

HYDRAULIC AUTOMATIC GAUGE CONTROL CYLINDERS

SUPERIOR MILL PERFORMANCE
FROM AN EXPERIENCED LEADER

MAXIMIZE MILL UTILIZATION

IMPROVE QUALITY, INCREASE VOLUME, MINIMIZE COST, AND TAKE CONTROL

TECHNOLOGY YOU CAN TRUST

In today's competitive marketplace, steel producers are under pressure to produce the highest quality products manufactured to precise tolerances, while keeping costs to a minimum. No single arrangement may be more important to achieving these goals than the Hydraulic Automatic Gauge Control (HAGC) system. These complex systems operate under extreme conditions and so a HAGC system of substandard design or one that is poorly maintained can directly affect the quality and volume of the product and lead to excessive and costly delays.

A knowledgeable mill builder and HAGC supplier can resolve these issues. Solutions may be as simple as training mill personnel on proper system maintenance and inspection methods, considering upgrades to the existing system components, or a complete hydraulic system upgrade. At Primetals Technologies we work directly with you to identify and address your unique requirements.

Primetals Technologies has designed, manufactured, reconditioned, and tested more than 1,000 heavy-duty HAGC cylinders. Our decades of experience in MORGOIL® Bearing and flat mill engineering allows customers to access our many years of mechanical, fluids, and electrical experience with HAGC systems through a single global supplier. Our expertise and infrastructure allow us to tailor a solution that meets your needs, including:

- Engineering and supply of the highest-quality HAGC systems and components
- Cylinder reconditioning and testing
- Cylinder redesigns
- Hydraulic system upgrades
- Hydraulic manifold or system upgrades
- Electrical control upgrades

FROM A COMPANY YOU KNOW

What separates Primetals Technologies and allows us to implement the right solutions for you is our highly experienced sales/service engineers supported by our in-house engineering groups and backed by nearly a century of experience as the OEM manufacturer of the original MORGOIL Bearings.

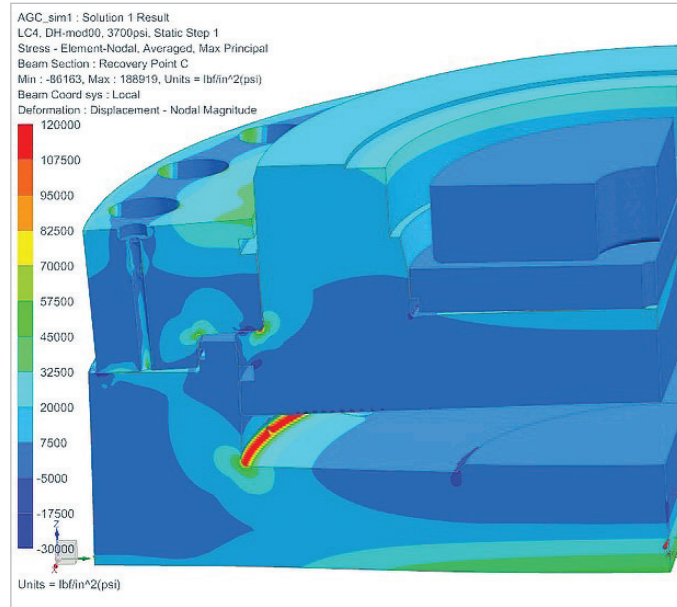
Primetals Technologies designs and commissions world-class components which perform the most critical functions in hot or cold rolling processes. HAGC cylinders belong to this short list of sensitive components which require extensive attention and expertise.

