Scope

Kawasaki Heavy Industries Quarterly Newsletter

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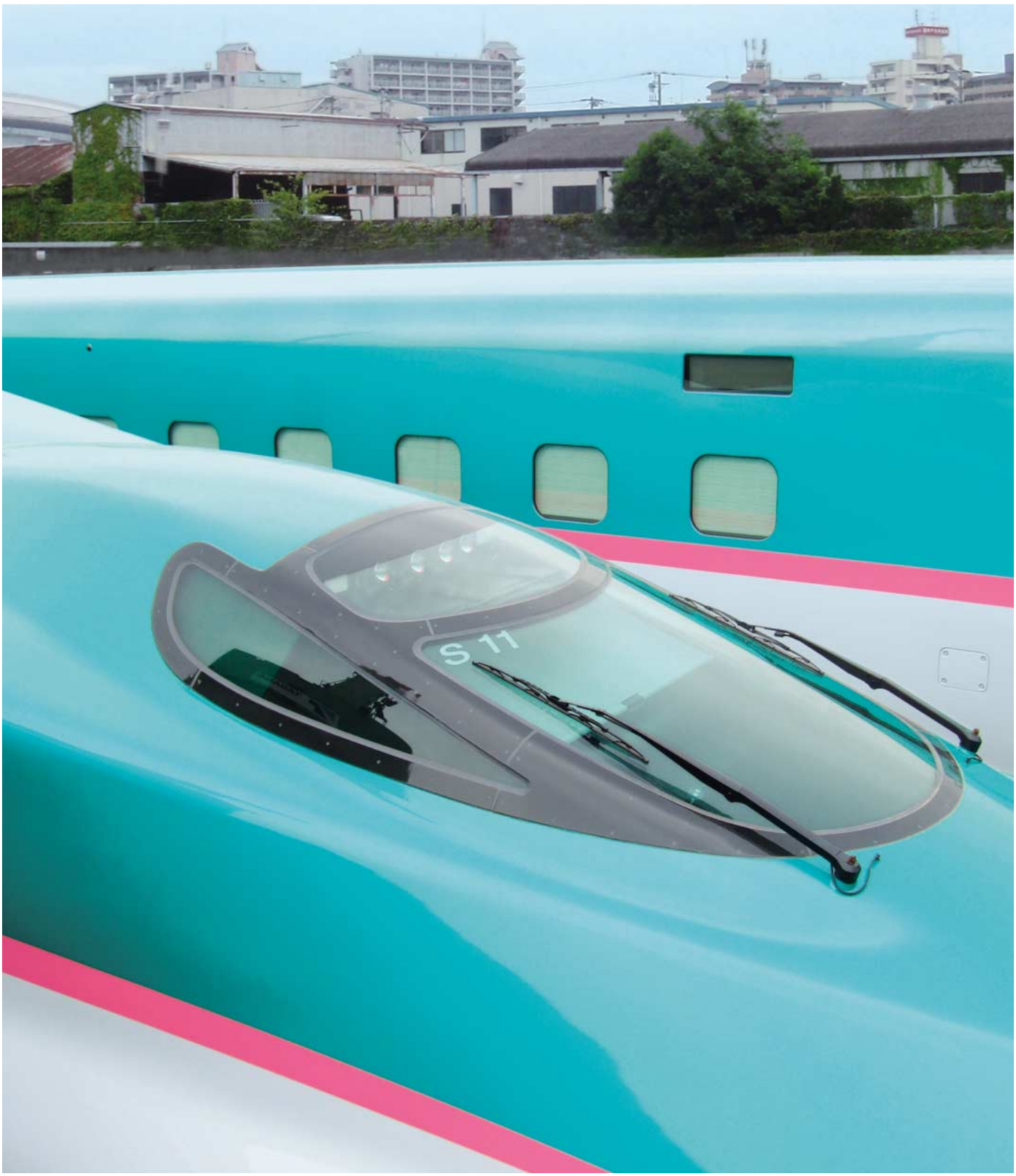

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in this issue...

About the Cover
Two pre-mass-production Series E5 Shinkansen cars lie side by side. This rare shot was taken after the cars were loaded onto a barge at Kawasaki's Hyogo Works prior to shipping. Find out more about it in this issue's Frontline.

KAWASAKI HEAVY INDUSTRIES, LTD.

Scope

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Series E5 Shinkansen: Faster, Cooler and More Comfortable than Ever

Setting a New Japanese Service Operation Speed Record of 320 kph

A new era of high-speed rail travel is just around the bend as production of Japan's new Series E5 *Shinkansen*, bullet train, continues to move right on track with the completion of a pre-mass-production ten-car train for final testing. This latest model, developed by the East Japan Railway Company (JR East), is designed for the Tohoku Shinkansen Line, where expansion work in Japan's northern prefecture of Aomori is slated for completion in December 2010.

The most exciting feature of the Series E5 is speed. Traveling at up to 320 kph during normal service operation, it will be the fastest train in Japan. The series is not only ultrafast; it also includes enhanced environmental and safety features as well as elements designed for optimal passenger comfort.

Kawasaki has manufactured five of the ten Series E5 train cars, including the front car. The train is currently being test run on the Tohoku Shinkansen Line between Tokyo and Hachinohe at the maximum speed of 320 kph.

This issue's *Frontline* provides a close-up view of this shining new addition to the Shinkansen family, as everyone eagerly awaits the upcoming launch.

Pre-mass-production Series E5 train readies for a test run.

Overhead view of the Series E5's long nose.

The front car is loaded onto a barge for shipment from Kawasaki's Hyogo Works.

A low-noise pantograph fitted with an acoustic insulation panel minimizes environmental noise when operating at speeds up to 320 kph. (Photo courtesy of JR East.)

