

Development of New Model LIFE Incorporating Concept of “Technology with Heart”

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ABSTRACT

The new model Honda LIFE was developed based on the concept of “Technology with Heart.” The aim was to achieve high performance levels in the areas of safety, design, packaging, utility and driving. The engine, transmission and platform are entirely redesigned, making the vehicle more compact, with a resulting 95 mm increase in effective cabin area and increased collision safety performance. The vehicle has a high fuel economy of 19.8 km/L in Japanese 10-15 mode, and is certified as an Ultra Low Emission Vehicle (ULEV). The superior aerodynamic characteristics of the vehicle’s exterior provide a high level of driving stability and NV performance. With its front-to-rear walk-through seating arrangement, a multi-information display and a variety of other distinctive features, the new LIFE is a next-generation small car offering a high degree of utility and driving pleasure.

1. Introduction

Honda’s mini-compact car history commenced in 1966 with the N360. This was the very beginning of automobile manufacture at Honda, and the philosophy developed centered on safety as the most important consideration. In addition, the company wanted the vehicle to provide a comfortable space for users despite its size, and for it to be fun for anyone to drive. This human-centered approach has been passed down as an unbroken tradition at Honda, and is still very much alive in the company’s current automotive manufacturing operations. 20th century technology enriched our lives, but tended to stress efficiency above all else. The development team behind the new LIFE felt that 21st century technology should be kinder to humans, more in tune with their senses, something that provides everyone using it with a feeling of comfort. In developing the vehicle, the team wanted to ensure the excellent economy, environmental performance and the other benefits that mini-compact cars have traditionally been known for. But, the team also wanted

to make the vehicle more pleasurable to use, a mini-compact that users would drive with pride and abundant feelings of warmth. The exterior of the new LIFE developed on this basis is shown in Fig. 1.



Fig. 1 Exterior view of LIFE

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2. Concept and Development Goals

The development concept for the new LIFE is “Technology with Heart.” This means not merely attempting to achieve physical efficiency to increase the number of functions or the level of performance, but rather to apply technologies on the basis of empathetic thinking, seeking to help users gain a sense of genuine satisfaction. The team believed that applying this perspective to the development process would enable them to produce a small car suited to the future - one that would emotionally effect users, to afford a sense of intimacy and which would be loved by all users.

The following themes and objectives were put in place to do this:

- (1) Safety: Safety technologies which are effective in vehicle-to-vehicle collisions, to enable users to feel the vehicle is designed with safety in mind.
- (2) Design: A design that expresses the functionality of the vehicle with beauty, to generate excitement and have an emotional resonance
- (3) Packaging: Packaging which is efficient, but also user-friendly
- (4) Utility: Utility designed from the user’s perspective and focusing on even the smallest details
- (5) Driving: Design of a new power train to provide a level of driving performance combining environmental friendliness with driving pleasure

3. Package Layout

3.1. Long Room Package

A long room package was selected for the new LIFE to provide the “total comfort cabin,” one that not only enables users to feel the sense of comfort and well-being associated with a more spacious cabin, but one that is also beautiful to the eye, easy to use, and easier to drive. The total height of this long room package is reduced to help driving stability, and this also reduces aerodynamic resistance, thereby contributing to increased fuel economy. Working within the standard dimensions for a mini-compact car, the space required for mechanical devices is reduced to increase space available to users. A variety of measures, including the use of a newly developed 60 mm shorter engine, enable the total engine room to be shortened by 95 mm. In this way, distance from the accelerator pedal to the tailgate lining increases 95 mm relative to the previous model. Shortening the nose of the vehicle enables the luggage compartment to be lengthened by 15 mm. Use of a newly developed rear suspension system enables a low floor to be employed in the luggage compartment (525 mm above the ground), increasing storage capacity to a volume of 200 L (VDA system).

3.2. Driving Position

To provide a driving position that is comfortable for users of various physiques even if driving for extended periods, we raised the steering shaft angle and positioned the shaft higher to increase the amount of space around the driver’s knees. The upper part of the steering wheel was also brought closer to the driver, to offer both excellent operability and sufficient upper body room. In addition, the accelerator pedal was brought closer to the floor, to help reduce the burden on the driver’s ankle. To allow easy driver ingress and egress and to help with visibility, the hip point was set 580 mm above the ground. The front edge of the side belt line descends

smoothly. A seat height adjuster enables the seat to be raised or lowered 30 mm, which allows drivers to set their eye point to match their height. Triangular windows are used to help reduce the blind spot caused by the front pillar, providing excellent visibility in all directions, front and rear, left and right, and diagonally.

4. Engine

4.1. Engine Development Goals

The following are the four development targets established for the new engine to produce a compact vehicle that consumes little energy and is kinder to people and the environment:

- (1) Improved environmental performance (Increased fuel efficiency and compliance with ultra-low emissions standards)
- (2) Significantly improved torque in the practical use range
- (3) Reduced weight and compact size
- (4) Reduced noise and vibration

4.2. Engine Overview and Specifications

4.2.1. Overview

Engines of mini-compact cars are frequently subject to high loads in actual use. The new engine is therefore designed with the following characteristics:

- (1) Reduced friction at high engine speeds by means of short stroke
- (2) Increased valve diameter and reduced pumping loss by employing a big bore
- (3) High compression ratio achieved by use of two valves and two spark plugs

Table 1 shows the main engine specifications, and Fig. 2 shows an external view of the engine. The use of a bore/stroke ratio of 0.78 and a low piston speed (average = 12.4 m/sec at engine speeds generating the highest power) reduces friction at high speeds, while the employment of two large-diameter valves controls increases in pumping loss. The compression ratio is set at 11.2 in the NA model, the highest level for a regular gasoline engine.