ADVANTAGES OF PRIMETALS TECHNOLOGIES HAGC SYSTEMS

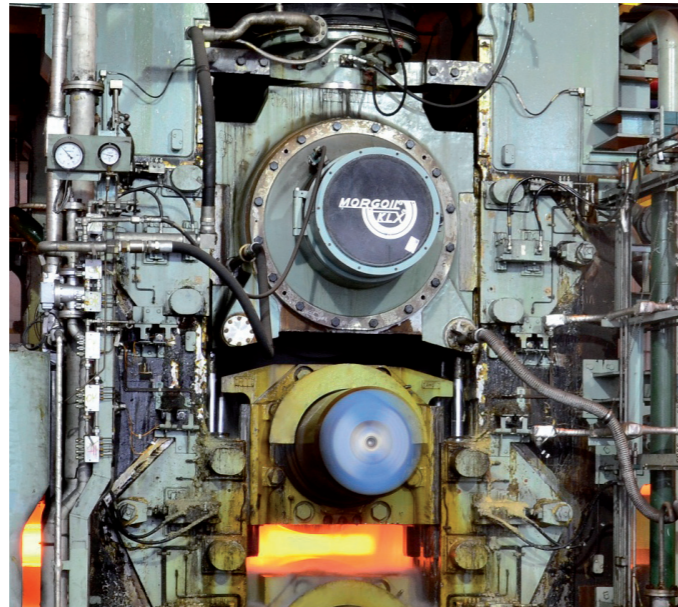
- Achieve superior strip quality
- Accurately maintain product tolerances
- Minimize head and tail losses
- Maximize mill utilization
- Eliminate unplanned downtime due to poorly performing gauge control
- Component improvements are applied as new developments become available

UNPARALLELED KNOWHOW

BENEFIT FROM THE EXCLUSIVE KNOWLEDGE OF AN ORIGINAL EQUIPMENT MANUFACTURER



Finite Element Analysis of HAGC cylinder under deadhead loading conditions



Primetals Technologies design and manufactured AGC cylinder

YOUR HAGC LIFE-CYCLE PARTNER

As both an original equipment manufacturer and service provider, Primetals Technologies combines years of experience and customer feedback into our industry-leading HAGC designs. As a product life-cycle partner we support your equipment from its commissioning and startup throughout its years of operations.

AGC CYLINDERS

AGC cylinders are high-precision components that endure the greatest stress of any piece of the HAGC system. They are also the most difficult part to change and the costliest to repair. AGC cylinders require precise machining, grinding, and assembly to obtain the highest performance from their sealing and guiding components.

Primetals Technologies engineers and manufactures, repairs, refurbishes, tests, and upgrades cylinders for multiple applications. When applicable, new up-to-date technical improvements are implemented to ensure improved performance, reliability, and a longer lifespan for your components.

To ensure mill availability and product quality, cylinders must be overhauled on a scheduled basis. Primetals Technologies recommends that cylinders undergo repair and rebuilding every two to four years, recognizing that each mill is different. Waiting until cylinders show noticeable degradation will cause periods of poor quality, unscheduled downtime, and higher-than-necessary repair costs. Consult with us to learn about the recommended service requirements for your specific mill type.



Fluid analysis performed by a Primetals Technologies fluids engineer

HYDRAULIC SYSTEM

HAGC hydraulic systems are well-suited for condition-based maintenance programs. Pumps and servo valves usually have redundant components, and the system will generally degrade slowly, which allows the identification of future problems through proper inspection methods.

The use of pressure- and temperature-measuring devices, ultrasonic listening equipment, system fluid analysis reports, and other instruments and methods can allow maintenance personnel to diagnose emerging problems, with the assistance of our skilled expert technicians.



Inspection performed by a Primetals Technologies electrical engineer

ELECTRICAL CONTROL SYSTEM

The tuning of the electrical control system may have a serious impact on product quality as well as the reliability and longevity of the mechanical systems. Close cooperation among electrical, hydraulic, mechanical, and operations personnel is required to ensure these systems operate optimally throughout the mill. Let Primetals Technologies' expertise in these key disciplines help to orchestrate the collaboration of your vital systems.

