ENTEGRIS INC
Form 10-K
February 17, 2017
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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-K

(Mark One)
x ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2016
or
o TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the transition period from to
Commission file number: 001-32598

Entegris, Inc.
(Exact name of registrant as specified in its charter)

Delaware	41-1941551
(State or Other Jurisdiction of Incorporation or Organization)	(I.R.S. Employer Identification No.)

129 Concord Road, Billerica, Massachusetts 01821
(Address of principal executive offices and zip code)
(978) 436-6500
(Registrant's telephone number, including area code)
Securities registered pursuant to Section 12(b) of the Act:

Title of Class	Name of Exchange on which Registered
Common Stock, $0.01 Par Value	The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Act: None

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Indicate by check mark if the registrant is a well known seasoned issuer, as defined in Rule 405 of the Securities Act. x Yes o No
Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. o Yes x No
Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No o
Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes x No o
Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§229.405) is not contained herein and will not be contained, to the best of registrant's knowledge, in definitive proxy or information

statements incorporated by reference in Part III of Form 10-K or any amendment to this Form 10-K. o

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer or a smaller reporting company. (Check one):

Large Accelerated Filer x	Accelerated Filer o
Non-Accelerated Filer o (Do not check if a smaller reporting company)	Smaller reporting company o

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ¨ No ý

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The aggregate market value of voting stock held by non-affiliates of the registrant, based on the last sale price of the Common Stock on July 2, 2016, the last business day of registrant's most recently completed second fiscal quarter, was $1,819,711,619. Shares held by each officer and director of the registrant and by each person who owned 10 percent or more of the outstanding Common Stock have been excluded from this computation in that such persons may be deemed to be affiliates of the registrant. This determination of affiliate status for this purpose is not necessarily a conclusive determination for other purposes.

As of February 14, 2017, 141,220,481 shares of the registrant's Common Stock were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Definitive Proxy Statement for its 2017 Annual Meeting of Stockholders scheduled to be held on May 24, 2017, or the 2017 Proxy Statement, which will be filed with the Securities and Exchange Commission, or SEC, not later than 120 days after December 31, 2016, are incorporated by reference into Part III of this Annual Report on Form 10-K. With the exception of the portions of the 2017 Proxy Statement expressly incorporated into this Annual Report on Form 10-K by reference, such document shall not be deemed filed as part of this Annual Report on Form 10-K.

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FOR THE FISCAL YEAR ENDED DECEMBER 31, 2016

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PART I

Item 1. Business.

THE COMPANY

Entegris, Inc. (“Entegris”, “the Company”, “us”, “we”, or “our”) is a leading global developer, manufacturer and supplier of microcontamination control products, specialty chemicals and advanced materials handling solutions for manufacturing processes in the semiconductor and other high-technology industries. Entegris seeks to leverage its unique breadth of capabilities to create value for its customers by developing mission-critical solutions to maximize manufacturing yields and enable higher device performance.

To produce faster and more powerful semiconductors, manufacturing technology has been rapidly moving to smaller process nodes, adopting new device architecture, such as FinFET transistors and 3D-NAND, and utilizing new and innovative manufacturing materials. Maximizing yields in this increasingly complex manufacturing environment requires the effective development and application of these new materials, a reliable and consistent supply, contamination-free transportation, storage and delivery, seamless integration into the semiconductor manufacturing process, and even higher levels of purity and contaminant control throughout the entire process.

Entegris is uniquely positioned to deliver advanced and specialty materials, free from contamination, with optimized packaging and delivery solutions, and in-process filtration and purification to ensure that liquid chemistries and gases are free from contaminants before reaching the wafer. Our technology portfolio includes approximately 20,000 standard and customized products and solutions to achieve the highest levels of purity and performance that are essential to the manufacture of semiconductors, flat panel displays, light emitting diodes, or LEDs, high-purity chemicals, solar cells, gas lasers, optical and magnetic storage devices, and critical components for aerospace, glass manufacturing and biomedical applications. The majority of our products are consumed at various times throughout the manufacturing process, with demand driven in part by the level of semiconductor and other manufacturing activity.

Our business is organized and operated in three operating segments which align with the key elements of the advanced semiconductor manufacturing ecosystem. The Specialty Chemicals and Engineered Materials (SCEM) segment provides high-performance and high-purity process chemistries, gases, and materials and safe and efficient delivery systems to support semiconductor and other advanced manufacturing processes. The Advanced Materials Handling (AMH) segment develops solutions to monitor, protect, transport, and deliver critical liquid chemistries and substrates for a broad set of applications in the semiconductor industry and other high-technology industries. The Microcontamination Control (MC) segment offers solutions to purify critical liquid chemistries and gases used in semiconductor manufacturing processes and other high-technology industries. While these segments have separate products and technical know-how, they share a single, global sales force, unified core systems and processes, global technology centers, strategic and technology roadmaps, and a focus on a common set of customers. The Company leverages its expertise from these three segments technologies to create new and increasingly integrated solutions for its customers.

SEMICONDUCTOR INDUSTRY BACKGROUND

Semiconductors, or integrated circuits, are key components in modern electronic devices such as computers, smart phones, tablets, home appliances, digital cameras, televisions, light bulbs and automobiles. The manufacture of semiconductors requires hundreds of highly complex and sensitive manufacturing steps, during which a variety of materials are repeatedly applied to a silicon wafer to build integrated circuits on the wafer surface. We provide specialty materials and chemicals utilized in many of these process steps, offer a broad range of products to monitor, protect, transport, and deliver these critical process materials during the manufacturing process and provide systems to purify liquid chemistry and gases throughout the manufacturing process. The process steps that rely most heavily on our products are described below.

Deposition. The two main deposition processes are physical vapor deposition, where a thin film is deposited on a wafer surface in a low-pressure gas environment, and chemical vapor deposition, where a thin film is deposited on a wafer surface using a gas medium and a chemical bonding process. In addition, electro-plating technology is used for the deposition of low resistance conductive materials such as copper. Our advanced precursor materials and electro-plating chemicals are utilized to enable the composition, uniformity and thickness of deposited films and our

filtration and purification products are used to remove defects and contaminants from liquids and gases used during the deposition process. These products are critical to ensuring the performance of the semiconductor circuit and, consequently, the manufacturing yield.

Chemical Mechanical Planarization (CMP). CMP is a polishing process used by semiconductor manufacturers to planarize, or flatten, many of the layers of material that have been deposited upon silicon wafers. We offer a broad range of products used by semiconductor manufacturers during and immediately following the CMP process. Our formulated cleaning chemistries remove residue from wafer surfaces after the CMP process, and prevent subsequent corrosion. Our filtration and purification systems are used to filter liquid slurries and cleaning chemistries in order to remove oversized particles and contaminants that can cause defects on a wafer's surface. Our roller brushes are used in conjunction with our cleans chemistries to clean the wafer after completion

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of the CMP process in order to prepare the wafer for subsequent operations and our pad conditioners are used to prepare the surface of the CMP polishing pad prior to every polishing cycle.

Photolithography. Photolithography is a process repeated many times that uses light to print, or pattern, complex circuit patterns onto the wafer. To print the projected optical pattern, the wafer is coated with a thin film of light-sensitive material, called photoresist. Light is projected to expose the photoresist, which is then developed (somewhat like photographic film) to create a stenciled image pattern. Our liquid filtration and liquid dispense systems play a vital role in assuring the pure, accurate and uniform dispense of photoresists onto the wafer so that manufacturers can achieve acceptable yields in the manufacturing process, and our gas microcontamination control systems eliminate airborne contaminants that can disrupt effective photolithography processes.

Etch and Resist Strip. During the etch process, specific areas of the film that have been deposited on the surface of a wafer are removed to leave a desired circuit pattern. After the etch process, the hardened resist needs to be completely removed. Our formulated chemical solutions remove photo resists and post-etch residues, and our gas filters and purifiers help assure the purity of the process gas streams used in the etch process. We expect an increased need for wet chemistries capable of selectively removing material at advanced technology nodes to drive demand for selective wet etch formulations.

Ion Implant. Ion implantation is a key technology for forming transistors and is used many times during semiconductor fabrication. During ion implantation, wafers are bombarded by a beam of electrically-charged ions, called dopants, which change the electrical properties of the exposed surface films. Our Safe Delivery Source® (SDS®) and VAC® (Vacuum Actuated Cylinders) gas delivery systems assure the safe, effective and efficient delivery of the toxic gases necessary for the implant process. In addition, our proprietary low temperature plasma coating processes for core components are critical elements of ion implantation equipment.

Wet Cleaning. Ultra-high purity chemicals and photoresists of precise composition are used to clean the wafers before and after several of the processes described above, to pattern circuit images and to remove photoresists after etch. The cleaning chemicals must be maintained at very high purity levels without the presence of foreign material such as particles, ions or organic contaminants in order to maintain manufacturing yields and avoid defective products. Our proprietary formulated cleaning chemistries are used in these wet cleaning processes and our liquid filters and purifiers assure the purity of these chemicals.

Transportation and Protection. Our wafer and reticle carriers are high-purity “micro-environments” that carry wafers between each of the above process steps, protecting them from damage and contamination during transportation. Front-end wafer processing can involve hundreds of steps and take several weeks. As a result, a batch of 25 fully processed wafers, the standard number of wafers that can be transported in one of our 200 mm and 300 mm products, can be worth several million dollars. It is essential that the wafer be well protected to minimize the risk of any damage. Our products enable semiconductor manufacturers to: minimize contamination (often measured in parts per trillion); protect semiconductor devices from electrostatic discharge and shock; avoid process interruptions; prevent damage or abrasion to wafers and materials during automated processing caused by contact with other materials or equipment; prevent damage due to abrasion or vibration of work-in-process and finished goods during transportation to and from customer and supplier facilities; and eliminate the dangers associated with handling toxic chemicals.

Many of the processes used to manufacture semiconductors are also used to manufacture photovoltaic cells, LEDs, flat panel displays and magnetic storage devices resulting in the need for similar filtration, purification, control and measurement capabilities. We seek to leverage our products, technologies and expertise to address these important market opportunities.

INDUSTRY TRENDS

Semiconductor manufacturing continues to increase in complexity as new materials and new process technologies have been introduced to enable future generations of higher-performing and smaller devices and to achieve productivity gains for manufacturers. At advanced technology nodes, there has been an increasing need for innovative materials and the reliable, consistent and quality-controlled supply of these materials. These critical materials must be pure during the various stages of manufacture, from delivery to the manufacturer to point-of-use on the wafer. Manufacturers are requiring a greater level of integration of these materials into the manufacturing process and fab operation. We expect these trends to continue and to increase the need and demand for our advanced materials, our

products designed to monitor, protect, transport, and deliver critical materials and our purification solutions. We have been collaborating with our customers to develop new materials, to develop enhanced methods of filtration and purification and to introduce advanced materials packaging and monitoring capabilities that will address the challenges of the advanced technology nodes.

Our semiconductor customers have become increasingly focused on materials handling solutions that enable them to safely store, handle, process and transport critical materials throughout the manufacturing process to minimize the potential for damage or degradation to their materials and to protect their investment in processed wafers. We believe that these trends provide opportunities for us to utilize our unique breadth of capabilities to provide innovative materials, materials management, purification, wafer transport, and process solutions to semiconductor customers to enable them to successfully manage this growing complexity.

The market for semiconductors has grown significantly over the past few decades. This trend is expected to continue as the Internet of Things, the connectivity of a broad range of devices, such as home devices, automobiles and smart grids, grows. We believe that the Internet of Things will drive growth in the demand for semiconductors and create significant opportunities for our products.

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Emerging applications relating to the autonomous car, cloud computing, machine learning and artificial intelligence, and virtual reality, along with existing applications in data processing, wireless communications, broadband infrastructure, personal computers, handheld electronic devices and other consumer electronics, are also expected to drive demand for semiconductors, and in turn, our products.

Our customers require greater capabilities from their key materials suppliers. For example, our customers require that their suppliers demonstrate a focus on sustainability, scalability, and flexible manufacturing, with increasing importance on quality control capabilities. We have responded to these demands by deploying resources to enable us to align with the requirements of our customers and drive operational excellence. We believe these trends will allow us to leverage our manufacturing and operational capabilities, along with our broad technology portfolio, to become an increasingly important strategic supplier to our customers.

The semiconductor industry is currently undergoing consolidation, with a number of major firms merging or being acquired, and we have seen our customer base within the semiconductor industry consolidate. While we continue to strengthen our relationships in the semiconductor industry, we seek to leverage our products, technologies and expertise in serving semiconductor applications to address adjacent market opportunities, including in manufacturing processes for flat panel displays, high-purity chemicals, solar cells, optical magnetic storage devices and products for life sciences.

An additional factor that could spur future industry growth is semiconductor industry development in China, which currently represents a relatively small portion of global semiconductor production. Expansion and growth of the semiconductor industry in China could increase the need and demand for our products.

