

A large industrial steel mill at night, illuminated by numerous bright lights that create starburst effects. The complex structure of the mill is silhouetted against the dark sky, with various pipes, walkways, and large cylindrical tanks visible. The foreground shows some greenery and a road with speed limit signs.

# IMPROVE STEELMAKING

Steelmaking is the backbone of global industrialization. It is critical to economic development and provides the essential material for construction, transportation, infrastructure, and manufacturing. The industry is responsible for transforming raw materials like iron ore, coal, and scrap metal into usable steel products through various processes like the blast furnace method and the electric arc furnace method. As one of the largest industrial sectors worldwide, steelmaking also faces increasing pressure to reduce its environmental impact, particularly its significant carbon emissions. Today, steelmakers are tasked with balancing the growing demand for steel with the urgent need for cleaner, more sustainable production methods, and maintaining operational safety and profitability. In the automotive industry, higher strength steels are important for vehicle weight reduction and energy absorbing safety structures. Producing these steels require precise process control, and REXA actuators deliver a reliable solution. All REXA products are proudly made in the USA and have been proven through decades of use in a global installed base. With high positioning accuracy, repeatability, energy efficiency, and reliable continuous duty, REXA actuators promise a long service life with minimal maintenance all while empowering steelmakers to operate more efficiently, reliably, safely and profitably.

## ELECTRAULIC™ ACTUATION

## The REXA Advantage

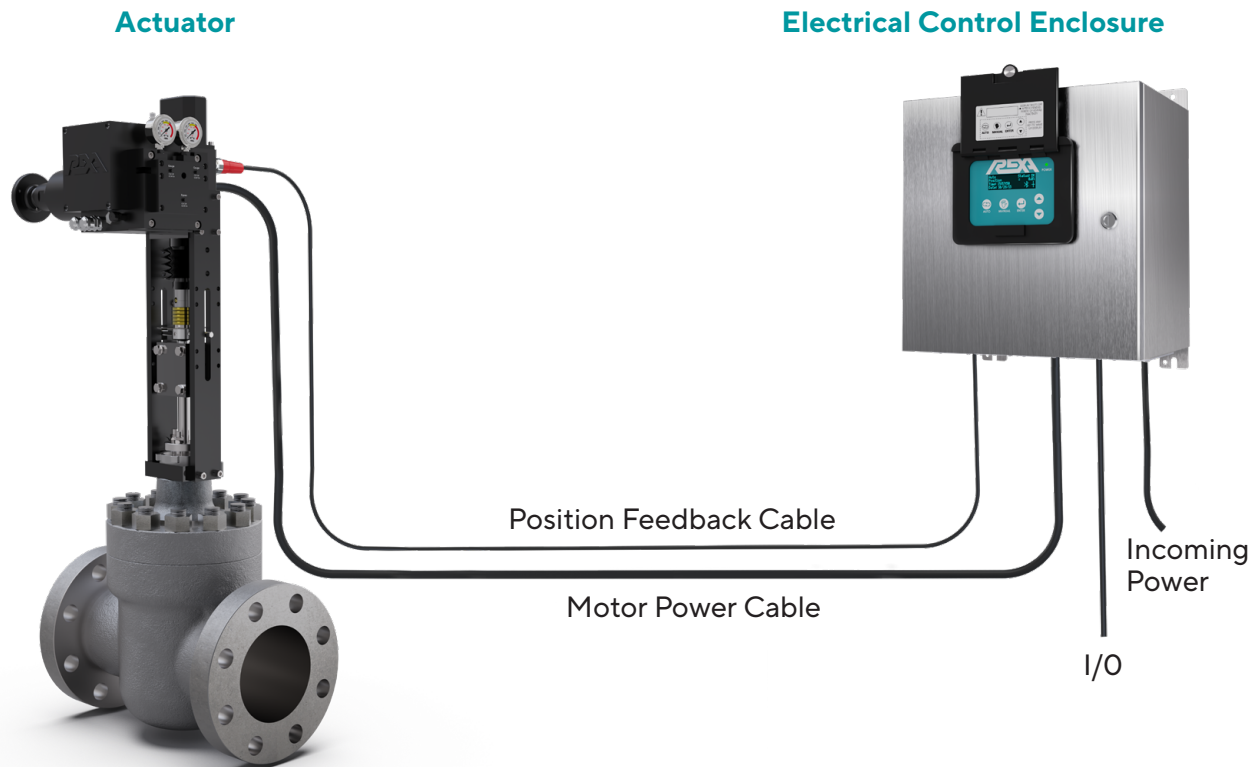
REXA has more than 30 years of experience in the steelmaking market. REXA linear and rotary actuators can be adapted to any style valve. They are built to withstand the harshest environments in the most critical applications. High quality, low maintenance Electraulic™ Actuation combines the simplicity of electric operation with the power and performance of hydraulics. This unique pairing provides high efficiency and reliability along with minimal maintenance and low cost of ownership over the long term.

