

Development Phase/Products

Aerospace, Industrial Products, Eco Technologies Companies, Clean Enterprise

FHI comprises the Aerospace Company, the Industrial Products Company for general-purpose engines, the Eco Technologies Company for environmental apparatuses and turbine generator systems, and the Clean Enterprise, besides the Automotive Business Unit. Making full use of reliable technologies accumulated so far, FHI is making every effort to provide products useful for society and people's daily lives. Each unit and company are working hard on the development of products friendly to the global environment and the creation of state-of-the-art technologies.

Aerospace Company

In recent years, global environmental issues such as ozone holes, global warming, and marine contamination have been very controversial, while the necessity for disaster monitoring has been emphasized. Innovative research and development is indispensable for taking the initiative in finding global solutions to such issues. Under the circumstances, the Aerospace Company has been contributing with remarkable participation in research and development to actualize the stratospheric platform.

The stratospheric platform means to arrange a network base for global observation, disaster monitoring, telecommunications, and broadcasting with an unmanned airship equipped with observation sensors and communication equipment that remains in the stratosphere at an altitude of around 20 km, where meteorological conditions are relatively stable. The airship is powered by clean electric energy from solar cells and regenerative fuel cells. Toward the actualization of this, the Ministry of Education, Culture, Sports, Science and Technology has been tackling the development jointly with the Ministry of Internal Affairs and Communications. As the main manufacturer under a contract with the Japan Aerospace Exploration Agency (JAXA), the Aerospace Company has designed, manufactured, and implemented flight tests of two prototype airships (a



48-meter, non-powered, balloon-like, high-altitude, flight-testing model and a 68-meter unmanned reusable low-altitude model).

Image of the stratospheric platform (photo provided by JAXA/ISTA)

Flight Test of 68-Meter Model

Following the success of the duration flight test in the stratosphere in August 2003, the 68-meter unmanned reusable low-altitude model manufactured by the Aerospace Company succeeded in a stationary flight test under automatic control for an hour at an altitude of 4 km on November 22, 2004. Computer controlled automatic operation is indispensable for long stationary flights of many hours at very high altitudes with no influence from airflow and other elements. This was actualized in an airship for the first time in the world.

This stationary flight test was implemented by JAXA and the National Institute of Information and Communications Technology (NICT) in Taiki-cho, Hokkaido, for about a year from December 2003. From the Aerospace Company, twenty-five engineers and manufacture-related persons stayed there to take part

in the manufacture and assembly of the airship and a variety of development tests. The goals were attained in all of the tests for global observation from the sky, telecommunications, and broadcasting, as well as stationary flight.

Thus, the Aerospace Company utilizes its cutting-edge technologies in the



environmental industry for our everyday life.

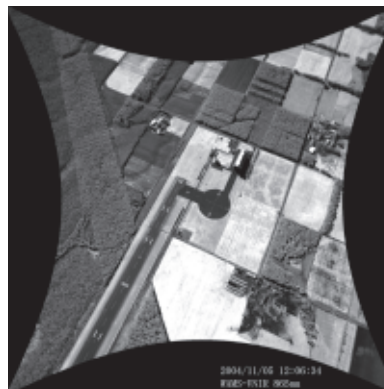
Takeoff on a test flight (photo provided by JAXA/ISTA)

● Stationary Flight Test Model

- ◆ Overall length: 68 m (the largest unmanned airship in the world, the same length as the Boeing 747 jumbo jet)
- ◆ Weight : 6,400 kg
- ◆ Volume : 10,660 m³
- ◆ Power : Propeller driven by electric motors
- ◆ Control : It takes off and attains an altitude of about 100 m by remote control from a pilot. Then, it gains altitude, maintains stationary flight, and comes down for a gliding approach under automatic control by the flight control computer installed in the airship.



