Gore Lithography Cables
& Cable Assemblies

ULTRA-CLEAN, RELIABLE LITHOGRAPHY CABLES

Engineered to empower DUV, EUV and
next-generation semiconductor manufacturing

Together, improving life

Microchips: Driving the Economy, Shaping Society

In recent years, no technology has done more to shape our economy, society and lives than microchips.

Semiconductors are now integral to the way we live, work and interact with people and things.

In 1965, American engineer Gordon Moore predicted the number of transistors per silicon chip would double each year. His prediction — now known as "Moore's Law" — has held true for well over half a century.

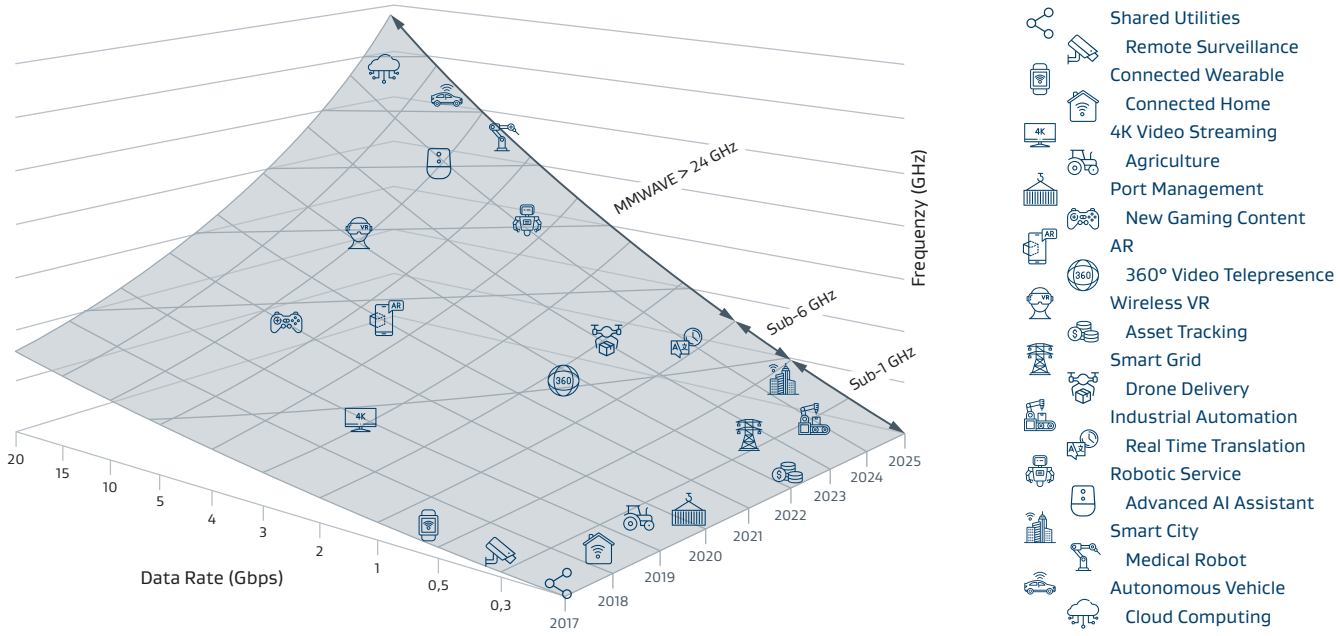
In that time, advancements in semiconductor wafer fabrication have yielded progressively smaller and smarter chips, enabling ever-smaller devices and even more powerful builds, as with SoC (System on a Chip) applications.

This demand for "smaller and smarter" will only accelerate as societies more fully embrace Artificial Intelligence, 5G, the Cloud, the Internet of Things and electrified/autonomous vehicles in the years and decades ahead.

Will Moore's Law still be valid in the future?

Realizing new extremes in semiconductor miniaturization is almost certain, based on the continuing advances in photolithography technologies and equipment:

- **Deep Ultraviolet (DUV) lithography** processes carve electric circuits into semiconductor wafers with processes of > 7 nm.
- Newer **Extreme Ultraviolet (EUV) lithography** technology achieves even smaller processes of 2 nm and beyond. This advance, which allows more electric circuits to be squeezed onto a chip, is vital to sustaining Moore's Law.
- Next-generation **High Numerical Aperture (High-NA EUV) lithography** systems are currently in development. They are anticipated to enable even higher-resolution patterning, which should validate Moore's Law in the foreseeable future.



