



# electronicsupdate

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## Expanding Global Photovoltaics Industry Can Benefit From Company's Lower Cost of Ownership Options

With the rapid growth of the world's photovoltaics industry, especially solar panels being used in response to environmental quality and energy security demands, the Air Products Electronics Division is well positioned to help manufacturers reduce their cost of ownership.

"We have numerous solutions for first generation and thin film solar cell manufacturers including electronic specialty materials, gas and chemical delivery equipment, and technology support," said Pascal Legrande, global Photovoltaic commercial manager based in Europe.

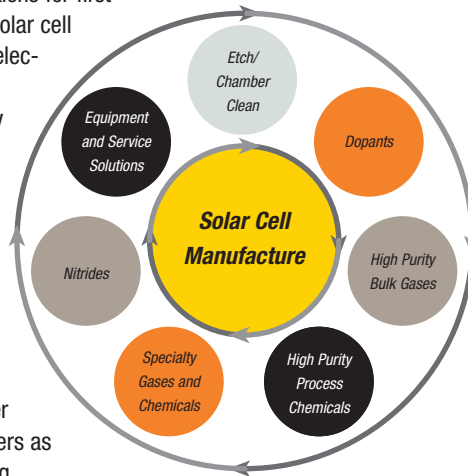
"However, we feel the most important thing Air Products can now offer photovoltaics manufacturers as they grow larger is helping them to reduce cost of ownership, which is what we do best for many customers in other segments of the global electronics industry," stressed Legrande.

He cited the company's Bulk Specialty Gas System (BSGS), particularly for supplying silane for thin film solar cells. BSGS can deliver large quantities of electronic specialty materials more cost-effectively, while helping to ensure consistency, Legrande said.

"Solar cell manufacturers are using higher volumes of hydrogen and nitrogen. We can offer them delivery by truck or pipeline. Or, in some instances, on-site generation might make sense and further reduce costs for large users," he continued.

For Air Products, which is already a leading supplier to the broader electronics industry, applying that experience to photovoltaics makes perfect sense, Legrande said. Also, Air Products has an outstanding environmental, health, and safety record, as well as extensive experience in developing customer chamber cleaning methods that reduce greenhouse gases.

The company has a significant Electronics global infrastructure that matches the geography for photovoltaics. For example, some 30 percent of solar cells are made in Europe, particularly Germany, a country well served by Air Products Electronics Europe.



Air Products offers a complete portfolio for solar cell manufacture.



Pascal Legrande

## Air Products Adds WF<sub>6</sub> Capacity to Meet Increased Demand

It wasn't too long ago that industry observers predicted that demand for the electronic specialty gas WF<sub>6</sub> (tungsten hexafluoride) would drop significantly, particularly as copper replaced tungsten as the interconnect metal of choice.

While copper has replaced WF<sub>6</sub> in logic applications, today's demand for WF<sub>6</sub> is stronger than ever as the memory and NAND flash markets continue to use WF<sub>6</sub> longer than originally forecast, according to Sandra L. Snead, Air Products WF<sub>6</sub> product manager.

"That's why we are expanding WF<sub>6</sub> capacity at our ESM manufacturing facility at Hometown, Pa. This production addition is aligned with the company's previously announced staged capacity plan and the new capacity will come on-stream this summer," said Snead.

"We forecast solid growth for WF<sub>6</sub> and feel that the timing is right to add more capacity, and further extend our leadership in fluorine chemistry," said Corning Painter, vice president of Electronics for Air Products.

The Hometown expansion enables Air Products to produce 60 percent more WF<sub>6</sub> for the semiconductor industry, in particular, memory chip manufacturers.

Snead said the new production unit would be an exact duplicate of Air Products' existing production capabilities, including all-nickel construction with automated process systems and a proprietary distillation process to remove impurities.

(cont. on page 5)



A Hometown technician readies WF<sub>6</sub> nickel-coated steel cylinders for shipping.

