Creating the World's Most Environmentally-Friendly High-Speed Train

JR East is endeavoring to develop the world's leading high-speed train – the Shinkansen that superior in many ways: speed, safety, comfort, and environmental performance. Creating this new high-speed train will increase the convenience of rail transport while reducing the CO_2 emissions. It will promote a shift from other modes of transport, and lead to the reduction of society's overall CO_2 emissions.

"We have already made a variety of improvements in the environmental features of *Hayate* Shinkansen trains, which are now in use," says Yusuke Wakabayashi, of the Environmental Technology Group, Advanced Railway System Development Center, JR East Research & Development Center.

The major environmental impacts of the Shinkansen are noise, energy consumption, and the sonic boom when the train enters a tunnel. As an example of the measures taken, to eliminate wind-noise from the pantograph which draws electricity from the overhead wires, the pantograph covers and the overall shape of the pantograph were improved. Also, meticulous changes were made to produce more streamlined railcar bodies.

As for energy consumption, by making improvements such as reduction in the weight of railcar bodies, the Shinkansen's energy consumption was reduced by about 30% compared to 20 years ago. Regenerative brakes utilize energy generated during the braking of trains: the train motors generate electricity during braking, and return this electricity to the overhead wires.

To deal with the sonic boom, an explosive sound caused by compressed air exiting a tunnel when a train enters it at a high-speed, the shape of railcars and tunnel entrances were redesigned. In such ways as these, countless improvements were made to reduce the environmental impacts of the Shinkansen.

Profiles of Shinkansen trains currently in operation. Many steps have already been taken to reduce their environmental impacts.

These certainly make a train excellent, but in order to become the best high-speed train in the world, it is still necessary to take further measures for the environment. Three years ago, JR East set a goal of developing the best high-speed train in the world: a train that could run safely and comfortably at 360 km/h, and also be environmentally sound. Since then, the development team has been tackling this bold challenge.

Innovative ideas create a quieter train

In June 2005, a prototype model of FASTECH 360S, with the aim of creating the world's best high-speed train, was completed. Besides improvements in all technologies and better overall environmental performance, the prototype railcars incorporate designs that overturn conventional engineering wisdom.

One of these is the installation of sound-absorbing material as part of the train body. The bottom and sides of train bodies are covered with such sound-absorbing material, which reduces the amount of noise that would otherwise reverberate between soundproof walls along the railway tracks and the train body, before disappearing into the surrounding air. However, because sound-absorbent material is not strong, it is easily damaged by bouncing gravel and other objects. Engineers had originally thought that it made no sense to attach sound-absorbent materials to the exterior surfaces of the railcar body. Other noise-reduction innovations include a newly-developed, low-noise pantograph with better performance, allowing them to reduce the number from two to one per train. In addition, new and higher-performance sound-dampening panels with improved cross-sectional profile were developed and installed.