Two Challenges and One Solution

The semiconductor industry faces unprecedented dual demands: produce smaller, smarter chips of the highest quality, and deliver higher chip output. Gore can help you succeed at both.

Challenge #1:

More Miniaturization = More Precision & Cleanliness

The relentless demand for smaller, more powerful chips with higher data rates creates an exponential increase in process complexity. And the smaller the chip, the greater the challenge.

To continue shrinking structures on chips will require even more equipment and filters, more extreme parameters for precision, and more rigorous control of any equipment within the high-vacuum environment, to prevent contamination via outgassing or particulation.

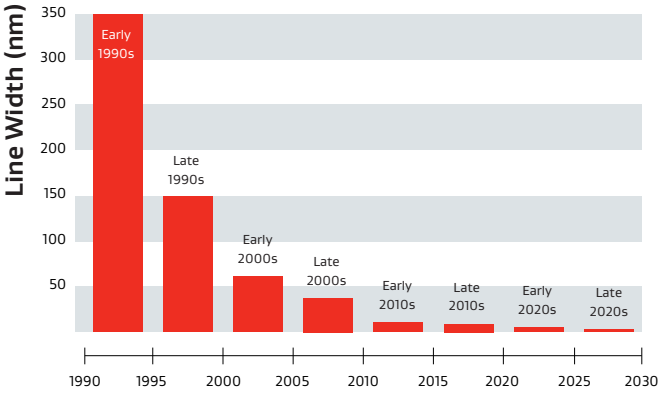
In 20 years (early 1990s–late 2000s) line widths were reduced by nearly 90%. The following 20 years saw another reduction of even more than 90%. What will be possible by 2040?

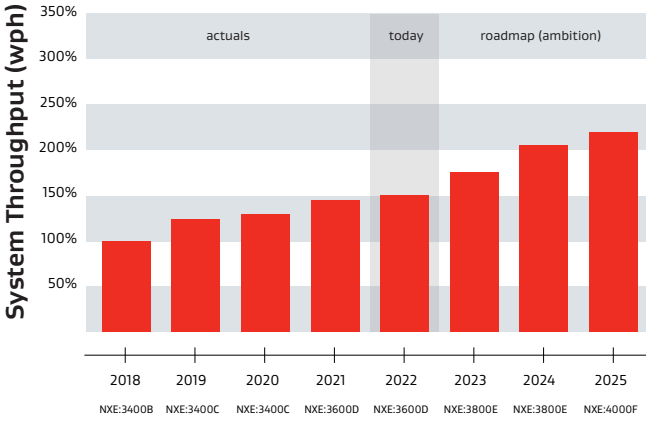
Challenge #2:

Rising Demands for Yield, Quality and Speed

The world needs more — and more sophisticated — chips than ever before. But achieving maximum production capacity with maximum quality is not a simple task.

High-value semiconductor lithography equipment must work at maximum efficiency, and deliver maximum yields, to make the production process profitable. But maximizing throughput comes at a cost: it demands more machine run-time per day with minimal downtime and higher wafer-per-hour (wph) speeds, which puts more stress on components like cables. **Semiconductor manufacturing can only advance to the next level when all key suppliers can also meet the same challenges.**





Source: ASML Investor Day 2021, Christophe Fouquet presentation "EUV Products and Business Opportunity."

Gore Cable Solutions Meet the Challenges

Gore's durable, high-performance cable solutions for both static and flexible applications have already been qualified in the most demanding high-vacuum environments. Our proven cable reliability can mean decreased maintenance, decreased downtime and lower total costs over time.

GORE® Ultraclean Static Round Cables & Assemblies: Cleanliness Grade 1

Our highest-purity cables can be found in the innermost parts of the equipment with the most extreme cleanliness requirements.