### Steelmaking Target Application Areas

- Coke Ovens
- Blast Furnaces
- Electric Arc Furnaces
- HBI/DRI
- Hot Rolling Mill
- Powerhouse

The REXA XPAC Series 3 Electraulic™ Actuator is a superior positioning device well suited for critical control applications, such as those found in steelmaking plants. It controls severe process conditions in harsh environments and provides high reliability. REXA Electraulic™ Actuators and Drives provide the final control element capabilities to match the most sophisticated instrumentation and distributed control systems.

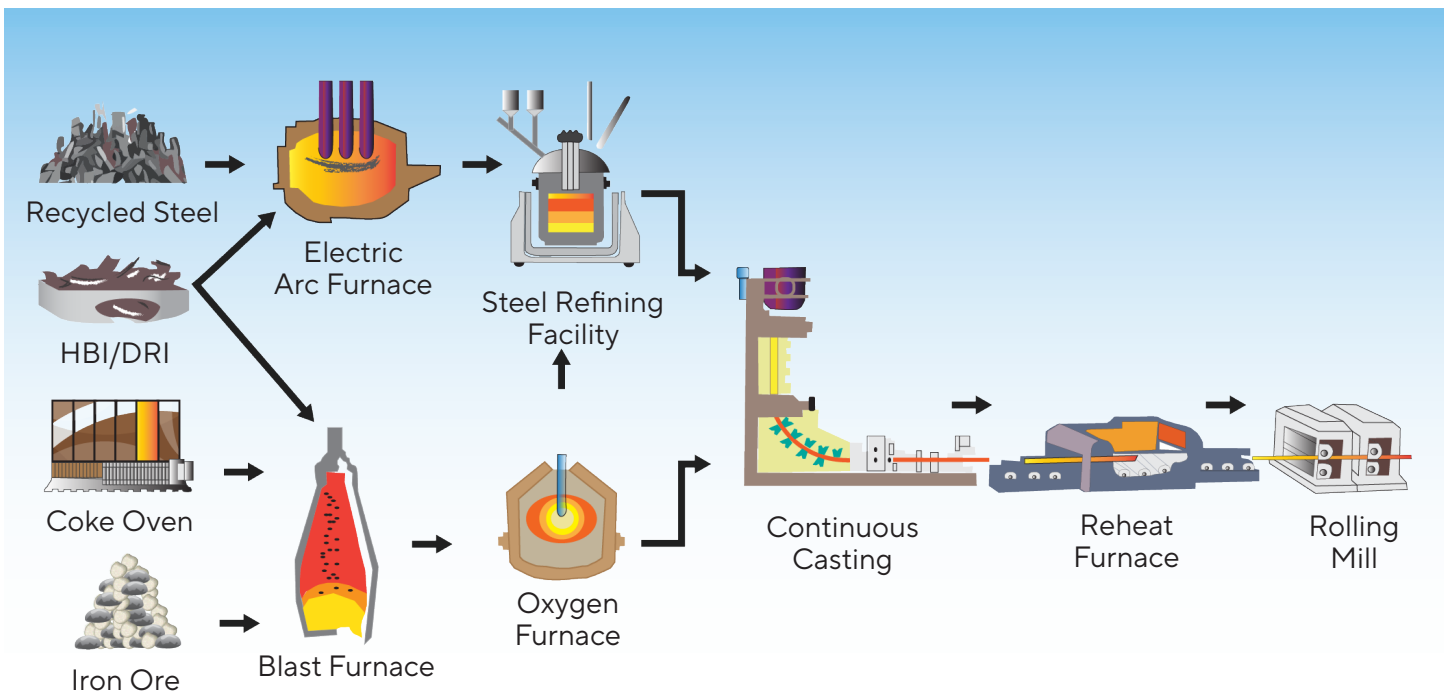
The XPAC Series 3 is comprised of the actuator and electrical control enclosure. The actuator consists of a double acting hydraulic cylinder, position feedback sensor and an Electraulic™ Power Module. The power module is a unique, self-contained, positive pressure-sealed hydraulic pumping system which manages oil pressure and flow to and from the cylinder. The electrical control enclosure consists of power supplies, motor drivers and a dedicated microprocessor. The combination of these mechanical, hydraulic, and electronic technologies ensures precise and repeatable control of steelmaking processes.