● 15-meter-long Nose Minimizes Sound Blast in Tunnels

It's midnight at Sendai Station. Four gleaming headlights pierce the dark night as a sleek new train glides in alongside the platform. It's the pre-mass-production Series E5 Shinkansen train heading for a test run. Tests have been conducted since mid-June of last year during the late-night hours after the Tohoku Shinkansen services have ended for the day.

The Series E5's most striking feature is its 15 m nose, which is approximately 6 m longer than the noses on existing Tohoku Shinkansen Hayate or Series E2 trains. The streamlined arrow design helps reduce noise when the train enters a tunnel.

This optimal nose design was based on the performance results for the Fastech 360S high-speed Shinkansen test train, which was rigorously tested in 2005 (see sidebar article). The nose shape results in an ideal smaller cross-sectional car body area, minimizing the noise (micropressure waves) generated when the train enters a tunnel. It's so effective that the Series E5, running at a speed of 320 kph, is quieter than the current Hayate running at a speed of 275 kph.

Five of the cars in the ten-car Series E5 test train, including the front car, were produced at Kawasaki's Hyogo Works. The nose takes up more than half the length of the 26.5 m front car. This section was painstakingly manufactured by hand with more time and effort than usual.

● Speeding White Clouds over Evergreens

Made of an aluminum alloy, the new Shinkansen body is green on top and white on the bottom. Like everything else about this train, the colors are special. The *tokiwa* green used on the E5 represents evergreen trees shining brightly in the sun and symbolizes the eternal nature of things. Green is also JR East's corporate color. The *hiun* white represents clouds speeding across the sky and symbolizes being on the cutting edge, as well as speed.

Signature ***tokiwa*** green and ***hiun*** white carbody.

● Tests Focus on Running, Curving and Stopping

The Series E5 is now being tested mainly for its running, curving and stopping performance. These tests don't simply look at the train's performance while running at speeds up to 320 kph. A whole range of aspects are evaluated, including everything from the reduction of micropressure waves in tunnels to the impact of 320 kph high-speed operation on switch points, rail tracks and ballasts, as well as the wind generated by the train. Since running at high speeds increases vibration of the overhead lines, the tests also check whether or not the train's pantographs maintain contact with these lines to ensure the flow of a steady electrical current.

Another important aspect of the train's performance is cabin comfort while traveling along curved sections of track. When the train rounds a curve at high speed, it is subject to an outward centrifugal force, which could affect passenger safety and comfort. All Series E5 cars are equipped with an airspring tilting system that tilts the carbody via airsprings when rounding curves. The innovative system is so effective that the train can round a curved section at high speed without its passengers even being aware that the train is turning.

A train running at high speeds experiences vibrations in different directions due to track distortions and aerodynamics. Lateral vibrations, in particular, significantly affect passenger comfort. To control these vibrations, the Series E5 employs an actuator installed between the bogie and the car body that counteracts the vibrating force. While pneumatic actuators are used in the Hayate trains, a comprehensive vibration control system (full active suspension system) employing an electric actuator with enhanced response characteristics and higher output is installed in all Series E5 cars.

The third aspect is stopping, or braking. In the event of an emergency, especially an earthquake, high-speed trains must be able to come to a swift stop. The Series E5 Shinkansen employs optimal brake controls as well as a new material that enhances adhesion between the rails and wheels to obtain higher braking performance. Thanks to these innovative features, the Series E5 has achieved a braking distance of approximately 4,000 m at 320 kph, which is just as good as the braking performance on the slower Hayate.

1 While the Fastech 360S used two types of nose-shape designs, Kawasaki's design was adopted in the Series E5 due to its better performance.

2 Windshield being installed on the nose.

3 Installing a bogie.

Fastech 360S High-Speed Shinkansen Test Train (E954)

The Fastech 360S is a high-speed Shinkansen test train developed by JR East with an aim to setting a world-record-breaking service operation speed of 360 kph. Kawasaki took part in the Fastech 360S project, in which various cutting-edge technologies were employed to overcome numerous hurdles in the development of stable, durable high-speed trains with a special focus on environmental performance and passenger comfort.

Kawasaki developed the state-of-the-art technique used to create the optimal nose design that cuts down micropressure waves that are generated whenever a train enters a tunnel. The Fastech 360S is also equipped with air brakes* that resemble cat ears to increase air resistance. A number of other cutting-edge technologies were incorporated into the design of this experimental train, including an airspring carbody tilting system and electromagnetic vibration control system that offsets lateral vibrations, which were both developed by Kawasaki, as well as sound-absorbing panels that cover the lower section of the car body. The research and development of the Fastech 360S laid the groundwork for building the new Series E5 Shinkansen, which will take train travel to new limits at a top speed of 320 kph.

*Since these air brakes are not ideally suited to operations at speeds up to 320 kph, they will not be employed in the Series E5.

Photo courtesy of JR East.


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1 Ordinary car seats set the overall design tone with an accent on open space.
2 Green Car interior.
3 Artist's rendering of Super Green Car (tentative name).
4 Kawasaki's proposal for adjustable headrests incorporated in final design.
5 The cockpit is based on the current Series E2 Hayate design.
6 A lavatory so spacious, it can even be accessed by mobility scooter.
7 Large full-color LED sign.

Photos 1 through 7 courtesy of JR East.

Bogie Shrouds and Intercar Fairings Create a Lean, Clean Running Machine

The myriad of devices installed under the car flooring, including an auxiliary power supply and storage units as well as a main transformer, have all been fitted with acoustic materials wherever possible to minimize any noise. Specially designed shrouds have also been installed on the bogies to cut down subfloor mechanical noise. The carbody sides have been covered from top to bottom to make the surface as smooth as possible in order to reduce aerodynamic noise. The bogies were developed in light of the results of the Fastech 360S operation tests, with a keen focus on safety, stability and minimizing weight.

