PCB® offers dynamic pressure sensors, force sensors and microphones for Aerodynamic Engineers to use in wind tunnels to test aircraft or rocket models. The chart below provides a recommendation of sensors based on the wind tunnel classification, from subsonic to hypersonic speeds.

Wind tunnel sensors include; acoustic, high resolution and micro ICP® pressure sensors, prepolarized surface and pressure field microphones, and piezoelectric force sensors.

### Applications
- Airfoil Studies on Aircraft
- Rockets Buffeting Tests
- Re-entry Vehicles
- Engine Nacelle Noise Testing
- Dynamic Force Balance

### PCB® Wind Tunnel Sensors

<table>
<thead>
<tr>
<th>PCB® Model</th>
<th>Model #</th>
<th>Subsonic</th>
<th>Transonic</th>
<th>Supersonic</th>
<th>Hypersonic</th>
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<tbody>
<tr>
<td>Prepolared Microphone</td>
<td>377A14</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Microphone System</td>
<td>378A14</td>
<td>✗</td>
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<tr>
<td>Acoustic Pressure Sensor</td>
<td>103B01</td>
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<td>✗</td>
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<tr>
<td>High Res ICP® Pressure Sensor</td>
<td>112A22</td>
<td>✗</td>
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<tr>
<td>Mini ICP® Pressure Sensor</td>
<td>112M362</td>
<td>✗</td>
<td></td>
<td>✗</td>
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<tr>
<td>Micro ICP® Pressure Sensor</td>
<td>132A31</td>
<td>✗</td>
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<tr>
<td>Piezoelectric Force Sensor</td>
<td>260A01</td>
<td>✗</td>
<td>✗</td>
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<td>Surface Microphone</td>
<td>130B40</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
</tr>
</tbody>
</table>
## Microphones for Wind Tunnels

### Prepolarized Pressure Field Microphones

**Model 377A14**
- 1/4” Pressure microphone
- Open circuit sensitivity: 1.0 mV/Pa
- Dynamic range: >174 dB
- Noise: <35 dB
- Frequency range: 4 to 70,000 Hz
- IEC 60651 Type 1 compliant
- IEC 61672 Class 1 compliant for premium sound level meter use
- Calibration reference microphone, traceable through PTB, compliant with ISO 9001 & 17025, A2LA accredited

### Side Vented Pressure Response Field Microphones

Model 377A14 is a side vented pressure field design which allows for equalization of atmospheric pressure when used in a flush mounted cavity, tube, wall or panel where the static operating pressure inside varies greatly compared to the outside of the structure. The 377A14 is used for high level or high frequency measurements and is mounted flush to the wind tunnel wall. For optimum results use with the PCB® model 426A05 vent-less preamplifier, or order as a Model 378A14, microphone and preamplifier mated pair.

### Polarization Voltage

Model 377A14 is a prepolarized design. When combined with a preamplifier it is designed to operate on ICP® sensor power, or any 2-20 mA constant current supply. This modern design is preferred for portable measurements or operation in high humidity applications. Design advantages include the use of ordinary coaxial cables and interchangeability with other ICP® sensors (accelerometers, pressure sensors, force sensors, etc.) resulting in setup time savings and low channel cost.

### Prepolarized Surface Microphones

**Model 130B40**
- Prepolarized (ICP®) microphone and preamplifier combination
- Dynamic range: 35 dBA to 142 dB (150 dB before clipping)
- Operating temperature: -40°F to +176°F (-40°C to +80°C)
- 1/8” Height, fits where most microphones are not capable
- Water and dust resistant mesh grid

### Low Profile Surface Microphones

Model 130B40 is a cost effective microphone for measuring true surface pressure. Through CFD modeling software, the microphone and pad design were able to be optimized for wind induced noise applications. The flexible design allows for flush mounting or adhesive mounting on flat planar or curved surfaces. A low 1/8” (3 mm) profile height allows for noise measurements to be taken where traditional microphones would not fit. The water and dust resistant mesh grid cap makes it an excellent choice for tire well and other rough environments. The unit comes with a built-in preamplifier and attached 5 foot cable terminating in a 10-32 microdot coaxial connector. The vent for the microphone is at the surface for easy atmospheric pressure equalization. TEDS IEEE P1451.4 is supplied standard.

