

# Honda Civic

## Dedicated CNG Sedan



The U.S. Department of Energy (DOE) is promoting the use of alternative fuels and alternative fuel vehicles (AFVs). To support this activity, DOE has directed the National Renewable Energy Laboratory (NREL) to conduct projects to evaluate the performance and acceptability of light-duty AFVs. We tested a pair of 1998 Civics: one dedicated CNG and a gasoline model as closely matched as possible. Each vehicle was run through a series of tests, explained briefly below. Each of these procedures has a page, on the vehicle evaluation website, with detailed descriptions.

**Acceleration:** Three tests performed: (1) elapsed time from a standstill to 60 mph at wide open throttle, loaded and unloaded; (2) elapsed time from 40 to 60 mph at wide open throttle (passing simulation); (3) elapsed time and maximum speed at a quarter mile. Values are the average of six measurements.

**Braking:** Dry surface is concrete, wet surface is low friction Jennite pad. Minimum stopping distance from 62 mph (100 km/h) on dry surface, and from 31 mph (50 km/h) on wet surface with no wheels locked. Panic stops are minimum measured distance from 31 mph (50 km/h) on wet and dry surfaces at maximum pedal pressure with no attempt to steer. Values are average of six stops.

**Fuel Economy:** City fuel economy determined using an urban driving cycle—a distance of 2 miles with 8 stops. Highway fuel economy used a 70 mph average driving cycle with no stops. The 150 mile trip alternated between urban and highway cycles until 150 miles was reached. Results are reported in 70% highway driving for total trip.

**Cold Start:** Vehicle placed in a temperature-controlled room at -20°F for first test (minimum soak time 12 hr\*). Crank time and idle rating recorded. If start successful, procedure repeated at -20°F for confirmation. If start unsuccessful, procedure repeated at higher temperature until minimum temperature is determined.

**Driveability and Handling:** Four different drivers rated each aspect of the vehicles; final rating is average of the four.

**Emissions:** Duplicate tests performed on each vehicle using EPA's Federal Test Procedure. CNG Civic tested on CNG, gasoline Civic tested on RF-A (industry average gasoline).

\*Soak time allows the vehicle to stabilize at a given temperature

*Beginning with the 1998 model year, Honda has equipped its popular Civic sedan with a 1.6L In-line 4 cylinder dedicated natural gas engine. Honda chose the Civic to be its first natural gas vehicle because of its low cost and high fuel efficiency. Extensive research by Honda lead to a CNG dedicated engine designed for optimized performance on natural gas. Features of the vehicle include an increased compression ratio and specially formulated 3-way catalysts. The gasoline Civic was certified to low emission vehicle standards (LEV), but the CNG Civic was designed to have emissions levels that are 1/10 ultra low emission vehicle standards (ULEV).*

### General Description

	CNG Civic GX	Gasoline Civic LX
<b>Engine:</b>		
Displacement	1.6 liter	1.6 liter
Configuration	In-line 4	In-line 4
Transmission	4-speed automatic	4-speed automatic
Fuel System	Multi-port fuel injection	Multi-port fuel injection
Engine Family Code	WHNXV01.6KAY	WHNXV01.6CA3
Compression Ratio	12.5:1	9.4:1
<b>Capacities:</b>		
Fuel	8 equivalent gal	12 gal
Passengers	2 front/2 rear	2 front/3 rear
Trunk Space (cu ft)	4.7	11.9
<b>Dimensions:</b>		
Length	175.1 in	175.1 in
Width	67.1 in	67.1 in
Curb Weight	2599 lbs	2456 lbs

**Other features:** Both vehicles were front wheel drive sedans equipped with air conditioning, power steering, power brakes, power door locks and windows, tilt wheel, and cruise control. The CNG Civic was also equipped with an anti-lock braking system (ABS), which is not standard on the gasoline vehicle. The gasoline model tested had a standard power brake system.

