

## Experiment #10 Vacuum technologies in precision machines

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- Location: INESC-MN- Clean Room

- Objectives

To learn the principles of vacuum technologies. Several vacuum systems will be used as case-studies, aiming a better understanding of the vacuum pumps operation mechanisms, the physical principles for pressure reading. Some hardware required to operate in vacuum environment will be highlighted during the laboratory sessions. The work will be divided into 4 sessions (4.5h each), to be carried once a week.



### Session 1

- Why the need of low pressure systems in microtechnologies for materials deposition and patterning.
- Creating vacuum: vacuum pumps, chambers and valves. Automation of the pumping cycles. Principles and hands-on.

### Session 2

- Measuring pressure down to  $10^{-9}$  Torr: reviewing different gauges and their principles of operation. De-assembly of a pressure sensor for filament cleaning.
- Monitoring pumping speed using mechanical pumps, turbomolecular pumps and cryogenic pumps.

### Session 3

- Manipulation of samples in vacuum environments: robots for sample handling, loadlocks, windows, electrical and actuator feedthroughs. Materials for vacuum systems. Automation mechanisms.

### Session 4

- Measuring the atmosphere inside a vacuum system using a residual gas analyzer for mass spectroscopy. Monitoring the air molecules partial pressure during pumping cycles from atmosphere pressure ( $\sim 10^2$  Torr) down to  $\sim 10^{-7}$  Torr.