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View our complete offering of Acoustic Sensors & Instrumentation at wwwpcb.com/Acoustics

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Photo Courtesy of NASA

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Photo Courtesy of NASA
Pressure Sensors for Aerodynamic Testing and Analysis

Acoustic ICP® Pressure Sensor
Model 103B01
- Measurement range: 3.00 psi (180.3 dB)
- Sensitivity: ±15% 1500 mV/psi (217.5 mV/kPa)
- Resolution: 0.00002 psi (77 dB)
- Low frequency response: (-5%) 5 Hz
- Resonant frequency: ≥13 kHz

High Resolution ICP® Pressure Sensor
Models 112A22 & 112M362
- Measurement range: 50 psi (345 kPa)
- Sensitivity: ±15% 100 mV/psi (14.5 mV/kPa)
- Resolution: 0.001 psi (0.007 kPa)
- Low frequency response: (-5%) 0.50 Hz
- Resonant frequency: ≥250 kHz

Micro ICP® Pressure Sensor
Model 132A31
- Measurement range: 50 psi (345 kPa)
- Sensitivity: ±30% 140 mV/psi (20.3 mV/kPa)
- Resolution: 0.001 psi (0.007 kPa)
- Low frequency response: (-5%) 11 kHz
- Resonant frequency: ≥1000 kHz
- Pigtail connector for high frequency velocity or TOA measurements

Flight Tested ICP® Acoustic Pressure Microphones
Series 103B ICP® Acoustic Pressure Sensors measure pulsating, transient, and turbulent acoustic phenomena on air vehicles and other structures. For use in measurement of dynamic and acoustic pressure in aircraft and rocket applications. ICP® microelectronics are used for low impedance, high voltage output and ability to withstand shock during stage separations.

Miniature High Sensitivity ICP® Probes
Used to measure small dynamic pressures such as turbulence, noise, sound, cavitation and pulsations, especially in adverse environments. Capable of measuring high intensity sound pressures from 0.001 psi to 50 psi (111 to 205 dB in air) at any static level from full vacuum to 500 psi. Internal acceleration compensation minimizes vibration sensitivity and an internal discharging resistor automatically eliminates static (DC) signal components.

Acoustic Micro ICP® Pressure Sensors
Acoustic pressure micro sensor for measurement of hypersonic boundary-layer transition that measures shock and standing waves. With a resonant frequency greater than 1 MHz and acoustic pressure resolution of 7 Pascal, it is sensitive enough to detect the bow and stern of shock waves. The small size of 0.125 inch (3 mm) diameter and 0.3 inch (7 mm) length is easy to mount in small models typical of a hypersonic wind tunnel.
Piezoelectric Force Sensors for Wind Tunnels

3-Component ICP® Quartz Force Sensor
Model 260A01
- Sensitivity: 2.5mV/lb (0.56 mV/N) (z-axis)
- Sensitivity: 10mV/lb (2.2 mV/N) (x, y-axis)
- Compression range: to 1000 lb (4500 N) (z-axis)
- Compression range: to 500 lb (2200 N) (x, y-axis)
- Side-orientated 4-pin connector
- Low frequency response: 0.01 Hz
- Resonant frequency: 90 kHz

3-Component Force Sensors:
Piezoelectric force sensors are well suited for measuring dynamic and quasi-static force. They feature high stiffness, fast response, and repeatable performance, permitting them to capture high frequencies and follow fast transient events such as impacts. The high stiffness allows them to survive repetitive cycles without fatigue.

The Aerospace & Defense division of PCB Piezotronics serves the Turbine Engine, Helicopter Health and Usage Monitoring (HUMS), Ground Vibration Test, Flight Test, Wind Tunnel Test, Fuze/Safe and Arm, Spacecraft and Aerospace Systems design and development communities with sensors and associated signal conditioning for measurement of acceleration (vibration, shock and rigid body), acoustics; pressure; force; strain; and torque. Sensor technologies employed include piezoelectric, piezoresistive (both strain gauge and MEMS) and variable capacitive (both MEMS and microphone). Manufacturing operations are certified to AS9100 and ISO 9001, with calibration procedures accredited by A2LA to ISO 17025. Products can be manufactured to meet specific aerospace environmental standards, with program design requirements to meet RTCA-D0-160 and MIL-STD-810, and low outgassing designs available for specific applications.

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