In order to further reduce the noise caused by trains

Yusuke Wakabayashi
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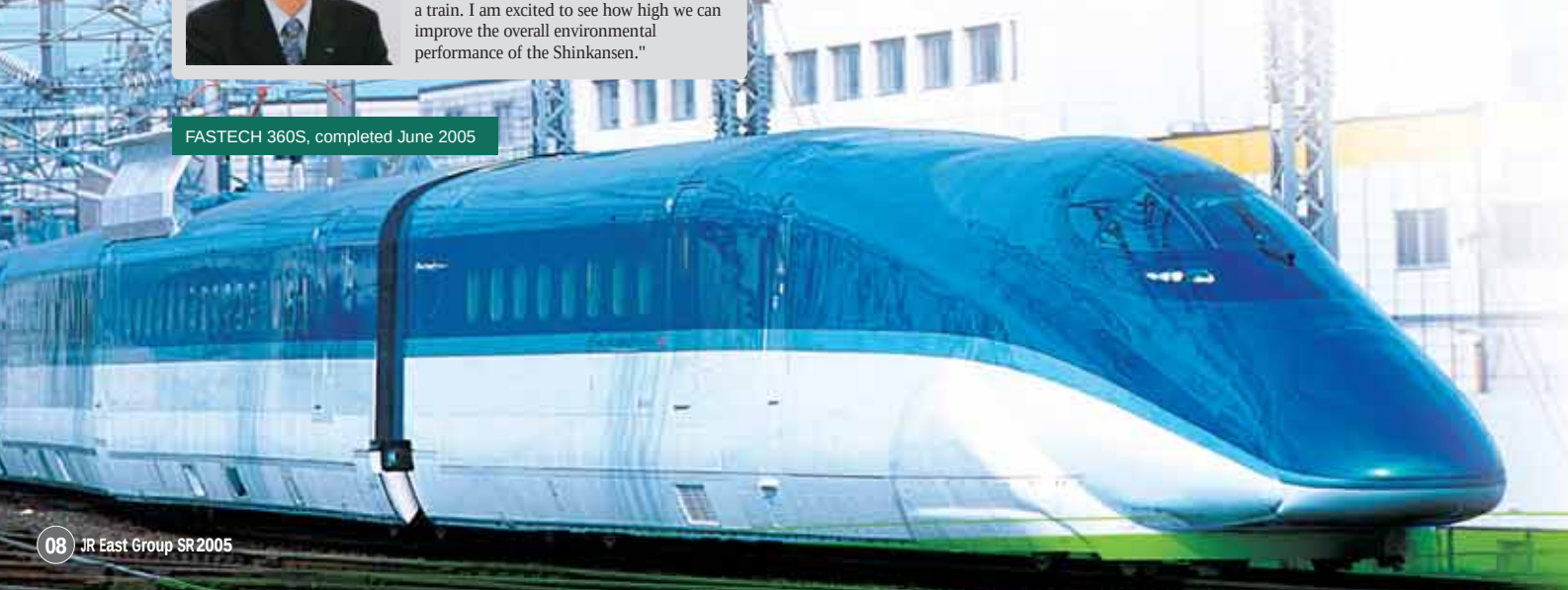
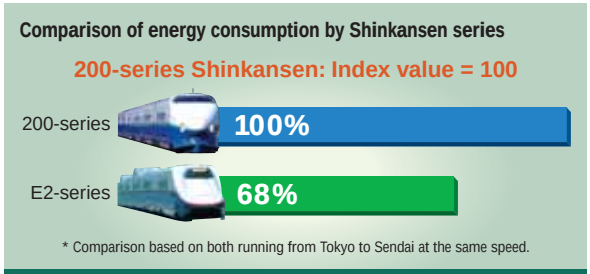
"There are no other examples of this many environmental technologies being built into a train. I am excited to see how high we can improve the overall environmental performance of the Shinkansen."



FASTECH 360S, completed June 2005



Trains such as the *Hayate* and *Asama* use the E2-series of railcars to conserve energy as a result of a variety of improvements.

entering tunnels, two designs were developed – both 16 meters long – that optimize the shape of the prototype train's front end to minimize the sonic boom. Such measures reduce the changes in air pressure when a train enters a tunnel.

"We aim to feed back as much prototype test-data as possible into future development, so that we can make railcars with the lowest possible environmental impacts," concludes Mr. Wakabayashi.

The culmination of all technology to date

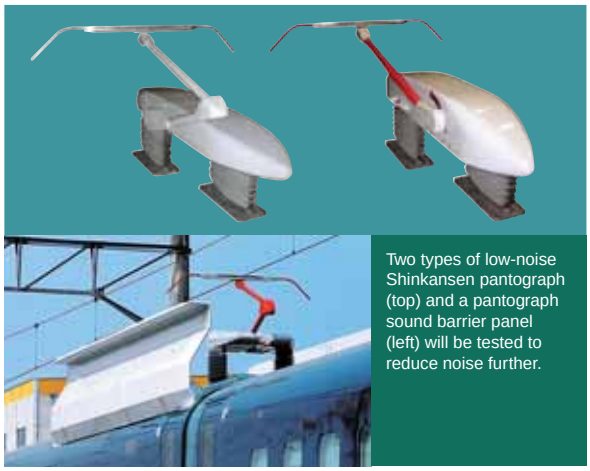
A variety of improvements are also made on the speed, safety, and comfort aspects of the new Shinkansen. "FASTECH 360 is the culmination of all our previous Shinkansen technologies," says Seiichi Watanabe, Manager (Rolling Stock Basis Technology), Advanced Railway System Development Center, JR East Research & Development Center.