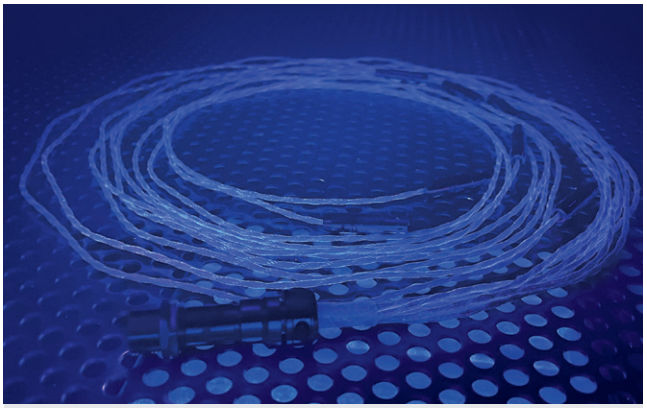
Our ultraclean cables for static EUV applications can meet Cleanliness Grade 1 standards, because:

- Gore employs rigorous IP-protected cleaning processes throughout every step, from manufacturing through final testing.
- GORE® Ultraclean Static Round Cables are constructed of various fluoropolymers such as expanded polytetrafluoroethylene (ePTFE), a very flexible, low-outgassing polymer. Gore can further optimize outgassing values to meet specific customer requirements.

Technical Data

Property	Vacuum (acc. to Cleanliness Grade 1)
Jacket material	PTFE & fluoropolymer
Jacket color	white and opaque
Core types	signal, power
Minimum bend radius	> 10 × OD
Temperature range [°C]	–20 to +260 [a]
Outgassing rate [mBar x l/sec × cm²]	
H_20 (AMU 18) [b]	6.00E-10
CxHyv (volatile CxHy) (AMU 45-100) [b]	2.00E-12
CxHynv (non-volatile CxHy) (AMU 101-200) [b]	5.00E-13
Hydrogen-induced outgassing (HIO)	applicable
Forbidden materials	applicable
Particle-free	applicable
Certifications	UL

[a] depending on application requirements
[b] AMU = Atomic Mass Units



APPROVED FOR CLEANLINESS GRADE 1

For Gore, “Ultraclean” is not just a product name: It defines the result of our materials expertise and IP-protected cleaning processes that enable these cables & assemblies to meet the industry’s highest cleanliness standards.

OPTIMIZE RUN-TIME AND MINIMIZE DOWNTIME

To prevent costly downtime, Gore’s static cables and assemblies undergo rigorous purity processes, testing and inspections at every stage of production. It’s how we deliver cable cleanliness, performance and reliability that qualifies for the most advanced EUV applications.

GORE® High Flex Cables & Assemblies: Cleanliness Grades 2 and 4

Our flex cables for EUV and DUV applications provide reliable performance and purity even under higher-speed/higher-stress, multi-million flex cycles.

GORE® High Flex Cables and Assemblies can meet Cleanliness Grade 2 and 4 standards, because they:

- Undergo rigorous, IP-protected cleaning processes at every stage of the cable production process.
- Are constructed of ePTFE, which enables low-outgassing flex cables with high reliability and reduced particulation over long-duration cycles.

With a proven flex life and durability in complex environments where other cables fail, GORE® High Flex Cables and Assemblies are engineered for improved signal integrity and transmission speeds. These are crucial for complex cable configurations that incorporate tubes for gas or fluid transport alongside cabling for data and for high- and low-power electrical signals.

Gore is known for developing complex cable configurations that incorporate all these elements — without propagating crosstalk, interference or interaction among the components. With the breadth and depth of our engineering expertise, we can develop a one-of-a-kind solution to the singular needs of your next new program.

