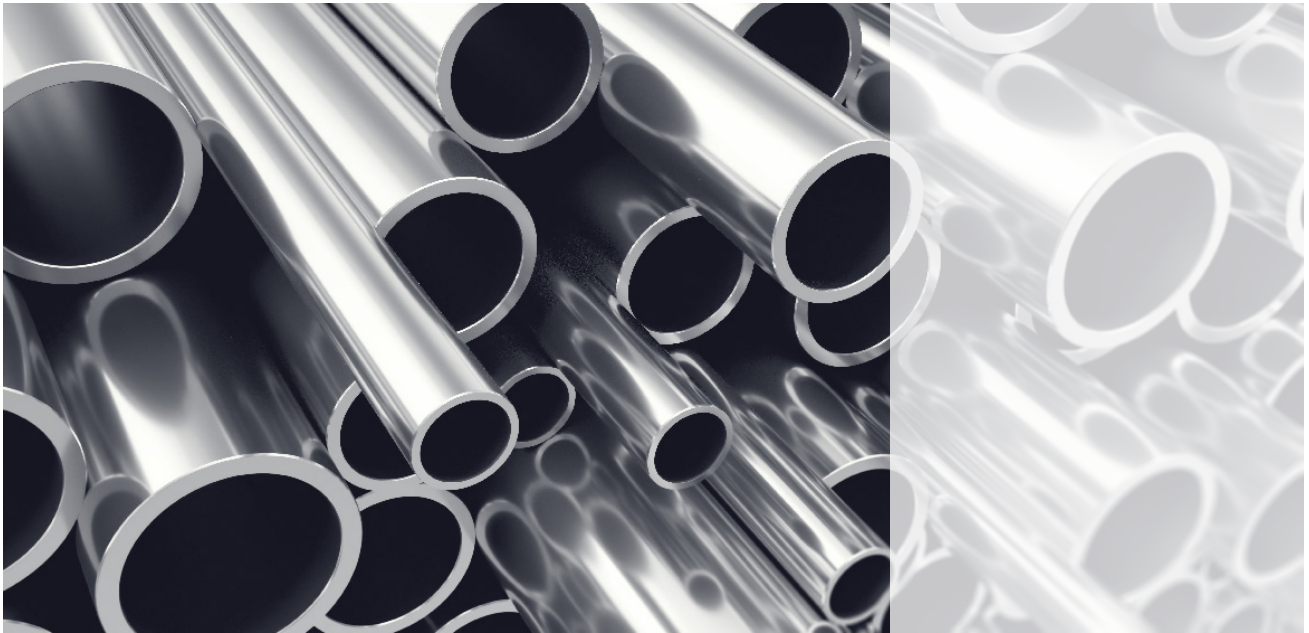


Keep Your Annealing Atmosphere in its Sweet Spot with Air Products Smart Monitoring Technologies



What is annealing?



Aluminum
Titanium
Copper

Annealing of ferrous and non-ferrous metals represents one of the most valuable and most common heat treatment processes. Annealing softens a metallic part or form by altering its grain structure through a controlled heating and cooling profile over a specified time. After annealing, the metal has improved formability or machinability, relieved residual stresses, and increased dimensional stability.

Steel is commonly annealed, but aluminum, titanium, and copper can be too. Tubes, wire, sheet, and rods are typically annealed following a work hardening process such as drawing or rolling. Metallic parts are also annealed after pressing, stamping, or welding. Annealing can be combined with other treatment processes such as decarb annealing of electrical steels or galvannealing of exposed automotive sheet.

A variety of furnaces are used for annealing, including batch furnaces, such as bell, pit, box, or vacuum, and continuous furnaces, such as strip,



roller hearth, or mesh belt. What is common and critical regardless of the type of furnace or shape of the parts is the close control of the time-temperature profile in a protective atmosphere. This can now be aided by Air Products Smart Technology, a process monitoring and data acquisition system developed specifically for furnace annealing.

What is important in annealing and how to achieve it?



Furnace operating parameters impact the most important product properties, such as hardness, residual stress, tensile strength, surface finish, etc. Proper atmosphere control prevents oxidation and decarburization, and in a carbon-based atmosphere, carbon pick-up or soot formation. The economics of the process are driven by energy consumption, atmosphere costs, asset utilization, and quality control. Each of these can be improved or ensured with a furnace monitoring system.