Table 1 Engine specifications

Engine	NA model	Turbo model
Cylinder configuration	In-line 3-cylinder	In-line 3-cylinder
Bore × stroke (mm)	71 × 55.4	71 × 55.4
Displacement (cm ³)	658	658
Compression ratio	11.2	8.5
Valve train	SOHC 2valves	SOHC 2valves
Number of valves	2 per cylinder	2 per cylinder
Valve diam. Inlet (mm)	35	35
Exhaust	30	30
Fuel supply system	Programmed fuel injection	Programmed fuel injection
Ignition system	Dual point sequential ignition	Dual point sequential ignition
Max. power (kW/rpm)	38/6 700	47/6 700
Max. torque (N·m/rpm)	61/3 800	93/3 800

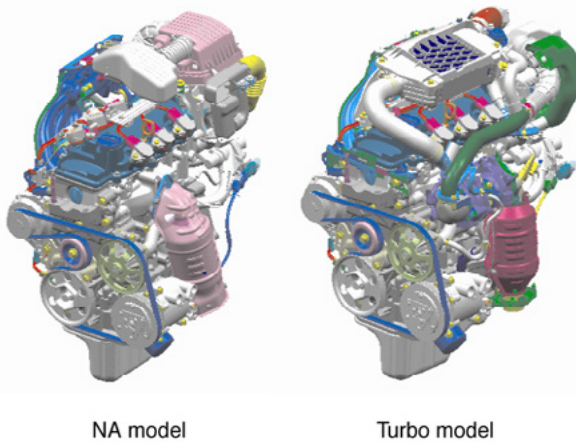


Fig. 2 Engine models

4.2.2. Reducing weight and increasing compactness

The angle of mounting of the engine is changed from a forward inclination of 60 deg in the previous model to 5 deg in the new LIFE; together with direct mounting of the auxiliary equipment on the cylinder block and the direct mounting of a catalyzer (NA model) or a turbocharger (turbo model) underneath the cylinder head which is integrated with the exhaust manifold. These changes reduce engine room by 95 mm relative to the previous model, increasing the compactness of the vehicle. Optimization of the crankshaft, the shape of the area around the cylinder block and the overall layout, together with the employment of a resin intake manifold, cylinder head cover, oil strainer and oil level gauge, enable the mass of the engine to be reduced by 9%.

4.3. Engine Performance

4.3.1. Fuel economy

The stoichiometric air-fuel ratio employed in the new engine has reduced BSFC by 7%. In addition to using a short stroke to reduce friction at high engine speeds, a variety of other friction reduction methods are employed in the new engine. The diameters of the roller follower and the crank journals have been reduced in size and OW-20 low-viscosity engine oil is employed. A variety of features found in the Civic Hybrid are also used – plateau honing, an offset cylinder structure, an ion plated piston ring, burring of the main metal and conrod metal, and molybdenum disulfide shot peening of the piston skirts.

4.3.2. Power

Figure 3 shows engine performance curves. The maximum torque of the new engine is identical to that of the previous model, but it displays an average increase in torque of 7% up to 4 000 rpm. Both engines have the same practical power characteristic, producing maximum power at the low engine speed of 500 rpm. The superior knocking performance of the engine has been exploited to enable turbocharging from a lower speed in the turbo engine, ensuring smooth acceleration performance.

4.3.3. Emission reduction technology

The main emission reduction technologies employed in the new engine are discussed below. The turbo model is the first turbocharged engine to achieve compliance with ultra-low emissions standards.

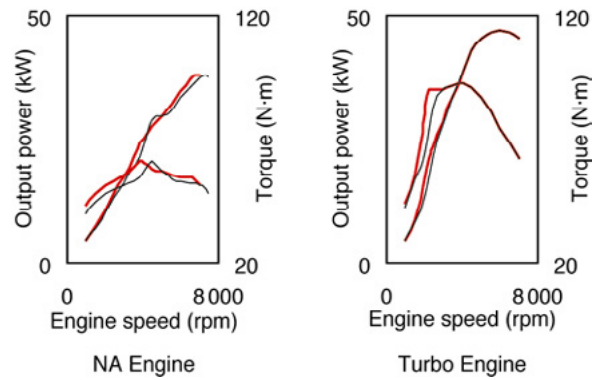


Fig. 3 Engine performance

- (1) Highly accurate air-fuel ratio control
 - The positioning of an A/F sensor in front of the catalyzer and an O₂ sensor downstream from the catalyzer enables highly accurate air-fuel ratio control.
 - The positioning of a multi-hole fuel injector in the cylinder head port reduces the delay in providing fuel.
- (2) Rapid heating of catalyzer
 - Integration of the cylinder head with the exhaust manifold
 - Positioning of the catalyzer directly underneath the engine
 - Direct mounting of the turbocharger on the cylinder head (turbo model)
- (3) Application of stoichiometric air-fuel ratio control directly after cold start is enabled by stabilization of combustion
- (4) Control of delay angle at large ignition timing for early activation of catalyst

4.3.4. Technologies to improve engine NV performance

A lower block structure is employed in the cylinder block to increase quietness and to reduce the amount of noise and

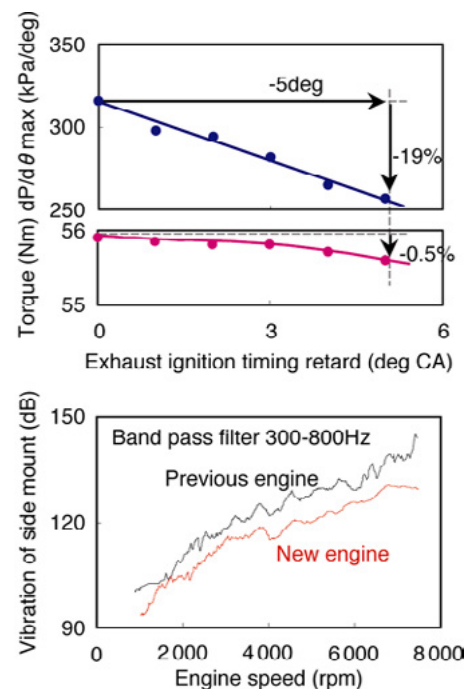


Fig. 4 Vibration level of new engine

vibration produced by rapid combustion. Each journal is integrated with the outer wall of the lower block, and its curvature and the placement of ribs are optimized, resulting in a 38% increase in the rigidity of the journals. In addition, the structure employed eliminates the need for reinforcement to ensure coupling rigidity between the engine and the transmission. The use of a short stroke enables the overlap in the diameters of the crankshaft journals and pins to be increased, ensuring a highly rigid structure effective for reducing knocking noise. Vibration is suppressed by the use of a full balance weight. Phased ignition control between the two spark plugs effectively reduces crank knocking noise. The use of a 5 deg delay angle when sparking on the exhaust side reduces (dP/dθ) max by 19% and externally transmitted engine noise by 17% relative to simultaneous sparking, while maintaining engine torque at virtually the same level. The increased rigidity of the engine framework and the phased ignition control discussed above reduce mid-frequency vibrations at the engine mounts by 5-10 dB as shown in Fig. 4.