(cont. on page 5)



## Korean Team Wins Three Awards from Korea Government

Air Products Korea won three awards from the Korean Government at the 43rd Annual Trade Ceremony held in Seoul. The awards included the "\$100 Million Export Tower," "The Medal of Honor for Export," and "The Official Commendation."

Soo-Yon Lee, president of Air Products Korea, was awarded the "\$100 Million Export Tower." This is the first time this honor was bestowed in the Korean industrial gases industry. The award was presented by the president of the Republic of Korea, Moo-Hyun Roh.

Chul-Ho Yang, Electronics Operation director, received "The Medal of Honor for Export" award from President Roh, and Kyo-Yung Kim, Global ESM marketing director, was awarded "The Official Commendation" from the Minister of MOCIE (Ministry of Commerce, Industry, and Energy) for an outstanding contribution to the growth of country export business over the past year.

Air Products Korea has been recognized for making extraordinary efforts to localize specialty gases production to support the electronics industry in Korea and as a pioneer in developing foreign markets by exporting electronics specialty materials to the leading electronics companies in Asia.

"These are honorable and meaningful awards to the company and award-ees. I would like to take this opportunity to express my heartfelt thanks to all global Air Products colleagues as well as all employees in Korea, whose

support and cooperation enabled us to have this opportunity. We'll make more effort to maintain this leading position both in local and export markets in the Korean industrial gases industry," said Soo-Yon Lee, president of Air Products Korea, after receiving the award.

The Korea Government has awarded Export Tower Awards to companies that dedicate great effort to export works in the annual ceremony of "Day of Trade." There were about 1,500 in attendance for this ceremony who are related to trade business, including President Roh and the Minister of MOCIE.

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Kyo-Yung Kim, Soo-Yon Lee, and Chul-Ho Yang display our awards.



## Silane Safety Seminar Held in Korea

More than 200 attended our Korea Silane Safety Seminar.

Air Products, Air Products HYT, and Air Products Korea sponsored a silane safety seminar on January 30 in Seoul.

Silane is an electronics specialty gas that has been used in commercial quantities since the mid-1960s when the integrated circuit (IC) industry first began. Silane is also used in the TFT-LCD (flat panel, a growing industry in Korea) and photovoltaic cell (PVC) industries. A pyrophoric gas, silane may auto-ignite under certain conditions when exposed to air. Recent industry code and standard changes address the safe handling of silane due to numerous incidents involving silane over the last 40 years. Air Products conducted this seminar to help explain the hazards and how to handle silane safely.

More than 230 attended, including customers, suppliers, local regulatory agencies, and Air Products employees. Presenters included industry representatives and the Korea Gas Safety Council (KGSC).

Our presenters were: Jim VanOmmeren, process safety engineering associate; Jong Duck Lee, engineering and manufacturing manager, GasKeeper, Air Products HYT; Cindy Hughes, senior product engineer for GASGUARD® systems; and Eugene Ngai, director of Emergency Response and Disposal, who also coordinated the technical and safety content of the presentations.

Ngai said, "This seminar follows the success of the first silane safety seminar held in Taiwan. We now have reached more than 700 users and suppliers in this rapidly growing region, once again demonstrating Air Products commitment to safety."

Y.S. Kwak, vice president and representative director of Air Products HYT, and S.Y. Lee, president Air Products Korea, co-hosted the seminar.

Kwak said, "This was a great opportunity for us to educate our customers about the safe handling of silane and to coordinate all of the various sources of information out there. We received a lot of positive feedback from our customers, many of whom have requested more detailed follow-up training." Lee, who gave the welcoming remarks at the seminar, added, "This type of seminar demonstrates the Air Products commitment to safety and shows our leadership and industry expertise in product safety."

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## Air Products Expands N<sub>2</sub>O Production Capacity in Taiwan

Air Products, through its subsidiary Air Products San Fu, recently expanded nitrous oxide (N<sub>2</sub>O) capacity at its Nanke plant in Taiwan to support the fast growing semiconductor and thin film transistor-liquid crystal display (TFT-LCD) markets in Asia. The new capacity, which has been on-stream since the beginning of this year, doubles the N<sub>2</sub>O capacity and produces high purity N<sub>2</sub>O products to meet existing and potential customers' requirements.

