

Calibration Certificate

Issued By: Castle Group Ltd

Date Of Issue : 14/06/17

Certificate No : 000000/00000

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All instruments are tested to check compliance with particular specifications. These specifications may be appropriate British Standards, or if the instrument was not originally designed to meet any British Standard, or when the instrument was originally manufactured a relevant British Standard did not exist, the instrument will be tested to the manufacturer's original specification.

Absolute calibration of vibration calibrators and vibration meters is checked at one or more standard frequencies against an independent sound source with calibration directly traceable to the Physikalisch-Technische Bundesanstalt (PTB) in Germany. The PTB reference applicable for the calibration of the test equipment is shown below.

The performance of the instrument was determined by comparison with the manufacturers' specification as found in the instrument handbook or other technical publication. Any significant uncertainty of the measuring system will also be included.

The instrument was allowed to stabilise for a period of 30 minutes prior to measurements made.

The ambient temperature and relative humidity throughout calibration were 22 ± 2 °C and 50% RH respectively.

Instruments used to carry out this calibration are as follows: -

Vibration Calibrator: SV111 Serial Number 25039

Vibration Exciter: GA606 Serial Number 4357

Applicable Reference: PTB-17012-2017, reference no: 1.71-1508/0317.

Subject of Calibration: GA2006M

Instrument: HARM + Whole-Body Vibration Meter

Serial No: 000000

Accelerometer Type: KD1006

X Axis:

Sensitivity (mV/g) Y Axis:

Z Axis:

Accelerometer Serial No:

X Axis:

Calibration Coefficient Y Axis:

Z Axis:

Accelerometer Type: KD1009

X Axis:

Sensitivity (mV/ms²) Y Axis:

Z Axis:

Accelerometer Serial No:

X Axis:

Calibration Coefficient Y Axis:

Z Axis:

Basis Of Test: Compliance to Manufacturer's Original Specification

Calibrated By:

A N Engineer

(Approved Signatory)

Date of Calibration: 14 Jun 2017

Completed Status: Pass

Checked By:

A N O Engineer

(Approved Signatory)

Recalibration Due: 01 Jul 2018

Client: End User Company Name

Address: Place

Street

Location

Town

County

Postcode

Client Reference: If Applicable

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CALIBRATION RESULTS

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INDICATED RESPONSE (Reference Range) Relative to 10.02ms² at 159.20Hz

HARM (TRANSDUCER = 10mV)

| X-AXIS | ACTUAL VALUE | PREFERED VALUE | TOLERANCE |
|-------------------------------|--------------|----------------|--------------------|
| METRIC (ms ⁻²) | | 1.009 | 0.9525 to 1.0687 |
| dB (Ref 1e-6) | | 120.077 | 119.577 to 120.577 |
| IMPERIAL (fts ⁻²) | | 3.310 | 3.125 to 3.506 |
| g | | 0.1029 | 0.0971 to 0.1090 |

| Y-AXIS | ACTUAL VALUE | PREFERED VALUE | TOLERANCE |
|-------------------------------|--------------|----------------|--------------------|
| METRIC (ms ⁻²) | | 1.009 | 0.9525 to 1.0687 |
| dB (Ref 1e-6) | | 120.077 | 119.577 to 120.577 |
| IMPERIAL (fts ⁻²) | | 3.310 | 3.125 to 3.506 |
| g | | 0.1029 | 0.0971 to 0.1090 |

| Z-AXIS | ACTUAL VALUE | PREFERED VALUE | TOLERANCE |
|-------------------------------|--------------|----------------|--------------------|
| METRIC (ms ⁻²) | | 1.009 | 0.9525 to 1.0687 |
| dB (Ref 1e-6) | | 120.077 | 119.577 to 120.577 |
| IMPERIAL (fts ⁻²) | | 3.310 | 3.125 to 3.506 |
| g | | 0.1029 | 0.0971 to 0.1090 |

INDICATED RESPONSE Relative to 1.00ms² at 15.92Hz

WHOLE BODY (TRANSDUCER = 1000mV)

| X-AXIS | ACTUAL VALUE | PREFERED VALUE * | TOLERANCE |
|-------------------------------|--------------|------------------|-------------------|
| METRIC (ms ⁻²) | | 0.1773 | 0.1674 - 0.1878 |
| dB (Ref 1e-6) | | 104.973 | 104.473 - 105.473 |
| IMPERIAL (fts ⁻²) | | 0.582 | 0.549 - 0.616 |
| g | | 0.0181 | 0.0171 - 0.0191 |

| Y-AXIS | ACTUAL VALUE | PREFERED VALUE * | TOLERANCE |
|-------------------------------|--------------|------------------|-------------------|
| METRIC (ms ⁻²) | | 0.1773 | 0.1674 - 0.1878 |
| dB (Ref 1e-6) | | 104.973 | 104.473 - 105.473 |
| IMPERIAL (fts ⁻²) | | 0.582 | 0.549 - 0.616 |
| g | | 0.0181 | 0.0171 - 0.0191 |

| Z-AXIS | ACTUAL VALUE | PREFERED VALUE | TOLERANCE |
|-------------------------------|--------------|----------------|-------------------|
| METRIC (ms ⁻²) | | 0.7745 | 0.7311 - 0.8204 |
| dB (Ref 1e-6) | | 117.780 | 117.280 - 118.280 |
| IMPERIAL (fts ⁻²) | | 2.541 | 2.399 - 2.691 |
| g | | 0.0790 | 0.0746 - 0.0836 |

* Multiplication factor of 1.4 applied to X and Y axis in accordance with the European Union Physical Agents Directive 2002/44/EC for whole body calculations.