5. Transmission

To enable the development concept established for the new LIFE to be realized, the transmission had to be made compact, contribute to improved fuel economy, and to offer a commercial appeal beyond the vehicle's class. While the previous model employed a hydraulically controlled 3-speed AT, the new LIFE employs a newly developed electronically controlled 4-speed AT provided with a lockup mechanism.

5.1. Compact Structure

To help achieve a reasonably safe level of collision safety performance while increasing cabin space, a parallel three-shaft layout has been adopted for the new 4AT, shown in

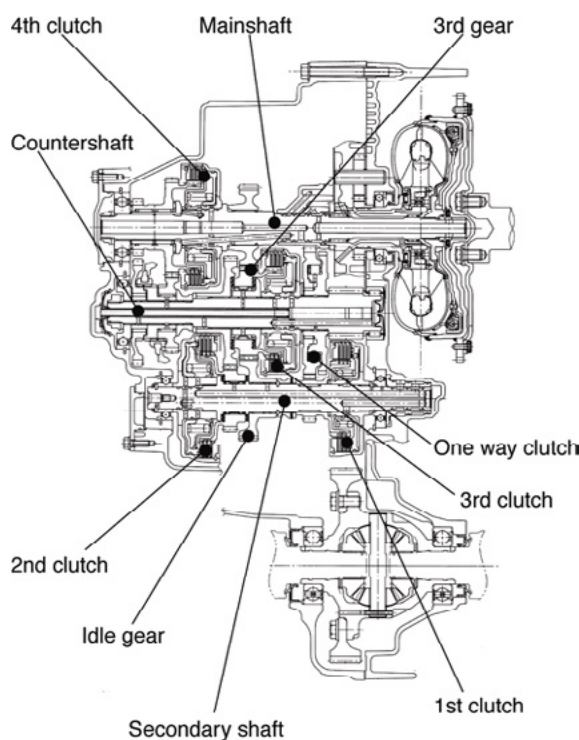


Fig. 5 Cross-section view of new 4AT

cross-section in Fig. 5. The third gears and the idle gears are common, reducing the total and longitudinal length of the transmission.

In order to avoid any increase in length despite the addition of a lockup clutch, a new highly efficient torque converter has been developed, which maintains the same high torque ratio as a conventional 3AT but has a flow channel flatness ratio (torus cross-section) of 81%. As a result, despite using a 4AT with a lockup clutch, the total length of the unit is 13 mm shorter than the previous 3AT. The vehicle is also made more compact in the longitudinal direction thanks to a layout in which the differential shaft is located towards the bottom of the engine, as shown in Fig. 6.

5.2. Technologies for Improved Fuel Economy

Because the absolute value of engine torque is low in mini-compact cars, the ratio of friction loss, a cause of poor fuel economy, increases. Reducing friction loss was therefore a major focus in developing the new 4AT. A low drag torque-type clutch pack is used at all stages in the clutch to reduce drag torque. The shape of the grooves in the friction materials of the friction plate was studied, and redeveloped to enable lubricating oil to flow away more easily. Various measures, including the optimizing of lubrication specifications, are adopted to reduce oil pump driving loss and agitation resistance in the differential. As a result, while the shift

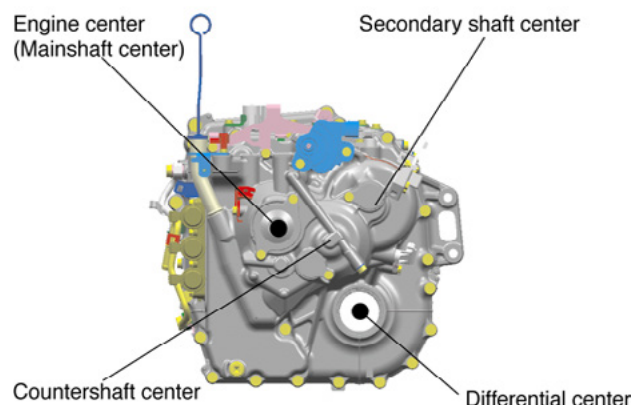


Fig. 6 Side view of new 4AT

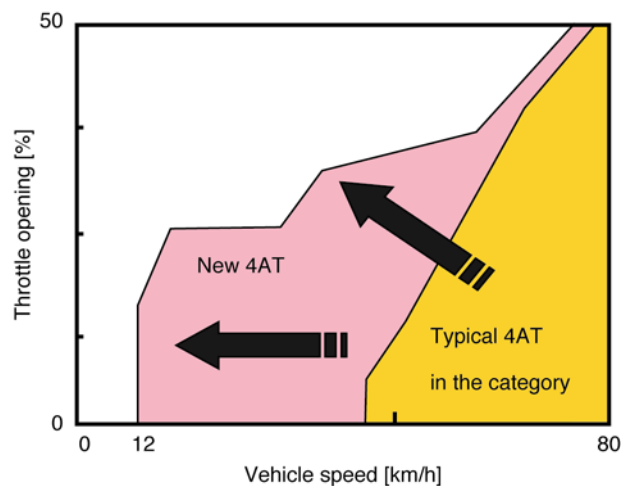


Fig. 7 Comparison of lock-up control area

stages are increased, the new 4AT has the same level of friction as the previous 3AT. A lock-up clutch is employed to both increase fuel economy and ensure drivability. The use of the Active Lock-up II system, which is provided with a lock-up clutch and which uses a linear solenoid for control in all vehicle variations, enables lock-up from 2nd to 4th gears, including shift transitions. In this system, the lockup clutch uses a long torsion damper to attenuate variations in torque from the engine. A linear solenoid provides highly accurate oil pressure control, enabling more precise feedback control in the transient area. As Fig. 7 shows, these measures enable lockup from 12 km/h in 2nd gear, significantly expanding the lockup range when the vehicle is cruising and accelerating.

