



## 270 FEET OF ANYTHING'S POSSIBLE

### JUMBO BLOOM VERTICAL CASTER HELPS ANSWER YOUR TOUGHEST ENGINEERING CHALLENGES

When we built our Faircrest Steel Plant in the early 1980s, we reserved floor space for the future installation of a jumbo bloom vertical caster. Over time, new casting technologies—combined with our expertise in materials and applications, metallurgical research and operational excellence—allowed us to make those plans a reality.

Today, our operation features the world's largest jumbo bloom vertical casting machine, towering 180 feet (54.86 meters) above ground and extending 90 feet (27.43 meters) below ground, boasting an overall height of 270 feet (82.29 meters).

The state-of-the-art caster is the only one of its kind in North America, giving us yet another advanced capability offering that helps create the answers to your toughest engineering challenges. The caster helps enable superior internal and surface product quality. This new operation also gives us broader capabilities to support your needs in the special bar quality (SBQ) and seamless mechanical tube market segments.

The caster marks the capstone to a set of carefully planned, strategic investments over the past decade totaling about \$500 million.



## WHAT'S IN OUR NAME?

How do we define the words jumbo bloom, vertical and continuous for our caster?

- **Jumbo bloom** denotes a large cross-section area, generally greater than 200 square inches (508 square centimeters). Ours is 432 square inches (1,097 square centimeters), with a section size of 18 x 24 inches (457.2 x 609.6 millimeters). We also vertically cast a section size of 11 x 17 inches (279.4 x 431.8 millimeters) for our small and intermediate bar products.
- **Vertical** notes that the caster is 100 percent vertical. Most casters feature a curved design. The vertical aspect improves inclusion flotation and overall steel cleanliness.
- **Continuous** indicates our caster design for continuous operation with ladle exchange, grade change and tundish exchange technology.

### Why Vertical?

The vertical design of the strand allows for continuous casting of certain high-alloy grades that is not possible on conventional casters. The pure vertical design also produces cleaner steel than conventional casting machines. The steel is more uniform, with better inclusion distribution.

The caster improves our efficiency and flexibility, expands our product range and increases our capacity to serve demand. The caster—combined with other assets—enables the broadest size range combination in North America for steel bars, billets and seamless mechanical tubing. The design of this caster also provides a unique combination of continuous casting efficiency, large section size and industry-leading internal cleanliness levels.

With an ability to cast difficult-to-produce alloy steel grades, the caster is an efficient source of input materials to our in-line forge press. The forge press, coupled with the new caster, expands our capabilities and helps improve sound centers in large-bar sizes, efficiently giving customers more of what they need.



## COMBINING LEADING STEELMAKING WITH INNOVATIVE EQUIPMENT

The caster uses an optimized tundish design and advanced clean steelmaking technology. The fully automated caster operates dependably, featuring innovative process monitoring and control.

By converting a large portion of Faircrest production to strand cast through the new caster, we gain additional flexibility in our operations, helping to shorten lead times during periods of high demand. Strand casting allows for better solidification control and center segregation, with advanced features such as air-mist cooling and dynamic soft reduction. These improved technologies promote a more favorable and consistent chemistry segregation pattern from both end-to-end and surface-to-center.

Surface and internal quality further improves as there is no bending—or unbending—of the strand. Dynamic mechanical soft reduction and electromagnetic mold stirring produce a superior solidification structure. Eddy current mold-level detection and precisely controlled air-mist cooling sprays provide superior bloom surface quality.

The caster makes two flexible sizes of blooms to feed our rolling mills. The large section size is 18 x 24 inches (457.2 x 609.6 millimeters), and the second mold size is 11 x 17 inches (279.4 x 431.8 millimeters).