UNMATCHED SERVICE

PROFIT FROM THE LATEST TECHNOLOGY AND MATERIALS ADVANCEMENT DURING REBUILDS



Components being cleaned prior to inspection in an industrial parts washer in Warren, OH, USA

RESTORING OPTIMAL PERFORMANCE

Primetals Technologies is uniquely qualified to quickly and precisely, repair or recondition your existing cylinders due to our global network of workshops, service facilities, and in-house engineers. Our workshops are equipped with state-of-the-art turning, milling, drilling, and grinding equipment, and our skilled machinists consistently achieve the tight tolerances and fine finishes this equipment demands. The components are then reassembled by our dedicated teams of technicians to ensure proper fit and function. Before completing the project, our trained technicians prove, through extensive testing, that the cylinders meet all requirements and will function correctly when reinstalled in your mill.

We offer several levels of refurbishments to meet your needs. As part of the rebuild procedure, cylinders are leakage- and friction-tested under load to meet rigorous standards and ensure like-new performance. Over the past several years, we have reconditioned hundreds of cylinders for our customers.

REBUILD PROCESS

- We receive your cylinders at our nearest facility
- All cylinders are cleaned and disassembled
- Our technicians assess each cylinder
- A detailed report is compiled based on the findings
- A technical meeting is held with the customer (in-person or virtual)
- Improvements may be proposed (where applicable)
- Cylinders are repaired and reassembled
- Upgrades are executed (where applicable)
- Dynamic and static tests are performed, and reports are generated
- Equipment is carefully prepared, packaged, and shipped back to your facility



SELECT CUSTOMER

MILL TYPE

Anshan	HSM
Arconic Bohai Aluminum	Aluminum
Beihai Chengde Steel	TCM
Dingsheng ESP	ESP
Dongfang Special Steel	HSM
Jiujiang Steel	PM
Nanyang Hanye Steel	PM
Rizhao ESP	ESP
Shangang Rizhao Steel	PM
Taihang ESP	ESP
Tangshan Steel	PLTCM
Tongren Aluminum	Aluminum
VAMA Steel	PLTCM
Xiangtan Steel	PM
Alcan	Aluminum
Alcoa	Aluminum
Algoma Steel	HSM/PM
AM/NS Calvert	HSM

SELECT CUSTOMER

MILL TYPE

Angang New Steel	HSM
ArcelorMittal DOFASCO	HSM
Cleveland Cliffs	HSM/CM
Essar Steel	HSM/CM
Jindal United Steel	HSM/CM
Lloyds Steel	HSM/CM
Logan Aluminum	Aluminum
Nucor Steel	HSM/CM
Reynolds Metals	Aluminum
Ternium	HSM
US Steel	HSM/CM
Wise Alloys/ Wise Metals	Aluminum
Hindalco Industries	Aluminum
Jindal Steel and Power	HSM
Jindal United Steel Limited	HSM
JSW	HSM
Steel Authority of India	HSM/CM/PM
Tata Steel	HSM

UNRIVALED CAPABILITIES

TAKE ADVANTAGE OF THE MOST ADVANCED HAGC CYLINDER TEST STANDS IN THE WORLD

GLOBAL TESTING CAPABILITIES

Primetals Technologies has the world's most advanced test facilities for HAGC cylinders, offering both static and dynamic friction testing. Our dedicated HAGC repair and service centers, located in Warren, Ohio (USA), Changxing (China), and Mumbai (India), have AGC cylinder test facilities comprised of a restraining frame and a purpose-built hydraulic system. Designed using solid modeling and finite element analysis, the frames are adjustable to simulate various-sized mill housings and will react elastically under variable loads of up to 4.5 million kg.

