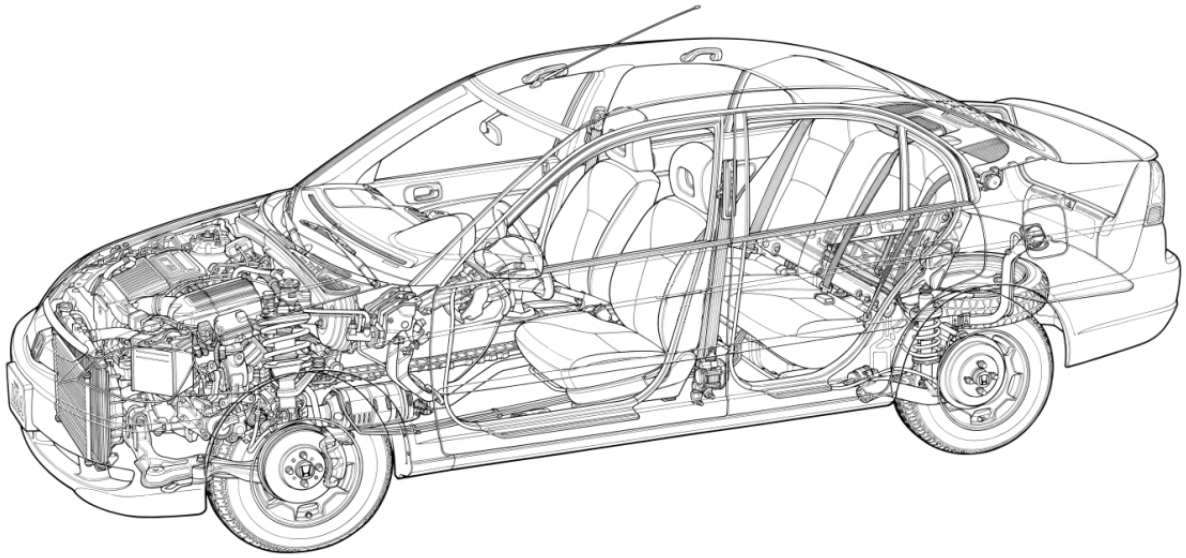
2003 Honda Civic Hybrid

INTRODUCTION



Overview

The 2003 Honda Civic Hybrid ushers in a new era of high efficiency transportation by incorporating the second generation of Honda's Integrated Motor Assist technology into the Civic, the best-selling car in Canada. Originally debuting on the Honda Insight in 1999, Integrated Motor Assist (IMA) uses a gasoline engine coupled to an electric motor (creating a hybrid system) that boosts performance and fuel mileage. Since its inception, Honda's goal has been to apply IMA technology to a mass-produced vehicle on an existing platform. After years of development and a proven real world track record with the Insight, the next generation of high efficiency automotive technology arrives with the introduction of the 2003 Honda Civic Hybrid.

The newly developed Civic Hybrid IMA system employs new technology that improves performance and provides greater packaging freedom compared to the Insight's IMA system. The heart of the Civic Hybrid's system is a new 1.3-litre i-DSI 4-cylinder engine that is coupled to a high-output electric motor located between the engine and the transmission. While braking or decelerating, energy is re-captured by the electric motor and stored in the battery for later use. As the vehicle accelerates, stored energy is directed to the high-torque electric motor to supplement the engine's performance. All of this takes place automatically without any additional driver input. The end result is a roomy and comfortable 5-passenger sedan capable of achieving approximately 4.6 L/100km (48-mpg) which translates to a 35 per cent increase compared to a conventional Civic LX sedan with an automatic transmission. Just turn the key and go, like you would in any conventional car, and since the Civic Hybrid's electrical system is completely self-sustaining, it never needs to be plugged in for recharging. The Civic Hybrid retains all of the Civic family's class leading safety, performance, refined handling characteristics, reliability and legendary build quality.

Concepts and Goals

The development concept for the Civic Hybrid was to adapt Integrated Motor Assist technology to a high-volume, mainstream vehicle.

Top Goals

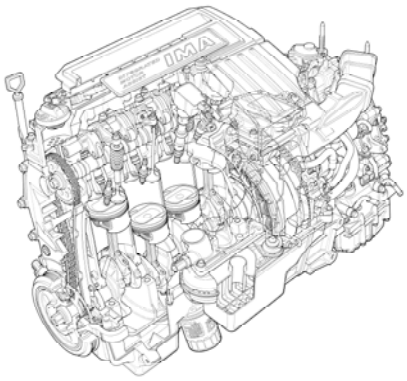
- Achieve optimum levels of fuel economy for a 5-passenger sedan.
- Provide a refined driving experience with good performance.
- Be as easy-to-use as any conventional automobile.

Second Generation IMA System and New 1.3-litre i-DSI Lean Burn Engine

While the outward appearance of the 2003 Civic Hybrid remains similar to the conventional Civic sedan, mechanically the vehicle is significantly different. The Civic Hybrid melds the technological concept of the Honda Insight into the current production model of the Civic sedan to create an exciting new vehicle.

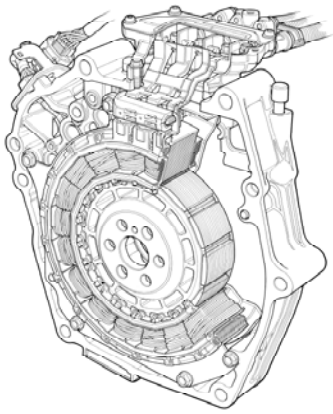
Civic Hybrid Technology Overview

- Second generation Integrated Motor Assist (IMA) hybrid system
- Newly developed 1.3-litre i-DSI 4-cylinder gasoline engine
- New "intelligent" i-DSI (Dual & Sequential Ignition) lean burn combustion technology with two spark plugs per cylinder
- VTEC controlled Cylinder Idling System
- Improved ultra-thin DC brushless motor
- New Intelligent Power Unit (IPU)
- Continuously Variable Transmission (CVT) with Creeping Aid System



i-DSI 4-Cylinder Engine

VTEC Controlled Cylinder Idling System



IMA Electric Motor

Additional Product Information

Availability – The Civic Hybrid will go on sale in May 2002 as a 2003 model.

History – The Hybrid is the second Honda vehicle to use Honda's patented Integrated Motor Assist technology. The first was the 2000 Honda Insight, which went on sale in North America in December 1999.

Diverse Civic Lineup – Nine Civic models and trim levels will soon be available in sedan, coupe and three-door style. The models are: Civic SiR, Civic sedan (DX, DX-G, LX, Hybrid), Civic coupe (DX, LX, Si, Si-G).

Drive and Feel – Overall, the Civic Hybrid provides an exceptionally refined driving experience with an agile and sporty suspension, comfortable ride, good acceleration performance and a quiet interior.

Summary – The Civic Hybrid's IMA system combines the advantages of proven hybrid technology into the best-selling car in Canada to create the ultimate in efficiency, comfort, style and refinement. The Honda Civic Hybrid will be the first established, mainstream vehicle equipped with a gasoline-electric hybrid system to hit the automobile market.

2003 Honda Civic Hybrid

POWERTRAIN

Overview

The concept for the 2003 Civic Hybrid's powertrain is grounded in simplicity – use a highly efficient gasoline engine and supplement the performance with an electric motor. On the surface, the system may appear complex, but the Civic Hybrid powertrain provides a simple solution for the seemingly incompatible task of combining both efficiency and performance. Honda's patented Integrated Motor Assist (IMA) system, also referred to as a "hybrid" system, uses two power sources – gasoline and electricity. This system allows the Civic Hybrid to use a smaller gasoline engine (compared to other Civics) without any significant loss of performance, but a significant increase in fuel efficiency.

The Civic Hybrid IMA system is comprised of three main components: the gasoline engine, the electric motor, and an energy storage device. The electric motor is positioned between the engine and transmission. The electric motor assists the engine when accelerating or ascending grades and recaptures energy when braking or decelerating (referred to as regenerative braking). Most of the vehicle's propulsion comes from the gasoline engine with the electric motor providing assist as needed. The IMA system is especially effective when you consider that acceleration requires a significant amount of power and energy, normally requiring a larger displacement engine at the expense of overall fuel economy. But the extra displacement is not necessary while driving at a constant speed on a level road (where vehicles spend the majority of their time). The IMA system effectively manages this challenging aspect of vehicle propulsion. The IMA system combines the respective strengths of the gasoline and electric systems to increase overall efficiency. The electric motor enhances the power provided by the gasoline engine. Reciprocally, the gasoline engine allows the electric motor to be smaller and operate without the need for an outside power source to recharge the batteries (ie. it does not need to be plugged in).

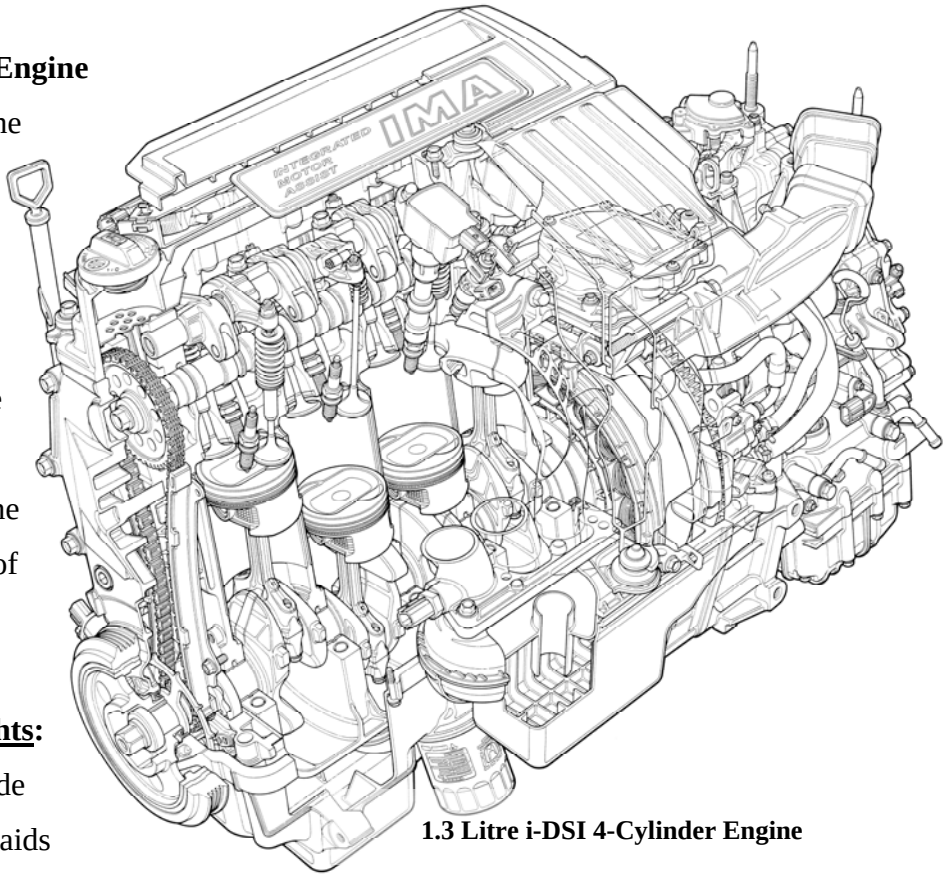
The 2003 Civic Hybrid uses a new generation of Honda's IMA technology, building on the system originally debuted on the 1.0-litre, 3-cylinder, 2000 Honda Insight. The new Civic Hybrid has a larger 1.3-litre 4-cylinder gasoline engine featuring several technology breakthroughs and a more powerful electric motor. Also, numerous electrical system components have been combined, lightened and reduced in size.

The Civic Hybrid's gasoline-electric powertrain occupies the same width dimensions in the engine bay as the conventional Civic sedan's engine even with the increased componentry from the IMA system. The 1.3-litre inline 4-cylinder i-DSI engine is shorter than the 1.7-litre inline 4-cylinder engine used in the Civic sedan, which allows room for the 10 kilowatt electric motor/generator to be positioned between the engine and transmission within the same engine bay. Both transversely mounted powertrains measure the same length, 883mm (35.8 in.). Widthwise from the front of the engine bay to the back, the Civic Hybrid powertrain measures 575 mm (25.8 in.), which is slightly narrower than a conventional Civic.

CIVIC HYBRID ENGINE

1.3-Litre i-DSI 4-Cylinder Engine

The main power source for the Civic Hybrid is the 1.3-litre 4-cylinder i-DSI engine. The main characteristics of this design are low fuel consumption and high torque at low and medium speed ranges. It is a lean burn engine and has a compression ratio of 10.8:1.



1.3 Litre i-DSI 4-Cylinder Engine

<u>Engine Technical Highlights</u>:

- High swirl effect inside combustion chamber aids combustion efficiency.
- Compact combustion chamber features a narrow angle valve layout (30-degrees) for added combustion efficiency.
- Compact single overhead cam (SOHC) head.
- Dual & Sequential Ignition (i-DSI) with two spark plugs per cylinder and precise sequential ignition results in ultra lean burn combustion and light off, less fuel consumed and clean exhaust emissions.
- VTEC-controlled Cylinder Idling System promotes low friction inside the engine (due to reduced pumping losses) during deceleration for increased regenerative braking capability.
- Automatic idle stop feature shuts the engine down during complete stops for reduced fuel consumption and lower emissions.
- The 1.3-litre 4-cylinder i-DSI engine aluminum cylinder block uses a new frame structure technology for reduced weight and greater packaging flexibility.

