> </tr> </thead> <tbody> <tr> <td>UDDS (Cold Start)</td> <td>19.7 mpg (Start-Stop On); 19.5 mpg (Start-Stop Off)</td> <td>17.0 mpg</td> <td>16.9 mpg</td> </tr> <tr> <td>UDDS</td> <td>21.5 mpg (Start-Stop On); 21.0 mpg (Start-Stop Off)</td> <td>20.0 mpg</td> <td>18.2 mpg</td> </tr> <tr> <td>HWFET</td> <td>32.6 mpg</td> <td>29.4 mpg</td> <td>30.4 mpg</td> </tr> <tr> <td>US06</td> <td>21.0 mpg (Start-Stop On); 20.7 mpg (Start-Stop-Off)</td> <td>20.2 mpg</td> <td>19.5 mpg</td> </tr> <tr> <td>SC03</td> <td></td> <td></td> <td>18.1 mpg</td> </tr> <tr> <td>NEDC</td> <td>24.6 mpg (Start-Stop On); 23.1 mpg (Start-Stop Off)</td> <td></td> <td></td> </tr> <tr> <td>NYCC</td> <td>12.1 mpg (Start-Stop On); 10.7 mpg (Start-Stop Off)</td> <td></td> <td></td> </tr> </tbody> </table> <p><u>Fuel Economy at Steady-State Speed, 0% Grade</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>10 mph</td> <td>19.0 mpg</td> <td>50 mph</td> <td>36.3 mpg</td> </tr> <tr> <td>20 mph</td> <td>33.8 mpg</td> <td>60 mph</td> <td>31.8 mpg</td> </tr> <tr> <td>30 mph</td> <td>38.9 mpg</td> <td>70 mph</td> <td>26.7 mpg</td> </tr> <tr> <td>40 mph</td> <td>37.6 mpg</td> <td>80 mph</td> <td>22.6 mpg</td> </tr> </tbody> </table> <p><u>Duration of Passing Maneuver at Grade⁷</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">0% Grade</th> <th style="text-align: center;">3% Grade</th> <th style="text-align: center;">6% Grade</th> </tr> </thead> <tbody> <tr> <td>35-55 mph</td> <td style="text-align: center;">4.1 s</td> <td style="text-align: center;">4.5 s</td> <td style="text-align: center;">4.4 s</td> </tr> <tr> <td>55-65 mph</td> <td style="text-align: center;">3.3 s</td> <td style="text-align: center;">3.9 s</td> <td style="text-align: center;">3.4 s</td> </tr> <tr> <td>35-70 mph</td> <td style="text-align: center;">7.5 s</td> <td style="text-align: center;">8.6 s</td> <td style="text-align: center;">9.3 s</td> </tr> <tr> <td>55-80 mph</td> <td style="text-align: center;">6.7 s</td> <td style="text-align: center;">8.0 s</td> <td style="text-align: center;">8.9 s</td> </tr> <tr> <td colspan="4" style="text-align: center;">Maximum Speed at 25% Grade from Stop: 51.9 mph</td> </tr> </tbody> </table>					72 °F	20 °F	95 °F + 850 W/m ²	UDDS (Cold Start)	19.7 mpg (Start-Stop On); 19.5 mpg (Start-Stop Off)	17.0 mpg	16.9 mpg	UDDS	21.5 mpg (Start-Stop On); 21.0 mpg (Start-Stop Off)	20.0 mpg	18.2 mpg	HWFET	32.6 mpg	29.4 mpg	30.4 mpg	US06	21.0 mpg (Start-Stop On); 20.7 mpg (Start-Stop-Off)	20.2 mpg	19.5 mpg	SC03			18.1 mpg	NEDC	24.6 mpg (Start-Stop On); 23.1 mpg (Start-Stop Off)			NYCC	12.1 mpg (Start-Stop On); 10.7 mpg (Start-Stop Off)			10 mph	19.0 mpg	50 mph	36.3 mpg	20 mph	33.8 mpg	60 mph	31.8 mpg	30 mph	38.9 mpg	70 mph	26.7 mpg	40 mph	37.6 mpg	80 mph	22.6 mpg		0% Grade	3% Grade	6% Grade	35-55 mph	4.1 s	4.5 s	4.4 s	55-65 mph	3.3 s	3.9 s	3.4 s	35-70 mph	7.5 s	8.6 s	9.3 s	55-80 mph	6.7 s	8.0 s	8.9 s	Maximum Speed at 25% Grade from Stop: 51.9 mph			
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NOTES:

1. Performance numbers based on “Normal” vehicle mode. Performance numbers are averages from multiple tests.
2. Vehicle track testing occurs when the vehicle has achieved its “break-in mileage” of between 4,000 to 6,000 miles, and at the delivered curb weight plus 332 ± 10 lb (including driver and test equipment), distributed in a manner similar to the original curb loading of the vehicle. Track testing on the pre-conversion vehicle took place on May 27, 2014 with a beginning vehicle odometer reading of 4,074 miles. The ambient temperatures ranged from 94 °F to 97 °F. No accessories were used except for headlights as required by track regulation.
3. The acceleration event is initiated from a stop with the foot brake engaged and then transitioning to wide-open throttle (WOT). The acceleration time is measured from the point at which the vehicle begins to move. The acceleration and maximum speed results were averaged from 12 runs.
4. The maximum speed was reached before the one-mile mark.
5. Dynamometer testing occurs, after the track testing is complete, at Argonne National Laboratory. Dynamometer testing on the pre-conversion vehicle began on July 2, 2014 with the vehicle odometer reading 4,293 miles. Unless stated otherwise, the start-stop system is active for all test results. A comprehensive explanation of the dynamometer facility and methodology can be found at <http://www.transportation.anl.gov/D3/>, titled “Chassis Dynamometer Testing Reference Document”. The ABC coefficients derived from track coastdown testing for the pre-conversion vehicle and matched on the dynamometer were A: 37.3256 lb, B: 1.11147 lb/mph, and C: 0.01888 lb/mph².
6. The Cycle Results table presents the fuel economy achieved by the vehicle on five EPA drive cycles as well as other cycles of interest at three different ambient temperatures: (1) 72 °F with vehicle climate-control off, (2) 20 °F with vehicle climate-control set to 72°F Auto, and (3) 95 °F with vehicle climate-control set to 72°F Auto. The vehicle is also subjected to 850 W/m² of solar load at 95 °F to simulate direct sunlight. The drive cycles include a hot start unless otherwise indicated.
7. The passing maneuver value indicates the amount of time required for the vehicle to transition from the first to the second speed, at the specified grade.

POST-CONVERSION PERFORMANCE STATISTICS¹

TRACK TESTING ²	DYNAMOMETER TESTING ⁵				
<p><u>Acceleration 0-60 mph³</u> Measured Time: 10.2 s</p> <p><u>Maximum Speed</u> At ¼ Mile: 82.7 mph Maximum Speed⁴: 94.5 mph</p>	<u>Cycle Results: Gasoline⁶</u>				
	72 °F				
	UDDS (Cold Start)	19.4 mpg			
	UDDS	21.3 mpg (Start-Stop On); 20.5 mpg (Start-Stop Off)			
	HWFET	32.0 mpg			
	US06	20.3 mpg			
	<u>Cycle Results: CNG^{6,7}</u>				
	72 °F			20 °F	95 °F + 850 W/m ²
	UDDS (Cold Start)	0.118 gal, 691.7 g, 18.9 MPGe	0.180 gal, 701.3 g, 16.2 MPGe	0.066 gal, 954.8 g, 16.5 MPGe	
	UDDS	0.044 gal, 788.6 g, 20.8 MPGe (Start-Stop On); 0.006 gal, 927.9 g, 19.8 MPGe (Start-Stop Off)	0.043 gal, 869.8 g, 19.0 MPGe (Start-Stop On); 0.006 gal, 993.9 g, 18.5 MPGe (Start-Stop Off)	0.048 gal, 876.2 g, 18.6 MPGe (Start-Stop On); 0.008 gal, 1038.9 g, 17.6 MPGe (Start-Stop Off)	
HWFET	0.003 gal, 851.2 g, 29.8 MPGe	0.001 gal, 952.4 g, 26.8 MPGe	0.000 gal, 919.3 g, 27.9 MPGe		
US06	0.088 gal, 837.9 g, 18.9 MPGe	0.088 gal, 896.7 g, 17.9 MPGe	0.436 gal, 0.0 g, 18.4 MPGe		
SC03			0.005 gal, 516.7 g, 16.9 MPGe		
NYCC	0.021 gal, 207.3 g, 11.4 MPGe (Start-Stop On); 0.001 gal, 293.2 g, 10.0 MPGe (Start-Stop Off)	0.21 gal, 206.1 g, 11.4 MPGe (Start-Stop On); 0.001 gal, 299.3 g, 9.8 MPGe (Start-Stop Off)	0.024 gal, 268.1 g, 9.1 MPGe (Start-Stop On); 0.000 gal, 352.9 g, 8.4 MPGe (Start-Stop Off)		