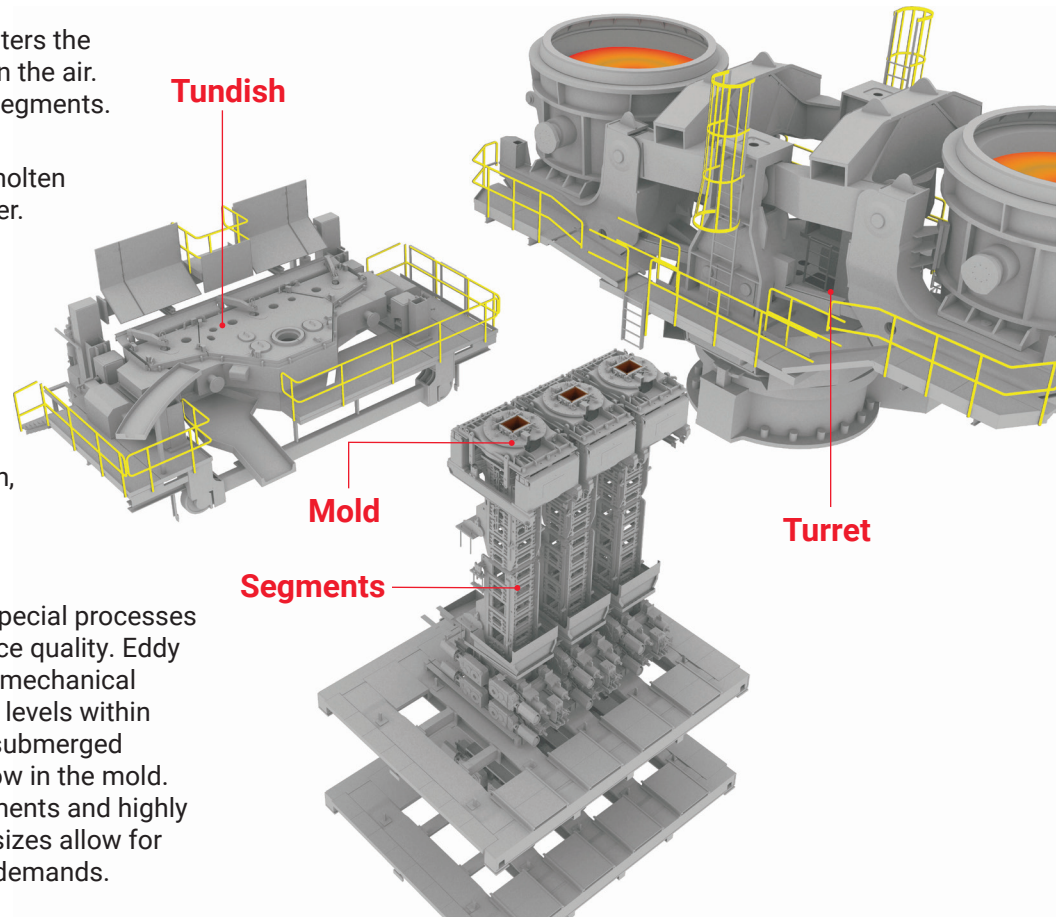
## CASTING FLOOR

The casting floor, where molten steel enters the turret, is the equivalent of eight stories in the air. It features a turret, tundish, molds and segments.

The turret holds two ladles containing molten steel and rotates the ladle over the caster.

The large tundish allows for optimum inclusion flotation and cleaner steel. This sits below the turret and serves as the entry point for steel into the caster. The tundish features carefully designed internal dimensions. As the steel transfers from ladle into the tundish, it's shrouded with inert gas to protect it from oxidation.

As steel passes from tundish to mold, special processes help improve product internal and surface quality. Eddy current mold-level detection and electromechanical stopper rod control enable precise steel levels within the mold. Electromagnetic stirring and submerged entry nozzle design provide optimum flow in the mold. Long containment zones have two segments and highly controllable air-mist sprays. Dual mold sizes allow for production flexibility to meet customer demands.