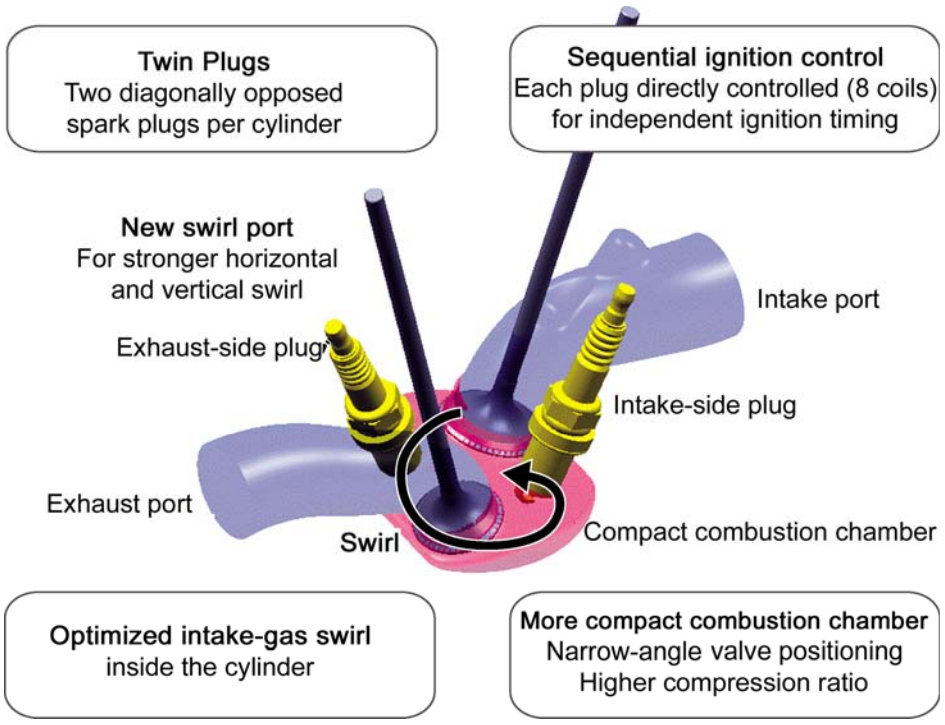
Engine Block and Internal Components

The design concept for the 1.3-litre i-DSI aluminum engine block and its components focused on creating a lightweight package with extremely low friction qualities. To save weight, the block has thin sleeve construction. Friction reducing measures include plateau honing, low friction pistons, low tensile force piston rings and an offset cylinder bore.

- Thin sleeve cylinder wall construction results in a reduction of the total amount of material used in the engine for a lightweight engine block.
- Plateau honing lowers the friction level between the pistons and the cylinders by creating an ultra smooth surface. Plateau honing is a two stage machining process that uses two grinding processes instead of the more conventional single honing process. This also enhances the long-term wear characteristics of the engine.
- Low friction pistons made of aluminum alloy are lightweight and have “micro-dimples” on the cylinder walls for improved lubrication.
- Offset cylinder bores help minimize friction by positioning the crankshaft axis in a more efficient alignment to the cylinder bore axis. This reduces friction caused by the side thrust of the pistons against the cylinder walls, just after top-dead-center, as each piston begins its descent on the firing stroke.
- Connecting rods are special high strength forged steel units that have been treated with a special carbon process that hardens the surface and allows engineers to use a design that weighs less than a traditional rod for this application.
- Low tensile force piston rings further reduce friction.

i-DSI (Dual & Sequential Ignition) with Twin Plug Sequential Ignition Control

The i-DSI Twin Plug Sequential Ignition Control helps facilitate an intense and rapid combustion process in the engine. In order to ignite as much of the air/fuel mixture as possible, the spark plugs are positioned so that under certain circumstances, they can ignite precisely in a sequential fashion with the intake and exhaust ports. When the air/fuel mixture enters the combustion chamber on the intake side, the first spark plug located near the intake port ignites. Shortly thereafter, the second plug located near the exhaust port ignites, accelerating the combustion process by forcing the flame to rapidly propagate. The spark plugs can also ignite simultaneously under certain circumstances. This process results in a more complete combustion compared to a single plug system. To achieve this, the ignition control has eight ignition coils that are independently controlled according to a dynamic engine map program. Honda's patented Twin Plug Sequential Control system is programmed to respond to engine rpm and load conditions. Since the system has eight individual ignition coils, it can manipulate the ignition timing of individual spark plugs located near the air intake port and the exhaust port. The benefits are more power, less fuel consumption and reduced emissions.



Twin Plug Sequential Ignition Control System Program

Throttle Position	RPM	Ignition	Notes
Half	Low	Sequential	Air intake side has advanced ignition to balance torque and fuel economy.
Half	Mid – high	Simultaneous	Air intake and exhaust side spark plugs both simultaneously ignite to balance power and engine noise.
Full	Low	Sequential	The air intake side spark plug has advanced ignition and the exhaust side has delayed ignition for maximum torque.
Full	Medium	Sequential	Air intake side spark plug has advanced ignition and the exhaust side has further delayed ignition to balance torque and engine noise.
Full	High	Simultaneous	The air intake side spark plugs and the exhaust side spark plugs ignite simultaneously for maximum horsepower.

VTEC Controlled Cylinder Idling System

A major aspect of regenerative braking is to reclaim as much energy as possible during deceleration. Since the electric motor, which also acts as an electric generator, is attached directly to the crankshaft of the engine, the engine should create as little resistance as possible during deceleration to allow the generator to produce high levels of electricity and charge the batteries. In a traditional engine, the pumping action of the cylinders will actually create a moderate amount of resistance, or “engine braking,” during deceleration. The Cylinder Idling System effectively reduces engine drag by closing the intake and exhaust valves on up to three of the four cylinders and allowing the pistons to move more freely within the cylinders, thus allowing the generator to provide maximum resistance (instead of the engine) and, consequently, produce more electricity.

The system uses Honda's patented VTEC (Variable Valve Timing and Lift Electronic Control) technology to close the intake and exhaust valves on up to three of the four cylinders at engine speeds as low as 1000 rpm to reduce the pumping action in the engine. Whereas traditional applications of VTEC engage an alternative cam profile at high rpm and high oil pressure for improved performance, this new VTEC system engages at low rpm and low oil pressure to close the valves for a different kind of improved performance – reduced engine resistance during deceleration.

VTEC Controlled Cylinder Idling System

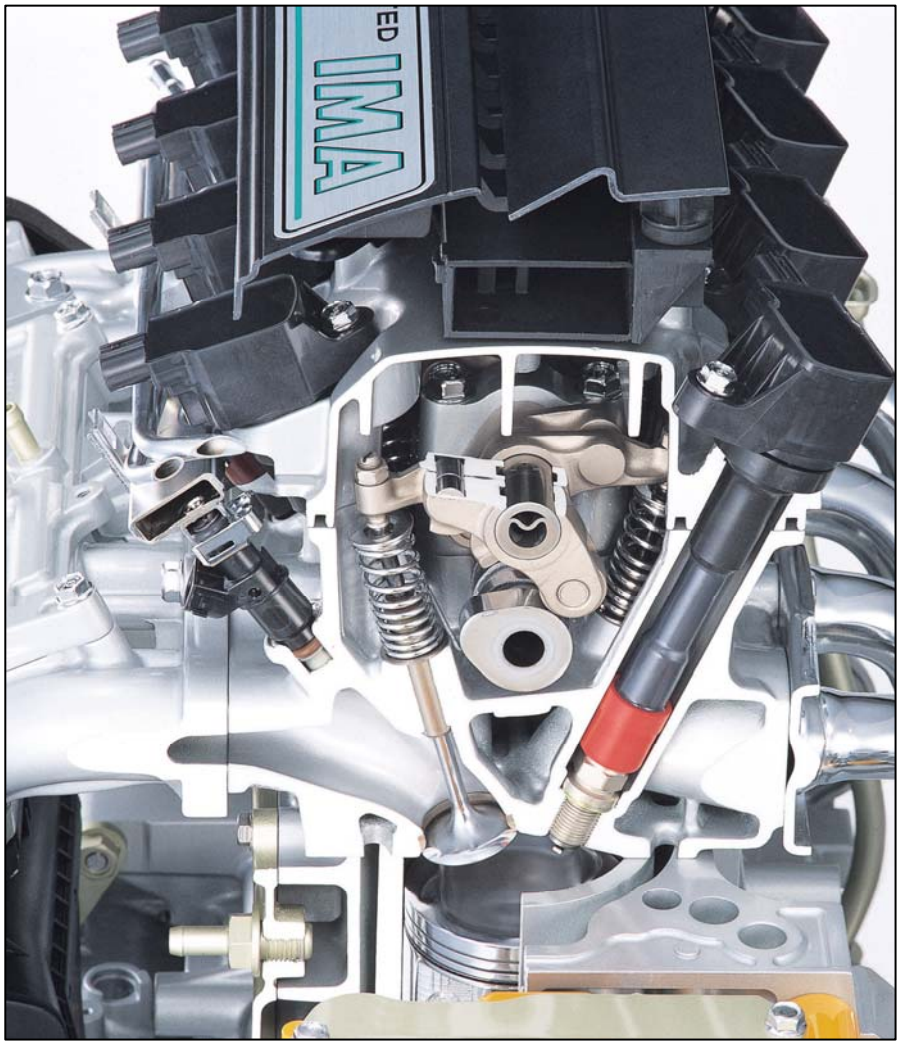
Lightweight Plastic Resin Intake Manifold Chamber and Engine Parts

The engine's intake manifold chamber is constructed of a plastic resin instead of aluminum alloy in order to save weight. The individual pieces that make up the manifold chamber are permanently connected with a die-slide welding technique.

In addition to the intake manifold chamber, another engine component that makes use of high strength plastic resin technology is the idler (tensioner) pulley.

Cylinder Head with Narrow Angle VTEC Valvetrain

The Civic Hybrid's single overhead camshaft (SOHC) cylinder head uses a compact chain drive and a compact, low friction VTEC system. It uses a common rocker shaft for both the intake and exhaust rocker arms. Placing all the rocker arms on one shaft eliminates the need for a second rocker-arm shaft, so the valve mechanism can be lighter and more compact. To reduce friction, the rocker arms have rollers built-in.



The compact valvetrain allows for a desirable narrow angle (30-degrees) between the intake and exhaust valves, which helps supply a more powerful direct charge into the cylinder chamber. The narrow angle valvetrain allows for a more compact combustion chamber. The intake ports create a swirl effect in the cylinder chamber that promotes a well-balanced and even air fuel mixture as it enters the engine. This optimizes the air fuel mixture for cleaner, more efficient combustion.

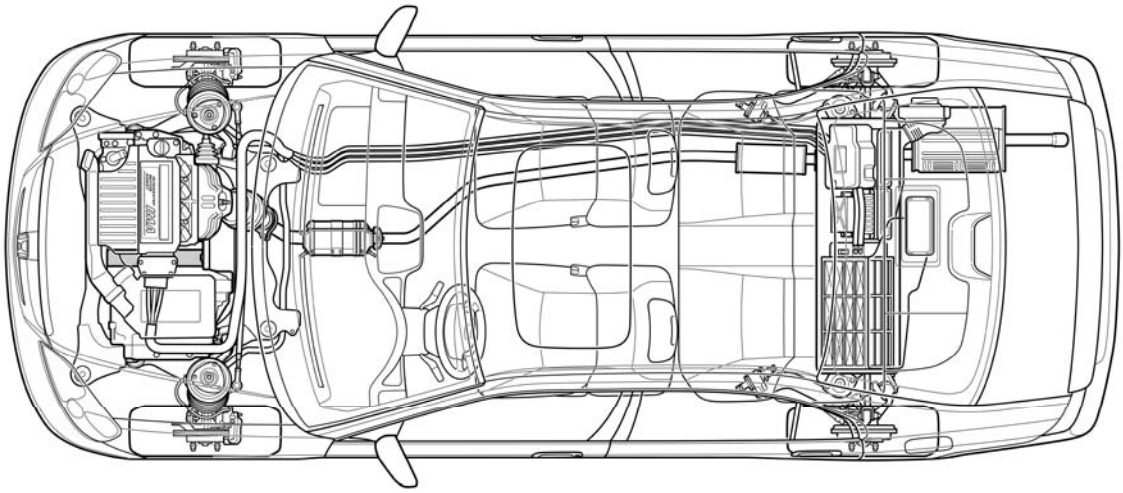
Exhaust and Emission System with Nitrogen Oxide Adsorptive Catalytic Converter

Lean air-fuel ratios improve fuel economy and reduce hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx). However, conventional 3-way catalysts are not very effective in converting NOx into normal nitrogen when excess oxygen is present. To keep NOx emissions within ULEV levels on various Honda vehicles, Honda engineers developed a nitrogen-oxide-adsorptive catalytic converter. The catalyst uses a proprietary mixture of platinum and other metals to attract NOx molecules to its surface during lean air-fuel mixture combustion. Then, when the IMA engine is operating with a richer air-fuel ratio, the catalyst combines these NOx molecules with the hydrocarbons and CO present in the exhaust to form water vapor, carbon dioxide and nitrogen. The engine's nitrogen-oxide adsorptive catalyst plays an important role in helping the Civic Hybrid meet California's stringent ULEV emissions standards.

Engine Mounts

The engine mounts are optimally located over the axis of inertia, with consideration for the Civic Hybrid power unit's vibration characteristics. Moreover, liquid seal mounts are employed on the engine sides and transmission to dampen vibration. These features significantly reduce vibration from the power unit, resulting in a more comfortable ride.

CIVIC HYBRID INTEGRATED MOTOR ASSIST (IMA)



System Overview

The new, more advanced version of Honda's patented Integrated Motor Assist (IMA) system represents the second generation of IMA technology from Honda. The new IMA system uses technology that delivers increased performance and provides enhanced packaging flexibility within the vehicle.

Primary motive power for the Civic Hybrid is provided by the system's 1.3-litre i-DSI gasoline engine. Although the engine alone provides sufficient driving performance, the electric motor mounted between the engine and transmission provides power assistance under a broad range of conditions, such as initial acceleration from a stop and climbing hills. And since the electric motor is used only for power assistance and not for primary motive power, it can be made smaller and lighter (along with the batteries) compared to the full-size traction motors in other hybrid systems.

As the IMA gasoline engine enters its cruising operating range, the electric motor assist has a minimal role and the engine supplies the power required. Power for the electric motor is mainly generated by capturing energy from the forward momentum of the vehicle rather than from the gasoline engine. When the Civic Hybrid is coasting or the brakes are applied, the electric-assist motor becomes a generator, converting forward momentum (kinetic energy) into electrical energy, instead of wasting it as heat during conventional braking. Energy is stored in the system's Nickel Metal Hydride (NiMH) battery pack located behind the rear seat in the trunk. If the charge state of the IMA battery is low, the motor generator will also recharge the battery while the Civic Hybrid is cruising.