5.3. Commercial Appeal Beyond the Vehicle's Class

5.3.1. Shift

Direct control of clutch pressure by means of a linear solenoid that uses a control logic normally employed in high-class vehicles is used in the new LIFE to achieve a smooth and highly responsive shift feeling. The structure of the clutch enables centrifugal hydraulic cancellation from 2nd to 4th gears, improving the accuracy of clutch hydraulic control and realizing a smooth shift feeling with excellent stability of quality.

5.3.2. Climbing and descending slopes

To respond to the load generated by climbing or descending a slope, PROSMATEC (PROgressive Shift schedule MANagement TEchnology) is used in all variations to enable optimal selection of the shift stage from 2nd to 4th gears. This eliminates unnecessary shifting when climbing or descending and enables optimal control of the engine brake when descending, thereby increasing drivability.

5.3.3. NV performance

The idle gears are positioned in the center of the shafts, controlling the effect of the misalignment of meshing generated by changes in input load. Together with new settings for the mesh ratio of the gears, this contributes to the quietness of the vehicle.

6. Suspension

In addition to focusing on excellent city driving performance as an aspect of the basic performance of the vehicle, the development team became convinced (by repeated driving tests in Europe, where the driving environment is tougher than Japan's) that ready high-speed driving performance also is important. The following performance improvements were therefore required:

- (1) Stable high-speed running and solid steering close to neutral
- (2) Linear and confident responsiveness up to high speeds
- (3) Suspension with a great deal of give to absorb the tossing of the vehicle when driving on roads with large undulations and a matching body, to ensure a flat, smooth ride in which passengers are not shaken around excessively and do not experience high Gs
- (4) Smooth response to steering input and reliable transmission of road surface information to the driver when the steering wheel is turned

To help ensure rigidity and precision in the mounts of the front suspension, a Macpherson strut provided with a high-rigidity L-shaped lower arm connected to the subframe is

adopted. A compact new H-beam is redesigned for the 2WD rear suspension. There are no variations in the scuff. The difference between left and right in the jack up position is reduced to zero. The wheel base is increased by 60 mm, but an increased tire angle ensures that the turning radius of the vehicle is unchanged from the previous model, at 4.5 m (Fig. 8). The EPS system is redesigned to achieve a more natural steer feel, and employs a CPU with approximately three times the power of the previous model to provide more subtle assist settings (Fig. 9).

6.1. Brakes

The pedal ratio and the brake master power characteristic are optimized to help produce a stable brake feeling and to provide a solid pedal feel and a brake response in line with the amount of pressure put on the pedal. A wheel geometry is employed whereby, when braking during a turn, the front TOE points outside the turn for both the inner and outer wheels. This helps prevent the vehicle from being oversteered in a turn, and helps allow the vehicle to stop stably. Brake assist enables a higher braking force to be generated. To help prevent the tires from locking and to assist the stability and maneuverability of the vehicle, electronic brake-force distribution (EBD) is employed in the ABS throughout the vehicle, enabling optimal distribution of braking force between the front and rear wheels and enabling the vehicle to make maximum use of braking force. The use of ABS throughout reduces unpleasant braking noise and

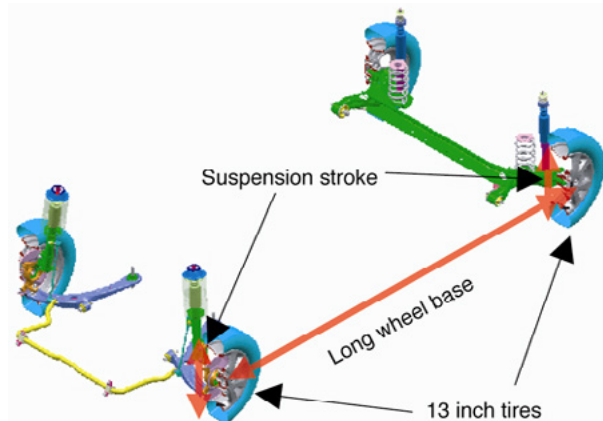


Fig. 8 New suspension system

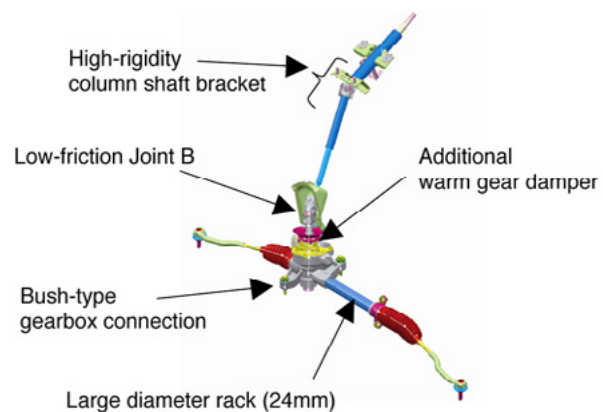


Fig. 9 New EPS system

vibration to the maximum extent, so the vehicle is more comfortable for users even in situations in which the brakes are applied frequently. To allow a front-rear and side walk-through layout, the parking brake has been changed from the former hand brake to a foot-operated type. The height and position of the pedal have been optimized, and the required force and stroke are set to allow comfortable operation by female users. The amount of sound generated by operation and release of the ratchet has also been reduced.