## Industry Demands

Steel is a vital component for the economies of many countries around the world, supplying automotive, construction, machinery, energy, and transportation industries. Specifically, the production of hot-rolled and cold-rolled flat steel, which is used in automobiles and consumer durable goods. Production has been strong despite lagging global demand for lower-grade construction and infrastructure steel. The production of cold-rolled flat steel requires good quality iron ore and metallurgical coke feed materials, as well as good quality hot metal and slabs. Whether a mill uses a blast furnace or an electric arc furnace, the more control and precision they have in the process results in a higher quality end product.

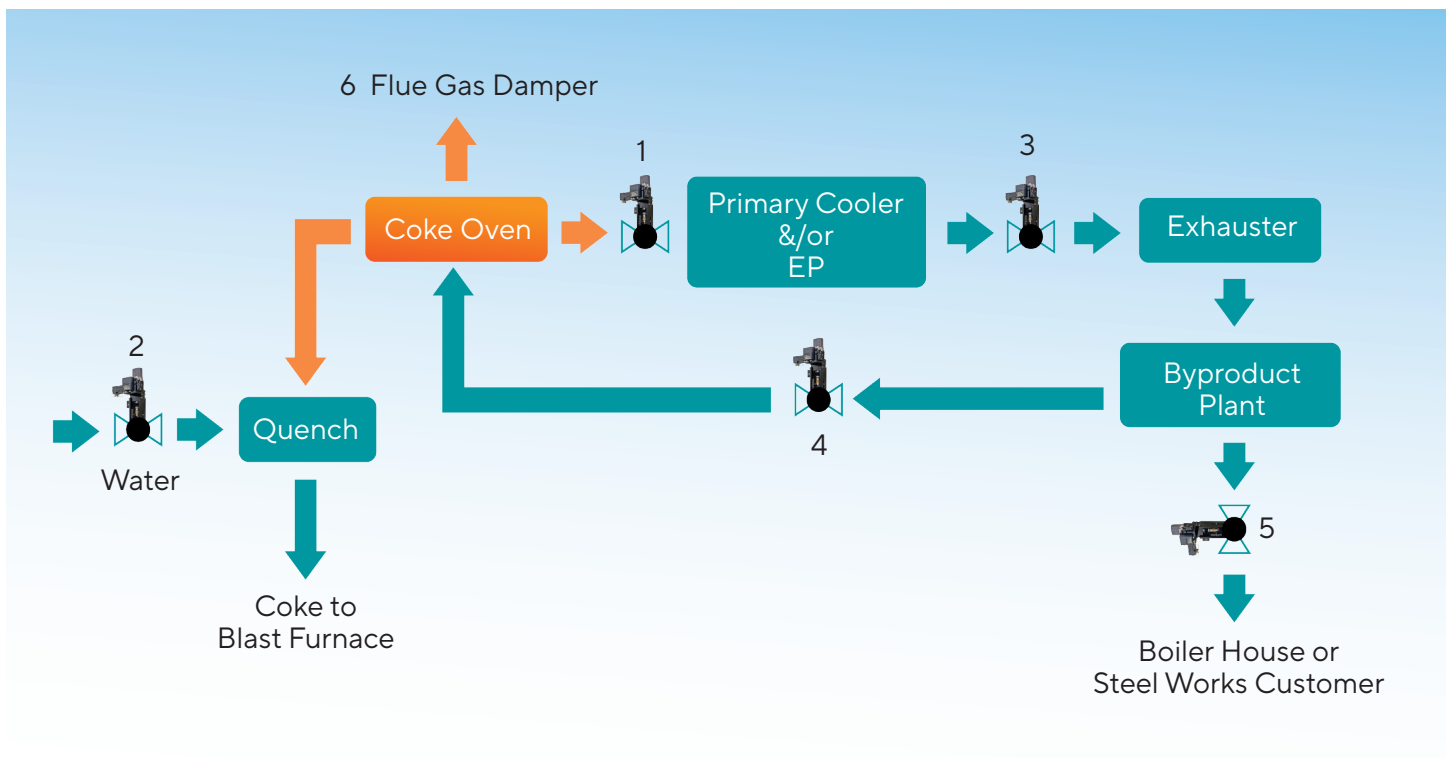
## Steelmaking Process



## Coke Ovens

Coke ovens process coal into coke that is used as a fuel source in blast furnaces. The coking process is a batch process in individual ovens. The requirements to adequately handle changing gas generation and coke oven temperature