



FHI Develops a New-generation Subaru Boxer Engine

*-- New Horizontally-Opposed engine,
providing superior combination of environmental friendliness and enjoyable driving --*

Tokyo, September 23, 2010 - Fuji Heavy Industries Ltd. (FHI) has developed its new-generation boxer engine* that combines the technology and know-how used in Horizontally-Opposed Boxer engines, the core technology that has supported Subaru's unique driving since it was first employed in the Subaru 1000 in 1966. This overall renewal is the first in 21 years, since the second generation boxer engine was introduced in the first Legacy models in 1989.

This new-generation Horizontally-Opposed 4 cylinder gasoline engine, the third generation Subaru boxer engine, showcases Subaru's latest engineering research and development. It offers a new performance level by further refining Subaru's unique expertise in Boxer engine technology. The engine was entirely renewed, starting from the basic structure, while all the advantages of the horizontally-opposed layout were maintained: lightweight, compact, low center of gravity, and superior vibration balance. New-generation improvements include advances in both environmental friendliness, such as an approximately 10% improvement in fuel efficiency, and driving performance for smooth acceleration in all speed ranges. Furthermore, FHI designed the new engine with consideration of the technology's expandability and potential capability to receive further upgrades meeting future environmental measures.

FHI built a new factory at the Gunma Oizumi Plant exclusively for the production of this new-generation boxer engine. This new plant offers state-of-the-art production facilities that make full use of FHI's engine manufacturing know-how developed to date, as well as a highly efficient production system delivering products meeting the highest quality standards.

* Boxer engine: Also known as a Horizontally-Opposed engine. In this design, the pistons are arranged symmetrically left and right along the crankshaft. When the pistons move, they resemble the punches thrown by boxers, thus resulting in this popular name.



The New-generation Subaru Boxer engine

[Major Features of the New-generation Subaru Boxer engine]
The overall structure of this engine has been totally renewed, by reviewing the bore and stroke for the basic structure to allow a longer stroke than current engines. It is designed to achieve high efficiency in basic performance, allowing the smooth and sporty rotational properties for which Horizontally-Opposed engines are known, while also making improvements in practical torque and environmental friendliness. This engine is available with 2,500 cc or 2,000 cc displacement, both with 4 cylinders. These models will now be positioned as our main engines.

- The bore and stroke, the basic structure of this engine, have been reviewed to achieve a compact combustion chamber as well as a long stroke, which was difficult previously due to chassis mounting conditions in boxer gasoline engines. This allows high combustion efficiency, and generates a sufficient mid-low speed torque with improved fuel efficiency and practicality.
- Improved fuel efficiency has been achieved through optimization of intake port configuration and the addition of partitions inside ports, the use of TGV (Tumble Generated Valve), and the use of an EGR (Exhaust Gas Recirculation) cooler.
- AVCS (Active Valve Control System) is used on both intake and exhaust valves. For the intake side in particular, an intermediate lock system allows valve timing to be advanced or delayed for precise control over intake and exhaust valve timing, allowing maximum engine performance in output, fuel efficiency, and exhaust emission.
- The use of lightweight primary moving parts, such as pistons and connecting rods, and a highly efficient and compact oil pump provides an approximately 30% reduction in friction loss and improves fuel efficiency and revolution response.
- Cooling has been optimized by using separate engine cooling circuitry for the block and the head, resulting in improvements in fuel efficiency and output characteristics.

[Engine Outline^{*1}]

	New Boxer engine	Current engine
Engine type	Horizontally-Opposed 4 cylinder DOHC	Horizontally-Opposed 4 cylinder DOHC
Displacement	1,995 cc	1,994 cc
Compression ratio	10.5	10.2
Bore x Stroke	84 x 90 mm	92 x 75 mm
Max. output	109kW	109kW
Max. torque	196Nm	191Nm

[Major Changes and Results^{*2}]

Items	Output	Fuel efficiency	Exhaust emissions
Longer stroke	O	O	O
Compact combustion chamber	O	O	O
Lighter parts in moving parts		O	
Cooled EGR system	O	O	
Intake/Exhaust AVCS	O	O	O
TGV		O	O
Compact oil pump		O	

*1 Compared to a 2,000 cc naturally-aspirated engine

*2 Changes with regard to domestic specifications

<p>Advantages of horizontally opposed engines (Reference)</p> <p>[Kinematic performance]</p> <ul style="list-style-type: none"> • Compared to in-line engine and V-type engine, the height of horizontally opposed engine is lowered, allowing a lower center of gravity for the entire vehicle. • The lightweight, compact design and symmetrical layout allow a smaller yaw moment of inertia. <p>[Reduced vibration]</p> <ul style="list-style-type: none"> • The pistons on the left and right sides move in symmetrical opposition, cancelling out any vibration. This allows a smooth revolution feeling with little vibration. In addition, since no balancer shaft is required, the weight increase of the engine is minimized. <p>[Collision safety]</p> <ul style="list-style-type: none"> • Since the engine is sitting low, strong forces from the front such as a head-on collision will result in the engine being driven underneath the car. As a result, there is a reduced risk of the engine being forced into the cabin and injuring passengers. • Since the engine is sitting low, there is ample space between the engine and the hood. This space will absorb some of the force in the event of a collision, reducing injury to pedestrians.

FHI is fully committed to develop new products on the theme of integrating enjoyable and reliable driving with environmentally friendly solutions. This same theme applies to this new-generation boxer engine, which will be positioned as a main engine and the starting point of its future power unit strategy. Starting with the Forester, the new engine will be deployed in other Subaru products in the future.

About Fuji Heavy Industries Ltd.

Fuji Heavy Industries Ltd. (FHI), the maker of Subaru automobiles, is a leading manufacturer in Japan with a long history of technological innovations that dates back to its origin as an aircraft company. While the automotive business is a main business pillar, FHI's Aerospace, Industrial Products and Eco Technologies divisions offer a diverse range of products from general-purpose engines, power generators, and sanitation trucks to small airplanes, crucial components for passenger aircrafts, and wind-powered electricity generating systems. Recognized internationally for its AWD (all-wheel drive) technology and Horizontally-Opposed engines in Subaru, FHI is also spearheading the development of environmentally friendly products and is committed to contributing to global environmental preservation.