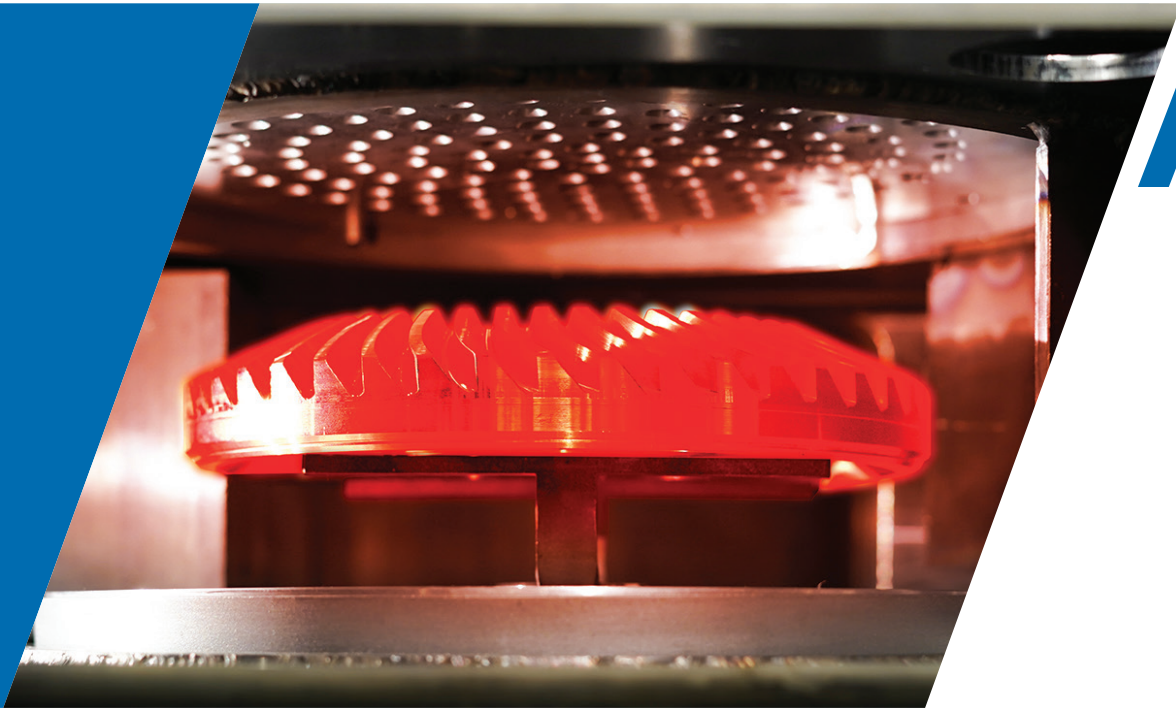


**SECO/VACUUM**

*We support your success.*



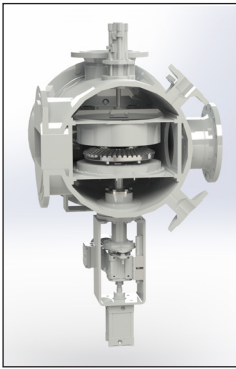
**SINGLE-PIECE FLOW  
UNICASE MASTER<sup>®</sup>  
TECHNOLOGY FAMILY**



## / 4D Quench®: The Heart of Unicast Master®

**4D Quench® predicts and controls distortion to save you \$\$\$.**

4D Quench technology has been created out of necessity for heat treaters who significantly need to increase production quality and economy for the gears and power transmission components they produce. SECO/VACUUM offers four options to implement 4D quench, depending on your needs.