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## Performance

	CNG	Gasoline
<b>Acceleration</b>		
0-60 mph loaded (sec)	15.24	14.38
0-60 mph unloaded (sec)	13.64	12.41
40 to 60 mph (sec)	7.07	5.87
1/4 mile time (sec)	19.84	19.18
1/4 mile speed (mph)	72.10	73.28
<b>Fuel Economy (mpg)</b>		
City	24.3	23.5
Highway	34.2	32.0
Combined City/Highway	31.1	28.5

	CNG (with ABS)		Gasoline (without ABS)	
	meters	feet	meters	feet
<b>Braking</b>				
Effectiveness stops:				
62 mph (100 kph)	53.4	175.2	52.5	172.4
dry pavement				
31 mph (50 kph)	23.4	76.8	36.6	120.1
wet jenite				
Panic stop				
31 mph (50 kph)	12.8	42.2	12.8	42.2
dry pavement				
31 mph (50 kph)	24.2	79.5	46.6	152.9
wet jenite				

Cold Start Temperature °F	CNG		Gasoline	
	crank time	idle rating	crank time	idle rating
-20		—	48	4
-15	4 sec	6		

Idle ratings from 1 to 9, 1 being lowest rating

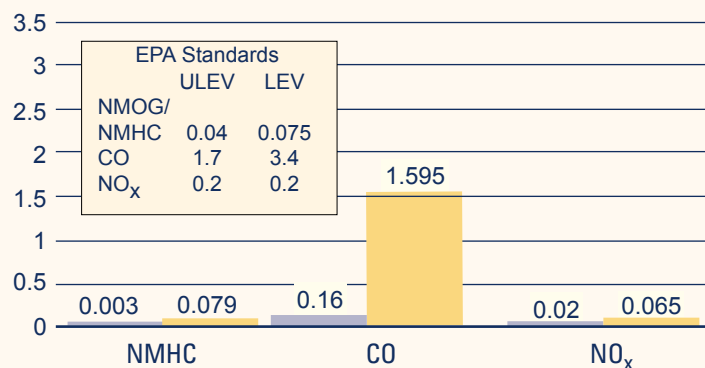
## Subjective Ratings:

	CNG	Gasoline
Routine handling	■	■
Emergency handling	■	■
Acceleration	■	■
Braking	★	■
Ride; fully loaded	■	■
Ride; lightly loaded	■	■
Noise	■	■
Driving position	■	■
Front seat comfort	■	■
Rear seat comfort	■	■
Climate control	★	★
Access	■	■
Controls & displays	★	★
Trunk	○	★

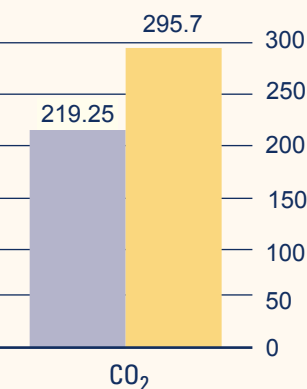
★ = Excellent ■ = Good ● = Fair ○ = Poor □ = Very Poor

## Emissions

### Regulated Exhaust Emissions (g/mi)



### CO<sub>2</sub> Emissions (g/mi)



This project was sponsored by the Office of Technology Utilization in the Department of Energy's Office of Transportation Technologies and managed by the National Renewable Energy Laboratory.

## Evaluation Summary

Evaluation results from a dedicated CNG Civic and a gasoline Civic showed very little difference in acceleration, and driveability and handling. Evaluators reported that both vehicles handled well, but that the gasoline control had slightly better acceleration. The trunk space is significantly reduced for the CNG Civic because the CNG fuel cylinder is installed in the trunk. During the braking tests on dry pavement the Civics performed nearly identically, but the CNG Civic out-performed the gasoline vehicle on the wet surface. This was not surprising since the gasoline Civic was not equipped with ABS, and the CNG Civic was. It is expected that performance for the wet braking tests would have been similar if both vehicles had ABS. The results revealed fuel economy as much as 8% higher for the CNG Civic compared to the gasoline Civic. Engine design changes, including operating at a higher compression ratio, likely contribute to higher overall efficiency and improved fuel economy of the CNG Civic. During cold start testing, the CNG Civic started at -20 degrees the first time, but failed to start in 2 subsequent tests. The test at -15 degrees was successful. The gasoline model started in both -20 degree tests. Emissions test results showed one of the biggest benefits of the CNG Civic. Although the emissions measured from both vehicles were low for the regulated constituents, those from the CNG Civic were at or below 1/10 the ULEV certification level. Emissions of potency weighted toxics (including: benzene, 1,3-butadiene, formaldehyde, and acetaldehyde)\* for the CNG Civic were 97% lower than that of the gasoline Civic.

\* For more information on the calculation of potency weighted toxic emissions see the section on emissions on the website (<http://www.afdc.doe.gov/demoproj/ldv/nve>).