is challenging for operations to consistently and effectively produce quality coke safely. The co-product gas exiting the coke oven is tightly pressure controlled to  $\sim 10 \pm 1$  MMWC. Too high a pressure in the collection main may cause the gas to be diverted from the co-product plant to atmosphere. Insufficient pressure may cause air to enter the oven, ruining the coke. Air in the ovens or exhaust system can ignite, which is an unsafe condition. REXA actuators have the capability to precisely control the coke oven collection line gas pressure.

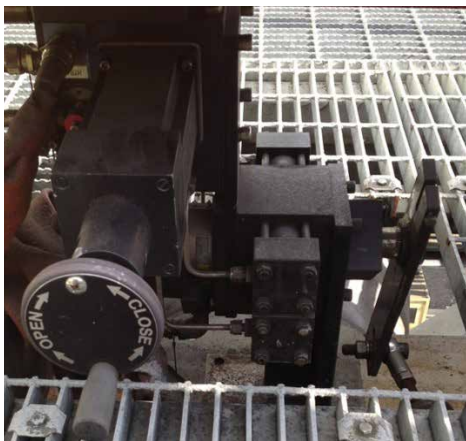
### The Coking Process



1. Collection Main Pressure  
2. Quench

3. Suction Main Pressure  
4. Underfire Gas Heating

5. COG Pressure  
6. Flue Gas Damper



### Collection Main Pressure Control

**Problem:** "The first hour of an oven charge we risk purging the oven gas because the pressure gets too high."

- Can the crossover valve position quickly and accurately during charging?
- Is your current system slow to respond to pressure spikes?