The expanded capacity will continue to use the exact technology as the existing production capabilities. There will be no change in raw material supply for production, and Air Products will continue to maintain its strict online monitoring of the operational process and the thorough analysis of the finished goods produced at Nanke.

"This expansion reinforces our commitment to our customers and maintains our position as the leading world supplier of electronics specialty gases. We will leverage our global capabilities and product portfolio to be the most reliable supplier to the industry," said Corning Painter, vice president, Global Electronics Division at Air Products.

N<sub>2</sub>O is used with silane for chemical vapor deposition of silicon nitride layers, which are typically used as a passivation, masking, or insulating layers. Another of its main applications is in the plasma deposition of Fluorinated Silica Glass (FSG) as a low-k dielectric insulating film between adjacent metal lines.

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## New ACT® EZSTRIP® 527 Aids Single Wafer Processing

Air Products is introducing ACT® EZSTRIP® 527, a novel product that can effectively and selectively remove bi-layer resists when used on an SEZ Single Wafer Spin Processor.

The new addition to the company's ACT line of electronic formulated products is the result of a collaboration among researchers from SEZ AG, Villach, Austria; Advanced Micro Devices' Fab 30 and 36, Dresden, Germany; and the Air Products Electronics Formulated Product (EFP) Technology team.

ACT EZSTRIP 527 is being unveiled at the 2007 Sematech Surface Preparation and Cleaning Conference being held in Austin in April.

Arifin Budihardjo, ACT product manager responsible for new product development, said this latest addition to the company's portfolio is in response to the increasingly popular back end of line (BEOL) cleaning in single wafer wet processing rather than in batches.

"The single wafer approach is being extended to processes beyond post-etch residue removal. One such process is all-wet photoresist removal," said Budihardjo.

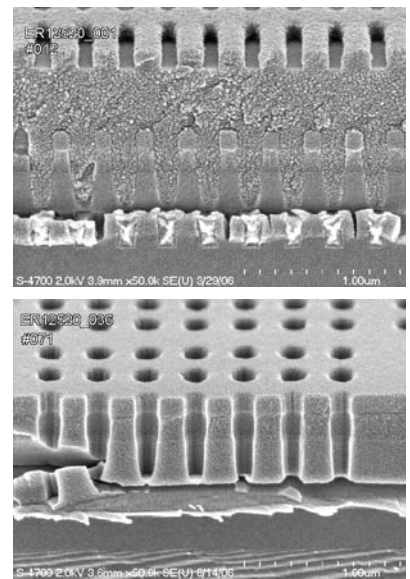
"Traditionally, batch process tools or wet benches have been primarily used in BEOL resist removal due to their ability to handle existing chemistries used for this application. However, as the technological requirements of this application become more stringent, suppliers like Air Products are responding by developing novel chemistries appropriate for use on single wafer tools, now the preferred method of stripping rather than in batches."

The major advantage of ACT EZSTRIP 527 is that it selectively dissolves the bi-layer photoresist layers using a single wafer process that does not damage the underlying low-k or copper interconnect.

Scanning electron microscope and light-point defect detection analysis of wafers cleaned with the new ACT EZSTRIP 527 revealed high residue removal efficiency and low defect count.

The results of the research are contained in a paper, "Photoresist Stripper Development for Bi-Layer Photoresist Rework Using a Single Wafer Tool Process."

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Before and after examples of ACT® EZSTRIP® 527 BEOL cleaning.

## Electronics E-Learning Center

If you haven't checked out the Air Products Electronics E-Learning Center, we invite you to do so. Our Electronics E-Learning Center is a way to share knowledge. It's your resource to our latest technical information. Now you can download our new Podcasts, featuring conversations on some of our key product offerings and developments within our Electronics Division. You can also pick a topic and listen to narrated PowerPoint presentations, or download recently published articles, and technical papers.

