

Air Products and Chemicals, Inc.
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Air Products in the Electronics Industry

In the Beginning

Air Products has been serving the electronics industry for more than 25 years, dating back to the industry's infancy. In the 1970s, Air Products installed a nitrogen pipeline along Highway 101 to serve a handful of fledgling companies in a little town called Santa Clara, Calif. Over time, Santa Clara grew into Silicon Valley and Air Products grew right along with it. Along with the Silicon Valley nitrogen pipeline which would eventually serve 65 customers, Air Products built another pipeline to serve customers in Arizona. Then, Air Products crossed the pond and built nitrogen pipeline supply systems in the United Kingdom, continental Europe, and eventually Korea.

In the early 1980s, Air Products expanded its portfolio from bulk gases to include specialty gas delivery. In the mid 1980s, the MEGASYS™ service offering was developed in response to customers who wanted us to do more than just deliver our bulk and specialty gas. . . they leveraged our expertise to manage the supply as well. From there, MEGASYS turned into an on-site management system which helped us develop an understanding of not only what our customers needed, but where they were going and how we could apply our expertise to help them get there. The MEGASYS service offering gave the Electronics Division a deeper understanding of the technology roadmap and what we could do to anticipate problems, remove obstacles and develop next generation technology.

Building Relationships, Positioning For Worldwide Growth

During the 1980s, while the Electronics Division was building major infrastructure in North America, it was also forging headlong into Asia by partnering with local companies who understand the business needs of regional customers. One of these partnerships started in 1980 with Korea Industrial Gases Ltd. (KIG). By the middle of the decade, Air Products entered Malaysia via a partnership with another industrial gas company Sitt Tatt. And in 1987, Air Products inked a deal with San Fu, an industrial gas company located in Taiwan. As these relationships were solidifying, many of Air Products' major North American customers were setting up shop in Europe and not long after, Air Products was established in Europe as well to make sure the growing needs of customers, and the industry, continued to be met.



The 90s were a time of key strategic acquisitions and continued joint venture development for the growing Electronics Division. In 1996, we formed Daido Air Products Electronics (DAP), a joint venture with Daido Hoxan Inc. to provide gases and related chemicals, environmental systems, equipment and services to the electronics industry in Japan.

Schumacher became part of Air Products' Electronics Division in the late 1980s and a member of the Air Products Electronic Chemicals family in mid-1998. Schumacher supplies ultra-high purity chemicals and delivery equipment systems, process chemicals for CVD dielectrics and metals, oxide passivation, diffusion and ion implant applications, and supplies a full line of temperature controllers, vapor delivery systems and bulk refills systems. Headquartered in Carlsbad, Calif., Schumacher's capabilities extend from R&D development of new technologies to expertise in the purification, packaging and analysis of semiconductor chemicals, to worldwide sales, distribution and service with manufacturing and customer support centers in the U.S., Europe and the Pacific Rim.

In 1998, we acquired Solkatronic Chemicals from Solvay America, Inc which got us into the compound semiconductor business and added to our established position with silicon semiconductors. Solkatronic, part of Air Products' specialty materials offering, manufactures ultrahigh-purity gases, chemicals and gas handling equipment with headquarters in Fairfield, N.J. Today, Solkatronic operates a specialty gas manufacturing plant in Morrisville, Pa., Catoosa, Okla. and a distribution site in Chandler, Ariz.

A year later and nearly twenty years after first entering Asia, Air Products bought out its remaining interest in KIG which was by then the largest industrial gas company in Korea. Today, KIG has liquid plant and pipeline franchises in Kumi, Onsan/Ulsan, and in Kiheung/Cheonan. KIG also owns and operates standalone onsite plants, including cryogenic oxygen/nitrogen, nitrogen pressure swing adsorption, nitrogen membrane and oxygen vacuum swing adsorption units. Through an affiliate, KIG operates a specialty gas facility in Shihwa that transfills and produces over 10 ultrahigh-purity specialty gases—including silane, nitrogen trifluoride, boron trifluoride and dopant mixtures, including arsine, phosphine and diborane—for semiconductor manufacturers.

Also in 1999, we created TRiMEGA, a 50/50 joint venture with The Kinetics Group, Inc., a wholly owned subsidiary of United States Filter Corporation. Lasting for five years—the joint venture ended in 2004—TRiMEGA was a complete turnkey solutions provider for all the process-critical materials and systems required for new fabs or major expansions of existing fabs, including its latest offering, the Fab Renovation Model.

Later in 1999, we acquired a majority interest in Han Yang Technology (HYT)—Korea's leading specialty gas equipment manufacturer for the semiconductor industry—to further build on our electronics position in Asia. Air Products entered Japan in 1973 and currently sells a variety of specialty and performance chemicals, as well as industrial gases and related equipment in the country directly and through commercial alliances.

Maintaining an Industry-Wide Leadership Position

The turn of the century presented multiple opportunities for Air Products to gain market share by expanding its portfolio of product offerings and customer services.

