New Generation Rotary!

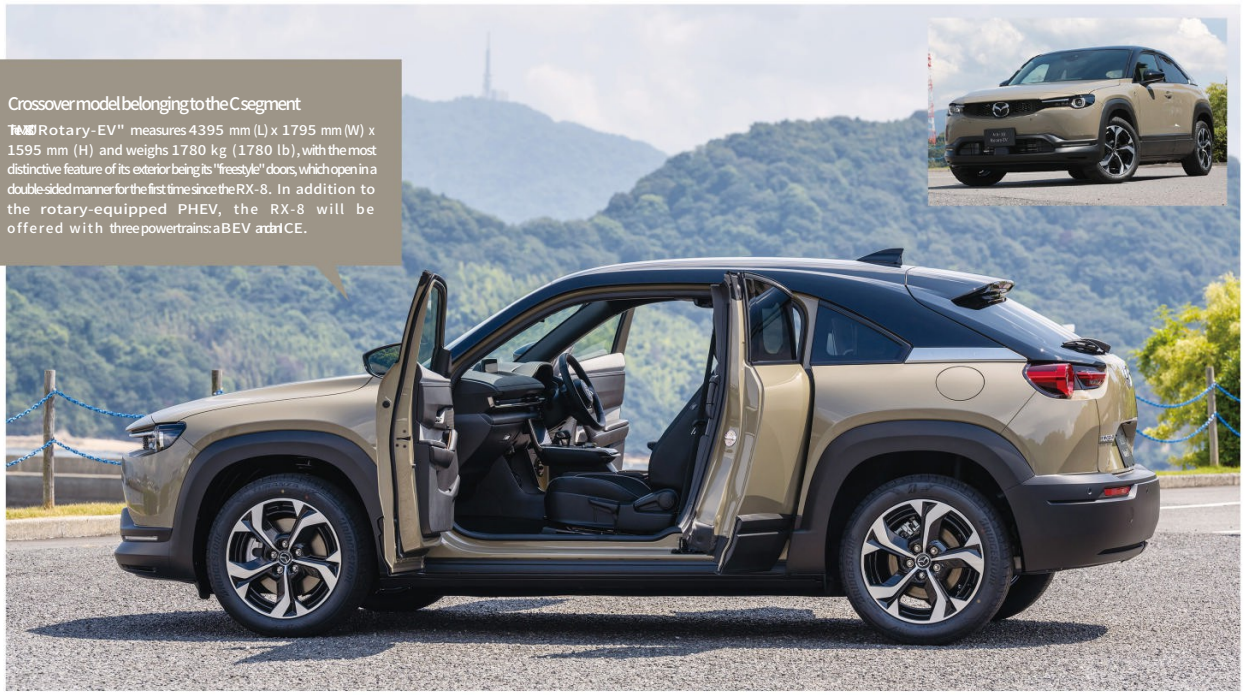
Part 06

New model for rotary engine

MX-30 Rotary-EVというクルマ

The rotary engine, Mazda's identity, has been revived after an 11-year gap. The MX-30 will be equipped with this powertrain. This is a new option for freestyle-door personalities, which has been preceded by the release of a mild hybrid and an electric car.

TEXT: MFi PHOTO: Hiroya YAMAGAMI / MAZDA FIGURE: MAZDA



Crossover model belonging to the C segment

The MX-30 Rotary-EV" measures 4395 mm (L) x 1795 mm (W) x 1595 mm (H) and weighs 1780 kg (1780 lb), with the most distinctive feature of its exterior being its "freestyle" doors, which open in a double-sided manner for the first time since the RX-8. In addition to the rotary-equipped PHEV, the RX-8 will be offered with three powertrains: a BEV and an ICE.

The rotary engine revived for a new era will be powered by the Mazda MX-30, the company's first mass-produced BEV, which made its world premiere at the 2019 Tokyo Motor Show and is unique not only in its powertrain but also in its "freestyle doors," which feature a center pillar-less, center-opening structure Although it belongs to the same segment as the MAZDA3 and CX-30, the MX-30's framework has undergone considerable improvements in conjunction with the aforementioned freestyle doors and electrification. Initially, it was thought to be a BEV-only model, but when it is introduced to the Japanese market in the fall of 2020, an ICE vehicle combining a SKYACTIV-G 2.0 gasoline engine and a unique mild hybrid system will be available, expanding the range of variations.