**REXA Solution:** REXA can give you confidence to precisely position with minimal deadtime.

## Blast Furnaces

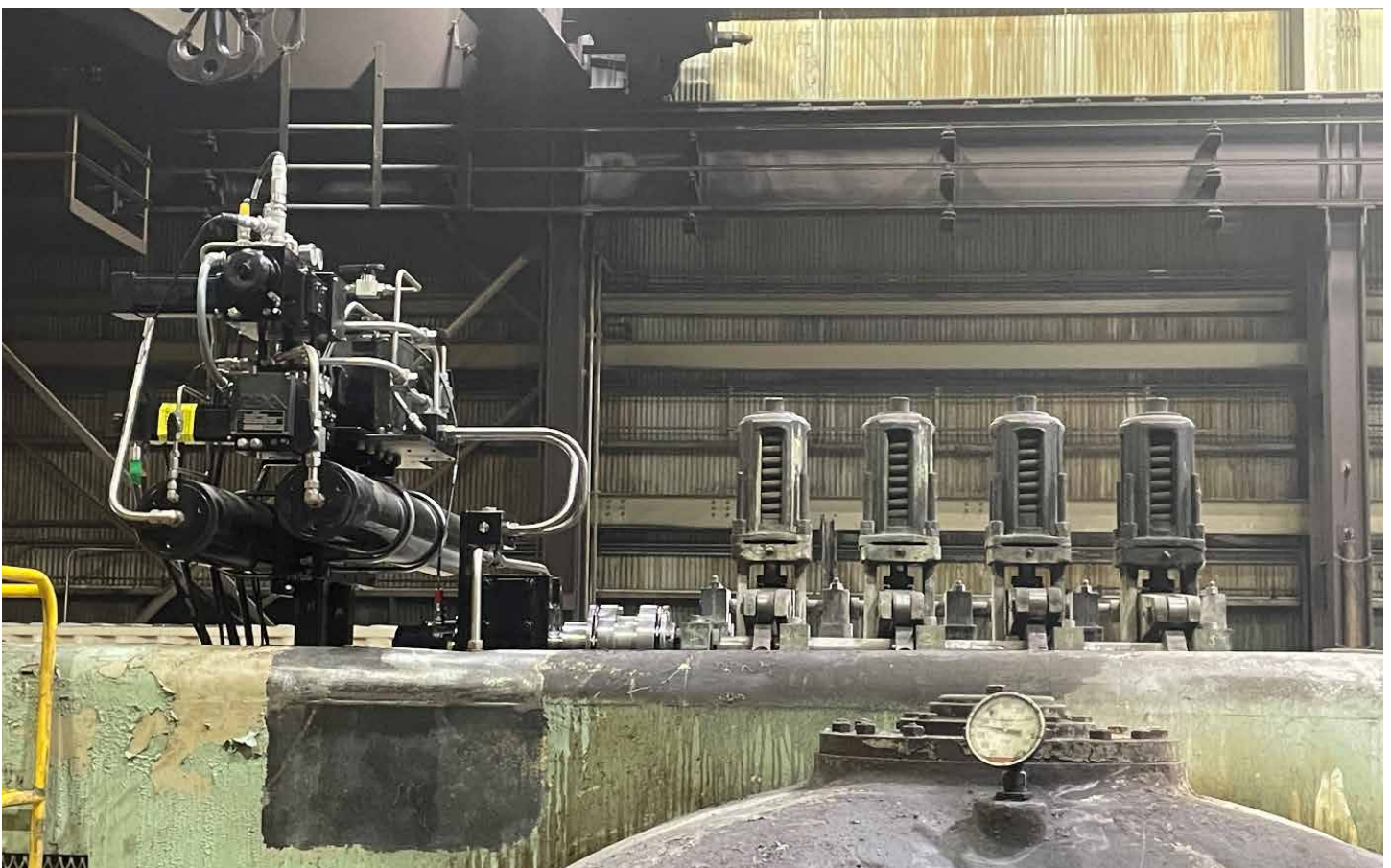
In Indiana, a steel producer recently installed REXA actuators to position critical steam turbine speed control valves and air flow variable stator vanes on three turbo blowers that feed wind to the blast furnaces to guide air flow on first 6 to 13 rotor stages.

**Problem:** *“Recurring hydraulic system failures on turbo-blowers have led to frequent operational disruptions at the blast furnaces, resulting in production losses and increased safety risks.”*

- Reliability issues
- Chronic leaks on fittings and poor cooling resulting in seal failures
- Usually need to replace both control servos every time hydraulics taken down due to plugged up filters
- Resulting partial or total loss of furnace production costing an average of \$960,000 per year
- Safety – oil leaks from hose fittings were a fire risk

### REXA Solution:

- Reliability improved with more precise and smooth positioning control
- No more oil leaks or high-pressure hydraulic showers; less risk to operations personnel
- Oil maintenance eliminated along with hydraulic system component replacement
- Payback period for entire upgrade project is < 6 months per turbo blower
- 2024 AIST Reliability Achievement - Gold Award Winner



# Blast Furnaces

The blast furnace makes cast iron from iron ore, coke and limestone by reducing the iron and melting it into molten cast iron. Hot blast air blown into the bottom of the furnace at 1800° F and 500 mph helps the coke burn which reduces and melts the iron ore. For this continuous process the temperatures in the furnace reach 3,500°F. Waste gases are cleaned and used for heating stoves for hot blast air and to boilers for power generation.