Engineering Goals

The engineering goals for using the second generation IMA system on the Civic platform included increasing total power output of the system, increasing the regenerative braking capability and making the overall package smaller. The end result of the IMA development process is performance similar to a Civic LX sedan with the 1.7-litre engine, yet the Civic Hybrid has a 1.3-litre engine. Additionally, the IMA batteries and related components utilize minimal cargo space in the trunk, leaving room for items such as two large pieces of luggage or a baby stroller.

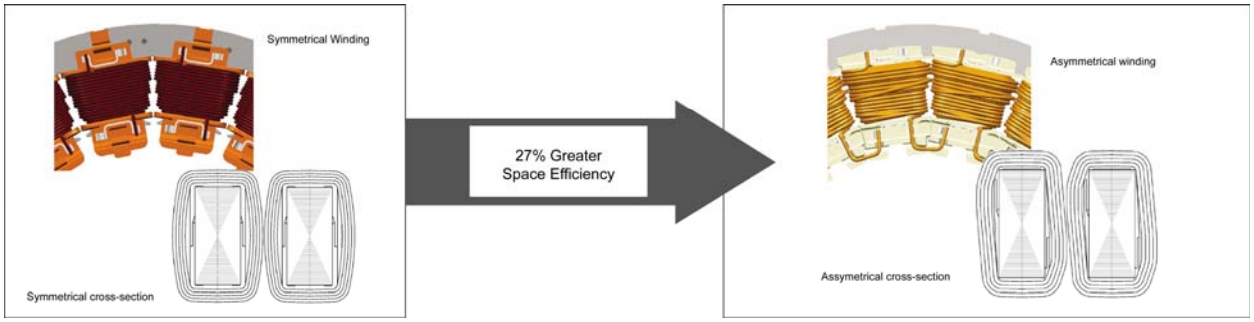
IMA Technology Highlights

- Ultra thin DC brushless motor is 30 per cent more efficient.
- The size of the Intelligent Power Unit (IPU) has been reduced by 42 per cent compared to the system used in the Insight.
- NiMH battery is 30% smaller in volume than Insight with more capacity
- Idle Stop feature incorporated with Continuously Variable Transmission

Technological Advancements

Several key technology advancements have occurred to extract more power out of the smaller IMA package. Compared to the Insight, the major areas of improvement to the IMA system involve the decreased size of fundamental components such as the Intelligent Power Unit (IPU), Power Control Unit (PCU), motor electronic control unit, energy storing system, IPU cooling system and the merging of major components into the centralized IPU.

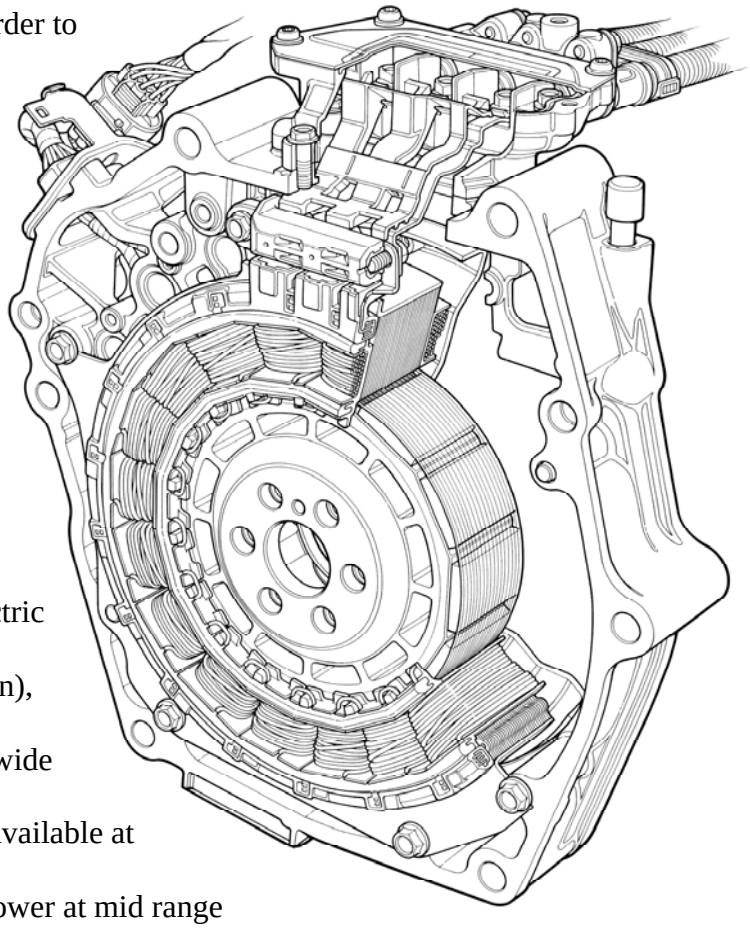
- New winding methods for the electric motor wire result in greater wire density within same space.



- Within the IPU, the combination of the inverter and pre-driver results in a 28 per cent weight savings and a 39 per cent volume savings.
- Used in the inverter, new high-density silicone wafers contribute to 25 per cent less heat loss.
- A new cooling system combines two fans into one while consuming 85 per cent less energy to cool both the battery and the PCU, resulting in a 32 per cent weight reduction and a 20 per cent volume reduction for the cooling system.
- The battery module has reduced resistance and energy losses, which has improved output density by 23 per cent. More welding points between the pole plates and current collector plates contribute to this improvement.

Electric Motor

The 13-horsepower, 144-volt, ultra-thin DC brushless electric motor's function is to boost the output of the efficient gasoline engine in order to provide powerful acceleration. The electric motor does not provide primary motivation for the vehicle, and in fact, the Civic Hybrid would continue to operate with reasonably good performance on the gasoline engine alone.



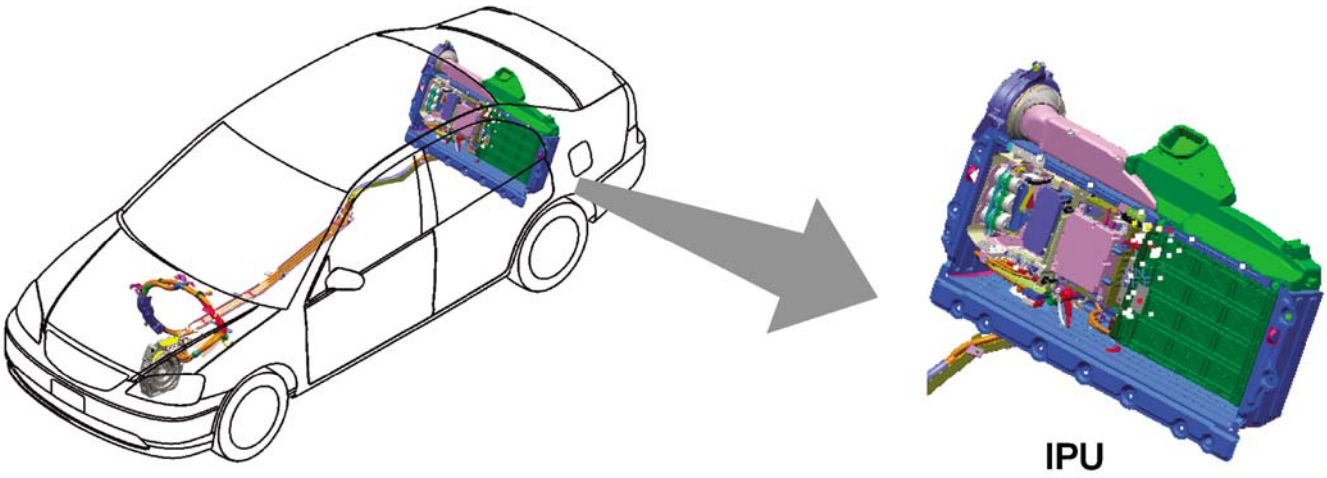
Ultra Thin DC Brushless Electric Motor

The performance characteristics of the electric motor, which has a width of 65 mm (2.55 in), results in high amounts of torque across a wide rpm range with a peak torque of 36 lb.-ft. available at 1000 rpm. It produces a peak of 13 horsepower at mid range engine rpm. The gasoline engine excels at providing horsepower at higher rpm, and in the case of the i-DSI engine, it supplies reasonably good torque, too. The most significant contribution the electric motor makes to overall performance of the vehicle is adding significant amounts of torque at lower rpm.

The electric motor is positioned between the gasoline engine and the transmission. The crankshaft of the engine connects directly to the electric motor and the output shaft of the electric motor attaches directly to the transmission. The electric motor and the gasoline engine always turn in tandem since they are connected together.

Intelligent Processing Unit (IPU)

The Intelligent Processing Unit (IPU) controls the power of the IMA system. The IPU houses the Power Control Unit (PCU), motor Electric Control Unit (ECU), energy storage module (battery), and a compact cooling system.



Battery

The battery box is located inside the IPU. The battery box's dimensions measure 495-mm x 372-mm x174-mm for a volume of 26.8 litres (a volume reduction of approximately 30 per cent compared to the Insight) and it weighs 28.6 kg (a reduction of approximately 6 per cent compared to the Insight). The battery system is comprised of 120 individual 1.2-volt cells for a total battery system output of 144 volts and a capacity of 6.0 AH. The warranty for the battery is 8 years/130,000km.

Automatic Idle Stop

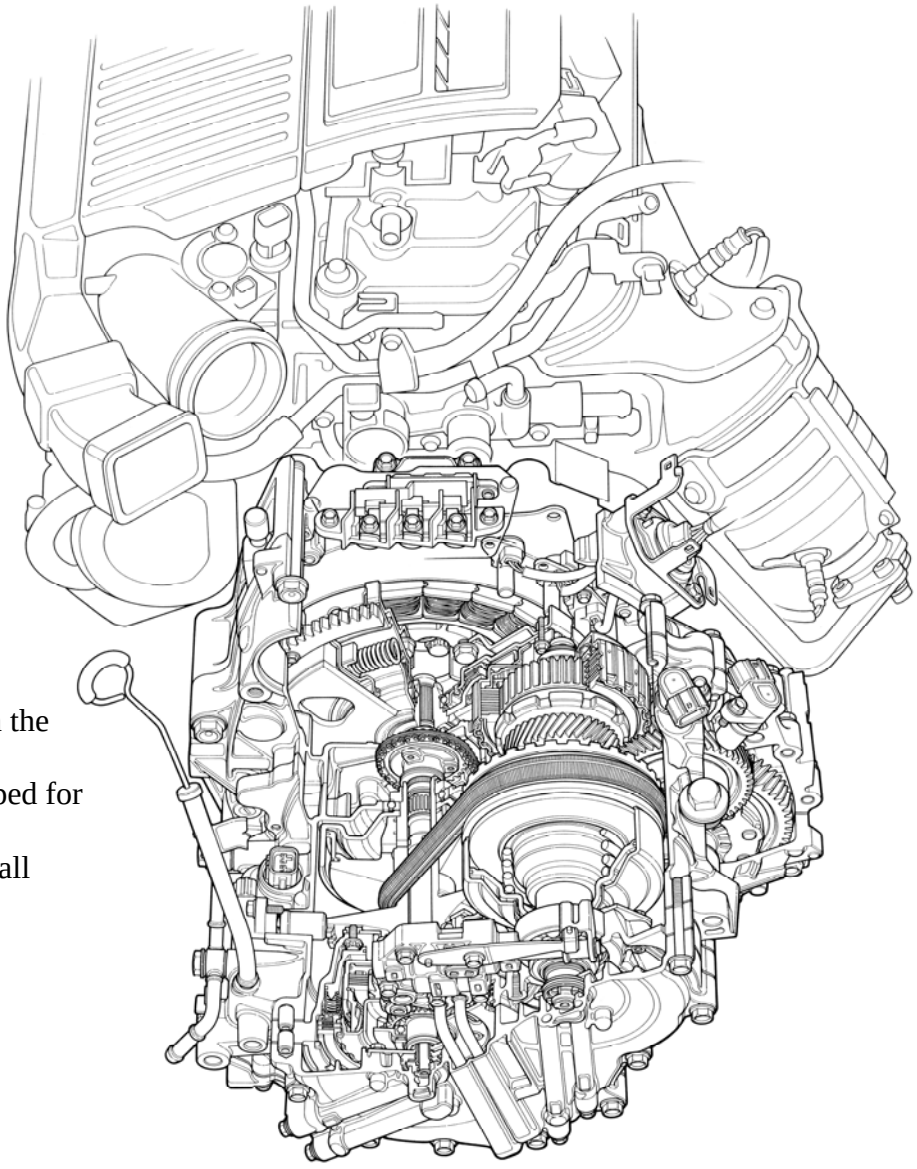
The Civic Hybrid automatically turns off the gasoline engine during complete stops under most circumstances. This feature allows the Hybrid to use no fuel and emit no emissions at stoplights and other traffic conditions where the car is not moving. The system uses the IMA electric motor to re-start the engine. The Idle Stop feature is not activated during the first few minutes of engine startup or if the automatic climate control system is being used in air conditioning mode unless "Economy Mode" is selected. Also, the Idle Stop system will not operate at ambient temperatures below 0 degrees Celsius.

TRANSMISSION

Automatic Continuously Variable Transmission (CVT)

The CVT's unique stepless shifting system is smoother than a normal automatic transmission with a torque converter, and there is less torque loss – meaning more of the engine's output can be fully transmitted. There is no gear shift shock (providing a seamless feel) and the acceleration is smooth while fuel consumption is reduced. The CVT can change the "gear" ratio from 2.367:1 to an overdrive level of 0.407.

The CVT transmission used in the Civic Hybrid has been developed for good torque capacity and overall efficiency.



CVT Transmission

CVT Features:

- High torque capacity.
- Compact design.
- Hydraulic controls on clamp and pulley systems.
- Deceleration feedback control for increased regenerative braking.
- Facilitates seamless integration of cruise control.
- Lining material incorporates carbon fibre for the starting clutch.
- Refined start feel and precise movement within the transmission.
- Creeping Aid System minimizes the car from rolling backwards from a stop on steep hills.