OUR BUSINESS STRATEGY

Our objective is to be a leading global provider of advanced materials and material handling and contamination control solutions used in processing and manufacturing in high-technology industries. We intend to leverage our market-leading position and strengthen our core business in the semiconductor industry. We will also build upon our position as a worldwide developer, manufacturer and supplier of advanced specialty materials, filtration and purification solutions, delivery systems, and materials packaging solutions to grow our business in other high value-added manufacturing process markets. Our strategy includes the following key elements:

Technology Leadership. We continuously improve our products as our customers' needs evolve. As semiconductor devices become smaller and more powerful, and new materials and processes are deployed to produce them, we seek to expand our technological capabilities by developing advanced products that address the requirements for greater purification, protection and transport of high value-added materials and by developing advanced chemical materials for use in critical fabrication processes. For example, we have introduced sub-10 nanometer and 7 nanometer filtration products, advanced deposition materials for next generation transistor and interconnect technologies, advanced reticle pods for extreme ultra-violet or EUV photolithography applications, advanced 300 mm wafer carriers and advanced coatings to meet the rigorous demands of the advanced technology nodes faced by our customers.

Leveraging our Expertise. We leverage our broad expertise across our portfolio of advanced materials, materials handling and purification capabilities to create innovative new solutions to address unmet customer needs. For example, our industry-leading post-CMP cleaning chemistry is developed and manufactured by our SCEM segment, packaged with our ultra clean container and connector system made by our AMH segment, and delivered to the process tools through fluid handling systems also made by AMH segment. In the process tool, these chemistries may go through one or several purification systems made by our MC segment to eliminate particles and contaminants. Another example of the results of this strategy is our advanced deposition materials business, where we leverage our ability to synthesize unique molecules, our knowledge of how to purify these materials, and our capability to safely transport these materials and deliver them onto the wafer at the highest throughput. We believe our diverse expertise in areas of increasing importance to semiconductor manufacturers is a competitive advantage.

Comprehensive and Diverse Product Offerings. As semiconductor manufacturers are driving towards more advanced technology nodes, our customers are seeking suppliers who can provide a broad range of reliable, flexible and cost-effective products and materials, as well as the technological and application design expertise necessary to enhancing their productivity, quality, and yield. We believe our comprehensive offering of materials and products creates a competitive advantage as it enables us to meet a broad range of customer needs and provide a single source

of flexible product offerings for semiconductor device and capital equipment manufacturers as they seek to consolidate their supplier relationships and pursue advanced technology nodes.

Global Presence. We have established a global infrastructure of design, manufacturing, distribution, service and technical support facilities to meet the needs of our global customers. We have, for example, expanded our manufacturing operations in Taiwan and South Korea to support our important customers in these regions, established new sales and service offices in China in anticipation of a growing semiconductor manufacturing base in that country, expanded our presence in Singapore to enhance our global and regional management of supply chain and manufacturing processes, and increased our investment in advanced technology centers in Taiwan and South Korea. We service our customer relationships in Asia, Europe and the Middle East predominantly via direct sales and support personnel and to a lesser extent through selected independent sales representatives and distributors.

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Operational Excellence. We have established leading-edge manufacturing plants located in the United States, France, Malaysia, Japan, South Korea and Taiwan that possess the advanced manufacturing capabilities described under Manufacturing below. Our strategy is to develop our advanced manufacturing capabilities into a competitive advantage with our customers by focusing on the following priorities:

- use of manufacturing equipment and facilities incorporating leading-edge technology including advanced cleanroom and cleaning procedures;
- implementation of standardized manufacturing systems stressing optimization of equipment effectiveness, predictive maintenance, and direct labor productivity;
- implementation of automated quality systems that provide both process monitoring and process control throughout the manufacturing process as well as predictive quality data to mitigate against potential quality excursions;
- implementation of supply chain management systems that assure a reliable and responsive supply of high-quality raw materials;
- conduct of manufacturing operations to assure the safety of our employees and of the individuals using our products; and
- maintaining an agile manufacturing organization that is capable of rapid design and development of prototypes of new and derivative products, as well as quickly responding to customer feedback concerning prototypes and that has the ability to quickly commercialize and ramp production of prototypes accepted by our customers.

Strong Relationships with Broad Customer Base. We have strong relationships with our customers, which include leading semiconductor manufacturers, original equipment manufacturers (OEMs), and semiconductor materials suppliers. These relationships provide us with significant collaboration opportunities at the product design stage, which facilitate our ability to introduce new products and applications. For example, we work with our key customers in the development of advanced manufacturing processes to identify and respond to their requests for current and future generations of products for emerging applications requiring cleaner materials, as well as systems that maintain the integrity and stability of materials during transport through the manufacturing process. We believe that our large customer base will continue to be an important source of new product development opportunities. Due to the specialized nature of our products, manufacturing complexity, qualification requirements in customers' fabrication processes, high customer re-formulation and qualification change costs, and extensive proprietary products, we believe our supply position with our customers is strong.

Adjacent Markets. We leverage our expertise in the semiconductor industry by developing products for other industries that employ similar technologies and production processes and that utilize materials integrity management, high-purity fluids and integrated dispense systems. For example, outside of the semiconductor industry, our products are used in manufacturing processes for flat panel displays, high-purity chemicals, solar cells, optical magnetic storage devices and products for life sciences. We plan to continue to identify and develop products that address needs in adjacent markets. We believe that by utilizing our technology to provide manufacturing solutions across multiple industries, we are able to increase the total available market for our products and reduce, to an extent, our exposure to the cyclicality of any particular market.

Strategic Acquisitions, Partnerships and Related Transactions. We will continue to pursue strategic acquisitions and business partnerships that enable us to address gaps in our product offerings, secure new customers, diversify into complementary product markets, broaden our technological capabilities and product offerings and achieve benefits of increased scale. The ATMI acquisition is an example of this strategy, bringing a whole new portfolio of technologies and materials products to serve our semiconductor customers. Further, as the dynamics of the markets that we serve shift, we will reevaluate our existing businesses and in the event that we conclude that a business is not able to provide value-added solutions to its markets in a manner that contributes to achieving our financial objectives, we expect to restructure or replace that business. Finally, we are continuously evaluating opportunities for strategic alliances, such as the strategic alliance with Enthone, joint development programs and collaborative marketing efforts with key customers and other industry leaders.

OUR SEGMENTS

As discussed, our business is organized and operated in three operating segments which align with the key elements of the advanced semiconductor manufacturing ecosystem: Specialty Chemicals and Engineered Materials (SCEM);

Advanced Materials Handling (AMH); and Microcontamination Control (MC). The Company leverages its expertise from these three segments to create new and increasingly integrated solutions for its customers. The following is a detailed description of our three segments:

SPECIALTY CHEMICALS AND ENGINEERED MATERIALS SEGMENT

The SCEM segment provides high-performance and high-purity process chemistries, gases, and materials and safe and efficient delivery systems to support semiconductor and other advanced manufacturing processes. Utilized in critical semiconductor manufacturing processes such as deposition, cleaning, and integration of complex materials, these products enable enhanced device performance. When used in conjunction with products from our MC and AMH segments, these materials provide unique solutions to advance semiconductor manufacturing processes.

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Specialty Gas Products. Our specialty gas solutions provide advanced safety and process capabilities to semiconductor manufacturers. Our SDS cylinders store and deliver hazardous gases, such as arsine, phosphine, germanium and boron trifluoride, at sub-atmospheric pressure through the use of our proprietary carbon-based adsorbent materials. These products minimize potential leaks during transportation and use, providing significant safety and environmental improvements over traditional high-pressure cylinders, and allow more process gas to be stored in the cylinder, providing significantly higher rates of productivity than traditional methods of gas delivery. New generations of SDS products further dramatically increase the gas storage capacity, reducing tool down time and, therefore, resulting in significant cost savings for our customers. We also offer VAC, a complementary technology to SDS where select implant gases are stored under high pressure but delivered sub-atmospherically.

Specialty Materials Products. Specialty materials products are made from specialized graphite, silicon carbide and/or a variety of unique, high purity coatings and serve as critical components in semiconductor manufacturing equipment at various stages of the semiconductor manufacturing process, including dry or plasma etch, chemical vapor deposition and ion implant. Our POCO® premium graphite is used to make precision consumable electrodes for electrical discharge machining, hot glass contact materials for use in glass product manufacturing and forming, and a number of graphite consumable products for various industrial applications, including aerospace, optical, medical devices and printing. Our high-performance specialty coatings, such as our Pegasus™ coatings, provide corrosion and erosion resistance and desired conductivity, minimize particle generation and prevent contamination on critical components used in semiconductor and other high-technology manufacturing operations.

Advanced Deposition Materials Products. Our advanced deposition materials include advanced liquid, gaseous and solid precursors which are incorporated in chemical vapor deposition (CVD) and atomic layer deposition (ALD) processes by the semiconductor industry, such as our UltraPur™ 4MS and UltraPur™ TEOS products. We offer containers that allow for reliable storage and delivery of low volatility solid and liquid precursors required in ALD processes. When combined with our proprietary corrosion resistant coatings and filtration solutions from our MC segment, our advanced deposition materials enable the industry’s highest purity levels, resulting in improved device performance.

Surface Preparation and Integration Products. We offer a range of materials used to prepare and integrate the surface of a semiconductor wafer during the manufacturing process. For example, our Viaform® product (a trademark of and exclusively licensed from Enthone Inc. (Enthone), a subsidiary of Alent plc (acquired by Platform Specialty Products Corporation in late 2015)) includes inorganic and proprietary organic molecules that provide the wiring for copper interconnects and allows manufacturers to eliminate processing steps. We also offer CMP cleaning solutions for applications such as semiconductor post-etch residue removal, wafer etching, organics removal, negative resist removal, edge bead removal, and corrosion prevention. Our wet chemistries solutions, combined with filtration solutions from our MC segment and fluid handling solutions from our AMH segment, provide enhanced purity resulting in improved capability and consistency in our customers' processes. Our line of consumable PVA roller brush products are used to clean the wafer following the CMP process and our line of pad conditioners, based on our silicon carbide capabilities, offer unique preparation solutions for each distinct CMP pad application, with significant improvement in CMP pad life.

ADVANCED MATERIALS HANDLING SEGMENT

The AMH segment develops solutions to monitor, protect, transport, and deliver critical liquid chemistries and substrates for a broad set of applications in the semiconductor industry and other high-technology industries. These systems and products improve our customers’ yields by protecting wafers from abrasion, degradation and contamination during manufacturing and transportation and by assuring the consistent, clean and safe delivery of advanced chemicals from the chemical manufacturer to the point-of-use in the semiconductor fab. The effective management and maintenance of the entire fluidics system, from initial production of process chemistry, to transportation and dispensing onto the wafer, is critical to enhance device yield.

Wafer Solutions. We lead the market with our high-volume line of Ultrapak® and Crystalpak® products, for wafers ranging from 100 to 200 mm, which ensure the clean and secure transport of wafers. We also offer a front-opening shipping box, or FOSB, for the transportation and automated interface of 300 mm wafers.

We provide front opening unified pods, or FOUPs, wafer transport and process carriers and standard mechanical interface pods, or SMIF pods, which meet a spectrum of industry standard wafer handling needs, in sizes up to

300mm. These microenvironment products safely and accurately deliver wafers to the various process fabrication steps and are optimized with filtration products from our MC segment to ensure the purest ambient environment around the wafer.

Chemical Containers. We produce a wide range of flexible packaging and polymer containers that chemical companies use to ship process chemistries to semiconductor fabs. Our packaging ensures the purity of the chemistry during transportation to enhance yields for the fab. We optimize the compatibility and performance of these products on chemistries through close collaboration with our SCEM segment. We have a broad portfolio of packaging products, from low-volume containers to transport high-value photoresist chemistries, such as our NOWPak® products, to large intermediate bulk containers, or IBCs, for high volume chemical consumption, such as our FluoroPure® products.

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Fluidics. We are a leader in high-purity fluid transfer products such as valves, fittings, tubing, pipe, custom fabricated products and associated connection systems, such as our PrimeLock® connections, for high-purity chemical applications. Our comprehensive product line provides our semiconductor manufacturers, process tool makers and chemical customers with a single-source provider for their process chemical management needs throughout the manufacturing process.

Our patented digital valve control technology improves chemical uniformity on wafers and improves ease of optimized system operation. Our IntelliGen® integrated high-precision liquid dispense systems enable the uniform application of advanced chemistries during the wafer fabrication process, integrating our valve control and filter device technologies from our MC segment, so that filtering and dispensing of photochemicals can occur at different rates, conserving high-value chemistry and reducing defects on wafers.

The AMH segment collaborates closely with the SCEM segment in developing products that are compatible with advanced chemistries to enhance yield, while integrating liquid filtration technology from our MC segment to deliver the most consistent, defect-free chemistry.

MICROCONTAMINATION CONTROL SEGMENT

The MC segment offers solutions to purify critical liquid chemistries and gases used in semiconductor manufacturing processes and other high-technology industries. The design and performance of our liquid chemistry and gas filtration and purification products are critical to the semiconductor manufacturing process because they directly reduce defects and improve manufacturing yield. Our proprietary filters remove chemical and nanometer-sized contaminants and bubbles from the different fluids and gases used in the manufacturing process, including photolithography, deposition, planarization and surface etching and cleaning. Our products prevent defects that could result contamination altering the physical and electrical properties of our customers' products.

Liquid Microcontamination Control Products. We offer a variety of unique products that are optimized to control contaminants in our customers' liquid processes. Our Torrento® series of filters is an example of one line of our products used in leading-edge applications for the filtration of aggressive acid and base chemistries for both semiconductor fabs as well as specialty chemical manufacturers including our SCEM segment. Our Impact® series of filters are used in point-of-use photochemical dispense applications, including those provided by our AMH segment, where the delivery of superior flow rate performance and reduced microbubble formation is critical.

