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 superficial 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.

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* Originally published in *Kawasaki Steel Gihō*, 23(1991)2, 121-123
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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.

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

<table>
<thead>
<tr>
<th>Quality characters</th>
<th>Process</th>
<th>Necessity function</th>
<th>Countermeasure</th>
<th>Inspection in line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size tolerance</td>
<td>Furnace</td>
<td>Uniformly reheating</td>
<td>Special burner</td>
<td>Profile meter</td>
</tr>
<tr>
<td>Rolling line</td>
<td>Interstand tension</td>
<td>Accurate leading of stock</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>Decarburization</td>
<td>Furnace</td>
<td>Atmosphere</td>
<td>O₂-ratio control system Special burner</td>
<td>Furnace control system</td>
</tr>
<tr>
<td>Rolling line</td>
<td>Low temp. rolling</td>
<td>Low temp.</td>
<td>No. A−2 std.: High power and compact mill Block mill: heavy-duty-type mill</td>
<td></td>
</tr>
<tr>
<td>Surface defect</td>
<td>Furnace</td>
<td>No rubbing</td>
<td>Walking beam and hearth roll</td>
<td>Surface defect detector</td>
</tr>
<tr>
<td>Rolling line</td>
<td>No rubbing</td>
<td>One strand and no-twisting mill Roller type guides</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

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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