## Target Applications

BF Air Steam Turbine Governor

Cold Air Mixing

BF Gas to Boiler Pressure



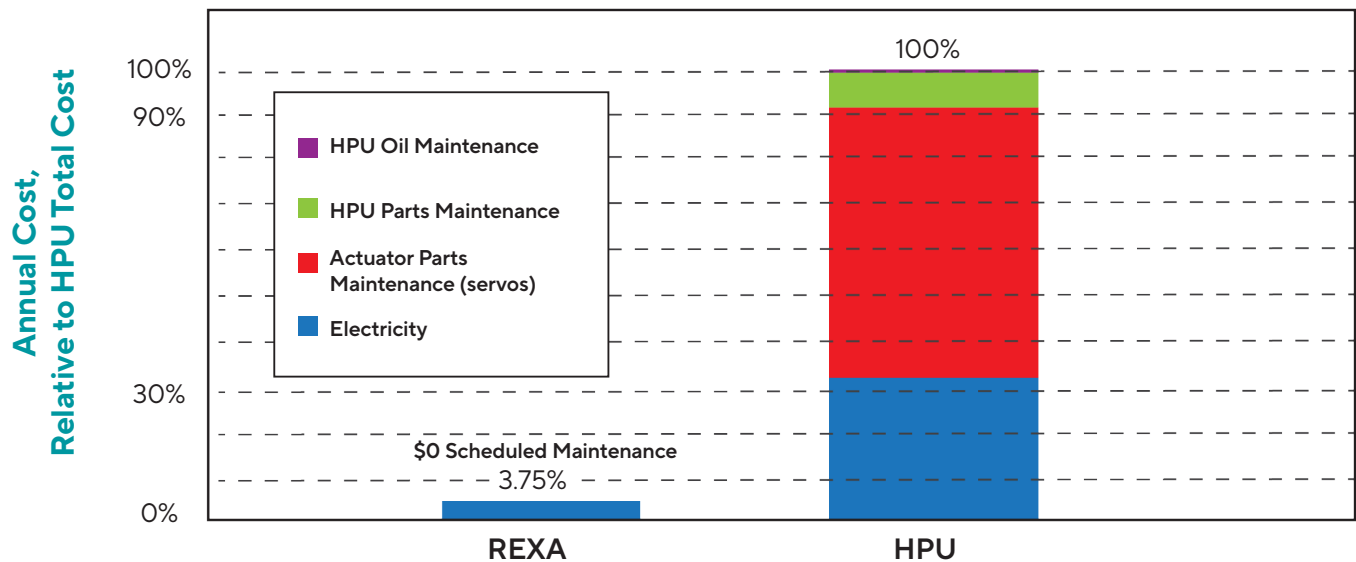
### Blast Furnace Gas Feed To Boiler Pressure Control

**Problem:** "High pressure BF gas fluctuations negatively impact boiler combustion efficiency."

- Is the blast furnace gas pressure to the boiler stable and achieving set point?
- Can the blast furnace operational flow changes be controlled in a stable manner?

**REXA Solution:** REXA can give you confidence to precisely position the butterfly valve to provide consistent blast furnace gas to the boiler, improving boiler operation and producing consistent steam output.