How it works…

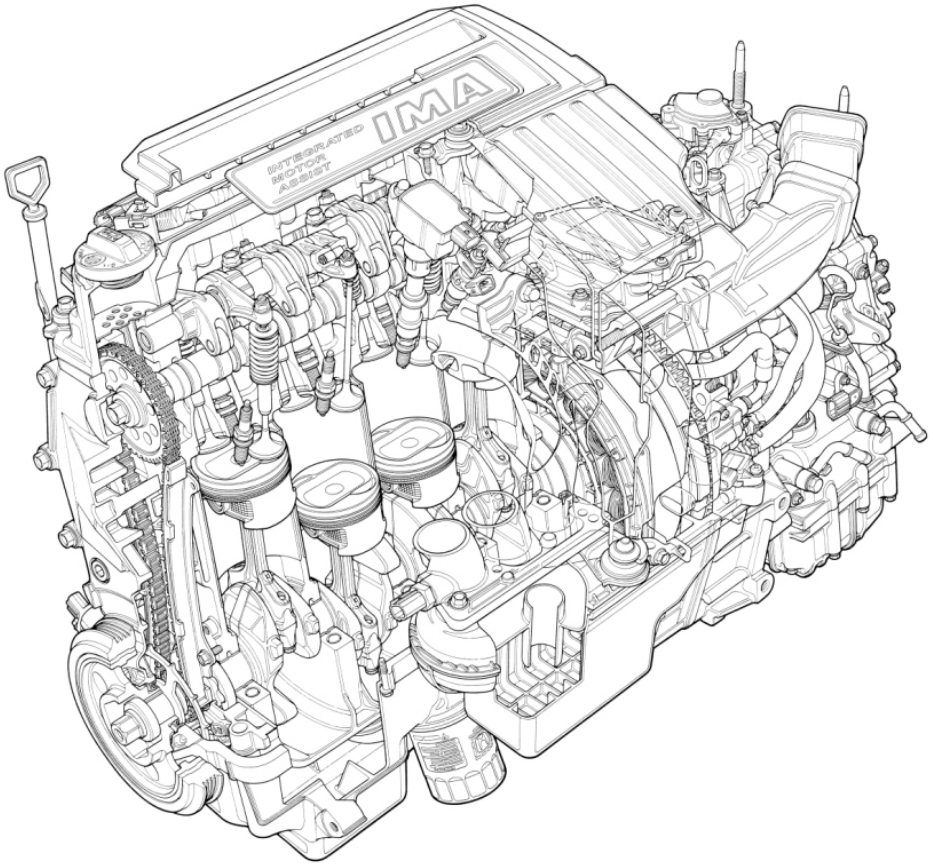
The CVT system works by varying the position of a high-strength steel belt between two metal cones under high pressure – one cone connects to the power input of the transmission and one cone connects to the power output side of the transmission. Through various guides within the transmission, the belt can occupy any position between the two cones to create the most suitable gear ratio for any vehicle speed and throttle input.

The CVT is completely automatic and virtually provides an infinite range of gear ratios for smooth, stepless shifting, combined with maximum efficiency and performance. The CVT also works in conjunction with the unique "idle stop" feature, avoid using gas while at red lights or idling in traffic. The engine automatically re-starts when the brake pedal is released.

The Civic Hybrid is the first Honda vehicle to be equipped with a CVT transmission in Canada.

POWERTRAIN HIGHLIGHTS

- Second generation Integrated Motor Assist (IMA) hybrid system uses a 1.3-litre 4-cylinder gasoline engine with Dual & Sequential Ignition (i-DSI) and is assisted by a powerful electric motor with a compact Intelligent Power Unit (IPU).
- New i-DSI lean burn combustion technology uses two spark plugs per cylinder and maximizes combustion for economy and power.
- New cylinder idling system adapts Honda's VTEC variable valve control system to significantly increase the amount of kinetic energy recovered during deceleration. The system reduces engine resistance, greatly improving the vehicle's regenerative efficiency.
- Improved ultra-thin DC brushless motor delivers the world's highest output density for an electric motor and achieves 30 per cent more torque than the previous model – without a size increase.
- New Intelligent Power Unit (IPU) combines the Power Control Unit (PCU) and the battery into one package, which results in a 42 per cent reduction in volume (compared to the Insight's IPU) for improved packaging flexibility and reduced weight.
- An advanced Continuously Variable Transmission (CVT) automatic transmission.
- Creeping Aid System minimizes the car's tendency to roll backwards from a stop on steep hills.
- Designed to meet California's stringent ULEV emissions standards.



Civic Hybrid Powertrain

1.3-Litre i-DSI Engine Specifications vs. 2002 Civic LX Sedan and 2002 Insight Engine Specifications

	2003 Civic Hybrid	2002 Civic LX Sedan	2002 Honda Insight
Displacement	1339 CC (1.3 L)	1668 CC (1.7 L)	995 CC (1.0 L)
No. of Cylinders	4	4	3
Horsepower (gas only)	85 @ 5700 rpm	115 @ 6100 rpm	67 @ 5700 rpm
Torque (gas only) lb.-ft.	87 @ 3300 rpm	110 @ 4500 rpm	66 @ 4800 rpm
Horsepower (combined)	93 @ 5700 rpm	-	73 @ 5700 rpm
Torque (combined) (lb.-ft.)	105 @ 3000 rpm	- -	91 @ 2000 rpm
Compression Ratio	10.8:1	9.5:1	10.8:1 MT
Fuel Economy (L/100km)	4.9/4.6 est. city/hwy*	AT 7.9/5.8 NRCan city/hwy MT 7.3/5.5 NRCan city/hwy	3.9/3.2 NRCan city/hwy
Emissions	ULEV	ULEV	ULEV

* Fuel Economy figures represent Honda in-house estimates for comparison purposes only (not official NRCan estimates).

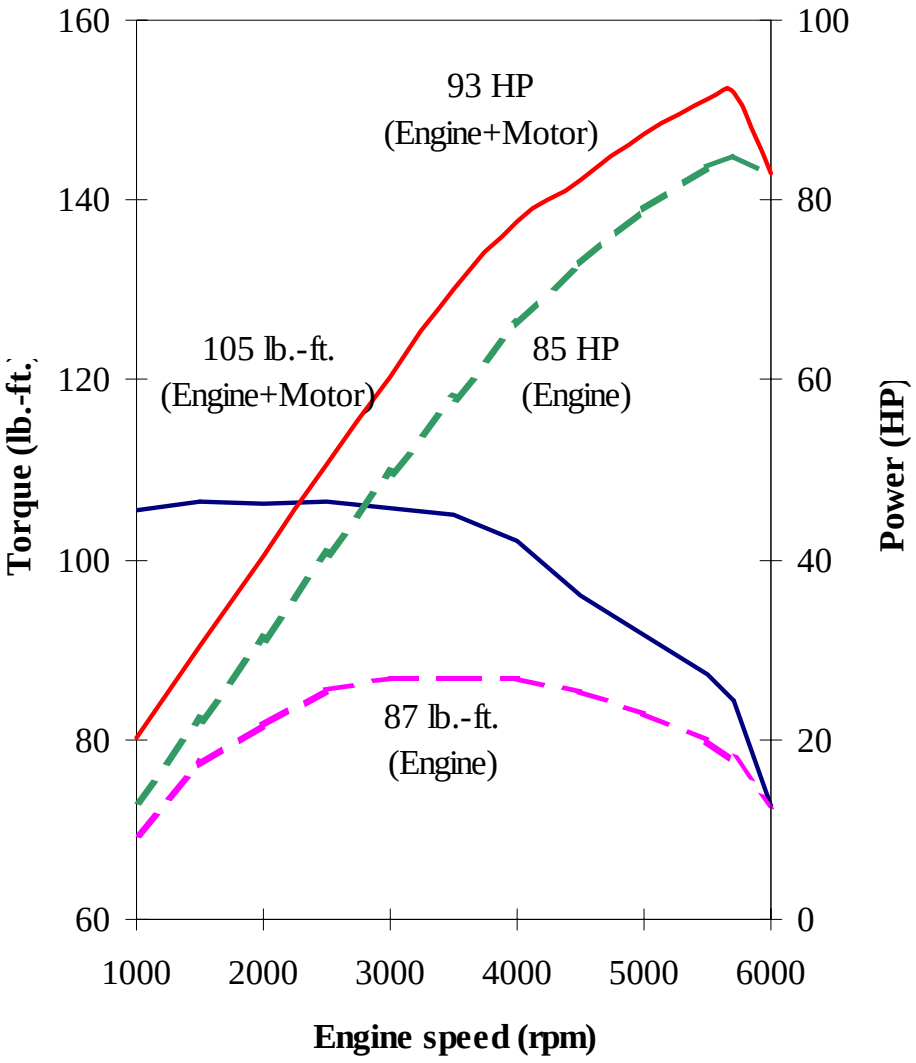
Electric Motor Specifications

Voltage Rating	144 volts
Power Output (electric motor only)	13 horsepower/10kW@4000 rpm
Torque (electric motor only)	36 lb.-ft. torque @ 1000 rpm
Number of Phases	3
Number of Poles	12
Number of Slots	18

Battery Specifications

Battery Type	Nickel-Metal Hydride (NiMH)
Output	144 V (120 cells @ 1.2 Volts)
Capacity	6.0 AH
Weight	28.6 kg (63 lbs.)

CIVIC HYBRID POWER CURVE

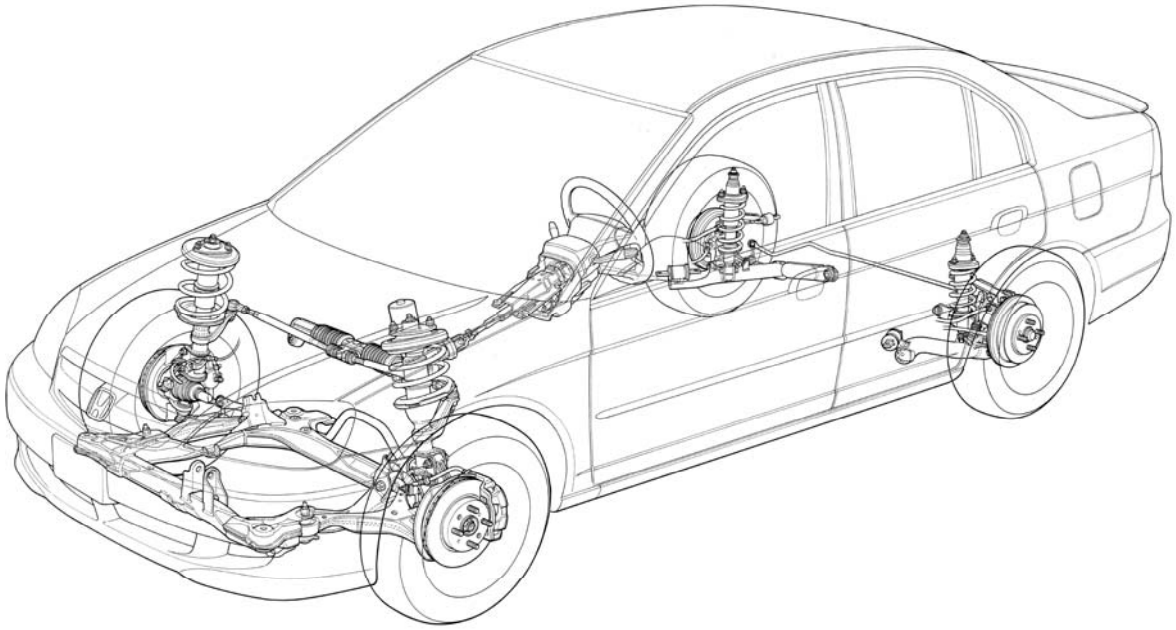


With IMA: ——————

Without IMA: - - - - - - - - - - -

2003 Honda Civic Hybrid

CHASSIS



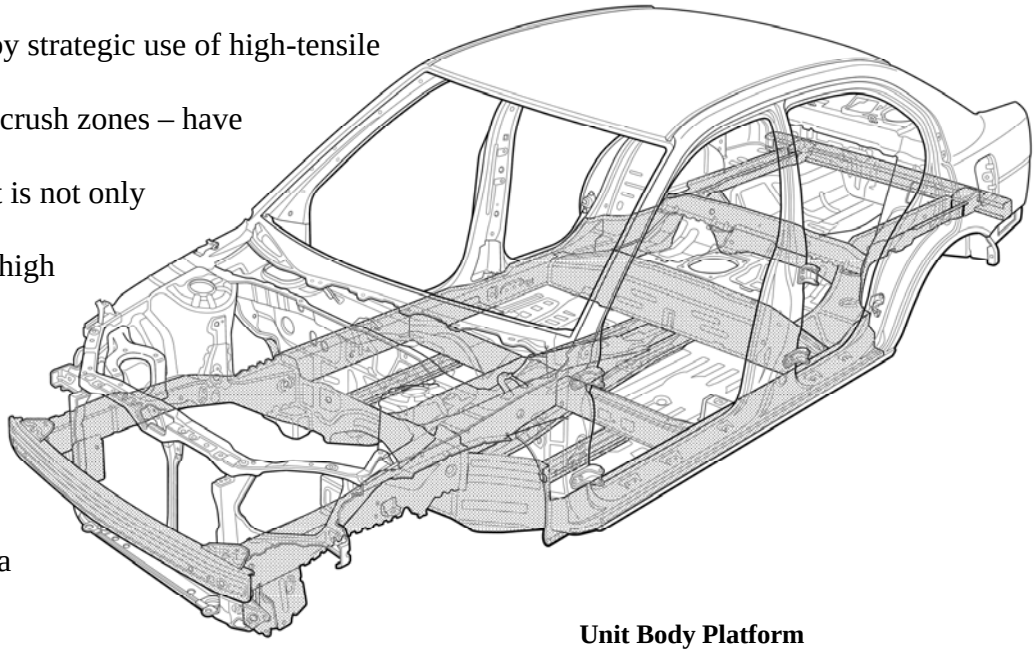
Overview

The 2003 Honda Civic Hybrid chassis is similar to the rest of the Civic family, however it does have a few notable differences. The Hybrid uses the same toe control-link independent strut front suspension and reactive-link double wishbone rear suspension as other Civic models. This setup provides nimble steering, excellent handling performance and a comfortable ride, while enhancing interior space and safety. Some of the features that the Civic Hybrid adds are:

- Electric Power Steering (EPS).
- Standard Anti-Lock Braking System (ABS) with Electronic Brake Distribution (EBD).
- Low rolling resistance tires and alloy wheels.
- Stiffer springs and increased shock absorber dampening rates.
- Increased diameter front stabilizer bar.
- Larger rear drum brakes.

