Kawasaki Heavy Industries
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Scope

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Contents

120th Anniversary Logo

Kawasaki will mark its 120th anniversary on October 15 this year. With this logo, we wish to express a symbol of trust backed by 120 years of history and tradition as well as our continued commitment to meeting the needs of society and further improving corporate value —a task we take on through products and services employing advanced technologies.

About the Cover

MULE PRO-FXT being driven off-road. See Techno Box for further details.

To the Northern Land

The Hokkaido Shinkansen entered commercial service on March 26, 2016, marking the first step in extending Japan's high-speed rail lines into Hokkaido, Japan's northernmost island. Half a century after the Tokaido Shinkansen commenced operations in 1964, the network of Shinkansen lines now runs all the way from Hokkaido to Kagoshima, covering a total distance of 2,150 km. The trains that will be running to the new frontier are called the Series H5, built to order for Hokkaido Railway Company (JR Hokkaido). The first set of these trains was delivered by Kawasaki.

The Series H5, Designed for Hokkaido

Initially, the Hokkaido Shinkansen will link the 149 km section from Shin-Aomori Station (Aomori City), the northernmost stop of the Tohoku Shinkansen, to Shin-Hakodate-Hokuto Station (Hokuto City, Hokkaido). The new trains have a top speed of 260 km/h, the same as those of the Hokuriku Shinkansen and Kyushu Shinkansen. The fastest trains will travel between Tokyo and Shin-Hakodate-Hokuto in just four hours and two minutes.

The new Series H5 trains, which JR Hokkaido introduced for the Hokkaido Shinkansen, are based on the Series E5, operated by East Japan Railway Company on the Tohoku

Shinkansen line. The Series H5 features enhancements that enable the trains to withstand the harsh winter weather of Hokkaido. In addition, both the interior and exterior of the Series E5 are designed on the theme of a “Prologue of the North Experience,” so the trains heighten passengers’ expectations for the journey ahead.

Work is already under way to extend the Hokkaido Shinkansen line from Shin-Hakodate-Hokuto to Sapporo, with the 212 km section slated to begin operations by the end of fiscal 2030. When this project is completed, the network of Shinkansen lines will span the entire length of Japan, from Japan’s major city of the north all the way to Kagoshima at the southern tip of Kyushu.

Technologies to Fight the Cold Weather, Condensation and Ice

The Hokkaido Shinkansen was launched before an expectant crowd at the opening ceremony on March 26. The Series H5 cars developed for JR Hokkaido were primarily designed by Kawasaki, which delivered the first trainset. As work progresses on building the extension to Sapporo, numerous challenges will need to be addressed, including various problems associated with operating in cold regions. According to Kawasaki personnel involved in the project, the opening of the Hokkaido Shinkansen is a milestone for the company’s rolling stock technologies and marks the start of new challenges and technological innovation.

Nobuyoshi Takehiro, who led Kawasaki’s team that designed the car body of the Series H5 Shinkansen, commented, “Although the Series H5 is based on the Series E5, the development involved reinforcing the trains to withstand the unique harsh winter conditions. And that entailed not just dealing with snow but also finding a way to prevent icing.”

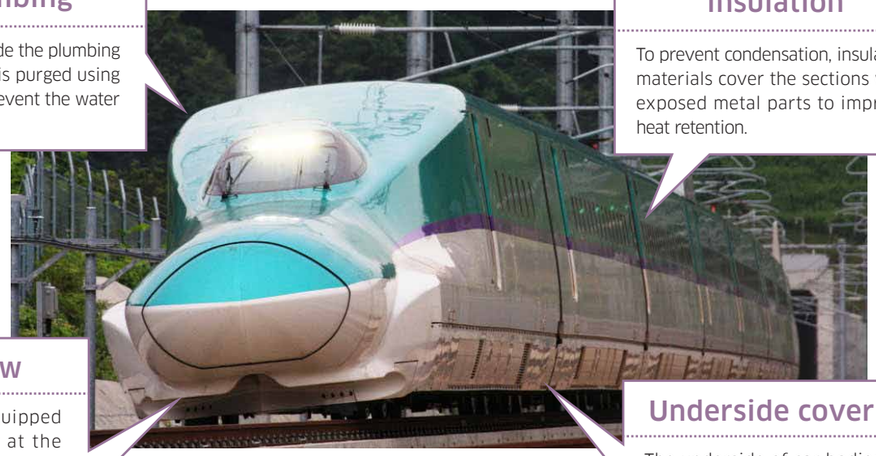
The Series E5, which was developed for the Tohoku Shinkansen, already has a number of design features for cold regions. For example, the underside of the cars is covered to prevent snow from accumulating on electrical systems such as motors and to keep out the wind while traveling at high speeds. The lead car is fitted with a snowplow for clearing snow from the tracks. According to Takehiro, the Series H5 required additional improvements in three areas: condensation, snow and icing.