Air Products Smart Monitoring is a cloud-based assistance system that can include:

- Simple, reliable sensors to monitor the atmosphere, including the following:
 - Sample pump and filters
 - Gas Density Sensor for H_2 composition
 - Dew Point Sensor for H_2O (moisture level)
 - Zirconia Oxide Probe for oxidation, reduction potential
- Logging of basic furnace data, such as temperatures, belt speeds, etc.
- Industrial gas tank contents and condition monitoring
- Wireless data communication to Air Products Smart View Portal, a secure cloud server
- Standard or customized daily reports e-mailed directly to you
- Data input that can be evaluated and thermodynamic calculations that can be carried out in the cloud
- Alarming that can be available locally and remotely for measured and/or calculated parameters. This can include e-mail, text messaging, or visual/audible alarm system

Simple Reliable

Levels of service to meet your specific needs

Air Products Commercial Technology team offers a furnace audit or atmosphere spot check to troubleshoot process problems you may have. Our Smart Monitoring takes that spot check to a new level with continuous monitoring of the health of your furnaces. We offer two tiers of Smart Monitoring service:

| | Tier 1 Process Reporting | Tier 2 Process Monitoring |
|--|---|--|
| Process monitoring, data logging and storage | X | X |
| Daily email report | X | X |
| Real-time process alerting (control limit based) | | X |
| Advanced email and reporting options | | X |
| Equipment condition monitoring | | X |
| Communication to/from SCADA system | | X |

Success Story

A European annealing shop treats steel in a roller hearth furnace. Prior to implementing our Smart Technology, they set the hydrogen/nitrogen atmosphere ratio as a constant. With dew point and hydrogen concentration monitoring, the system was set up to calculate their hydrogen to dew point ratio. This ratio determines whether the annealing atmosphere is oxidizing or reducing to the steel at different furnace temperature. Setting the hydrogen/nitrogen atmosphere flow by that ratio allows them to maintain a reducing atmosphere at lower hydrogen concentrations resulting in up to 30% savings in atmosphere cost.

30% savings



Air Products Smart Gas Density Sensor

Inside the compact probe, the frequency response of a quartz sensor exposed to the gas sample is converted by a microprocessor to a density measurement. The density is compensated for temperature and pressure. In a binary gas mixture, such as hydrogen and nitrogen, the density is directly converted to an accurate percent hydrogen concentration. The probe can tolerate typical cooling zone temperatures and may be used on a sample withdrawn from the hot zone. This probe is available exclusively from Air Products.

What to expect with Air Products Smart Monitoring

Better Improved Proven

Better atmosphere monitoring and control

Many furnaces have limited or no atmosphere measurement. With proven and reliable sampling systems and analyzer probes, Air Products Smart Monitoring can monitor dew point (capacitive polymer probe), H₂% (AP Gas Density Sensor, see box), and oxidation/reduction potential (Zirconia oxide-probe). Typically all three would be monitored in the hot zone and cooling zone of a continuous furnace. However, the sensor selection can be tailored to meet your specific situation by adding or removing sensors. In an industrial gas-based atmosphere, there is no need for three expensive gas infrared analyzers to monitor carbon species in the atmosphere.

Improved quality with lower atmosphere cost

As noted in the success story (see box on page 2), monitoring the oxidation/reduction potential of an annealing furnace atmosphere allows operators to run at optimal levels. Without atmosphere measurement, operators may use a higher hydrogen level than necessary to prevent oxidation or de-carburisation.

Process troubleshooting with historical data

Customisable daily e-mail reports become an indispensable part of your daily operational reviews. You can look back further if needed as the Smart System stores your data in the Smart View Portal, a secure cloud server.

Compliance with design specifications, NADCAP, CQI-9, etc.

Documentation of furnace operating parameters is a key part of compliance with design or industry standards. Customisable data reports can be provided in a format that complies with your documentation requirements.

Proven components with customisable implementation

All of the components – sensors, dataloggers, WIN Nodes, PLC of the system, etc. – are tested and proven in 100s of installations.

Data Security

Air Products takes the security of your data seriously. We use state-of-the-art tools to protect your data, and to make sure it is available when you want it. For example, data transfers use Transport Layer Security (TLS) for WIFI or Access Point Name (APN) for cellular

encryption. Data integrity is ensured on the Microsoft Azure cloud server. Data is backed up daily and kept for 30 days. Access is restricted to people with work e-mail addresses designated by you. The dataloggers have passed a penetration test without issues.

Simple and quick implementation

Implementation can typically be accomplished in 2 visits by Air Products. In the first, we will work to understand your interests and needs, assess existing and new data points to be logged, and develop a system specification. After this visit, we will assemble and test in our own facility the data logging and communication panel, along with atmosphere analytical panels needed. Then we will return to your facility to install and start the system up. Typically, this requires 0.5 to 2 days in your plant. When we leave, you will have a working system, be connected to your data on the Air Products Smart Cloud Server and signed up for daily e-mail reports and alerts, depending on the service tier you have chosen.

Typical Installation

Our Smart Monitoring Systems on a typical continuous furnace can have a customised number of inputs.

- Furnace temperature(s)
- Atmosphere dew point, %H₂, O₂ at three points
 - Atmosphere inlet
 - Hot zone
 - Cooling zone
- Furnace data may include:
 - Pressures
 - Differential pressure
 - Product sensors or cameras
 - Product IR temperature sensor





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