Global Compact Car Platform

Honda's global compact car platform creates the foundation for the Civic Hybrid. This unit body design, first introduced on 2001 Honda Civic models, incorporates a toe control-link independent strut front suspension and a reactive-link double wishbone rear suspension to create a spacious, rigid, sporty and comfortable Civic chassis. The combination of the platform's components – enhanced by strategic use of high-tensile steel, cross members and crush zones – have resulted in a platform that is not only lightweight and provides high levels of safety, but one that also offers excellent handling and refined road manners for a compact vehicle.



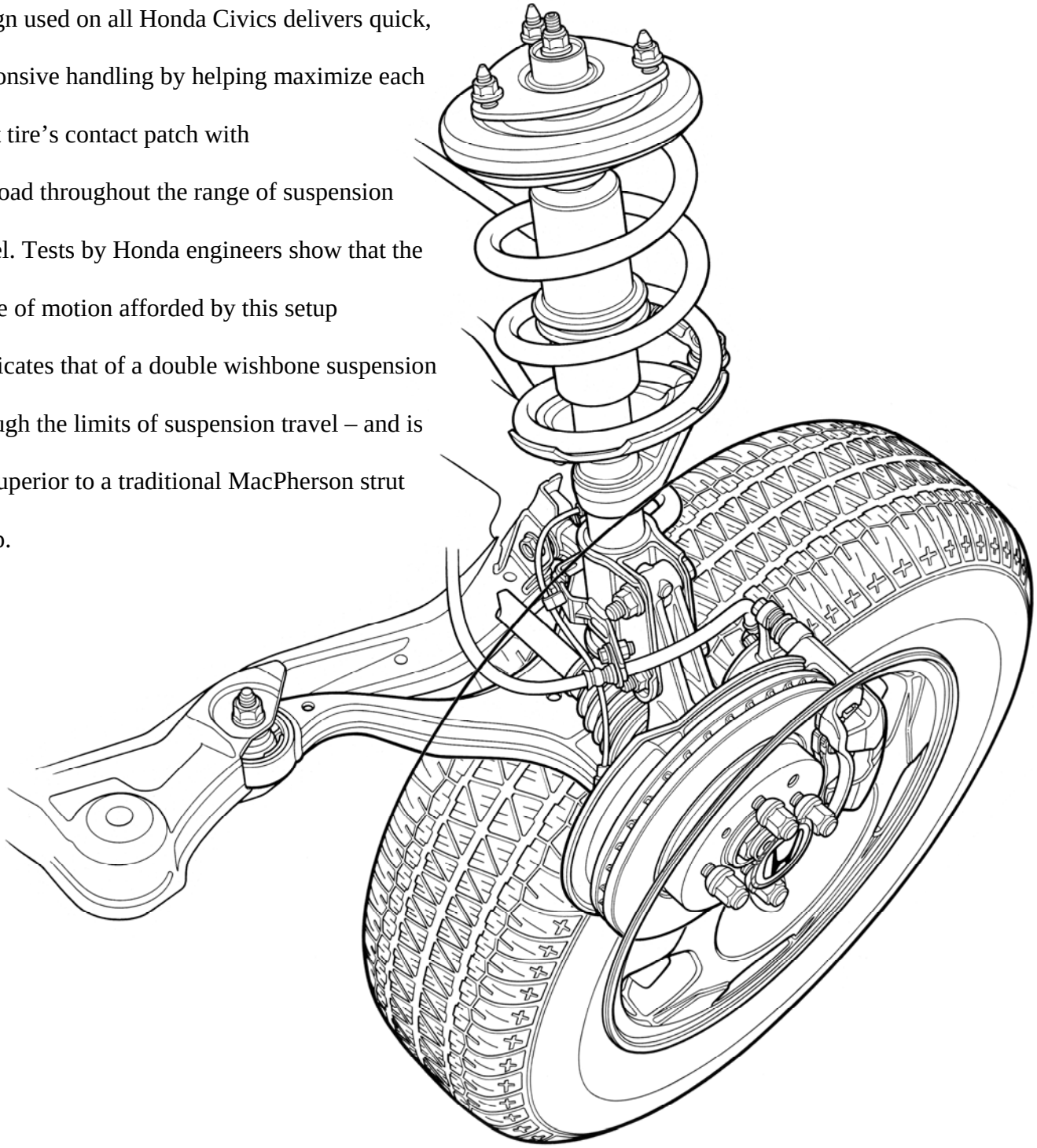
Unit Body Platform

Rigid Front Sub-Frame

The Civic's parallel front sub-frame supports and surrounds the engine and helps provide efficient energy absorption in the event of a collision. This sub-frame, dubbed a "shark's jaw" by Honda engineers because of its unique shape, is made using a hydro-forming manufacturing technique. Hydro-forming the sub-frame makes it lighter and more rigid. The engine mounts to the sub-frame in two places, helping isolate the engine from the body and reducing noise and vibration in the passenger compartment.

Toe Control-Link Independent Strut Front Suspension

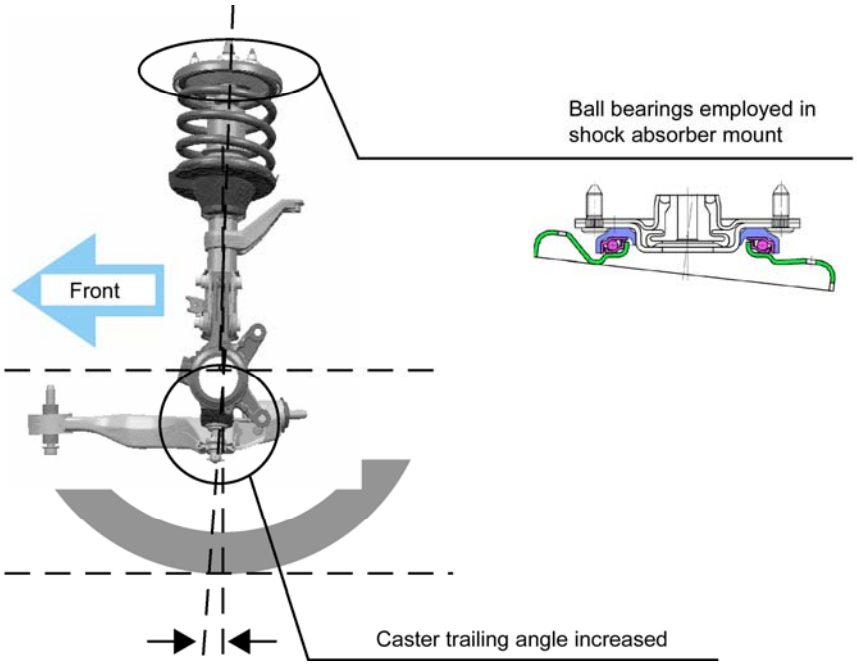
The toe control-link independent strut front suspension design used on all Honda Civics delivers quick, responsive handling by helping maximize each front tire's contact patch with the road throughout the range of suspension travel. Tests by Honda engineers show that the range of motion afforded by this setup duplicates that of a double wishbone suspension through the limits of suspension travel – and is far superior to a traditional MacPherson strut setup.



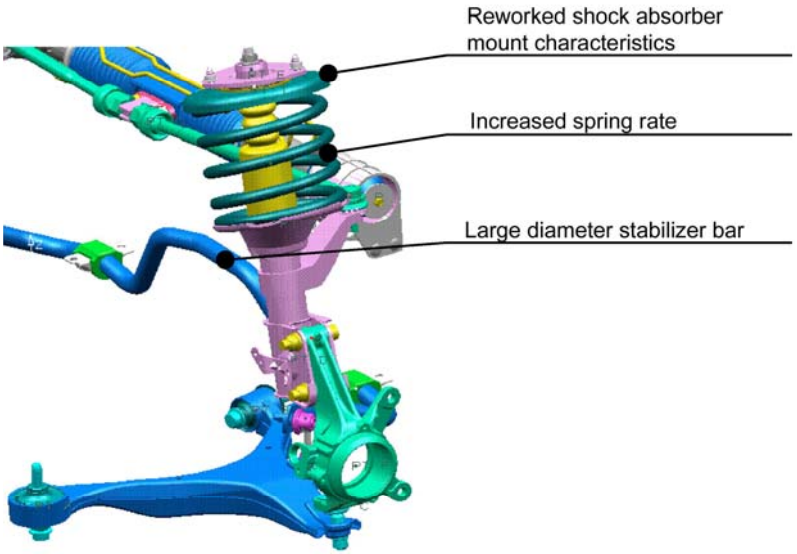
Toe Control-Link Independent Strut Front Suspension

The Civic Hybrid's suspension is custom tuned with increased spring rates and shock tuning (with increased dampening) compared to the Civic LX sedan. The front stabilizer bar has been made thicker for increased cornering stability. To improve inline stability, the caster trailing angle has been increased. Also, ball bearings are used in the front shock absorber mounts to minimize friction. These changes allow for an enhanced ride and refined handling.

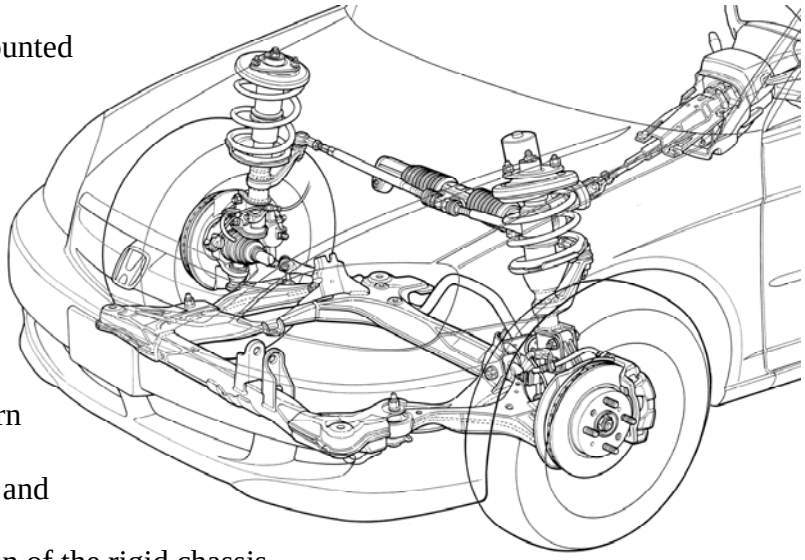
- Front Toe Control-link Independent Strut Suspension



Front Toe Control-link Independent Strut Suspension

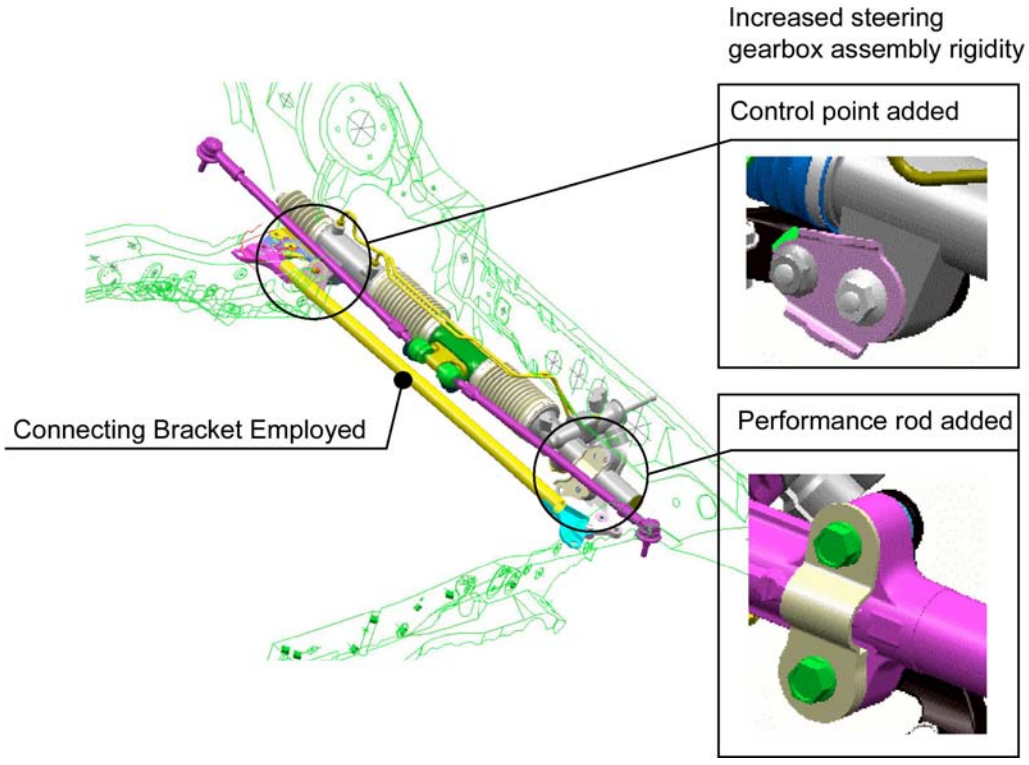


High-Mounted Steering Box



High-Mounted Steering Box

The 2003 Civic Hybrid features a high-mounted steering gearbox similar to other Civic models. This arrangement maximizes toe-control (the amount the tires angle in toward the body) when compared to a conventional strut suspension, which in turn allows the Civic Hybrid to track smoothly and confidently through corners. A combination of the rigid chassis and refined suspension geometry increases the front tire's contact patch with the ground so the vehicle feels stable on the road, particularly during lane change maneuvers. The Civic Hybrid has a turning diameter of 10.6 meters (34.8 feet) as measured at wheel center.