The MX-30 "Rotary-EV," a series-type plug-in hybrid model that uses the rotary engine exclusively for power generation, will be available for pre-order in Japan from September 14, 2011, with deliveries starting in early November. The price is 4,235,000 yen.

A residual value credit plan with a 55% residual value rate after three years is also available.

The battery has a capacity of 17.8 kWh, and the car can travel 107 km in WLTC mode on battery power alone. In addition, the rotary engine fuel tank used as a generator has a capacity of 50 liters for long-distance driving. The battery pack and 50-liter fuel tank were installed simultaneously, and the space efficiency of each was thoroughly improved to achieve this structure.

The motor drives the front wheels in all driving situations, and when acceleration output is required, such as rapid acceleration, it can be [illegible] with a logic that starts the rotary engine depending on the accelerator pedal position according to the remaining battery level, even when EV mode is selected.

Electric Q-Vectoring Control Plus (e-GVC Plus) and highly precise torque control based on human characteristics. It also includes a "motor pedal."

It is said to pursue the "Jinba Ittai" (unity of rider and horse) driving experience that only Mazda can offer. The MX-30, which offers three powertrains, is representative of Mazda's "multi-solution strategy of offering choices to the right people in the right places. The revival of the rotary is not the only thing that is attracting attention.

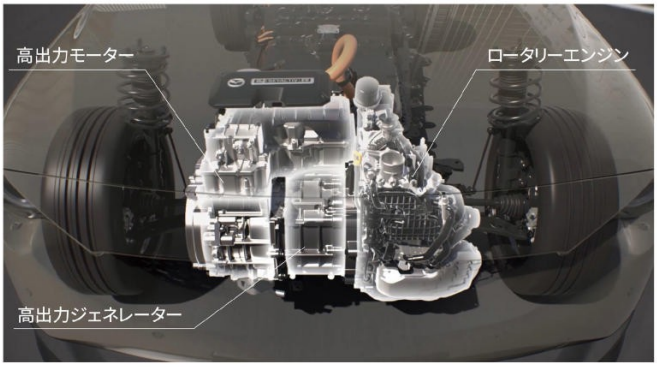
It is equipped with many features that are not present.

1-rotor rotary and electric unit

The engine compartment of the MX-30 "Rotary-EV. Not only does it maximize the advantages of the rotary, which is much more compact than a typical engine, but it also changes from the conventional unit's two rotors to a single rotor by making it dedicated to power generation.

Right : Mild hybrid spearheads the domestic market

The first model for the MX-30 domestic market in the fall of 2020 will be a 2 . The ICE vehicle, which combines a 2.0-liter straight-4 SKYACTIV-G engine with a 24V integrated starter-generator, will be the first model to be offered in Japan in the fall of 2020. The transmission is a 6-speed AT common to the 7th generation product line.

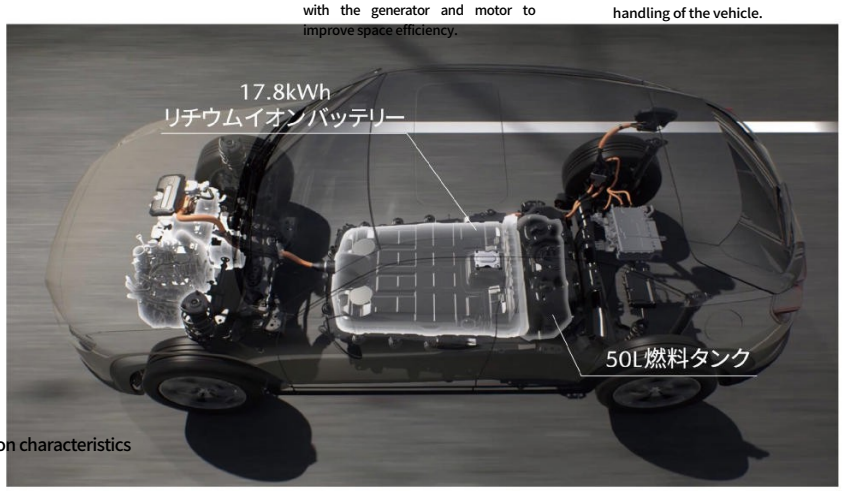


Left : PHEV with coaxial arrangement of main units

The layout of the MX-30 "Rotary-EV" powertrain: a compact one-rotor engine was chosen because it was to be mounted in a C-segment class engine compartment and in the same body frame as the BEV model. Compared to a typical reciprocating engine of the same power output, the compact engine is coaxially arranged with the generator and motor to improve space efficiency.

