JFE TECHNICAL REPORT
No. 15 (May 2010)

Increase of Billet and Bar Finishing Line Capacity†

1. Introduction

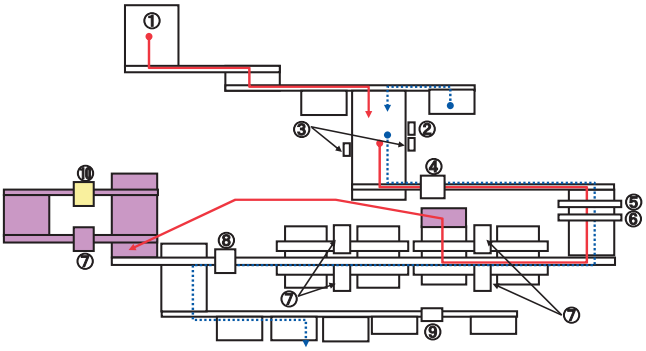
Demand for special steels has grown dramatically in recent years, centering on the automobile industry. In order to respond to this demand, JFE Steel has increased its steel bar and wire rod production capacity. It was possible to increase total production capacity by 40% by increasing the capacity of the round billet finishing line at the Billet Mill and the bar finishing line at the Wire Rod and Bar Mill, as these are the bottleneck processes in the two plants. This report introduces the content of these expansion projects.

2. Equipment Expansion Projects

2.1 Billet Mill Round Billet Finishing Line

2.1.1. Layout and outline of expansion

Billets are the base material for the Wire Rod and Bar Mill. JFE Steel produces two billet cross sections, a 175 mm dia. billet, which receives grinding at the Billet Mill round billet finishing line, and a 150 mm square billet, which receives grinding at the Wire Rod and Bar Mill. **Figure 1** shows the layout of the Billet Mill round billet finishing line. The round billet mill receives inspections and grinding on three types of round bar products, these being round billets for use in seamless pipe production, billets for the Wire Rod and Bar Mill, and round bars for external sale, which are shipped directly from the Billet Mill. It is possible to process billets in the size range of 90 mm–400 mm in diameter and 5.5 m–12.5 m in length. In processing, after deburring of both ends, surface inspection by a magnetic leakage flux tester (MLFT) and internal inspection by an automatic ultrasonic tester (AUT) are performed, and defective parts are removed by grinding with a grinder. The line is laid out as a continuous process, so that the defect residual availability of the part which received grinding is inspected with a manual magnetic particle tester (MMT) after grinding, and if residual defects are found in the part which received grinding, grinding is repeated. In 1997, this plant also began manufacture of round billets from square billets as billets for the Wire Rod and Bar Mill. Automation of surface and internal inspections is possible, and high detection accuracy has been achieved.



: An addition equipment
: Standard trimming billet
: Strict trimming billet

①Cooling bed
②Label reader
③Debaring machine
④Shot blast
⑤MLFT
⑥AUT
⑦Grinder
⑧No.1 MMT
⑨Peeling machine
⑩No.2 MMT

Fig. 1 Layout of billet finishing yard

Table 1 Inspection equipment for billet

Equipment	Specification	Installation date
No. 1 MMT Method Accuracy	Prod type Length: 10 mm	Feb., 1984
No. 2 MMT Method Accuracy	Yoke method Length: 10 mm	May, 2007

In this expansion of the equipment at the round billet finishing line, the surface flaw grinding capacity was increased by installing one additional grinder and MMT. **Table 1** shows the main specification of the MMT which as installed at the new line.

2.1.2 Features of new equipment

In conventional treatment of billets, which have a large number of surface flaws, grinding with the grinder requires much time. As a result, the grinder equipment had been the bottleneck process at this plant. The aim of the recent expansion was to eliminate this bottleneck process by adding one additional unit of grinder equipment. However, no space was available for this

† Originally published in *JFE GIHO* No. 23 (Mar. 2009), p. 67–68

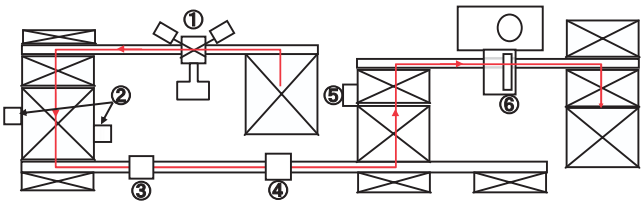
expansion with the current equipment layout, making it necessary to locate the grinder at the delivery side of the MMT. As the processing flow, after flaw inspection by the automatic inspection facilities, a new carry-out table was constructed at the entry side of the grinding line in order to feed the billets to the new grinder equipment. The line employs the assurance system in which flaw removal is performed by the grinder equipment after charging to the new line and the defect residual availability after grinding is inspected by MMT, and is laid out to perform repeated grinding by the grinder equipment if residual flaws are detected. A new label reader was also installed for identification management and results management after charging from the existing line to the new line. Tracking control is performed in 1 billet units.

