Cleanliness Chain

When it comes to semiconductor manufacturing, you need to know that every supplier process, from raw material selection to final inspection of installed components, is designed to get you from source to exhaust with maximum cleanliness and no contamination. And how you get there is the Swagelok difference.

CONTINUE

How Are We Different?

Cleanliness starts with our commitment to ultrahigh-purity materials, followed by our manufacturing processes, cleaning specifications, and quality control procedures. With these tools, you can trust Swagelok to provide the products you need so you can manufacture products with confidence.

CONTINUE

Where Do You Want to Go?

The path to success just got shorter. Swagelok high-purity offerings help ensure clean manufacturing. Not only do we have the products, but we provide customized solutions, too. We consider your operating environment and account for factors such as corrosiveness, the need for repeatability and throughput, and eliminating contamination. Innovations like our ALD diaphragm valve enhance manufacturing efficiency of semiconductor components. Swagelok's ongoing commitment to quality ensures speed, consistency, and cleanliness—every time.

Design

Purity

Throughput and Repeatability

Quality, Reliability, and Safety

Installation Training

Stronger Together

From Wafer to Die

When it comes to semiconductor manufacturing, you know best what you need. High yield and throughput. Maximum cleanliness and reliability. Swagelok helps you get there with our innovative products, manufactured to the highest standards of cleanliness and customizable for your application.

- Smooth internal surface finish reduces the risk of particle entrapment and material contamination
- Innovative designs promote less areas for entrapment, rapid purging, and less stress in high-cycle applications

We don’t stop there, though. We back our products with support for your high- and ultra-high purity applications, from fabrication to finished product. Click on the buttons to learn more.

Fittings

Valves

Regulators

From Idea to Installation

Fittings

Choose the right fittings for your application.

Weld Fittings

Face Seal Fittings

Options and Accessories

Valves

Choose the right valves for your application.

- Bonnet Valves
- Bellows Valves
- Diaphragm Valves
- High-Purity Check Valves
- Valve Seats
- Special Valve Configurations

Regulators

Precise control to reduce fluid supplies at higher pressures to safe and usable pressures.

PRESSURE REGULATOR
KPR-SERIES

COMPACT HIGH-FLOW GAS REGULATOR
HF SERIES

HIGH-FLOW MANUAL GAS REGULATOR
HFE SERIES

From Idea to Installation

How do you make a great product even better? When you customize it to meet your exact requirements.

Swagelok Engineered-to-Order products

We know our products, and we know what they can do for you. Swagelok design experts help you customize our products to meet the demands of your application, then we build it, test it, ship it, and warranty it.

Swagelok Custom Solutions

We go beyond components to provide a complete, customized solution that brings together your idea and our expertise. And like our products, our solutions are backed by our limited lifetime warranty too.

Support and Service

We support you with ongoing technical assistance and field engineering services to ensure your processes are operating exactly as you need them to, when you need them to.

Start the conversation. Contact your authorized sales and service center today.

Fittings
Weld Fittings

Provide high-quality, permanent connections.

TUBE SOCKET WELD

AUTOMATIC TUBE BUTT WELD

BUTT WELD

Fittings

Weld Fittings

Tube Socket Weld	How does this product meet my application needs?
	Especially suited for areas in which entrapment and potential corrosion is not a risk. Welded design may create entrapment areas, resulting in increased dry-down times and potential corrosion. Non-autogenous weld requires filler material. Care should be taken to ensure filler material is compatible with requirements of the manufacturing process.

Fittings

Weld Fittings

Automatic Tube Butt Weld	How does this product meet my application needs?
	Design facilitates reduced entrapment area. Autogenous weld; no filler material required. Alignment enhanced by integral filler ring.

Fittings

Weld Fittings

Butt Weld	How does this product meet my application needs?
	Constructed of materials especially suited for ultra-high purity applications. Autogenous weld; no filler material required. Especially for installation in small spaces where component spacing is minimal. Designed for enhanced alignment and precise fit; full tube penetration avoids entrapment, corrosion, and leakage.

Fittings

Face Seal Fittings

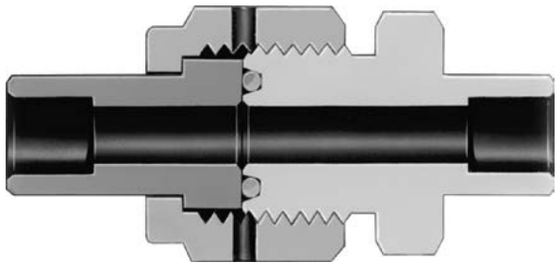
Deliver leak-tight service from vacuum to positive pressure.

VCO O-RING FACE SEAL

VCR METAL FACE SEAL

Fittings

Face Seal Fittings

VCO O-Ring Face Seal	How does this product meet my application needs?
	Designed for high-purity applications in a range of temperatures. Smooth finish on gland face and vacuum coupling captive O-ring provide leak-tight sealing. Ideal for easy, rapid installation where space is limited; no axial clearance required. See available options and accessories.

Fittings

Weld Fittings

VCR Metal Face Seal	How does this product meet my application needs?
	Metal-to-metal seal for ultra-high purity applications in a range of temperatures. Bead design and precision manufacturing provide optimal sealing mechanism. Variety of gasket options suited for specific requirements See available options and accessories.

Fittings

Options and Accessories

GASKETS

FLOW RESTRICTORS

LOCKING DEVICES

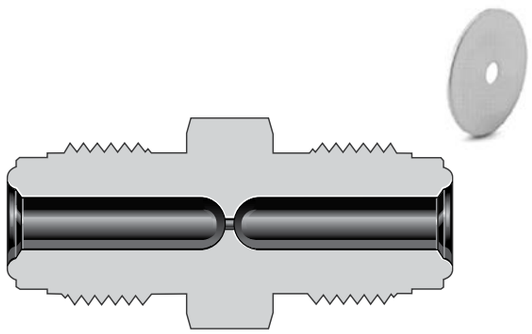
Fittings

Options and Accessories

Gaskets	How does this product meet my application needs?
	Gaskets available in stainless steel, copper and nickel; plated and electropolished **Blind:** Protects unused ends for cleanliness **Retained:** Provides additional security in gasket placement **Side-load retainer:** Facilitates installation in compact spaces **Snubber:** Provides filtration for added protection to internal components. Available in a variety of filtration levels (in microns).

Fittings

Options and Accessories

Flow Restrictors	How does this product meet my application needs?
	Used in liquid or gas delivery systems where repeatable flow reduction or limiting is required Restricting orifices available in sizes to meet your flow requirements

Fittings

Options and Accessories

Locking Devices	How does this product meet my application needs?
	Designed for high-torque, high-vibration applications. When used together, these devices increase vibration resistance for better fitting performance and longer life. **Locking Device:** clamps on the nuts to prevent unintentional disassembly of VCR fitting components **Knurled Gasket:** prevents gland rotation

Valves

Bonnet Valves

Precise, pressure-tight control.

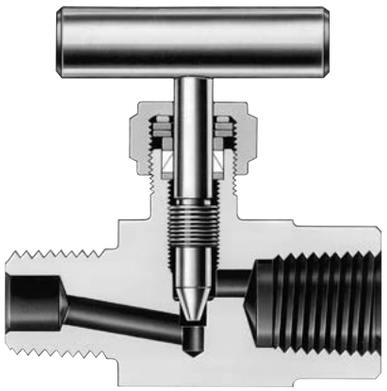
INTEGRAL BONNET NEEDLE VALVE
20-SERIES

SCREWED BONNET VALVE
JB-SERIES

UNION BONNET VALVE
N-SERIES

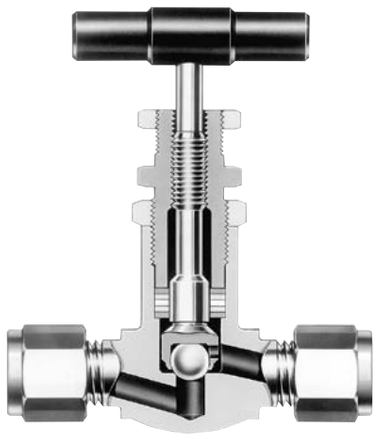
Valves

Bonnet Valves

Integral-Bonnet Needle Valve 20 Series	How does this product meet my application needs?
	Externally adjustable packing for stem and shell seal. 2-piece chevron packing below stem threads with disc springs for sealing, reduced wear, and reduced operating torque. Rotating stem tip for general industry applications.