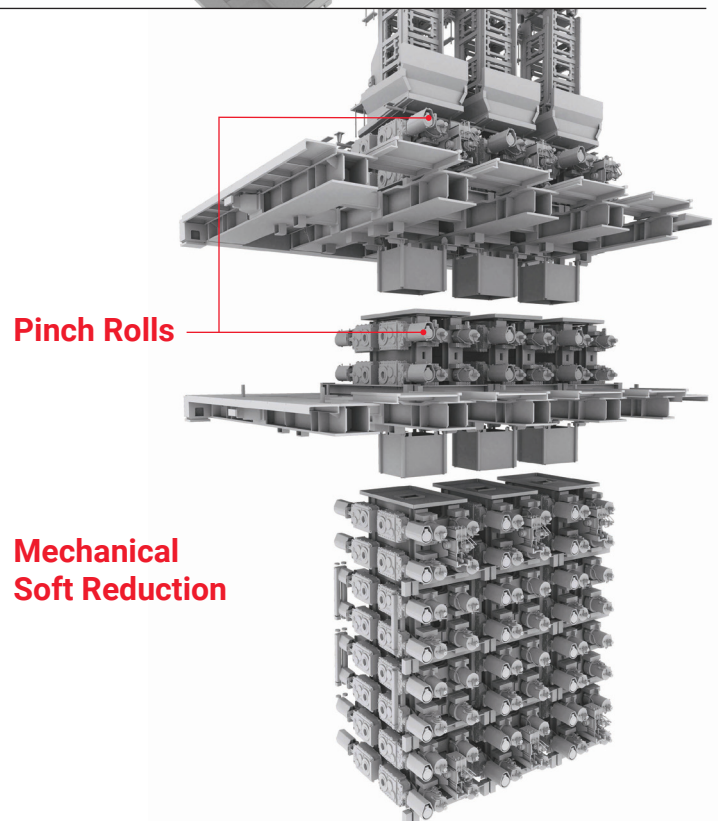


## STRAND SUPPORT AND BLOOM WITHDRAWAL

Internal quality improves as the steel moves through the caster. We control casting speed through a series of large rolls supporting the strand. Dynamic soft reduction creates a small bloom deformation at a precise point in the solidification process. This minimizes chemical segregation and center porosity.

Dynamic control is critical to apply effective soft reduction in the pinch rolls. This ensures we can apply soft reduction across a large variety of grades. We offer more than 450 grades of high-performance alloy, carbon and microalloy steel in the largest size range in North America.