Smooth intercar fairings introduced on the Shinkansen for the first time were developed jointly by JR East and Kawasaki to reduce aerodynamic noise generated from the joining sections between cars. The smoother the car body, the lower the aerodynamic noise. Low-noise pantographs and insulators as well as pantograph noise insulation panels have also been employed to cut environmental noise emissions during high-speed operations.

The Series E5 has a noticeably sleek rooftop. All the devices mounted on the roof have been covered to minimize noise. High-voltage cables (AC 25,000 V) that are fed electricity from overhead lines via the train's pantographs are also installed in the space between the car ceiling and roof.

Full Support for Kawasaki Headrest Concept

The cars' interiors feature warm colors that create a quiet, relaxing atmosphere. Everything has been designed with an eye to providing a spacious, soothing environment where the passenger is treated as a special guest.

The ordinary cars (second-class) feature walls that are a light shade of gray and direct lighting using warm colored lights. Each car consists of five-seat rows in a 2+3 configuration. All the seats boast a greater pitch, or distance between the rows, of 1,040 mm for more legroom than in previous Shinkansen models. Another new feature marks a first for second-class cars: Adopting a Kawasaki proposal, all the seats now have an adjustable headrest for optimal passenger comfort.

The Series E5's seats were designed by Kawasaki Rolling Stock Component Co., Ltd., a Kawasaki group company based at the Hyogo Works that specializes in the design and production of train seats. The company also designed and manufactured seats for JR East's Series E2-1000 Hayate train for Tohoku Shinkansen service and Series E3-2000 Tsubasa train for Yamagata Shinkansen service.

The Green Cars (first-class) feature soothing wood-grain walls and indirect lighting using warm colored lights. The seats are arranged in rows of four (2+2) with a pitch of 1,160 mm, and were designed to remind passengers of clouds floating over a mountain range, accentuating the car's chic, elegant ambience. All seats come equipped with an adjustable headrest, reading lamp and automatic leg rest that can be elevated to an angle of 65 degrees, as well as an electrical outlet.

Super Green Car Takes Comfort to New Heights

Each Series E5 train will have a Super Green Car (the tentative name for the car, which is currently under development). The draft design proposal by JR East features rows of three seats (2+1) with a pitch of 1,300 mm. Each seat is equipped with a power recliner and leg rest, reading lamp, foot light and more. Boasting design specs based on airline business class cabin features, the Super Green Car will offer a quiet and relaxing environment with an emphasis on maximum comfort and luxury.

Saving Time over the Long Run

The Series E5 also features large, full-color LED signs installed in each car. In addition, its barrier-free design offers a totally comfortable, passenger-friendly travel experience. The train is also equipped with lavatories, washbasins, and multipurpose rooms that are all wheelchair and mobility-scooter accessible. There are even lavatories and washrooms exclusively for women. All these great features make the Series E5 a one-of-a-kind Shinkansen with outstanding characteristics.

Test runs of the pre-mass-production Series E5 train have been progressing without any hitches. The Series E5 will debut in the spring of 2011 after the scheduled December 2010 opening of the extension to the Tohoku Shinkansen line between Hachinohe and Shin Aomori. Series E5 trains will initially operate at a top speed of 300 kph, which will then be increased to 320 kph by the end of March 2012. Once 320 kph operations begin, the travel time between Tokyo and Shin Aomori, some 675 km away, will be only 3 hours and 5 minutes.

A sleek carbody featuring bogie shrouds installed on the lower section.

Intercar fairings wrap around the adjoining sections between cars to help reduce aerodynamic noise.

Rooftop components are completely encased.

Bogie developed with a focus on safety, stability and minimal weight.

Shin Aomori Station, currently under construction.

Hachinohe Station. The expanded line to Shin Aomori covers approximately 82 km.

After completing a test run, the Series E5 train returns to JR East's Shinkansen General Rolling Stock Center via Sendai City.

How a Hydraulic Pump Works

Swash plate axial piston pump.

Pascal's Law at Work

Pascal's Law states that when pressure is applied to a confined fluid, that same pressure is conveyed to the fluid in all directions at the same rate. That's exactly what's going on in a hydraulic system.

Hydraulic systems are able to provide a huge amount of pressure using relatively small components. They can instantaneously apply the desired amount of pressure as well as alter fluid speed and direction. They can also easily be controlled remotely (i.e., power can be distributed to distant places). Due to these advantages, hydraulic systems are used in a wide range of applications, including everything from construction machinery, like excavators and cranes, to pressing machines used to bend steel plates, hot rolling mills employed in steel plants, cargo winches and steering mechanisms for marine vessels.

Developed, Designed and Produced by Kawasaki Precision Machinery

Inside every piece of hydraulic equipment is a hydraulic drive system that provides it with hydraulic power. At the core of any hydraulic drive system is a hydraulic pump that supplies the oil (operating fluid) to drive its component units, like the hydraulic cylinders and hydraulic motors.

The Kawasaki Group's Kawasaki Precision Machinery Ltd. (KPM) specializes in the development, design and production of hydraulic and precision equipment. Highly rated for their compact designs, superior reliability and low noise characteristics, KPM's hydraulic pumps are used extensively in construction and industrial machinery.

Hydraulic Pump
Driven by a motor (e.g. electric motor, engine), hydraulic pumps draw in oil from a tank to supply the operating fluid that drives the various system components, such as hydraulic cylinders and motors.

Hydraulic pumps can be categorized into several types depending on the method used to supply the operating fluid. KPM produces swash-plate axial-piston pumps. This pump is characterized by a drive shaft that rotates a cylinder block. Inside the block are pistons that move up and down as they follow along the surface of an angled swash plate. The reciprocating pistons create the pumping action that continually draws in and forces out the fluid.