Automatic operation in a test flight (photo provided by JAXA/ISTA)



Observation of vegetation and the atmosphere during a test flight (photo provided by JAXA/EORC)

Industrial Products Company

The Industrial Products Company produces general-purpose engines. These engines are loaded in machines that support our life such as construction and agricultural machinery to establish infrastructures, leisure-related equipment to fulfill our life, snow removal equipment, and engine-equipped generators for harsh environments. Product development is implemented by repeating demanding tests so that these engines and machines will always work stably under the worst conditions imaginable on the earth, such as severe heat, extreme arctic cold, blistering desert heat, and rough marine applications.

Cleaner Exhaust Emissions and Improved Fuel Economy in General-purpose Engines

In fiscal 2004, we produced the following results.

- Fuel economy: Improved 11% compared to fiscal 1995
- Exhaust emission: Reduced 46% compared to fiscal 1995

EH09-2 General-purpose Engine

The EH09-2 general-purpose engine, which was launched in December 2004, is an air-cooled 4-cycle OHV gasoline engine with a displacement of 86 ml. As the successor engine to the conventional side valve engine (EY08), the EH09-2 was developed as an engine friendly to the environment with excellent mounting performance. By optimizing the combustion chamber shape, intake port, and cam profile, high power was simultaneously actualized with reductions in the fuel consumption rate and the exhaust emissions level. The engine is applied to machinery used for



EH09-2 general-purpose engine

a variety of purposes, including small construction equipment, generators, pumps, and agricultural machinery as a power source useful to our life.

Feature 1: Friendly to the environment

High power is actualized, as well as low fuel consumption and a low exhaust emission level. The exhaust emission standards are satisfied in the US EPA Phase 2 Regulations, the CARB Tier 2 Regulations, the EU Exhaust Emission

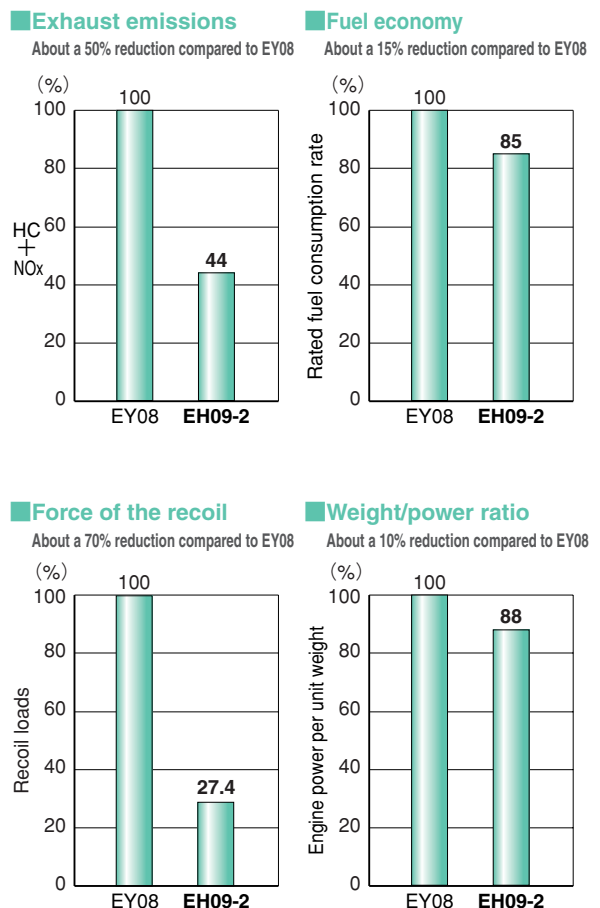
Regulations, and the Domestic Voluntary Agreed Regulations. In addition, substances with environmental impact are reduced and recyclable materials are adopted.

Feature 2: Gentle to people

The ignition coil with spark advance function*1 and the mechanical decompression mechanism*2 are adopted to ensure excellent engine starts without reverse rotation causing a kick back.*3 The force of pulling the recoil rope to start engine is reduced to about 30% of the conventional EY08 for easier engine starting.

Feature 3: Excellent mounting performance

High power, durability, and excellent operability are integrated in the smallest package. Adoption of the thin recoil has increased the possibility of being mounted in a variety of equipment. In addition, the power per unit weight is the highest in its class.