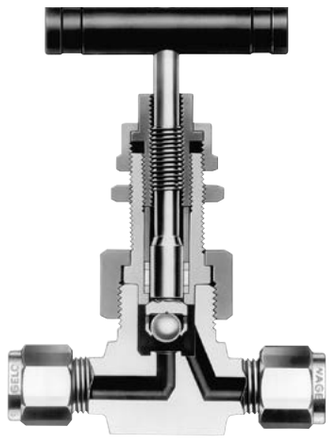
Valves

Bonnet Valves

Screwed Bonnet Valve JB-Series	How does this product meet my application needs?
	Stem threads isolated from wetted areas for maximum cleanliness. Externally adjustable packing for stem and shell seal. Non-rotating ball stem tip provides repetitive, leak-tight shutoff.

Valves

Bonnet Valves

Union Bonnet Valve N-Series	How does this product meet my application needs?
	Metal-to-metal seal to atmosphere reduces emissions. Externally adjustable packing above the threads for stem and shell seal isolates packing from wetted area to maintain cleanliness. Non-rotating ball stem tip extends seat sealing capability in high-cycle applications. Union bonnet design facilitates inspection and cleaning.

Valves

Bellows Valves

Perform reliably in high-purity applications.

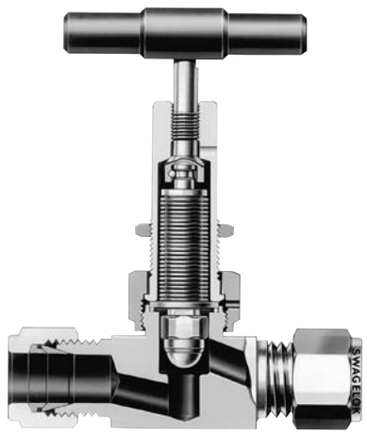
CONVENTIONAL BELLOWS VALVE
B-SERIES

INVERTED BELLOWS VALVE
BN-SERIES

BELLOWS METERING VALVE
BM-SERIES

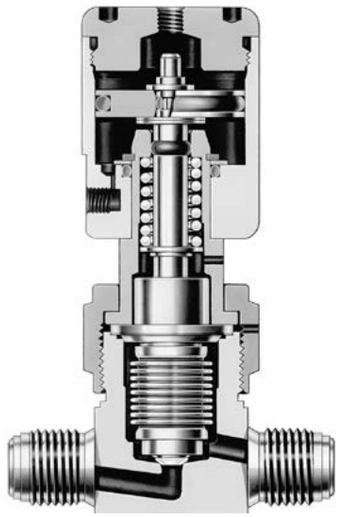
Valves

Bellows Valves

Conventional Bellows Valve B-Series	How does this product meet my application needs?
	All-metal bellows seal to atmosphere for leak-tight performance. Internally-pressurized conventional bellows design for reliable operation. Non-rotating stem tip extends seat sealing capability in high-cycle applications. Union bonnet design facilitates inspection and cleaning. Learn more about the all-metal seat used with this valve.

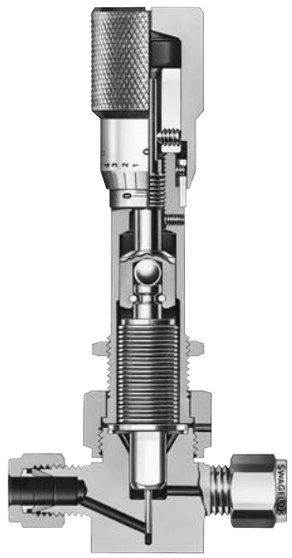
Valves

Bellows Valves

Inverted Bellows Valve BN-Series	How does this product meet my application needs?
	Externally-pressurized, inverted bellows for improved flow path. Swept flow path enhances purging and gas replacement for clean operation.

Valves

Bellows Valves

Inverted Bellows Valve BN-Series	How does this product meet my application needs?
	Bellows seal to atmosphere for reliable operation. Micrometer adjustment and tapered stem tip for fine flow control. Learn more about the metering stem tip seat used with this valve.

Valves

Diaphragm Valves

Clean, leak-proof operation reduces risk of escaping emissions.

DIAPHRAGM VALVE
DL SERIES

SPRINGLESS DIAPHRAGM VALVE
DP SERIES

PLASTIC RADIAL DIAPHRAGM VALVE
DRP SERIES

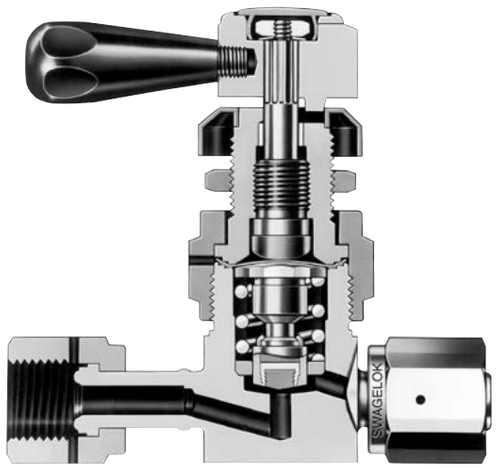
ALD VALVE

THERMAL IMMERSION DIAPHRAGM VALVE
DH SERIES

THERMAL IMMERSION DIAPHRAGM VALVE
DHZ SERIES

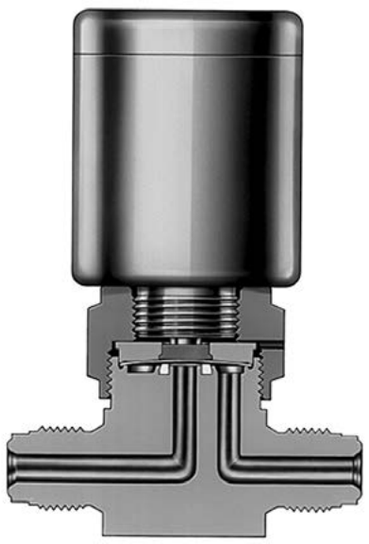
Valves

Diaphragm Valves

Diphragm Valve DL-Series	How does this product meet my application needs?
	Spring-return stem tip is suitable for high-pressure applications. All-metal body seal for resistance to strong chemistries and reduced emissions. Learn more about the compensating soft seat used with this valve.

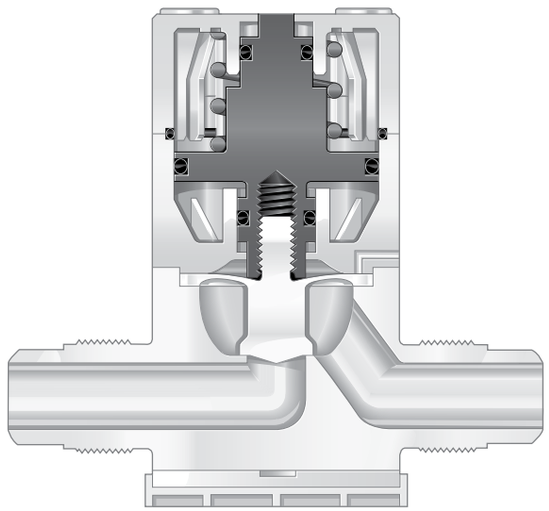
Valves

Diaphragm Valves

Springless Diphragm Valve DP-Series	How does this product meet my application needs?
	Springless diaphragm design eliminates need for internal spring or tied diaphragm, creating a fully-swept flow path. Fully-swept flow path enhances purging and gas replacement for ultra-clean operation. Learn more about the fixed soft seat used with this valve.

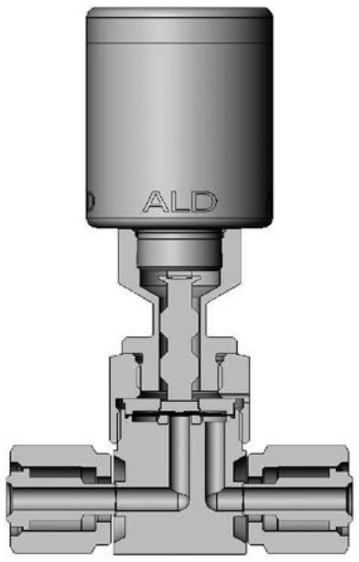
Valves

Diaphragm Valves

Plastic Radial Diphragm Valve DRP-Series	How does this product meet my application needs?
	Tied diaphragm connects upper and lower stems to pull seat away from valve for higher flow and improved purging. Soft-acting spring closure helps prevent hydraulic shock, particle generation, and damage to the seat seal.

Valves

Diaphragm Valves

ALD Valve	How does this product meet my application needs?
	Diaphragm designed for ultra-high life cycle. Pneumatic actuator for high-speed performance, repeatability, and flow consistency delivers precise chemical dosing. Optional thermal actuator limits conductive heat transfer from the body to the actuator. Learn more about the fixed soft seat used with this valve.