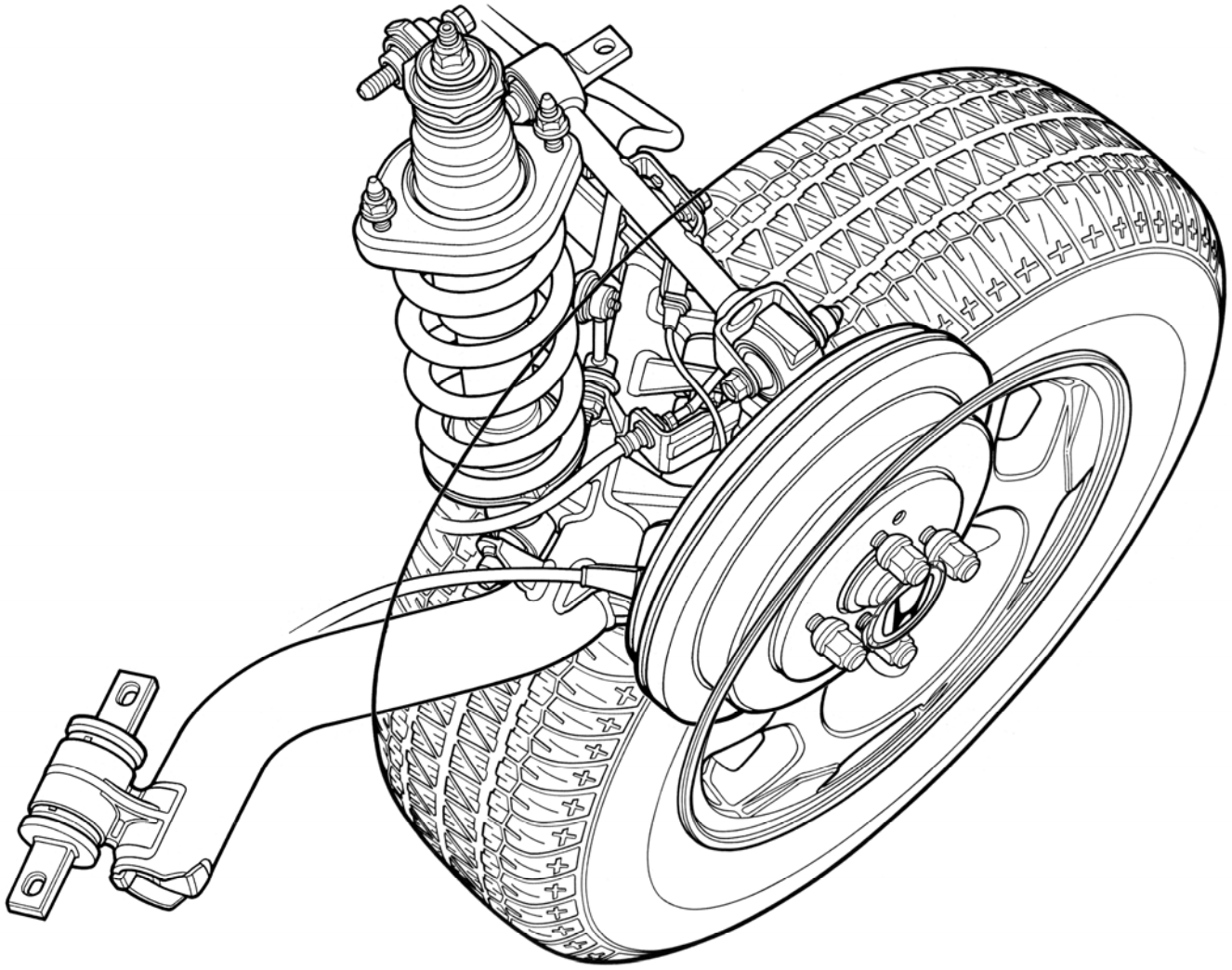
The Civic Hybrid uses a special performance rod, located in front of the steering box, for increased steering assembly rigidity. A control bracket has also been added near the ends of the steering assembly, which further braces the steering assembly. These changes enhance the handling characteristics of the Civic Hybrid, and allow for the vehicle to best utilize the full potential of the newly added Electric Power Steering system (EPS).

Electric Power Steering (EPS)

In place of a hydraulically assisted power steering system found on other Civic models, the Civic Hybrid uses a electrically assisted rack-and-pinion system commonly referred to as EPS, or electric power steering. The system is similar to the type used on the Insight, Civic SiR, S2000 and Acura NSX. The EPS system, which is specially tuned for the Civic Hybrid, has several advantages including simplicity, lighter weight, compactness and greater efficiency due to the system's low power consumption (as compared to a hydraulic system). The system is designed to operate very smoothly and react responsively to driver input. The EPS system is estimated to improve fuel efficiency by 1.8 per cent.

Reactive-Link Double Wishbone Rear Suspension

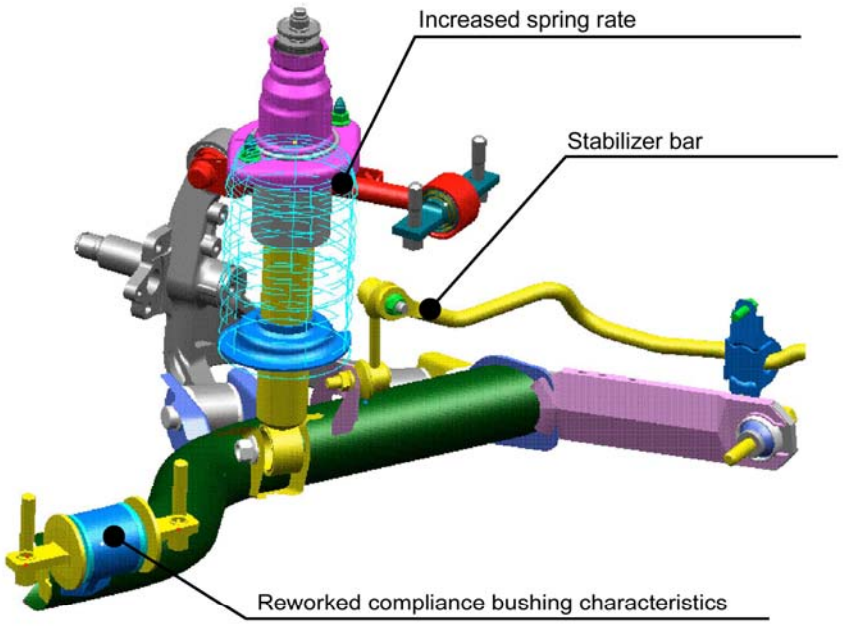
In the rear, the Civic Hybrid is equipped with a reactive-link double wishbone system that helps provide a smooth ride and crisp, predictable handling. This suspension design allows the back tires to move rearward in order to reduce the shock from the road surface for a smoother, more comfortable ride. The rear suspension provides secure tire-to-ground contact for smooth, stable handling.



Reactive-Link Double Wishbone Rear Suspension

A rear stabilizer bar is used to enhance cornering stability and help provide a smoother ride similar to a luxury sedan. For the Civic Hybrid, spring rates and shock dampening rates have been optimized and the compliance bushings (where the double wishbones attach to the frame) have been enhanced.

Rear reactive-link double wishbone suspension



Low Rolling Resistance Tires

The Civic Hybrid features specially designed P185/70R14 low rolling resistance, all weather tires. These tires account for approximately a 20 per cent reduction in rolling resistance compared to the standard Civic DX sedan.

Anti-Lock Braking System (ABS) with Electronic Brake Distribution (EBD)

The Civic Hybrid comes equipped with 262 mm (10.3 inches) front discs and 220 mm (8.7 inches) rear drums along with standard ABS (Anti-Lock Braking System). As with the 2002 Civic SiR, the Civic Hybrid employs Electronic Brake Distribution (EBD) controlled by the ABS computer (also referred to as the control module).

The ABS system employs four-sensors and three-channels with a speed sensor located at each wheel to send signals to the ABS control module. ABS enhances steering control during hard braking. The EBD system provides enhanced stability by adjusting braking force to the front or the rear of the vehicle depending on passenger (or cargo) positioning. Under braking, the ABS computer with EBD controls the hydraulic pressure to the rear wheels via the oil pressure controlling actuator. With a heavy payload under hard braking, rear braking force is fully engaged. Under light braking or with a light payload, rear brake force engages with less clamping force. The system monitors front and rear wheel speed. When brake force is applied, the computer decides the proper braking distribution based on the difference between the front wheel and rear wheel speeds.

This setup reduces stopping distances by enhancing tire lock limits – especially with a heavy load in the vehicle. When the system detects impending wheel lockup, it first holds, then reduces hydraulic pressure to the affected wheel, letting it regain traction before full braking resumes.

The ABS function is also highly effective on split-friction surfaces in which the wheels on one side of the vehicle have significantly less traction than those on the other side. With this four-

sensor, three-channel system, it apportions braking power to the front wheels independently and to the rear wheels together. This enhances the driver's ability to maintain steering control during hard stops on slick road surfaces.

Fuel Tank

All Civics feature a blow-moulded plastic fuel tank. This design allows for a more complex shape so it can be moulded around other components, optimizing fuel tank capacity. The fuel tank capacity is 50 L – the same as other Civic sedan and coupe models.

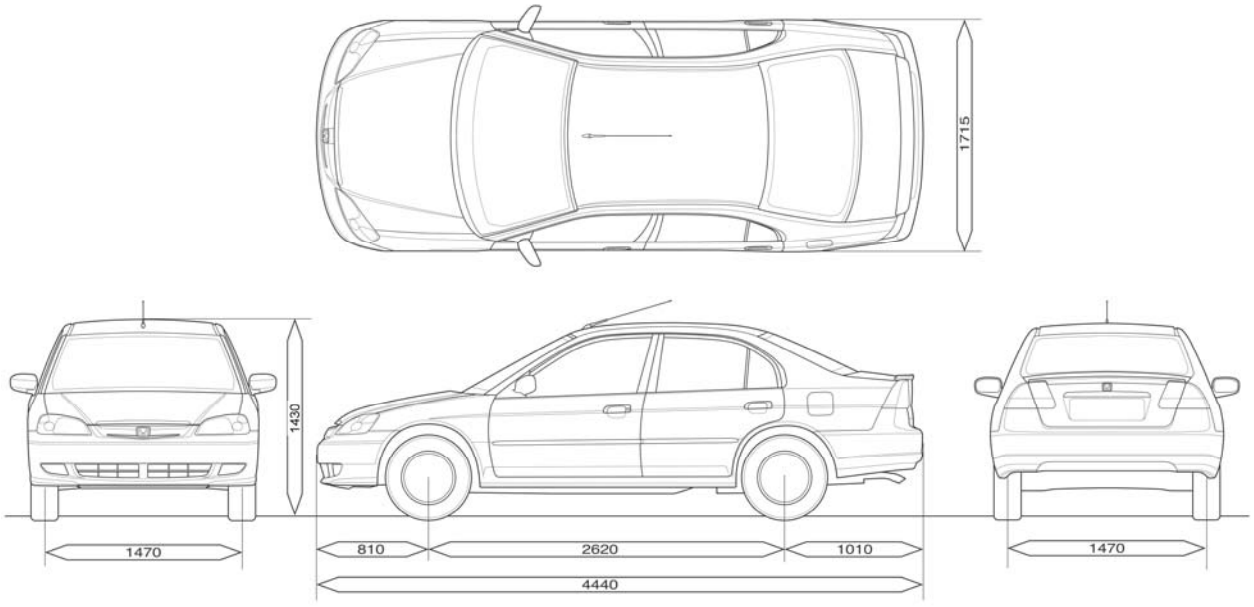
Vehicle Weight and Load Capacities

- The 2003 Civic Hybrid weighs 1,243 kg (2,732 lbs.).
- Weight distribution from front to rear is approximately 58/42.
- Load capacity is 403 kg (888 lbs.).

The Civic Hybrid is not designed to tow trailers. The Civic Hybrid model can be towed behind a recreational vehicle using the same procedures as other Honda Civics.

2003 Honda Civic Hybrid

BODY



Exterior Dimensions (mm)

Overview

The current Civic sedan provides an ideal platform for the first application of hybrid technology to an existing, mass-produced model. It offers high levels of passenger car safety, tight fit and finish, good aerodynamics, a lightweight body and low levels of NVH. The exterior styling concept of the Civic sedan when it was completely redesigned for the 2001 model year, “Solid and Dynamic”, formed the foundation for the Civic Hybrid. Staying true to these roots, the Civic Hybrid goes one step further with a styling theme of “Solid, Dynamic and Sophisticated.” In the quest to achieve this goal, Honda engineers subtly manipulated the body of the familiar Civic sedan for the Hybrid.

While the 2003 Civic Hybrid shares a majority of its body components with the Civic LX sedan, a variety of enhancements have been made to the Hybrid's body for improved aerodynamic performance. The Civic Hybrid provides enhanced aerodynamics, unique badging, and special exterior trim and unique lighting fixtures.

Unique 2003 Civic Hybrid Body Features:

- Aerodynamic enhancements include a refined front bumper, front grille, engine under cover, rear floor side under covers and a trunk spoiler.
- Unique multi-reflector rear combination taillights.
- UV reducing green glass.
- Roof antenna.
- Unique badging including rear Hybrid insignia and a bigger front grille H-mark.
- Lightweight aluminum alloy wheels.
- Exclusive colour option (Fluorite Silver Metallic).