We hope you find this information helpful. And we welcome your suggestions and feedback on how we can make it even more effective.

You can access the E-Learning Center at [www.airproducts.com/electronics](http://www.airproducts.com/electronics).



## New *nCtrl*<sup>™</sup> Offering Aids ESM, Schumacher Product Lines

As the electronics industry moves to smaller and smaller design features, it continues to strive for higher quality products that reduce process variations.

To that end, the company has introduced a ship-to-control offering known as *nCtrl*<sup>™</sup> materials for customers using our electronic specialty materials (ESM), which includes electronic specialty gases and Schumacher products.

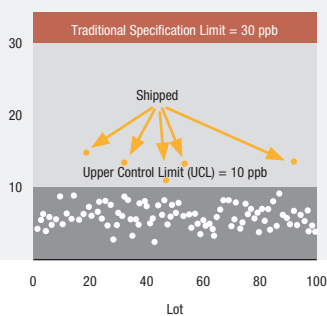
Air Products' *nCtrl* offering reduces variations from container-to-container for semiconductor materials by developing specifications based on statistically generated upper control limits (UCLs). There will be no need for customer notification of out-of-control (OCC) material since only *nCtrl* material will be shipped.

Air Products understands the importance of this program to our customers, and that it's vital to them to minimize variability and receive consistent products to help them reduce their process risks. Our *nCtrl* material is the solution to providing high-purity materials with reduced variation between containers based on our manufacturing, analytical, and technical expertise, while using a common industry standard to calculate the control limit specifications.

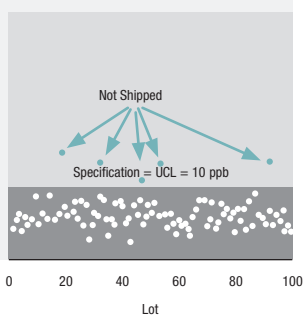
For additional information on our *nCtrl* offering, please go to our website, [www.airproducts.com/electronics](http://www.airproducts.com/electronics), and click on the E-Learning Center. Look for our two latest podcasts: "SEMI Standards: Draft Statistical Guidelines for Ship-to-Control of Semiconductor Materials" with Tom Bzik and "*nCtrl* Specialty Materials: An Overview" with Carrie Dancziger. Or contact Dancziger directly.

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### Before *nCtrl* Material



### After *nCtrl* Material



Before *nCtrl* (left) and after *nCtrl*.

## Nitrogen Generator Operating at Samsung Austin

Air Products announced that its 450,000-scf/hr-nitrogen generator at Samsung Austin Semiconductor's new 300mm memory fab in Austin, Texas, is on-stream.

The new 300mm fab is expected to manufacture DRAM and/or flash memory chips for computers, cell phones, and DVD and MP3 players.

Besides nitrogen, Air Products will also supply bulk specialty gases to the DRAM facility as well as specialty gas and chemical equipment.

The diversity of Air Products' offerings continues to position us as the go-to supplier to the global semiconductor industry," said Mike Hilton, vice president and general manager, Electronics and Performance Materials. "Air Products is proud to be able to support Samsung's growth in the U.S., just as we have done in Korea."

Samsung currently operates a 200mm fab in Austin where a dedicated team of MEGASYS<sup>®</sup> technicians manage Samsung's materials and equipment. Air Products also operates a 240,000-scf/hr nitrogen generator for the 200mm fab and supplies its liquid bulk gas requirements, as well as specialty materials, delivery systems, and bulk specialty gases and equipment.

## High-k Materials Advance 45nm Chip Development

Recent advances by major semiconductor manufacturers to develop 45 nm chips have been enhanced through the use of high-k materials in the gate dielectric.

Air Products produces and markets a variety of high-k precursors that are used to deposit defect-free gate dielectrics through CVD or atomic layer deposition. The use of high-k dielectrics in conjunction with metal gates improves semiconductor performance and meets consumer demand for smaller, faster devices with longer battery lifetimes. Use of these chips will allow electronic devices to operate at even quicker speeds, while using considerably less power.