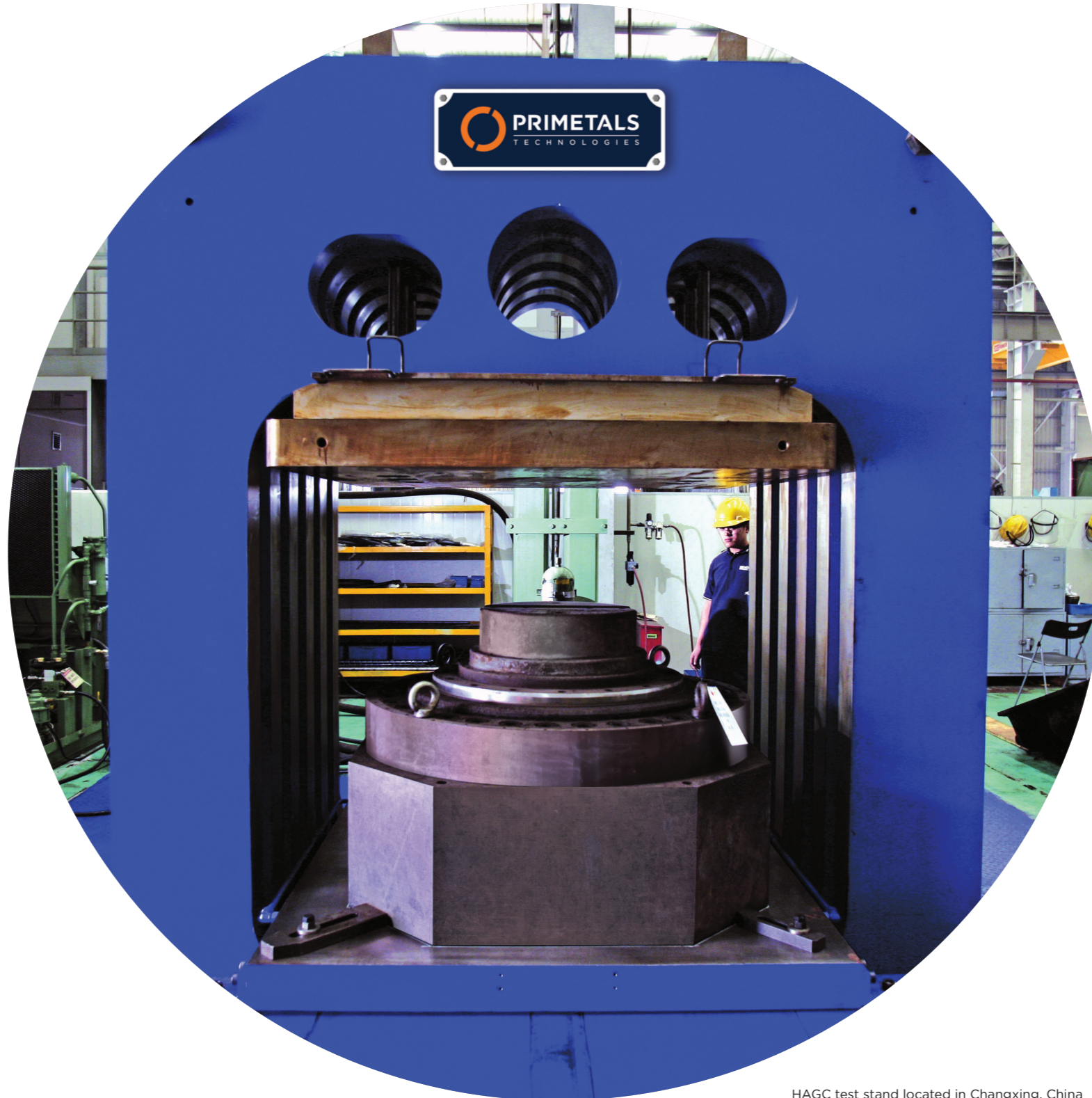
We can operate and test your AGC cylinders up to 400 bar dynamic and static pressure. Test results are provided with each unit shipped. Our test stand utilizes extremely high-speed digital control equipment to ensure valid and repeatable.

TEST STAND FEATURES

- Operating force between 15,000 kN and 50,000 kN
- Dedicated hydraulic units for testing and flushing
- Manifold block equipable with servo-valve and accumulator
- Control and data acquisition equipment managing analogical and digital sensors
- Pressure and position sensors available when customer instruments are not

WHAT YOU CAN EXPECT

- Schedule: 3 to 6 months upon receipt of components
- Detailed scope of supply according to the necessary repairs
- Spare parts management and supply
- Improvements proposed during the refurbishment process