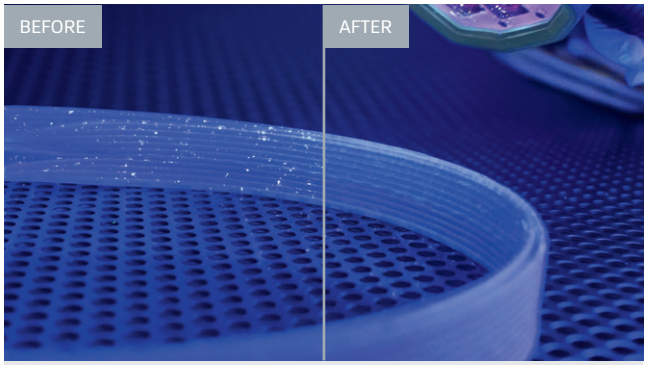
Technical Data

Property	Vacuum (acc. to Cleanliness Grade 2)	Non-vacuum (acc. to Cleanliness Grade 4)
Jacket material	PTFE	expanded PTFE (ePTFE) composite
Jacket color	white	white
Core types	signal, power, pneumatic, fluids	signal, power, fiber optic, pneumatic, fluids
Maximum self-supporting length [mm (inch)]	500 (20)	500 (20)
Maximum width of cable [mm (inch)]	130 (5)	300 (12)
Minimum bend radius	> 10 × OD [a]	> 10 x OD [a]
Maximum acceleration [m/sec²] [b]	> 40 [a]	> 40 [a]
Speed [m/sec]	> 3 [a]	> 3 [a]
Flex life (Cycles) (BR. 50 mm up to 4G accelerations)	> 20 million [a]	> 20 million [a]
Temperature range [°C]	–20 to +260 [a]	–20 to +90 [a]
Particulation [c] (ISO14644-1 / VDI Guideline 2083)	< 0.1 %	< 0.1 %
Outgassing rate [mBar × l/sec × cm²]		
H_2O (AMU 18) [d]	4.00E-09	n.a.
CxHyv (volatile CxHy) (AMU 45-100) [d]	1.00E-10	n.a.
CxHynv (non-volatile CxHy) (AMU 101-200) [d]	6.00E-12	n.a.
Particle-free	applicable	applicable
Certifications	UL	UL

[a] depending on application requirements
[b] For applications requiring higher acceleration and speed, please contact a Gore representative.
[c] Details of the Fraunhofer Institute's study available at gore.com/particulation.
[d] AMU = Atomic Mass Units

ROBUST AND RELIABLE

GORE® High Flex Cables and Assemblies are custom-engineered and quality tested to ensure they meet customer specifications for high performance with no cross-talk, and low contamination over multi-million flex cycles.



VERIFIED CLEANLINESS GRADES 2 & 4

Our multi-step purity processes include use of a UV Chamber to identify and remove particulates, and Residual Gas Analysis (RGA) to verify that each cable meets the customer's specified cleanliness grade.

The Gore Advantage

Why choose Gore for lithography cables? Our high quality translates to real value in use: less equipment maintenance and downtime for lower total costs over the equipment's life cycle.

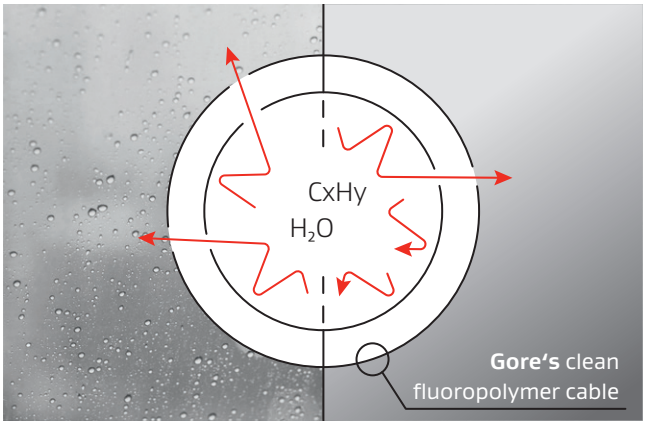
Gore is positioned to provide that value, because:

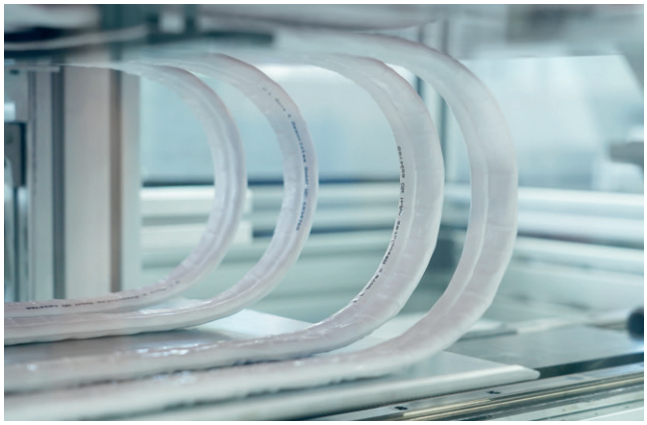
- Our cables deliver the lowest contamination, lowest particulation and reliable signal integrity for high-purity lithography or vacuum applications. And our cables enable tight radius bends, to facilitate easier installation and more flexible routing.
- Our expertise, application knowledge and highly integrated processes enable co-engineering of custom cable solutions, tight control of cleanliness and quality through every step, and access to extended support if needed. From raw materials to finished assembly, Gore owns the process — and the responsibility to ensure our products perform as we say they will.