Gas Microcontamination Control Products. Our metal filters, such as stainless steel and nickel filters, reduce out gassing and improve corrosion resistance. Our purifiers chemically react with and absorb contaminants, such as oxygen and water, to prevent contamination, and our vent diffusers reduce particle contamination and processing cycle times. Our GateKeeper® gas purifiers leverage technology developed from our SCEM segment and effectively remove gaseous contaminants down to part-per-trillion levels. Our Chambergard™ gas diffusers provide semiconductor equipment manufacturers with the capability to rapidly vent their tools to atmosphere without adding particles to the wafers under process.

Other products. We also offer our eVOLV™ wet chemical process to recycle electronic waste and recover precious metals and other high-value materials from discarded printed circuit boards and semiconductor chips.

OUR CUSTOMERS AND MARKETS

Our most significant customers include semiconductor device manufacturers, OEMs that provide equipment to semiconductor device manufacturers, gas and chemical manufacturing companies, leading wafer grower companies and manufacturers of high-precision electronics. We also sell our products to flat panel display OEMs, materials suppliers and manufacturers, primarily in in Japan, Korea, China and other parts of Asia.

In our other high-technology markets, our customers include manufacturers and suppliers in the solar and life science industries and, for our Poco Graphite products, electrical discharge machining customers, glass and glass container manufacturers, aerospace manufacturers and manufacturers of biomedical implantation devices.

In 2016, 2015 and 2014, net sales to our top ten customers accounted for 45%, 44% and 42%, respectively, of combined net sales. In 2016, 2015 and 2014, one customer, Taiwan Semiconductor Manufacturing Company Limited, accounted for $161.9 million, $134.1 million and $130.9 million of net sales, respectively, or approximately 14%, 12% and 14% of our net sales, respectively, including sales from each of our three reporting segments. International net sales represented 78%, 77% and 75%, respectively, of net sales in 2016, 2015 and 2014. Approximately 2,300

customers purchased products from us during 2016.

We may enter into supply agreements with our customers. These agreements generally have a term of one to three years, but do not contain any long-term purchase commitments. Instead, we work closely with our customers to develop non-binding forecasts of the future volume of orders. However, customers may cancel their orders, change production quantities from forecasted volumes or delay production for a number of reasons beyond our control.

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SALES, MARKETING AND SUPPORT

We sell our products worldwide, primarily through our direct sales force and strategic independent distributors located in all major semiconductor markets. Independent distributors are also used in other semiconductor market territories and for specific market segments. As of December 31, 2016, our sales and marketing force consisted of 478 employees worldwide.

Our unique capabilities and long-standing industry relationships have provided us with the opportunity for significant collaboration with our customers at the product design stage, which has facilitated our ability to introduce new materials and new solutions that meet our customers' needs. We are constantly identifying for our customers a variety of materials, purification and process control challenges that may be addressed by our products. Our sales representatives provide our customers with worldwide support and information about our products and materials.

We believe that our technical support services are important to our sales and marketing efforts. These services include assisting in defining a customer's needs, evaluating alternative products and materials, designing a specific system to perform the desired operation, training users and assisting customers in compliance with relevant government regulations. Additionally, our field applications engineers, located in the United States and approximately ten other countries, work directly with our customers on product qualification and process improvements in their facilities. We maintain a network of service centers, applications laboratories and technology centers located in all key markets internationally and in the United States to support our products and our customers with their advanced development needs, provide local technical service and ensure fast turnaround time.

COMPETITION

The market for our products is highly competitive. While price is an important factor, we compete primarily on the basis of the following factors:

historical customer relationships;
technical expertise;
product quality and performance;
total cost of ownership;
customer service and support;
breadth of product line;
breadth of geographic presence;
advanced manufacturing capabilities; and
after-sales service.

We believe that we compete favorably with respect to all of the factors listed above, but there are no assurances that we will continue to do so. We believe that our key competitive strengths include our broad product line, our strong research and development infrastructure and investment, our manufacturing excellence, our advanced quality control systems, the low total cost of ownership of our products, our ability to provide our customers with quick order fulfillment and our applications expertise in semiconductor manufacturing processes. However, our competitive position varies depending on the market segment and specific product areas within these segments. While we have longstanding relationships with a number of semiconductor and other electronic device manufacturers, we also face significant competition from companies that also have longstanding relationships with other semiconductor and electronic device manufacturers and, as a result, have been able to have their products specified by those customers for use in manufacturers' fabrication facilities.

The competitive landscape is varied, from multinational companies to small regional, narrow-portfolio focused companies. Overall, industry trends are indicating a shift to localized, cost-competitive and consolidated supply chains.

Because of the unique breadth of our capabilities, we believe that there are no global competitors that compete with us across the full range of our product offerings. Many of our competitors are local companies that participate in only a few products or in specific geographies. While there are other larger, broad-based materials suppliers, many are concentrated in specific product areas, such as filtration, specialty chemicals or materials handling. Key competitors include Pall Corporation (which was acquired by Danaher Corporation in 2015), Shin-Etsu Polymer Co., Ltd., Gemu Valves, Inc., Tokyo Keiso Co., Ltd., Mersen (France), Versum Materials, Inc., DuPont Electronic Technologies, Dow Chemical Company (including Rohm and Haas), Air Liquide, Praxair, Inc., SAES Pure Gas, Inc., Donaldson Company, Inc. and Parker Hannifin Corp.

ENGINEERING, RESEARCH AND DEVELOPMENT

We believe that technology is important to success in each of our businesses, and we plan to continue to devote significant resources to engineering, research and development (R&D), balancing efforts between shorter-term market needs and longer-term investments. Our aggregate engineering, research and development expenses in 2016, 2015 and 2014 were $107.0 million, $105.9 million and $87.7 million, respectively. As of December 31, 2016, we had 436 employees in engineering, research and development. We have supplemented and may continue to supplement our internal research and development efforts by licensing technology from unaffiliated third parties and/or acquiring rights with respect to products incorporating externally owned technologies. Our R&D expenses consist of personnel and other direct and indirect costs for internally funded project development, including the use of outside service providers.

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We believe we have a rich pipeline of development projects. For example, our engineering, research and development efforts have been focusing on growth opportunities in areas such as bulk photochemical filtration, new boron mixtures for ion implant, new solid precursors for deposition, specialty coatings for key applications and new CMP pad conditioners. Our engineering, research and development efforts are directed toward developing and improving our technology platforms for semiconductor and advanced processing applications and identifying and developing products for new applications, often working directly with our customers to address their particular needs.

We have engineering, research and development capabilities in California, Connecticut, Minnesota, Massachusetts, Colorado, Texas, Japan, Korea, Taiwan, France, China, Singapore and Malaysia to meet the global needs of our customers. We use sophisticated methodologies to research, develop and characterize our materials and products. Our capabilities to test and characterize our materials and products are focused on continuously reducing risks and threats to the integrity of the critical materials that our customers use in their manufacturing processes.

We participate in Semiconductor Equipment and Materials International (SEMI®), an association of semiconductor equipment suppliers, and leading industry consortia, such as the Interuniversity Microelectronics Centre (imec®) and Semiconductor Manufacturing Technology (SEMATECH), including its Global 450 Consortium (G450C). For example, we have participated with SEMI to develop specifications for the next generation of wafer shipping and handling products and we have worked with a major customer to develop specific wafer handling products for 450 mm wafers.

PATENTS AND OTHER INTELLECTUAL PROPERTY RIGHTS

We believe that, while intellectual property is important for our business, our success also depends upon close customer contact, innovation, technological expertise, responsiveness and worldwide distribution. Additionally, while our intellectual property may delay or deter a competitor in offering a competing product, we do not believe that our portfolio functions as a barrier to entry for any of our competitors. As of December 31, 2016, our combined patent portfolio included 639 current U.S. patents, 1,364 current foreign patents, including counterparts to U.S. filings, 281 pending U.S. patent applications, 86 pending filings under the Patent Cooperation Treaty not yet nationalized and 943 pending foreign patent applications. We rely on a combination of patent, copyright, trademark and trade secret laws and license agreements to establish and protect our proprietary rights. We refresh our intellectual property on an ongoing basis through continued innovation. While we license and will continue to license technology used in the manufacture and distribution of products from third parties, we do not consider any particular patent or license to be material to our business.

We vigorously protect and defend our intellectual property. We require each of our employees, including our executive officers, to enter into standard agreements pursuant to which the employee agrees to keep confidential all of our proprietary information and to assign to us all inventions made while employed by us. We also require all outside scientific collaborators, sponsored researchers, and other advisors and consultants who are provided confidential information to execute confidentiality agreements upon the commencement of the consulting or collaboration relationship in question. These agreements generally provide that all confidential information developed or made known to the entity or individual during the course of the entity’s or individual’s relationship with the Company is to be kept confidential and not disclosed to third parties except in specific limited circumstances.

MANUFACTURING

Our customers rely on our products and materials to assure the integrity of the critical materials used in their manufacturing processes by providing dimensional precision and stability, purity, cleanliness and consistent performance. Our ability to meet our customers’ expectations, combined with our substantial investments in worldwide manufacturing capacity, position us to respond to the increasing demands of the semiconductor industry and other industries that require yield-enhancing materials and solutions.

To meet our customer needs worldwide, we have established an extensive global manufacturing network with manufacturing and coating facilities in the United States, Japan, Taiwan, France, Malaysia and South Korea. Because we work in an industry where contamination control is paramount, we maintain Class 100 to Class 10,000 cleanrooms for manufacturing and assembly. We believe that our worldwide manufacturing operations and our advanced manufacturing capabilities are important competitive advantages. Our advanced manufacturing capabilities include:

injection molding; specialty coating capabilities;

extrusion;
blow molding;
rotational molding;
compression molding;
membrane casting;
cartridge manufacturing;
graphite synthesis;
machining;
assembly;
tool making;
high-purity materials packaging; and
gas delivery systems.

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We have made significant investments in systems and equipment to create innovative products and tool designs, including metrology and 3D printing capabilities for rapid analysis and production prototype of products.
In addition, we use contract manufacturers for certain of our gas microcontamination control and other electronic materials products both in the U.S. and Asia.

RAW MATERIALS

Our products are made from a wide variety of raw materials that are generally available from multiple sources of supply. However, while we seek to have several sources of supply for all of these materials, certain materials included in our products, such as certain liquid filtration membranes in our MC segment, petroleum coke in our specialty materials products in our SCEM segment and polymer resins in our microenvironment products in our AMH segment are obtained from a single source or a limited group of suppliers. Additionally, our specialty gas products in our SCEM segment use a broad range of specialty and commodity chemicals and polymers in the development of its products, including parts and sub-assemblies that are obtained from a single supplier or a limited number of suppliers, or from suppliers in a single country. We have entered into multi-year supply agreements with a number of suppliers for the purchase of raw materials in the interest of supply assurance and to control costs.
Although the Company seeks to reduce dependence on these sole and limited source suppliers, the partial or complete loss of these sources could interrupt our manufacturing operations and result in an adverse effect on the Company's results of operations. Furthermore, a significant increase in the price of one or more of these components could also adversely affect the Company's results of operations.

GOVERNMENTAL REGULATION

Our operations are subject to federal, state and local regulatory requirements relating to environmental, waste management and health and safety matters, including measures relating to the release, use, storage, treatment, transportation, discharge, disposal and remediation of contaminants, hazardous substances and wastes, as well as practices and procedures applicable to the construction and operation of our plants. There can be no assurance that we will not incur material costs and liabilities or that our past or future operations will not result in exposure to injury or claims of injury by employees or the public. Although some risk of costs and liabilities related to these matters is inherent in our business, as with many similar businesses, we believe that our business is operated in substantial compliance with applicable regulations. However, new, modified or more stringent requirements or enforcement policies could be adopted, which could adversely affect us. While we expect that capital expenditures will be necessary to assure that any new manufacturing facility is in compliance with environmental and health and safety laws, we do not expect these expenditures to be material.

EMPLOYEES

As of December 31, 2016, we had 3,542 full-time employees, as well as approximately 185 temporary and part-time employees. Of our employees, 436 work in engineering, research and development and 478 work in sales and marketing. Given the variability of business cycles in the semiconductor industry and the quick response time required by our customers, it is critical that we be able to quickly adjust the size of our production staff to maximize efficiency. Therefore, we use skilled temporary labor as required.
None of our employees are represented by a labor union or covered by a collective bargaining agreement other than statutorily mandated programs in certain European countries.

FINANCIAL INFORMATION ABOUT OUR OPERATING SEGMENTS

For a discussion of revenue and segment profitability with respect to each of our reporting segments, see Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations - Segment Analysis below, which is incorporated herein by reference. See also note 15 to our consolidated financial statements. Approximately 78%, 77% and 75% of our net sales were made to customers outside North America in 2016, 2015 and 2014, respectively. Industry and geographic segment information is also discussed in note 15 to the Entegris, Inc. consolidated financial statements included in response to Item 8 below, which is incorporated herein by reference.

