

Success and Solutions

Semiconductor Industry Case Studies

Semiconductors are key components in the electronics industry. Their production requires robust, accurate and safe weighing technology to precisely manufacture silicon wafers and to accurately monitor the dispensing process during integrated circuit (IC) packaging. Learn about our broad portfolio of weighing components designed for automation that have become indispensable tools for manufacturers across the semiconductor production value chain, enabling the seamless and fast production of high quality chips.

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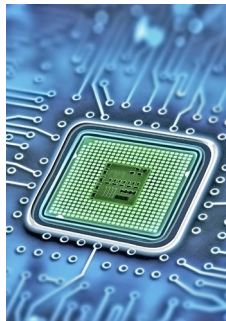
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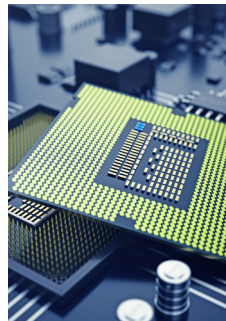
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Dispensing Accuracy Meeting Typhoons Head-On



“ The new weigh modules make it possible for us to deliver quality product in all environmental conditions. ”

Quality Manager

An integrated circuit (IC) packaging vendor located in a coastal city was experiencing production disruptions during typhoon and earthquake season. After upgrading their dispensing machine using a high-precision weigh module outfitted with a built-in typhoon filter, the customer is maximizing its production capacity by ensuring high-accuracy dispensing year-round.

Situation

Environmental concerns were interrupting processes that required calibrating dispensing nozzles to a 0.01 mg readability. The company's inability to assure automated quality at these times resulted in production downtime.

The customer contacted us for a solution that could help them meet their production goals.

Solution

The company upgraded its dispensing system with a WXS205 weigh module. The weigh module, which includes a special built-in typhoon-fighting filter:

- Automatically calibrates dispensing based on environmental conditions.
- Improves measurement results to maximize accuracy in fill processes.
- Enables uninterrupted production during typhoons and mild earthquakes.

The Challenge

Unreliable jet-nozzle calibration made it next-to-impossible for the company to produce quality in very sensitive dispensing processes. The result was a declining process capability index, or CPK, which was hurting yield. The customer had three choices. One, it could accept the high probability of quality fluctuations during environmental events. Two, it could shut down during such events. Three, it could find a new solution. The solution chosen – the WXS205 with typhoon filter – provides peace of mind by ensuring 0.01 mg accuracy when calibrating the dispensing jet nozzles, which helps to keep manufacturing results within tolerance.



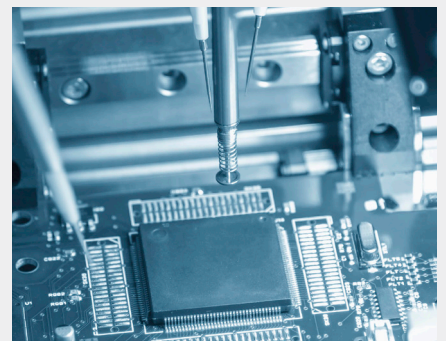
The “Typhoon Fighter”

The WXS205, an automated precision weighing (APW) module from METTLER TOLEDO, provides high-resolution weighing to 0.01 mg. The specially designed typhoon filter is built-in to fight disruptions caused by typhoons and mild earthquakes and provides a level of accuracy that fulfills company requirements. Despite limited system space, the compact digital solution has been easy to integrate. Using simple commands, the customer enables the filter when a storm or quake is coming, helping to eliminate quality risk and downtime.



The Outcome

All dispensing machines were upgraded with the typhoon-fighting WXS205. During the next typhoon season, the APW WXS205 offered premium repeatability within a range of 0.03 mg ($0.5 \text{ mg} \pm 3\%$), enabling a CPK standard above 1.66 under all environmental conditions. Most importantly, downtime was reduced and end-user satisfaction increased with the company’s ability to deliver on-time, high-quality product. This outcome has proven the WXS205 to be a profitable investment with a fast ROI and excellent long-term business potential.



