

Development of Environmentally Friendly E231 Series

The E231 series reduces operational energy consumption by 50% compared to that of the 103 series, and in terms of weight, 90% of the E231 series railcar can be recycled. Servicing the *Yamanote*, *Takasaki*, *Utsunomiya*, and other metropolitan lines, the E231 series currently realized the most environmentally friendly design.



Hiroshi Kato

Deputy Manager,
Rolling Stock Design Division
Niitsu Rolling Stock
Manufacturing Factory

"The use of lighter trains brought us unintended additional benefits such as lessened frequency of rail replacement."

Substantial weight reduction for energy conservation

The noise of welding fills the factory large enough to house an entire set of train. Sparks fly as the workers weld together the stainless steel plates of the railcars. This is the Niitsu Rolling Stock Manufacturing Factory in Niitsu City, Niigata Prefecture, which has handled all aspects of E231 manufacture since 1994, from design to production. About half of the commuter and metropolitan area trains used by JR East are built here. It is also the first factory in the JR East Group to acquire ISO9001 and ISO14001 certification.

The E231 series is a train designed as a standard commuter and suburban train. Deputy Manager Hiroshi Kato of the Rolling Stock Design Division says that the major environmentally friendly feature of the new train is its low operational energy consumption.



► 15% reduction in flat car weight over the 103 series
Weight reduction is the key to reducing energy consumption

Operational energy consumption of the E231 series is 47% of the 103 series, which was the major metropolitan area commuter train when JR East was established. Lighter overall weight, effective use of braking energy, and greater motor efficiency are the three factors that have made such substantial energy conservation possible.

Compared to the 103 series whose weight is 40 tons, that of the E231 is mere 23 tons. Stainless steel has replaced iron in railcars, not only reducing weight but also the propensity to rust, thereby eliminating the need for painting. The number of railcars with motors per 10-car train has been cut from 6 in the 103 series to 4 in the E231 series. Lighter weight and progress in control technology have greatly contributed to bringing about this change.

Efforts to reduce weight started with the "halving railcar weight" target that initiated development of the 209 series, the predecessor of the E231 series. Energy savings achieved for the 209 series have been passed on in the development of the E231 series. An improved train information management system (TIMS) has reduced the amount of wiring per trainset by 34 %, or roughly 1.4 tons compared to the 209 series.

In addition to being light-weight, regenerative brakes are also contributing to reducing energy consumption. The regenerative brake is a mechanism which utilizes the driving electric motors to generate electricity when the brake is applied, and the generated electricity is fed back into the overhead electric line to be used efficiently.

Variable Voltage/Variable Frequency (VVVF) inverter control also contributes to energy conservation for its effective control of motor revolution through electronic control, without resorting to electrical resistance adjustments.



► A new E231 series railcar. Completed trainsets are delivered to the metropolitan rolling stock centers.

Superior recyclability and longer component lifespan

Superior recyclability means that about 90% of the weight of the E231 can be recycled. Almost all of the exterior material can be recycled. Resource saving artifices are also applied to the interior; the seats are now made of recyclable polyester resin and the seat covers are also designed for easy replacement when damaged.

The lifespan of parts has also been extended. For example, brake shoes, disk brakes, and other parts that press against or pinch wheels or axles during braking are exposed to wear and have to be replaced regularly, but the higher efficiency of the E231 braking system reduces wear and significantly lengthens the interval between replacements.

"Being in charge of design, I would want to expand the use of environmentally friendly materials," Kato says of his aspiration. Completed railcars undergo a variety of inspections during test runs and are delivered to the metropolitan area through JR East's railway lines.



► Brake shoe(left: before use, right: after use) used to press against the wheel during braking and brake shoe replacement (above) at Mitaka Electric Car & Drivers Depot



► Niitsu Rolling Stock Manufacturing Factory, the only railcar manufacturing plant in Japan owned by the railway company. About 250 railcars are manufactured per year.



Kazuyoshi Machida
Manager, Rolling Stock Development Project,
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Railway Operations Headquarters

Pursuing improvement of energy conservation and recyclability

Since the introduction of the 209 series in 1993, we have focused on making environmentally friendly railcars. Use of common parts in commuter trains and metropolitan area trains – until then two separate product lineups – started with the arrival of the E231 and since then we have gradually reduced use of resources and lowered energy consumption. Developing environmentally friendly railcars continues to be one of the most important challenges and it is our intention to further improve the efficiency of regenerative brakes to lower energy consumption, as well as raise the level of interior material recyclability at the same time. Development of the AC Train (Advanced Commuter Train) employing a drive system different from that of today will garner still greater energy efficiency and further reduction in energy consumption.



Yoshishige Honda

Assistant Manager
Mitaka Electric Car & Drivers Depot

"Reduced frequency of braking shoe replacement on the E231 series clearly shows the improved efficiency of TIMS braking system."