

COOPER SHIFTS ESG PUSH INTO HIGH GEAR

Cooper Releases New Lower Emissions Solutions For AJAX And Superior Engine Lines, Launches Hydrogen Natural Gas Fuel Mixture Initiative, Unveils Emissions Reductions Solutions, And Eliminates Hazardous Processes



Power Ring Set Manufacturing At Cooper's Houston Factory

BY MATT FORCEY AND GORDON MISHLER

Since Cooper Machinery Services (Cooper) transitioned to private ownership in late 2019, our commitment to increase the company's focus on emissions reductions has been a cornerstone of our strategy to include solutions for both large-bore, slow-speed engines and high-speed equipment. To accomplish that goal, Cooper has improved its existing operations and acquired several new companies to support global flywheels turning for the next hundred years. We don't want to give our clients a reason

to think about retiring their horsepower, so we're executing a deliberate and calculated plan for long-term growth that positions our company for the future without sacrificing the needs of the current marketplace.

Over the last few years, we've made it clear we aren't buying companies for the sake of headlines, but instead, putting the pieces together as part of a broader growth strategy. Cooper's acquisitions of Epic International's energy services business and Reciprocating Technology Services provided



Dual-Coated Cooper Bessemer GMW Pistons

a way for Cooper to strengthen its position in aftermarket parts and services, particularly with Clark, Ingersoll Rand, and Worthington engines. The acquisition of the Sinor Engine Company and Energy Dynamics Inc. strengthened Cooper's position as the original equipment manufacturer (OEM) for the Superior engine line and served as a springboard for entry into the Waukesha VHP and Caterpillar 3600 after-sales support businesses. The acquisition of Hoerbiger's Engine Legacy Solutions business enhanced Cooper's specialty in repairs and services, but also added a significant edge when it comes to overhauls, upgrades, and emissions advancements for large reciprocating, natural gas, and dual-fuel engines. And finally, the formation of Turbocharger Solutions International is all part of Cooper CEO John Sargent's plan to "rebuild Cooper into the market leader once again."

We are constantly on the lookout for opportunities to improve and add to our emissions product offering. Today, our suite of engine and compressor upgrade products not only target combustion emissions but also greenhouse gases (GHGs), fugitive compressor emissions, and heavy metals.

Industry Leader In Emissions Reductions

Lowering NO_x and GHG emissions is one of the most visible and talked about aspects of environmental protection. Over the last few decades, governments around the world have steadily lowered emissions thresholds; Cooper has responded with excellent solutions. Cooper has eliminated more than 3.5 million tons (3.18 million tonnes) of NO_x using its CleanBurn technology while also reducing total hydrocarbons. Cooper has manufactured nearly 900 new engines with CleanBurn technology and developed cleaner technology for Clark, Ingersoll Rand, and Worthington integral engine-compressors.

NO_x and GHG Reduction Solutions For Large-Bore Reciprocating Integral Engines

Cooper offers a complete engine upgrade solution to achieve a minimum of 0.5 grams per brake horsepower-hour (g/bhp-hr). NO_x emissions for any Clark, Cooper-Bessemer, Ingersoll Rand, and Worthington slow-speed engine can be reduced with Cooper's proprietary solution. Through the combination of upgrades on your turbocharger and the addition of electronic ignition, pre-combustion chambers, Hyperfuel, Hyperbalance, and Hyperlogic, lowering emissions on large-bore, slow-speed integrals is a relatively quick and inexpensive endeavor, especially when compared to the cost of horsepower replacement.

In a major increase in Cooper's ability to reduce NO_x emissions, the company is launching a 0.5-g/bhp-hr NO_x solution in Q1 2022 for the AJAX and Superior lines of engines.