***Hydraulic cylinder**
A hydraulic cylinder is a mechanical component that moves a rod back and forth to convert hydraulic flow into linear movement.

***Hydraulic motor**
A hydraulic motor is a mechanical component that converts hydraulic pressure into torque on a drive shaft.

• Here are some of KPM's hydraulic equipment and drive systems that are employed in a wide range of applications.

Kawasaki wheel loader

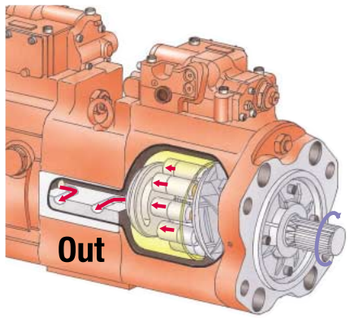
Hydraulic excavator

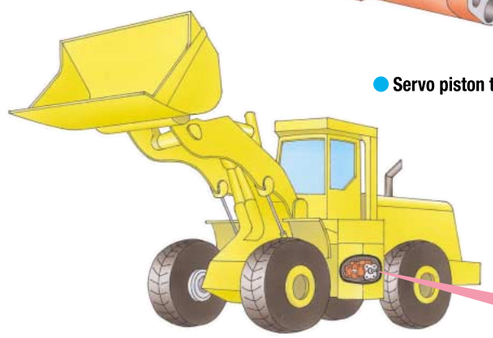
Firefighting vehicle

Injection molding machine

Hydraulic equipment for marine vessels

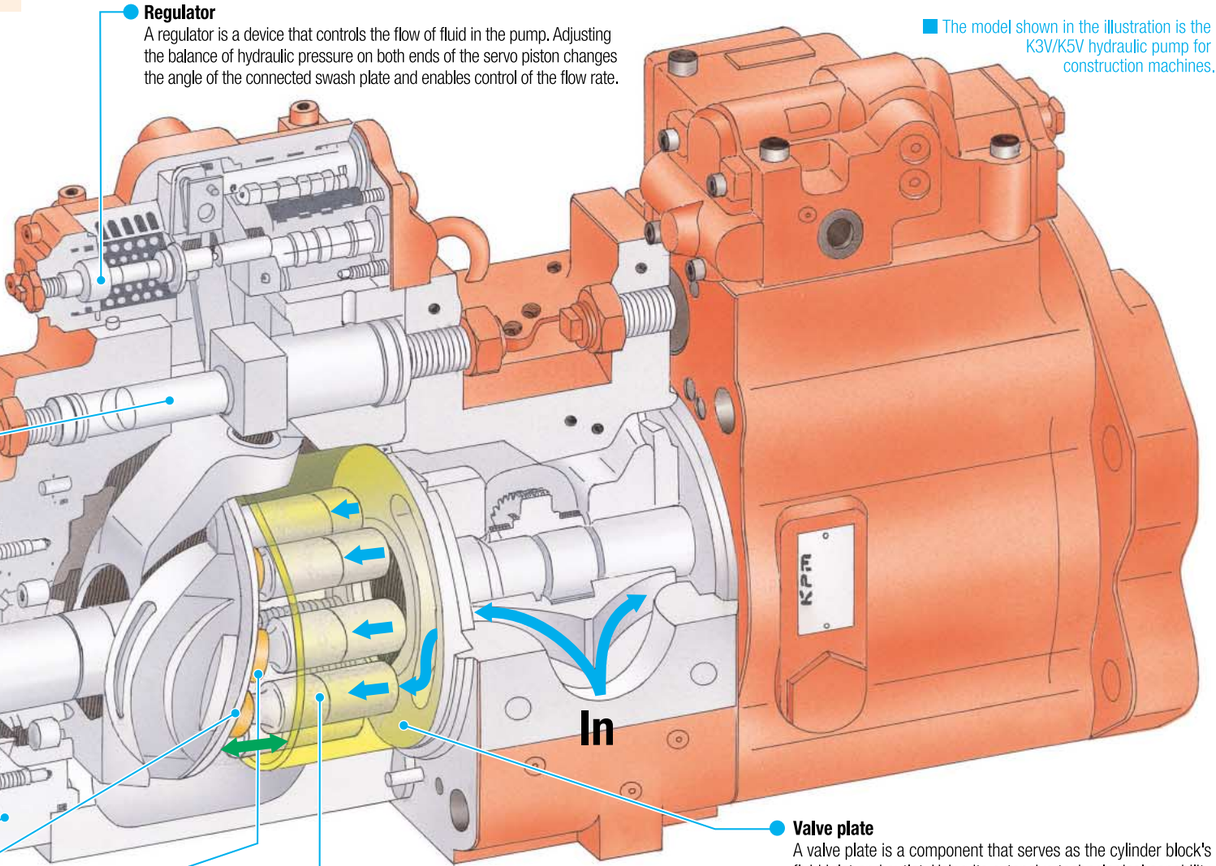
Shield machine





■ The model shown in the illustration is the K3V/K5V hydraulic pump for construction machines.

● Regulator
A regulator is a device that controls the flow of fluid in the pump. Adjusting the balance of hydraulic pressure on both ends of the servo piston changes the angle of the connected swash plate and enables control of the flow rate.



● Servo piston tilt pin

● Drive shaft
The drive shaft is connected to a motor (e.g. electric motor, engine) that delivers the power needed to make it rotate.

● Swash plate support

● Swash plate
As the nine piston shoes (see the section describing the cylinder block) rotate, their ends are pushed against the surface of the tilted swash plate. The angle of the plate, which can be changed to alter the stroke of the pistons and adjust the pump fluid output as desired, causes the pistons to move back and forth through the cylinder opening.