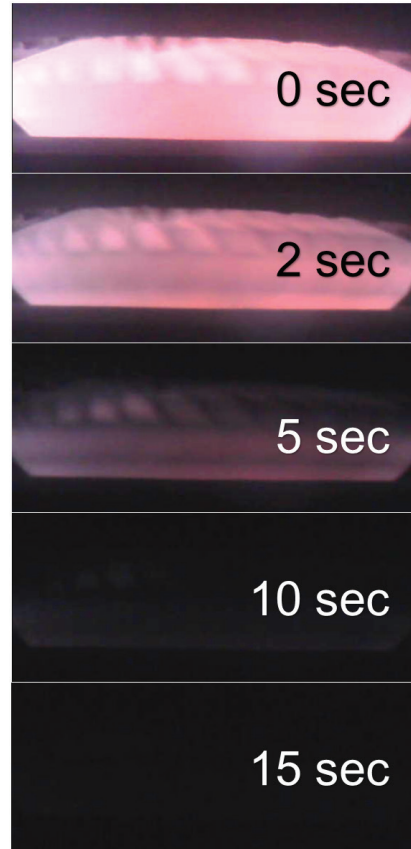


### How it Works

At the core of the 4D Quench system lies the quench chamber. It can function either as a standalone system to replace a press quench at the end of a continuous atmosphere furnace or it can be integrated with the vacuum heating chamber with options for austenitizing only and austenitizing with low pressure carburizing.

When integrating 4D Quench with a vacuum furnace, each component undergoes single piece continuous flow (all under vacuum) from the furnace to the 4D Quench chamber. Once it enters the chamber, a distinctive configuration of cooling nozzles envelops the part (3D cooling) while simultaneous rotation occurs (the 4th dimension) during quenching. This method ensures a uniform flow of cooling gas from all angles – top, bottom, and sides – allowing for rapid cooling rates equal to that of oil quenching.