Learn more:

▶ www.mt.com/APW

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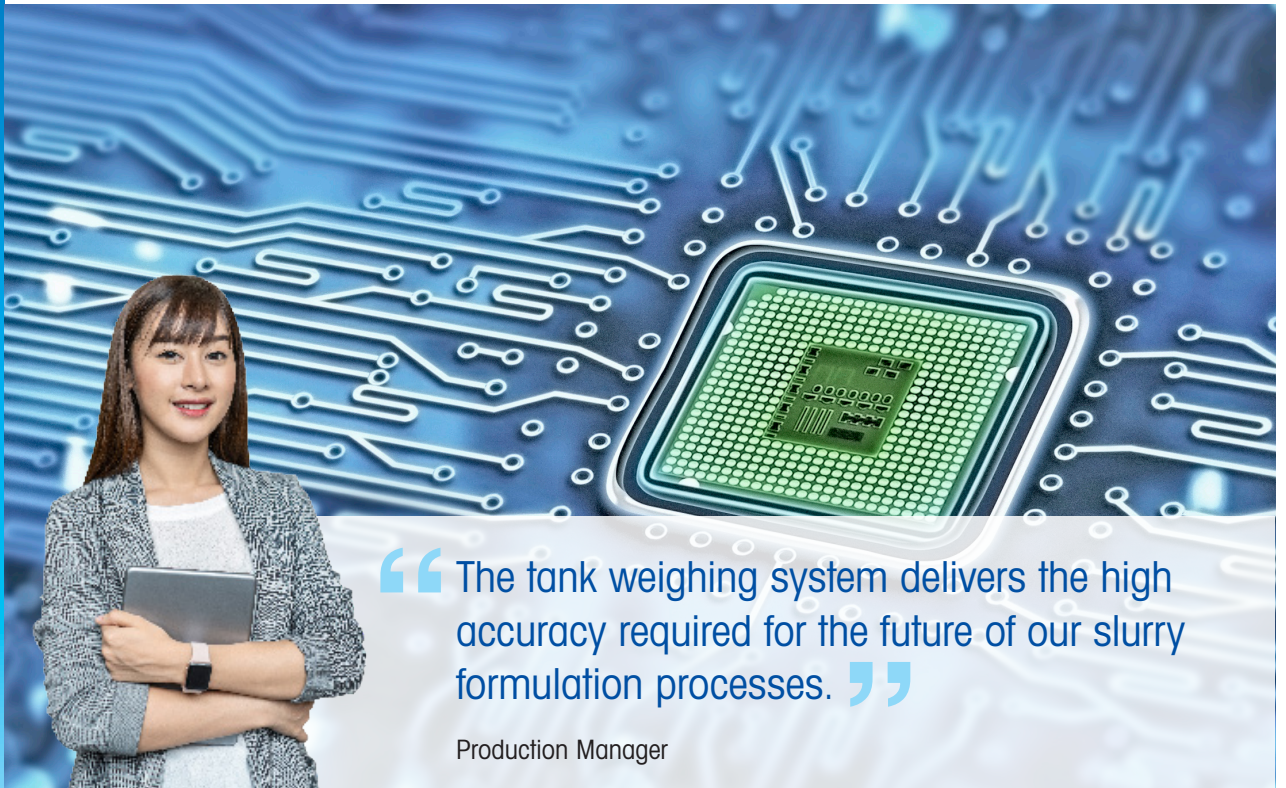
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Precision Slurry Production

Enabling High-Quality Wafers



“ The tank weighing system delivers the high accuracy required for the future of our slurry formulation processes. ”

Production Manager

A leading producer of semiconductor chips sought higher precision in its chemical-mechanical polishing (CMP) process. The company successfully integrated high-precision PBK9-APW bench scales into its fully automated slurry formulation process, making it possible for management to achieve ambitious precision requirements.

Situation

The semiconductor company requires a precise slurry formulation and mixing process to ensure its final chips perform to specification. Production managers wanted a fully integrated, high-precision solution that could handle tanks with capacities up to 300 kg and deliver a repeatable resolution of less than 5 g.

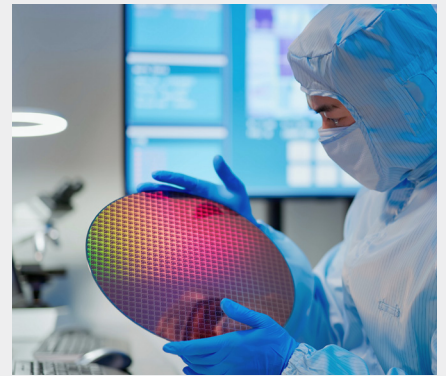
Solution

The PBK9-APW delivers high accuracy CMP slurry formulation. The platform's automated internal calibration compensates for temperature fluctuations, while a Good Weighing Practice™ (GWP®) Verification has optimized service frequency. Benefits realized include:

- Enhanced precision
- Reduced maintenance costs

The Challenge

The semiconductor company stored the slurry in small tanks. They required a weight-based solution to mix the components and apply the slurry to the wafers at precisely controlled quantities. They sought a 300 kg scale that could be fully integrated into the remotely controlled vessel operation. The solution needed to continuously deliver results within predefined specifications. This meant that not only did the company need the right scale – it also needed a well-defined scale maintenance and calibration regimen for its chosen solution.