● Piston shoe

● Cylinder block
A cylinder block has nine openings that house pistons. The piston shoes attached to the ends of the nine pistons touch the surface of the swash plate. As the cylinder block rotates, the pistons move back and forth inside their housings. As each piston moves away from the valve plate, it draws fluid through the inlet port and into the cylinder block (intake). When the piston moves toward the valve plate, it forces the fluid (hydraulic fluid) out through the discharge port (output). It's as if nine water pistols were arranged in a circle, each loading and shooting water in a repeated cycle.

● Valve plate
A valve plate is a component that serves as the cylinder block's fluid inlet and outlet. Using its extensive technological capability and expertise has enabled KPM to significantly boost efficiency and reduce the noise emitted by its hydraulic pumps.

5S-H Fairing Has Space Station Cargo Supplier Covered

New Fairing Successfully Splits in Half

August 12, 2009 - It's quiet enough to hear a pin drop on this summer's day at the Harima Works, where joint testing with the Japan Aerospace Exploration Agency (JAXA) of Kawasaki's new 5S-H payload fairing is underway. Then suddenly the silence is broken. "Three, two, one, ignition!" The countdown builds into a thrilling crescendo that culminates with an explosive burst as the payload fairing splits open like a clamshell and its two halves fall to either side. The test is a success. JAXA gives the fairing's separation and release function the thumbs up.

Special Protective Casing for HTV

JAXA is currently working on a project to launch the H-II Transfer Vehicle (HTV), an unmanned cargo transporter designed to deliver food, devices used in experiments and other supplies to the International Space Station (ISS*). The HTV is a 10 m long cylinder with a diameter of 4.4 m that can carry up to 6 tons of supplies. It weighs 16.5 tons when fully loaded, making it the heaviest payload ever developed in Japan.

The H-IIB launch vehicle developed to put the HTV into space is a 56 m long rocket with 1.4 times the launch capacity of its 53 m long predecessor, the H-IIA. The 5S-H payload fairing was developed especially to launch the HTV via the H-IIB launch vehicle.

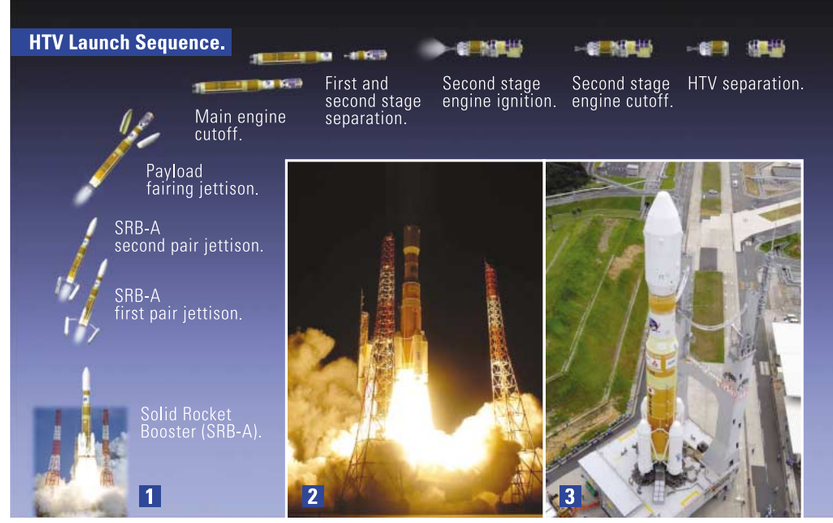
*The ISS is a research facility being constructed through a 15-nation joint project, including Japan, the United States, Russia, Canada and 11 other countries affiliated with the European Space Agency. The various scientific experiments and astronomical observations conducted on the ISS take advantage of the special characteristics of the space environment, such as zero gravity, with an eye to using the results to find new industrial applications and enhance our lives on earth.

30 Precision-Built Fairings and Counting

Payloads, like satellites and the HTV, are mounted on the top of a launch vehicle. Payload fairings are designed to protect these payloads against the impact of the atmosphere during liftoff.

The fairing must have a degree of rigidity and tensile strength sufficient to withstand the aerodynamic load during the ascent. It must be equipped with heat-resistant and noise-reduction features that will insulate the payload from aerodynamic heating and noises. It must also meet a host of other strict requirements such as minimal weight and the ability to separate and release a payload into space with precision accuracy.

Over the last 10 years, Kawasaki has leveraged its unique strengths in aerospace technologies, including composite structures and thermal dynamics, to provide Japan's space industry with payload fairings that have been built entirely in-house. To date, Kawasaki has developed five models to accommodate various payload sizes and produced a total of 30 fairings, including those used for tests. Kawasaki's fairings have earned an enviable track record with the successful operation of every fairing that has ever been installed on a launch vehicle.



1 Flight sequence for the H-IIB Launch Vehicle Test Flight launched on September 11. The payload fairing was successfully jettisoned about 220 seconds after liftoff. On September 18, the HTV was successfully berthed at the ISS as scheduled. 2 Liftoff. 3 The 5S-H payload fairing installed on the tip of an H-IIB Launch Vehicle. [Source: JAXA]

Separation System's Explosive Burst Jettisons Fairing

Kawasaki's payload fairings employ a honeycomb sandwich structure (a honeycomb core sandwiched between two aluminum plates, or skin, with a thickness of 0.4 to 0.6 mm) resembling a clamshell. The fairing is separated by electrically detonating the explosive section of the separation system installed on the clamshell joint. During testing, 558 bolts joining the clamshell halves were blown via detonation, successfully separating the fairing into two pieces.