Valves

Diaphragm Valves

Thermal Immersion Diaphragm Valve DH Series	How does this product meet my application needs?
	Diaphragm designed for ultra-high life cycle. Pneumatic actuator for high-speed performance and repeatability. Suited for high temperature applications; Fully immersible at temperatures up to 220 °C (428 °F). Actuator seals designed for vacuum environments. Body and actuator replacement kits for ease of maintenance. Learn more about the fixed soft seat used with this valve.

Valves

Diaphragm Valves

Thermal Immersion Diaphragm Valve DHZ Series	How does this product meet my application needs?
	Suited for high temperature applications; Fully immersible at temperatures up to 250 °C (482 °F). Diaphragm designed for ultra- high life cycle. All-metal belows actuator, without soft seals or actuator lubrication for zero emissions enables in-chamber use. Actuator designed for high-speed performance, repeatability, and flow consistency delivers precise chemical dosing. Learn more about the fixed soft seat used with this valve.

Valves

High Purity Check Valve

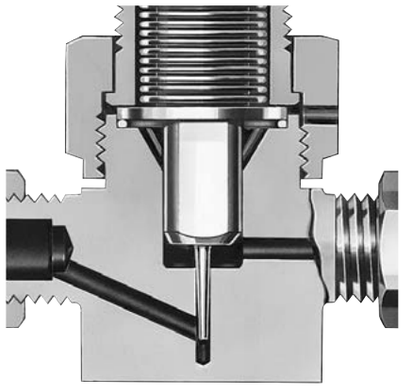
Clean, leak-proof operation reduces risk of escaping emissions.

Check Valve CW-Series	How does this product meet my application needs?
	All welded construction; no seal for resistance to strong chemistries and reduced emissions. Linear Guidance Wafer aligns poppet for less particle generation, resulting in less contamination. Bonded elastomer poppet eliminates wetted O-ring for longer life.

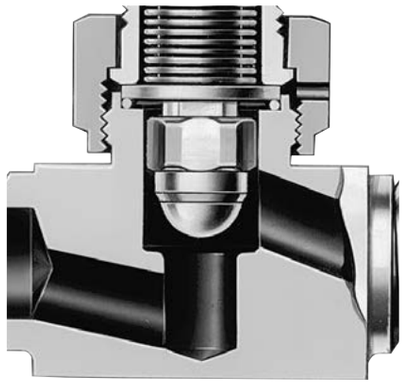
Valves

Valve Seats

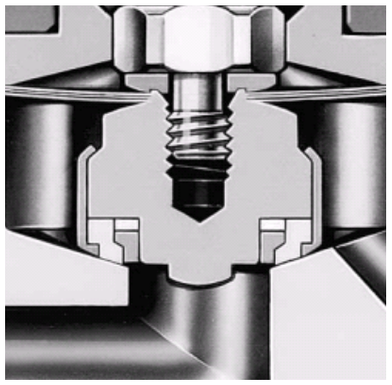
Provide precise flow control in a variety of valve designs.



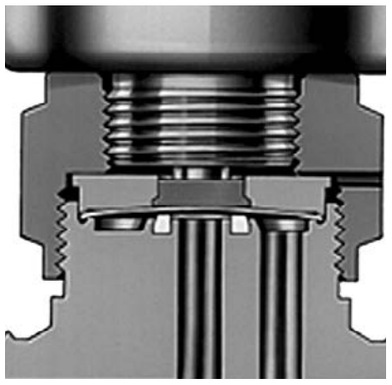
METERING STEM TIP



ALL-METAL SEAT



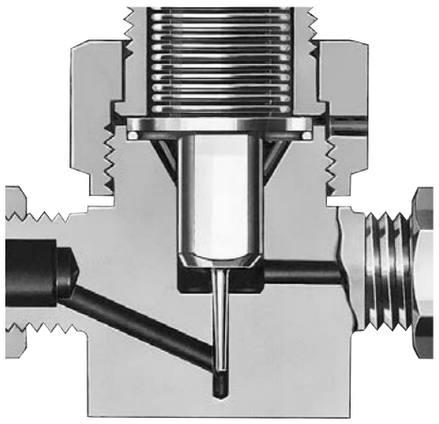
COMPENSATING SOFT SEAT



FIXED SOFT SEAT

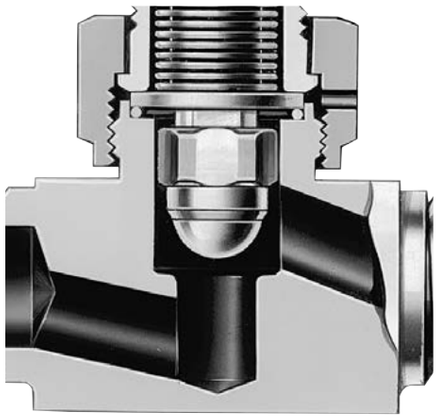
Valves

Valve Seats

Metering Stem Tip	How does this product meet my application needs?
	Suited for high temperature applications. Metering stem tip provides fine flow control. Not for use in shutoff applications or applicable to diaphragm valve designs.

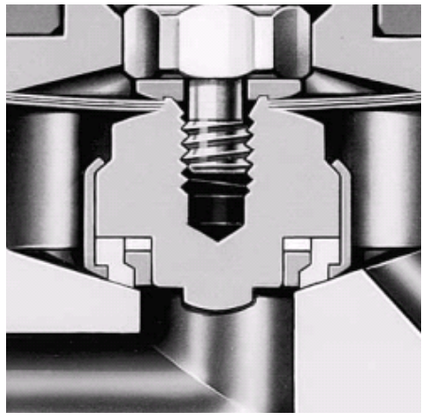
Valves

Valve Seats

All-Metal Seat	How does this product meet my application needs?
	Suited for high temperature and corrosive applications. Sensitive to contamination from potential particle generation from metal-on-metal surfaces.

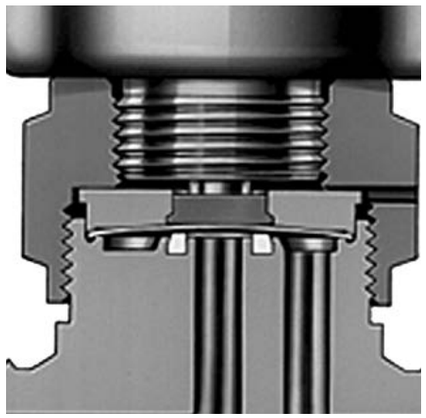
Valves

Valve Seats

Compensating Soft Seat	How does this product meet my application needs?
	Suited for moderate-temperature applications. Positive, long-life shutoff. Compensating seat action ensures contamination resistance. Not adaptable to springless diaphragm valves.

Valves

Valve Seats

Fixed Soft Seat	How does this product meet my application needs?
	Low internal volume for ultra-high purity applications. Positive containment and fully contained high-purity grade wide seat for optimum shutoff excellent resistance to swelling and contamination. Sensitive to gross contamination.

Valves

Special Valve Configurations

Maximize flow, minimize leak points with any valve.

MONOBLOCK AND
MULTI-VALVE MANIFOLD

MULTI-PORT VALVE

Valves

Special Valve Configurations

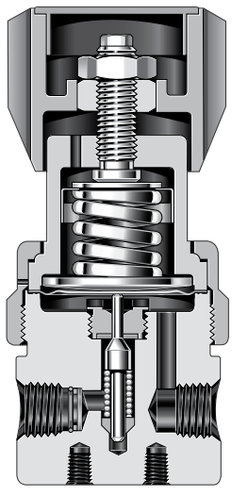
Monoblock and Multi-Valve Manifold	How does this product meet my application needs?
	Reduced number of connections decreases the number of potential leak points. Reduced internal system volume for faster purging.

Valves

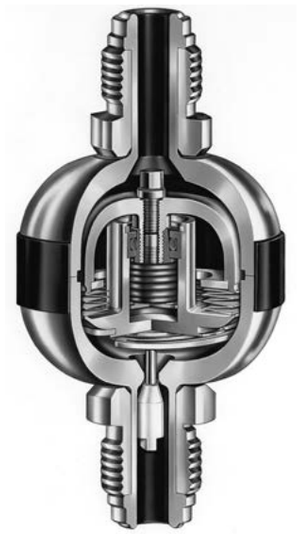
Special Valve Configurations

Multi-Port Valve	How does this product meet my application needs?
	Several port options provide multiple flow paths for flexibility. Reduced internal system volume for faster purging.

Regulators

Pressure Regulator KPR-Series	How does this product meet my application needs?
	Metal-to-metal diaphragm seal for integrity against leaks. Free poppet operation, especially suited for inert gases and point of use process gases. Two-piece cap design provides linear.load on the diaphragm seal. High-flow filter reduces contamination on the seat.