The cooling nozzles can be customized to accommodate the specific size and shape of the part. A robust nitrogen cooling system delivers uniform quenching, resulting in precise repeatability and a substantial reduction in distortion. All of this is done without oil or helium quenching media.



*The component undergoes rotation while cooling nozzles, positioned on all sides of the part, rapidly and consistently quench a component.*



**INTEGRATED / AUTOMATED / HIGH PRESSURE QUENCH  
/ DISTORTION CONTROL / QUALITY / PRECISION**

# / Unicase Master® Solo 4D Quench® Module

**Replaces a standalone press quench following atmosphere carburizing or austenitizing.**

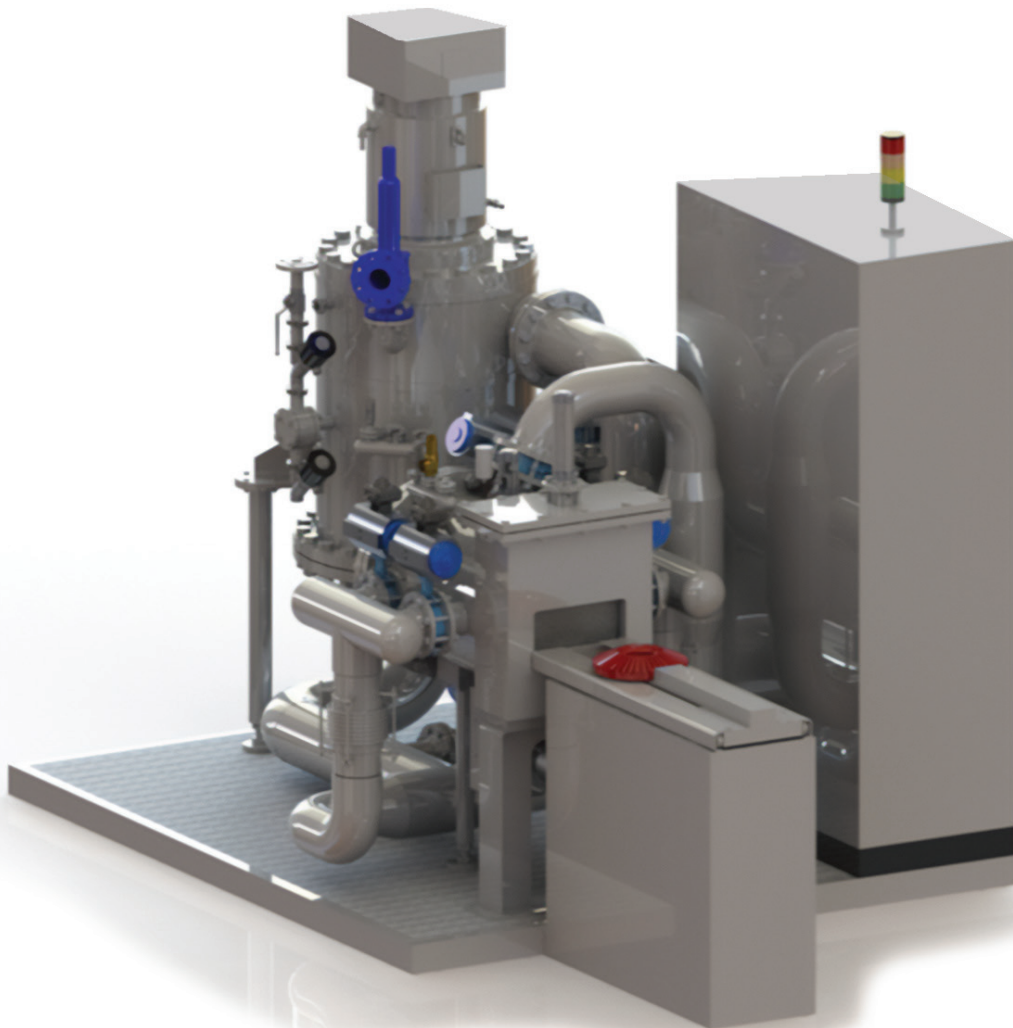
SECO/VAC's 4D Quench provides distortion control and is a modern solution to press quenching while eliminating a number of the challenges linked to their operation.