OUR HISTORY

The Company was incorporated in Delaware on March 17, 2005 in connection with a merger between Entegris, Inc., a Minnesota corporation, and Mykrolis Corporation, a Delaware corporation. On April 30, 2014, the Company acquired ATMI, Inc., a Delaware corporation based in Danbury, CT, referred to throughout this report as ATMI and the ATMI

acquisition. In 2016, Entegris celebrated its 50th year of helping customers solve their critical materials challenges and enhance their manufacturing yields, tracing its corporate origins back to Fluoroware, Inc., which began operating in 1966.

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AVAILABLE INFORMATION

Our Internet address is www.entegris.com. On this web site, under the “Investors-Financial Information-SEC Filings” section, we post the following filings as soon as reasonably practicable after they are electronically filed with, or furnished to, the U.S. Securities and Exchange Commission (SEC): our annual, quarterly, and current reports on Forms 10-K, 10-Q, and 8-K; our proxy statements; any amendments to those reports or statements, and Form SD. All such filings are available on our web site free of charge. The SEC also maintains a web site (www.sec.gov) that contains reports, proxy and information statements, and other information regarding issuers that file electronically with the SEC. The content on our website, and any other website, as referred to in this Form 10-K is not incorporated by reference into this Form 10-K unless expressly noted.

Item 1A. Risk Factors.

You should carefully consider the following risks and other information in this Annual Report on Form 10-K in evaluating us and our common stock.

Any of the following risks could materially and adversely affect our financial condition, results of operations or cash flows. Our operations could be affected by various risks, many of which are beyond our control. Based on current information, we believe that the following list identifies the most significant risk factors that could affect our financial condition, results of operations or cash flows. There may be additional risks and uncertainties that adversely affect our financial condition, results of operations or cash flows in the future that are not presently known, are not currently believed to be material, or are not identified below because they are common to all businesses. Past financial performance may not be a reliable indicator of future performance and historical trends should not be used to anticipate results or trends in future periods. For more information, see “Cautionary Statement” in Item 7 of this Annual Report on Form 10-K.

Risks Relating to our Business and Industry

THE SEMICONDUCTOR INDUSTRY HAS HISTORICALLY BEEN HIGHLY CYCLICAL AND INDUSTRY DOWNTURNS COULD REDUCE OUR NET SALES AND PROFITS.

Our business depends on the purchasing patterns of semiconductor manufacturers, which, in turn, depend on the current and anticipated demand for semiconductors and products utilizing semiconductors. The semiconductor industry has historically been highly cyclical with periodic significant downturns, which often have resulted in significantly decreased expenditures by semiconductor manufacturers. Even moderate cyclicality can cause our operating results to fluctuate significantly from one period to the next. We have in the past experienced significant revenue deterioration and incurred significant operating losses due to a severe downturn in the semiconductor industry. We are unable to predict the ultimate duration and severity of future downturns for the semiconductor industry.

Furthermore, in periods of reduced demand, we must continue to maintain a satisfactory level of engineering, research and development expenditures, continue to invest in our infrastructure and maintain the ability to respond to any significant increases in demand, if they occur. Changes in order patterns have a more immediate impact on our revenues because we typically do not have significant backlog. We expect the semiconductor industry to continue to be cyclical. During downturns our revenue is reduced and there is likely to be an increase in pricing pressure and shifts in product and customer mix, all of which may affect gross margin and net income. Such fluctuations in our results could cause our stock price to decline significantly. We believe that period-to-period comparisons of our results of operations may not be meaningful, and you should not rely upon them as indicators of our future performance.

In addition, there may not be new high-opportunity applications to drive growth in the semiconductor industry, as was the case in earlier market cycles. Accordingly, the semiconductor industry may experience lower growth rates during any recovery cycle than has historically been the case and its longer-term performance may reflect this lower growth rate.

WE MAY BE UNABLE TO MEET DEMAND IN RESPONSE TO THE SEMICONDUCTOR INDUSTRY’S RAPID DEMAND SHIFTS OR ACCURATELY FORECAST DEMAND FOR OUR PRODUCTS, WHICH COULD CAUSE A REDUCTION IN OUR MARKET SHARE AND ADVERSELY AFFECT OUR BUSINESS, FINANCIAL CONDITION AND OPERATING RESULTS.

Our ability to increase sales of our products, particularly our capital equipment products, depends in part upon our ability to ramp up our manufacturing capacity for such products in a timely manner, often in as little as a few months, and to quickly mobilize our supply chain. If we are unable to expand our manufacturing capacity on a timely basis or manage such expansion effectively, our customers could seek such products from other suppliers, and our market share could be reduced. Because demand shifts in the semiconductor industry are rapid and difficult to foresee, we may not be able to increase capacity quickly enough to respond to any such increase in demand.

We typically operate our business on a just-in-time shipment basis with a modest level of backlog and we order supplies and plan production based on internal forecasts of demand. We have, in the past, and may again in the future, fail to accurately forecast

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demand for our products, in terms of both volume and product type. This has led to, and may in the future lead to, delays in product shipments, disappointment of customer expectations, or, alternatively, an increased risk of excess inventory and of inventory obsolescence. If we fail to accurately forecast demand for our products, our business, financial condition and operating results could be materially and adversely affected.

IF WE ARE UNABLE TO CONTINUE OUR TECHNOLOGICAL INNOVATION AND INTRODUCTION OF NEW PRODUCTS, WE WILL NOT BE ABLE TO SUCCESSFULLY COMPETE.

The semiconductor industry is subject to rapid technological change, changing customer requirements and frequent new product introductions. As a result, the life cycle of our products is difficult to determine. We believe that our future success will depend upon our ability to continue to develop mission-critical solutions to maximize our customers' manufacturing yields and enable higher performance of end-market materials or devices. This requires that we successfully anticipate and respond to technological changes in manufacturing processes in a cost-effective and timely manner. A failure to develop new products or enhancements to our existing products or the inability to timely manufacture and ship these products or enhancements in sufficient volume could harm our business prospects and significantly reduce our sales. In addition, if new products have reliability or quality problems, we may experience reduced orders, higher manufacturing costs, delays in acceptance and payment, additional service and warranty expense, and damage to our reputation.

OUR SALES ARE CONCENTRATED ON A SMALL NUMBER OF KEY CUSTOMERS AND, THEREFORE, OUR NET SALES AND PROFITABILITY MAY MATERIALLY DECLINE IF ONE OR MORE OF OUR KEY CUSTOMERS DOES NOT CONTINUE TO PURCHASE OUR EXISTING AND NEW PRODUCTS.

We depend and expect to continue to depend on a limited number of customers for a large portion of our business, and changes in several customers' orders could have a significant impact on our operating results. Our top ten customers accounted for 45%, 44% and 42% of our net sales in 2016, 2015 and 2014, respectively. Our net sales and profitability may decline significantly if any one of our key customers decides to purchase significantly less from us or to terminate its relationship with us entirely. We could also lose our key customers or significant sales to our key customers because of factors beyond our control, such as a significant disruption in our customers' businesses generally or in a specific product line, a change in the manufacturing sourcing policies or practices of these customers or the timing of customer inventory adjustments. For example, our SCEM segment customers' and their customers' aggressive management of inventory has adversely affected its results of operations in the past and may adversely affect future results of operations. Given the generally fixed nature of our costs, if our customers delay or cancel their orders or reduce ordered quantities from forecasted volumes, we may be required to hold inventory for longer than anticipated, our profitability may be reduced, our ability to fund our operations may be restricted, our revenue may incur unanticipated reductions or be delayed and our gross margins may decline.

Our customers could stop incorporating our products into their products with limited advance notice to us and suffer little or no penalty for doing so. The semiconductor industry is currently undergoing consolidation, with a number of major firms merging or being acquired. If any of our customers merge or are acquired, we may experience lower overall sales from the merged or surviving companies. Because we develop long-term relationships with key customers in the product areas we serve, and because we have a long product design and development cycle for most new products, which are then subject to lengthy customer product qualification periods, we may be unable to quickly replace these customers, if at all.

COMPETITION FROM NEW OR EXISTING COMPANIES COULD HARM OUR FINANCIAL CONDITION, RESULTS OF OPERATIONS AND CASH FLOW.

We operate in a highly competitive industry. We compete against many domestic and foreign companies that have substantially greater manufacturing, financial, research and development and marketing resources than we do. In addition, some of our competitors may have better-established relationships with our existing customers than we do, which may enable them to have their products specified for use more frequently and more quickly by these customers. We also face competition from the manufacturing operations of our current and potential customers, who continually evaluate the benefits of internal manufacturing versus outsourcing. As more OEMs dispose of their manufacturing operations and increase the outsourcing of their products to liquid and gas delivery system and other component companies, we may face increasing competitive pressures to grow our business and portfolio of products in order to

maintain our market share. If we are unable to maintain our competitive position, we could experience downward pressure on prices, fewer customer orders, reduced margins, the inability to take advantage of new business opportunities and a loss of market share, which could have a material adverse effect on our results of operations. Further, we expect that existing and new competitors will improve the design of their existing products and will introduce new products with enhanced performance characteristics. The introduction of new products or more efficient production of existing products by our competitors could diminish our market share and increase pricing pressure on our products. Further, if we do not respond to pressure from our customers to lower prices, shorten delivery times and enhance product capability, we could lose customers or orders.

IF WE ARE UNABLE TO OBTAIN FUTURE BUSINESS OPPORTUNITIES ASSOCIATED WITH NEW PRODUCT INITIATIVES AND RELATED CAPITAL INVESTMENT PROJECTS, OUR REVENUE AND PROFITABILITY MAY DECLINE.

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In the semiconductor market, while the development period for a product can be very long, the first company to introduce an innovative product meeting an identified customer need will often have a significant advantage over offerings of competitive products. For this reason, we may make significant cash expenditures to engineer, research, develop and market new products and make significant capital investments in technology and manufacturing capacity in advance of future business developing and without any purchase commitment from our customers. For example, we incurred $107.0 million, $105.9 million and $87.7 million for engineering, research and development expense in 2016, 2015 and 2014, respectively.

Following development, it may take a number of years for sales of a new product to reach a substantial level, if ever. A product concept may never progress beyond the development stage or may only achieve limited acceptance in the marketplace. If this occurs, we do not receive a direct return on our expenditures, we may not realize any indirect benefits, we may lose market share and our revenue and profitability may decline. For example, while we made significant cash expenditures and capital investments to develop the capability to manufacture shippers and FOUPs for 450 mm wafers, the size and timing of the development of the market for 450 mm wafer shippers and FOUPs remains uncertain. As major semiconductor manufacturers have delayed the implementation of 450 mm manufacturing and others have announced that they would not initiate 450 mm manufacturing until after 2020, we cannot assure you that we will be able to successfully sell significant quantities of our 450 mm shipper and FOUP products or realize a return on our investment in the near term or ever.

WE MAY ACQUIRE OTHER BUSINESSES, FORM JOINT VENTURES OR DIVEST BUSINESSES THAT COULD NEGATIVELY AFFECT OUR PROFITABILITY, REQUIRE US TO INCUR DEBT AND DILUTE YOUR OWNERSHIP OF THE COMPANY.

As part of our business strategy and as we have in the past, we expect to continue to address gaps in our product offerings, diversify into complementary product markets or pursue additional technology and customers through acquisitions, joint ventures or other types of collaborations. We also expect to adjust our portfolio of businesses to meet our ongoing strategic objectives. As a result, we may enter markets in which we have no or limited prior experience and may encounter difficulties in divesting businesses that no longer meet our objectives. Competition for acquiring attractive businesses in our industry is substantial. In executing this part of our business strategy, we may experience difficulty in identifying suitable acquisition candidates or in completing selected transactions at appropriate valuations. Alternatively, we may be required to undertake multiple transactions at the same time in order to take advantage of acquisition opportunities that do arise. This could strain our ability to effectively execute and integrate these transactions. We would consider a variety of financing alternatives for each acquisition which could include borrowing funds, reducing our cash balances or issuing additional shares of our common stock to complete an acquisition. This could impair our liquidity and dilute your ownership of the Company. Further, we may not be able to successfully integrate any acquisitions that we do make into our existing business operations, and we could assume unknown or contingent liabilities or experience negative effects on our reported results of operations from dilutive results from operations and/or from future potential impairment of acquired assets, including goodwill, related to future acquisitions. We may experience difficulties in retaining key employees or customers of an acquired business, and our management’s attention could be diverted from other business issues. We may not identify or complete these transactions in a timely manner, on a cost-effective basis or at all, and we may not realize the benefits of any acquisition or joint venture.

WE MAY NOT EFFECTIVELY PENETRATE NEW MARKETS.

Part of our business strategy is to leverage our expertise in our core competencies for growth in new and adjacent markets, such as photovoltaic cells, LEDs, flat panel displays, lithium ion batteries, magnetic storage devices and life sciences. Our ability to grow our business could be limited if we are unable to execute on this strategy.

WE FACE THE RISK OF PRODUCT LIABILITY CLAIMS AND, IN PARTICULAR, CERTAIN OF OUR PRODUCTS ARE USED TO TRANSPORT TOXIC GASES USED IN THE SEMICONDUCTOR MANUFACTURING PROCESS AND A LEAK COULD RESULT IN SIGNIFICANT HARM AND LIABILITY.

