

## APPENDIX

## Custom Capabilities & Quality Systems

### Custom Capabilities

Dytran Instruments is equipped to design and manufacture custom sensors and cable assemblies to meet the requirements of unique commercial, aerospace/defense and OEM applications, including unique packaging configurations, special connectors and calibrations. In addition to the standard product line, Dytran has a dedicated focus to offer custom sensor offerings. Some of the most critical factors which influence Dytran's willingness and ability to create precise, custom designs to fit your specific application or program include the in-house design engineering center, R&D and engineering laboratory, in-house CNC machine shop and highly experience and trained engineers. Should requirements call for additional support items not detailed here, please contact a member of our sales or customer service team for additional information. We appreciate the opportunity to design and manufacture custom products for your unique requirements.



### Quality Management System

Dytran Instruments Quality Management System meets the requirements of the following standards:

- ISO 9001:2008 and AS 9100 Revision B and in accordance with requirements of AS9104A
- ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994

The goal of the Quality Management System is to ensure all Dytran products are manufactured for outstanding performance, high reliability and durability for all applications. Process control with continuous improvement drives the spirit of all departments; from sales, initial design, through manufacturing, and service and customer support. On time delivery, satisfaction and value are the basis of Dytran's Quality policy. If you require compliance to a standard not noted above, we welcome opportunities to accept new challenges by advancing technology or processes.



Dytran Instruments believes that customer service and support simply do not end at the point of sale. Alternatively, the company continues to stand behind its products with value added service offerings designed to maximize the value of your investment of Dytran sensors, while also helping to extend their useful service life. Below is an overview of some of the most popular value added service offerings from Dytran Instruments, both prior, during and after the sale. Should requirements call for additional support items not detailed here, please contact a member of our sales or customer service team. We appreciate the opportunity to exceed your service expectations.

### Technical Field Sales Support

Dytran technical field sales personnel, and members of our authorized sales representative network, are available to provide on-site support worldwide. Whether it is a new requirement, a complicated test setup, or questions concerning the most suitable Dytran sensor for your application, the sales team at Dytran offers the necessary technical training and experience to ensure requirements are met and expectations exceeded. The Dytran technical sales team prides itself on regular ongoing communication with customers about sensor requirements, application troubleshooting and their overall experience in doing business with us. All customer feedback is valuable. It allows Dytran to actively listen and respond to your needs, with development of the "right" new product, enhancements to the existing product portfolio, and continued R&D efforts that keep pace with changing testing and evaluation needs. If you are a first time Dytran customer, visit our website at [www.dytran.com](http://www.dytran.com) to locate your nearest technical field sales team member.

### Customer Service

A team of highly experienced and trained customer service personnel are available to assist with general product questions, requests for quotations, order placements and status, and delivery verifications. Whether it's an expedited order request, or a need to investigate other types of sensors to support amended testing requirements, count on the team to quickly and efficiently respond. If Dytran customer service cannot immediately determine an answer to your question, expect to receive acknowledgement of your inquiry and an estimated response time, every time. Know that any inquiry, regardless of how big or small, will always receive the same high level of care and professionalism and our utmost attention.

### Repair and Calibration Services

In the uncommon event that a Dytran sensor is underperforming within published specifications, the team will

make every effort to evaluate the root cause and determine a resolution. Whether it's a sensor, cable or other component creating an unforeseen challenge, Dytran has the necessary in-house tools for a detailed Failure Analysis and prompt resolution.

Under extended normal use conditions, particularly within more extreme testing environments, over time sensor performance may begin to fall below published specifications. To ensure continued measurement accuracy of Dytran sensors, annual calibrations are recommended. All Dytran calibrations are A2LA accredited to the 17025 standard at the time of manufacture. These processes also extend to our routine calibration services. To schedule a repair evaluation of your Dytran sensor, or a calibration of sensors both Dytran and non-Dytran, please contact any member of our service team. Prior to sending any hardware to the factory, you will need to receive an RMA number from the Service Department. For your convenience, Dytran also offers expedited calibration services and blanket calibration orders. Please consult the factory for details.

### Comprehensive Website and Online Order Capabilities at [www.dytran.com](http://www.dytran.com)

Customers have the availability of conducting business with Dytran 24 hours per day, 7 days a week. The company has established online ordering capabilities at [www.dytran.com](http://www.dytran.com) (for U.S. customers only). The site contains the most up-to-date listing of available product offerings, data sheets and drawings, all available for download on demand. It also contains real-time data on any product specifications which may have been enhanced since the printing of this catalog. Dytran's website contains a unique QuickSearch function, which offers the ability to research products by category, part number or keywords. An automated request for quotation module allows customers to submit an itemized list of selected products and receive fast pricing and delivery information. Customers are encouraged to visit the site frequently for updates on new sensors, capabilities and service offerings.