Nobuyoshi Takehiro
Senior Staff Officer, Engineering Section 1, Engineering Department, Engineering Division, Rolling Stock Company

Ryo Tahara
Eastern Region Marketing Department, Marketing & Sales Division, Rolling Stock Company

Tsutomu Maeda
Manager, Transportation Section, Transportation Department, Kawasaki Rolling Stock Component Co., Ltd.

Cold Weather Features of the Series H5



Anti-icing measures for plumbing

Water remaining inside the plumbing pipes of toilets, etc. is purged using compressed air to prevent the water from freezing.

Enhanced thermal insulation

To prevent condensation, insulating materials cover the sections with exposed metal parts to improve heat retention.

Snowplow

The lead car is equipped with a snowplow at the front for clearing snow from the tracks. The trains can travel at normal speeds in snow of depths up to 30 cm.

Underside cover

The underside of car bodies, where the bodies and electrical systems such as motors are mounted, is covered to keep out the wind and snow.

Of the 149 km section that was recently opened, the Seikan Tunnel accounts for 54 km. The temperature inside the tunnel is kept at 20°C and the humidity at 80 to 90% all year round. On the other hand, the average temperature in Aomori and Hakodate during the coldest time of the year is 1 to 2°C below zero. When a cold train suddenly enters a tunnel where both the temperature and humidity are high, condensation forms instantly, and then when the train exits the tunnel back out into the cold, the condensation freezes, damaging parts and components. Because of the speed at which the Shinkansen travels, even a small amount of snow or ice can severely damage the car body. Sections with exposed metal parts are particularly susceptible to condensation, so they are tightly covered with insulating materials, taking care not to leave any gaps.

In terms of measures against snow, repeated tests were conducted to ensure the brakes work as designed when traveling at high speeds in snowy conditions.

Even more care went into developing anti-icing measures for various systems and equipment. One example is the water used to flush toilets. While the trains are stored at a depot overnight, any water remaining in the plumbing pipes may freeze, causing the pipes to burst. To prevent this, the piping is provided with a drain, along with other technologies such as using compressed air to purge the water remaining in the pipes. “The Series H5 is able to purge all water remaining in plumbing pipes even if the main power supply is cut off,” explained Takehiro. “Such invisible efforts are the basis of operational safety.”

Major Project Supported On-Site

Ryo Tahara, a Kawasaki sales rep, played a key role in the success of this major project. Working closely with JR Hokkaido project

Manufacturing Processes of the Series H5

Production and assembly of body shells

Car body shells are created by welding long-shape materials together to create the side structure, then welding it together with an underframe to form a box-shaped shell.

Painting

To prevent corrosion, the metal body shells are coated with antirust, which is scarlet, before color paints are applied.

Outfitting

Piping, electric wiring, parts, etc. are fitted inside the cars and under the floor. Operators work with care and precision, often in uncomfortable positions.