The manufacture and sale of our products involve the risk of product liability claims. In addition, a failure of one of our products at a customer site could interrupt the business operations of the customer. For example, while we believe that our SDS and VAC delivery systems are the safest available in the industry, as with any products involved in the

transport and storage of toxic gases, if a leak were to occur during transport or during storage at our customers' location, serious damage could result including injury or death to any person exposed to those toxic gases creating significant product liability for us. There can be no assurance that our insurance will be adequate to satisfy any such liabilities and our financial results or financial condition could be adversely affected.

LOSS OF OUR KEY PERSONNEL, WHO HAVE SIGNIFICANT EXPERIENCE IN THE SEMICONDUCTOR INDUSTRY AND TECHNOLOGICAL EXPERTISE, COULD HARM OUR BUSINESS, WHILE OUR INABILITY TO ATTRACT AND RETAIN NEW QUALIFIED PERSONNEL COULD INHIBIT OUR ABILITY TO OPERATE AND GROW OUR BUSINESS SUCCESSFULLY.

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Many of our key personnel have significant experience in the semiconductor industry and deep technical expertise. The loss of the services of one or several of our key employees or an inability to attract, train and retain qualified and skilled employees, specifically research and development and engineering personnel, could result in the loss of customers or otherwise inhibit our ability to operate and grow our business successfully. In the past, during downturns in the semiconductor industry, we have had to impose salary reductions on senior employees and freeze or eliminate merit increases in an effort to maintain our financial position. These actions may have an adverse effect on employee loyalty and may make it more difficult for us to attract and retain key personnel.

IF WE ARE UNABLE TO PROTECT OUR INTELLECTUAL PROPERTY AND TECHNOLOGY, IF OUR COMPETITORS WERE TO DEVELOP SIMILAR OR SUPERIOR INTELLECTUAL PROPERTY OR TECHNOLOGY, OR, IF OUR INTELLECTUAL PROPERTY OR TECHNOLOGY VIOLATE THIRD-PARTY RIGHTS, OUR BUSINESS AND PROSPECTS COULD BE HARMED.

Our future success and competitive position depend in part upon our ability to obtain and maintain proprietary technology used in our principal product families. We rely, in part, on patent, trade secret and trademark law to protect that technology. We have obtained a number of patents relating to our products and have filed applications for additional patents. We cannot assure you that any of our pending patent applications will be approved, in key jurisdictions or at all, that we will develop additional proprietary technology that is patentable, that any patents owned by or issued to us will provide us with competitive advantages or that these patents will not be challenged, invalidated, circumvented, and rendered unenforceable or otherwise compromised by third parties. In addition, if we do not obtain intellectual property protection in the international jurisdictions we serve, our competitiveness in these markets could be significantly impaired, which would limit our growth and future revenue. While we routinely enter into confidentiality agreements with our employees and with third parties to protect our proprietary information and technology, these agreements may not be enforceable or they may be breached by such employees or third parties, and we may not have adequate remedies for such breaches. Furthermore, our confidential and proprietary information and technology could be independently developed by or become otherwise known to third parties and third parties could design around our patents.

Competitors may misappropriate our intellectual property, and disputes as to ownership of intellectual property may arise. We may institute litigation in order to enforce our patents, copyrights or other intellectual property rights, to protect our trade secrets, to determine the validity and scope of the proprietary rights of others or to defend against claims of infringement. Such litigation could result in substantial costs and diversion of resources and could negatively affect our sales, profitability and prospects regardless of whether we are able to successfully enforce our rights. For example, in January 2011, we settled multiple patent litigations with Pall Corporation (which was acquired by Danaher Corporation in 2015). We prosecuted and defended these cases vigorously and incurred substantial costs in pursuing them. It may become necessary for us to initiate other costly patent litigation against our competitors in order to protect and/or perfect our intellectual property rights. We cannot predict how any existing or future litigation will be resolved or what its impact will be on us.

Our commercial success depends, in part, on our ability to avoid infringing or misappropriating any patents or other proprietary rights owned by third parties. If we are found to infringe or misappropriate a third party’s patent or other proprietary rights, we could be required to pay damages to such third party, alter our products or processes, obtain a license from the third party or cease activities utilizing such proprietary rights, including making or selling products utilizing such proprietary rights. If we are required to obtain a license from a third party, there can be no assurance that we will be able to do so on commercially favorable terms, if at all.

OUR RESULTS OF OPERATIONS COULD BE ADVERSELY AFFECTED BY CLIMATE CHANGE OR NATURAL CATASTROPHES IN THE LOCATIONS IN WHICH WE, OUR CUSTOMERS OR OUR SUPPLIERS OPERATE, SUCH AS THE MARCH 2011 EARTHQUAKE AND TSUNAMI IN JAPAN AND THE JUNE 2012 WILDFIRES IN COLORADO SPRINGS, COLORADO.

We have manufacturing and other operations in locations subject to natural events such as severe weather and earthquakes that could disrupt operations. In addition, our suppliers and customers also have operations in such locations. A natural disaster that results in a prolonged disruption to our operations, or our customers’ or suppliers’ operations, may adversely affect our results of operations and financial condition. Also, climate change poses both

regulatory and physical risks that could harm our results of operations or affect the way we conduct our businesses. While the March 2011 earthquake and tsunami in Japan did not materially impair manufacturing operations at our Yonezawa, Japan plant and while the June 2012 wildfires did not materially impair manufacturing operations at our Colorado Springs plant, there can be no assurance that future such catastrophes will not impact our manufacturing operations or those of our supply chain partners by disrupting our ability to manufacture and deliver products to our customers, resulting in an adverse impact on our business and results of operations.

WE MAY BE SUBJECT TO INFORMATION TECHNOLOGY SYSTEM FAILURES, NETWORK DISRUPTIONS AND BREACHES IN DATA SECURITY.

Information technology system failures, network disruptions and breaches of data security from cyber-attacks, employee social media use on our computers or through failure of our internet service providers and other cloud computing service providers to

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successfully secure their own systems could disrupt our operations, cause customer communication and order management issues, cause the unintentional disclosure of customer, employee and proprietary information, and cause disruption in our transaction processing, which could affect our reputation and reporting of financial results. While our management has taken steps to address these concerns by implementing network security, hiring personnel and establishing internal control measures, there can be no assurance that a system failure or data security breach will not have a material adverse effect on our financial condition and operating results.

Risks Related to Our Indebtedness

WE HAVE A SUBSTANTIAL AMOUNT OF INDEBTEDNESS, WHICH COULD ADVERSELY AFFECT OUR FINANCIAL HEALTH AND OUR ABILITY TO OBTAIN FINANCING IN THE FUTURE, REACT TO CHANGES IN OUR BUSINESS AND MAKE PAYMENTS ON THE INDEBTEDNESS.

As of December 31, 2016, we have an aggregate principal amount of approximately $594 million of outstanding total indebtedness, comprised of our 6% senior unsecured notes due April 1, 2022 (“Notes”) and our senior secured term loan facility due 2021 (“Term Loan”). In addition, we have approximately $75 million of unutilized capacity under a senior secured asset-based revolving credit facility (“ABL Facility”), which is subject to a borrowing base.

Our high level of debt could have important consequences, including:

- making it more difficult for us to satisfy our obligations with respect to the Notes, the Term Loan and the ABL Facility;
- limiting our ability to obtain additional financing to fund future working capital, capital expenditures, acquisitions or other general corporate requirements;
- requiring a substantial portion of our cash flow to be dedicated to debt service payments instead of other purposes, thereby reducing the amount of cash flow available for working capital, capital expenditures, acquisitions and other general corporate purposes;
- increasing our vulnerability to adverse changes in general economic, industry and competitive conditions;
- exposing us to the risk of increased interest rates as certain of our borrowings, including borrowings under the Term Loan and the ABL Facility include variable interest rates;
- limiting our flexibility in planning for and reacting to changes in the industry in which we compete;
- preventing us from raising funds necessary to repurchase all Notes tendered to us upon the occurrence of certain changes of control, which could constitute a default under the indenture governing the Notes;
- placing us at a disadvantage compared to other, less leveraged competitors or competitors with comparable debt at more favorable interest rates; and
- increasing our cost of borrowing.

In addition, the indenture that governs the Notes and the credit agreements governing our Term Loan and our ABL Facility contain restrictive covenants that will limit our ability to engage in activities that may be in our long-term best interest. Our failure to comply with those covenants could result in an event of default which, if not cured or waived, could result in the acceleration of substantially all of our debt.

DESPITE OUR CURRENT LEVEL OF INDEBTEDNESS, WE MAY STILL BE ABLE TO INCUR SUBSTANTIALLY MORE DEBT, WHICH COULD FURTHER EXACERBATE THE RISKS TO OUR FINANCIAL CONDITION DESCRIBED ABOVE AND PREVENT US FROM FULFILLING OUR OBLIGATIONS UNDER OUR EXISTING INDEBTEDNESS.

We may incur significant additional indebtedness in the future. Although the indenture that governs the Notes and the credit agreements governing our Term Loan and our ABL Facility contain restrictions on the incurrence of additional indebtedness, these restrictions are subject to a number of qualifications and exceptions, such as indebtedness to finance working capital, capital expenditures, investments or acquisitions, or for other purposes, and the additional indebtedness incurred in compliance with these restrictions could be substantial. For example, our Term Loan provides that we have the right to request additional loans and commitments, and to the extent that the aggregate amount of such additional loans and commitments exceeds $225 million, the incurrence thereof will be subject to our secured net leverage ratio being less than a specified ratio, or in the case of unsecured loans or other unsecured debt, or loans or other debt secured by junior liens, our total net leverage ratio being less than a specified ratio. If we incur any additional indebtedness that ranks equally with the Notes, subject to collateral arrangements, the holders of that

debt will be entitled to share ratably with the holders of the Notes and the lenders under the Term Loan and the ABL Facility in any proceeds distributed in connection with any insolvency, liquidation, reorganization, dissolution or other winding up of our Company. These restrictions also will not prevent us from incurring obligations that do not constitute indebtedness. If new debt is added to our current debt levels, the related risks that the Company now faces could intensify.

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WE MAY NOT BE ABLE TO GENERATE SUFFICIENT CASH TO SERVICE OUR INDEBTEDNESS AND MAY BE FORCED TO TAKE OTHER ACTIONS, WHICH MAY NOT BE SUCCESSFUL, TO SATISFY OUR OBLIGATIONS UNDER OUR INDEBTEDNESS.

Our ability to make scheduled payments on or refinance our debt obligations depends on our financial condition and operating performance and the condition of the capital markets, which are subject to prevailing economic, industry and competitive conditions, as well as certain financial, business, legislative, regulatory and other factors beyond our control. We may be unable to maintain a level of cash flow from operating activities sufficient to permit us to pay the principal, premium, if any, and interest on our indebtedness. If our cash flow and capital resources are insufficient to fund our debt service obligations, we could face substantial liquidity problems, be forced to reduce or delay investments and capital expenditures, dispose of material assets or operations, seek additional debt or equity capital or restructure or refinance our indebtedness, and our financial position and results of operations could be materially and adversely affected.

Any refinancing of our debt could be at higher interest rates and may require us to comply with more onerous covenants, which could further restrict our business operations. We may not be able to effect any such alternative measures on commercially reasonable terms or at all and, even if successful, those alternative actions may not allow us to meet our scheduled debt service obligations. Our ability to dispose of assets and use the proceeds from those dispositions is restricted by the agreements governing our indebtedness and we may not be able to consummate those dispositions or to obtain proceeds in an amount sufficient to meet any debt service obligations then due.

If we cannot make scheduled payments on our debt, we will be in default and holders of the Notes could declare all outstanding principal and interest to be due and payable, the lenders under the Term Loan and the ABL Facility could terminate their commitments to loan money, our secured lenders could foreclose against the assets securing their borrowings and we could be forced into bankruptcy or liquidation.

THE TERMS OF OUR CREDIT AGREEMENTS GOVERNING OUR TERM LOAN AND OUR ABL FACILITY AND THE INDENTURE GOVERNING THE NOTES RESTRICT OUR CURRENT AND FUTURE OPERATIONS, PARTICULARLY OUR ABILITY TO RESPOND TO CHANGES OR TO TAKE CERTAIN ACTIONS.

The credit agreements governing our Term Loan and our ABL Facility and the indenture that governs the Notes contain a number of restrictive covenants that impose significant operating and financial restrictions on us and may limit our ability to engage in acts that may be in our long-term best interest, including restrictions on our ability to:

- incur certain liens;
- incur additional indebtedness and guarantee indebtedness;
- pay dividends or make other distributions in respect of, or repurchase or redeem, capital stock;
- prepay, redeem or repurchase certain debt;
- make investments, loans, advances and acquisitions;
- sell or otherwise dispose of assets, including capital stock of our subsidiaries;
- enter into transactions with affiliates;
- alter the businesses we conduct;
- enter into agreements restricting our subsidiaries' ability to pay dividends; and
- consolidate, merge or sell all or substantially all of our assets.

In addition, the restrictive covenants in the credit agreement governing our ABL Facility may, at certain times, require us to maintain a fixed charge coverage ratio. Our ability to meet this financial ratio can be affected by events beyond our control.