*1. Ignition coil with spark advance function: The ignition coil has an additional function that changes (advances) the ignition timing for starts against the ignition timing when the engine is operating at a high speed. This coil prevents reverse rotation causing a kick back. *2. Mechanical decompression: This means relaxation of pressure (decompression) in the combustion chamber when starting the engine. This mechanism reduces the recoil force of the recoil starter, and facilitates starting. *3. Reverse rotation causing a kick back reaction: For small construction machines and small general-purpose engines for agricultural use, the recoil starter, which is a manual starter using a rope, is widely used. When the rotation speed of the crankshaft is slow in starting the engine (the rope is not pulled fast enough), the crankshaft rotates in reverse and the starter rope is sometimes pulled back due to the strong reaction. By combining mechanical decompression with the ignition coil's spark advance function, startability is enhanced and the reverse rotation that causes the kick back reaction is securely prevented.

Eco Technologies Company

Eco Technologies Company deals with a variety of products that contribute to creating comfortable living environments and a resource recycling society with an Environmentally-Sound Material Cycle, including a refuse sorting system (intermediate treatment interim disposal) and the recent refuse disposal system for skyscrapers, as well as various vehicles and equipment for waste collection, transport, and recycling. Handling the wind turbine generator systems to produce clean energy, Eco Technologies Company contributes to conservation of the global environment with its ecological products.

Vehicles that Collect and Transport Waste

Development of the New Refuse Collection Vehicle with Attachable and Detachable Body^{*1}

This is a new multipurpose refuse collection vehicle. The carrier can be loaded with the container where a cargo box is integrated with a loader as a unit, as well as the conventional container used at factories and construction sites. The feature of this vehicle is to be able to cope with loaders of different styles as well.^{*2} By loading different containers according to waste types and recycling purposes, the vehicle enables diversified and multipurpose collection and transport, as well as efficient operation of attachment/detachment of containers. By connecting the dedicated portable hydraulic unit to the container where the cargo box is integrated with the loader, stationary loading operation is available at construction sites for reduction of waste volume and temporary storage of waste.



Refuse collection vehicle with an attachable and detachable body



When connected to the dedicated hydraulic unit, it loads and unloads waste at a fixed spot

Development of Automatic Body Weighing System for Refuse Collection Vehicles

Development of Automatic Body Weighing System for Refuse Collection Vehicles
By attaching the system to the refuse collection vehicle, the weight of individual waste loaded into the vehicle is weighed on the spot, as well as having available a highly accurate measure of the total weight of the loaded waste (with an error of about

±0.5%). In addition, the system enables indication of the loadage, the issue of slips, and an interface with a personal computer for management and calculation based on



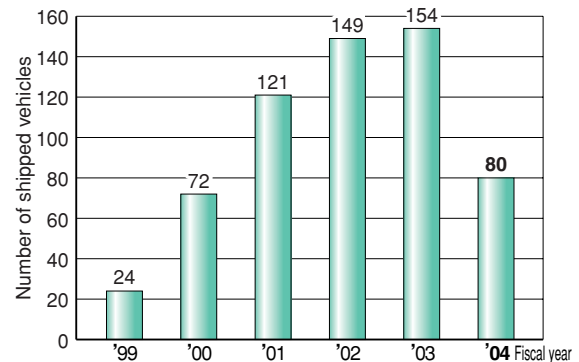
Introduction of the automatic body weighing system to the dumping discharging style refuse collection vehicle first in Japan

the data retained. This system is expected to make a contribution to promoting a reduction in waste.

CNG Refuse Collection Vehicles

The refuse collection vehicle that uses compressed natural gas (CNG) as its fuel for clean emission has come into wide use by making the most of its features.