7. Body/Fittings/Electrical System

7.1. Body Framework

To enable a long frame package to be employed and to provide excellent stability, fuel economy and running performance, the vehicle was redesigned from the platform. As Fig. 10 shows, higher strength 780/980 MPa grade high tensile strength steel has been employed in the new vehicle. Including the 440/590 MPa grade materials that were carried over from the former model, the ratio of high tensile strength steel is 32% of the mass of the body-in-white, and 71% if looking only at framework components. Appropriate use of high tensile strength steel and soft steel with consideration of the purpose of the relevant part has helped in achieving a high level of collision safety performance while reducing the weight of the vehicle.

7.2. Body Rigidity

A bulkhead has been added to the tailgate opening and stiffeners have been used in the suspension system mounts in order to achieve excellent steering stability and NVH performance. In terms of static rigidity, this has resulted in improvements of 55% in bending rigidity and 16% in twisting rigidity against the previous model. From the perspective of dynamic rigidity, a significant improvement of 11 Hz has been achieved in both front goose-necking and rear twisting.

7.3. Door

To allow for a variety of conditions of use, the degree of opening of both the front and rear doors is increased, and they can lock in three separate positions. Because the rear

door is often used to stow large parcels or bags in the vehicle, the angle of opening is increased to 79°. The multi-angle door handles are not only a design accent, but ensure that the handles function at the various angles they can be gripped from, increasing ease of use. A new door lock is employed to reduce the sound when the door is closed, resulting in a high-class, refined sound with reduced high-frequency components.

7.4. Collision Safety Performance

Compatibility improvement technology⁽¹⁾, developed as a result of research on car-to-car crashes⁽²⁾, is employed in the body framework of the new LIFE (Fig. 11). A pretensioner is also used for both the lap belt and the shoulder belt at the driver's seat. This helps assist the vehicle in achieving the established collision safety performance target in a 50% offset collision with a vehicle of up to two tons when both vehicles are traveling at 50 km/h. The vehicle also performs well in a frontal full-wrap collision at 55 km/h and a frontal offset collision at 64 km/h. Together with measures helping the vehicle perform well in a side collision of 55 km/h and a rear collision of 50 km/h, this enables the vehicle to achieve a level of collision safety performance at the top of the mini-compact class. The body, incorporating these compatibility measures, is able to disperse impact and help absorb the

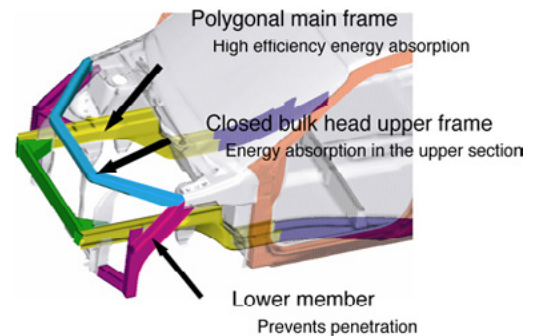


Fig. 11 Layout of new body structure

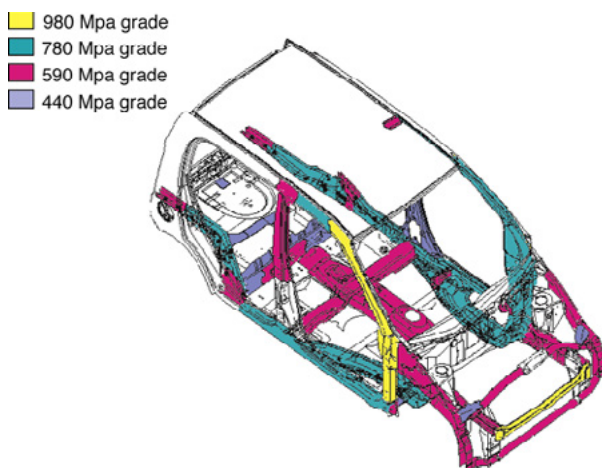


Fig. 10 Area of application of high tensile strength steel



Fig. 12 Car-to-car crash test

energy of a collision. Not only is damage to the vehicle itself reduced, but also the effect of the collision on the other vehicle is reduced. Inside the cabin, head protecting interiors in the side of the roof and the pillars help reduce potential injuries to passengers. Pedestrians have also been considered, as the body includes features to help reduce injuries to pedestrians in the event of a collision. The front of the body has a structure enabling it to soften in a collision, to help reduce the degree of injury to a pedestrian's head and legs. Figure 12 shows a car-to-car crash test.

7.5. Improved Noise and Vibration Performance

Making the cabin quiet during driving was an indispensable element in realizing the development concept, which stressed achieving a level of comfort that exceeds expectations for a mini-compact vehicle. Noise and vibration were reduced at the source with the newly designed engine and transmission discussed above. Simultaneous with the additional car-to-car collision measures, the body features gains from the commercial appeal of improved noise and vibration performance. The change to an H-beam in the rear suspension reduces the road noise caused by vibration permeating from the suspension. The use of a new platform specifically designed for a mini-compact vehicle enables the achievement of a level of noise and vibration in which there is a balance between input and response, improving quietness to the level normally associated with the small car class.

An inertial main axis mount system, which provides support at three points, is positioned to wrap around the center of gravity of the power plant. This increases the support rigidity of the engine as compared with the previous model (despite the smaller engine room) and reduces the vibration. Hydraulic envelope mounts are used for the side engine mounts. Side and transmission mount brackets are constructed of high-rigidity aluminum materials to increase passenger comfort, reduce the transmission of vibration to the body, and lower weight. Increased rigidity in the subframe and the body, including the power plant and underbody mounts, significantly reduces input from the body (Fig. 13). A lightweight but highly effective asphalt vibration damping

material is used for soundproofing on the surface of the floor panel. The material has the added benefit of reducing the weight by 40%. Optimum deployment and placement of vibration damping, soundproofing and sound absorbing materials, including the use of a high-performance urethane sound-proofing material in the dashboard, and a sound absorbent roof lining, increases cabin quietness in the high-frequency range. (Fig .14)

7.6. Fittings

7.6.1. Interior

Color coordination of the interior fittings is employed to make the cabin bright, unique, and to display a high quality. A two-tone effect is achieved by coordinating the color of the coating on the instrument panel and the skin on the doors with the bright beige used on the seats. Metallic accents are used on the operating equipment, producing a bright but high-quality impression. The employment of plastic of a single color and finish without surface treatment for all the interior fittings further increases the sense of quality. The plastic materials and skins are redesigned to achieve a high-quality gloss. In addition, a texturing surface treatment for the metal surfaces and a new maintenance method are developed.