Our failure to comply with these covenants could result in an event of default that, if not cured or waived, could result in the acceleration of some or all of our indebtedness, which could lead to bankruptcy, reorganization or insolvency. These restrictions may affect our ability to grow in accordance with our plans and could adversely affect our ability to:

- finance our operations;
- make needed capital expenditures;
- make strategic acquisitions or investments or enter into joint ventures;

- withstand a future downturn in our business, the industry or the economy in general;
- compete effectively and engage in business activities, including future opportunities, that may be in our best interest; and
- plan for or react to market conditions or otherwise execute our business strategies.

A LOWERING OR WITHDRAWAL OF THE RATINGS ASSIGNED TO OUR DEBT SECURITIES BY RATING AGENCIES MAY INCREASE OUR FUTURE BORROWING COSTS AND REDUCE OUR ACCESS TO CAPITAL.

The Notes have been rated by Standard & Poor's and Moody's. There is no assurance that such credit ratings will remain in effect for any given period of time. Rating agencies also may lower, suspend or withdraw ratings on the Notes or our other debt in the

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future. Any lowering, suspension or withdrawal of such ratings may have an adverse effect on the market prices or marketability of our indebtedness and make it more difficult or more expensive for us to obtain additional debt financing.

Manufacturing Risks

OUR DEPENDENCE ON SINGLE AND LIMITED SOURCE SUPPLIERS COULD AFFECT OUR ABILITY TO MANUFACTURE OUR PRODUCTS.

We rely on single or limited source suppliers for some plastic polymers, filtration membranes, petroleum coke and certain other materials, such as chemicals and gases, which are critical to the manufacturing of our products. At times, we have experienced a limited supply of certain raw material polymers as well as the need to substitute polymers, resulting in delays, increased costs and risks associated with qualifying products made from such new polymers with our customers. An industry-wide increase in demand for these polymers or the discontinuation of such polymers could affect our ability to acquire sufficient quantities. If we are unable to obtain an adequate quantity of such supplies, our manufacturing operations may be interrupted. Obtaining alternative sources would likely result in increased costs and shipping delays, which could decrease profitability and damage our relationships with current and potential customers. Prices for polymers can vary widely. In a volatile oil price environment, some suppliers have added and may in the future add surcharges to the prices of the polymers we purchase. While we have long-term arrangements with certain key suppliers of polymers that fix our price for purchases up to specified quantities, if our polymer requirements exceed the quantities specified, we could be exposed to higher material costs. If the cost of polymers increases and we are unable to correspondingly increase the sales price of our products, our profit margins will decline.

Our filtration products incorporate a wide variety of filter membranes designed to meet specific customer filtration needs, not all of which are produced internally. In the event that a manufacturer of outsourced membrane discontinues supply or production, we may be required to identify and qualify an alternative filter membrane for that application to incorporate into our products. This could require extensive lead times and increased costs which may cause us to lose sales and cause our profit margins to decline.

Our graphite synthesis process requires petroleum coke that meets specified criteria. While there are multiple suppliers for this petroleum coke, the sources are limited and our required criteria may cause the price of this petroleum coke to increase.

The unavailability or reduced availability of the materials or resources we use for our SCEM segment products may require us to reduce production of these products or may require us to incur additional costs in order to obtain an adequate supply of these materials or resources. The occurrence of any of these events could adversely affect our business and results of operations.

OUR MANUFACTURING PROCESSES ARE BECOMING INCREASINGLY COMPLEX, AND OUR PRODUCTION COULD BE DISRUPTED IF WE ARE UNABLE TO AVOID MANUFACTURING DIFFICULTIES.

Our manufacturing processes are complex and require the use of expensive and technologically sophisticated equipment and materials. These processes are frequently modified to improve manufacturing yields and product quality. We have, on occasion, experienced manufacturing difficulties, such as occasional critical equipment breakdowns and the introduction of impurities in the manufacturing process, which cause lower manufacturing yields, make our products unmarketable and/or delay deliveries to customers. A number of our product lines are manufactured at only one or two facilities in different countries, and any disruption could impact our sales until another facility could commence or expand production of such products. We could experience these or other manufacturing difficulties, which might result in a loss of customers and exposure to warranty and product liability claims.

WE MAY LOSE SALES IF WE ARE UNABLE TO TIMELY PROCURE, REPAIR OR REPLACE CAPITAL EQUIPMENT NECESSARY TO MANUFACTURE MANY OF OUR PRODUCTS.

If our existing equipment fails, or we are unable to obtain new equipment quickly enough to satisfy any increased demand for our products, we may lose sales to competitors. In particular, we do not maintain duplicate tools or equipment for most of our important products. Fixing or replacing complex tools is time consuming, and we may not be able to replace a damaged tool in time to meet customer requirements. In addition, from time to time we may

upgrade or add new manufacturing equipment that may require substantial lead times to build and qualify. Delays in building and qualifying new equipment could result in a disruption of our manufacturing processes and prevent us from meeting our customers' requirements, which could lead our customers to seek seek other suppliers.

WE ARE SUBJECT TO A VARIETY OF ENVIRONMENTAL LAWS THAT COULD CAUSE US TO INCUR SIGNIFICANT LIABILITIES AND EXPENSES.

Failure to comply with the wide variety of federal, state, local and non-U.S. regulatory requirements affecting our business relating to the release, use, storage, treatment, transportation, discharge, disposal and remediation, of, and human exposure to, hazardous chemicals, which have tended to become stricter over time, could result in future liabilities or the suspension of production. For example, the Frank R. Lautenberg Chemical Safety for the 21st Century Act modified the Toxic Control Substances Act ("TSCA") by requiring Environmental Protection Agency ("EPA") to prioritize and evaluate the environmental and health risks of existing

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chemicals and providing EPA with greater authority to regulate chemicals posing unreasonable risks. According to this statute, EPA is required to make an affirmative finding that a new chemical will not pose an unreasonable risk before such chemical can go into production. As a result, TSCA has been updated so that it operates in a similar fashion to the Registration, Evaluation, and Authorization of Chemicals ("REACH") legislation in Europe. Regulations similar to REACH have been enacted in South Korea and Taiwan. Any such changes to these and similar regulations promulgated by other countries could increase our cost of doing business and have a negative impact on our financial condition, results of operations and cash flows. Furthermore, the nature of our business exposes us to risk of liability for environmental contamination if hazardous materials are released into the environment, which could result in substantial losses, reputational harm, increase in our insurance cost or otherwise adversely impact our results of operations. In addition, compliance with present or future laws could restrict our ability to expand our facilities or to build or acquire new facilities or require us to acquire costly control equipment, incur other significant expenses, such as costs of remediation of contamination found on any site that we may acquire, or to modify our manufacturing processes.

IF WE ARE UNABLE TO SUCCESSFULLY MANAGE OUR MANUFACTURING OPERATIONS, OUR ABILITY TO DELIVER PRODUCTS TO OUR CUSTOMERS COULD BE DISRUPTED AND OUR BUSINESS, FINANCIAL CONDITION AND RESULTS OF OPERATIONS COULD BE ADVERSELY AFFECTED.

In order to enhance the efficiency and cost effectiveness of our manufacturing operations, and to better serve customers located in various countries, as we have in the past, we may in the future move several product lines from one of our plants to another and consolidate manufacturing operations in certain of our plants. If we are unable to establish stable processes to efficiently and effectively produce high quality products in relocated manufacturing processes in the destination plant, production may be disrupted and we may not be able to deliver these products to meet customer orders in a timely manner, which may cause us to lose credibility with our customers and harm our business. Even if we successfully move our manufacturing processes, there is no assurance that the cost savings and efficiencies we anticipate will be achieved.

International Risks

WE CONDUCT A SIGNIFICANT AMOUNT OF OUR SALES AND MANUFACTURING ACTIVITY OUTSIDE THE UNITED STATES, WHICH SUBJECTS US TO ADDITIONAL BUSINESS RISKS AND MAY CAUSE OUR PROFITABILITY TO DECLINE DUE TO INCREASED COSTS.

Sales to customers outside the United States accounted for approximately 78%, 77% and 75% of our net sales in 2016, 2015 and 2014, respectively. We anticipate that international sales will continue to account for a majority of our net sales. In addition, a number of our key domestic customers derive a significant portion of their revenues from sales in international markets. We also manufacture a significant portion of our products outside the United States and are dependent on international suppliers for many of our parts and raw materials. We intend to continue to pursue opportunities in both sales and manufacturing internationally. Our international operations are subject to a number of risks and potential costs that could adversely affect our revenue and profitability, including:

- unexpected changes in regulatory requirements that could impose additional costs on our operations or limit our ability to operate our business;
- greater difficulty in collecting our accounts receivable and longer payment cycles than are typical in domestic operations;
- changes in labor conditions and difficulties in staffing and managing foreign operations;
- expense and complexity of complying with U.S. and foreign import and export regulations;
- liability for foreign taxes assessed at rates higher than those applicable to our domestic operations;
- unanticipated government actions, such as trade wars; and
- political and economic instability.

In the past, we have incurred costs or experienced disruptions due to the factors described above and we expect to do so in the future. For example, our operations in Asia, and particularly South Korea, Taiwan and Japan, have been negatively impacted in the past as a result of regional economic instability. In addition, Taiwan and South Korea account for a growing portion of the world's semiconductor manufacturing. There have historically been strained relations between China and Taiwan and there are continuing tensions between North Korea and other countries,

including South Korea and the United States. Any adverse developments in those relations could significantly disrupt the worldwide production of semiconductors, which may lead to reduced sales of our products. Furthermore, we incur additional legal compliance costs associated with our international operations and could become subject to legal penalties in foreign countries if we do not comply with local laws and regulations, which may be substantially different from those in the United States. In a number of foreign countries, some companies engage in business practices that are prohibited by U.S. law applicable to us, such as the Foreign Corrupt Practices Act. Although we implement policies and procedures designed to ensure compliance with these laws, there can be no assurance that all of our employees, contractors and agents, as well as those companies to which we outsource certain of our business operations, including those based in countries where practices that violate such U.S. laws may be customary or common, will not take actions in violation of our

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policies. Any such violation, even if prohibited by our policies, could have an adverse effect on our business and results of operations.

WE WILL LOSE SALES IF WE ARE UNABLE TO OBTAIN GOVERNMENT AUTHORIZATION TO EXPORT CERTAIN OF OUR PRODUCTS OR TO IMPORT CERTAIN OF OUR PRODUCTS INTO FOREIGN MARKETS, AND WE WILL BE SUBJECT TO LEGAL AND REGULATORY CONSEQUENCES IF WE DO NOT COMPLY WITH APPLICABLE EXPORT AND IMPORT CONTROL LAWS AND REGULATIONS.

Exports of certain of our products are subject to export controls imposed by the U.S. Government and administered by the U.S. Departments of State and Commerce. In certain instances, these regulations may require pre-shipment authorization from the administering department. Certain of our products are subject to the Export Administration Regulations ("EAR") administered by the Department of Commerce's Bureau of Industry and Security, which requires a license depending on the type and end use of the product, the final destination, the identity of the end user and whether a license exception might apply and the International Traffic in Arms Regulations ("ITAR") administered by the Department of State's Directorate of Defense Trade Controls, for which a license is often required. Failure to comply with these regulations could result in the prohibition of our ability to export altogether, which could materially and adversely affect our business.

Products developed and manufactured in our foreign locations are subject to export controls of the applicable foreign nation. Obtaining export licenses can be difficult, time-consuming and costly. Failure to obtain export licenses could significantly reduce our revenue and materially and adversely affect our business, financial condition and results of operations. The absence of comparable restrictions on competitors in other countries may adversely affect our competitive position.

In addition, certain countries require import and other special licenses in order for certain of our products to be imported into or sold in that country. Our inability to satisfy these requirements in a timely manner has in the past prevented, and may continue to prevent us from meeting our customers' expectations in these countries and to lose sales. For example, in response to recent explosions at gas storage facilities in Singapore and China, the import of gas canisters and chemicals viewed as dangerous have come under increased regulatory scrutiny by governmental officials. This increased regulation may impair the ability of our SCEM segment to import those products into Singapore and China and may cause us to lose sales.

CHANGES IN TAXATION OR ADVERSE TAX RULINGS COULD ADVERSELY AFFECT OUR RESULTS OF OPERATIONS.

We have facilities in many foreign countries and, as a result, are subject to taxation at various rates and audit by a number of taxing authorities. Our results of operations could be affected by changes in applicable tax rates or audits by the taxing authorities in countries in which we operate, changes in laws and regulations governing calculation and location of earned profit and taxation thereof, changes in laws and regulations affecting our ability to realize deferred tax assets on our balance sheet and changes in laws and regulations relating to the repatriation of cash into the United States. Each quarter we forecast our tax liability based on our forecast of our performance for the year. If that performance forecast changes, our forecasted tax liability may change.

We have undertaken a number of complex internal reorganizations of our foreign subsidiaries in order to rationalize and streamline our foreign operations, focus our management efforts on certain local opportunities and take advantage of favorable business conditions in certain localities. While we have exercised diligence in undertaking this internal reorganization, there can be no assurance that this reorganization, or any future internal reorganization, will not result in adverse tax consequences in the United States or in foreign countries in which we have operations. This could adversely impact our profitability from foreign operations and result in a material reduction in our results of operations.

As we purchase raw materials and components from foreign countries in an effort to reduce the cost of our products or to obtain the highest quality materials, our products manufactured from these materials and components may be burdened by import taxes and duties, and these additional costs may put our products at a competitive disadvantage.

