The Accelerometer Calibration Workstation Model 9155C features accurate back-to-back comparison calibrations of ICP® (IEPE) and charge mode piezoelectric accelerometers in accordance with ISO 5347-3. Benefits of the Model 9155C form in two areas: conformance to existing standards and automation of the calibration task.

The system is designed to perform accelerometer calibrations emulating the procedure in ISO 5347-3 for secondary calibrations. Hardcopy printed certificates fulfill the requirements set forth by ISO 17025 for calibration certificates. The system also calculates measurement uncertainty according to ISO 5347-3.

The automation afforded by the easy to use Windows software provides for simplified calibration procedures, as test parameters are stored and recalled automatically for each accelerometer. This makes for 'hands-off' operation once the sensor is mounted. Even faster data acquisition is possible when using broadband excitation (option 9155C-200).

The Model 9155C is a turn-key solution, providing all necessary system components 'out-of-the-box'. Principle components are the Windows PC controller, printer, data acquisition hardware, reference accelerometer, shaker table, and signal conditioning.

Use the 9155C as your first step toward conforming to vibration calibration requirements!

**Features:**

- Assures accurate, NIST and/or PTB traceable calibrations
- Turn-key system includes all necessary components
- Windows PC supplies familiar, intuitive user interface
- Setup tests, acquire data, save results, and print reports with precision and automation
- Define multiple pass/fail criteria for each test and automatically recall them from the internal database
- Printed certificates comply with ISO 17025
- Automated calibration procedures
- Self-documenting measurement uncertainty
- Traceable calibrations at 33 frequencies

**“YOUR ONE STOP SOUND AND VIBRATION SHOP”**
As a crucial part of the Model 9155C Accelerometer Calibration Workstation, the Windows XP control software has been designed to provide accurate calibrations and an easy-to-use graphical user interface, based on the 30+ years of accelerometer manufacturing experience at PCB Piezotronics.

**Software Features**

- Broadband excitation provides faster, more efficient test cycle times
- Software automatically updates TEDS sensors with new calibration data
- Phase measurement calibration provides additional confidence in sensors
- Calibrates velocity output sensors, reported in English or metric units
- Database of sensor specifications and test requirements automate system setup
- Clearly defines Pass/Fail criteria for each sensor type
- Retrieve and archive calibration data in SQL compliant database
- Export calibration data for third party systems (MET/TRACK, etc.)
- Printed calibration certificates comply with ISO 17025 requirements and can be customized to user’s requirements
The accelerometer has largely supplanted all other types of transducers for vibration measurements. This wide-spread use has been satisfied by several sensing technologies including piezoelectric, piezoresistive, capacitive, and servo. Accordingly, hundreds of thousands of these accelerometers are used each year.

In some applications, calibration is not needed. Amplitude scaling is unnecessary if frequency discrimination, such as measurement of resonances, is the only requirement. However, magnitude scaling is often critical for advanced problem solution, especially in cases of trending, animation or modeling.

Without traceability to an absolute physical standard, the reliability of a non-traceable vibration transducer (and the data acquired) is of limited value. Correct and meaningful vibration transducer calibration ensures traceability to an absolute physical standard, which provides a defined degree of confidence in all of your vibration measurements.

Calibrating a vibration transducer at just one frequency will provide the vibration engineer with the sensitivity of the transducer. However, it will not reveal anything regarding the usefulness of the transducer at other frequencies. True confidence in the performance of the vibration transducer can only be obtained by calibrating the sensitivity at more than one frequency. Your transducer should be calibrated over the entire specified frequency range to ensure that the transducer has not been damaged. Transducer damage will typically show up as irregularities in the Frequency Response Function (FRF) curve. The 9155C system detects any irregularities by recording both magnitude and phase at each tested frequency.

Studies at both the Imperial College of London and the University of Cincinnati have confirmed that improper scaling is a common error in acceleration frequency response measurements [1,2]. This figure from UC’s vibration course clearly indicates this. All measurements were taken from identical points on the same structure. The difference between curves are calibration errors. Users need to obtain and use proper calibration values to eliminate this problem.

There are many ways to calibrate an accelerometer: gravity, fixed frequency/amplitude handheld exciters, reference standards, and reciprocity. Each of these methods relies on additional equipment to provide a scaling value for an accelerometer under calibration. When not controlled properly, significant variances occur in measurement. The figure below from an Australian National Measurements Laboratory round-robin study shows variances in calibrations performed by accredited calibration laboratories [3].

This round-robin report concludes that uncertainties on the order of 3% can be expected. Uncertainty increases at smaller accelerations and lower frequencies. Even among participating laboratories, results from several had to be dismissed where “due care” with instrumentation or documentation had not been taken.