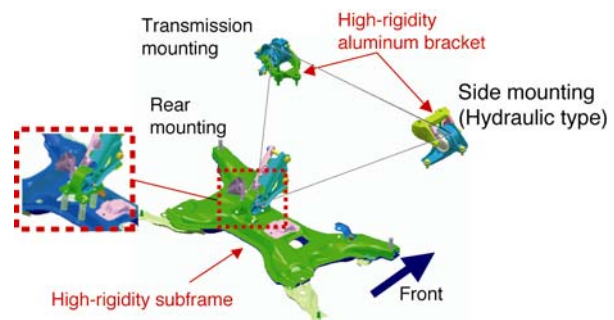


Fig. 13 Engine mounting system

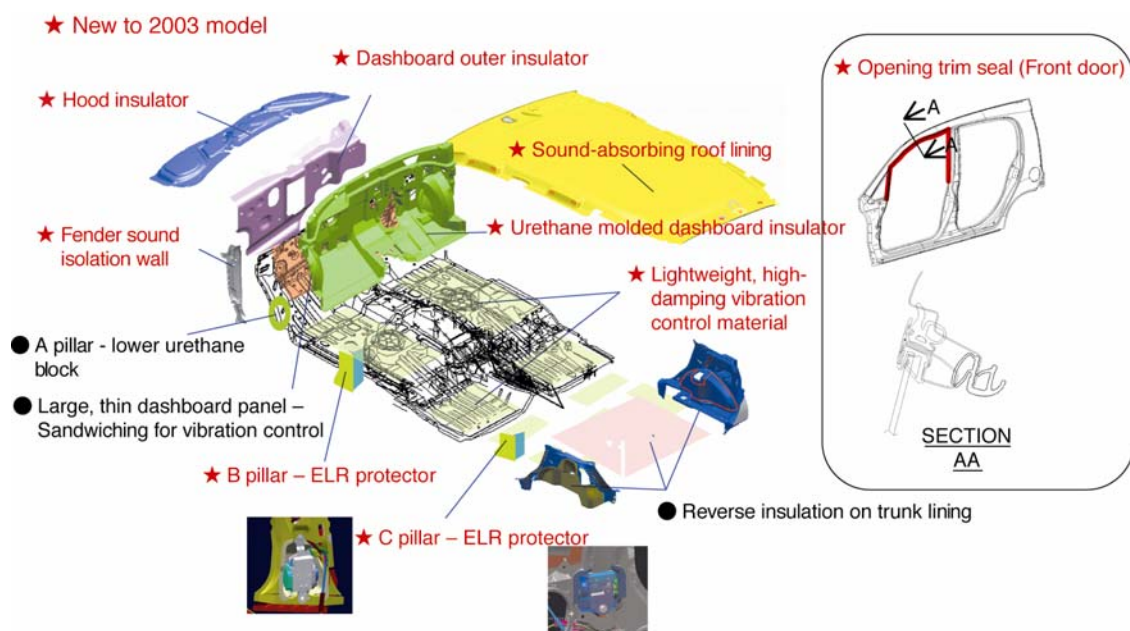


Fig. 14 Packaging employs high-efficiency soundproofing (Sound- and vibration-absorbing)

7.6.2. Instrument panel/Passenger seat airbag

Join lines and seams between the components on the instrument panel are eliminated and the components are arranged in a stepped layout both to produce quality and to increase ease of use. The lid of the passenger seat front airbag is integrated with the panel, and the opening is formed from behind with a laser to make it invisible and seamless. This has also contributed to the production of a well-constructed instrument panel with an integrated color scheme and finish. A large tray is used to increase ease of use. There is a divider between the upper box and the inside of the tray, and sufficient storage space is ensured for items like ticket holders, etc.

7.6.3. Seats

The seats are redesigned to make them more user-friendly - both relaxing and enveloping and to help provide safety for the occupant. The size of the seats is increased over the previous model, and the urethane along with the other materials used in the skin are improved to produce a soft and comfortable surface capable of distributing pressure while also maintaining a firm grip on the occupant. Convenience is further increased by using tip-up and long slide seat adjustment mechanisms in the F-grade passenger seats to enable side and front-rear walkthrough accessibility (Fig. 15).

7.7. Air-conditioner

The target for the air-conditioner was to achieve improved performance while reducing operating noise and energy consumption, and to produce extremely easy-to-use controls on the instrument panel. The performance of the unit itself remains equivalent to the previous model, but resistance to the air flow is dramatically reduced, resulting in a 10% decrease in operating noise and a 10% increase in the volume of air. To reduce energy consumption, the compressor is redesigned; a resulting 20% increase in cycle efficiency contributed to improved fuel economy. The panel, designed for ease of use, features three continuous dials for normal operation, making it possible to make fine adjustments - four stages are available for FAN SW, for example. Full auto air-conditioning is available as an option, and features a large dial for adjusting temperature and a large liquid crystal display to make it even easier to use.

7.8. Multi-information Display

Because it is important to help reduce anxiety in driving situations, a new multi-information display is being provided in the new LIFE. The display features a full-dot liquid crystal screen and offers the freedom to choose display content in order to be able to offer drivers more vehicle data (Fig. 16).