FLUCTUATIONS IN THE VALUE OF THE U.S. DOLLAR IN RELATION TO OTHER CURRENCIES MAY LEAD TO LOWER NET INCOME AND SHAREHOLDERS' EQUITY OR MAY CAUSE US TO RAISE PRICES, WHICH COULD RESULT IN REDUCED NET SALES.

Foreign currency exchange rate fluctuations could have an adverse effect on our net sales, results of operations and shareholders' equity. Foreign currency fluctuations against the U.S. dollar could require us to increase prices to foreign customers, which could result in lower net sales by us to such customers. Alternatively, if we do not adjust the prices for our products in response to foreign currency fluctuations, our profitability could decline. In addition, sales made by our foreign subsidiaries are generally denominated in the currency of the country in which these products are sold, and the currency we receive in payment for such sales could be less valuable at the time of receipt versus the time of sale as a result of foreign currency exchange rate fluctuations.

VOLATILITY IN THE GLOBAL ECONOMY COULD ADVERSELY AFFECT OUR RESULTS.

Financial markets in the United States, Europe and Asia have been experiencing extreme disruption in recent years, including, among other things, volatility in securities prices, severely diminished liquidity and credit availability, rating downgrades of

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sovereign debt, declining valuation of certain investments, declines in consumer confidence, declines in economic growth, volatility in unemployment rates, and uncertainty about economic stability. In the past such conditions have had a significant adverse impact on our industry, our financial condition and results of operations. There may be further changes in the global economy, which could lead to further challenges in our business and negatively impact our financial results. For example, the U.K. vote in favor of leaving the European Union may cause instability in European economies and may negatively impact the outlook for the global economy. Tightness of credit in financial markets could adversely affect the ability of our customers and suppliers to obtain financing for significant purchases and operations and could result in a decrease in orders and spending for our products and services. We are unable to predict the likely duration and severity of any disruption in European or global financial markets and adverse economic conditions and the effects they may have on our business and financial condition. If uncertain economic conditions return or deteriorate, our business and results of operations could be further materially and adversely affected.

TERRORIST ATTACKS, SUCH AS THE ATTACKS THAT OCCURRED IN NEW YORK AND WASHINGTON, D.C. ON SEPTEMBER 11, 2001, AND OTHER ACTS OF VIOLENCE OR WAR MAY AFFECT THE MARKETS IN WHICH WE OPERATE OR OUR OPERATIONS AND ADVERSELY AFFECT OUR ABILITY TO MANUFACTURE PRODUCTS AND OUR PROFITABILITY.

Terrorist attacks may negatively affect our operations and any security we issue. There can be no assurance that there will not be future terrorist attacks against the United States or U.S. businesses. These attacks or other armed conflicts may directly impact our physical facilities or those of our suppliers or customers. Our primary facilities include headquarters, research and development and manufacturing facilities in the United States; sales, research and development and manufacturing facilities in Japan, South Korea, Taiwan and Malaysia; and sales and service facilities in Europe and Asia. Attacks may also disrupt the global insurance and reinsurance industries with the result that we may not be able to obtain insurance at historical terms and levels for our facilities. Furthermore, such attacks may make travel and the transportation of our supplies and products more difficult and more expensive and may ultimately affect the sales of our products in the United States and overseas. As a result of terrorism, the United States may enter into additional armed conflicts, which could have a further impact on our domestic and international sales, our supply chain, our production capacity and our ability to deliver products to our customers. The consequences of these armed conflicts and the associated instability are unpredictable, and we may not be able to foresee events that could have an adverse effect on our business and any security we issue.

Risks Related to Owning our Common Stock

THE PRICE OF OUR COMMON STOCK HAS BEEN VOLATILE IN THE PAST AND MAY BE VOLATILE IN THE FUTURE.

The price of our common stock has been volatile in the past and may be volatile in the future. In 2016, the closing price of our stock on The NASDAQ Global Select Market (“NASDAQ”) ranged from a low of $10.60 to a high of $18.55, and, as in past years, the price of our common stock may show greater volatility.

The trading price of our common stock is subject to significant volatility in response to various factors, some of which are beyond our control or may be unrelated to our operating results, and which may adversely affect the market price of our common stock, including the following: the failure to meet the published expectations of securities analysts; changes in financial estimates by securities analysts; press releases or announcements by, or changes in market values of, comparable companies; volatility in the markets for high-technology stocks, general stock market price and volume fluctuations, which are particularly common among securities of high-technology companies; stock market price and volume fluctuations attributable to inconsistent trading volume levels; the public perception of equity values of publicly traded companies and the other risks and uncertainties described in this Annual Report on Form 10-K and in our other filings with the SEC. Future decreases in our stock price may adversely impact our ability to raise sufficient additional capital in the future, if needed.

IF OUR COMMON STOCK TRADES BELOW BOOK VALUE OR OUR BUSINESS OUTLOOK ERODES, WE COULD BE REQUIRED TO RECORD MATERIAL IMPAIRMENT LOSSES FOR OUR LONG-LIVED ASSETS, INCLUDING PROPERTY, PLANT AND EQUIPMENT AND OUR IDENTIFIABLE INTANGIBLES.

In accordance with U.S. generally accepted accounting principles, we review our long-lived assets whenever events or changes in circumstances indicate that the carrying amount of such assets may not be recoverable. If the carrying amount of an asset or group of assets exceeds its undiscounted cash flows, the asset will be written down to its fair value. The evaluation of the recoverability of long-lived assets requires us to make significant estimates and assumptions, including, but not limited to, the identification of the asset group at the lowest level of independent cash flows and the primary asset of the group, and long-range forecasts of revenue, reflecting management's assessment of general economic and industry conditions, operating income, depreciation and amortization and working capital requirements.

Due to the inherent uncertainty involved in making these assumptions and estimates, actual results could differ from our estimates and the conclusion that an asset group's carrying value is recoverable, or that an asset is impaired, including the extent of the

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impairment, may not be accurate. Due to the uncertain economic environment within the semiconductor industry, we continually monitor circumstances and events to determine whether asset impairment testing is warranted.

It is possible that in the future we may no longer be able to conclude that there is no impairment of our long-lived assets, nor that we can we provide assurance that material impairment charges of long-lived assets will not occur in future periods.

OUR ANNUAL AND QUARTERLY OPERATING RESULTS ARE SUBJECT TO FLUCTUATIONS AS A RESULT OF RAPID DEMAND SHIFTS AND OUR MODEST LEVEL OF BACKLOG, AND IF WE FAIL TO MEET THE EXPECTATIONS OF SECURITIES ANALYSTS OR INVESTORS, THE MARKET PRICE OF OUR COMMON STOCK MAY DECREASE SIGNIFICANTLY.

Our sales and profitability can vary significantly from quarter to quarter and year to year. Because our expense levels are relatively fixed in the short-term, an unanticipated decline in revenue in a particular quarter could significantly reduce our net income, or lead to a net loss, in that quarter. In addition, we make a substantial portion of our shipments shortly after we receive the order, and therefore we operate with a relatively modest level of backlog. As a consequence of the just-in-time nature of shipments and the modest level of backlog, our results of operations may decline quickly and significantly in response to changes in order patterns or rapid decreases in demand for our products. We anticipate that fluctuations in operating results will continue in the future. Such fluctuations in our results could cause us to fail to meet the expectations of securities analysts or investors, which could cause the market price of our common stock to decline substantially. We believe that period-to-period comparisons of our results of operations may not be meaningful, and you should not rely upon them as indicators of our future performance.

IF WE FAIL TO MAINTAIN AN EFFECTIVE SYSTEM OF INTERNAL CONTROLS, WE MAY NOT BE ABLE TO ACCURATELY REPORT OUR FINANCIAL RESULTS. AS A RESULT, CURRENT AND POTENTIAL STOCKHOLDERS COULD LOSE CONFIDENCE IN OUR FINANCIAL REPORTING, WHICH WOULD HARM THE TRADING PRICE OF OUR STOCK.

Effective internal controls are necessary for us to provide reliable financial reports. We have in the past discovered, and may in the future identify, material weaknesses in internal controls over financial reporting, which represent a reasonable possibility that a material misstatement of our annual or interim financial statements would not have been prevented or detected. If we fail to implement and maintain our controls over our financial reporting, or encounter difficulties implementing improvements in our controls, we may not meet our reporting obligations. Any failure in our internal controls that leads to a material weakness could also cause investors to lose confidence in our reported financial information, which could have a negative impact on the trading price of our stock.

CHANGES IN THE SECURITIES LAWS AND REGULATIONS HAVE IN THE PAST INCREASED OUR COSTS AND MAY DO SO IN THE FUTURE.

The Sarbanes-Oxley Act of 2002 and the Dodd-Frank Wall Street Reform and Consumer Protection Act, as well as related rules and listing standards promulgated by the Securities and Exchange Commission and the NASDAQ, effected, at least in part, in response to the turmoil over the past several years in the securities and credit markets, as well as the global economy, required changes in some of our corporate governance, securities disclosure and compliance practices. Compliance with these rules and listing standards has increased our legal and financial and accounting costs, and we expect these increased costs to continue indefinitely. While these costs are no longer increasing, they may increase in the future.

PROVISIONS IN OUR CHARTER DOCUMENTS AND DELAWARE LAW MAY DELAY OR PREVENT AN ACQUISITION OF US, WHICH COULD DECREASE THE VALUE OF YOUR SHARES.

Our restated certificate of incorporation and by-laws and Delaware law contain provisions that could make it harder for a third party to acquire us without the consent of our board of directors. These provisions include limitations on actions by our stockholders by written consent.

Our restated certificate of incorporation makes us subject to the anti-takeover provisions of Section 203 of the Delaware General Corporation Law. In general, Section 203 prohibits publicly held Delaware corporations to which it applies from engaging in a “business combination” with an “interested stockholder” for a period of three years after the date of the transaction in which the person became an interested stockholder, unless the business combination is approved in a prescribed manner. This provision could discourage others from bidding for our shares of common

stock and could, as a result, reduce the likelihood of an increase in the price of our common stock that would otherwise occur if a bidder sought to buy our common stock.

Our restated certificate of incorporation provides that our board of directors is authorized to issue from time to time, without further stockholder approval, up to 5,000,000 shares of preferred stock in one or more series and to fix and designate the rights, preferences, privileges and restrictions of the preferred stock, including dividend rights, conversion rights, voting rights, redemption rights and terms of redemption and liquidation preferences. Such shares of preferred stock could have preferences over our common stock with respect to dividends and liquidation rights. Our issuance of preferred stock may have the effect of delaying or preventing a change in control. Our issuance of preferred stock could decrease the amount of earnings and assets available for distribution

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to the holders of common stock or could adversely affect the rights and powers, including voting rights, of the holders of common stock. The issuance of preferred stock could have the effect of decreasing the market price of our common stock.

YOUR PERCENTAGE OWNERSHIP IN US MAY BE DILUTED BY FUTURE ISSUANCES OF CAPITAL STOCK, WHICH COULD REDUCE YOUR INFLUENCE OVER MATTERS ON WHICH STOCKHOLDERS VOTE.

Subject to applicable NASDAQ standards, our board of directors has the authority, without action or vote of our stockholders, to issue all or any part of our authorized but unissued shares. Issuances of common stock or the exercise of employee and director stock options would dilute your percentage ownership interest, which will have the effect of reducing your influence over matters on which our stockholders vote. In addition, we may issue substantial quantities of our common stock in order to effect acquisitions which would also dilute your ownership interest. If the issuances are made at prices that reflect a discount from the then current trading price of our common stock, your interest in the book value of our common stock might be diluted.

Item 1B. Unresolved Staff Comments.

Not Applicable.

Item 2. Properties.

Our principal executive offices are located in Billerica, Massachusetts. We also have manufacturing, research and equipment cleaning facilities in the United States, Japan, France, Taiwan, South Korea, Singapore and Malaysia. Information about our principal facilities is set forth below:

Location	Principal Function	Approximate Square Feet	Leased/ Owned	Reporting Segment
Bedford, Massachusetts	Research & Manufacturing	80,000	Owned	MC & SCEM
Billerica, Massachusetts[(1)]	Executive Offices, Research & Manufacturing	175,000	Leased	MC & SCEM
Bloomington, MN	Research & Manufacturing	68,000	Leased	AMH
Burnet, TX	Research & Manufacturing	77,000	Owned	SCEM
Chaska, Minnesota	Executive Offices, Research & Manufacturing	186,000	Owned	AMH
Colorado Springs, CO	Manufacturing	82,000	Owned	AMH
Colorado Springs, CO	Manufacturing	40,000	Leased	AMH
Danbury, CT	Research & Manufacturing	73,000	Leased	SCEM
Decatur, Texas	Manufacturing	359,000	Owned	SCEM
Hsin-chu, Taiwan	Executive Offices, Sales Research & Manufacturing	109,000	Leased	MC, SCEM & AMH
Yangmei City, Taiwan	Manufacturing	40,000	Leased	AMH
JangAn, South Korea	Manufacturing	127,000	Owned	SCEM & AMH
Kulim, Malaysia	Manufacturing	195,000	Owned	SCEM & AMH
Montpellier, France	Cleaning Services	53,000	Owned	AMH
Suwon, South Korea	Executive Offices & Research	42,000	Leased	MC & SCEM
Tokyo, Japan	Executive Offices, Sales & Research	27,000	Leased	MC, SCEM & AMH
Wonju City, South Korea	Manufacturing	39,000	Owned	AMH
Yonezawa, Japan	Manufacturing	185,000	Owned	MC & AMH

[(1)] This lease has been extended through September 30, 2026 and is subject to one five-year renewal option.