Above : BEV model Engine room with plenty of room

The engine compartment of the MX-30 "EV-MODEL," which houses only the drive motor without an engine or generator, has an aluminum mount on the passenger side that appears to be highly rigid. Because there is little weight in front of the vehicle, the so-called "lightness of the nose" stands out in the handling of the vehicle.

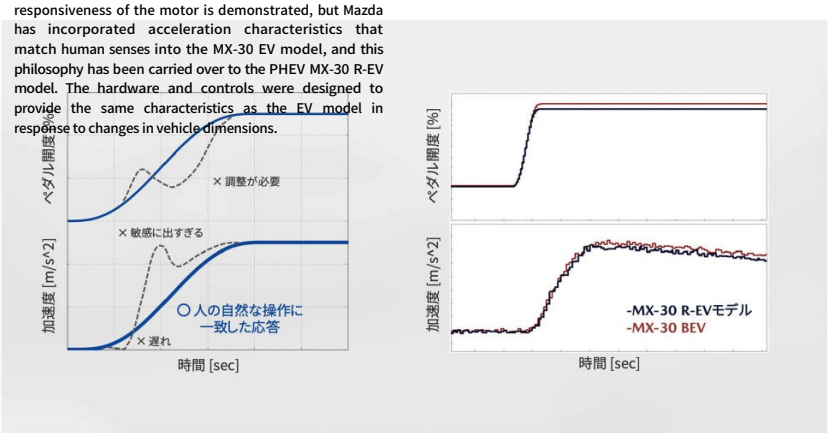


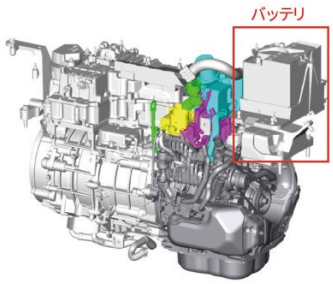
Right : Large battery and large-capacity fuel tank coexist

To eliminate concerns about range, the vehicle is equipped with a 50 L capacity fuel tank (using regular gasoline) This is roughly equivalent to the 51 L capacity of the MX-30 ICE vehicle 2WD model. Another key point is that the height of the battery case has been reduced through high-density mounting of the battery module and a refrigerant cooling system with a thin structure. The battery pack is tightly connected to the body, which also contributes to improved body rigidity.

Below : Control pursuing human-centered acceleration characteristics

It is not difficult to extract acceleration responsiveness that is far superior to that of an ICE vehicle when the high responsiveness of the motor is demonstrated, but Mazda has incorporated acceleration characteristics that match human senses into the MX-30 EV model, and this philosophy has been carried over to the PHEV MX-30 R-EV model. The hardware and controls were designed to provide the same characteristics as the EV model in response to changes in vehicle dimensions.





To avoid interference with lead-acid batteries

The rotary for power generation is laid out in the transmission position, which interferes with the lead-acid battery in the engine compartment. Experienced rotary packaging engineers solved this problem by designing a " pentroof" package that assembled the upper related parts.

GM, Toyota, NSU (the predecessor of today's Audi), and the Soviet Union all gave up RE development in the 1970s. In the 2000s, inspired by the RENESIS 13B, the Austrian company AVL developed a small RE for power generation, and the Chinese private company Chery Automobile showed interest in it and developed a range extender BEV, which ended up as a prototype.

This is extremely unfortunate for RE. There is only one company in the world (Mazda) that has a wealth of knowledge (3). In the case of anormal reciprocating ICE, millions of engineers have probably been involved in the past. Reciprocating ICEs grew out of a sea of knowledge. SIP under the jurisdiction of the Japanese Cabinet Office. (Strategic Innovation Program) finally achieved a net thermal efficiency of over 50%. Laboratory Phase

Nevertheless, exceeding 50% is a figure that is slowly approaching the 64% of the most efficient natural gas power turbines.

