

Close-Tolerance Bars and Wire Rods*

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1 Introduction

Over and beyond the conventional demand for excellent quality in final products free from trouble during their processing, customers of bars and wire rods in recent years have increasingly demanded yet higher-grade quality products that permit them to even bypass their processing so as to attain cost reduction through enhanced yield and labor saving.

The close-tolerance bars and wire rods introduced here are products that have been developed to match these requirements by offering high levels of dimensional accuracy, surface quality, and internal quality. Kawasaki Steel Corp. manufactures these bars and wire rods at the Mizushima Works mainly for the automobile industry.

2 Features of Close-Tolerance Bars and Wire Rods

These materials possess outstanding as-rolled workability so that most pre-treatment processes can be omitted. In addition, the possibility of reducing super-

floous thickness contributes to higher yield and efficient processing.

(1) High Dimensional Accuracy

The dimensional tolerance for round bars is usually to JIS rating or the higher-accuracy bar tolerance rating of AISI, but as shown in **Fig. 1**, the closer tolerance of Kawasaki Steel products is to a super-high accuracy of 0.1 to 0.15 mm; hence, there is no need for users to carry out preliminary dimensional adjustment.

(2) Outstanding Surface Quality

These close-tolerance rolled products have outstanding surface quality without decarburization and defects, so that they can be worked on directly without requiring preliminary processing to remove surface defects. These products are used for manufacturing pins, spindles, bolts, bearings, constant-velocity joints and gears that are employed in automobile components and construction machinery equipment.

Figure 2 shows examples of the uses of these close-tolerance rolled products.

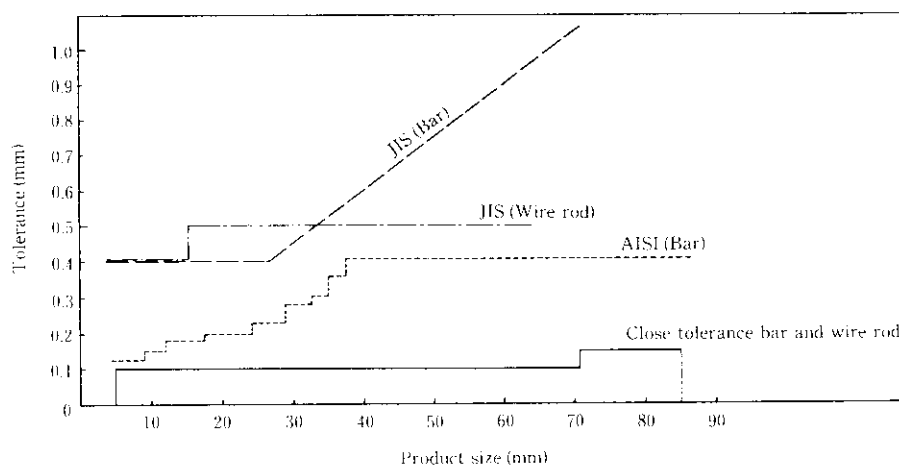


Fig. 1 Comparison of size tolerance (JIS, AISI, and close tolerance grade)

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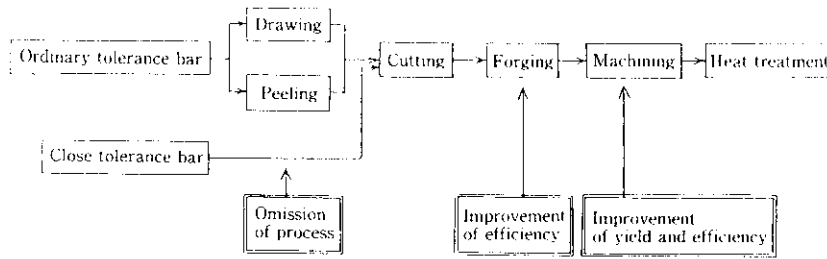


Fig. 2 Comparison of user's process

3 Manufacturing Facilities

Figure 3 shows the shop layout for manufacturing steel bars and wire rods by close-tolerance rolling. As shown in Table 1, each stage of manufacture imparts the required characteristics, and rigorous inspection is carried out at every stage to control the consistently high levels of quality that are offered in full lengths of the products.

4 Quality Characteristics

4.1 Dimensional Accuracy

Figure 4 shows examples of product-dimension records, and Fig. 5 shows a chart from the hot-profile meter. Uniform heating in the reheating furnace and controlled rolling with a no-twist inter-stand minimize dimensional fluctuation in the total length of the rolled material. Circularity is ensured by the use of carefully

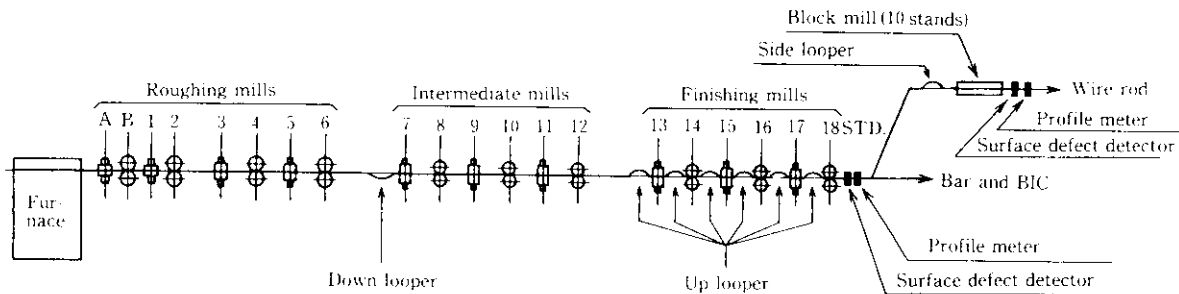


Fig. 3 Layout of rolling line

Table 1 Countermeasure and inspection in line to produce the close tolerance product