Previously, the industry had used silicon dioxide to build transistor gate dielectrics. However, as the industry continues the drive to smaller chip geometries, gate dielectric thickness has decreased dramatically. This has led to an increase in gate oxide leakage, a major technical hurdle facing the semiconductor industry. High-K materials combat the leakage issue, while at the same time preserve the capacitance necessary for transistor performance.

Air Products' high-k offerings include precursors for hafnium, zirconium, aluminum, and lanthanum. The various material choices present unique delivery challenges. In response to this, Air Products has developed proven high-volume delivery systems that meet the consistency and reliability needs of customers.

Air Products is the only high-k material supplier offering a full portfolio of products and services to complement our high-k materials, including:

- Proven refill delivery equipment specially designed to handle many of these often-sensitive materials.
- High-k material-etching and chamber clean expertise;
- Front end of line (FEOL) formulated cleans that prepare the wafer surface for subsequent processing steps by selectively removing post-etch polymer residue without damaging the transistor region.

While high-k materials will make their debut in logic chips at the 45 nm node, they are already seeing use in memory chips as stacked and trench capacitors.

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## China Technology Center Expanded

Air Products has completed a major expansion of its China Technology Center in Shanghai to support the fast-growing businesses in Asia. The expanded center complements our regional technology centers in Japan, Korea, and Taiwan.

The expansion, built on space adjoining the current facility, includes a high bay equipped with two high-pressure polyurethane machines and accessory tools for both rigid and flexible applications that supplement the existing shoe sole capability. Two spray booths, aqueous and non-aqueous, will be used for spray coating development.

The new space also features a general-purpose lab with additional fume hoods, expanded chemicals storage areas, and associated office space to provide new application and product development, technical services, process R&D, and in-region analysis to support all businesses including Gases, Performance Materials, and Electronics.

"This latest step in strengthening our technology capabilities will support our fast-growing busi-

nesses in China and across the Asia region," said Wilbur Mok, Air Products' Asia President. "Our new investment in China will bring us closer to our customers throughout the region, and increase the speed by which we create innovative solutions and value-added offerings that address the specific requirements of local markets."

Bobby Chen, Air Products' Asia Technology Director, said the expansion in Shanghai underscores Air Products' commitment to driving growth through innovation. "Our Asian Technology Centers are fully integrated into our global technology network," he said. "They complement and support one another, with each center having specific market focus in serving customers by leveraging the company's strength in material and surface sciences, analytical technology, application and engineering excellence."

The company has also recently upgraded its Electronics technology capabilities in Korea and Taiwan, and Performance Materials technology capabilities in Japan. The Electronics and Performance Materials business is one of Air Products' four global business divisions.

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## Global Photovoltaics Industry

(cont. from page 1)

"Germany has been very aggressive in attracting photovoltaics manufacturers, especially near Dresden and Berlin. The recent 21st European Photovoltaic Solar Energy Conference and Exhibition held in Dresden attracted a record number of 2,700 visitors and participants from 95 countries. Japan, the U.S., China, Taiwan, and India are also key locations for the industry," noted Legrande.

The world's photovoltaic industry has been growing at the rate of 40 percent a year for the last seven years, Legrande said. "Today they are producing solar cells as large as a king-size bed with a thickness of only 1 mm. Much of the growth is being driven by the demands for a cleaner environment and energy security."

There's no question that photovoltaics will continue its rapid growth and expand to other regions of the world.

"As customers get bigger, they'll demand more economies of scale. They'll want bigger tools and faster throughput. We believe that our specialty products can easily be integrated into photovoltaic manufacturing across the globe to safely provide direct cost and productivity benefits," said Legrande.

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## Air Products Adds WF<sub>6</sub> Capacity

(cont. from page 1)

"There will be no change in raw material supply and we will continue to ship finished product in nickel or non-reactive electroless nickel-coated steel cylinders to prevent metallic impurities from contaminating the product," she continued. Nickel-coated steel cylinders are the standard container for the company's Megaclass Grade WF<sub>6</sub>.