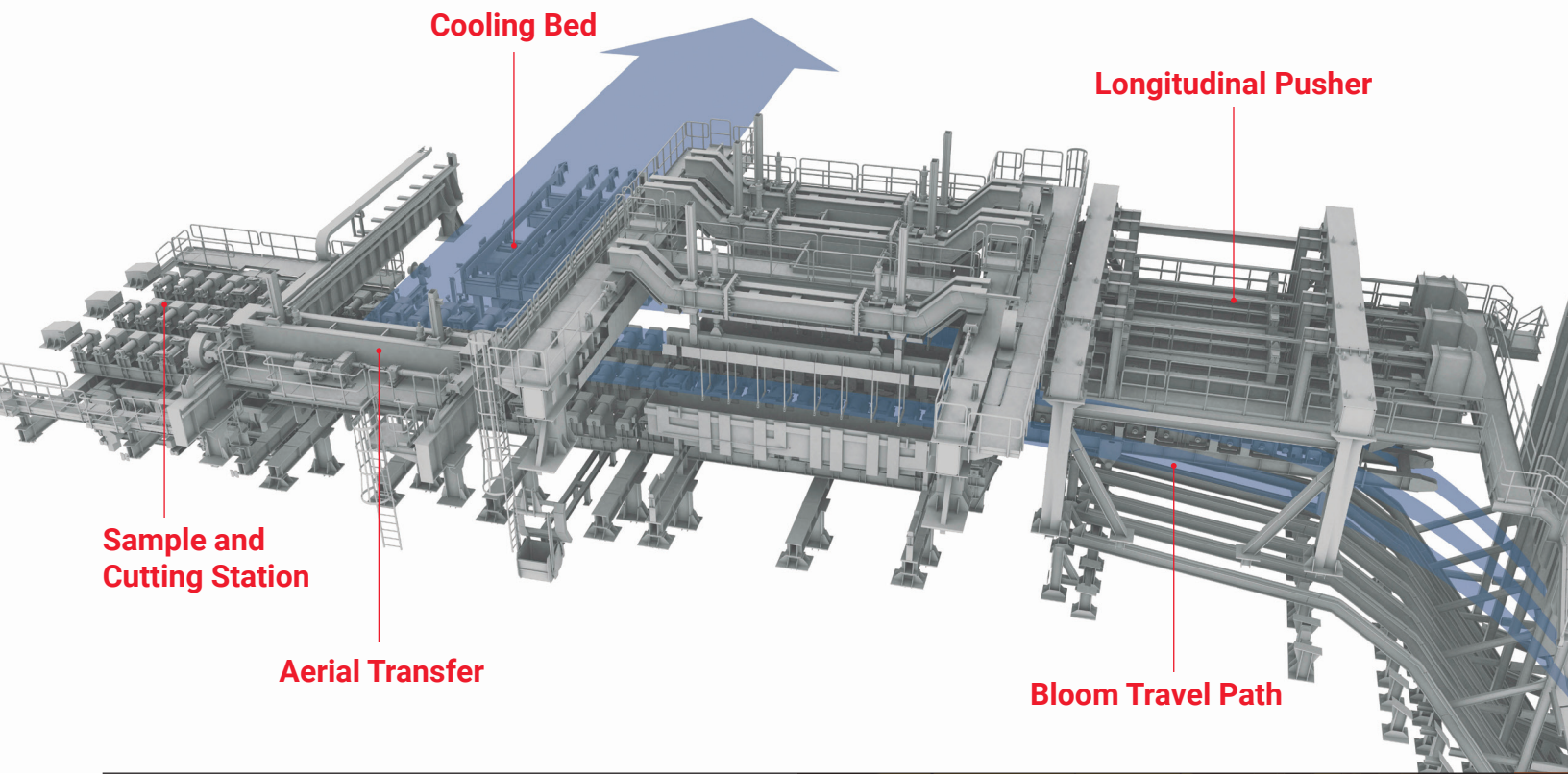
We can match customer bar size and length requirements. Torch-cutting machines cut custom-length blooms, helping meet our customers' exact needs.



## DISCHARGE AREA

The discharge area moves the steel from the strands back into the rolling mill.

A transportation car moves the cut blooms to ground level. We then use a longitudinal pusher to send the blooms to the discharge table. An aerial transfer then lifts the blooms to a cooling bed. We ensure traceability of our products throughout the process by tagging each bloom. In some cases, at our sample and cutting station, we use cutting torches to cut metallurgical samples or crops.



## WHAT DO ELECTROMAGNETIC STIRRING AND SOFT REDUCTION MEAN?

The new operation features advanced operating technology, including electromagnetic stirring and dynamic soft reduction for optimized surface quality. What do these terms mean?

- **Electromagnetic stirring** takes place when electromagnetic force stirs the liquid metal in the casting mold to maximize chemical homogeneity from surface to center.
- **Soft reduction** occurs with the mild squeezing/rolling of the strand prior to complete solidification of the as-cast bloom. Soft reduction reduces segregation and improves the sound center condition of the as-cast bloom.





## WE'RE UP FOR THE CHALLENGE

We customize every product and service we deliver to meet customers' specific needs. Our focus is on improving performance by addressing the toughest challenges, whether that requires SBQ steel bars or seamless mechanical tubing, value-added steel components, honing, drilling or thermal-treatment services or supply chain solutions.

Our engineers are experts in materials, processing and applications, so we can work closely with each customer to deliver flexible solutions related to our products as well as their applications and supply chains. We believe few others in our industry can consistently deliver this kind of breadth, customization and responsiveness.

**METALLUS**

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