Safety Targets

When the engineers and designers created the current Civic platform, one of their primary objectives was to obtain a 5-star NCAP rating for frontal impact – the highest rating possible. The 2003 Honda Civic Hybrid is expected to meet the same high targets as other Civic models in government and private sector crash testing, including:

- National Highway Traffic and Safety Administration (NHTSA).
  5-star NCAP rating for frontal impact
  4-star SINCAP rating for side impact
- Insurance Institute for Highway Safety (IIHS).
  "Good" IIHS rating for front offset impact (best possible rating)

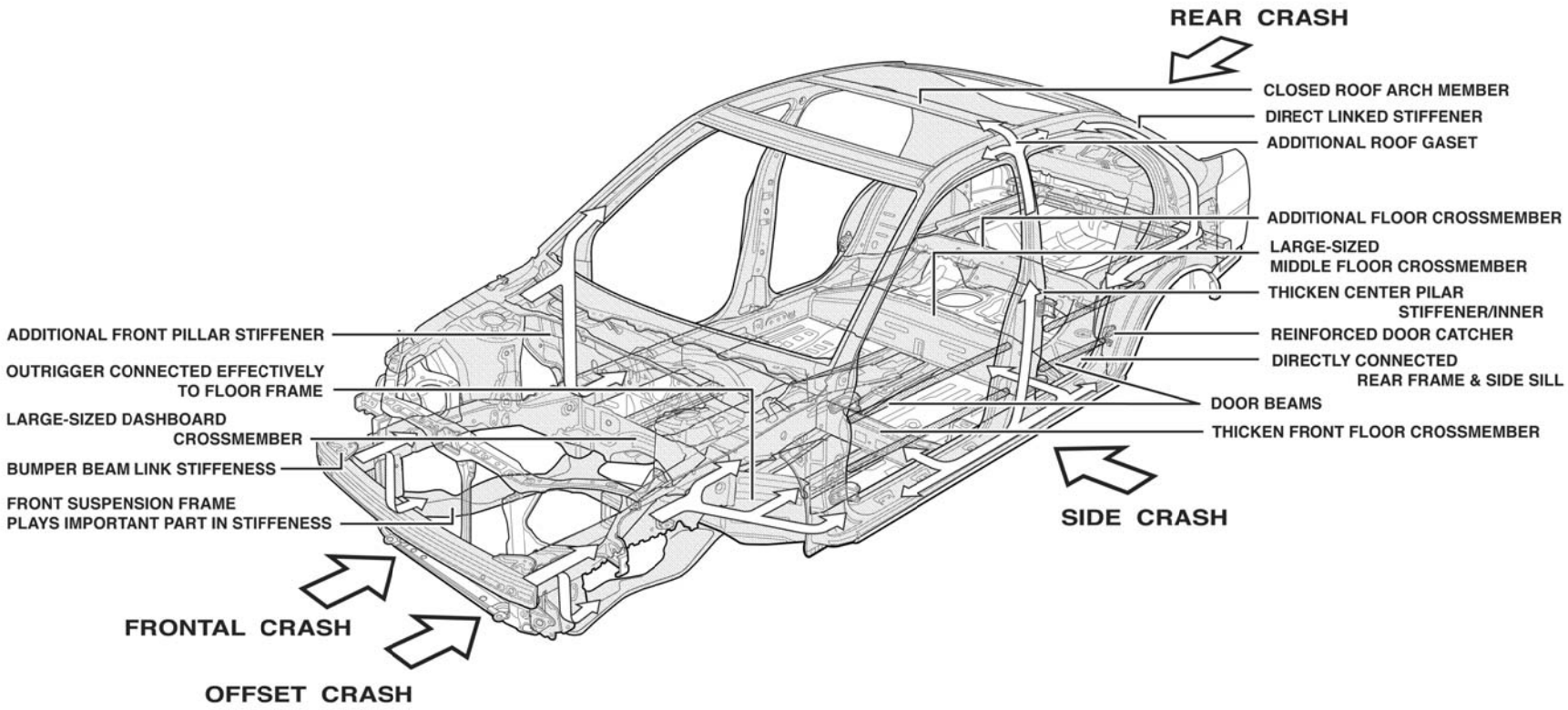
"Smart-Linked" Body Shell

The body of the 2003 Civic Hybrid has been designed to efficiently absorb the energy of an impact as other Civic models. One way this was accomplished was through the use of multi-directional cross members. Together, these cross members create a "smart-linked" body shell for strength and rigidity.

- In a frontal collision, the energy is divided between the parallel side frame and sub-frame.
- For side impact protection, the 2003 Civic Hybrid features a roof gusset and larger high-strength steel cross members.

PASSENGER CELL REINFORCEMENT

- CRASH SAFETY -



Aerodynamic Detailing with Under Floor Covers

The current Civic body styling lends itself well to the Hybrid because it is already aerodynamically efficient. When formulating the seventh generation Civic body concept, designers studied every aspect of the body in an effort to reduce drag and minimize wind noise. This included developing the general shape of the body, refining the front spoiler, adding a rear suspension cover and refining the shape of the door mirrors. The Civic Hybrid integrates several key elements into the Civic's already efficient design to improve aerodynamic efficiency to 0.28 Cd, an improvement of 0.025 Cd, according to Honda's in-house testing.

- The front bumper has a unique one-piece design and it uses an exclusive grille shape (with a larger center grille slat) to direct air more efficiently over the vehicle.
- Underneath, the Civic Hybrid's aerodynamics qualities are enhanced through the use of under-floor covers for the engine and rear-sides that prevent turbulence from forming underneath the vehicle. The covers can be easily removed for service access.
- A rear spoiler has been added to reduce turbulence behind the vehicle.

Use of High-Tensile Steel

Similar to other Civic models, the Civic Hybrid makes extensive use of lightweight and strong high-tensile steel.

- About 50 per cent of the body structure, including the important mid-floor cross members and floor gussets, are made of high-tensile steel.

Tight Tolerances

Honda vehicles have long been synonymous with outstanding fit and finish. This attention to detail is evident in the increased body panel fit accuracy – making significant reductions in the sizes of gaps between body panels and interior components.

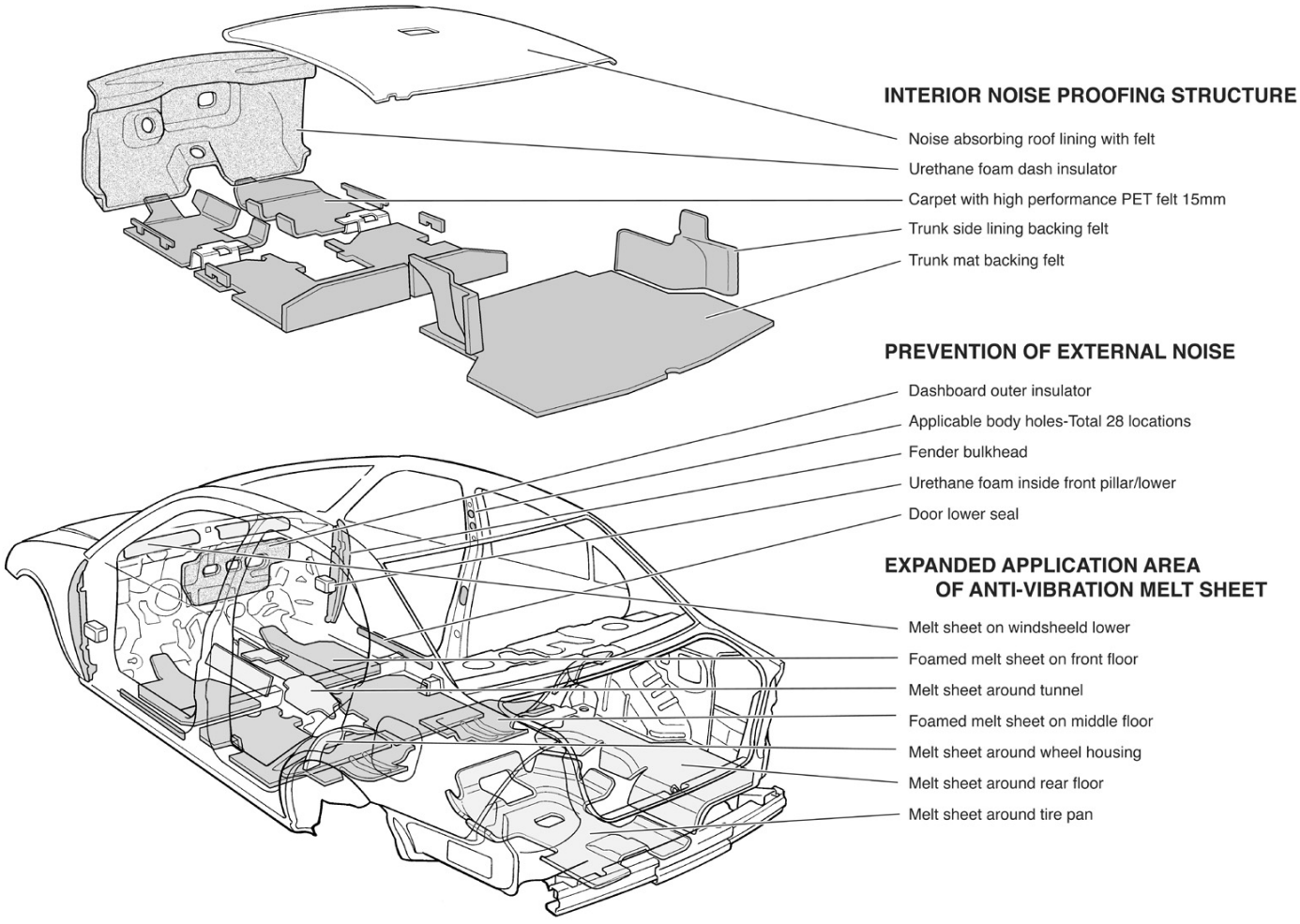
The entire Civic lineup features what is known as a "0" gap standard for the front and rear bumpers, or less than a single millimeter of space. This gives the bumpers a more integrated appearance, yet keeps collision costs to a minimum by isolating various body components so fewer replacement panels are required in the event of an accident.

Noise and Vibration Dampening

Significant effort to reduce interior noise and vibration was put into the current Civic platform. The Civic offers low levels of passenger compartment engine noise during acceleration. This is due in part to the high levels of torsional rigidity the Civic platform provides along with cross braces and high-energy absorption materials. At 100 km/h on flat road, the Civic Hybrid records a low 66 db sound level because of such noise-reduction features as:

- The Civic Hybrid utilizes "melt sheets" on the floor, around the tunnel, and around the tire pan in the trunk. This asphalt insulation material is literally "melted" into place on the floor to ensure a precise fit.
- Rubber-backed floor mat insulators help against road noise.
- A dashboard insulator reduces engine noise.
- Urethane foam is sprayed into the pillars to fill the gaps and reduce noise transmitted to the interior.
- The doors have 2-lipped seals.

OPTIMIZATION OF NVH MATERIAL SPECIFICATION



Multi-Reflector Rear Combination Taillights

The Civic Hybrid comes with special clear red multi-reflector rear taillights. The special lenses and housings, which feature unique turn, stop and backup lights have smoked lenses to convey an upscale and high-tech look consistent with the sophisticated aspect of the design.

High Mount Roof Antenna

The Civic Hybrid has a high mount roof antenna. Its location helps prevent interference that may occur from the advanced electronics in other parts of the vehicle. The antenna is isolated from interference sources and enhances reception. The antenna can pivot 90 degrees on its center mounted roof mount and quickly unscrews for car washes. Non-hybrid Civic sedans and coupes use a rear window glass integrated antenna.

Flat Floor

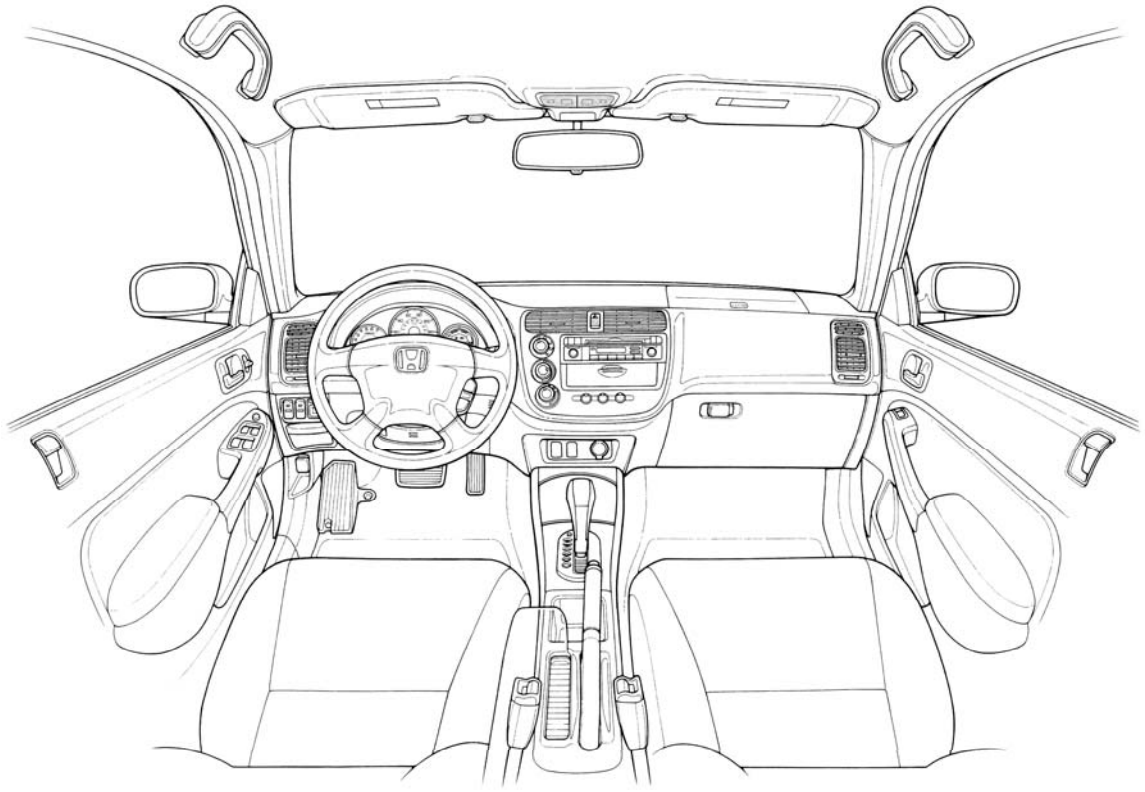
An integral part of all Civic models is its unique flat floor, and the Civic Hybrid retains this feature. The challenge presented by a flat floor is reduced rigidity (because a flat sheet flexes more readily than a formed one). To overcome this tendency, the Civic has a "tunnel side frame" with a large, flat cross section replacing the usual tunnel structure. This improves torsional rigidity and makes the frame stronger.

