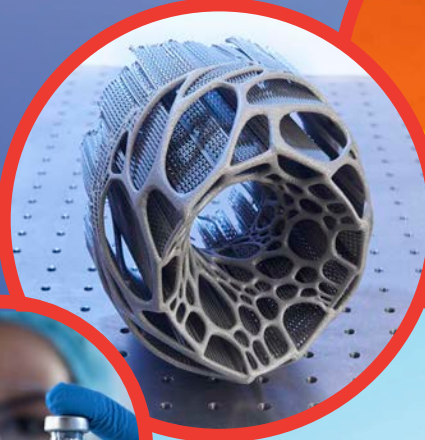


The Messer Technical Center

**Customer Solution Development Center
in Applied Gas Technologies for the Americas**



Innovation in Applied Gas Technologies

Welcome to the epicenter of innovation and customer solutions in applied gas technologies – the Messer Technical Center in Cleveland, Ohio. Here, our team of Messer engineers and gas application experts demonstrate leading application technologies to customers and innovate to address emerging industry needs – and specific customer challenges.

Over the past few years, Messer has completed significant expansions and upgrades to the Technical Center, and is equipped throughout with the gases necessary to demonstrate our technologies. The facility includes a central laboratory as well as dedicated labs serving customers of our business groups – Food & Beverage; Metals, Glass, Heat Treatment and Combustion, Industrial and Additive Manufacturing and Chemistry, Energy & Environmental Industries.

Customers and prospects visit, or virtually connect with, the Technical Center for a variety of reasons: To tour the facility and meet our people, to attend new product demonstrations, to witness the processing of their products with Messer technologies and to learn more about the processing equipment prior to installation.

They also can receive technical and safety training at the Center or they may visit to work on joint development projects. Messer follows all government guidelines to ensure the health and safety of our Technical Center visitors.

It is fitting that our Technical Center is in the birthplace of Rock 'N' Roll. We thrive on solutions that “shake things up,” break new ground, and create measurable value. Working closely with our customers, we can tailor processes and often meet multiple goals at the same time. These may include gains in increased production capacity, reduced labor and operating costs efficiencies or operating flexibility, as well as improved plant safety or lower emissions.



The Messer Technical Center At-a-Glance

Dedicated Test Labs

- Food Processing
- Metals, Glass, Heat Treatment and Combustion
- Industrial and Additive Manufacturing
- Chemistry, Energy and Environmental

In addition, our Central Lab focuses on developing solutions for tomorrow. Development is proprietary, but results of our efforts are embodied in technologies as new Messer equipment and solutions are commercialized.

Technical Services

When you adopt a new industrial gas technology, it is not just the equipment that is important, but the people who stand behind it. Some of the services provided by the engineers and experts in our Applications Equipment Group at our Technical Center include:

- **Customer Product Testing** on Messer's application equipment
- **Technical Training** on specific processing equipment and topics such as safety and equipment maintenance
- **Equipment Design and Factory Acceptance Testing** of processing equipment

Virtual Demonstrations

Although there's nothing like being on-site for a demonstration, the next best option is virtual. We use the latest virtual reality technology to enhance the remote demonstration experience. A virtual communications headset allows customers to experience demonstrations through the eyes of our on-site technical experts and to interact directly with them. Contact us to book your virtual demonstration today.

Spare Parts Program

The Messer Technical Center is also home to our robust Spare Parts Program, designed to help customers maintain smooth, reliable operations. The following three elements work together to save customers time and money.

- **Parts Procurement**
- **On-Site Critical Spare Parts Inventory**
- **Shipping and Receiving**

Our experienced parts staff is available Monday through Friday 8:30-5:00 EST.



Food Processing Lab

Our Food Laboratory is where we explore fresh approaches to food processing issues, develop new technologies and fine tune existing cryogenic chilling and freezing processes.

Our Messer Food Team can perform various tests on customer food products. These include calorimetry to determine specific heat loads, yield and moisture retention, quality tests and crust-freezing demonstrations.

In addition to the development of cryogenic technologies, we help define ideal processing parameters for chilling, crusting or freezing specific foods using Messer solutions. We estimate operating costs of the proposed solution versus the existing process.

We also can validate performance on our cryogenic equipment installed at the Food Lab. This includes traditional equipment to simulate current conditions, and recommended proprietary solutions to explore the latest freezing and chilling technologies on the market.

Selecting the proper cryogenic equipment and control system for the customer's plant, and then defining process parameters in advance reduces time for installation and startup. More importantly, an optimized chilling or freezing solution can provide both immediate and long-term benefits.

In many cases, our cryogenic solutions reduce floor space and labor, boost production, lower operating costs and contribute to food safety programs at the plant.





It is not uncommon for our cryogenic solutions to increase revenue potential for our food customers by \$1 million or more per year on a single line.

Metals, Glass, Heat Treatment and Combustion Lab

Messer has a history of success in applying industrial gases and process and equipment solutions to improve the efficiency of thermal treatments and oxyfuel combustion processes.

Because of the exclusive nature of customer equipment, collaboration is essential to customizing an appropriate solution.