Quality characters	Process	Necessity function	Countermeasure	Inspection in line
Size tolerance	Furnace	Uniformly reheating	Special burner	Profile meter
	Rolling line	Interstand tension Accurate leading of stock	No. A~6 std.: Free tension control system No. 6~7 std.: Down looper No. 7~13 std.: Free tension control system No. 12~18 std.: Up loopers No. 18~Block mill.: Side looper One strand and no-twisting mill Roller type guides	
Decarburization	Furnace	Atmosphere Low temp. reheating	O ₂ -ratio control system Special burner	Furnace control system
	Rolling line	Low temp. rolling	No. A~2 std.: High power and compact mill Block mill: heavy-duty-type mill	
Surface defect	Furnace	No rubbing	Walking beam and heath roller	Surface defect detector
	Rolling line	No rubbing	One strand and no-twisting mill Roller type guides	

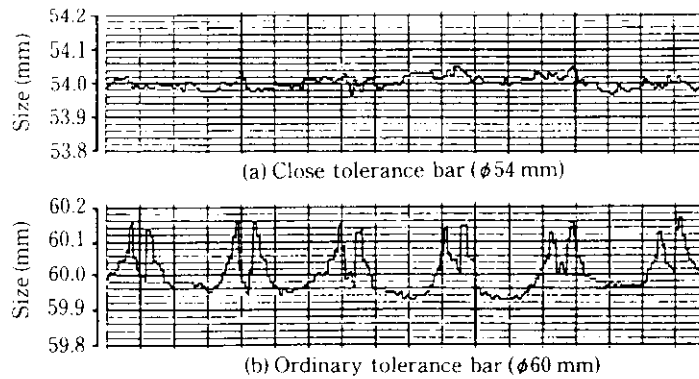


Fig. 5 Chart of profile meter

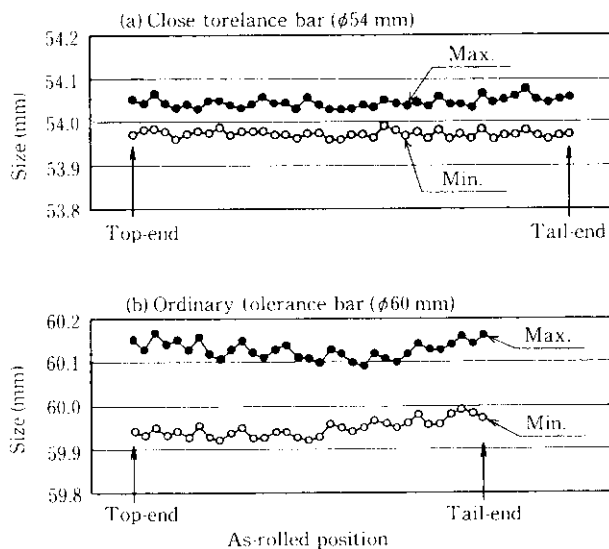


Fig. 4 Example of product diameter

profiled roller guides to give products with very high dimensional accuracy.

4.2 Surface Decarburization

Decarburization depth is significantly affected by both the atmosphere in the reheating furnace and by the reheating temperature, as shown in Fig. 6. The Kawasaki Steel process uses low-temperature extracting and rolling to obtain products of a uniform structure through the whole cross-section with virtually no decarburized layer.

4.3 Surface and Internal Defects

The high-quality filament, which is inspected by a magnetic flaw tester and ultrasonic flaw detector is given a single-strand no-twist rolling in full lengths to minimize the generation of surface defect. In addition, the surface quality is monitored by an eddy-current flaw detector throughout the whole length.

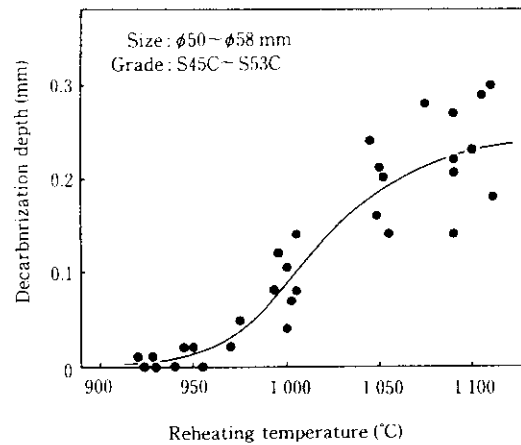


Fig. 6 Effect of reheating temperature on decarburization depth

5 Concluding Remarks

The close-tolerance rolled products introduced here meet very strict standards for bars and wire rods in terms of dimensional accuracy, surface quality and internal quality, and are used by many customers.

In addition to these products, Kawasaki Steel also manufactures various kinds of non-heat-treating steels by controlled rolling, controlled cooling and furnace heat treatment, and will continue to develop new products by combining these manufacturing techniques.

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