## Benefits

- Improved quenching with precise control and minimization of distortion.
- The quenching process can be engineered prior to manufacturing as the cooling nozzles can be arranged in a specific arrangement to attain the optimal gas quenching profile on a part, while utilizing nitrogen or clean dry compressed air; outcomes are equal to that of press quenching.
- Introducing a green machined component and extracting a freshly hardened component, the 4D Quench system processes materials in a continuous flow for seamless production.

## Features

- Equipment can be installed and is operable adjacent to current heat treating equipment on the manufacturing floor.
- 4D Quench system is equipped with a rotary load table that provides precise rotation control and speed.
- The touchscreen control interface is simple, user-friendly and intuitive to use.



# / Unicast Master<sup>®</sup> Reheat +4D Quench<sup>®</sup>

## Vacuum Austenitize and 4D Quench<sup>®</sup> system replaces atmosphere heating and press quenching.

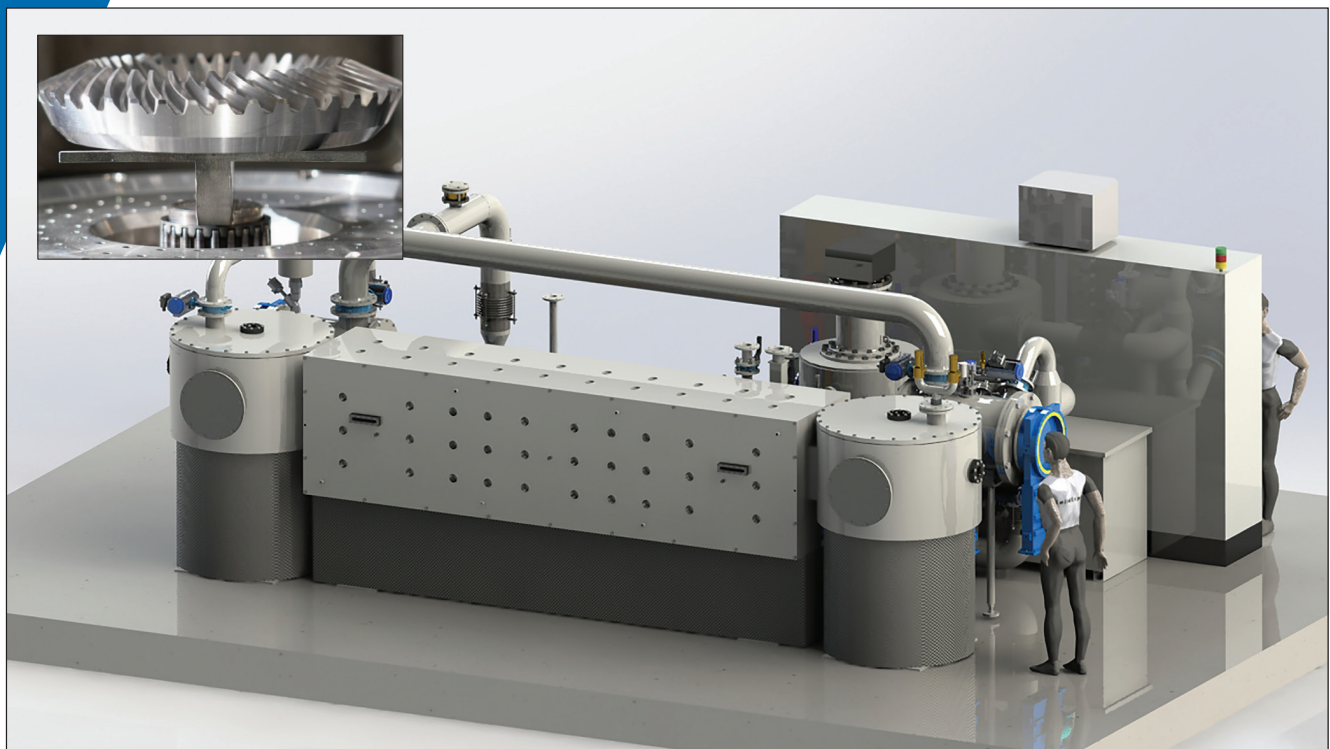
The Austenize & Reheat 4D Quench Reheat Furnace is a single-level design that showcases a single-piece flow vacuum heating chamber and 4D Quench chamber designed specifically for austenitizing and high-pressure gas quenching.

### Benefits

- Seamlessly integrated into continuous production lines, enabling single-piece flow heat treatment.
- Capable of high-volume heat treatment for gears and power transmission components.
- Substantial enhancement of production quality and cost-effectiveness.
- Vacuum heating and vacuum material transfer to the 4D Quench chamber produces IGO-free components.

### Features

- Simple in-line configuration with no need for bulky part handling, reducing the risk of part mishandling that can lead to a fall onto an oil-contaminated floor and eliminates the need for press maintenance.
- Utilizes high velocity and high pressure nitrogen gas quenching system for efficient and effective cooling.
- Features automated load and unloading to facilitate easy part transfer into the vacuum furnace and out of the 4D Quench chamber.
- Eliminates the use of quench oils, washers, and washing fluids, streamlining the overall heat treatment process while reducing its environmental impact.