Snead said Air Products would continue to ensure purity of supply by analyzing the gas in its state-of-the-art trace metals laboratory, which is also located at Hometown. Strict quality control is also used to verify cylinder performance.

The primary use of WF<sub>6</sub> in integrated circuits manufacturing is for vias on the front end of line. Despite the near universal use of copper in logic devices, tungsten is still used as the contact via due to thermal budgets. In memory, tungsten and aluminum are used in both flash and DRAM devices due to costs, performance, and the fact that there are fewer metal interconnection layers.

Tungsten can also be found in memory for the bit line and in the gate. New possible tungsten applications include using it as a replacement for TiN and WCoP barrier layers, which is being investigated by the industry.

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## Nitrogen Plant Goes On-Stream at IVO in China

Air Products has brought a new nitrogen plant in China on-stream for InfoVision Optoelectronics (IVO), a leading Chinese producer of flat-panel displays. It is the first nitrogen plant of its kind designed and built locally in China.

The new plant is based on Air Products' high efficiency design, which delivers reliable and cost-effective nitrogen to customers in the electronics and other industries around the world. This plant is located at IVO's factory in Kunshan, Jiangsu Province and provides nitrogen to IVO under a long-term contract. IVO produces 5G TFT-LCD panels in a state-of-the-art production facility that represents a US\$1 billion investment. It is a major project under China's Eleventh Five-Year Plan.

The plant is also the first Air Products nitrogen plant in China commissioned using local resources including design, manufacturing, and construction. The cold box was fabricated by Air Products' equipment manufacturing facility in Caojing, Shanghai. The main air compressor was assembled locally.

"The successful completion of this project is a milestone in our development in China. The localization not only allows us to meet the project targets on time, it also enables us to supply our customer with reliable bulk nitrogen at a competitive cost while maintaining the quality standards for which Air Products is known worldwide. This greatly reinforces our position as a leading gas supplier to China's electronics industry," said Andy Tuan, general manager of the Electronics Division in China.

"We are very pleased with Air Products' performance on this project," said Hsueh Ching Yuan, head of the Facility Department of InfoVision Optoelectronics. "The nitrogen plant was completed on time and on budget, thanks to close cooperation between the Air Products team and our own people. A reliable and high-quality nitrogen supply is critical to the production of LCDs."

Strategically located adjacent to Shanghai Chemical Industry Park, the Air Products facility in Caojing has broad capabilities for the design, engineering, and manufacture of cryogenic equipment to support air separation unit projects in China and other Asian markets. The Caojing facility is complemented by Air Products' Shanghai Engineering Center, which handles engineering design, project development, and project management.

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Students visit the Air Products' booth at the SDSA fair.

## news of interest:

### Carlsbad Facility Supports Science Fair

Our Carlsbad facility participated in the annual San Diego Science Alliance (SDSA) High Tech Fair, targeted to middle and high school students studying the sciences. The theme of this year's fair was "That's SO Ten Minutes Ago: Keeping Pace with Science and Technology."

Air Products wowed the students with experiments using liquid nitrogen for a "levitating" semi conductive magnet experiment; quick-freeze experiments including the "banana hammer" and various frozen food items; and culminating the exhibit with ice cream made with liquid nitrogen. Air Products earned the highly coveted "Most Fun Exhibit" award from the students of San Diego IT/Engineering Academies.

"San Diego's business community must spark the imagination of tomorrow's scientists if San Diego is to remain a hub for genetic, biotech, telecommunications, computer, and defense-related industries," said Mark Shults, president of SDSA's board of directors and associate director of AT&T California, presenting sponsor for this year's event.

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### WaiGaoQiao Site Wins Two Awards

Air Products' WaiGaoQiao (WGQ) site in the Shanghai WGQ Free Trade Zone received two awards from local government agencies.