### Actuator Operating Cost Per Year, Relative



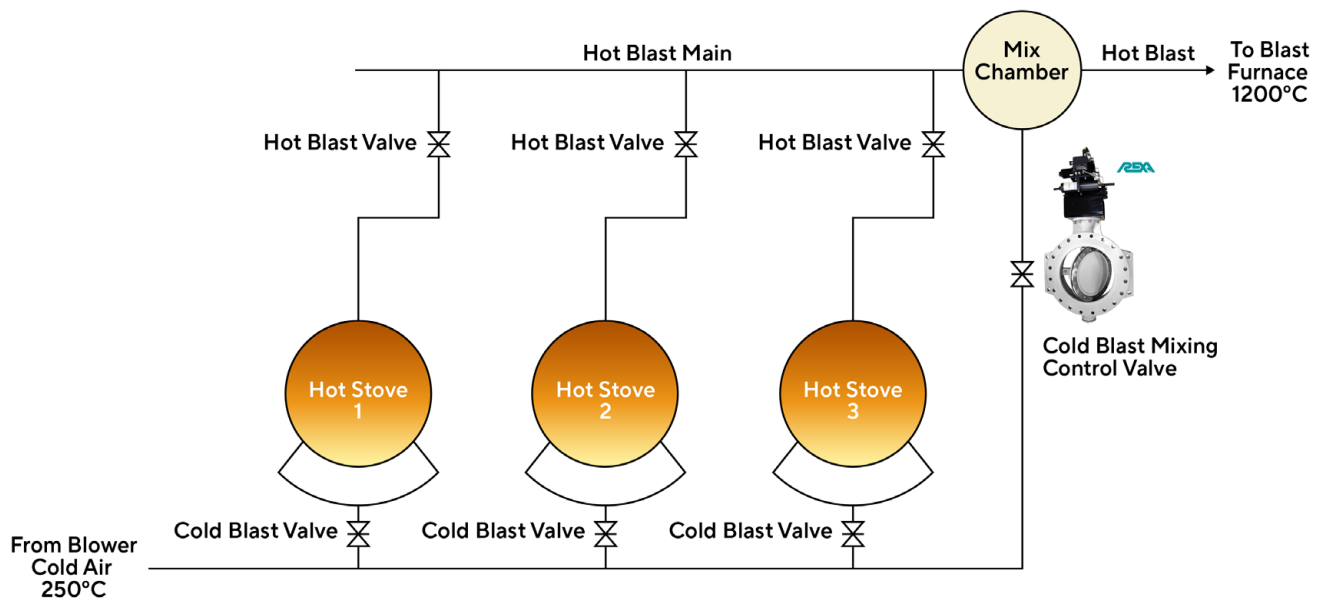
# Blast Furnaces

## Cold Blast Mixing Valve Temperature Control

**Problem:** “The pneumatic actuator positioning the mixing valve overshoots the setpoint.”

- Is the cold blast valve reliably positioning due to repeated cycling?
- Is the incoming blast furnace air feed temperature consistent?

**REXA Solution:** REXA can give you confidence to precisely position the mixing valve to provide consistent gas temperature to the blast furnace, improving furnace operation.



## Electric Arc Furnaces

The Electric Arc Furnace (EAF) uses steel scrap or direct reduced iron to charge. The process melts the steel at 1800° C. This is a batch process that has lower emissions and more flexible operations. A baghouse is an air pollution control device used commonly in steel mills to remove particulates out of hot gases from various steel making processes. The use of air dampers control the gas pressure to optimize particulate recovery and process availability. Even a slight positive pressure inside the baghouse can result in reduced cleaning efficiency. REXA actuators are used to precisely maintain vacuum pressure.

### Target Applications

Main Air Pressure Control

Canopy Pressure Control

Baghouse Pressure Control



## Hot Briquetted Iron & Direct Reduced Iron

Hot Briquetted Iron (HBI) and Direct Reduced Iron (DRI) are used primarily in the steel industry as a high-quality iron feedstock into EAF and Blast Furnaces. HBI is compressed into dense briquettes, less porous than DRI. It is more stable and less oxidizable than DRI so it is safer to transport globally. Both HBI and DRI provide a clean, reliable iron source when high-quality scrap steel is limited. When used, HBI/DRI lowers steelmaking impurities such as sulfur and phosphorous which improves steel quality. HBI/DRI production uses natural gas, allowing lower CO<sub>2</sub> emissions compared to traditional blast furnaces.

### **Problem:** "Poor Pneumatic control performance causing trips"

- Process gas compressor start-up attempts could sometimes be 6 attempts, with each trip requiring 3-4 hours to restart

### **REXA Solution:**

- 0 trips since REXA install May 2022
- Automated startups without failures and improved process control allowing for better tuning of HBI product chemistry
- \$240,000/YR in HBI pellet production revenue



Before - Pneumatic actuator



After - REXA actuator

# Hot Rolling Mill

Hot rolling is a metalworking process that occurs above the recrystallization temperature of the material. After the grains deform during processing, they recrystallize, which maintains an equiaxed microstructure and prevents the metal from work hardening. The starting material is usually large pieces of metal, like semi-finished casting products, such as slabs, blooms, and billets.

## Target Applications

Reheat Furnace Flue Gas

Reheat Furnace Gas Feed

Cooling Water Feed

**Problem:** *“Is it frustrating that the reheat furnace pressure fluctuates and we can even scale that impacts hot rolled steel quality”*

- Does your furnace pressure at risk of not meeting control setpoint limits?
- Is your excess air setpoint set high such the fuel usage is excessive?

**REXA Solution:** REXA actuators can provide accurate and stiff positioning by eliminating linkages and improve combustion efficiency, saving natural gas usage



Before



After

## Example Installations





### **Headquarters & Factory**

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