

Thin Gauge Wide Hot Rolled Strip with Excellent Uniformity in Dimensional and Mechanical Properties*

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1 Introduction

In order to preserve the global environment and reduce costs to customers, there has been an increasing need to reduce product weight by realizing higher accuracy in the dimensions and mechanical properties of hot rolled strip and to promote a changeover from cold rolled strip to hot rolled strip. Chiba Works No. 3 hot strip mill was constructed to respond to these requirements, and comprises the most advanced equipment and control technologies.^{1,2)} Practical application of these functions has made it possible to manufacture strips with smaller thicknesses and larger widths than those of conventional products, and at the same time, to substantially improve the uniformity of dimensional and mechanical properties.

This report describes the levels of accuracy achieved in the dimensional and mechanical properties of thin gauge wide hot rolled strip and presents examples of products in which these materials have been adopted.

2 Available Production Range and Uniformity of Dimensional and Mechanical Properties

Figure 1 shows the production availability of hot rolled strip and cold rolled strip at Chiba Works. With the startup of Chiba Works No. 3 hot strip mill, it has become possible to produce hot rolled strips with smaller thicknesses and larger widths than those of conventional products. There is a region of overlap between the production availability of hot rolled strip and cold rolled strip. However, in this region, cold rolled products were frequently selected, in spite of the superior economy of hot rolled strip, because the dimensional accuracy and uniformity of mechanical properties of hot rolled products were inadequate.

Figures 2 and 3 show the thickness accuracy achieved at Chiba Works No. 3 hot strip mill; Fig. 4 presents a

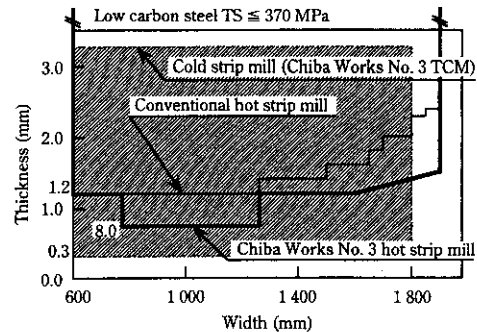


Fig. 1 Production availability

comparison of the accuracy of mechanical properties at No. 3 hot strip mill and a conventional mill. Practical application of high level control functions has resulted in a remarkable improvement in both dimensional accuracy and the accuracy of mechanical properties in comparison with the conventional mill.³⁻⁷⁾ These improvements have made it possible for customers to reduce costs by partially substituting hot rolled sheets for cold rolled sheets, which had been used until the present, and to reduce product weight by using sheets with excellent dimensional accuracy.

3 Examples of Applications

3.1 Base Material for Setback of Light Trucks

Photo 1 shows an example of the application of a galvanized hot rolled steel sheet to the floor of a light-weight truck. The sheet was manufactured using a new thin gauge wide hot rolled strip product, with a thickness of 1.4 mm and width of 1 600 mm, as the substrate material. Conventionally, galvanized steel sheets manufactured from 270 MPa grade cold rolled strip material have been used in this part. Hot rolled steel sheets were

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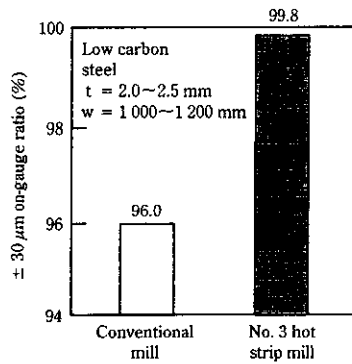