WHAT YOU CAN EXPECT CONTINUED

- Post-repair performances validated in our test-shop
- A wide range of tests performed in one session
- Real-time supervision of tests by Primetals Technologies experts
- Test reports as quality insurance
- Follow-up and support by our experts who, in many cases designed and commissioned the original technology and are well-versed in all other HAGC cylinder and hydraulic block brands and designs

TESTS PERFORMED ON

- HAGC cylinders: Cylindrical base, squared base, single or double acting
- Hydraulic Bending Blocks: T, L, or C types

TESTS PERFORMED INCLUDE

- Static leak test - Apply pressure, typically 150% of operating pressure (may be limited by the maximum load limit of the restraining frame). Leakage measured past the piston and rod seals.
- Friction tests - Plot hysteresis curves for the cylinders to confirm that friction values are within specified parameters.
- Various dynamic tests can be performed to ascertain cylinder performance under cyclically applied pressure loading. Specific tests and testing requirements can be discussed for your layout.

DYNAMIC TESTS INCLUDE

- Response-time measurement
- Controllability test
- Frequency test
- Stroke measurement
- Position sensor function
- Pressure sensor function

HAGC test stand located in Changxing, China

ABOUT 1,800 SERVICE SPECIALISTS AROUND THE WORLD ARE ALWAYS CLOSE TO OUR CUSTOMERS

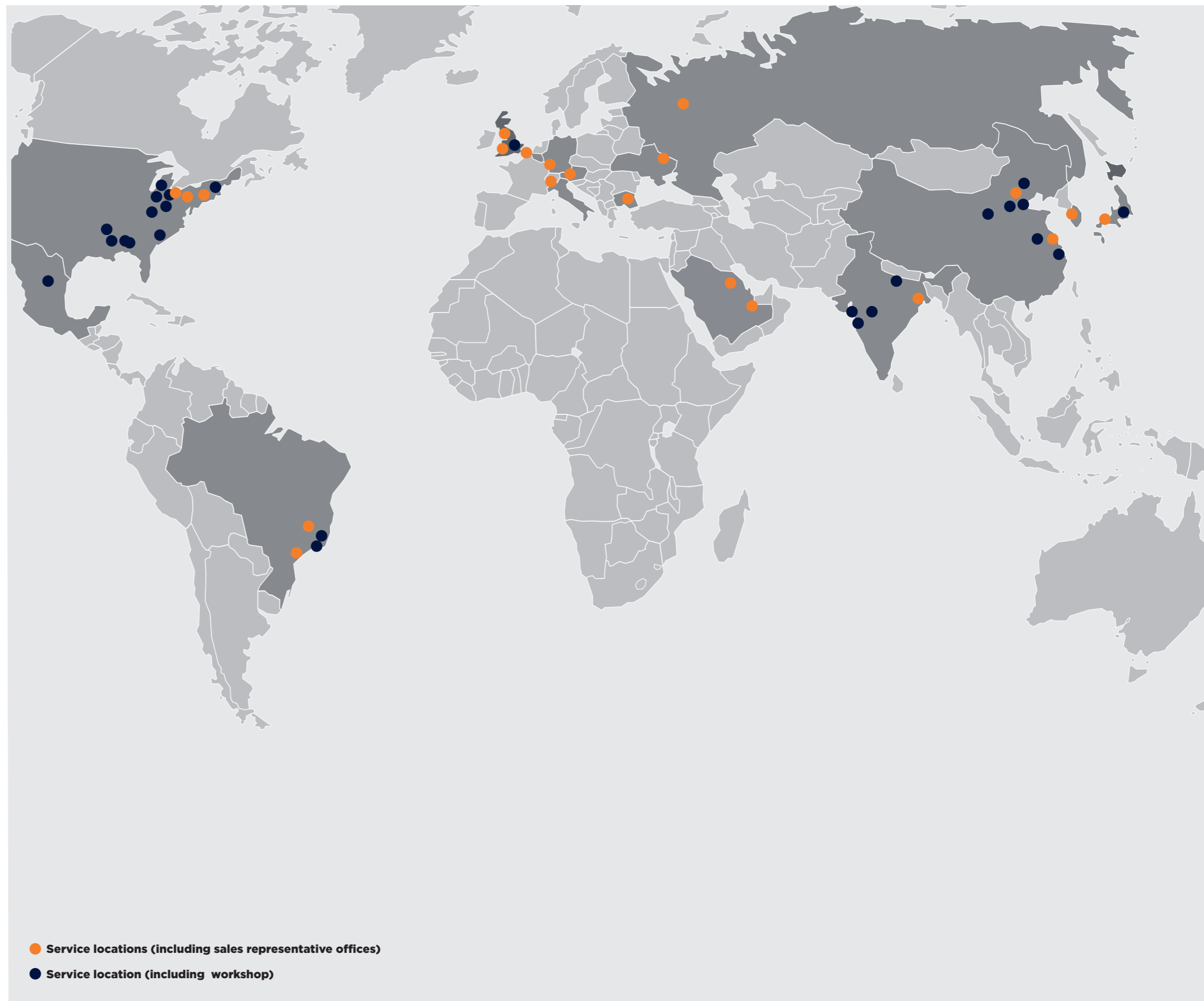
GLOBAL PRESENCE FOR LOCAL SUPPORT

Primetals Technologies customers can rely on a unique service network throughout the world. Our service and expertise are at your disposal from more than 25 service locations worldwide. Benefit from comprehensive support, close to your facilities.

- **Mexico:** Monterrey
- **United States:** Alpharetta, GA; Benton Harbor, MI; Blytheville, AR; Canonsburg, PA; Calvert, AL; Columbus, MS; Cortland, OH; Decatur, AL; Ft. Washington, PA; Ghent, KY; Huger, SC; New London, OH; Sutton, MA; Warren, OH
- **Brazil:** Belo Horizonte, MG; Santa Cruz, RJ; São Paulo, SP; Volta Redonda, RJ
- **United Kingdom:** Scunthorpe, Sheffield, Stockton
- **Belgium:** Drogenbos
- **Germany:** Erlangen, Legelshurst
- **Austria:** Linz
- **Italy:** Asti