Bogie installation

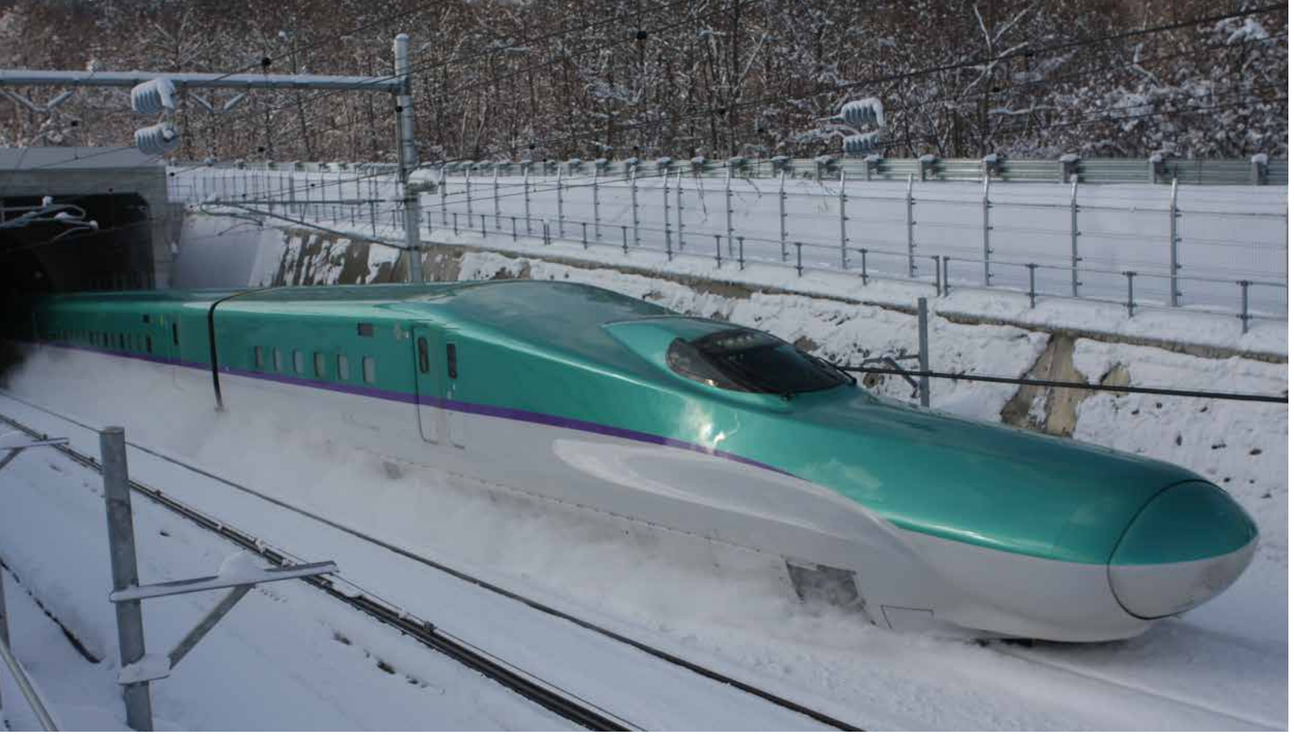
Body shells and bogies manufactured separately are joined together. The body shells are lifted up and the bogies are slid under, then the body shells are lowered onto the bogies.

Final inspection

An inspection is carried out to ensure that everything is in place and works as designed, including the seats.

Functional tests and on-premise test run

Tests are conducted on the premises of the Hyogo Works in the final inspection of the train’s operations and equipment. If no problems are found, the trains are shipped out.



staff in Sapporo, he was instrumental in ensuring that the development of the Series H5 went smoothly. “I made sure that all questions and requests of the client got through to our design department,” he said, “whether general concepts and ideas, or specific requests for improvement.”

The most nerve-racking moments for the project team came during inspections, especially those carried out midway through the development process and at the very end.

“Even a small chip remaining on machined parts, for instance, could cause a malfunction in the future,” explained Tahara. “For this reason, we made utmost effort to ensure that our inspections were really thorough. This is part of our commitment to the safety of passengers using our trains.”

The project team had to incorporate various requests for improvement by the time of the final acceptance inspection. Even after the trains have been delivered, we maintain close relations with the client to keep the trains in good working order. Tahara recalled, “Our client values our ability to resolve new challenges, and asked us to perform various technical verifications. I am truly grateful to our engineers who faithfully handled every request.”

