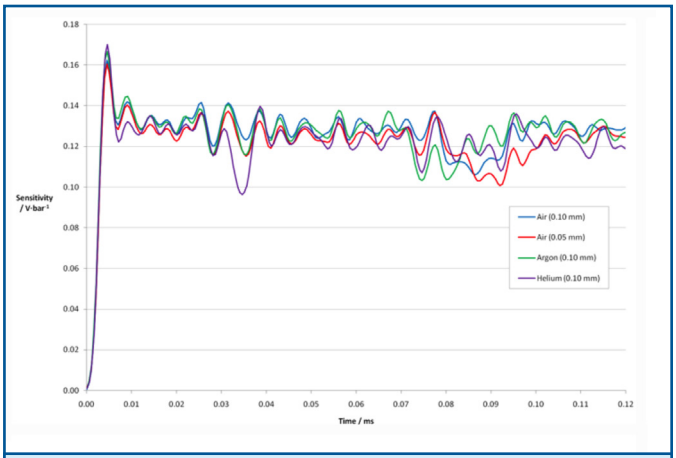
Dynamic pressure facility

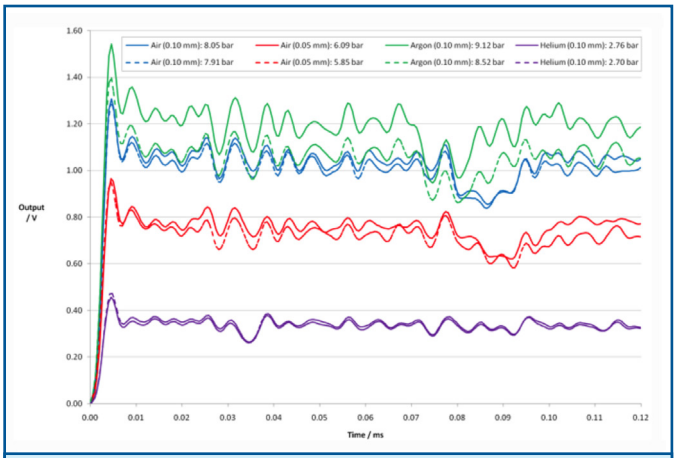
The National Physical Laboratory (NPL) has developed a dynamic pressure sensor calibration facility, based on shock tube techniques and secondary equipment. These can traceably characterise the amplitude and frequency response of pressure sensors up to high frequencies, by exposing them to extremely fast pressure steps of up to 1.4 MPa. This facility is particularly suited for characterising sensors used in applications such as gas turbine and internal combustion engine development.

Many industrial pressure sensors are used to make dynamic measurements, yet have often only been calibrated using static pressures. It is well known that a mechanical sensor will exhibit distinctive dynamic behaviour that deviates increasingly from its static characteristics as the frequency increases. The use of a sensor in a different mode from that in which it was calibrated is therefore likely to be a significant factor affecting the reliability and uncertainty of the measurement result. The facilities at NPL can be used to quantify these variations and investigate ways in which to minimise them. Testing of the sensors in more realistic conditions (for some applications) is also available, using either the shock tube or a secondary facility, in which the dynamic pressure is generated within a liquid.

Aluminium diaphragm which was burst within the NPL shock tube.



Output sensitivity trace of sensor in different gases. Throughout this period the sensor was exposed to a steady pressure step, and the signal structure is due to vibration of the sensor mount and the sensor's dynamic characteristics.

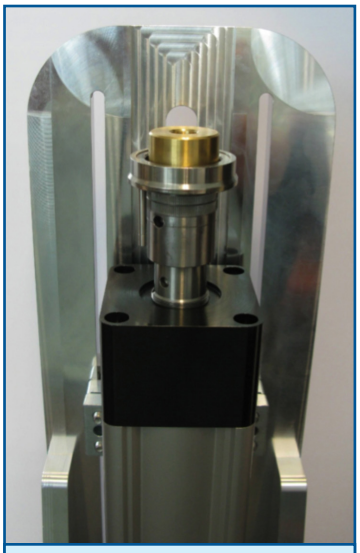


Sensor output for varying gas species and pressures in response to a pressure step.

Within the shock tube a pressure step of up to 1.4 MPa can be obtained by using different combinations of gases, different offsets for initial static pressure, different tube lengths, and single or double diaphragm bursts. The theoretical rise time for these pressure steps is of the order of a few nanoseconds, and consequently the input's frequency content is sufficient for practically all industrial applications.

The shock tube can provide a calibration process that extends the measurement traceability of the pressure sensors to the dynamic regime. For example, this could find the sensor's resonant frequency, or its amplitude and phase response over a range of frequencies. Traceability to the SI is derived from the starting pressures, gas species, and shock wave velocity measurements. As well as these standard tests, NPL is happy to use its facilities in collaboration with its customers to help them investigate the dynamic characteristics of their measurement systems.

NPL 1.4 MPa shock tube, viewed from driver end.



Piston end of the secondary pressure generator device.

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