For example, in order to boost speed, they reduced the size and boosted the output of motors as well as the equipment that drives those motors. Three types of newly developed high-output equipment, enabling the prototype train to be driven at a top speed of about 400 km/h, will be installed and compared. In addition, installed into the pantograph is a newly developed multi-split strap-board that allows the equipment to draw a stable supply of electricity from overhead wires, even at high speeds.

In the safety dimension, to shorten stopping distances, for the first time in the world spoilers are installed on a train as air brakes. During sudden braking, aluminum plates in the railcar body are released, thereby reducing stopping distance by boosting air resistance. By enhancing this and other braking functions, they aim to reduce braking distance to about the same or less than for a train stopping from 275 km/h (about 4 km).

Improvements to boost comfort are also included. For example, active suspension, which *Hayate* was the first Shinkansen train in Japan to use, has been modified. The floors, windows and walls are designed to have excellent sound-dampening features, reducing the noise from running and from electrical equipment.

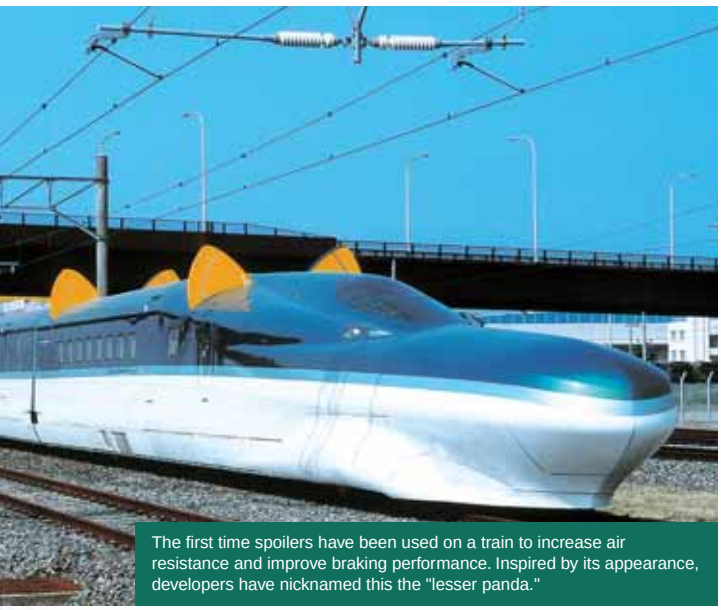
"The Shinkansen is not just railcars. It is an integrated system, of many things – the rails, the maintenance, the method of operation, and so on," says Watanabe. And as one would expect, the development of the world's best high-speed train involves many people from a wide range of departments at JR East. "In applying all our energy to the tough challenge of being the best in the world in environmental terms, JR East Japan can meanwhile boost the level of its technological capabilities," says Mr. Watanabe.



Two types of low-noise Shinkansen pantograph (top) and a pantograph sound barrier panel (left) will be tested to reduce noise further.

Seiichi Watanabe
Manager (Rolling Stock Basis Technology)
Advanced Railway System Development Center
JR East Research & Development Center

"The Shinkansen is a system. It involves many different departments of the company, and we are all concentrating our efforts into creating the FASTECH 360."



The first time spoilers have been used on a train to increase air resistance and improve braking performance. Inspired by its appearance, developers have nicknamed this the "lesser panda."

In addition to environmental and safety performance, the new Shinkansen train incorporates improvements in comfort, themed "futuristic comfort mobility space."

The new train offers a variety of "spaces:" Special type Car 5 (above) and ordinary type Car 6 (right).