The PBK989-APW

Slurry components are directly deposited into the tank, mixed, and then dosed onto the wafer surface. Each tank is mounted on a PBK989APW-CC300 bench scale connected to the company's Allen-Bradley PLC. The filtering settings of the PBK9 weighing platform can be fine-tuned to compensate for environmental influences such as temperature, which can negatively impact results accuracy. Automated calibration with a built-in calibration weight and plug-in cables supports easy maintenance and consistent, high performance. A GWP® Verification assured that the weighing equipment would meet the initial need and deliver ongoing accuracy with the right maintenance.



The Outcome

All components of the PBK989-APW successfully integrated with the manufacturer's Allen-Bradley PLC, and the first installations have proven highly successful. In fact, the production team at the semiconductor manufacturer is so pleased with the output and productivity of the new setup that they are planning to install the system in additional production locations around the world.



Learn more:

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Semiconductor Chemicals

Ensuring the Right Mix



“ We are eliminating two weeks of decontamination downtime per year and exceeding quality, production and sustainability targets. ”

Quality Manager

A semiconductor chemicals manufacturer faced the challenge of proving that their multi-vendor tank-weighing system could deliver accuracy. To eliminate this challenge, management sought an automated system that would provide performance assurance and a new calibration method that would eliminate production delays and disposal costs.

Challenge

The customer's former system was sourced from several vendors, making it a challenge to prove that the combination could successfully produce required accuracy. Mix-and-match components meant errors were difficult to diagnose. Calibrating 15-30 ton tanks also required days of downtime, and the entire system did not connect to their new control system.

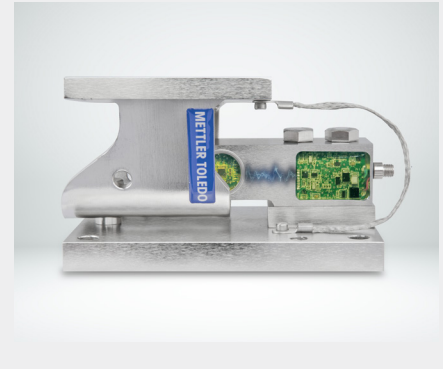
Benefit

By choosing a METTLER TOLEDO automated tank-scale system the customer has been able to:

- Prove fitness for purpose with Good Weighing Practice™ (GWP®).
- Reduce system and vendor complexity for easier maintenance.
- Quickly and reliably connect scales.
- Calibrate without water, eliminating lengthy production delays.

Solution 1: Smart Sensors

POWERCELL® smart sensors eliminated junction boxes, which were the company's single largest source of maintenance issues. These smart sensors immediately alert operators of load cell or cable damage so the issue can be fixed in less than 15 minutes without any special tools or training (compared to hours of downtime with their old system). Cables can be replaced independently of load cells, saving hundreds if not thousands on avoidable recalibration costs.



Solution 2: Standard Automation Interface (SAI™)

SAI™-enabled products like the IND360 compact automation indicator connect easily and intuitively to a wide range of weighing equipment. By combining the IND360 with a flexible-mount platform, configuration and setup is complete in just five minutes. Operators have full remote condition monitoring to make sure there are no bad measurements to affect product quality or production schedules. Smart5™ alarms provide prioritization and simple guidance to recover quickly when incidents do occur. A blazingly fast update rate ensures more accurate target control and boosts system productivity by as much as 50% vs. their previous system.



Solution 3: RapidCal™ Calibration

The producer has been able to reclaim six hours per tank per calibration by implementing RapidCal™ tank scale calibration. RapidCal™ is also helping them save over one million liters of water and associated hazardous material disposal costs per calibration cycle, while also eliminating an additional two weeks of plant decontamination downtime per year. This is allowing the producer to exceed their quality, production, and sustainability targets. Furthermore, they are eliminating the safety hazards associated with large test weights and working in confined spaces with hazardous chemicals that they faced when using their previous calibration approach.



Learn more:

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Slurry-Delivery Equipment

Smart Weighing, Effective Designs



“ The automated solution has helped us improve slurry quality, maximize uptime, and save materials. ”

Quality Manager

Abrasive particle distribution is a critical parameter in a chemical-mechanical polishing (CMP) slurry, affecting key metrics such as the rate of material removal. This makes high-accuracy ingredient weighing critically important. A C6 PowerMount™ weigh module paired with an IND360 weighing indicator enables highly accurate mixing control at a 50 g readability.