Regulators

Compact High-Flow Gas Regulator HF-Series	How does this product meet my application needs?
	Innovative gas-actuated pressure-sensing assembly results in low droop, which eliminates the need for adjustment in many systems. Self-centering, tied poppet for clean operation and positive shutoff; minimizes creep. All-welded design—no seals to atmosphere. Compact, high-flow design allows close spacing of system components and process lines.

Regulators

High-Flow Manual Gas Regulator HFE-Series	How does this product meet my application needs?
	Welded diaphragm assembly maximizes pressure-sensing area. Spring-loaded design allows manual adjustment of outlet pressure. Less than half the size of conventional.

Purity

Swagelok's ultrahigh-purity solutions provide clean, reliable changeover and greater thermal control; help prevent contamination; and promote safe containment.

Material Selection

Manufacturing

Cleaning and Packaging

Choose your Path with Material Selection

Swagelok materials of construction are backed by science. They're formulated, tested, and proven for high-purity applications like semiconductor manufacturing. From the bar stock to the fluoropolymers, the properties of each of these materials help you to achieve the results you need. Swagelok chooses materials carefully for the manufacturing process, so you can be assured of materials that allow easy welding and installation, while providing you with the purity your application requires.

- 316/316L Stainless Steel
- 6LV & 6LVV Stainless Steel
- Alloy 22
- Further Refining the Process
- SS Material Compared to ASTM® Specification
- Weldability
- Corrosion-Resistance
- Fluoropolymers

Material Selection
316/316L Stainless Steel

Swagelok‘s stainless steels are of the finest alloys, blended to offer the maximum corrosion resistance, strength, and ductility, without sacrificing material strength. Swagelok meets and, in most cases, exceeds standards, resulting in the right balance of material properties to ensure fitness for semiconductor applications.

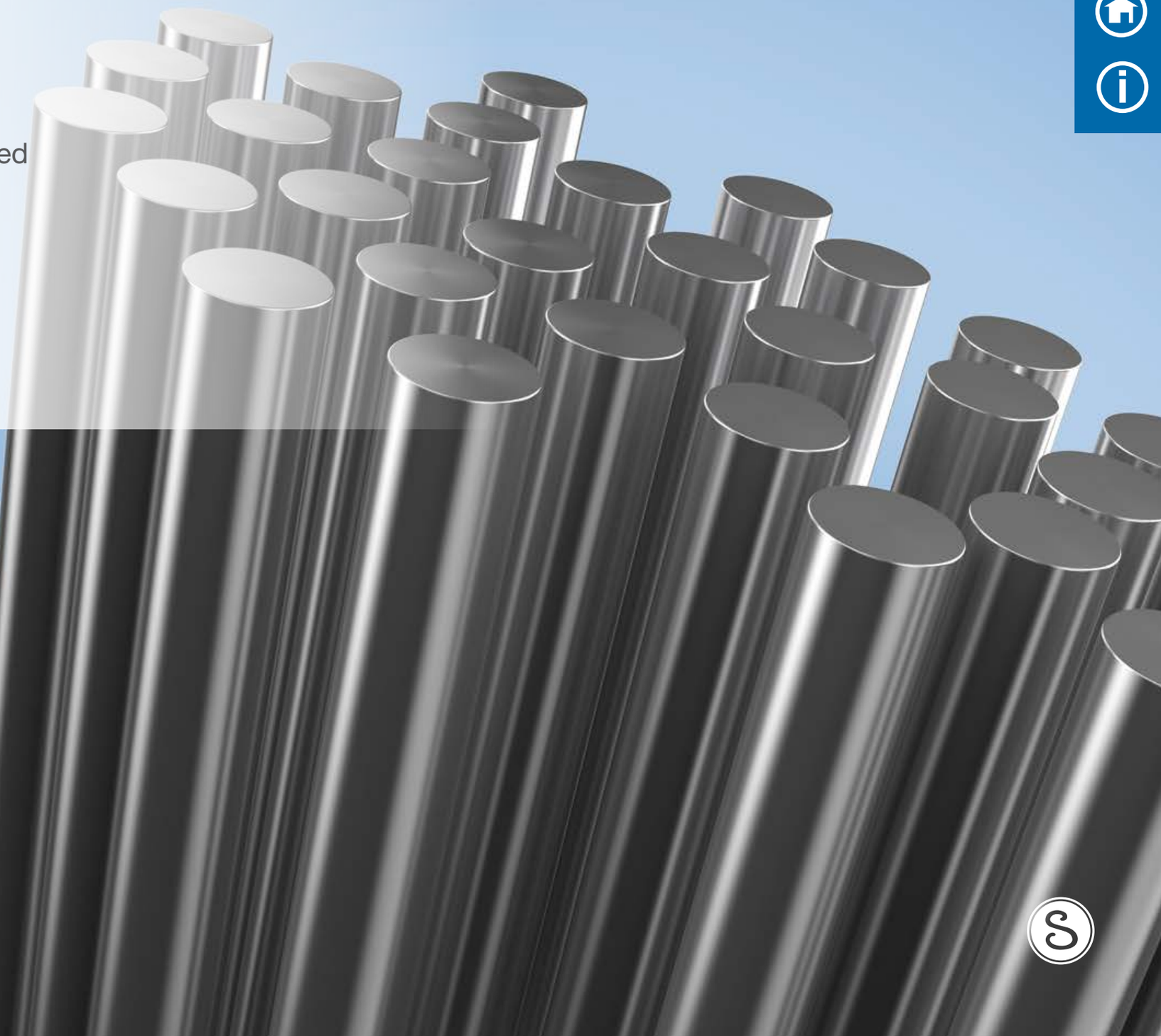
LEARN MORE ABOUT THE REFINING PROCESS.

Material Selection
6LV and 6LVV Stainless Steel

Swagelok offers multiple grades of 316 stainless steel for semiconductor manufacturing. Two of the most common types, both double-melted but differentiated by their primary melting methods are:

- High-purity 6LV (AOD + VAR)
- Ultrahigh-purity 6LVV (VIM + VAR)

LEARN MORE ABOUT THE REFINING PROCESS.



Material Selection
Alloy 22

Other options for compatible special alloys include Alloy 22, a nickel based alloy composed of chromium, molybdenum, and tungsten. With an iron content lower than other materials, Alloy 22 offers outstanding resistance to pitting and crevice corrosion, as well as to stress corrosion cracking, while maintaining weldability and performance in environments where corrosive chemistries are used.

LEARN MORE ABOUT THE PROPERTIES OF ALLOY 22.

LEARN MORE ABOUT WELDABILITY.

Material Selection

Properties of Alloy 22

Alloy 22 offers optimum corrosion resistance in applications in which moisture may be present. Because of its lower iron content, Alloy 22 is less likely to oxidize, so your process stays cleaner.

Alloy 22 is especially suited for more aggressive chemistries that are a characteristic of the evolving semiconductor manufacturing environment.

Material Selection

Further Refining the Process

How can you make already pure materials even more pristine? Vacuum melting facilitates the removal of impurities. High-purity 6LV material is remelted in a vacuum with the VAR method (AOD+VAR). Ultrahigh-purity 6LVV material is twice vacuum melted (VIM + VAR) for even greater cleanliness.

LEARN MORE ABOUT
THE MELTING PROCESS.

Material Selection

Stainless Steel Material Composition Compared to American Society for Testing and Materials® (ASTM)Specification

For corrosion resistance, weldability and material surface characteristics of the steel after it is polished or welded, you have to start with a better mix of alloys. Much of the stainless steel offered in the open market is made with lesser quantities of expensive elements, including nickel (Ni) and chromium (Cr). Swagelok optimizes the blend of alloys to formulate a melt for greater corrosion resistance and strength, as well as improved ductility.

LEARN MORE ABOUT NICKEL AND CHROMIUM FOR CORROSION-RESISTANCE, DUCTILITY, AND STRENGTH.

LEARN MORE ABOUT SULFUR FOR WELDABILITY AND MACHINABILITY.

Material Selection

316/316L Stainless Steel Material Composition Compared to ASTM® Specifications

Specification Composition by Percentage

Cr

Chromium content is at the high end of the range specified by ASTM to help ensure corrosion resistance.

Ni

Nickel content is at the high end of the range specified by ASTM to maximize corrosion resistance.

S

Sulfur content is tighter than the range specified by ASTM® to provide consistent weldability and machinability, without sacrificing the purity of the steel.

ASTM Specification

Swagelok 316L Specification

LEARN MORE ABOUT WELDABILITY

LEARN MORE ABOUT CORROSION-RESISTANCE

Material Selection

Melting Processes

The Argon Oxygen Decarburization (AOD) refining process results in material with desired chemistry and integrity for clean manufacturing. The Vacuum Induction Melting (VIM) process produces ingots that can be used as electrodes in the re-melting process to further refine the material. The Vacuum Arc Re-melting (VAR) process is a second melting method used to further refine and purify materials produced by AOD or VIM.