Neither the net thermal efficiency nor the BMEP of the Mazda Model 8C has yet been disclosed; the first difference from the Model 13B is the longer stroke. In the case of the RE, the K value obtained by dividing the eccentricity (e-value) between the rotating gear with internal teeth engraved in the center of the rotor and the fixed gear on the output shaft side by the distance (R) between the center of the output shaft and the top of the triangular rotor is equivalent to the stroke in the reciprocating ICE. K value is equivalent to the stroke in a reciprocating ICE. As with the series of SKYACTIV ICEs, a longer stroke has been achieved.

Another would be improved combustion. This is the author's impression of the disassembled 8C and Mazda's com

The combustion chamber (called the working chamber in RE) has a round cavity like the SkyActiv-G, the compression ratio has been increased to 11.9, the fuel supply is now direct in-cylinder injection instead of in the intake port, and one spark plug is used instead of two. In other words, the evolution of theSkyActiv-G has been transferred. Combustion should be further improved from the RENESIS 13B.

Also, the ICE is for power generation only and should not be used at high RPM. The most efficient power generation speed is said to be 2300 rpm. In other words, downspeeding. The displacement is enlarged, the rpm is lowered, and the injected fuel is burned and used up. This is exactly what Mazda has always said it would do to improve the ICE. Even though the form is different, the concept is the same as Skyactiv-G.

New Generation Rotary!

Part 07

Epilogue

ロータリーエンジンの行方

Will Mazda's RE, which was revived as a power generation ICE for BEVs, really develop into a drive ICE - as long as Mazda views RE from a management perspective, this is a great possibility.

Series HEV, or PHEV, or Hydrogen Burning RE...

TEXT & PHOTO: Shigeo MAKINO

Seals have been a source of much aggravation for RE developers. In the 1960s, even ox bones were tested. With the establishment of the discipline of tribology and the recognition of its importance, the future of this component became more promising. If a special oil for REs could be made and used in combination with seals, ... I think that the fundamentals of machinery that mankind has accumulated will be useful for REs in the future.

So, what if we move on from here?

In the past, Mazda has conducted several experiments with REs. The most impressive was the HEV (Hybrid Electric Vehicle) that combined a hydrogen-burning RE and an electric motor, and its development had begun in 1990. In 2003, an HEV combining an electric motor with hydrogen-fueled RE using an electrically assisted turbocharger was exhibited at the TMS.

In other words, Mazda started research on hydrogen combustion with REs around 1990, and confirmed that the cooling loss, which was a disadvantage of REs, was an advantage in hydrogen combustion.

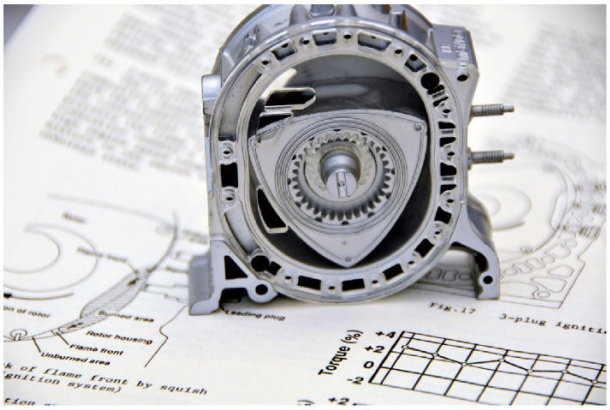
The culmination of these efforts was the Premacy Hydrogen RE Hybrid Concept, which was exhibited at the 2005 TMS. The culmination of these efforts was the Premacy Hydrogen RE Hybrid Concept exhibited at the 2005 TMS. It was a series HEV that used a hydrogen-burning RE exclusively for power generation, with the RE and electric motor in parallel and mounted horizontally. The new MX-30 rotary EV is a RE-HEV for the 2020s that uses gasoline as the fuel and has a RE for power generation and an electric motor for drive in a series configuration. This is what we can see from the past.

Another new 8C focus is side housing surface thermal spraying as a tribology (friction, wear, and lubrication) technology. Given the current situation where everything is aided by peripheral technologies, one would expect a jump in RE performance from technological innovations in the tribology area.

It has been supported by advances in conductors. Closer to home, advances in smartphone cameras and image sensors have changed entertainment and news reporting. The first thing that tells us what is happening on the front lines of the war in Ukraine is a video shot with a smartphone. Who would have imagined this 20 years ago? Even a year ago, LLM (Large Language Models) such as chat GPT could not be imagined.