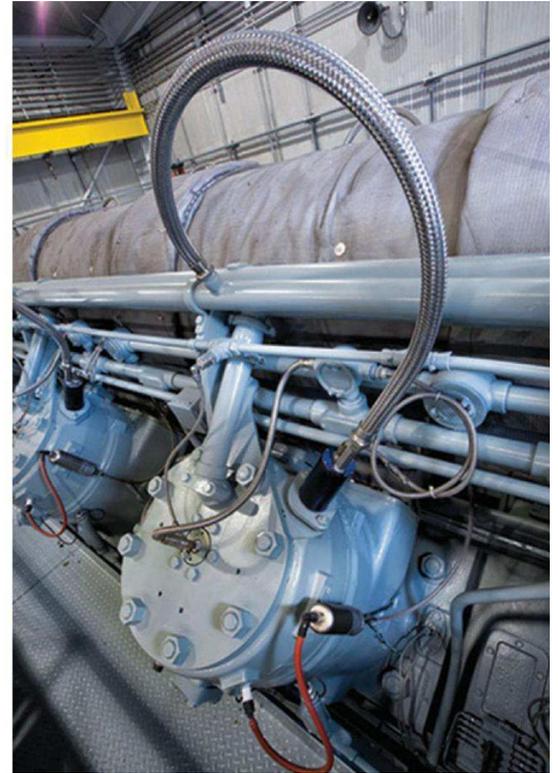
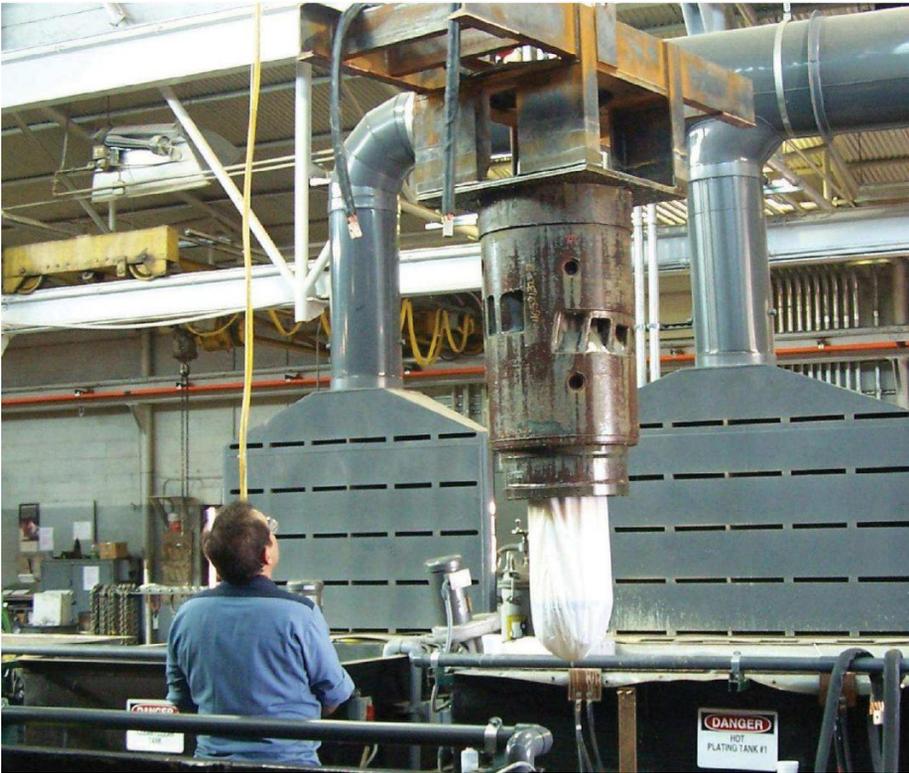
New Superior Low-Emissions Reductions Solution

Cooper is pleased to announce the pre-release of the new, low-emissions Superior 825. The new engine reduces emissions levels through redesign of engine components and combustion geometry. It provides reliable operations of the Superior SGTD engine while maintaining 0.5-g/bhp-hr NO_x emissions and reducing greenhouse gas (GHG) emissions for reduced fuel slip and improved fuel economy. The technical enhancements to the engine consist of newly designed bolt-in pre-chambers, the use of electronic pre-combustion chamber (ePCC) check valves, a turbocharger redesign, mass-based air/fuel ratio, and a new control system.