Beginning in 2000, Air Products made a minority equity investment for our Electronics Division in QuantumClean, which provided semiconductor tool parts cleaning services to the global industry and further expands the scope of outsourcing options available to semiconductor manufacturing customers. Shortly thereafter, we teamed up with SC Fluids,



Inc. to complete the development of supercritical carbon dioxide (CO₂) as an efficient photoresist stripping agent for semiconductor wafers.

The year 2001 saw a new partnership with DuPont Electronic Technologies in the form of a 50/50 joint venture called DA NanoMaterials. Now based in Tempe, AZ., the company develops, manufactures and markets silica-based slurries for electronic precision

polishing or planarization applications. Prior to the announcement, DuPont and Air Products had been working together in the competitive Chemical Mechanical Planarization (CMP) slurry market for more than a year under a joint development agreement.

In 2002, the company also acquired the remaining interest in San Fu, which today is a full service industrial gas and chemical company with a broad product portfolio supplying specialty gases, electronic piping and equipment, liquid/bulk gases, pipeline/on-site gases and chemicals to the Taiwan marketplace.

Because the division remained active during the Electronics industry downturn in 2001-2002, it was well positioned to hit the ground running when the industry corrected itself. In April 2003, Air Products introduced its Electronics Equipment Solutions unit, which seamlessly manages the development, design, manufacturing service and marketing of new equipment solutions. Operating from three major hubs in order to quickly respond to global requests, it is still headquartered from the Semiconductor Equipment Manufacturing Center (SEMC) in Allentown, PA. Other hubs are located at Han Yang Technology in Korea and Carlsbad, CA.

Air Products made its largest acquisition to date in August 2003, solidifying its position as the largest materials supplier to the global Electronics industry, with the purchase of the Ashland Electronics Chemicals business. The acquisition gave Air Products a more intimate electronic chemicals process knowledge, an expanded presence in the high-volume specialty materials arena, and a significantly broader reach in Asia. Added offerings included—but weren't limited to—the ACT[®] line of photoresist strippers, etch residue strippers and lo-k dielectric and copper strippers; high purity process chemicals; and CMP slurries and post-CMP cleans.

In 2004, Air Products leveraged the new CMP slurry line by adding it to its DA NanoMaterials joint venture. At the same time, DuPont contributed the slurry technologies of EKC Technology, a high performance chemical supplier it purchased as part of ChemFirst in 2002. The two new additions translated into significant new critical mass for the joint venture, strengthening its growing portfolio of products for electronic polishing and planarization applications.

And in 2004, Air Products also added the acquisition of Precision Purification Services, a provider of parts cleaning services to the semiconductor manufacturing industry. The acquisition allowed Air Products to offer additional parts cleaning capabilities to complement those found at its Phoenix, Ariz. and Carrollton, Tex. facilities, bringing an 18,000 sq. ft. cleaning facility complete with copper segregation into the fold.

Electronics—Driven By Portfolio Management

Air Products' strategic acquisitions and relationship building in the electronics industry is part of a comprehensive portfolio management process designed to improve the mix and value of its growth and core businesses. The portfolio management process involves examining all opportunities for value creation along the supply chain, including downstream integration, alliances, new ventures, acquisitions and divestitures. Other corporate growth platforms include Refinery Hydrogen and Energy Solutions, Performance Materials, and Healthcare.

Electronics Today

Since those first days in Silicon Valley, Air Products' Electronics Division has grown into a \$1.3 billion business (including affiliates) by building leading positions in North America, Europe and Asia, including regional headquarters in Allentown, Pa., U.S.; Hersham, England; and Taipei, Taiwan. In addition, Air Products operates the world's largest specialty gas facility located in Hometown, Pa. As a leading global supplier to the electronics industry, the company offers over 100 gases and chemicals that go into the manufacture of integrated circuits, compound semiconductors, a burgeoning flat-panel market and other electronics devices like Light Emitting Diodes (or LEDs). Air Products' comprehensive portfolio of products and services that create a total solution to the technology roadmap includes:

- Specialty Gases and Chemicals
- CVD Dielectrics and Metals
- Process Chemicals
- ACT[®] strippers
- OptiYield[™] Photoresist Developers
- Compound Semiconductor Materials
- DA NanoMaterials Polishing Slurries
- GASGUARD[®] UHP Gas Delivery Systems
- CHEMGUARD[®] Chemical Refill Systems
- Bulk and Pipeline Gases
- MEGASYST[™] Gas and Chemical Management Systems
- Worldwide Sales, Support and Distribution

Air Products (NYSE: APD) serves customers in technology, energy, healthcare and industrial markets worldwide with a unique portfolio of products, services and solutions, providing atmospheric gases, process and specialty gases, performance materials and chemical intermediates. Founded in 1940, Air Products has built leading positions in key growth markets such as semiconductor materials, refinery hydrogen, home healthcare services, natural gas liquefaction, and advanced coatings and adhesives. The company is recognized for its innovative culture, operational excellence and commitment to safety and the environment and is listed in the Dow Jones Sustainability and FTSE4Good Indices. The company has annual revenues of \$8.1 billion, operations in over 30 countries, and more than 20,000 employees around the globe.

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