The 5S-H payload fairing, developed by Kawasaki specifically for the HTV according to JAXA's specifications, measures 5.1 m in diameter. The diameter is the same as that of the fairing for the H-IIA launch vehicle, but the length has been extended 3 meters to reach a total of 15 m. The 5S-H also incorporates entirely new features designed exclusively for the HTV, including a large access door that enables operators to access the HTV after its encapsulation for final ground inspections.

From Components to Finished Fairings

Fairing components manufactured at Kawasaki's Gifu Works are assembled at the Harima Works' fairing assembly plant. Since the 5S-H's body is 3 m longer than conventional fairings, it was assembled in two sections, requiring more processes and greater production control. The aluminum skin that is bonded to both sides of the honeycomb core is extremely thin and must be handled with utmost care to avoid causing the slightest damage to the surface. Some of the components require precision machining to a hundredth of a millimeter. It was an intense period of time for the shop floor workers at the assembly plant, but their professionalism paid off.

All Systems Go as Test Flight Puts HTV into Orbit

The H-IIB Launch Vehicle Test Flight for the HTV Demonstration Flight blasted off on Sept. 11, 2009 from the Yoshinobu Launch Complex at JAXA Tanegashima Space Center, carrying food, devices used in experiments and other supplies. Just 220 seconds after liftoff — after the launch vehicle had left the earth's atmosphere — the payload fairing was jettisoned as scheduled, successfully putting the HTV on its intended course.

Kawasaki designed and installed some of the main facilities at the Yoshinobu Launch Complex, including the Vehicle Assembly Building, Mobile Launcher, Liquid Hydrogen Storage, and spacecraft and fairing assembly workstation. Prior to the launch of the H-IIB launch vehicle, Kawasaki also renovated the Vehicle Assembly Building, which had been designed for H-IIA launch vehicles. The extensive renovations were made to tailor the building to a vehicle with a larger diameter. The work involved modifications and upgrades to the movable floor, which serves as an assembly stage, and more. Kawasaki worked on the renovation project for over three years before completing the design and installation work as initially planned.

Under the ISS project plan, Japan is responsible for transporting supplies to the space station via the HTV. A total of seven HTVs, one a year, are scheduled to be launched beginning this year. Kawasaki's special payload fairings will be used for all of the scheduled HTV flights.

The 5S-H payload fairing at the test facility.

The 5S-H splits into halves upon detonation.

First eight-car train of PA-5 railcars delivered

Kawasaki Rail Car, Inc. (KRC), based in Yonkers, New York, recently delivered the first eight of 340 next-generation PA-5 railcars to Port Authority Trans-Hudson Corporation (PATH). Ordered in May 2005, the cars are for commuter service between New York and New Jersey.

The PA-5 railcars are equipped with cutting-edge technology that controls HVAC (heating, ventilation and air conditioning), doors and public address systems to guarantee optimum safety and passenger comfort.

The eight-car train was manufactured and tested at Kawasaki's Hyogo Works. KRC performed the testing and received conditional acceptance by PATH before delivery. The remaining 332 car bodies will be manufactured at Kawasaki's railcar plant in Lincoln, Nebraska, and equipment installation, final assembly and testing will be conducted at the plant in Yonkers.

KRC was awarded and executed the contract to produce 94 PA-4 cars and the rehabilitation of 248 PA-1, 2 and 3 cars in 1984. Following delivery of the new PA-5 cars, the existing PA-1, 2 and 3 cars will be gradually decommissioned.

Once all of the PA-5 cars are delivered in 2011, PATH's entire fleet will be replaced with cars manufactured by Kawasaki.

Offshore Gas Compression Project in India

Kawasaki recently received an order from Afcons-Gunanusa Joint Venture (AGJV) in India to provide a gas turbine-driven natural gas compressor and engineering services for an offshore gas compression module. The module will be installed off Mumbai on the site of the ICP-R Process Platform Project, which is part of the Mumbai High South Re-Development (Phase II) Project operated by the Oil and Natural Gas Corporation Limited (ONGC).

The compression module is a compact unit comprised of a compressor, driver, gas cooler, scrubber, valves, controllers and other equipment that compresses natural gas at sea and transports it to land via underwater pipelines. Its modular design enables optimum installation in the limited space available on an offshore platform.

The module will be assembled at Gunanusa Utama's assembly yard in West Java, Indonesia, before being installed on a process platform. The platform is scheduled to be delivered to ONGC in April 2011.

This marks the 51st order for a Kawasaki compression module and the 35th to India.

XC-2 Test Aircraft for Japanese Defense Ministry Completes First Flight

Kawasaki's #1 test XC-2 transport aircraft completed a successful first flight at its Gifu Works on January 26.

The aircraft took off from the Japan Air Self-Defense Force's Gifu Airbase at around 10:21 a.m. and landed safely after an approximately 71-minutes flight. It was piloted by Captain Satoshi Hasebe and Copilot Susumu Ishida, both from Kawasaki's Flight Test Section, as well as nine other crew members. The captain commented, "I'm glad that we successfully completed this much-anticipated first flight. I would like to thank everyone involved in this project for their hard work and cooperation. The plane's flight performance and operability were superb, and I can say without a doubt that it's a great plane that will fully meet the requirements from the Ministry of Defense."

The Ministry of Defense began development of the XC-2 in 2001 as a replacement of the current C-1. It has been developed concurrently with the XP-1 fixed-wing maritime patrol aircraft. In November 2001, Kawasaki was nominated as a prime contractor for developing these airplanes with aircraft manufacturers and other participating companies.

Kawasaki will continue to conduct in-house flight tests for the XC-2 at its Gifu Works. The aircraft is scheduled for delivery to the Ministry by the end of March 2010.

Joint Venture Will Produce Gasoline Engines in China

Kawasaki reached an agreement in mid-2009 with Kwang Yang Motor Co., Ltd. (KYMCO) of Taiwan to establish a joint venture company, Changzhou Kawasaki and Kwang Yang Engine Co., Ltd., for the production and sales of general purpose gasoline engines. The new joint venture company constructed an engine factory in the Changzhou National Hi-tech District and went online in January.