- **Turkey:** Istanbul
- **Ukraine:** Dnipro
- **Russia:** Moscow
- **Saudi Arabia:** Al Jubail
- **United Arab Emirates:** Dubai
- **India:** Dolvi, Jamshedpur, Kolkata, Pataiganga, Thurbe/Mumbai
- **China:** Beijing, Changxing, Chengde, Handan, Laoting, Shanghai, Tangshan
- **South Korea:** Seoul
- **Japan:** Hiroshima, Tokyo

MAIN BENEFITS

- Reduced plant downtime
- Increased plant availability and productivity
- Reduced operational and maintenance costs
- Availability of quality-proven spares
- Efficient logistics for just-in-time distribution of spare and wear parts, and components
- Primetals Technologies' leadership in technology and service



Primetals Technologies USA LLC

A Group Company of Mitsubishi Heavy Industries

250 Dietz Road
Warren, OH 44483, USA
Tel: +1 (330) 395-6061

[primetals.com](https://www.primetals.com)

Brochure No.: T10-3-N768-L2-P-V1-EN

© 2023 Primetals Technologies Ltd. All rights reserved

The information (including, e.g., figures and numbers) provided in this document contains merely general descriptions or characteristics of performance based on estimates and assumptions which have not been verified. These estimates and assumptions have to be analyzed on a case-to-case basis and might change as a result of further product development.

It is no representation, does not constitute and/or evidence a contract or an offer to enter into a contract to any extent and is not binding upon the parties. Any obligation to provide and/or demonstrate respective characteristics shall only exist if expressly agreed in the terms of the contract.

Primetals Technologies excludes any liability whatsoever under or in connection with any provided information, estimates and assumptions. The provided information estimates and assumptions shall be without prejudice to any possible future offer and/or contract.

Any information provided by Primetals Technologies to the recipient shall be subject to applicable confidentiality obligations and shall be used by the recipient at their own convenience and at their sole risk.

Primetals is a trademark of Primetals Technologies Ltd.
MORGOIL is a registered trademark of Primetals Technologies in certain countries