

TIMKEN®



SPECIAL BAR
QUALITY
STEEL

THE TIMKEN COMPANY

WORLD-LEADING QUALITY STEELS

SINCE MELTING ITS FIRST HEAT OF STEEL IN 1917, THE TIMKEN COMPANY HAS BEEN PRODUCING QUALITY STEEL BARS FOR CRITICAL APPLICATIONS. IN THE EARLY 1900'S, THE SEARCH FOR QUALITY STEEL TO ENSURE THE PRODUCTION OF BEARINGS FOR AUTOMOTIVE MANUFACTURERS LED TIMKEN TO ESTABLISH THE HARRISON STEEL PLANT IN CANTON, OHIO.

Today a strand-cast production facility, the Harrison Steel Plant is one of two Timken® steel bar manufacturing plants. In 1985, the company opened its second steel-making facility, the Faircrest Steel Plant, to supply ingot-cast steel bars to a growing customer base. Investment in a second plant definitively marked the company's commitment to producing world-class steels for external customers. It transformed Timken into North America's low-cost producer of large-diameter and intermediate-sized bars.

In 1917, the company's four five-ton furnaces comprised the largest electric-arc furnace facility in the country. Today, Timken melts more than 1.5 million tons of special bar quality (SBQ) steel per year for high-performance applications around the world.



QUALITY PEOPLE

We have tremendous pride in our associates, who comprise one of the most highly trained workforces in the industry. Metallurgical expertise permeates all aspects of our organization from the technical service staff to those developing new innovative steels that meet the requirements of our customers.

Our focus on quality goes well beyond our own product integrity. Our sales engineers work with customers to design and optimize steel products that are best suited to the customers' steel requirements.

QUALITY SYSTEMS

Timken maintains a quality system that ensures our products can meet some of the most demanding requirements. Our organization is QS9000 certified. This standard keeps our products and processes on the edge of technology to meet the expectations of our customers. This robust system drives us to better quality and cost.

However, our commitment to quality extends far beyond this distinction. We take the best quality elements and manage our business with it. To do that, we have processes in place that help to recognize and minimize defects well before they ever reach final inspection.