Approaching Storm Forces a Change of Route

The first of the four Shinkansen trainsets that were to be operated when the Hokkaido Shinkansen launched services was shipped from Kawasaki’s Hyogo Works in October 2014. Tsutomu Maeda, who was responsible for transporting the trains, said, “A single completed car weighs several tons, and so these cars must be transported with utmost care. They must be handed over to the client free of the slightest imperfection—not even a single scratch is permitted.” The transportation of the first 10-car set, however, faced an unexpected problem.

The first shipment was scheduled to arrive at Hakodate Port on October 13 and receive a welcome ceremony. In addition to local government representatives, some 200 children from local kindergartens were invited to the event. It takes three days for the train cars to be transported by sea from the Hyogo Works to Hakodate Port, so work began on October 8 to load the cars onto barges at the Works. But a strong typhoon—Typhoon Vongfong—was approaching Japan.

According to the weather forecast, the typhoon was projected to move north along the Pacific coast of Japan. “The cars were transferred to a transport vessel at Kobe Port, but the vessel might have been hit by the typhoon if it had sailed up the Pacific coast,” recalled Maeda. “So at the last moment we decided to sail up the coast of the Sea of Japan. We weren’t sure if we would make it by the ceremony on the 13th, and were really nervous.”

In the end, the ship reached Hakodate Port seven hours before the welcome ceremony. The wind was picking up strength due to the approaching typhoon. Given the conditions, there was great relief when the lead car, weighing some 31 tons even without a bogie, was successfully unloaded.

From Hakodate Port, the cars were transported by road to the Hakodate General Rolling Stock Depot in Nanae-cho. Test runs—an essential process for ensuring that the trains are safe to operate—began on December 1, 2014, and continued nonstop until services began on March 26, 2016.

The Hokkaido Shinkansen embodies the hope for renewed growth in Japan’s northern land, and Kawasaki’s rolling stock technologies will play a key role underpinning this great enterprise.

The first train of the Series H5 Shinkansen arrived at Hakodate Port on schedule on October 13, 2014, despite an approaching typhoon. The photo shows the lead car being unloaded.

Hokkaido Shinkansen launched on March 26

Early in the morning of March 26, 2016, a send-off ceremony was held for the first train leaving Shin-Hakodate-Hokuto Station bound for Tokyo. Many people involved in the project gathered to celebrate the occasion.

From the Project Team

By Junichi Terai

Vice Executive Officer, General Manager, Engineering Division
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Joint Creation Approach by Manufacturers and Customers is Highly Acclaimed by Railroad Companies around the World

In the United States and Europe, railroad companies normally purchase rolling stock that has already been manufactured, but in Japan railroad companies and manufacturers traditionally work closely together from the design and development stage, firming up the details of the specifications and jointly conducting technical verifications. In other words, rolling stock in Japan is a joint creation by manufacturers and customers.

The Series H5 for the Hokkaido Shinkansen was also developed jointly by Kawasaki and JR Hokkaido, including the future extension to Sapporo and the challenges that are likely to arise.

In the U.S., Kawasaki has received numerous orders for rolling stock from major transportation authorities in cities such as New York, Washington and Boston. In Asia, major contracts have been awarded in Taiwan and Singapore. This track record attests to the solid reputation overseas of Kawasaki’s joint development approach that has been honed through rolling stock manufacturing in Japan.

The technologies behind rolling stock and high-speed trains in particular are reaching new levels. Some trains already operate at 320 km/h, and to achieve even higher speeds, state-of-the-art knowledge is required in the development of the motors and brakes, as well as the shape of the leading end and car bodies. Accordingly, we will work together with the Corporate Technology Division—Kawasaki’s think tank—to attain technological synergies with in the company in areas such as aerodynamic analysis technologies cultivated through aircraft development, thus leveraging our strengths as a rolling stock manufacturer within a comprehensive heavy manufacturing company. We also plan to utilize the supercomputer K, which is located in Kobe, for development. Through this and other measures, we will differentiate ourselves from other rolling stock manufacturers.