Product Properties Designed for Extreme Applications

Lowest contamination from CxHy and H_2O
Gore's chemically inert fluoropolymers reduce outgassing of volatiles like CxHy and H_2O, which can diffuse into the vacuum vessel, contaminating the processing chamber and fogging the parabolic mirrors that are critical for imaging precision. Our material expertise, along with our rigorous and IP-protected cleaning processes, mean each element of our finished cables, from raw materials to individual strands and final assemblies, delivers the cleanliness that high-purity lithography processing and vacuum applications demand.

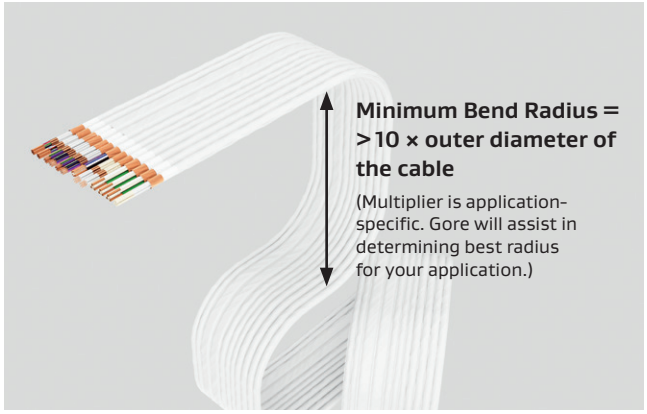
Lowest particulation
The mechanically robust low-friction components of Gore lithography cables achieve the lowest rates of particulation over high (> 20 million) flex-cycles, even at higher speeds/acceleration.
As vacuum cables flex and compress, if they contact each other, friction can cause the materials to shed particulates that can contaminate the vacuum environment. Gore's low-friction materials — and ability to further manipulate them — can achieve the lowest particulation despite the increased stress imposed by higher output (wafer/hour) goals.





Reliable signal integrity
The longer the cable, the more sensitive the data transmission. Gore's thin, flexible lithography cables have low dielectric constant, to maintain reliable signal integrity for high-speed data transmission over longer distances.

Routing flexibility
Gore's high-flex vacuum cables allow a tight bend radius, for easy installation in tight spaces and greater freedom to use special routings.



Collaborative Partnerships that Foster Innovation

A Proven Track Record
We began producing “can’t-fail” cables for harsh and vacuum environments more than 50 years ago, partnering with NASA and ESA. We still do: they choose our cables for countless high-profile missions. Meeting their tolerances and purity requirements gave us a solid foundation.

From there we continued to evolve our lithography capabilities, and to develop successful partnerships with leading lithography OEMs. Together, for more than 20 years, we’ve advanced Gore cable capabilities to support — and foster — lithography innovations.

We Customize. Without Compromise.
Each new project demonstrates Gore’s material expertise and commitment to co-engineering. That’s because every Gore lithography cable is a custom, co-engineered product: we design, produce and quality-assure all of it — from the ePTFE jacketing material, to the individual strands, to the completed cable configuration, which may include more than a thousand strands.

Every material, every element is tailored to specific customer requirements. We can fine-tune the characteristics of ePTFE for lowest particulation or other lithography-specific needs. And we continually evolve our methods and machinery in concert with the industry’s more demanding standards for cable cleanliness, durability, flex life and reliability.

Proprietary Processes.
Unmatched Cleanliness.