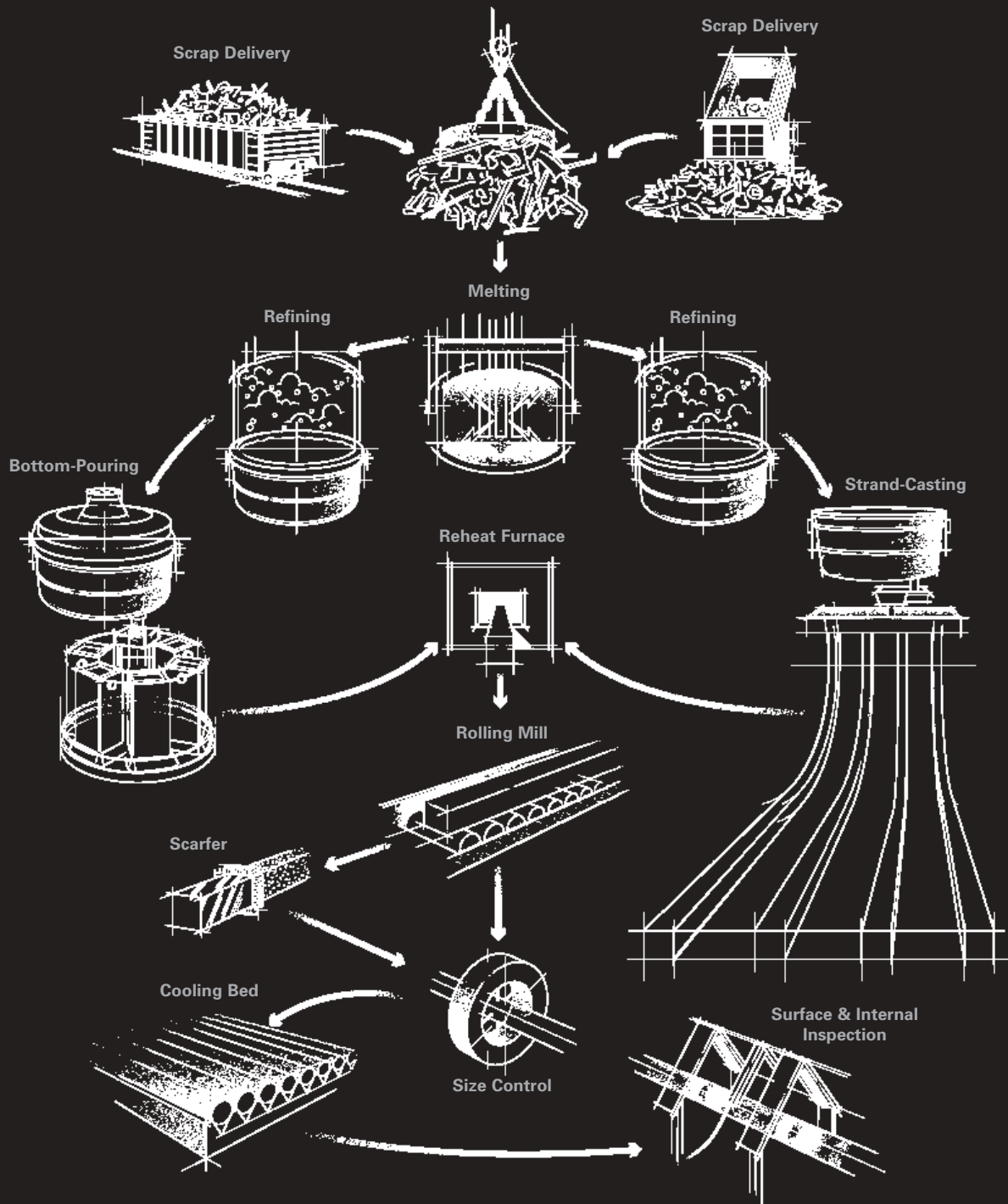
With more than a century of experience in precision bearing manufacturing, we understand the critical role of quality steels in the production of high-quality manufactured products. This knowledge and understanding of the process enables us to effectively monitor the production of your steel during each stage of manufacturing to ensure it meets quality standards along the way. This rigorous monitoring process is reinforced with a final inspection that assures quality standards are met or exceeded.

Steel samples are taken several times during production to ensure they meet Timken quality standards.

Timken can inspect steel down to 0.3mm surface defect tolerances.



STEEL MANUFACTURING PROCESS



RESEARCH AND DEVELOPMENT

Timken is a leader in steel process research, resulting in better products for our customers. Our research support begins with an experienced staff of sales engineers who work directly with customers to understand their application needs.

We use our research and development resources to respond to those unique needs with an improved product or process that performs well in the application. We can design a custom alloy to fit the product or process for optimal performance. For example, we can design a target microstructure of a given alloy for optimum processing in a customer's plant to achieve a machinability requirement and the best overall cost structure.



PERFORMANCE MARKETS

Custom Steels Timken produces custom steel grades for a variety of uses, including those grades that are often difficult to obtain. All heat-lot grades are available in minimum quantities of 30 tons. Some custom grades can be ordered in even lower quantities. Visit www.timken.com/custombar for exact minimums.

Automotive More than 100 million motorists depend on our steel every day in the drivetrain of their vehicles. Timken® steel is most often used in critical automotive applications where high performance is required. As a high-volume carbon and alloy steel bar manufacturer, we have assets designed to deliver quality steel in automotive production volumes.

Timken is the largest North American producer of crankshaft steels. Our steel can also be found in hubs, axles, constant-velocity joints, torque converters, one-way clutch assemblies and other transmission and transfer-case applications.

Bearing Timken began making steel in 1917 to serve the unmet quality needs of the bearing market. Today, the company continues to lead the way with a variety of bearing grades designed to meet demanding application requirements.

Distribution Timken has an authorized distribution network around the world that includes more than 300 locations in North America. We supply a complete range of long products – carbon and alloy steel bars and OEM stocking programs. In providing these products through distribution, we support the maintenance and material requirements of a wide variety of end users.