As noted at the beginning of this paper, RE's misfortune was that it had only a few engineers involved and that Mazda was the only company (3) that had accumulated knowledge. The only way to recover from this was to incorporate more and more peripheral technologies. Mazda fully understood this, which is why the 8C became the Skyactiv RE. The latest results from the reciprocating engine and MBD (Model Based Development) were incorporated into the RE. However, it is still a reciprocal

← Mr. Takumi Muroki, a member of the first RE development team, the so-called RE 47 Ronin, showed us a small single-rotor air-cooled RE for aircraft, which may be used for unmanned aerial vehicles somewhere. This is an example of how RE is being used in places we do not know.



→ A model of the RE, which used to be sold at Mazda's in-house store. The rotor rotates with the steering wheel. It is no longer seen, but we hope that it will be resold based on the design data of the 8C. This is an important missionary activity and a means to increase interest in RE.

The company is lagging behind in

We think that if there is a way to make up for this, it would be the unnervingly long seal dimensions compared to reciprocating engines. Just as the use of hydrogen as a fuel has brought advantages in terms of cooling loss, the evolution of tribological technology may play a role in "turning a disaster into a ..... disaster".

Combustion control technology is also promising. SkyActive ICE can now control in 50 milliseconds. This is fast. However, it is still far from the torsional resonance frequency of the drive shaft. I have a feeling that there will be a different world when the control time can be shortened. For example, instead of three combustion cycles per revolution, "thinned ignition" like cylinder deactivation in reciprocating engines may be effective when considering an ICE dedicated to power generation at a constant revolution, despite the author's amateurish conception.

The fact that Mazda is the only company with RE knowledge may be a blessing in disguise. Mazda always links the improvements made in reciprocating engines to "what would RE be like" and does not leak them to the outside world. At the same time, it is a great asset that many students still join Mazda with the motive of "I want to work on RE. No one else but Mazda can do RE R&D. I think there are probably many people who have ideas that they would like to use for RE.

These young people should be given opportunities to participate in RE development without being assigned to the RE development department. In a word, it is a plan to get rid of the "old man" (3). It is already said in some quarters that the automobile industry

is "wacko. I do not think so, but it is unfortunate that people think so. In order to eliminate this, it is necessary to abandon all ideas such as "this is the way it used to be" or "this is my way of doing things," and to encourage young people with a rebellious spirit who wish to engage in RE to exert their full strength.

They have to be committed. Otherwise, they will quit easily.

Although it is quite absurd, I sometimes think about "a plan to put a time machine to practical use in the future. It is just for fun, but I think Mazda might be able to do it. Mazda has been working on RE since the 1960s, and its latest model will be released in 2023. They have been working on RE since the 1960s, and the latest model will be released in 2023. It's brilliant.

And that there are researchers abroad who are fascinated by RE. I mentioned "Soviet Union" at the beginning of this article, but that was actually the case. There are remnants in Russia today. To commemorate the release of 8C, a RE world conference was held on the web, someone started a crowdfunding campaign for the development of 16C, and someone else started a RE startup on his/her own. Only young people can do this. All you old guys have to do is just laugh and watch.

Electric power steering

This is the first Land Cruiser to use an electrically power assisted system. It is a rack-parallel EPS system in which the motor is placed in parallel with the rack gears, and the motor torque is transmitted by a belt using a ball screw. The JTEKT logo could be seen on the label.

Electronic Stabilizer

The front anti-roll bar (stabilizer) is an electrically controlled type called SDM. The SDM is turned on during normal on-road driving to activate roll control, while it is turned off when the vehicle is driven at extremely low speeds with an excessive phase difference between the left and right wheels.

Place, 変える 変えない (after a noun) about the... part (of a person, thing, or person)

Toyota Land Cruiser 250

It seems that Prado is about to undergo a full change - the new Land Cruiser, which has finally made its debut, is called the "250. What features will the four-cylinder version of the new LC have?

TEXT & PHOTO：MFi

Toyota Land Cruiser as of September 2023 (LC) has a lineup that includes the "300" series station wagon, the "Prado" light-duty model, and the "70" series heavy-duty model (for overseas markets). The "250" series, the successor to the Prado, was unveiled as a prototype in early August. The rolling chassis exhibited at the event was said to be based on the TNGA platform GA-F. The current Prado (150 series) was introduced in 2009, and it was announced that the frame of the 120 series Prado, its predecessor, was basically retained at the time of its introduction.