Primary Process	Secondary Process	Purpose	Grade
AOD		Reduces the carbon content and recovers the steel's alloys. Impurities in the steel react with steel byproducts, such as slag, to refine the steel.	316/316L
AOD	VAR	In a VAR furnace, an electric arc remelts electrodes produced by the AOD process. Controlled melting and solidification in a vacuum leads to consistent chemistry and microstructure for resistance to fracture and fatigue.	6LV
VIM	VAR	The VIM+VAR process produces ingots with less impurities within an oxygen-free atmosphere. This limits the formation of non-metalic oxide inclusions.	6LVV

HOW DO WE COMPARE
TO THE SPECIFICATION?

Material Selection
Weldability

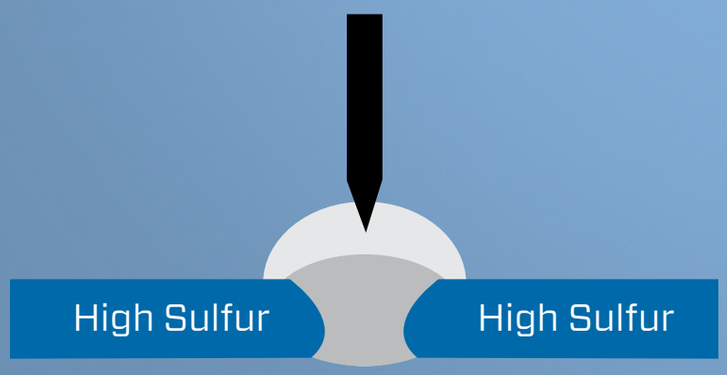
What makes a good weld profile? The answer lies not just in the skill of the welder, but also in the material chemistry—specifically the amount of sulfur in the steel. Although the ASTM specification allows a wide range of sulfur content, this variability can make getting a consistent weld bead difficult, and can impact throughput.

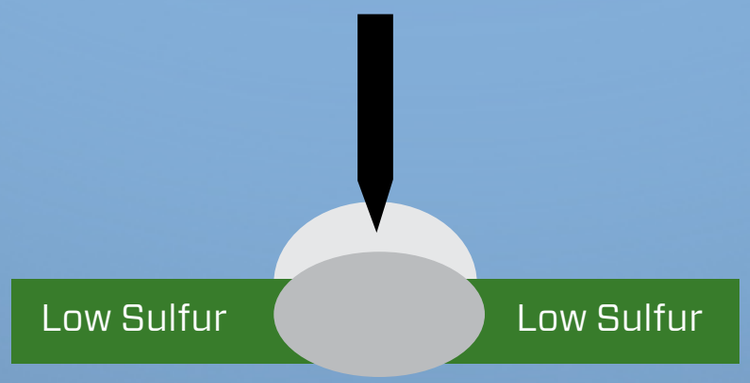
LEARN MORE ABOUT
GOOD WELD PROFILES.

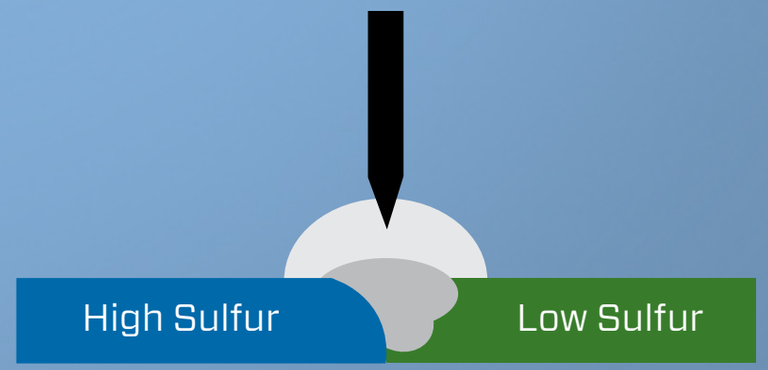
Material Selection

The Importance of a Good Weld Profile

Sulfur content is closely related to weldability. Welding parts that are made from stock at the lower end of the sulfur content band to parts at the higher end of the band will not result in a consistent semiconductor-grade weld. When you're welding tubing and a fitting together, the differing sulfur content between the two surfaces can result in differing amounts of weld bead shift. A good weld bead profile, neither concave nor convex, with full penetration to the ID of the weld joint is an essential requirement for integrity in high-purity applications.







LEARN MORE ABOUT CORROSION.

Material Selection

Corrosion-resistance

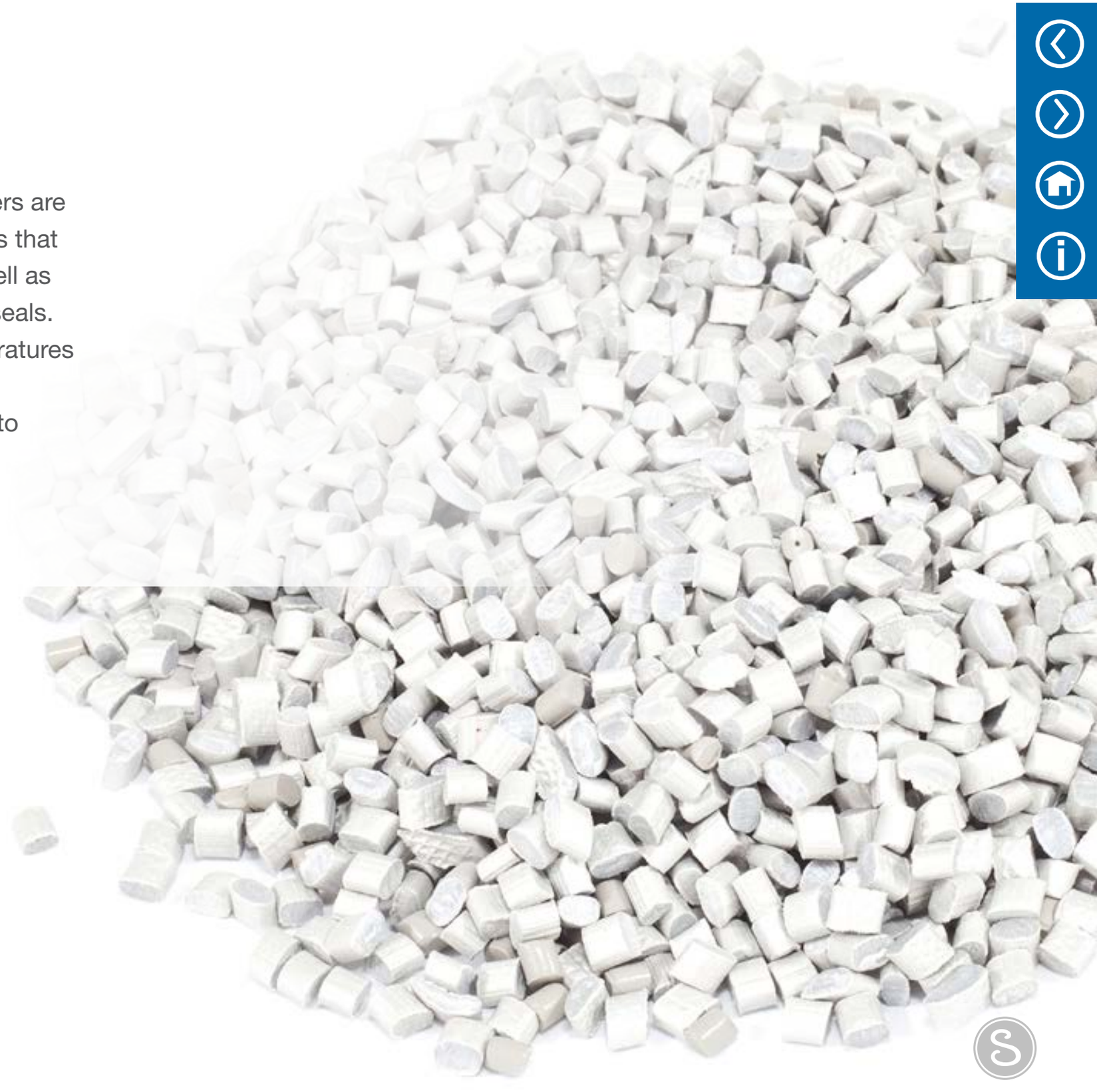
Swagelok has pioneered with Semiconductor Equipment and Materials International (SEMI) the use of a Critical Pitting Temperature (CPT) test for determining corrosion resistance. SEMI has adopted the ASTM® G150 Standard Test Method for Electrochemical Critical Pitting Temperature Testing of Stainless Steels in the SEMI F77 standard, as an alternative to traditional surface analysis. The CPT test eliminates inconsistent results of surface testing caused in part by variations among labs, test operators, and other factors. As well, the test can be performed as part of in-line process control rather than disrupting a process by sending the parts offsite for evaluation.