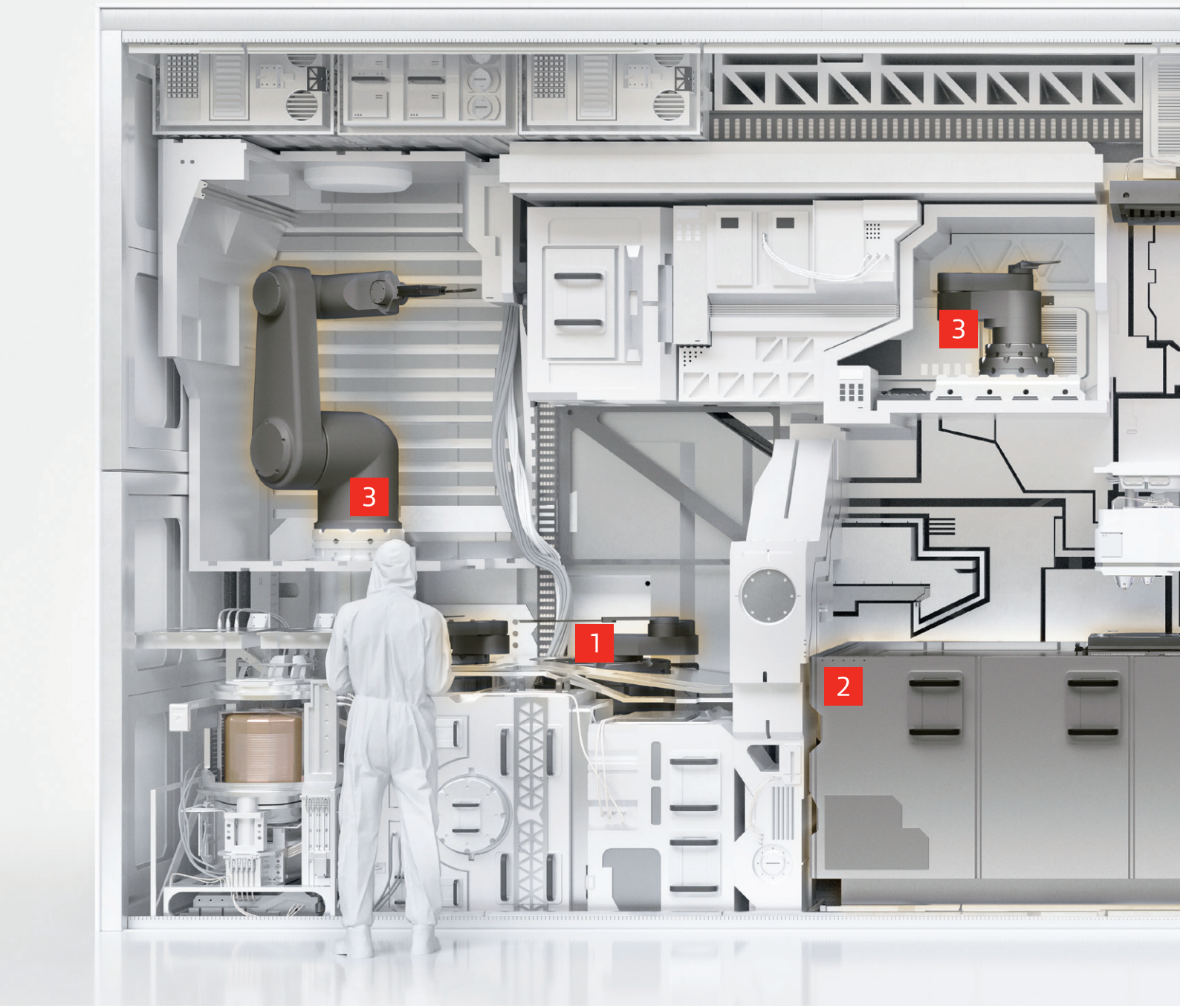
Our integrated resources enable us to take singular responsibility for every step of the process: design and raw materials, manufacturing and assembly, final product testing, and exemplary technical support.

Gore has developed — and continues to enhance — rigorous IP-protected cleaning processes to protect the purity of raw materials, the individual strands and the final cables and cable assemblies.

The same standard of excellence applies to Gore termination of cables for lithography applications: IP-protected Gore processes enable the fit of each cable assembly, ensuring stress-free contact areas with no pressure points that would collapse impedance.

Comprehensive Quality-Testing
To provide the most reliable product possible — and help to prevent costly downtime for our customers — Gore cables undergo rigorous testing at every step of the manufacturing and production processes. Our in-house laboratories quality test the raw materials, individual elements, cables and final assemblies to ensure their correctness, their performance and their cleanliness according to customer specifications.