Fig. 2 Thickness accuracy

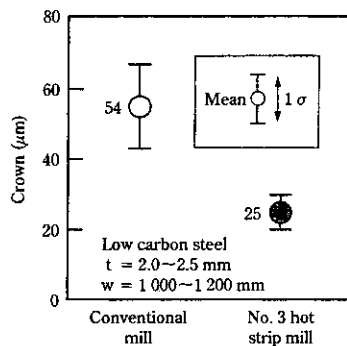


Fig. 3 Crown accuracy

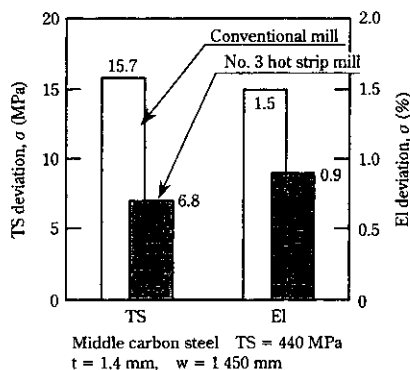


Fig. 4 Deviation of mechanical properties

not used, in spite of their superior economy, mainly because the dimensions of the part exceeded the available size range at the hot strip mill, and it was not possible to satisfy thickness accuracy requirements.

At Chiba Works No. 3 hot strip mill, the available size range has been expanded, as shown in Fig. 1, and by applying a high level gauge control function,³⁻⁵ it has also become possible to satisfy the Japan Iron and Steel Federation's standard value of $\pm 135 \mu\text{m}$ for cold rolled steel strip by a broad margin, even considering thickness deviations in the longitudinal direction and widthwise direction (Fig. 5). This improvement in thickness accuracy has enabled the user to change material from cold

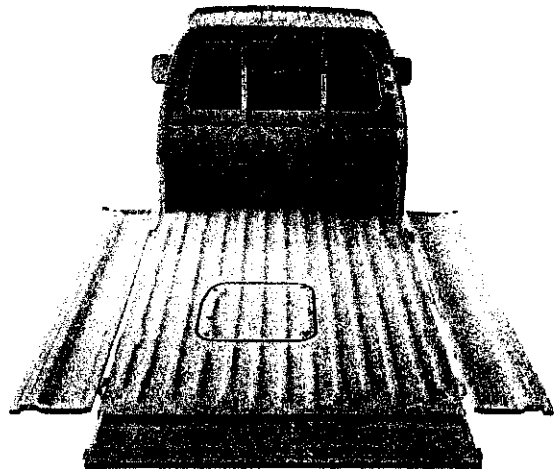


Photo 1 An example of application for thin gauge wide hot rolled strip

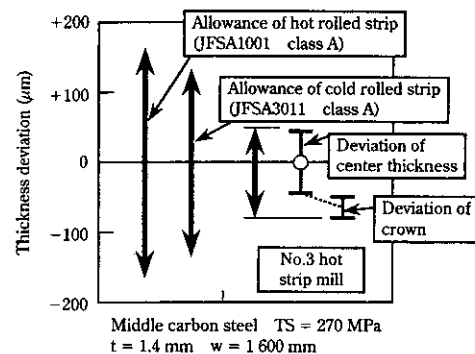


Fig. 5 Thickness deviation of 1.4 mm-thick product

rolled steel sheets to hot rolled sheets, and thereby reduce costs. Moreover, the omission of the cold rolling process is also contributing to preservation of the global environment by reducing energy consumption.

3.2 Base Material for Automotive Members

As the base material for automotive members, 440 MPa grade galvanized steel sheets with a thickness of 1.4 mm and width of 1 450 mm are used. From the viewpoints of dimensional accuracy during press forming and stability of the press forming operation, strict accuracy requirements are applied to the mechanical properties of these sheets. For this reason, cold rolled sheets had been used, even though the product was within the available size range for hot rolled sheets.

As shown in Fig. 4, it has been possible to reduce deviations in mechanical properties to approximately 2/3 to 1/2 that with the conventional mill by applying high accuracy temperature control^{6,7} and optimizing the chemical composition of steel, and as a result, users can now substitute hot rolled steel for the conventional cold rolled steel.

4 Conclusion

The following results were obtained by practical application of the advanced functions of Chiba Works No. 3 hot strip mill.

- (1) It has become possible to produce hot rolled steel strip with smaller thicknesses and larger widths than those of conventional products.
- (2) Advanced dimensional control and temperature control have made it possible to apply hot rolled steel sheets to products in which cold rolled sheets had conventionally been used. In the future, a further expansion in the range of applications is expected.

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