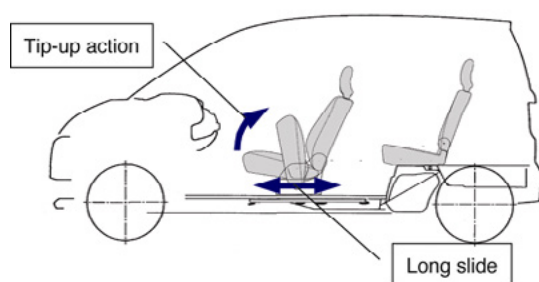


Fig. 15 Seat mechanism for walk-through

The vehicle employs newly developed engine and transmission ECUs, EPS ECU, integrated units, etc. The port output and analog output of each unit was developed from the outset by considering the provision of data to the meter displays. Figure 17 shows examples of displays available on the meters.

(1) Standard screen

During normal driving, the driver can easily select between three screens with the push of a button: one shows an odometer, a trip meter and outside air temperature, another moment-by-moment fuel consumption and average fuel consumption, and the third a tachometer. To help achieve a higher level of safety performance, the fuel meter is accessible from any of the screens. On the fuel consumption

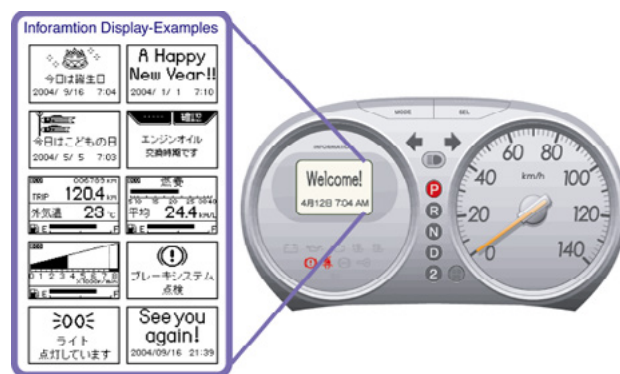


Fig. 16 Information display in instrument panel

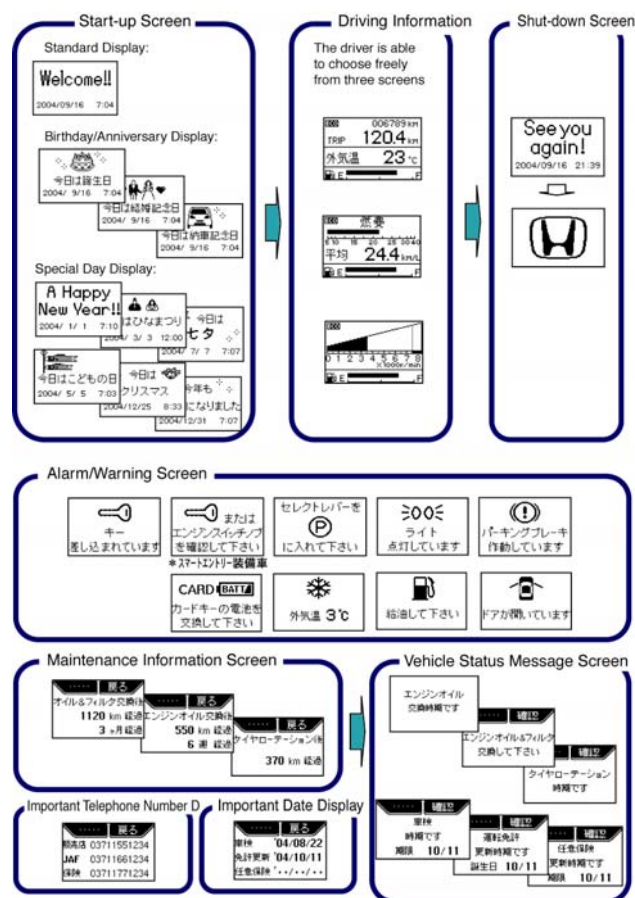


Fig. 17 Functional display

screen, a display of moment-by-moment fuel consumption makes it easier for the driver to be aware of changes in fuel consumption under different driving conditions. This information is displayed as a bar graph to make it easier to read while driving.

Average fuel consumption is numerically displayed, and, to increase convenience, the display is linked to the trip meter, enabling the driver to easily understand the correlation between the displayed average fuel consumption and the fuel consumption, which can be determined by dividing the distance traveled by the amount of fuel consumed before the tank is filled again. Outside air temperature is directly linked to driving conditions, as for example in situations in which ice forms on road surfaces during winter. An external air temperature sensor has therefore been employed (in models with manual air-conditioning), and a picture of a snowflake and a warning appears on the display when the temperature drops below 3 °C.

(2) Warning screens (Linked to sounding of an alarm)

If certain conditions occur during vehicle operation, an alarm sounds, and in five seconds the display changes from the standard screen to a warning screen. These screens show the driver the location of the condition in easy-to-understand pictures and text (Fig. 17). Driving with a door not properly closed or with a seat belt unbuckled will also cause warning screens to be displayed.

Because the parking brake is operated by foot, it is harder for the driver to see whether it is on or not. If the vehicle commences motion with the parking brake on, an alarm will sound and a warning screen will be displayed when the speed goes above 7 km/h. In addition, if the key has been removed and the lights are left on, an alarm will sound and the standard screens will be displayed despite the fact that ignition is off.

(3) Maintenance information

A screen informing the driver of the need for maintenance is displayed as the vehicle approaches the time for its periodic oil changes or tire rotations, enabling the driver to use the vehicle over the long-term with confidence. The requirement for an oil change is estimated from the elapsed time and number of kilometers driven, while the need for tire rotation is calculated from the distance traveled. A screen is also available which shows the number of days and the distance traveled since the last maintenance, enabling the user to check it as required.

(4) User data/Vehicle-related data

Another screen enables the user to easily input information such as the telephone numbers of the dealer, JAF (equivalent to AAA in the United States) and his or her insurance company, enabling the user to access it as needed. The user can also input dates like his or her birthday, his or her driver's license renewal date, and vehicle inspection validity periods. An information screen will be displayed on or shortly prior to each date.