Energy We specialize in machining and forging bars for oil and gas production where corrosion-resistance is needed. Impact® steel is a durable steel solution for harsh environments. The strength and toughness properties of this grade can result in longer life and dependability. Tailored for energy exploration and production applications, Impact steel meets or exceeds the National Association of Corrosion Engineers (NACE) standard.

We produce long-length kelly bars of up to 46 feet for the drill string. Timken steel can also be found in drill collars, drill bits and tool joints in the drill string, along with packers, gas lift mandrels and blast joints in the production string.

Industrial We make steel for a variety of industrial applications where performance is critical. Our manufacturing flexibility allows us to produce many grades in 10-ton minimums or less. We supply commercial forgings for unique applications like forgings used in braking systems, high-hardenability steels for gears and low-nitrogen steels for rail axles.

Our MicroTec® microalloy steel bars provide a low-cost alternative to heat-treated steels for applications like hydraulic cylinder rods. Other industrial applications include track links, gears, shafts, piston pins, straight and flanged axles, crankshafts and defense applications. Whatever the application, we have the custom grade that fits.



GLOSSARY OF TERMS

Argon – Inert gas commonly used to stir liquid steel and to provide a protective atmosphere to prevent its reoxidation.

Bloom – The first stage of steel after bottom-pouring or strand-casting. After the bloom is rolled, it becomes a billet.

Bottom pour – Filling ingot molds from the bottom. This process minimizes reoxidation and reduces turbulence and flash. It also results in improved surface finish.

Dams and Weirs – These refractory pieces are part of the tundish. They guide the flow of steel to ensure uniform flow.

Degassing – Putting liquid steel in a vacuum before the teeming process to remove hydrogen gas.

EAF furnace – Electric arc furnace. In the EAF – Timken's primary melting vessel – steel scrap is melted by passing electricity through carbon electrodes.

Hardenability – Ability of steel to harden to a specific depth. A steel's hardenability is controlled by the alloys contained within the steel.

Heat – The product of one batch of steel produced in an EAF.

Hot top – The insulated top on an ingot mold. A hot top helps keep the steel molten and ensures uniform density throughout the mold.

Ingot – The steel form that is removed from the ingot mold.

Ladle – A bucket-like vessel that holds molten steel.

Mold flux – The powdery refractory material used to prevent reoxidation. Mold flux also provides lubrication and insulation in both the continuous casting and EAF steelmaking processes.

Oxidizing slag – Type of slag used in an EAF. The slag removes phosphorous from the steel bath.

Refining – A processing step in which the steel is stirred to ensure homogenous temperature and chemistry. Heat and alloys also can be added and degassing performed in this step.

Reheat furnace – Furnace used to reheat blooms to rolling temperature.

Scrap – Primary raw material in Timken steel; a source of iron.

Shroud – A solid refractory or gaseous barrier that protects liquid steel from reoxidation.

Slag rake – Mechanized device that removes oxidation slag from the top of the ladle prior to refining.

Strand cast – Another term for "continuous cast." A method of teeming in which steel is continuously cast directly into bloom form.

Tapping – The act of pouring liquid steel from the EAF into a ladle.

Teeming – The act of pouring liquid steel from a ladle into a mold or tundish.

Tundish – The vessel used to transfer steel from the ladle into a continuous casting mold.

VAD – Vacuum arc degassing. A refining unit capable of electric-arc reheating.



MELTING

Timken produces the widest range of specialty steels in the world, offering more than 450 different grades of carbon and alloy steels. Our melting capability ranges from plain carbon to low alloy steels in production volumes from high-volume automotive to small quantities of custom steel grades that are often difficult to find. We produce quality levels from commercial to Parapremium™ steels. Although we produce no leaded steels, lead-free enhanced machinability steels are available.

We make steel in one of two ways. Our strand-cast process produces a strand-cast bloom size of 11 (279mm) by 14¾ (375mm) inches. We also bottom pour steel with a seven-ton, 28 (711mm) inch-sq. ingot size. Your exact specifications are entered into our process-control system as soon as we receive your order. From that point, we monitor your steel through each stage of the manufacturing process against those requirements to ensure it is made with your needs in mind.