The factory has an initial production capacity of approximately 200,000 units per year. The two-stroke engines and four-stroke single cylinder engines will be sold to original equipment manufacturers via Kawasaki's sales networks in Japan, Europe, the U.S. and elsewhere.

Before starting the joint venture, Kawasaki had been consigning the production of its gasoline engines to KYMCO's Chinese subsidiary, Changzhou Kwang Hsing Precise Machine Co., Ltd., since November 2008.

The new company is positioned as Kawasaki's third production base for general purpose gasoline engines following those in Japan and the U.S. The joint venture will enable Kawasaki to build an even stronger production foundation designed to meet a diverse range of customer needs.

Overview of Joint Venture

1. Company Name: Changzhou Kawasaki and Kwang Yang Engine Co., Ltd.
2. Location: Changzhou, Jiangsu Province, the People's Republic of China
3. Capital: US$5 million (JPY475 million*)
4. Capital Ratio: 50% Kawasaki Heavy Industries, Ltd.
   50% Kwang Yang Holdings Limited (KYMCO's wholly owned subsidiary)
5. Description of business: Production and sales of general purpose gasoline engines and parts
6. Production Capacity: Approximately 200,000 units/year
   (Increasing to 1 million units/year in five years)

*Calculated at 95 yen to the U.S. dollar

Ceremonies for 25th Anniversary of CH-47 Licensing

Ceremonies celebrating the 25th anniversary of the first licensing agreement for the CH-47 helicopter were held at Kawasaki's Tokyo Head Office and its Gifu Works in late October. The ceremonies were attended by representatives of Boeing, and Itochu Corporation, with a number of Kawasaki officers also taking part. Both ceremonies featured speeches and gift exchanges, providing an opportunity to solidify the continuing partnership among the three companies.

Kawasaki has participated with Boeing as a partner in the international joint development and production of civil aviation aircraft such as the Boeing 767, 777 and 787. Since signing its first licensing agreement with Boeing in 1984, Kawasaki had delivered a total of 84 CH-47 helicopters to the Ministry of Defense as of March 2009, including 56 to the Japan Ground Self-Defense Force and 28 to the Japan Air Self-Defense Force. In recent years, these CH-47s have been used to provide relief assistance to victims of the Niigata earthquake as well as to aid emergency relief efforts following the Sumatra earthquake. The CH-47 to be produced under the licensing agreement renewed in FY 2009 will incorporate some upgrades for enhanced performance (such as a new engine and equipment, including a transportability kit and more) that will further expand its scope of use.

LNG Jupiter Carrier Delivered

Kawasaki Shipbuilding Corporation recently delivered the *LNG Jupiter* carrier to Lloyds TSB Equipment Leasing (No.7) Limited.

The vessel, identified as Kawasaki Hull No.1592, is the third in Kawasaki's new line of 153,000 m^3 LNG carriers. While the new vessel's capacity has been increased by about 8,000 m^3 due to the installation of a 2 m tall cylindrical extension at the midsection of the four aft tanks, the size of the hull is the same as a 145,000 m^3 LNG carrier, enabling the vessel to enter most major LNG terminals around the world.

The *Jupiter* features excellent thermal insulation performance owing to the Kawasaki Panel System, which achieves a boil-off rate of 0.15 percent per day. The cargo tanks are protected against direct damage by double hulls and double bottoms.

Other features of this 289.5 m long ship include a computer-controlled navigation system in the wheelhouse that improves operability by integrating conventional navigation systems located in various areas of the vessels, as well as a 360° view window that ensures safe sailing.

Monitoring and control of cargo-handling is achieved by an Integrated Automation System (IAS) in the cargo control room, positioned for the best view of cargo-handling operations. The engine control room is also equipped with an IAS.

The vessel has a number of features that ensure the performance of its equipment under low-temperature conditions and enable it to operate in cold climates where the atmospheric temperatures reach -25°C and seawater temperatures are as low as -2°C. These features include enclosed navigation bridge wings, full compliance with Class NK winterization requirements, and an air-bubbling system that prevents the ballast tanks from freezing. The lower ends of the tank covers, which are subject to greater stress than other areas, use anti-fatigue steel to improve fatigue life.

6,000 kW Cogeneration System Ordered for Indonesian Plant

Kawasaki Gas Turbine Asia Sdn. Bhd. (KGA), Kawasaki's Kuala Lumpur-based gas turbine sales and service subsidiary for southern and southeastern Asia, recently received an order for a 6,000 kW gas turbine cogeneration system. KGA worked jointly with PT Euroasiatic, an Indonesian engineering firm, and Sojitz Corporation and its Indonesian subsidiary, PT Sojitz Indonesia, to earn this order from PT Amerta Indah Otsuka, a subsidiary of Otsuka Pharmaceutical Co., Ltd. The cogeneration system will be installed in Amerta Indah Otsuka's new beverage production plant.

The system, completed at the end of 2009, consists of a natural gas-fueled gas turbine power generation system, which can also be powered by liquid fuel in an emergency, employing Kawasaki's proprietary M7A-02 gas turbine and a waste heat recovery boiler. The system not only generates power but also recovers exhaust from the gas turbine power generation system using a heat recovery boiler that then supplies steam to the plant, resulting in an overall efficiency rate of more than 80%. The system will supply power and steam to the plant's production facilities, contributing to lower energy costs and a stable power supply. Kawasaki supplied the gas turbine power generation system while PT Euroasiatic was responsible for procurement of the boiler and auxiliary equipment as well as installation work.