The first was the prestigious "Safety Production Self-discipline Corporation" award from the Pudong New District Safety Supervision Bureau, the second consecutive one for the company. Criteria for winning it include assessment in three categories—safety management practices, hazardous chemicals/toxic materials management, and overall site management. Quarterly inspection scores are also used.

The second award was from the Shanghai Public Police Bureau as a "Qualified Safety/Security Company." The Bronze Model was bestowed by the police bureau during a site visit when the bureau congratulated our team for outstanding performance. Criteria for this award include assessment in five categories: organizational safety/security responsibilities, vindicating stabilization, information sharing, safety measures, and policy/regulation fulfillment. Monthly test results are also part of the award assessment.

Andy Tuan, general manager of China Electronics, commented that "This is another achievement and honor for the team at WGQ with support from whole China Electronics team. It's recognition that reflects the safety culture and dedication of the team and the fact that the team has maintained excellent work ethics and a good relationship with government agencies."

The WGQ location is a Global Operations (GO) site comprising the Shanghai Electronic Operations Technical Center, an Electronics Specialty Materials warehouse, and an high purity nitrogen plant that supplies pipeline nitrogen to electronics customers in the industrial park, a key nitrogen franchise for Air Products in China.

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A technician checks the cylinder fill area at the Ulsan plant.

### Ulsan Plant Wins Safety Award

Air Products' Ulsan Ammonia plant in Korea recently earned certification as a one-year "Accident Free Workplace" from KOSHA (Korea Occupational Safety & Health Agency), the only government organization for industrial safety and health. The plant has been running since October 2005 with an ammonia distillation capacity of 1000m<sup>3</sup> per year and is producing ultra-high purity ammonia (99.99999 percent pure), used for manufacturing of various electronics products.

The 10-member team has operated the facility safely, with training and support from our Korea Environmental, Health & Safety team. Young-Suk Lee, lead operator, was recognized by KOSHA as a major contributor to the honor.

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## Babcock & Brown, Air Products Launch Refurbishment Venture

International investment and advisory firm Babcock & Brown and Air Products jointly announced the signing of an equipment refurbishment and remarketing agreement.

Under the terms of the agreement, semiconductor equipment owned by or consigned to Babcock & Brown's U.S.-based subsidiary, Babcock & Brown Electronics Management (BBEM), will be refurbished by Air Products at its state-of-the-art clean room and refurbishment facility in Chandler, Arizona.

The repair and refurbishment will be performed prior to resale and will result in high-quality used equipment that meets customers' exacting requirements for reliability and refurbishment to the most recent configuration possible. In many cases, tool refurbishment will be performed with the involvement of OEMs in line with the business practices of both Air Products and Babcock & Brown.

Mike Herman, a senior executive with BBEM said, "The agreement between Air Products and Babcock & Brown will result in the availability to the semiconductor industry of very high-quality used and refurbished equipment. This will, in turn, minimize the risk to customers in acquiring used equipment. The combined resources of Air Products and BBEM further strengthen the BBEM strategy of becoming a global supplier of semiconductor capital equipment and of maximizing cost efficiency and ROI at all stages of equipment life."

BBEM is the electronics management division of Babcock & Brown that offers semiconductor manufacturers innovative financial products that ease up-front capital cost and commercially manage equipment from fab acceptance to end of life.

spring 2007

tell me more  
[www.airproducts.com/electronics](http://www.airproducts.com/electronics)

### company information

Air Products serves customers in industrial, energy, technology and healthcare markets worldwide with a unique portfolio of atmospheric gases, process and specialty gases, performance materials, and equipment and services. The company has annual revenues of \$9 billion, operations in over 40 countries, and over 20,000 employees around the globe.

*Electronics Update* is published for the global electronics industry customers of Air Products and Chemicals, Inc. For more information, please call 610-481-2601 or Email us at [mckendej@airproducts.com](mailto:mckendej@airproducts.com).

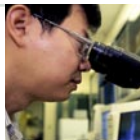
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