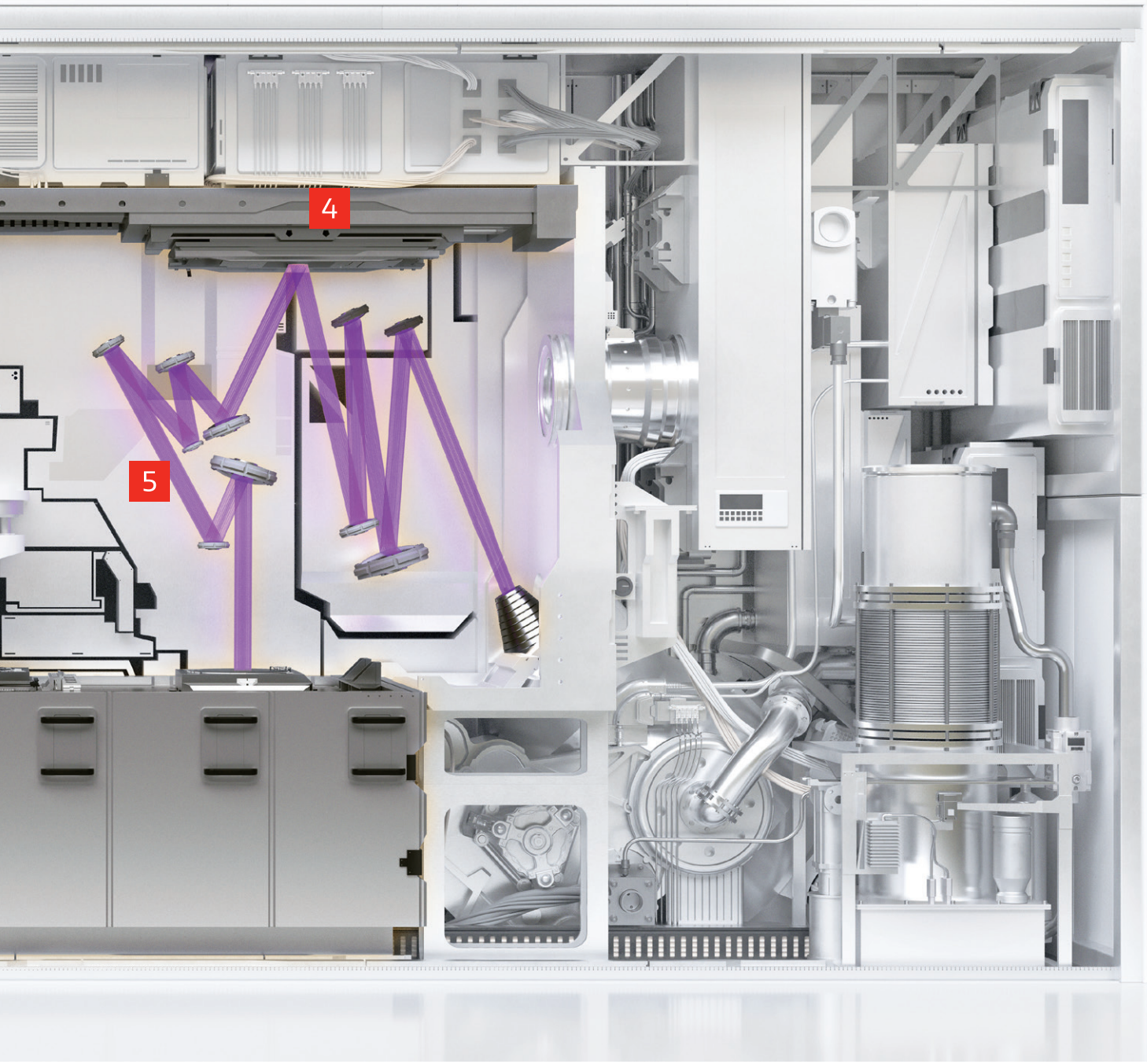
- Flex Tests
  (Mechanical Durability)
- High Frequency/Eye Diagram Tests
  (Electrical Signal Integrity)
- RGA Analysis
  (Purity Analysis)
- 3D Computer Tomography Scans
  (Structural Analysis)
- High-Voltage Tests
  (Electrical Performance)



Applications in EUV Lithography

You'll find Gore Cables & Assemblies in the wafer handling and exposure processes of the most advanced lithography equipment.

Advanced EUV lithography systems conduct multiple sophisticated handling, exposure and imaging functions, all within a high-vacuum environment that provides the high purity today's semiconductor standards require.



1 **WAFER HANDLER**

The wafer handler (“up-down robot”) carries the wafer to and from the wafer stage.