# / Unicase Master® HiFlow LPC +4D Quench®

## A high volume, low pressure carburizing, single piece flow system with precision 4D Quench®.

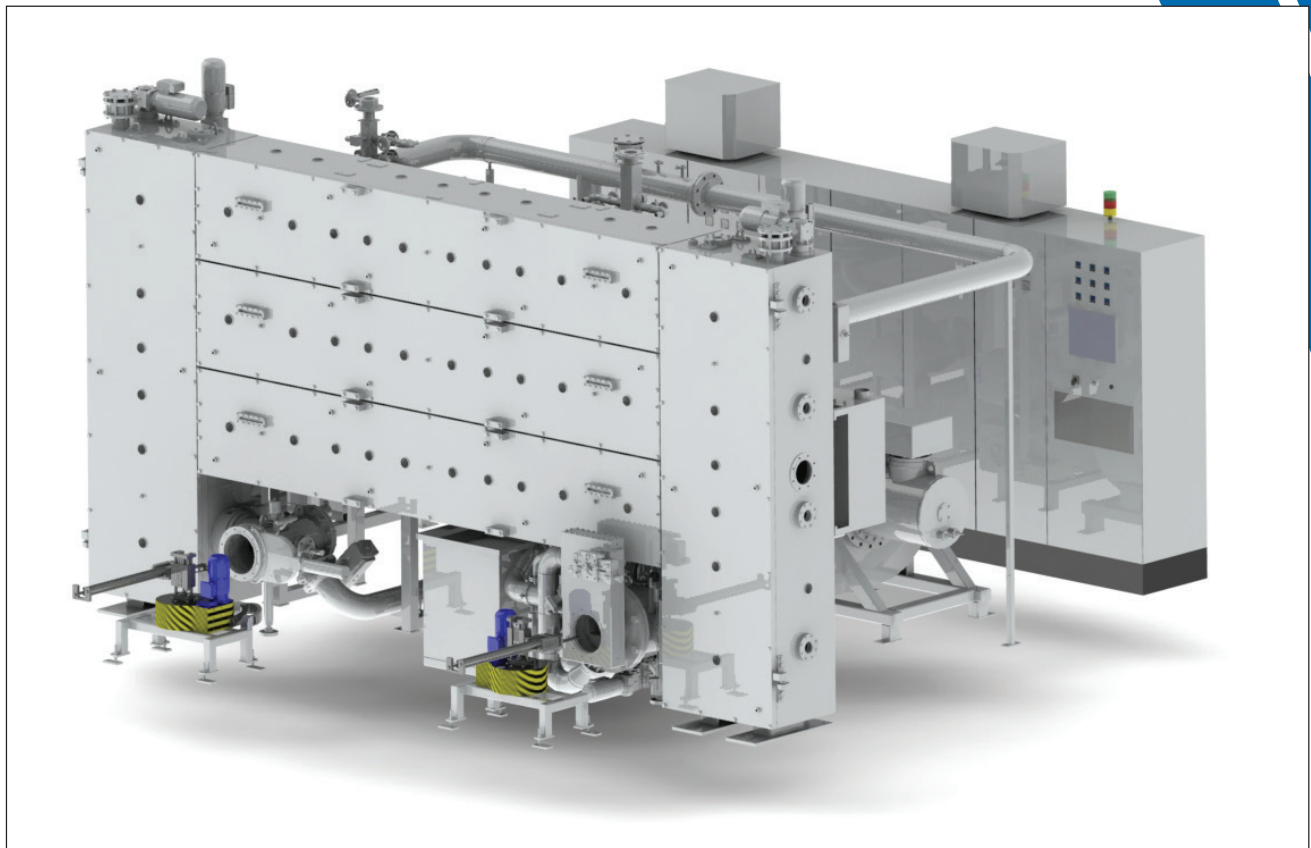
The multi-level LPC Pro & 4D Quench revolutionizes conventional case hardening methods for high-volume manufacturing of carburized gears. It employs a single-piece, in-line heat treating workflow coupled with high-precision case hardening and 4D Quench technology to streamline the entire case hardening process.

### Benefits

- Enables single-piece flow production for precision automotive parts, transmissions, and bearings.
- Achieves high precision and repeatability in manufacturing.
- Provides 100% traceability with individual part monitoring and comprehensive reporting.
- Allows for 100% in-line testing after case hardening for quality assurance.
- Ensures perfectly uniform cooling of parts, providing consistent results while minimizing distortion.

### Features

- Parts are individually quenched in a specially designed high-pressure 4D Quench chamber.
- Continuous single-piece workflow for case hardening of gears and bearings by low-pressure carburizing and high-pressure gas 4D Quenching.
- Capable of high-volume part throughput up to 1 million parts per year in a single furnace.
- Adaptable for thru hardening.