POST-CONVERSION PERFORMANCE STATISTICS¹

DYNAMOMETER TESTING⁵

Fuel Economy at Steady-State Speed, 0% Grade: Gasoline

15 mph	20.4 mpg	50 mph	34.8 mpg
20 mph	32.2 mpg	60 mph	29.2 mpg
30 mph	37.1 mpg	70 mph	25.8 mpg
40 mph	35.5 mpg	80 mph	20.8 mpg

Fuel Economy at Steady-State Speed, 0% Grade: CNG

15 mph	18.0 MPGe	50 mph	36.1 MPGe
20 mph	32.5 MPGe	60 mph	31.3 MPGe
30 mph	38.4 MPGe	70 mph	26.5 MPGe
40 mph	39.1 MPGe	80 mph	22.5 MPGe

Duration of Passing Maneuver at Grade: Gasoline⁸

	0% Grade	3% Grade	6% Grade
35-55 mph	4.3 s	4.7 s	4.6 s
55-65 mph	3.5 s	3.9 s	4.0 s
35-70 mph	7.8 s	8.8 s	9.7 s
55-80 mph	7.4 s	8.4 s	9.6 s

Duration of Passing Maneuver at Grade: CNG⁸

	0% Grade	3% Grade	6% Grade
35-55 mph	5.5 s	5.9 s	6.5 s
55-65 mph	4.5 s	4.5 s	5.8 s
35-70 mph	10.4 s	12.0 s	14.7 s
55-80 mph	10.5 s	13.2 s	21.2 s

NOTES:

- Performance numbers based on "Normal" vehicle mode. Performance numbers are averages from multiple tests.
- Vehicle track testing normally occurs when the vehicle has achieved its "break-in mileage" of between 4,000 to 6,000 miles, and at the delivered curb weight plus 332 ± 10 lb (including driver and test equipment), distributed in a manner similar to the original curb loading of the vehicle. Since this vehicle had already undergone its pre-conversion baseline testing in addition to a significant amount of additional on-road mileage accumulation, the mileage for this post-conversion testing was higher. Track testing took place on November 11, 2014 with a beginning vehicle odometer reading of 12,347 miles. The track testing was conducted on CNG fuel only. The ambient temperatures ranged from 66 °F to 70 °F. No accessories were used except for headlights as required by track regulation.
- The acceleration is measured from the point at which the vehicle begins to move. The acceleration and maximum speed results were averaged from 12 runs.
- The maximum speed was reached before the one-mile mark.
- Dynamometer testing normally occurs, after the track testing is complete, at Argonne National Laboratory. In this case, the post-conversion dynamometer testing occurred after the pre-conversion track and dynamometer testing and after the conversion, but before the post-conversion track testing. Dynamometer testing began on September 23, 2014. Testing was conducted at 72°F for both Gasoline and CNG modes. Unless stated otherwise, the start-stop system is active for all test results. A comprehensive explanation of the dynamometer facility and methodology can be found at <http://www.transportation.anl.gov/D3/>, titled "Chassis Dynamometer Testing Reference Document". The ABC coefficients derived from track coastdown testing and matched on the dynamometer were A: 42.9278 lb, B: 0.79451 lb/mph, and C: 0.02287 lb/mph².
- When in CNG mode, the vehicle starts initially on gasoline fuel and then transitions to CNG fuel once the engine is sufficiently warm and has surpassed 1,500 rpm. The Cycle Results table presents the fuel economy achieved by the vehicle on five EPA drive cycles as well as other cycles of interest at three different ambient temperatures: (1) 72 °F with vehicle climate-control off, (2) 20 °F with vehicle climate-control set to 72°F Auto, and (3) 95 °F with vehicle climate-control set to 72°F Auto. The vehicle is also subjected to 850 W/m² of solar load at 95 °F to simulate direct sunlight. The drive cycles include a hot start unless otherwise indicated.
- The results for the Combined Gasoline and CNG mode include the volume of gasoline (in gallons) and mass of CNG (in grams) consumed during the cycle, as well as an overall fuel economy value in units of miles-per-gallon-of-gasoline-equivalent (MPGe).
- The passing maneuver value indicates the amount of time required for the vehicle to transition from the first to the second speed, at the specified grade.

As a production vehicle, the pre-conversion vehicle is assumed to meet all Federal Motor Vehicle Safety Standards (FMVSS) for Internal Combustion Engine Vehicles.

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