However, our proprietary laboratory testing and computer-aided analysis enhances Messer's deep understanding of process parameters prior to installation. The team can, for example, use computational fluid dynamics (CFD) software to customize burners or gas-injection and control systems. By modeling the impact of multiple variables such as flame characteristics, injection points and flow rates, the theoretical performance of a process can be calculated, visualized, life tested and optimized for a specific application.

Combustion Testing

Messer is at the forefront in the development of new high-efficiency and low emission oxyfuel burners and control systems for steel reheating,

glass melting and aluminum remelting operations. These technologies are critical for maintaining the supply of recycled aluminum for automotive and aerospace applications, as well as the production of high-quality stainless steels and carbon-steel alloys. Our market-leading solutions give furnaces a boost by replacing a portion of nitrogen with pure, combustible oxygen. This typically triggers a dramatic increase in combustion efficiency and a cascade of benefits such as:

- Up to 100% increase in melting rates
- Up to 50% reduction in fuel costs
- Up to 90% reduction in emissions
- More even heat distribution with fewer hot spots
- Up to 50% increase in overall throughput
- 50% reduction in carbon footprint

Our lab is equipped with a furnace designed for combustion testing. It is often used to test and compare a wide range of air-fuel and oxyfuel burners, as well as our new high-efficiency and fast heating OXIPYR™ systems for flameless combustion. Combustion testing also allows for direct observation of operating parameters on flame characteristics as well as statistical analysis of furnace efficiencies. Our team of experts work with customers to develop and customize solutions to meet goals such as higher throughput, lower emissions and greater operational flexibility.

Heat Treatment Testing

Our Applications Team can test and demonstrate the value of Messer technologies for improving thermal treatment processes. This includes: High Speed Gas Injection (HSGI) for higher quality and shorter cycle times in heat treatment furnaces, sintering atmosphere control systems for high process repeatability, and deep cryo-treatment solutions, including those that can also temper the metal parts in the same unit.

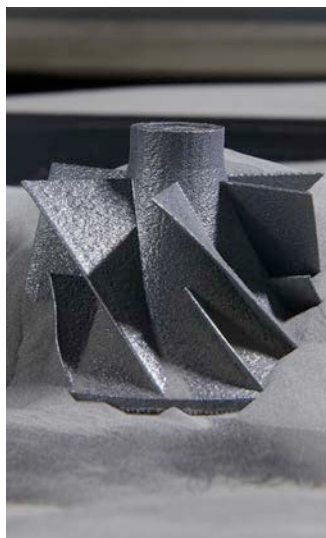


Customized solutions for higher throughput and lower emissions.

Industrial and Additive Manufacturing Applications Lab

Our Applications Team can help additive manufacturers improve process quality for more consistent high-quality parts, essential for many applications and for scaling to higher production rates. Among other AM technology, the lab can demonstrate the new ASURE3D™ atmosphere control unit which monitors and controls O₂, moisture and other critical parameters during 3D printing.

On the industrial side of our lab, our experts can provide detailed demonstrations of other Messer gas technologies. This includes high-pressure gas-supply systems for N₂, Ar and CO₂ industrial applications and cryogenic cleaning systems that can remove surface contaminants without water.



Chemistry, Energy and Environmental Lab

Our Chemistry Lab serves customers in diverse sectors of the chemistry, energy and environmental industries including: oil & gas exploration and processing, petrochemicals, biopharma, specialty chemicals, pulp and paper, water & wastewater treatment and air pollution abatement. We are focused on customizing solutions and validating equipment prior to installation.

As with the other labs at the Messer Technical Center, customers can see our processing equipment and receive training on operations and safety procedures. Equipment available in the Chemistry Lab includes:

1. CO₂ and O₂ equipment like flow skids and injection equipment for controlling pH and BOD/COD in water & wastewater processes,

2. CRYOSOLV™ units for cryocondensing VOCs and for solvent recovery from processing and storage facilities, and
3. CRYOCONTROL™ units for precise temperature control of low-temperature reactors.

In addition to process temperature and pressure measurements, the lab can perform basic tests such as titrations for optimizing gas injection levels in water treatment systems, and analysis of exhaust gases for performance and air-quality testing.



Cleveland Rocks

When you visit, consider planning ahead... Cleveland is a world class destination that is home to the Rock 'N' Roll Hall of Fame on the banks of Lake Erie, the Cleveland Botanical Gardens, the Cleveland Museum of Natural History, the Cleveland Museum of Art, and three pro-sports teams (the Cleveland Browns, Indians and the Cavaliers).

You can also shop downtown, and enjoy one of Cleveland's many excellent restaurants.



About Messer

Messer is the largest privately held industrial gas business in the world, and a leading industrial and medical gas company in North and South America. Messer offers over 120 years of expertise in industrial, medical, specialty, and electronic gases and safely delivers quality gases, related services and technology via an extensive production and distribution network. Messer Americas is part of Messer Group, representing a USD 3.5 billion enterprise with presence in the Americas, Europe and Asia. For more information, visit: www.messeramericas.com.

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