We lease approximately 13,000 square feet of research and development and manufacturing office space located in San Diego, California, approximately 31,000 square feet of manufacturing space located in Franklin, Massachusetts, an aggregate of approximately 23,000 square feet of manufacturing space in Anseong, South Korea, approximately 15,000 square feet of office space in Round Rock, Texas, and approximately 3,300 square feet of office space in Tempe, Arizona.

We lease approximately 10,000 square feet for our Asia manufacturing management offices in Singapore. In addition, we maintain a worldwide network of sales, service, repair or cleaning centers in the United States, Germany, France, Israel, Japan, Malaysia, Taiwan, Singapore, China and South Korea. Leases for our facilities expire through December 2024. We currently expect to be able to extend the terms of expiring leases or to find suitable replacement facilities on reasonable terms.

We believe that our facilities are well-maintained and suitable for their respective operations. All of our facilities are generally utilized within a normal range of production volume.

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Item 3. Legal Proceedings.

As of December 31, 2016, we were not involved in any legal proceedings that we believe will have a material impact on our consolidated financial position, results of operations or cash flows. From time to time the Company may be a party to litigation involving claims against the Company arising in the ordinary course of our business. We are not aware of any material potential litigation or claims against us which would have a material adverse effect upon our financial statements.

Item 4. Mine Safety Disclosures.

Not applicable.

EXECUTIVE OFFICERS OF THE REGISTRANT

The following is a list of our Executive Officers and their ages, as of January 31, 2017. All of the Executive Officers listed below were elected to serve until the first Directors Meeting following the 2017 Annual Stockholders Meeting.

Name	Age	Office	First Appointed To Office*
Bertrand Loy	51	President & Chief Executive Officer	2001
Gregory B. Graves	56	Executive Vice President, Chief Financial Officer & Treasurer	2002
Sue Lee	40	Senior Vice President, Secretary & General Counsel	2016
John J. Murphy	64	Senior Vice President, Human Resources	2005
Todd Edlund	54	Executive Vice President & Chief Operating Officer	2007
Clint Haris	44	Senior Vice President & General Manager, Microcontamination Control	2016
William Shaner	48	Senior Vice President & General Manager, Advanced Materials Handling	2007
Stuart Tison	53	Senior Vice President & General Manager, Specialty Chemicals and Engineered Materials	2016
Corey Rucci	57	Vice President, Business Development	2014
Gregory Marshall	59	Senior Vice President, Quality, EH&S and Entegris Business Support	2011
Michael D. Sauer	51	Vice President, Controller & Chief Accounting Officer	2011

* With either the Company or a predecessor company

Bertrand Loy has been our Chief Executive Officer, President and a director since November 2012. Mr. Loy served as our Executive Vice President and Chief Operating Officer since 2008. From August 2005 until July 2008, he served as our Executive Vice President and Chief Administrative Officer in charge of our global supply chain and manufacturing operations. He served as the Vice President and Chief Financial Officer of Mykrolis from January 2001 until August 2005. Prior to that, Mr. Loy served as the Chief Information Officer of Millipore Corporation during 1999 and 2000. From 1995 until 1999, he served as the Division Controller and Head of Manufacturing for Millipore's Laboratory Water Division. From 1989 until 1995, Mr. Loy served Sandoz Pharmaceuticals (now Novartis) in a variety of financial, audit and controller positions located in Europe, Central America and Japan. Mr. Loy served as a director of BTU International, Inc. (supplier of advanced thermal processing equipment) until its acquisition in January 2015. He also serves as a director of Harvard Bioscience, Inc. (scientific equipment) since November 2014 and has been a director for SEMI (Semiconductor Equipment and Materials International) (global high-technology manufacturing trade association) since July 2013.

Gregory B. Graves has served as our Executive Vice President and Chief Financial Officer since July 2008. Prior to that he served as Senior Vice President and Chief Financial Officer since April 2007. Prior to April 2007, he served as Senior Vice President, Strategic Planning & Business Development since the effectiveness of the merger with Mykrolis. Mr. Graves served as the Chief Business Development Officer of Entegris Minnesota since September 2002 and from September 2003 until August 2004 he also served as Senior Vice President of Finance. Prior to joining Entegris Minnesota, Mr. Graves held positions in investment banking and corporate development, including at U.S. Bancorp Piper Jaffray from June 1998 to August 2002 and at Dain Rauscher from October 1996 to May 1998.

Sue Lee has been our Senior Vice President, Secretary and General Counsel since April 2016. Prior to joining Entegris, Ms. Lee was general counsel and corporate secretary with CYREN, a network security firm since 2013. From 2010 to 2013, Ms. Lee served as general counsel for Harmonix Music Systems, a former MTV company. Prior

to that, Ms. Lee was vice president of business and legal affairs for MTV Networks and counsel at Genzyme Corporation. Prior to going in-house in 2005, Ms. Lee was an attorney at the law firm, Cleary Gottlieb Steen & Hamilton, in New York.

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John J. Murphy joined us as our Senior Vice President, Human Resources in October 2005. He served as the Senior Vice President Human Resources of HNTB, an engineering and architectural services firm, from February 2004 until October 2005 and as Corporate Vice President, Human Resources of Cadence Design Systems, Inc. from May 2000 through October 2003. Prior to that Mr. Murphy held senior human resources positions with Williams Companies, L.M. Ericsson Telephone Company and General Electric Company.

Todd Edlund has been our Executive Vice President and Chief Operating Officer since July 2016. Prior to that he was our Senior Vice President and Chief Operating Officer since November 2014. After the merger with ATMI, Mr. Edlund served as Senior Vice President and General Manager of our Critical Materials Handling business and prior to the merger with ATMI, he was the Vice President and General Manager of our Contamination Control Solutions division since December 2007. He served as the Vice President and General Manager of our Liquid Systems business unit from 2005 to 2007, and prior to that as Entegris Minnesota's Vice President of Sales for semiconductor markets from 2003 to 2005. Prior to 2003, Mr. Edlund held a variety of positions with our predecessor companies since 1995.

Clint Haris has been our Senior Vice President, Microcontamination Control since July 2016. Prior to that, Mr. Haris served as our Vice President, Liquid Microcontamination Control since August 2014. Prior to joining Entegris, Mr. Haris served in a variety of executive roles at Brooks Automation Inc. including Senior Vice President, Life Science Systems from 2010 to 2014 and Senior Vice President and General Manager, Systems Solutions from 2009 to 2010.

William Shaner has been our Senior Vice President, Advanced Materials Handling since July 2016. Prior to that, Mr. Shaner served as our Senior Vice President, Global Operations since February 2014 and as our Vice President and General Manager, Microenvironments division since 2007. He has served in a variety of sales, marketing, business development and engineering roles since joining Entegris in 1995.

Stuart Tison has been our Senior Vice President, Specialty Chemicals and Engineered Materials since July 2016. Prior to that, Mr. Tison served as Vice President, Specialty Gas Solutions since February 2015, as Vice President, Business Development since January 2010 and as Vice President, Corporate Development since July 2007. Prior to that he served Celerity, Inc. as Vice President, Engineering and served Entegris predecessor companies Mykrolis and Millipore in a variety of sales, marketing, business development and engineering roles.

Gregory Marshall has been our Senior Vice President, Quality, EH&S and Entegris Business Support since August 2016. Prior to that Mr. Marshall served as our Vice President, Quality and EH&S since March 2010 and our Global Director of Quality since the merger with Mykrolis Corporation, prior to which he served as the Director of Quality for Mykrolis. Prior to joining Mykrolis, Mr. Marshall served as the Director of US Quality for Kokusai Semiconductor Equipment Corporation.

Corey Rucci assumed his current position of Vice President, Business Development in February 2014. Prior to that he served as Vice President and General Manager of our Specialty Materials Division since 2011 and as General Manager of Poco Graphite, Inc. (POCO) since 2008 when we acquired POCO. Prior to joining Entegris, Mr. Rucci served POCO as the President and Chief Operating Officer since 2007, Chief Operating Officer since 2005, Chief Financial Officer since 2001 and Vice President of Business Development since 1998. Prior to that he worked at UNOCAL Corp. for 17 years in a variety of accounting, marketing and business development roles.

Michael D. Sauer has been our Vice President, Controller and Chief Accounting Officer since June 2012. Prior to that, he served as the Corporate Controller since 2008. From the time of the merger with Mykrolis until April 2008, Mr. Sauer served as Director of Treasury and Risk Management. Mr. Sauer joined Fluoroware, Inc., a predecessor to Entegris Minnesota in 1988 and held a variety of finance and accounting positions until 2001 when he became the Director of Business Development for Entegris Minnesota, the successor to Fluoroware, serving in that position until the merger with Mykrolis.

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PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Market Information and Holders:

Entegris' Common Stock, $0.01 par value, trades on the NASDAQ Global Select Market under the symbol "ENTG". The following table sets forth the high and low sales prices of the Company shares for each full quarterly period during 2016 and 2015. As of February 14, 2017 there were 1,198 shareholders of record. On February 14, 2017, the last sale price reported on the Nasdaq Global Select Market for our common stock was $21.60 per share.

	2016		2015	
	Low	High	Low	High
First quarter	$10.37	$13.80	$11.90	$13.94
Second quarter	$12.79	$14.77	$13.02	$15.11
Third quarter	$13.97	$17.73	$12.63	$15.20
Fourth quarter	$14.73	$18.95	$12.36	$14.32

Dividend Policy:

The Company has never declared or paid any cash dividends on its capital stock. The Company currently intends to retain all available earnings for use in its business operations and does not anticipate paying any cash dividends in the foreseeable future. Furthermore, the credit agreements governing our Term Loan and our ABL Facility and the indenture that governs the Notes contain restrictions that limit our ability to pay dividends.

Issuer Sales of Unregistered Securities During the Past Three Years:

None

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Comparative Stock Performance

The following graph compares the cumulative total shareholder return on the common stock of Entegris, Inc. from December 31, 2011 through December 31, 2016 with the cumulative total return of (1) The NASDAQ Composite Index, and (2) The Philadelphia Semiconductor Index, assuming $100 was invested at the close of trading December 31, 2011 in Entegris, Inc. common stock, the NASDAQ Composite Index and the Philadelphia Semiconductor Index and that all dividends are reinvested.

	December 31, 2011	December 31, 2012	December 31, 2013	December 31, 2014	December 31, 2015	December 31, 2016
Entegris, Inc.	$100.00	$105.15	$132.76	$151.32	$152.00	$205.04
NASDAQ Composite	100.00	117.45	164.57	188.84	201.98	219.89
Philadelphia Semiconductor Index	100.00	107.20	152.05	199.79	196.56	254.21

Issuer Purchases of Equity Securities:

On February 5, 2016, the Company’s Board of Directors authorized a repurchase program covering up to an aggregate of $100 million of the Company’s common stock in open market transactions and in accordance with one or more pre-arranged stock trading plans to be established in accordance with Rule 10b5-1 under the Securities Exchange Act of 1934, as amended. The authorization expired on February 15, 2017. This repurchase program represents a renewal and replacement of the repurchase program originally authorized by the Board of Directors on February 5, 2016, which expired February 15, 2017.

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The following table provides information concerning shares of the Company's Common Stock $0.01 par value purchased during the three months ended December 31, 2016:

Period	(a) Total Number of Shares Purchased	(b) Average Price Paid per Share	(c) Total Number of Shares Purchased as Part of Publicly Announced Plans or Programs	(d) Maximum Number (or Approximate Dollar Value) of Shares that May Yet Be Purchased Under the Plans or Programs
October 2 through October 31, 2016	30,000	$15.82	30,000	$95,952,609
November 1 through November 30, 2016	100,994	$17.74	100,994	$94,161,285
December 1 through December 31, 2016	95,105	$18.23	95,105	$92,427,294
Total	226,099	$17.69	226,099	$92,427,294

Item 6. Selected Financial Data.

The table that follows presents selected financial data for each of the last five years from the Company's consolidated financial statements and should be read in conjunction with the Company's Consolidated Financial Statements and the related Notes and with "Management's Discussion and Analysis of Financial Condition and Results of Operations" included elsewhere in this Annual Report on Form 10-K. The selected financial data set forth below as of December 31, 2016 and 2015 and for the years ended December 31, 2016, 2015 and 2014 are derived from our audited financial statements included in this Annual Report on Form 10-K. All other selected financial data set forth below is derived from our audited financial statements not included in this Annual Report on Form 10-K. Our historical results are not necessarily indicative of our results of operations to be expected in the future.

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(In thousands, except per share amounts)	Year ended December 31, 2016	Year ended December 31, 2015	Year ended December 31, 2014	Year ended December 31, 2013	Year ended December 31, 2012
Operating Results					
Net sales	$1,175,270	$1,081,121	$962,069	$693,459	$715,903
Gross profit	508,691	470,231	376,683	294,214	307,383
Selling, general and administrative expenses	201,901	198,914	231,833	137,123	147,405
Engineering, research and development expenses	106,991	105,900			