2 **WAFER STAGE**

The wafer stage is where the wafer is exposed. A chip may require 60–150 layers and therefore an equal number of exposure process steps.

3 **RETICLE HANDLER**

The reticle handler carries the reticle mask to and from the reticle stage.

4 **RETICLE STAGE & RETICLE MASK**

Reticle stage is where the reticle mask is integrated. Reticle mask is a photomask that defines the chip structure (identifies which areas will/will not be etched).

5 **PROJECTION OPTICS BOX & ILLUMINATOR**

In EUV, the Projection Optics Box and Illuminator is where optical assembly takes place. Light is transmitted from reticle to wafer using a complex series of mirrors that reduce the individual mask patterning onto the chip.

Applications in Semiconductor Inspection Systems

You'll find Gore Cables & Assemblies in a range of Metrology and Testing equipment for automated inspection of wafers, masks and chip quality.

OPTICAL METROLOGY SYSTEMS

The metrology system checks the quality of the exposed wafer by inspecting for specific defects.

MASK INSPECTION SYSTEMS

A mask inspection system is where reticle masks are inspected.

eSCAN MULTIPLE E-BEAM SYSTEMS

This system uses multiple e-Beams to conduct a thorough inspection and detect whether the exposure was successful, or if it produced faulty chips.

Commitment to Semiconductors

Gore cables and cable assemblies play a crucial role in enabling DUV and EUV lithography companies to run more productively and reliably. But there is much more to the story:

GORE® Microfiltration Media
Semiconductor fabrication requires high-purity process fluids (water, chemicals and specialty solutions) to protect sensitive fabrication steps, ensure chip performance and enable high processing yields. It's critical to have high-performance membrane filters that can withstand harsh operating conditions while effectively removing harmful contaminants.

Gore's hydrophobic and hydrophilic filtration membranes provide nanometer levels of particle capture while operating at the high flow rates required for advanced semi process tools. Our chemically inert membranes effectively remove contaminants, enabling the most demanding applications — wet etch and clean, resist stripping, photolithography, UPW and other fine filtration processes — to operate at optimal levels of purity.

Unlike other membranes that are vulnerable to heat or chemicals, or release extractables that compromise process purity, GORE® Microfiltration Media can provide greater contaminant retention at a given flow rate, which can enable higher yields in microchip fabrication without compromise to quality.

Learn more at **gore.com/micromedia**

GORE® Sealant Technologies
GORE® Gaskets effectively seal and protect equipment in demanding semiconductor manufacturing applications. They provide exceptionally reliable and chemically resistant sealing solutions. Our 100% pure expanded-PTFE gaskets are proven effective because they:

- Resist chemical attack by the most aggressive chemicals.
- Exhibit exceptional dimensional stability, resisting cold flow that could compromise the sealing system.
- Seal effectively with low applied gasket stress relative to other pure PTFE sealing options.
- Provide the low extractables of a 100% pure (expanded) PTFE solution.
- Withstand temperatures from –269 °C to +315 °C (–452 °F to +600 °F).

GORE® Gaskets maximize reliability and minimize sealing-related maintenance of high-purity process fluid systems, including UPW and chemical delivery systems for aggressive wet etch and clean chemistry.

Learn more at **gore.com/sealants**

More than 50 years of innovation in cable design enables Gore to meet today's most extreme DUV and EUV standards, and prepares us to anticipate and meet even more stringent demands in the future.

Gore Cable Solutions: For Lithography. For You.

Cables are central to who we are and what we do.
We've devoted more than 50 years to advancing our capabilities, commitments and application expertise in this market.

Gore's custom-engineered cables and assemblies have achieved a level of quality that is currently without equal — they have been qualified to meet EUV lithography's most extreme standards for:

- cleanliness
- durability and flexibility under the harshest operating conditions
- reliability even through multi-million-part production runs
- uncompromised signal integrity

It all adds up to one thing: Reliable cables for lithography, even over multi-million cycles at higher wph rates.

We are working in partnership to meet future challenges.
The same urge for scientific progress that informs Moore's Law also motivates our engineers. We continue to seek new solutions, new ways to partner with lithography equipment manufacturers that share the same spirit, and new ways to achieve even higher levels of cable cleanliness, durability, flexibility and reliability.

Find out what we can do for your next project:
Contact your local Gore representative or use the web form on **gore.com/lithography** to email us.

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