Introduction of the grinder equipment and MMT made it possible to increase the round billet finishing capacity. As a result, it has become possible to increase production of billets for the Wire Rod and Bar Mill and round billets for external sale, which are manufactured by the Billet Mill.

2.2 Wire Rod and Bar Mill Bar Finishing Line

2.2.1 Outline of capacity increase

In order to increase the processing capacity of the Wire Rod and Bar Mill finishing line, a new dedicated line was constructed for small diameter bars (16 mm–45 mm dia.). Due to lack of space in the existing Wire Rod and Bar Mill, this line was constructed in a separate yard. The existing bar finishing line (16 mm–90 mm dia.), which is located in the same yard as the rolling line, is called No. 1 finishing line, and the new line is No. 2 finishing line. At No. 1 line, the aim was to increase the operating time rate by reducing the frequency of size changes in the inspection facilities and other equipment, by using this line as a dedicated line for large diameter rods with diameters of 45 mm dia. and larger. Because No. 2 finishing line is located in a separate yard, it is necessary to transport the bars. However, direct transport of bars after rolling was made possible by installing pallets which are capable of handling warm billets (temperatures up to 250°C) and thus enable transportation after rolling. **Figure 2** shows the layout of No. 2 finishing line. Distinctive features of this line include: (1) material handling is possible using only one crane because the material feed and collection zones were arranged in close proximity; and (2) the material feed bed is located in the central part of the line. Because this line layout features a U-turn at the inspection line after charging, the layout is compact and it is possible to cope simultaneously with material feed and inspection line operations. Furthermore, in comparison with conventional



①Straightening machine
②Debaring machine
③MLFT
④RUT
⑤Labeler
⑥Banding machine

Fig. 2 Layout of the bar finishing yard

processes, the line is compact and efficient operation is possible because all handling on the line is performed by automatic hangers. The maximum line processing speed from the straightening line to the inspection line is 120 m/min. The layout of the inspection line includes an MLFT, length measuring instrument, curve measuring instrument, degaussing instrument, and rotary ultrasonic tester (RUT). This equipment composition is capable of quality assurance which meets advanced customer needs.

2.2.2 Line processing flow

In the processing procedure at the finishing line, first, control of in-process material by the bar finishing line tracking system begins with reading of the barcodes on the in-progress ID tags attached to bundles of bars. The tags are read by a barcode reader in one bundle units. The system was constructed so that the setting conditions for processing at the finishing line are set automatically to the finishing line at the same timing as barcode reading as instruction information from the mill system. In the layout of the finishing line, bars advance to the inspection line via a 2-roll straightener and both-end deburring machine. The bars are inspected in the order MLFT → RUT, and are then discharged on the delivery

Table 2 Inspection equipment for bar

Equipment	Bar size (mm)	Specification
Straightening machine	φ16–45	Method; Dual roll type Motor output; 132 kW Max speed; 120 m/min
MLFT	φ16–45	Method; bar penetrating type Accuracy; Depth: 0.1 mm Length: 10 mm Probe; Differential element 6 channels × 2 heads
RUT	φ16–45	Method; Bar penetrating type Frequency; Normal probe: 5.0 MHz Angle probe: 5.0 MHz Accuracy; 1 mm × 20 mm$L$, $S/N \geq 3$ Number of probes; Normal: 3, Angle: 3

side. **Table 2** shows the main specifications of the 2-roll straightener and the inspection facilities. Two nonconforming material reject beds (MLFT reject carry-out bed, RUT reject carry-out bed) are arranged at the delivery sides of the respective inspection facilities, enabling automatic sorting based on the pass/fail results of inspections by the inspection facilities. Materials which are passed by the inspection facilities are transported to the delivery side carry-out bed, and product labels are attached to the end of the products by a labeler. Labeling is performed in one bar units. Bars are charged into a material collecting pocket, in units corresponding to the number of bars in one bundle, and transported to the banding machine, which performs banding at 4 to 6 points. The bundles are then discharged to the material collection bed and shipped.

As described above, it was possible to increase the capacity of the Wire Rod and Bar Mill by adopting a two line system at the bar line by constructing a new No. 2 finishing line.

3. Conclusion

Measures to increase the finishing line capacities of the Billet Mill and Wire Rod and Bar Mill were introduced. As a result of these measures, the finishing capacity of the bar and wire rod division was increased by 40%. In the future, JFE Steel will continue to improve quality and delivery performance by increasing the accuracy of production control and improving technologies for building quality into products.

For Further Information, Please Contact:

Steel Bar and Wire Business Planning Dept., JFE Steel
Fax: (81)3-3597-3994