■ CNG Refuse Collection Vehicles Adopted



Products Contributing to Recycling Society

Fuswtan, a Refuse Conveyance System for Skyscrapers

In high-rise office buildings that require further recovery of resources, efficient vertical conveyance of refuse has been demanded in recent years, rather than conventional manual conveyance by elevator. Fuswtan is a refuse conveyance and sorting system, where refuse input from each floor is left to fall without damage by controlling the speed of the fall with pressure control, and recyclable waste is sorted according to types for efficient resource recovery. In March 2005, the system was installed in the head office building of the Kansai Electric Power Company, the first in the Kansai region.



Head Office Building of the Kansai Electric Power Company
Number of floors to be processed: From the second floor in the basement to fortieth floor

*1. New refuse collection vehicle with an attachable and detachable body: The attachable and detachable body is composed of the carrier and a container to store waste.
*2. The loading method of the refuse collection vehicle is selectable from the rotary board style, pressing style, and others according to the type of waste.

Subaru Wind Turbine Generator Systems

The wind power generation system contributes to the prevention of global warming by using natural energy for power generation. As one of the few domestic manufacturers, Subaru has commercialized the wind turbine generator systems for 40 kW and 100 kW, which were developed originally from our aircraft technology. Having state-of-the-art technologies, the systems are also friendly to the environment: easy to install, easy to start under low wind velocity, and low noise.



40 kW Wind Turbine Generator System
(Installed at the Ashikaga Institute of Technology)

Subaru also participated in a variety of events and seminars to raise environmental consciousness and make contributions to local communities. Hoping for development of wind power generation, we also gave presentations at academic conferences and local government related meetings.



Giving a lecture at the secretariat of the National Municipal Governments Association for Promotion of Wind Power Generation

Railroad Memorial Museum

The Railroad Memorial Museum was established to preserve the history of our railroad cars production after withdrawal from that business. The storage hall stores and exhibits representative cars FHI produced, including the rail bus*1 for the Tarumi Railway manufactured in 1984. The material hall stores the history of wagons in materials by exhibiting photo panels of representative cars and their production processes together with commemorative products, as well as accumulated photos and materials from a line of cars. The Museum, which is open regularly, is utilized as a spot for communication among local residents and retired employees, along with a square having a green in front of the museum as a relaxation space for employees.



Railroad Memorial Museum

Clean Enterprise

The Clean Enterprise tackled development of various running robot products, and actualized a cutting-edge elevator-interfaced cleaning robot system for conservation of energy and labor in cleaning buildings. In addition, we also provide an ozone deodorizing and purifying device applicable to various purposes.



Cleaning robot

Degerming and Deodorizing System with Ozone Gas

The system to degerm and deodorize rooms using ozone gas has been delivered to healthcare facilities for the elderly requiring nursing care. Under the system, ozone gas generators are installed on the ceilings of the bedrooms, service stations, dining rooms, and corridors, as well as in the lavatories, in order to degerm and deodorize the air. The device installed on the ceiling has an air cleaning system, where air taken in through the activated carbon filter is degermed and deodorized with ozone before being released back into the room. It is possible to control the concentration of ozone at an optional level by computer.

Ozone has strong germicidal power, and produces good effects in degerming and deodorizing without leaving toxins. Since ozone is produced from air (oxygen), it is easy to handle anyplace. This system is expected to improve the indoor environments of such facilities.

Robots Exhibited at the 2005 World Exposition, Aichi, Japan

At the EXPO 2005 Aichi, Japan, which started on March 25, the verification testing for prototype robots are implemented under the Project for the Practical Application of Next-Generation Robots by NEDO.*2 At the site, visitors can watch the robots actually moving. FHI participates in the project by exhibiting four units of outdoor cleaning robots, the Subaru Robohiter RS1, and three units of garbage can carrying robots, the Subaru Robohiter T1. These robots are displayed at the Robot Station. In addition, the Subaru Robohiter RS1 robots automatically clean the main street, called the Global Loop (2.6 km in total length and about 21 m in width), and around the West Terminal during closing hours.



Left: Subaru Robohiter RS1
Right: Subaru Robohiter T1

Subaru Robohiter RS1: By triangulation using GPS and a laser sensor, the robot recognizes the outdoor floor location, and cleans exterior floors with a brush on automatic drive.