# / Unicast Master® Multistage +4D Quench®

## A low volume, low pressure carburizing, single piece flow system with precision 4D Quench®.

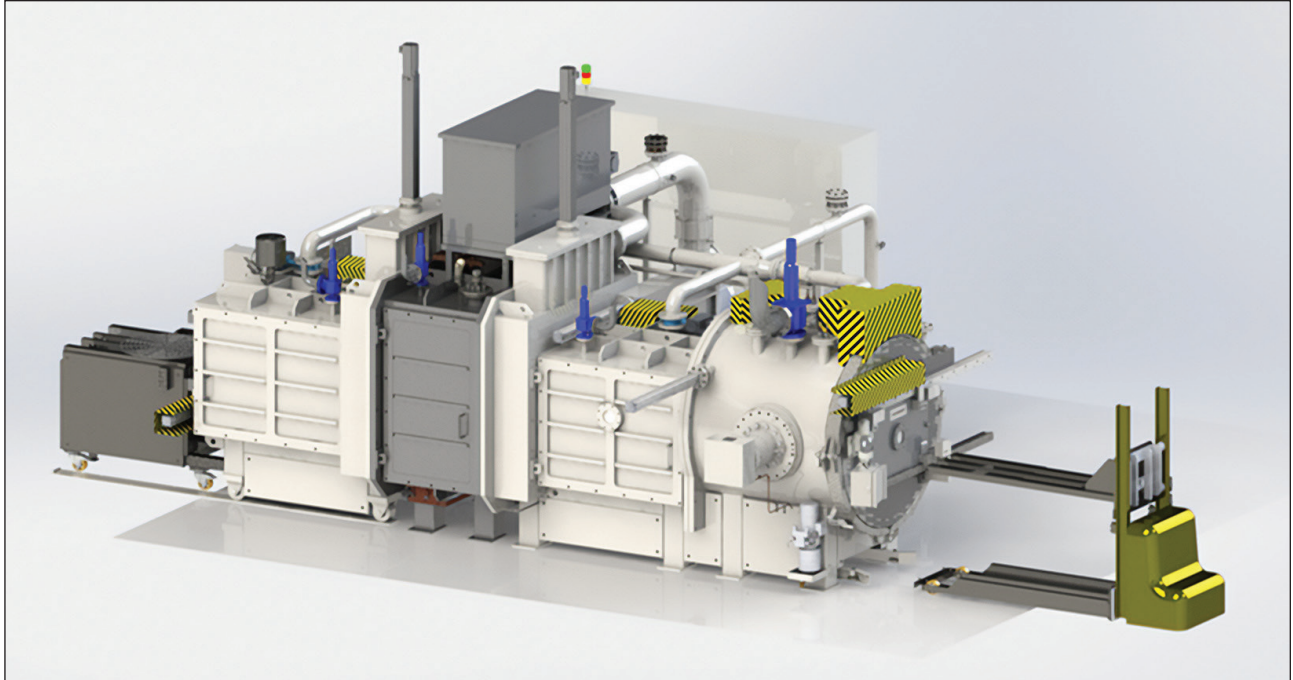
Incorporating precision 4D Quench and low pressure carburizing, this configuration offers a versatile solution for aerospace carburizing and hardening applications. The multi-chamber system has been configured into a single-piece flow for large parts with low volume, boasting advanced capabilities tailored to the needs of aerospace manufacturers.

### Benefits

- Single-piece flow for precision and repeatability.
- Individual part monitoring and reporting for 100 % traceability.
- Single part in-line testing after heat treatment.
- Flexibility and operational speed (quick on/off – no furnace conditioning required).
- Eliminates batch material handling steps.
- Green machined components can be introduced and released from the case hardening system one at a time.

### Features

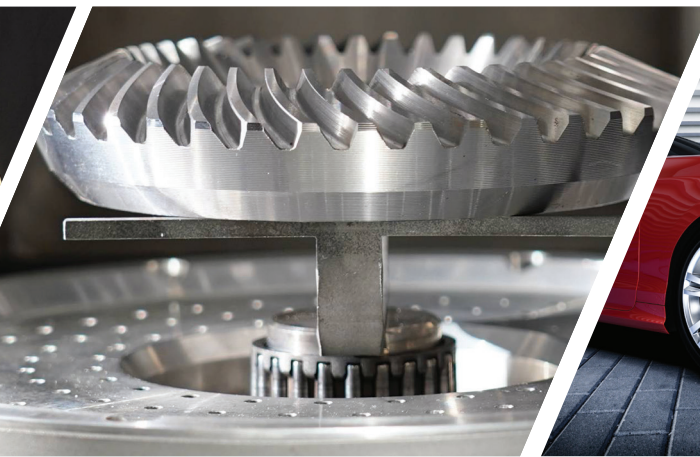
- Can be installed and operated directly on the manufacturing floor next to a CNC machining work cell and is designed with a similar footprint.
- Seamlessly integrates into a continuous, lean manufacturing line.
- Complies with modern safety and global environmental protection standards.



