

Japan Rail Satisfied With Stainless Steel for over 50 Years

Tokyu Car Corporation is the first Japanese railcar producer to use stainless steel in its products and to promote stainless in this type of application.

Stainless steel railcars were first produced in Japan in 1958 utilising SUS304 grade. Initially stainless steel was only used for the outer skin of these early models. All-stainless railcars were first introduced in 1962 (see photo on next page). As well as SUS304, high-tensile SUS301 grades were also used.

Today at Tokyu Car Corporation there is a distinct polarisation between the use of stainless steel and aluminium. Carbon steel is rarely used. Tokyu produces around 300-400 railcars a year, with 90% made from stainless and the remainder aluminium. Japan produces an estimated 1,000-1,200 stainless steel railcars each year.



Japan's first all-stainless steel railcar (Tokyu's 7000-series)
(Photo: Tokyu Car Corporation)



Recent stainless steel commuter train (JR East Japan's E233)
(Photo: Tokyu Car Corporation)

Until the 1980s carbon steel was a popular choice for railcars due to its lower initial cost. However, extra manufacturing processes such as coating and shape-correction have increased both the initial cost and repair and maintenance charges.

The cost of building a stainless steel railcar has been substantially lowered since the first models came into service in the 1950s. The wider use of robotics and automated processes mean that stainless railcars are often cheaper than their carbon steel counterparts.

The dominance of stainless steel over aluminium in commuter trains may be attributed to the following points:

1. Stainless steel railcars do not need coating and are easy to maintain. Aluminium railcars do normally require coating to improve their corrosion and stain resistance.

2. Aluminium railcars are often cited as being lighter in weight than their stainless steel competitors. However, this advantage is not high in railcars as aluminium trains must have a double-skin structure in order to reinforce the sides.

3. There is a growing awareness of stainless steel's superior recycling properties. Stainless railcars normally utilise 304 and 301L austenitic grades which can easily be reused. There is no deterioration in quality even when they are recycled. Series 5000, 6000 and 7000 grades are used to create aluminium railcars. These grades contain a quantity of iron to ensure rigidity. It can be time consuming and labour-intensive to remove them from the general aluminium waste stream. If they are recycled with other aluminium, the resulting material can only be reused for aluminium casting and similar applications.

The life of a railcar is usually estimated at between 30 and 35 years. With proper maintenance, this lifetime can be extended to 50 years in most cases. Until the 1990s it was assumed that repairing and refurbishing a railcar to extend its life for another 10 to 20 years was the most economical option. However, many years of experience have shown that:

1. Auxiliary devices, including electrical parts, become obsolete and impossible to procure after 20 years.
2. Advances in manufacturing technologies and the use of energy-saving electrical components have reduced railcar weight, enabling substantial

[More stories on stainless steel in railcars can be found here](#)

reductions in power usage and CO₂ emissions (see table).

3. Companies have significantly reduced their maintenance workforces making maintenance more expensive.
4. Dismantling stainless steel cars was seen as a costly practice. However, it is now widely understood that this is a simple process which does not require the scrap to be separated and sorted. The stainless scrap can also be sold for a high price.

JR East, the largest railway company in Japan, undertook a Life Cycle Assessment (LCA) to compare aluminium and stainless steel. The results influenced the company to decide on stainless steel cars for its commuter trains. The current JR East fleet mostly consists of stainless steel cars for commuter trains and aluminium cars for express services and the Shinkansen trains.

Annual CO₂ emissions and power consumption of a Tokyu 10 car train servicing the suburbs of Tokyo

	Power consumed	CO ₂ emissions
OLD CARS	4.37 million kWh	1,398 tonnes
NEW CARS	2.65 million kWh	848 tonnes
DIFFERENCE	-1.72 million kWh	-550 tonnes

Source: Tokyu Corporation's Report

When these factors are taken into account, Tokyu believes that making new railcars reduces lifecycle costs more effectively than repairing and maintaining old ones. Tokyu promotes this approach in suggestions and proposals it makes to rail companies. The company also utilises a video prepared by the Japanese Stainless Steel Association (JSSA) which explains the excellent recyclability of stainless steel. Tokyu's advice and the JSSA video have proved to be very useful in educating other railcar makers and railway operators of stainless steel's advantages.