If these calibration laboratories can err, it becomes obvious that control and traceability is extremely important. Typically, a certified lab should expect uncertainties at the reference frequency to be less than 2%. This is why the ISO 9001 and 10012 standards specifically concentrate on ensuring adequate calibration controls. Instituting a program based on calibration standards, like ISO 5347-3/1987, helps to ensure quality in measurements.

If measurement is a part of your job, consider establishing a controlled, traceable program for your equipment. The Modal Shop calibration systems and PCB reference sensors will provide a strong foundation for your program. Don’t let complicated standards or jargon deter you. We will be glad to provide assistance in creating a calibration program.

References:
The 9155C’s use of a dedicated vibration exciter provides a high quality vibration environment for accurate calibrations. ISO standard 5347-3 outlines the back-to-back configuration in which the Sensor Under Test (SUT) and the Standard Reference Accelerometer are subjected to identical input accelerations. Consequently, the ratio of the two transducers’ sensitivities are simply the ratio of their measured outputs. A comparison is performed by the control software, while obtaining the measured outputs at every frequency. On-line calculation of the sensitivity and phase of the SUT takes place in parallel to displaying the result on the screen.

### SPECIFICATIONS:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>5 Hz - 10 kHz</td>
</tr>
<tr>
<td>Typical Measurement Uncertainty*</td>
<td>1.4% (&lt;2000 Hz) 2.5% (2000-10,000 Hz)</td>
</tr>
<tr>
<td>Calibration Method</td>
<td>Back-to-back comparison per ISO 5347-3</td>
</tr>
<tr>
<td>Measurements</td>
<td>Sensitivity, Phase</td>
</tr>
<tr>
<td>Accelerometers Supported</td>
<td>ICP®, Charge, Voltage</td>
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<tr>
<td>Sensors Supported</td>
<td>Acceleration, Velocity</td>
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<tr>
<td>TEDS Sensor Support</td>
<td>IEEE P1451.4</td>
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<tr>
<td>Excitation Type</td>
<td>Stepped Sine, Broadband</td>
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<tr>
<td>Acceleration Levels</td>
<td>1 to 10 G</td>
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<tr>
<td>Max. Displacement</td>
<td>1 in. (2.54 cm) pk - pk</td>
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<tr>
<td>Reference Frequencies</td>
<td>100 and 159 Hz</td>
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<tr>
<td>Calibration Data Management</td>
<td>Yes</td>
</tr>
<tr>
<td>Automatic pass/fail Classification</td>
<td>Yes</td>
</tr>
<tr>
<td>Measurement Units</td>
<td>English, Metric</td>
</tr>
</tbody>
</table>
| Dimensions†                    | Main Cabinet: 29.5"H x 21.75"W x 23"D [75cm x 55cm x 58cm]  
Shaker: 9.25"H x 9.25"W x 7.5"D [23.5cm x 23.5cm x 19.1cm]  
115 Volts - optional 220 Volts |
| Main Voltage Supply            | 115 Volts - optional 220 Volts                   |

* random component estimated in software automatically  
† additional space required for PC monitor and keyboard

### REFERENCE ACCELEROMETER

<table>
<thead>
<tr>
<th>Model</th>
<th>PCB 301A10</th>
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<tbody>
<tr>
<td>Type</td>
<td>ICP®</td>
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<tr>
<td>Sensitivity</td>
<td>100 mV/Pa</td>
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<tr>
<td>Frequency Range</td>
<td>.5 Hz - 10 kHz</td>
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<tr>
<td>Weight</td>
<td>6.2 oz (176 g)</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>&gt; 35 kHz</td>
</tr>
</tbody>
</table>

### ORDERING INFORMATION:

- 9155C: Automated Accelerometer Calibration Workstation base system
- 9155C-200: Broadband Excitation, optional
- 9155C-300: Phase Calibration, optional
- 9155C-400: TEDS Sensor Support, optional
- 9155C-600: Velocity Calibration, optional
- 9155C-SC: Software Contract

### SUPPLIED ACCESSORIES:

- System Verification Sensor PCB Model 352A78
- Diamond edge whetstone
- Various mounting adapters & cables

### OTHER TMS CALIBRATION SYSTEM PRODUCTS

- 9350C: Precision Acoustic Calibration Workstation
- 9963C: Gravimetric Calibration System
- 9090C Series: Accelerometer Array Calibrator
- 9100C: Portable Vibration Calibrator

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*rev. 7.10.2002  ICP is a reg. trademark of PCB Group, Inc.  * In the interest of constant product improvement, specifications are subject to change without notice.