# / 4D Quench® Applications

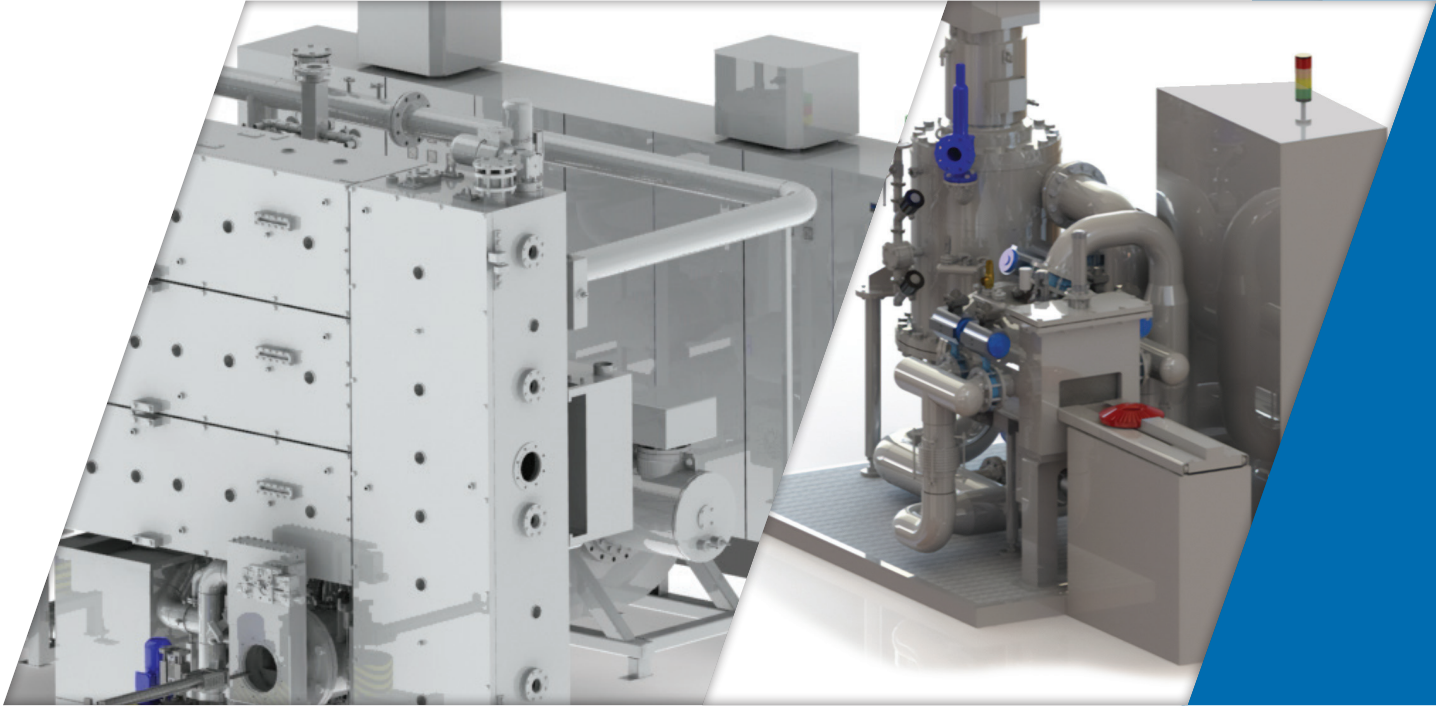
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- Aerospace
- Automotive
- eCar, eDrive
- Transmission
- Bearing
- Machinery



***To learn more about our entire family of 4D Quench  
Vacuum Technologies, call the SECO/VISORY team at  
1 814.332.8520***





***SECO/VACUUM***

*We support your success.*

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