New AJAX 2800 Ultralow-Emissions (ULE) Integral

Cooper has invested heavily in the AJAX 2800 series engines to reduce emissions levels. These enhancements deliver a large reduction in NO_x emissions using lean combustion without selective catalytic reduction (SCR). The new and improved AJAX 2800 ultralow-emissions (ULE) integral will operate below 0.5-g/bhp-hr NO_x levels with greater than 2.5% improvement in fuel efficiency. Retrofit kits will be available for existing AJAX engines supplying the same level of NO_x reductions as new engines. The technical enhancements to the AJAX 2800 series consist of high-compression-ratio pistons, optimized power cylinder heads, center-mounted pre-combustion chambers, ePCC, a new electronic fuel injection system, and an intake bypass system for methane emissions reductions. Each design element contributes to increased operational flexibility and environmental compliance. "To meet new source standards, Cooper designed and successfully tested AJAX emissions solutions that would allow customers to put units back in service," said Hans Mathews, Cooper's vice president of engineering. "AJAX is one of the most popular compression engines ever built, and we now can provide a path for getting them back up and running in a clean and environmentally friendly way."

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Dropping A Cylinder Into A Plating Tank At Cooper's Plating Center Of Excellence (Left) A retrofitted Cooper Bessemer GMVH with hyper-fuel and electronic pre-combustion chamber check valves. (Right)

Cooper Introduces Hydrogen (H₂) and Natural Gas Fuel Mixture Initiative

In October 2021, Cooper and Southern Star Central Gas Pipeline, Inc. (Southern Star), a US-based interstate natural gas pipeline company, announced the signing of a memorandum of understanding (MoU) to launch a joint hydrogen research project aimed at converting Southern Star's fleet of gas-fired reciprocating integral engines to gas-hydrogen-fired units. Starting in Q1 2022, Cooper and Southern Star will modify a Cooper-Bessemer GMVH-12 at Southern Star's Hugoton, Kansas, compressor station to run on a blend of hydrogen and natural gas. The teams will equip the engine with Cooper's HyperBalance IV system to monitor pressures, collect data, and ensure equipment safety during the test. Southern Star and Cooper plan to run the engine on a mixture of up to 10% hydrogen and will both provide engineering support and plans to publicize data to the industry once it becomes available.

"Cooper has been working on green environmental technology for some time and recently launched an official hydrogen initiative," said Sargent. "We are excited to partner with a forward-leaning and visionary organization like Southern Star who understands the necessity of our industry to embrace hydrogen and reduce its overall carbon footprint. Cooper began offering 'clean' technology on our engine-compressors in the 1970s, and we have converted thousands of engines to some degree of green technology over the years including many to the 0.5 g of NO_x level. Cooper engines can run on up to 10% hydrogen with minimal modifications."

Elimination Of Hazardous Processes

In addition to emissions reductions, Cooper has launched multiple initiatives to reduce or eliminate hazardous material in the manufacturing process for some of our most important product lines: power cylinders, piston rings, and power pistons. The elimination of chrome and tin in these processes reduces the use of toxic acid baths, hazardous byproducts, and other pollution risks.

Hard Iron Power Cylinder Plating Eliminates Chrome

The new Cooper hard iron plating process was developed as an alternative to chrome plating for power cylinder reclamation with a low environmental impact. Hard iron plating is 99.9% pure electrodeposited iron with excellent adhesion properties and can be molecularly bonded to a wide range of base metals. It is applied in the same manner as chrome plating and can be inspected under identical technical guidelines for adhesion and porosity variation. Hard iron plating can be uniformly deposited in the event of reclaiming a severely worn cylinder bore. This is achieved by depositing an underlay of iron of a lesser hardness that will not create stress and a weakening of the parent material.

Hard iron plating has the appearance of an original cast iron cylinder and an average tensile strength of 235,000 psi (16,203 bar) and shear strength exceeding 50,000 psi (3447 bar). The average hardness of hard iron plating is 45 to 50 HRC (421 Brinell).

At Cooper's Houston service center, our hard iron plating cell can accommodate most major lines of power cylinders, including the gas compression industry's largest, such as the Cooper-Bessemer Z-330 20-in. (508-mm) cylinders and the Clark, Ingersoll Rand, and Worthington 17-in. (432-mm) cylinders, or any smaller sizes.

Cooper's hard iron plating is also superior to thermally sprayed coatings for power cylinder restoration, as our product has no limitations for material bonding and ring compatibility. For the end user, the transition from chrome plating to electrolytic hard iron plating is seamless. Both hard iron and chrome cylinders can be used in the same engine at the same time. The same power ring sets are used for both.