Considering the fact that the company has been in the process of unceasingly renewing its basic framework for the first time in more than 20 years, this is indeed the first time in more than 20 years.

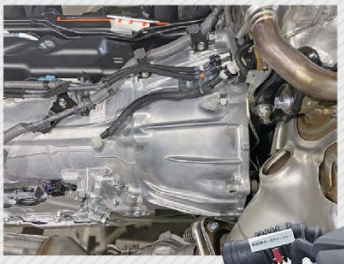
The body on top of it is 100 mm longer and 95 mm wider than that of the 150-series Prado, with an overall height of 20 mm and a wheelbase of 60 mm greater than that of the 300-series LC. As the numbers suggest, when

you see the car in person, you will be impressed by its imposing physique.

The complex part is the development of powertrains, which are used in different ways in different destinations. Broadly speaking

The former is for North America, China, and the Middle East, where diesel engines are not yet in full-scale use, and is powered by the T24A-FTS type (2.4L gasoline turbo). The latter model is for Europe and the Middle East, including the Japanese market, and is powered by a 1GD-FTV type (2.8L diesel turbo). In addition, a hybrid version is also available as an advanced version of each model. In addition, a 2TR-FE type (2.7L gasoline engine) is installed as a basic powertrain.

+6-speed AT available.



Hybrid vehicles are also available.

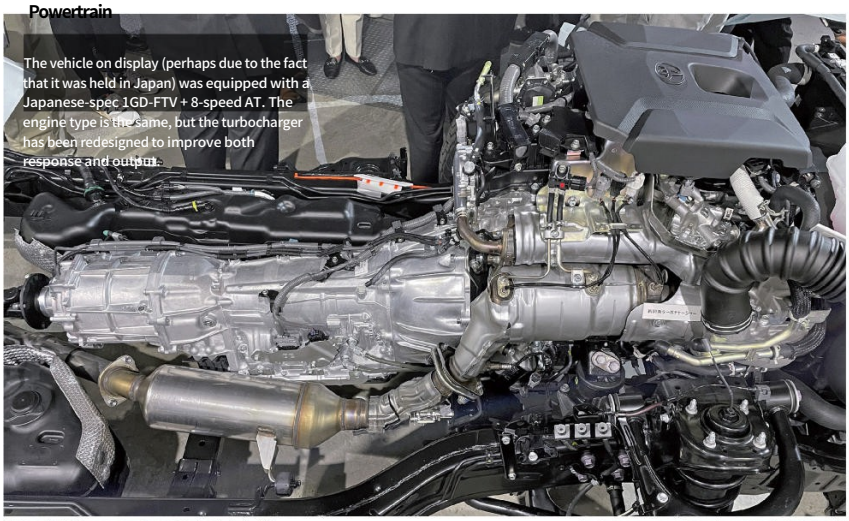
Both the 2.4-liter gasoline and 2.8-liter diesel models are announced to be available as hybrids. The former will be given a motor-generator and the latter a 48V system. The assist system will be a P2 arrangement in the bellhousing shown in the photo.

Non-linear tailored weld blanks

High-rigidity and lightweight technology adopted from the 300 series LC and GA-F. In contrast to the conventional structure in which reinforcement was applied to the top of the ladder frame, which had a uniform plate thickness, this structure integrates the reinforcement by wire welding, welding the reinforcement from the base metal, and finishing it as a single piece.

Powertrain

The vehicle on display (perhaps due to the fact that it was held in Japan) was equipped with a Japanese-spec 1GD-FTV + 8-speed AT. The engine type is the same, but the turbocharger has been redesigned to improve both response and output.



Left: The 8-speed AT is said to be a completely new construction, although it is thought to be an improved version of a conventional model. No details are known because the numbers, including the gear ratio, have not yet been disclosed. The 300 series LC is equipped with a 10-speed AT, so torque capacity should not be a problem. Right: The transfer section located to the left of the transmission. The propeller shaft to the front is diverted. Naturally, this is a full-time AWD transmission.

Land Cruiser 70 model

The 70 series LC, which returns to the Japanese market after a long absence, switches to a 1GD-FTV engine similar to the 250 series LC. In order to accommodate the 1GD-FTV in the engine compartment and to enhance pedestrian collision protection, the engine hood has been modified to a raised shape. The transmission is a six-speed AT, and the new model is not limited to a certain number of units but will continue to be sold.