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# Faster Production and High-quality End-products with Faster Vacuum Gauges

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An EMRP project has developed a new dynamic vacuum facility for calibrating gauges under rapidly changing pressures to improve manufacturing process efficiency and reduce contamination

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## **The Challenge**

Vacuum chambers are an important tool in the manufacture of many high-tech, high-value products, such as semiconductors, photovoltaics, and LED lighting. The manufacture of these products relies on processes carried out in a vacuum environment, with the semiconductor industry alone accounting for around 40 % of the vacuum market. Vacuum is also an important and indispensable tool for many other industrial processes in the lighting, pharmaceutical, and food packaging sectors.

Fast, accurate pressure measurements are used in process control, with product quality and production efficiency dependent on how quickly and consistently a vacuum can be applied. Thus, new measurement standards capable of measuring dynamic, rapidly changing pressures used in high-value production processes were needed to enable the most cost-effective products and processes.

## **The Solution**

A consortium of seven European NMIs and five private companies collaborated to develop a new vacuum gauge calibration facility capable of providing a well-defined, very rapid pressure drop for SI-traceable dynamic pressure calibrations under conditions encountered by sensors in industrial applications.

The EMRP project developed new facilities, metrological-based methods, and reference standards to improve the metrological traceability of industrially relevant vacuum and low-pressure measurements. This included a dynamic vacuum facility for calibrating industrial vacuum gauges under rapidly changing pressures (from 100 kPa to 100 Pa in 23 ms) and a calibration system for partial pressures to characterize and calibrate quadrupole mass spectrometers used in industrial settings. A series of reference outgassing samples was developed for a range of important industrially relevant gas species, such as water vapor, providing metrologically traceable, comparable measurements of the outgassing (i.e., release) of unwanted contaminants from vacuum equipment. Further, a practical guide for leak measurements using commercial leak detectors was developed for users of leak detectors and associated standards-developing committees.

## **A Quantifiable Impact**

A member of the research consortium, a manufacturer of gas analysis instruments, used the new facility to test the performance of a prototype vacuum gauge, demonstrating its rapid

response to rapidly changing pressures. Access to these services accelerated the development of a commercial ultrafast pressure measurement gauge and contributed to three patent applications. The now commercially available gauge enables rapid analysis of vacuum chambers used in production, allowing customers in the semiconductor industry to improve productivity and process efficiency. New technical specifications for mass spectrometric characterization and outgassing rate measurements were developed by the ISO vacuum standards committee (TC 112). These developments will significantly improve industrial vacuum measurements, reduce set-up times, and improve process control and product quality.

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A complete list of participants is provided on the EMRP Project IND12 Vacuum Page.<sup>1</sup>

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<sup>1</sup> EMRP Project IND12 Vacuum, "Vacuum metrology for production environments"  
<https://www.euramet.org/research-innovation/search-research-projects/details/project/vacuum-metrology-for-production-environments>