Available Exterior Colours

The Civic Hybrid is available in Taffeta White, Titanium Metallic or the Hybrid-exclusive Fluorite Silver Metallic.

2003 Honda Civic Hybrid

INTERIOR



Overview

Although the exterior dimensions of the Civic appear compact, the interior of the Civic has earned the reputation as "the biggest small car in history." The Civic Hybrid has a total passenger volume of 2588 L (91.4 cubic-feet) vehicle and a trunk capacity of about 286 L (10.1 cubic feet). Meanwhile, the interior receives a variety of special features that give it an upscale and high-tech feel, consistent with the “sophisticated and refined” design theme. While many high efficiency vehicles offer the minimum in feature content to save weight, the Civic Hybrid is anything but “minimum” on the inside.

Luxury/Safety/Security Features

- Dual stage driver and passenger front Air Bags (SRS).
- Keyless remote entry.
- High Power AM/FM CD player.
- Power, heated side mirrors.
- Cruise control.
- Power windows with driver's auto down feature.

Exclusive Hybrid Interior Features

- Digital and Analog Gauge Cluster with IMA system display and vehicle system performance meters.
- Premium fabrics.
- Fabric front door armrests.
- Two-tone dashboard (black upper dash/tan interior).
- Finely tailored seats with open head restraints (front).
- Silver trimmed center panel around radio and climate controls.
- Chrome appearance trim around gear selector.
- Automatic Climate Control.

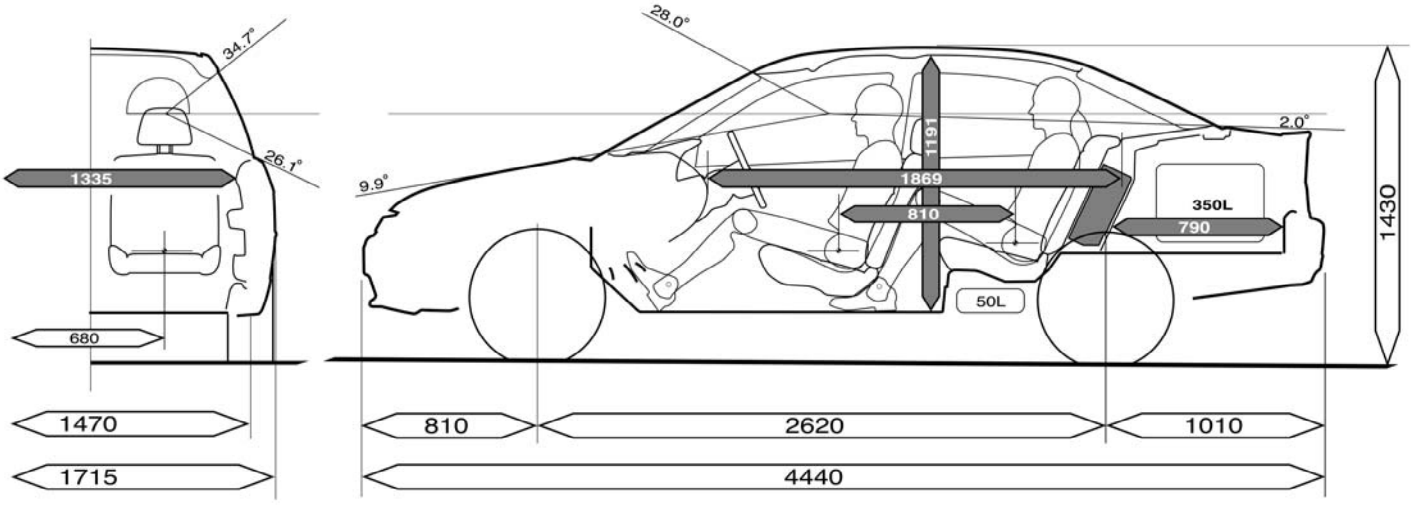
Concepts and Goals

The interior design for the 2003 Civic Hybrid focuses on creating a sophisticated atmosphere with a combination of luxury, modern, and high-tech styling attributes.

- The luxury feel is accomplished through the use of premium fabric seating surfaces along with generous comfort and convenience features.
- An ultra-modern styling theme is conveyed through the use of silver and chrome trim accents.
- The layout and functionality of the instrument panel and gauges conveys a high-tech feel.

Interior Spaciousness

When designing the current generation Civic, the designers and engineers realized that drivers in this category prefer compact exterior dimensions, yet do not want to give up interior spaciousness. When the current Civic was introduced in 2001, designers resolved this dilemma by reducing exterior dimensions while increasing interior volume. One way engineers made the interior of the Civic larger was to push the A-pillar forward. As well, the unique flat floor design creates additional rear seat foot room.



Interior Dimensions (mm)

Front and Rear Seat Features

The luxury-quality seats in the 2003 Civic Hybrid feature a highly stretchable material sewn with a special process resulting in no distinct hair cracks in the stitching. The driver's seat features a side armrest. The head restraints on the front seats feature an open design for comfort and a sporty appearance. The rear seats feature the same high-quality tricot material and sewing process as the front seats. Understandably, the rear seats do not fold down (a standard feature of the conventional sedan and coupe) because the Hybrid's Intelligent Power Unit (IPU) is located between the rear seats and the trunk. All seats have a firm and secure feeling with aggressive bolsters that hold the drivers and passengers in place under cornering.

Interior Trim and Colour Combinations

The Civic Hybrid features a unique two-tone interior with a Graphite Black upper dashboard and a beige lower dashboard with all exterior colours.

Electronic Instrument Display

Since the Civic Hybrid uses a unique powertrain, the vehicle's gauges and readouts are unique. The digital and analog electronic instrument display features the traditional set of meters along with comprehensive IMA readouts. When the ignition is turned off, the meter panel appears blank. When the vehicle is turned on, the gauges are backlit with high-tech blue and the needles glow red. A dimmer switch is located just to the right of the odometer and the gauges automatically adjust to nighttime mode when the lights are turned on.

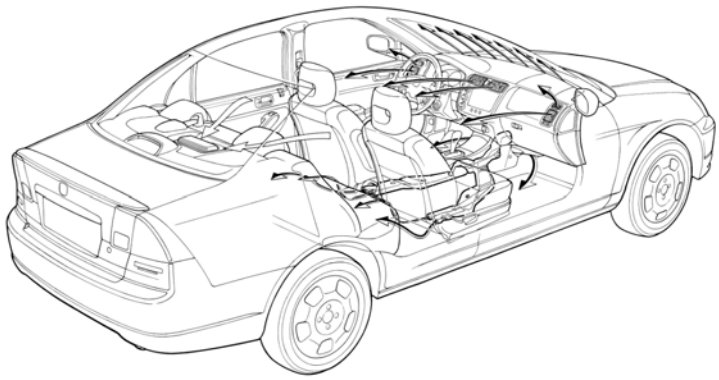
Electronic Instrument Display Features:

The electronic instrument display allows the driver to monitor more than 23 vehicle systems with the following instrument readouts:

- **Speedometer** (analog): Features large numbers.
- **Tachometer** (analog): Features large numbers.
- **Gear Selection Indicator**: Displays selected gear – park, reverse, neutral, drive, second and low mode.
- **Auto Stop**: When the engine turns off automatically using the Idle Stop feature, this light blinks.
- **Miscellaneous Indicator Lights**: Oil pressure, low fuel, SRS, EPS, IMA, parking brake and battery.
- **Odometer with Dual Trip Meters** (digital): Displays vehicle mileage and has two trip meters, marked A and B. Mileage display is controlled by pushing the Select/Reset button located under the speedometer
- **Fuel Economy Estimator –** (digital) Shows numerical estimate of litres per 100km for either trip A or trip B fuel economy.
- **Instantaneous Fuel Economy Meter**: Bar graph meter (with numbers) shows an estimate of real time fuel economy.
- **IMA Charge/Assist Meters** (LCD): Indicates when the IMA battery is being charged or when it is providing electrical power assist.
- **IMA Battery Charge Level** (LCD): Indicates how much power the battery has stored.
- **Fuel Gauge** (LCD).
- **Engine Temperature** (LCD).

Automatic Climate Control

The 2003 Civic Hybrid comes standard with a high-efficiency automatic climate control system that delivers year-round comfort and ease-of-use. Operated by three large, easy-to-use dials and three buttons on the dash, this integrated system delivers good cool-down performance. The system has an “Automatic” mode that varies fan power, air distribution and automatically controls the temperature according to sensor readings inside and outside the vehicle.



Ventilation System

The Economy Mode is integrated into the IMA system so that running the air conditioner has a reduced effect on fuel mileage compared to conventional systems. When Economy Mode is selected, the Idle Stop feature will shut the engine off when the car comes to a full stop for greater fuel economy. When Economy Mode is not selected, the engine remains running during full stops so that the A/C compressor is operational and occupants continue to receive cold air. The 2003 Civic Hybrid includes an integrated dust and pollen air filter for the heating/ventilation/air conditioning system. It is located behind the glovebox for easy servicing.

Audio System

The Civic Hybrid comes with a standard high-power audio system (30 watts x 4 channels) and has an AM/FM/CD unit in the dash. The high quality 4-speaker audio system (standard equipment on Civic LX sedan) has been specifically designed to enhance the acoustic environment of the Civic, giving it deep bass and crisp treble. The radio has a theft protection feature that requires a special code to be entered if battery power is interrupted. Owners are given this code to store in a secret location.

Comfort and Convenience Features, Interior Storage and Beverage Holders

There are two beverage holders in front, which can accommodate up to two 20-ounce plastic bottles. There is a pocket below the radio that can accommodate three CD cases. A convenient lower pocket in the center console is ideal for sunglasses.

Cruise Control

The 2003 Civic Hybrid is equipped with cruise control with controls located on the steering wheel for convenience and safety.

Power Windows

The 2003 Civic Hybrid features power windows with an auto down driver's window. The driver can deactivate the other window switches throughout the car with a central switch located on the driver's door armrest.

Keyless Remote Entry System

The 2003 Civic Hybrid comes standard with a keyless remote entry system. The transmitter features unique codes with non-replication technology, which incorporates a "copy protection system" making it virtually impossible to "clone" the keyless entry code. Every time the owner presses the keyless entry system, it locks or unlocks the doors, then changes to a new, random code. There is one button for locking the doors, another for unlocking the doors and a 'panic' button. Pressing the panic button activates the vehicle's lights and horn in the event of an emergency.

Trunk

The Civic Hybrid's trunk volume is approximately 286 L (10 cubic feet). Due to the location of the Integrated Motor Assist's Intelligent Power Unit (IPU), the Civic Hybrid has a slightly smaller trunk volume than the Civic LX Sedan. Even though the total volume of the trunk has a slightly lower total capacity than the conventional Civic sedan, high levels of functionality remain intact with the capacity to hold four golf bags, or a baby stroller or four 26-inch suitcases.

Flat Floor

The passenger compartment has a flat floor, eliminating the typical tunnel that runs the length of the interior. This is most noticeable in the back seat where the flat floor design provides considerably more foot room – particularly for middle passengers.

NRCan Classification

The Civic Hybrid is classified by Natrual Resources Canada as a Compact Car – the same rating as the conventional Civic sedan.

IMA Cooling Vent

The Intelligent Power Unit (IPU) resides in the trunk. It contains the Integrated Motor Assist electronics and batteries, which do create low levels of heat. In order to cool the system, a vent has been placed in the interior under the rear window to draw in air from the cabin and circulate it through the IPU and into the trunk.

Safety and Security

The 2003 Civic Hybrid is among the safest cars on the road. Anticipated National Highway Traffic Safety Administration (NHTSA) scores should meet five-star standards for frontal crash performance. In addition, the anticipated Insurance Institute for Highway Safety (IIHS) tests are expected to result in “Good” scores – the best possible – for offset frontal impacts.

Dual Pre-Tensioners on the Front Seatbelts

As part of the effort to achieve the five-star safety target, the 2001 Civic was the first compact car in the world to feature dual seatbelt pre-tensioners on both front seatbelts. Typically, a pre-tensioner has been used to pull the shoulder belt tightly in the event of a collision. In addition to the shoulder belt pre-tensioner, an inner buckle lap belt pre-tensioner is used on both front seats. Accordingly, in an accident, both the shoulder portion and the lap portion of the belt are pulled tightly, firmly securing the occupant in the seat.

SRS – Advanced Technology Airbags

The 2003 Civic Hybrid is equipped with a driver's and front passenger's airbag Supplemental Restraint System (SRS). This system has three sensors – including a front sensor, buckle switches to determine if front seatbelts are buckled, and a dual-stage inflator to match the airbag deployment speed with seatbelt use and the severity of the crash.

Dual-Stage Driver and Passenger Front Airbag System

In the event of a moderate to severe frontal collision, the SRS system in the 2003 Civic Hybrid determines the inflation rate depending on the severity of the collision and front seat occupant seatbelt use. When the front seat occupants are wearing their seatbelts during lower-speed collisions, the inflator system is triggered in sequence, resulting in slower overall airbag deployment with less initial force. In other more severe collisions, both inflators operate simultaneously for full, immediate inflation, to correspond with the greater impact force.

LATCH System

All Civic models feature the new LATCH (Lower Anchor and Tethers for CHildren) system so parents may use LATCH-compatible child safety seats. This system combines tether anchor points on the rear window shelf with anchor points located at the seat back/seat bottom contact point for secure mounting of child safety seats.

Flush Mounted Tether Anchors

Child safety seats are increasingly designed to be used with a tether strap. In the past, the tether anchors were bolted on to previous Civics and many other models. On the 2003 Civic Hybrid, these anchors are flush mounted and hidden away. If tether anchors are needed, they are available by flipping up the covers.

Theft Deterrent Measures

Various measures provide theft resistance for the Civic Hybrid (identical to other Civic models).

- The inside door lock knobs are pushed in when the door is locked.
- A plastic cover around the lock area deflects "Slim Jim" type mechanisms from being used to force a door lock.
- The outer door handle, which includes the key cylinder, is securely attached to the door, which makes it more difficult to tamper with.
- Current generation Civic models incorporate a built-in immobilizer system for enhanced theft prevention. The immobilizer system is integrated with the vehicle control unit – if an unauthorized key is used, the system automatically shuts down the electrical system.