7.9. Honda Smart Card Key System

To increase convenience for users, the new LIFE features key-free operation. Doors can be locked and unlocked and the vehicle started with a thin card key. The card key also has an immobilizer function to prevent car theft. When the user with a card key approaches the car (around 80 cm), the doors unlock and the vehicle can be started by simply turning the key knob if the card is in the vehicle. The doors will lock automatically when the user gets out of the vehicle, closes the door and walks away. All the doors and the tailgate can detect

the presence of the card key, a feature added to increase convenience for users who might be carrying parcels or small children. A new communications system is developed to enable operation in the detection areas with fewer antennas than used in standard card key systems. Antennas are positioned in four places (left and right door mirrors and inside left and right RR bumpers) to increase the detection area and reduce power consumption. Inside the vehicle, two antennas are located in the front and rear, and these will enable ignition if the card key is on any seat. This is convenient for users who may have their card key inside a bag, a briefcase, or a purse that they have placed on the passenger seat or the rear seat.

8. Environmental Performance

8.1. Elimination of PVC from Interior Components

Polyvinyl chloride (PVC) is said to be difficult to recycle. Designers of the new LIFE have succeeded in eliminating its use from the main interior components (Fig. 18).

(1) Thermoplastic olefin (TPO) is employed in the sun visor, run channel and weather strip. The shift knob is thermoplastic urethane (TPU), the seat coverings are fabric, and felt is used as the insulator under the floor carpet. Urethane rather than olefin is employed in the shift knob because of its excellent wear resistance, a particular requirement of materials used in the knob.

8.2. PVC in Exterior Components

New materials have been used in all the moldings (door, window and roof) and the quarter seals in order to eliminate PVC (Fig. 19). The moldings and seals are prone to damage, and the form of TPO used is selected from a variety of others for its toughness, on the basis of a cost-benefit analysis. To increase toughness even further, a multi-layered structure is employed, in which other materials are bonded to the TPO during the extrusion process.

8.3. Reduction in the Use of Lead

The amount of lead employed in the vehicle is reduced dramatically, to one-tenth the level stipulated by 1996 regulations, and the vehicle meets, in advance, the target as stipulated by the 2006 regulations of Japan Automobile Manufacturers Association, Inc. (JAMA) guidance. This is possible due to the development of substitutes for balance weight and the previously-employed paints, which contained a high quantity of lead.

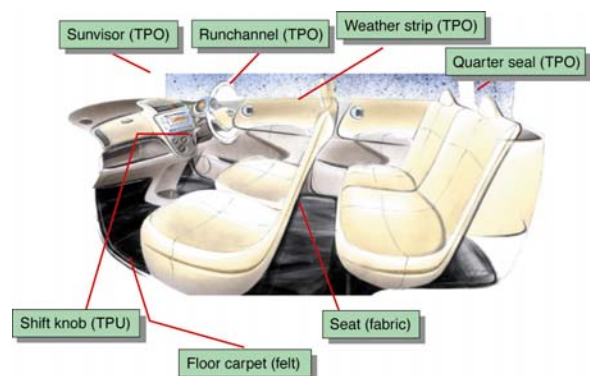


Fig. 18 Interior non-PVC parts

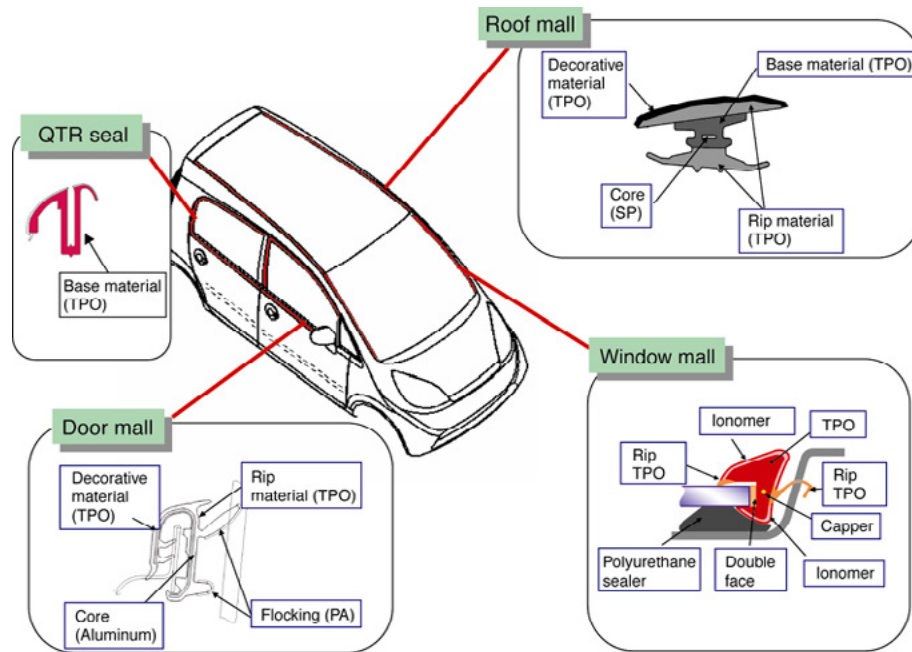


Fig. 19 Exterior non-PVC parts

9. Conclusion

The development of the new LIFE is based on the concept of “Technology with Heart.” Precisely because mini-compact cars are often used every day, the developers strived not only for superb performance in basic areas such as collision safety, running, turning and stopping, they also sought to fill the vehicle at every point with “Technology with Heart,” to provide a driving experience that is comfortable, enjoyable and tension-free. The development team is proud of its success with the new LIFE mini-compact vehicle.

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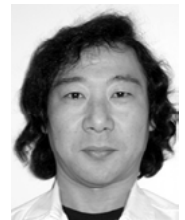
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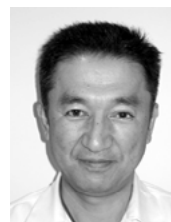
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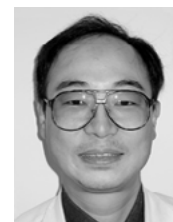
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