Plasma-Sprayed Power Rings Eliminate Chrome

To complement the hard iron-coated cylinders and liners and the dual-coated piston, Cooper introduced plasma-sprayed power piston rings that are dual-coated with molybdenum and nickel graphite (Mo2). Offered as an upgrade to traditional Ferrox coated rings, the Mo2 coating technology was first introduced to large-bore diesel engines in the marine industry many years ago and has been applied with great success around the world. Cooper is launching Mo2-coated rings to reduce risk of startup and break-in failures, and to allow extended time between ring replacements. The new coating also allows Cooper to further eliminate chrome from our manufacturing processes. The Mo2-coated rings are available for large-bore, slow-speed engine brands such as Cooper-Bessemer, Clark, Ingersoll Rand, and Worthington. Some advantages of the plasma-sprayed piston rings include anti-scuff properties, long ring life, fast and safe break-in and seating, better sealing via the barrel-shaped ring profile, and no hexavalent chrome. Cooper is the only engine OEM that manufactures engine power piston rings. We maintain a piston ring center of excellence in our Houston manufacturing and distribution center.

Dual-Coated Power Pistons Eliminate Tin

Cooper recently introduced dual-coated manganese phosphate and graphite technology as the engineering standard for the protection of power pistons for large-bore compression and power generation engines.

Traditionally, many engine manufacturers and service providers have used electroplated tin on the surface of the piston skirts. The purpose of this coating is to reduce friction and allow for break-in of the piston to the liner surface. The environmental, health, and safety concerns for tin-plated coating is rendering the tinning process a less attractive option within gas compression and power generation industries. In addition, tin can cause a loss of clearance and hot spots on the piston. Dual coating will replace the use of tin plating in its entirety within Cooper's new production.

Cooper has accumulated thousands of operational hours with dual-coated pistons on Cooper-Bessemer model

GMV, V-275, W-330, and Quad integral engines. Dual coating is available on new pistons for all product models of Cooper-Bessemer slow-speed integrals and will become available for AJAX, Clark, Ingersoll Rand, and Worthington slow-speed integral engines in early 2022.

The piston has a dual coating consisting of a bottom layer of manganese phosphate and a top layer of graphite-based, anti-friction coating. The combined thickness of the manganese phosphate and graphite is 0.0005 to 0.0015 in. (0.0127 to 0.0381 mm). Manganese phosphates' natural crystal structure is very durable and does not flake. Due to its structure, it performs well for break-in between the piston and cylinder liner, and it provides continued wear protection after the break-in period. In addition, manganese phosphate increases corrosion resistance, thereby greatly improving the piston shelf life. The dual coating of manganese phosphate and graphite provides excellent strength and oil lubrication properties that helps to significantly reduce friction losses and scuffing of the cylinder bore.

ESG Underscores Everything We Do

New products and technologies will continue to play a role in shaping the future of our increasingly decarbonized economy. However, lowering emissions and improving the performance of legacy equipment creates instant benefits without the need to replace entire fleets. Cooper's solutions serve the three-pronged benefit of lowering emissions, preventing the environmental harm that comes from scrapping heavy machinery, and saving the energy and raw material costs associated with building and installing completely new fleets.

We believe technological innovations in gas engines and compressors are key to improving energy efficiency. Our products and services help make access to clean energy more reliable and affordable. By doing so, we enhance the standard of living for all and stimulate economic growth, improving health and creating employment opportunities around the world.

In addition to our advancements in environmental protection and advocacy, Cooper wins with its people, and people must be at the center of all we do. We actively care about the health, safety, and well-being of every person we touch — something that must never be compromised. Our programs aim to care for our employees and partners, while our culture values diversity, inclusion, and equality of opportunity. We also aim to contribute to the strength of our communities through our philanthropic and volunteer efforts.

At Cooper, we operate a complex global business, serve a wide variety of customers from many industries, and have a supplier base located on five continents. Without strong values and processes around corporate governance, we could not survive. Our sustainable business practices are based on accountability, integrity, fairness, transparency, responsibility, and compliance with the laws and regulations in the nations we do business. And, most of all, we regard respect for human rights as part of our corporate responsibility along the entire value chain.