Unstable electricity supplies in Indonesia have given rise to a growing number of gas-fueled in-house power plants, mainly in urban and industrial areas where natural gas pipelines are being installed. Demand for gas turbine cogeneration systems in Indonesia is expected to increase.

Kawasaki first delivered a 3,000 kW class cogeneration system to Indonesia in 1994. Since then it has delivered a total of 15 gas turbines to the Indonesian market. The M7A-02 gas turbine, the core component of the latest delivery, is one of Kawasaki's best-selling products. Between 2004 and 2009, Kawasaki received orders for eleven M7A-02 gas turbines in the Indonesian market.

This latest order is a testament to the superior environmental performance and lifecycle cost of Kawasaki's gas turbine cogeneration systems as well as the company's outstanding technological capabilities. Kawasaki has established a proven track record in the Indonesian market, where its excellent customer support services have also earned high marks.

Kawasaki will step up its efforts to expand the market for cogeneration systems in southern and southeastern Asia via KGA, and leverage its global sales network encompassing Southeast Asia, North America and Europe, as well as the Middle and Far East to make further inroads into the global market.

KLX125 and D-TRACKER 125 Motorcycles Launched in Japan

KLX125

D-TRACKER 125

Kawasaki launched two new motorcycle models in the 125 cc class in Japan in December. The new dual-purpose KLX125 and motard* D-TRACKER 125 boast superior environmental performance and nimble handling.

Due to the ease of obtaining a driver's license as well as the downturn in the economy, 125 cc motorcycles have become increasingly popular in Japan among beginners looking for an entry model, as well as among big bike owners looking for a second motorcycle. Lightweight and compact, these motorcycles are favored as commuter bikes by urban riders due to their agility and convenience.

The KLX125 and the D-TRACKER 125 combine all the rider-friendly, versatile characteristics of compact motorcycles in bikes that are sheer fun to ride. They feature a 124 cm^3, air-cooled, four-stroke, fuel-injected single-cylinder SOHC engine designed for superior fuel economy and environmental performance in compliance with the new Japanese exhaust emissions regulations. Both models come equipped with a five-speed manual transmission and are fitted with exclusively designed frame and chassis components for optimal styling and riding performance.

The KLX125 and the D-TRACKER 125 are fitted with different suspensions and tires to fit their unique concepts. The KLX125's front suspension features a shock-absorbing, long-stroke conventional fork for enhanced on- and off-road performance, and 19-inch front and 16-inch rear tires are installed. The D-TRACKER 125 employs the same kind of inverted fork usually found on high-end models to provide enhanced stability on the road. Its 14-inch front and rear on-road tires go excellently with its 125 cc motard styling.

*Motard typically refers to an off-road motorcycle fitted with smaller on-road tires.

Three Kawasaki Subsidiaries to Be Remerged

Kawasaki will remerge Kawasaki Shipbuilding Corporation, Kawasaki Precision Machinery Limited (KPM), and Kawasaki Plant Systems, Ltd. (K Plant) into Kawasaki Heavy Industries, Ltd. as of October 1, 2010. The Kawasaki Board of Directors made the decision at the September 2009 board meeting.

Guided by the mission statement adopted in 2007, Kawasaki has been working to create new value for a better environment and a brighter future by applying its advanced technological capabilities across a broad range of fields.

These goals provided the basis for Kawasaki's decision to remerge Kawasaki Shipbuilding, KPM and K Plant. It's a move that will enable Kawasaki to achieve maximum efficiency in leveraging the Group's technological assets and human resources. Creating new value involves making existing products smarter through innovation and developing new products in totally new fields. The newly united Group will allow Kawasaki to meet the challenges of doing so.

From left: President Hayashi, K Plant; President Hasegawa, KHI; President Taniguchi, Kawasaki Shipbuilding and President Sonoda, KPM.

Aboard the Airliner of the Future

Boeing 787 Dreamliner successfully completed its first flight on December 15, 2009.

The innovative 787 is the world's first airliner in this class to be built of composite materials and features superior fuel efficiency. Kawasaki, which has worked with Boeing on its commercial airliners since 1974 and has been a partner in the 787's development program from the beginning, is responsible for the development and production of the new airliner's main components, including the forward fuselage, main landing gear wheel well, and the wing fixed trailing edge. The forward fuselage features a composite one-piece structure produced with an autoclave that is the largest class in the world.

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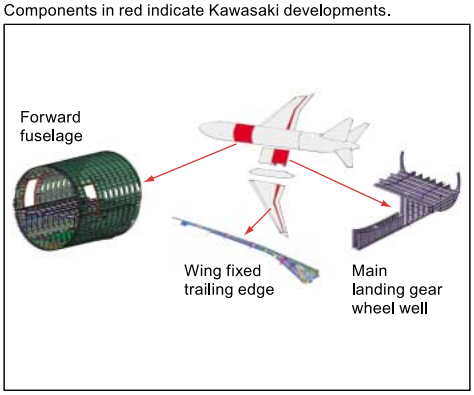
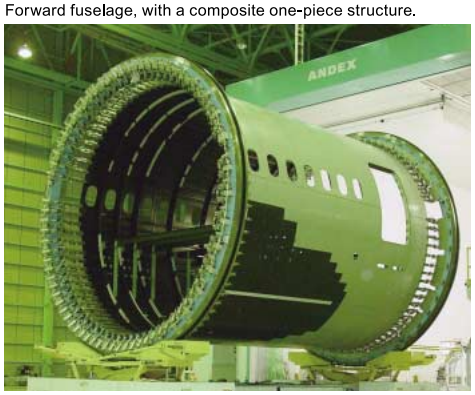
Components in red indicate Kawasaki developments.



Forward fuselage, with a composite one-piece structure.



Autoclave at the Nagoya Works (high-temperature, high-pressure curing system).

Kawasaki