Situation

Slurry delivery system (SDS) equipment builders are using SWB605 PowerMount™ weigh modules and IND360 indicators for mixing processes. A typical mixing tank capacity is 500 kg, but customers can require a resolution as high as 50 g readability. C6 PowerMount™ can meet this requirement, as it delivers up to 22,000 Y-values.

Benefit

C6 PowerMount™ and IND360 offer:

- High-resolution mixing with 22,000 Y-values.
- Easy, time-saving installation, connection, and configuration.
- Maximum uptime with condition monitoring and Smart5™ alarms.
- Better chemical resistance via an all stainless-steel design.

The Challenge

The size distribution of the abrasive particles is the critical design parameter in a CMP slurry, affecting key metrics such as the rate of material removal and surface defects. Therefore, during slurry mixing, high accuracy weighing of different ingredients becomes very important. More and more customers are seeking reliable weighing solutions to decrease the downtime and material waste that results from weighing component failures. SDS producers must prepare to meet these customer needs as semiconductor demand continues to increase.



The Solution

Three SWB605 22 kg C6 PowerMount™ weigh modules enabled with POWERCELL® load cells were connected to the CMP slurry-mixing tank via the IND360 automation indicator. The combination offers the benefits of condition monitoring and Smart5™ alarms to provide early indications of weighing issues before they cause quality failures. The C6 SLB615D POWERCELL® provides 22,000 Y-values and 50 g readability for high accuracy. The Good Weighing Practice™ (GWP®) Recommendation for Weighing Components provides proof that these selections are fit-for-purpose as part of the design qualification process.



The Outcome

The selected weighing system enables accurate mixing process control with 50 g readability. Customers can improve slurry material quality, which is very important to achieve the desired planarity of the substrate and the deposited layers. The Smart5™ alarms in IND360 together with the condition monitoring from POWERCELL® can help SDS customers maximize yield with higher uptime and save materials by ensuring high-quality CMP batches.



Learn more:

▶ www.mt.com/IND-Powermount

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Semiconductor Gas Bottling

Hazardous Area Performance



“ METTLER TOLEDO and Rockwell Automation are without equal, enabling us to safely and efficiently supply the gases our semiconductor industry customers need. ”

Reliability Engineer

A bottled gas supplier was facing difficulty finding an integrated weighing and automation solution that could meet both their stringent accuracy requirements and their safety needs. METTLER TOLEDO and Rockwell Automation turned out to be the winning combination, providing a seamless solution that helped them solve a nearly insurmountable problem.

Situation

A bottled gas supplier to the semiconductor industry faced several critical application requirements for their newest production facility. First and foremost, it needed an automated gas bottling system that could achieve nearly milligram precision in hazardous areas, which would require new automation data formats. They approached us to see what could be done.

Benefit

A partnership between Rockwell Automation and METTLER TOLEDO yielded a complete solution:

- Fit-for-purpose equipment with global hazardous area approvals capable of achieving required accuracy, and
- Fast and easy automation connectivity provided by globally trusted automation suppliers working together.

The Challenge

The mass comparators and balances required to weigh the gases precisely needed fast and easy automation connectivity and global hazardous area approvals. Moreover, the precision required of this particular application exceeded the capability of commonly available automation data formats, meaning new data types had to be implemented and tested prior to delivery and commissioning of the weighing and automation equipment.



Mass Comparators + ControlLogix®

Good Weighing Practice™ (GWP®) indicated that METTLER TOLEDO mass comparators were the best weighing fit that met hazardous area approval requirements. They were connected to Rockwell Automation ControlLogix® control systems via the IND360 Compact Automation Indicator. A custom add-on profile and sample code made PLC integration seamless; the connection was completed in less than 10 minutes. Qualified installation and accredited certification of the weighing equipment in use meant easy delivery of this turnkey project for everyone concerned.



The Outcome

Smooth specification, testing and delivery of over 100 gas-bottling stations complete with documented proof that they were fit-for-purpose along with qualified installation and calibration services meant the bottler was ready to meet expanded production demand. The combined solution delivered efficiency gains and yield improvement. Native hazardous area approvals eliminated hundreds of thousands of dollars' worth of cabinet space-robbing barriers. Our partnership with Rockwell Automation made this system a reality, solving a complex issue like no other automation or precision measurement company ever has before.



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