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RANGE TEST (Acceleration) Relative to 10.0ms² at 160Hz

TRANSDUCER = 10mV

LINEARITY RESPONSE The method employed was a direct electrical signal injection on the reference range.

| TARGET LEVEL (ms ²) | READING | | | TOLERANCE (ms ²) |
|------------------------------------|---------|---|---|---------------------------------|
| | X | Y | Z | |
| 1.00 | | | | 0.95 - 1.05 |
| 10.00 | | | | 9.50 - 10.50 |
| 100.00 | | | | 95.00 - 105.00 |
| 1000.00 | | | | 950.00 - 1050.00 |

LINEARITY RESPONSE (Other Measurement Ranges) The method employed was a direct electrical signal injection.

| RANGE | TARGET LEVEL (ms ²) | READING (X ONLY) | TOLERANCE (ms ²) |
|---------------|---------------------------------|------------------|------------------------------|
| 0.02 - 100.0 | 0.10 | | 0.095 - 0.105 |
| 0.02 - 100.0 | 1.00 | | 0.95 - 1.05 |
| 0.02 - 100.0 | 10.00 | | 9.50 - 10.50 |
| 0.02 - 100.0 | 100.00 | | 95.00 - 105.00 |
| 0.1 - 500.0 | 0.10 | | 0.095 - 0.105 |
| 0.1 - 500.0 | 1.00 | | 0.95 - 1.05 |
| 0.1 - 500.0 | 10.00 | | 9.50 - 10.50 |
| 0.1 - 500.0 | 100.00 | | 95.00 - 105.00 |
| 1.00 - 5000.0 | 1.00 | | 0.95 - 1.05 |
| 1.00 - 5000.0 | 10.00 | | 9.50 - 10.50 |
| 1.00 - 5000.0 | 100.00 | | 95.00 - 105.00 |
| 1.00 - 5000.0 | 1000.00 | | 950.00 - 1050.00 |

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RANGE TEST (Acceleration) Relative to 1.00ms^{-2} at 16Hz

TRANSDUCER = 1000mV

LINEARITY RESPONSE The method employed was a direct electrical signal injection on the reference range.

| TARGET LEVEL [ms^{-2}] | READING (Wd) | | TOLERANCE [ms^{-2}] |
|--------------------------------------|--------------|---|-----------------------------------|
| | X | Y | |
| 0.01 | | | 0.009 - 0.011 |
| 0.10 | | | 0.095 - 0.105 |
| 1.00 | | | 0.950 - 1.050 |
| 10.00 | | | 9.500 - 10.500 |

| TARGET LEVEL [ms^{-2}] | READING (Wk) | TOLERANCE [ms^{-2}] |
|--------------------------------------|--------------|-----------------------------------|
| | Z | |
| 0.01 | | 0.009 - 0.011 |
| 0.10 | | 0.095 - 0.105 |
| 1.00 | | 0.950 - 1.050 |
| 10.00 | | 9.500 - 10.500 |



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FILTER TESTS

HARM (Hand Arm Risk Measurement)

Wh FILTER TEST. The method employed was a direct electrical signal injection on the reference range.

| FREQUENCY (Hz) | TARGET LEVEL (ms ⁻²) | READING | | | TOLERANCE (ms ⁻²) |
|-------------------|-------------------------------------|---------|---|---|----------------------------------|
| | | X | Y | Z | |
| 2.0 | 9.92 | | | | 0.00 - 12.06 |
| 5.0 | 54.14 | | | | 44.51 - 65.84 |
| 16.0 | 89.92 | | | | 82.04 - 96.38 |
| 80.0 | 20.09 | | | | 18.54 - 21.78 |
| 160.0 | 10.00 | | | | 9.95 - 10.05 |
| 800.0 | 1.85 | | | | 1.71 - 2.00 |
| 1,600.0 | 0.53 | | | | 0.44 - 0.65 |

WBV (Whole Body Vibration)

Wd FILTER TEST. The method employed was a direct electrical signal injection on the reference range.

| FREQUENCY (Hz) | TARGET LEVEL (ms ⁻²) | READING | | TOLERANCE (ms ⁻²) |
|-------------------|-------------------------------------|---------|---|----------------------------------|
| | | X | Y | |
| 0.315 | 4.21 | | | 3.46 - 5.12 |
| 0.63 | 7.46 | | | 6.88 - 8.08 |
| 1.60 | 7.66 | | | 7.07 - 8.31 |
| 8.00 | 2.01 | | | 1.86 - 2.18 |
| 16.00 | 1.00 | | | 0.95 - 1.05 |
| 63.00 | 0.23 | | | 0.21 - 0.25 |
| 80.00 | 0.17 | | | 0.15 - 0.18 |

Wk FILTER TEST. The method employed was a direct electrical signal injection on the reference range.

| FREQUENCY (Hz) | TARGET LEVEL (ms ⁻²) | READING | TOLERANCE (ms ⁻²) |
|-------------------|-------------------------------------|---------|----------------------------------|
| | | Z | |
| 0.315 | 0.34 | | 0.28 - 0.42 |
| 0.63 | 0.59 | | 0.55 - 0.64 |
| 1.60 | 0.64 | | 0.59 - 0.69 |
| 8.00 | 1.34 | | 1.24 - 1.45 |
| 16.00 | 1.00 | | 0.95 - 1.05 |
| 63.00 | 0.24 | | 0.22 - 0.26 |
| 80.00 | 0.17 | | 0.14 - 0.21 |

Uncertainties of the measurement

The uncertainties in the table of results correspond to an estimated confidence probability of not less than 95%.

* Notes