LEARN MORE ABOUT THE CPT TEST.

Material Selection
Fluoropolymers

In the semiconductor industry, fluoropolymers are used to line the inside diameter (ID) of hoses that come in contact with fluids or gasses, as well as soft components, such as valve seats and seals. Fluoropolymers offer stability at high temperatures used in semiconductor manufacturing and chemical and corrosion resistance, helping to ensure the purity of your processes.

LEARN MORE ABOUT FLUOROPOLYMERS.



Material Selection

Properties of Fluoropolymers

Materials	Processing	Properties
Polytetrafluoroethylene (PTFE)	PTFE and modified PTFE are compression molded. Because this process is cleaner than traditional plastic molding processes, the inner surfaces of the material remain free of metal residue.	PTFE is highly non-reactive, so it is especially suitable for reactive and corrosive chemicals commonly used in semiconductor manufacturing.
Modified Polytetrafluoroethylene (PTFE)		Modified PTFE is a chemically modified version that provides improved tensile strength and greater resistance to permeation.
Perfluoroalkoxy Alkane (PFA)	PFA is formed with a traditional injection molding and extrusion process. PFA combines the processing ease of conventional thermoplastic resins with the properties of PTFE.	In addition to properties found in PTFE, PFA also provides improved flow, creep resistance, and thermal stability.

Our Commitment to Manufacturing

Swagelok components are manufactured to ensure consistent quality, ultrahigh-purity, corrosion resistance, and weldability. What begins with material selection is carried out in our stringent and highly controlled manufacturing processes, which include surface processing to help enhance corrosion resistance and minimize contamination by removing surface imperfections.

Swagelok materials are electropolished and finished with passivation.

LEARN MORE ABOUT ELECTROPOLISHING.

LEARN MORE ABOUT PASSIVATION.

Manufacturing
Electropolishing

Electropolishing is essential for creating a smooth inner surface for tubing to be used in gas distribution systems. Electropolishing uses an electrochemical process to remove metal ions from the material surface. This process is superior to mechanical polishing for semiconductor applications, since no abrasives are left behind, as is the case with mechanical polishing.

LEARN MORE ABOUT ELECTROPOLISHING.

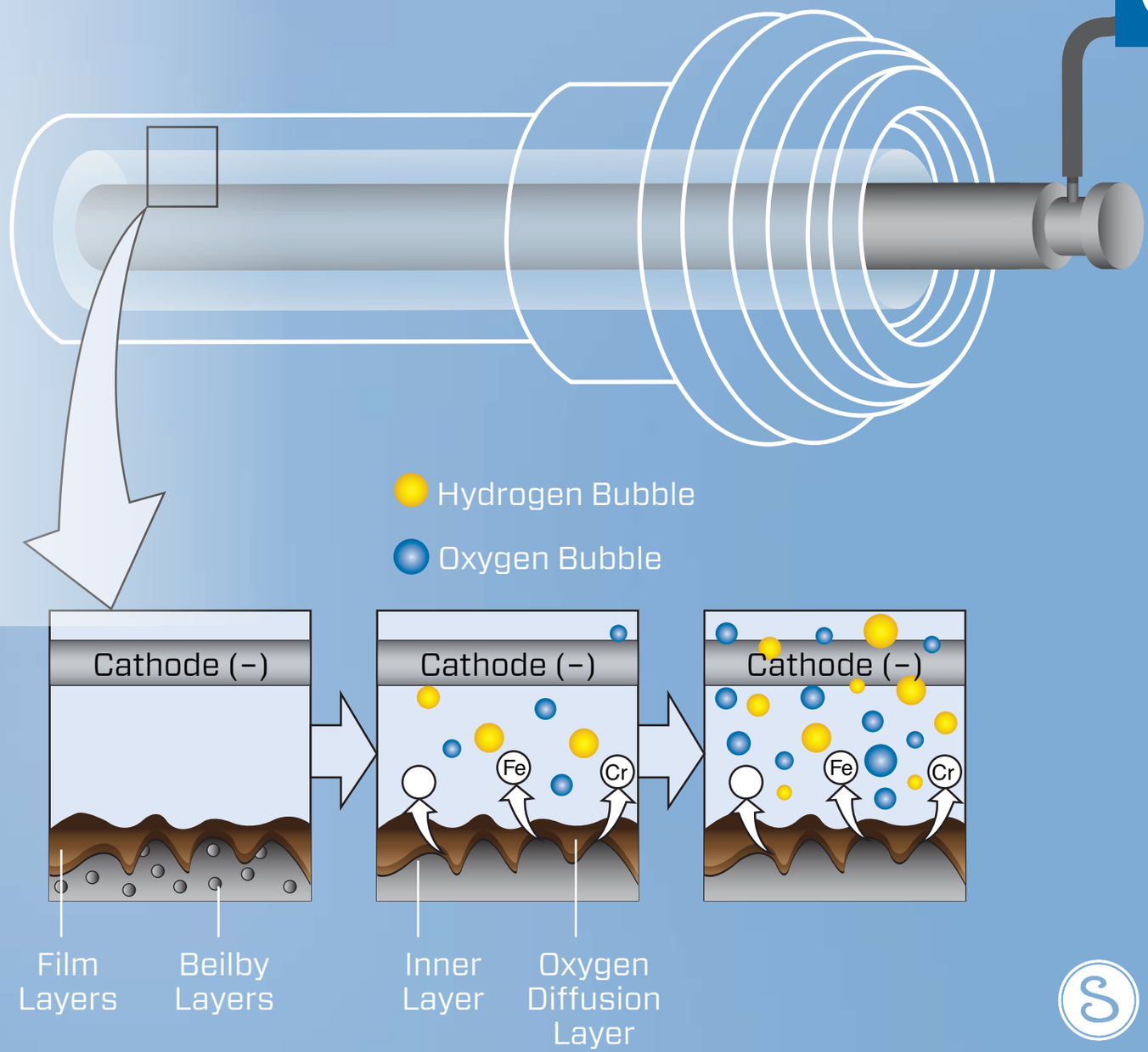
Manufacturing

How Electropolishing Provides a Clean Surface

During electropolishing, a viscous film forms on the anode, and the base metal surface dissolves through the film. Corrosion resistance is improved as a result of an enhanced chrome-to-iron ratio on the treated surface. This process results in a smoother wetted surface and reduced wetted surface area, which improves dry-down and system purge times.

Swagelok designs specialty fixtures and specific part parameters to ensure optimal electropolishing.

LEARN MORE ABOUT PASSIVATION.



Manufacturing
Passivation

Passivation uses an acid bath to further enhance the material's corrosion resistance by creating an inert passive layer that protects against damage from external elements.

Our Commitment to Cleaning and Packaging

We stand behind our product offerings with our commitment to ultrahigh-purity manufacturing. We understand the UHP industry's unique requirements for cleanliness, so we can help you meet or exceed industry standards.

Process Specifications

Typical Cleaning Processes

Cleaning and Packaging
Process Specifications

Various contaminants, such as machining oils/coolants, finishing media, and electropolishing electrolytes, can compromise purity if not thoroughly cleaned. Swagelok is the author of process specifications that encompass industry-leading requirements for performance and cleaning of components used in UHP manufacturing:

SC-01 Ultrahigh-Purity Process Specification
specifies guidelines for surface finish and materials of construction to help our products resist impurities and corrosion, resulting in less likelihood of contamination in semiconductor manufacturing.

SC-06 Photovoltaic Process Specification
offers both electropolished and standard finish components in specific products for ultrahigh-purity applications.

SC-11 Special Cleaning and Packaging Specification
specifies cleaning and packaging requirements for wetted system components that exceed standard cleaning and packaging requirements. This specification helps to ensure that no lubricants or particles enter the wetted stream or other critical paths in semiconductor manufacturing.