Electric Arc Furnace (EAF) The steel-making process begins with scrap selection where we custom blend scrap to meet the grade specifications and customer requirements. We use

nearly 150 classifications of the different types of scrap including fragment, busheling, cast iron and revert scrap. Our highly trained associates constantly monitor scrap for bulk chemistry, density, impurities and residuals. This analysis allows us to tailor design a scrap charge to best meet the requirements of the heat at the lowest cost.

Steel is melted in one 175-ton EAF furnace at the Faircrest Steel Plant or in two 130-ton EAF furnaces at our Harrison Steel Plant.

Tapping When the molten steel is tapped into a ladle at our Harrison Steel Plant, a slag rake is used to remove the oxidized slag from the heat. Our Faircrest process allows us to leave the slag in place and still meet stringent quality requirements. Oxygen is removed from the steel at this stage to prevent oxidation that could compromise the quality of the steel.

Refining The refining process is where the steel is really made. Several things happen to make sure the steel meets customer requirements. The refiner allows us to maintain the desired temperature of the steel. We also add alloys to get the desired chemistry and degas to minimize the levels of entrapped gases in the steel. During this process, the steel is stirred with argon to homogenize the temperature and chemistry of the entire steel heat.

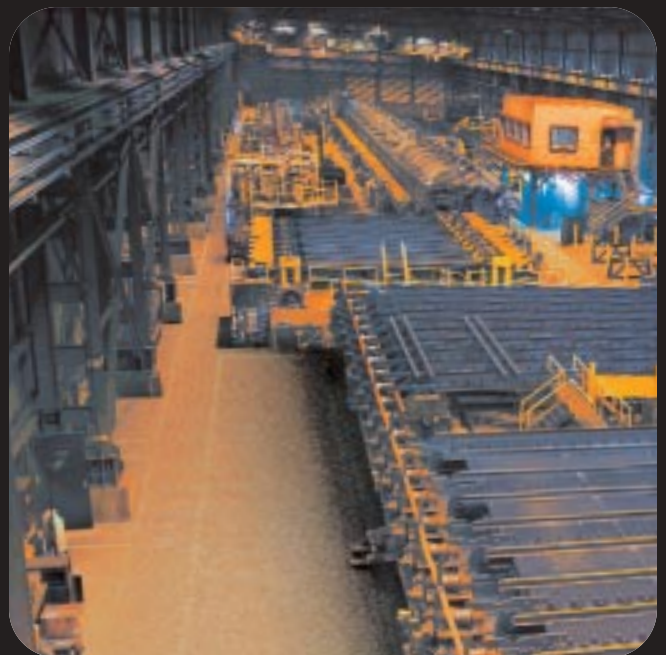
Our refiners are equipped with Vacuum Arc Degassing (VAD) units that provide the ability to reheat in the ladle. This direct reheat capability allows for very tight chemistry control and that means a more exact steel for your application. And our ability doesn't stop there. In addition, our computer-control ability allows us to dynamically modify pre-determined aims to more accurately meet a customer's hardenability requirements.

Bottom Pour The bottom-pour process creates some of the world's cleanest air-melt steels. It is one of two ways we make steel. We can produce ingots that are 28 (711mm) inches sq. nominally. Our ingot molds are "big end up" which means the tapered end is down to optimize internal cleanness.

To ensure cleaner steel, the steel stream is shrouded during teeming by an inert atmosphere to prevent reoxidation. We add a pre-measured mold flux to each mold to further protect the steel from reoxidation and enhance surface quality. Each mold has a hot-top to keep it in a liquid state while the ingot is fed. The mold flux and hot-top system is designed to maximize cleanness and minimize the chemical segregation of the ingot.

Timken is among the highest quality ingot-cast producers of large bars 6 (152mm) to 12 (305mm) inches.

Our continuous thermal treat facility (CTTF) is a state-of-the-art quench and tempering line with hot straightening for stress-free products.