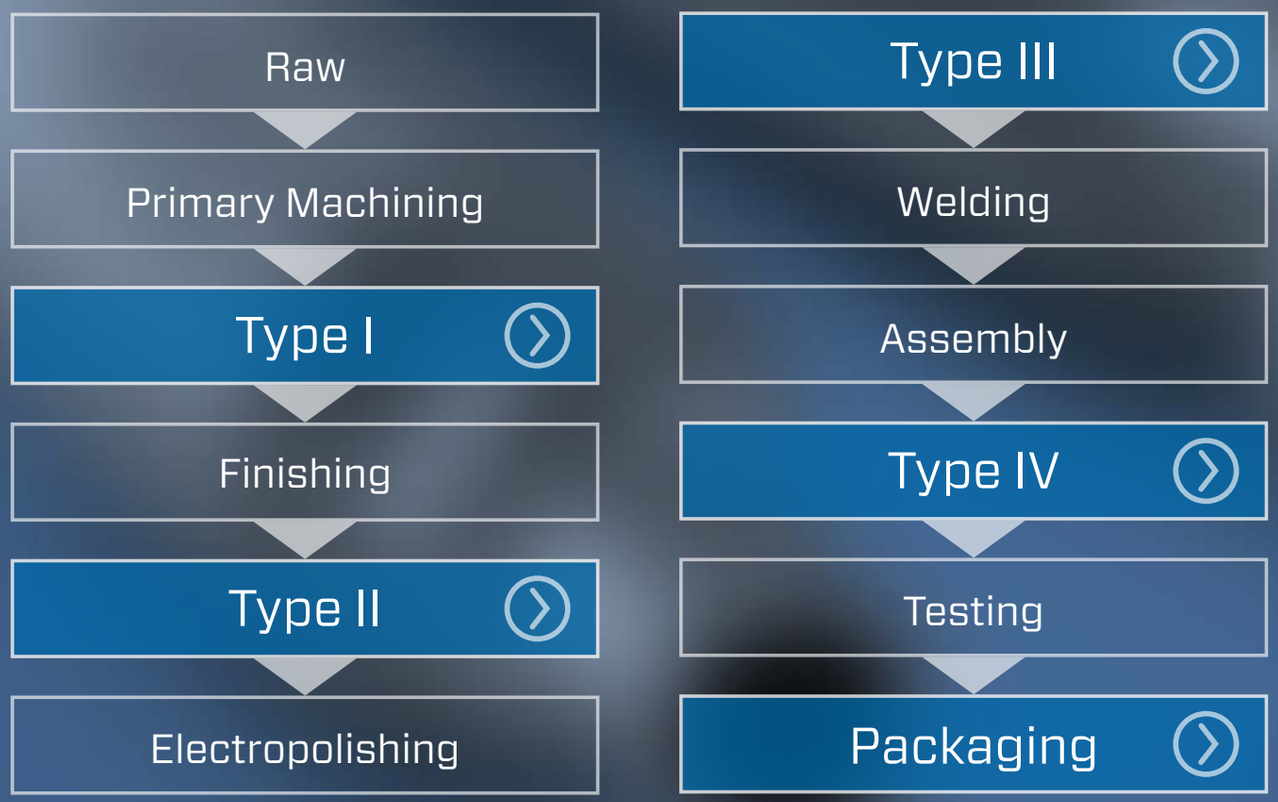
SC-10 Standard Cleaning and Packaging Specification
defines the cleaning, lubrication, assembly, and packaging requirements for standard products and describes the practices used to meet these requirements.

Cleaning and Packaging

Typical Cleaning Processes

Swagelok cleans material at several stages of its manufacturing process to ensure product integrity.

In all types of cleaning, products move through a series of ultrasonic washing and multistage water rinse tanks to a drying chamber. In SC-01 cleaning, all components of the washing and drying process are closed to the outside environment to limit particle contamination.



Cleaning and Packaging

Typical Cleaning Processes

Type I cleaning is performed after the component is initially processed and before it undergoes finishing operations. This type of cleaning includes bulk removal of machining contamination, such as coolant fluids and chips and other particulates.

Type II cleaning is performed after material finishing operations are complete, and before the component is electropolished. This process removes visible contamination from finishing operations, such as residue from lapping and electrolytes. This type of cleaning is typically done by both chemical and mechanical methods.

Type III cleaning is performed after the component is electropolished and welded. Since this is the final cleaning prior to assembly, this process establishes the final part cleanliness level.

Type IV cleaning is the final nitrogen purge prior to packaging valves cleaned to the SC-01 standard. This process ensures product cleanliness after assembly.

Packaging Once products have been finished to our exacting standards, end connections are covered with clean caps and plugs to protect threads and other critical surfaces, and to maintain cleanliness. We then package them to protect them from contamination and damage during shipping and storage.

Our Commitment to Throughput and Repeatability

Throughput means you get more material through your manufacturing system faster, with less downtime. Repeatability means that the product you produce is the same, every time. With Swagelok, you get these benefits and more when you select products based on their suitability for your high-purity application. Innovations like our ALD valve enhance semiconductor manufacturing efficiency.

- Cobalt-based super alloy (UNS R30003) material for strength and corrosion resistance
- Optimized, patent-pending design for ultrahigh cycle life
- High-speed and repeatable actuation
- Suitable for thermal immersion operations
- Capable of valve opening or closing time of less than 5 ms

Our Commitment to Quality, Reliability, and Safety

Swagelok's ongoing commitment to quality and reliability ensures our products last a long time, so you replace them less frequently. Our verification processes confirm the suitability of our products for use in the harsh extremes of the semiconductor industry—so you and your processes stay protected.

- Quality Verification
- Eddy Current Testing
- Immersion Ultrasonic Testing
- Critical Pitting Temperature Testing
- Scanning Electron Microscope

Quality, Reliability, and Safety

We Continue to Drive Quality Verification

Swagelok's quality metrics assure you of high value and high performance in all our processes. Our Swagelok Quality System (SQS) is compliant with the requirements of ISO 9001-2000. And this quality extends to the verification process. We inspect our material for flaws in several ways to ensure fitness for ultrahigh-purity manufacturing. Few or no material flaws mean less chance of leakage or interruption of the flow path, so your processes stay clean as well.

Our tests also validate that our products are well-suited for the long cycle life demanded of products used in semiconductor manufacturing—even in highly corrosive or toxic environments.

Quality, Reliability, and Safety

Eddy Current Testing

Incoming stainless steel bar stock is checked via eddy current testing. Eddy current testing uses electromagnetic induction to detect surface flaws in conductive materials. A circular coil carrying current is placed in proximity to the steel. The alternating current in the coil creates a changing magnetic field which interacts with the steel and generates eddy current. Variations in the electrical conductivity or magnetic permeability of the steel, or the presence of flaws, will cause a change in eddy current and a corresponding change in the phase and amplitude of the measured current.

Quality, Reliability, and Safety

Immersion Ultrasonic Testing

Once the steel is manufactured, it is subjected to immersion ultrasonic testing to detect internal flaws. With this testing method, short ultrasonic pulse-waves are transmitted through a couplant, such as oil or water, to detect internal flaws in the stainless steel. The material being examined is coupled to the part by a liquid column or is totally submerged in the couplant. Because of the penetrating power and sensitivity of this test, small flaws deep in the steel can be detected.

Quality, Reliability, and Safety

Critical Pitting Temperature (CPT) Test

The Critical Pitting Temperature test can predict susceptibility of stainless steel to pitting corrosion by testing the entire surface of the steel (rather than just selected testing points) for a breakdown in the protective passive surface oxide layer of the steel.

CPT values are the lowest temperatures at which pitting corrosion occurs during testing.

LEARN MORE ABOUT HOW WE CONDUCT THE CPT.

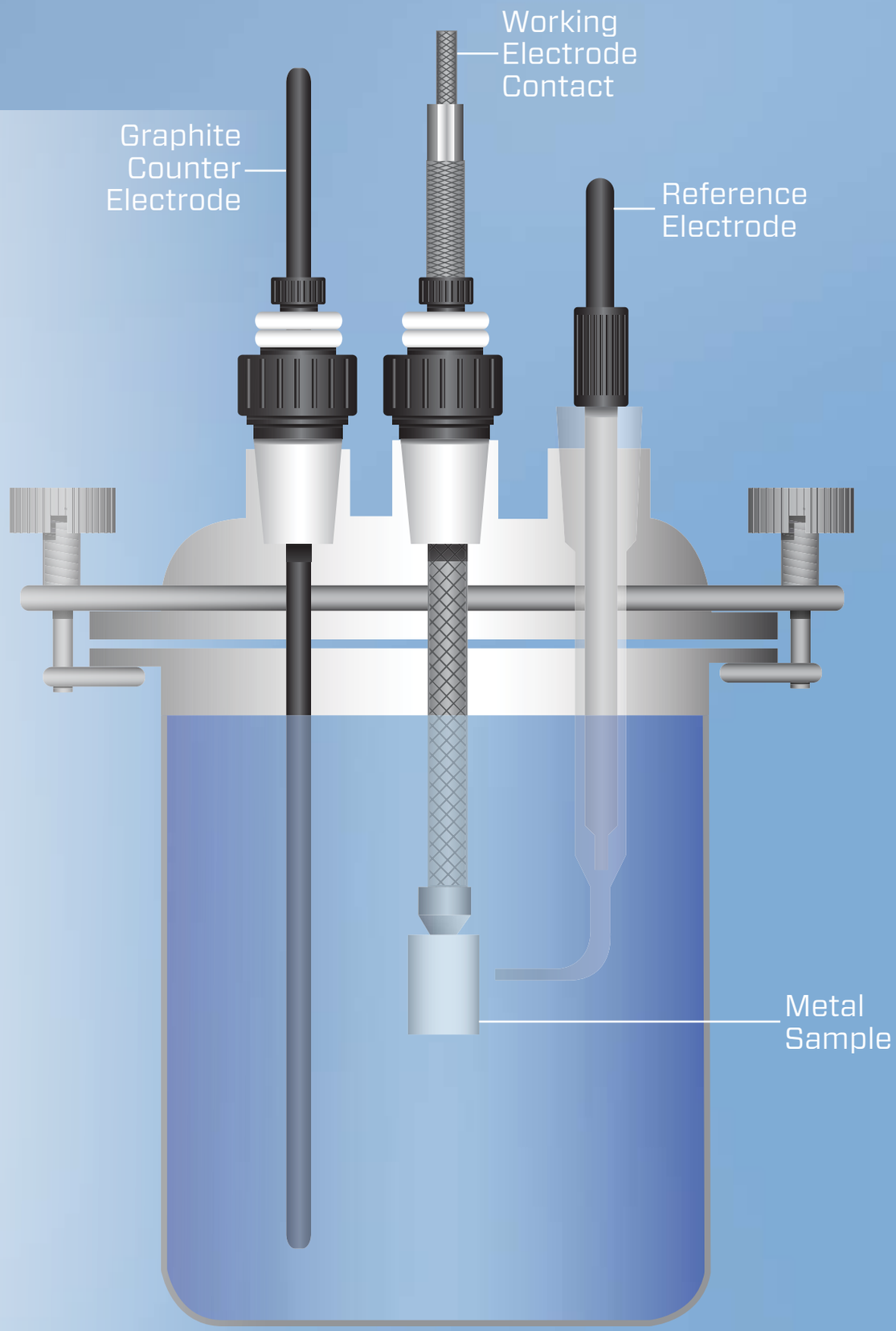
LEARN MORE ABOUT INTERPRETING CPT VALUES.

Quality, Reliability, and Safety

Performing the Critical Pitting Temperature (CPT) Test

1. Mask off the non-wetted areas of our components that should not be included in the test, leaving the wetted portions exposed to the test solution.
2. Immerse the component in the test solution.
3. Apply an electric current across the part at an initial temperature of 0°C.
4. Increase the temperature of the solution at a rate of 1°C/min. As the solution temperature increases, the passive layer of the stainless steel breaks down. This is verified by registering a higher conductivity, since the passive layer acts as an insulator.
5. Confirm that the solution has reached the critical pitting temperature. The CPT is defined as the temperature at which the current increases rapidly.
6. After the solution reaches the CPT, visually confirm the amount of pitting on the material sample.

LEARN ABOUT INTERPRETING CPT VALUES.

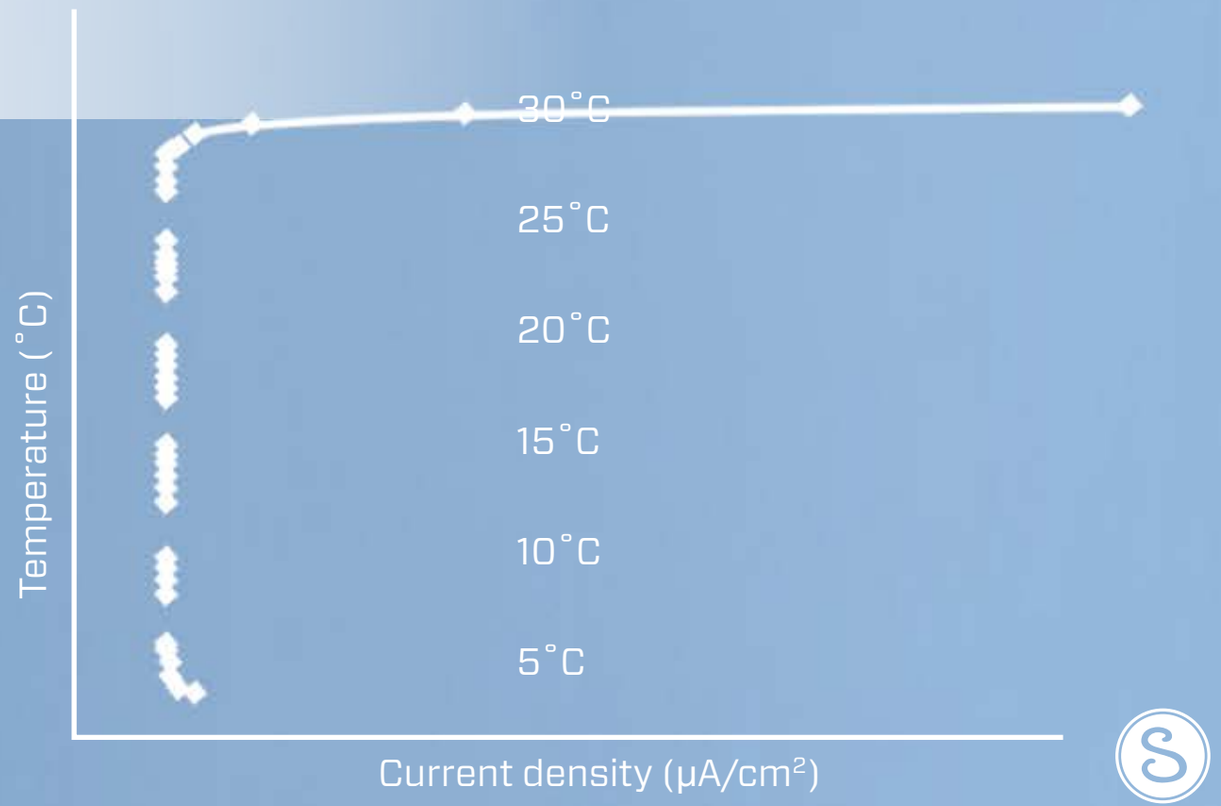


Quality, Reliability, and Safety

Interpreting the Critical Pitting Temperature (CPT) Values

The chart shows the relationship of temperature and current. The critical current is the point at which the passive surface layer of the part begins to break down, enabling pitting corrosion to occur. (The critical current is indicated by a dramatic slope change in the test). The critical pitting temperature is the temperature at which the onset of pitting corrosion is observed during an electrochemical pitting temperature scan.

LEARN MORE ABOUT WELDABILITY.



Quality, Reliability, and Safety

Scanning Electron Microscope Inspection

Material can also be inspected for surface and internal flaws with a scanning electron microscope equipped with X-ray spectroscopy, ensuring material integrity for safe, reliable performance.

Get there with Installation Training

How to bring your quest for cleanliness full circle? With complete installation training from Swagelok. In ultrahigh-purity manufacturing, system components must work together to maintain leak-tight seals on toxic, corrosive fluids and gasses while maintaining system integrity and purity under a wide range of operating conditions. Understanding how to optimize performance of Swagelok products with training in proper installation helps you meet your manufacturing goals, and ensures your processes and personnel operate safely.

LEARN MORE ABOUT OUR INSTALLATION TRAINING.

Get there with Installation Training

Here are some of the topics covered in installation training:

- Technical product overview
- Proper technique and tools
- Inspection

You will participate in hands-on activities like these:

- Product assembly
- Verification of proper technique
- Certification program to ensure personnel are properly qualified

In addition to our instructor-led classes, we offer Swagelok's on-line university. Swagelok University provides more than 100 interactive, online courses. Courses include general technical information, scientific fundamentals, plant science, industry-specific content, and product information. Online testing and tracking can monitor your progress.

VIEW THE SWAGELOK UNIVERSITY ONLINE COURSE CATALOG.

Stronger Together

Take advantage of our Distributor capabilities to strengthen your ultrahigh-purity manufacturing.

Select the right products.

Coordinate your project and connect with a single point of contact to authorized Swagelok sales and service centers worldwide. Product selection tools right where and when you need them, to help you choose the exact product for your job.

Dynamic processes require continuously-available products.

Swagelok can provide customized inventory management services as well as just-in-time delivery for optimum stock levels.

We're global. And local.

Isn't it good to know you can count on Swagelok for availability and support? A world-class manufacturer with global representation and over 200 local sales and service centers. So expertise and support is always close at hand—wherever in the world you are.

LEARN MORE AT SWAGELOK.COM.

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