Strand cast Strand casting is the second way we produce quality alloy steels. The molten steel is poured through a shroud into a 20-ton tundish with a system of dams and weirs designed to optimize metal flow to further enhance steel cleanliness. A refractory shroud with an argon seal protects against reoxidation.

From the tundish, the steel flows into four separate oscillating molds, again protected from reoxidation through submerged ceramic pouring tubes and mold flux. The mold level is controlled through a closed-loop, throttling slide-gate system to ensure good surface quality. Air-mist cooling of the strand is used to gently extract heat during solidification which minimizes thermal stress on the strand

The strand-casting process also features mold and strand electro-magnetic stirring (EMS) to minimize chemical segregation and ensure good as-cast structure. Each of these steps serves to further ensure the quality of Timken steel.

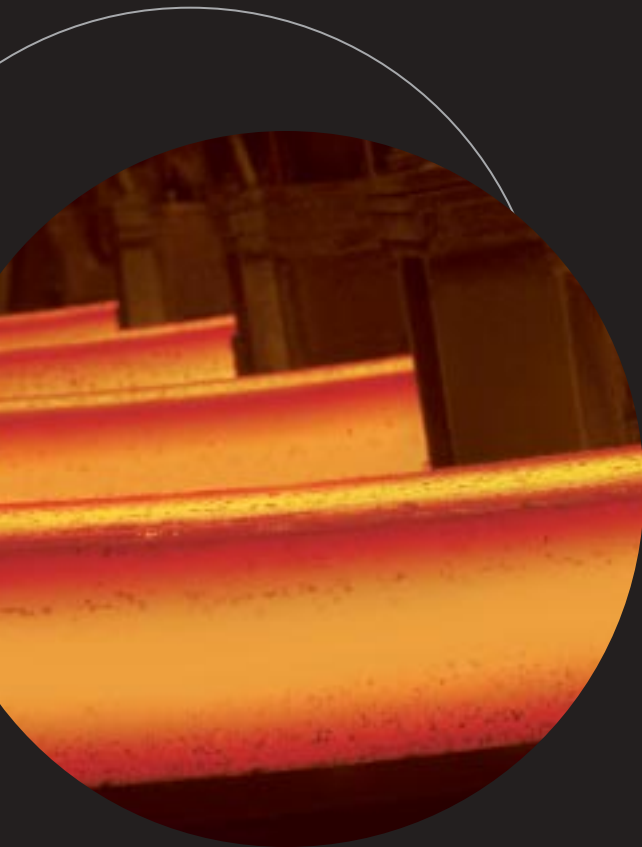
Rolling Once a steel bloom is produced, it enters a rolling mill for reduction to the customers' size range. We maintain good dimensional size control on the rolling mill that begins with precise temperature control in the reheat furnace and continues with an in-line, real-time precision gauging system that monitors size through the complete rolling process.

Inspection Our goal is to provide a defect-free hot-rolled steel bar that is extremely reliable. We inspect steel bars for both surface and internal quality. Our system allows us to inspect down to 0.3mm surface defect tolerances.

Our inspection process combines thermal-imaging technology for surface inspection with advanced ultrasonic capabilities. These features, along with two-level computer controls, bring you advanced product verification.

THE TIMKEN COMPANY IS A LEADING INTERNATIONAL MANUFACTURER OF HIGHLY ENGINEERED BEARINGS, ALLOY AND SPECIALTY STEELS AND COMPONENTS, AS WELL AS A PROVIDER OF RELATED PRODUCTS AND SERVICES. OUR LONG HISTORY AS A SPECIALIST IN QUALITY STEELS HAS LED TO THE MANUFACTURING, MATERIALS AND TECHNOLOGY EXPERTISE THAT HELPS DRIVE CUSTOMER INNOVATION TODAY. FROM SPECIALTY GRADES IN SMALL QUANTITIES THAT ARE DIFFICULT TO FIND, TO HIGH-VOLUME AUTOMOTIVE PRODUCTION, **TIMKEN HAS THE STEEL SOLUTION THAT MEETS YOUR SPECIFICATION.**





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WORLDWIDE LEADER IN BEARINGS AND STEEL