**Acceleration Compensation**

A design incorporating components within the sensor to cancel the effect of motion (vibration) on the sensor output signal.

**Acceleration Sensitivity**

In a pressure transducer or impulse hammer, this refers to the unwanted output signal from the sensor in response to vibration in the sensitive axis of the sensor. This parameter is specified in terms of psi/g for pressure sensors and lbs/g for impulse hammers. Certain Dytran sensors such as the Series 2200 and 2300 pressure sensors and the Dynapulse™ series of impulse hammers are acceleration compensated to minimize this effect.

**Charge Mode**

Sensors which contain piezoelectric crystals but no built-in electronics. These sensors may use quartz or piezoceramics to generate electrostatic charge signals in response to input measured.

**Current Source Power Unit**

A power supply expressly designed for use with IEPE sensors consisting of an energy source (batteries of DC power supplies) and a constant current element. These units are characterized by stable constant current output and high dynamic impedance. They also serve as signal decoupling devices.

**Discharge Time Constant (TC)**

The time required for the output voltage from a sensor or system to discharge to 37% of its original value in response to a zero rise time step function input. This parameter determines low frequency response.

**Fault Monitor Meter**

A DC Voltmeter incorporated into IEPE power units to read the DC voltage at the output of the current source. If a sensor is connected, the meter reads the sensor bias voltage and can be used to indicate open and shorted cables and sensors or to verify normal system operation.

**Frequency Response**

The highest and lowest frequencies at which measured deviations from a reference sensitivity (usually 100 Hz) lie within a specified error. The deviations are usually specified as -5%, but in some cases -3dB is specified.

**IEPE**

Internal Electronics Piezoelectric. Describes piezoelectric sensors with built-in impedance converting electronics.

**Linearity**

Actually the non-linearity or deviation from a straight line in a plot of output amplitude vs. input amplitude of a sensor or system. At Dytran, we use the popular

zero based best straight line method of determining linearity. Full scale is determined, a zero based best straight line plot of output vs. input is made, an error band is created using a specified percent of full scale. All points on the curve must fall within this error band.

**Mass Loading**

The change in actual sensitivity of a back-to-back accelerometer when loaded with masses significantly different from the transfer standard with which it was originally calibrated. Correction curves of actual sensitivity vs. frequency are referred to as "mass loading correction curves".

**Normalization**

See "Standardization".

**Phase Shift**

The difference in phase angle between input measured and output electrical signal, measured in degrees. The response may lag or lead the input.

**Picocoulomb**

A measure of electrostatic charge output from piezoelectric sensors. 1 Picocoulomb =  $1 \times 10^{-12}$  Coulomb.

**RMS**

Root Mean Square. In AC theory, this is the "heating value" of an AC waveform and it is equal in amplitude to .707 times the peak value of the waveform. Most AC meters are calibrated to read in RMS. To obtain the peak value of the waveform, multiply the RMS value by 1.414.

**Resonant Frequency**

Also called "natural frequency". The lowest frequency of a second order system (spring-mass system) which satisfies the solution to the differential equation of motion. At this frequency, the amplitude increases by factors of as much as 100. The useable upper frequency of a sensor is determined by this parameter. All sensors are spring-mass systems with intrinsic natural frequencies.

**Rise Time**

The time required for a sensor or system to respond to an instantaneous input step function, measured from the 10% to 90% points on the response waveforms.

**Sensitivity**

The scale factor of a sensor or system, measured in terms of change in output signal per change in input measured. Accelerometer sensitivity is expressed in terms of mV or pC/g, pressure sensor sensitivity is expressed in terms of mV or pC/psi and force sensor sensitivity is expressed in terms of mV or pC/LbF.

**Sensor Bias**

When IEPE sensors are supplied with constant current, a DC voltage bias exists at the center conductor of the sensor connector. The output signal is superimposed on this DC bias. The power unit extracts the signal from this bias by various means, effectively "blocking" it. The normal range for this voltage is +9 to +12 volts.

**Standardization**

As applied to systems, refers to the application of gain or attenuation as needed to correct the sensitivity of a sensor to the exact nominal (or design) sensitivity. As applied to sensors, refers to the process by which the sensor sensitivity is brought close to the nominal value. In specification sheets, it is the highest acceptable deviation of the measured sensitivity from the nominal value, expressed in percent.

**Transient Thermal Response**

The time history of the change in output (voltage or charge) from a sensor resulting from a sudden change in ambient temperature.

**Transverse Sensitivity**

The output of an accelerometer in response to motion in directions orthogonal to its sensitive axis, expressed as a ratio of measured output to cross axis input, in percent.

**Thermal Coefficient of Sensitivity**

The measured change in the sensitivity (of scale factor) of a sensor, from its room temperature (reference) value to the value at a higher or lower stabilized ambient temperature. This parameter is measured in percent of change in sensitivity per degree of temperature deviation.

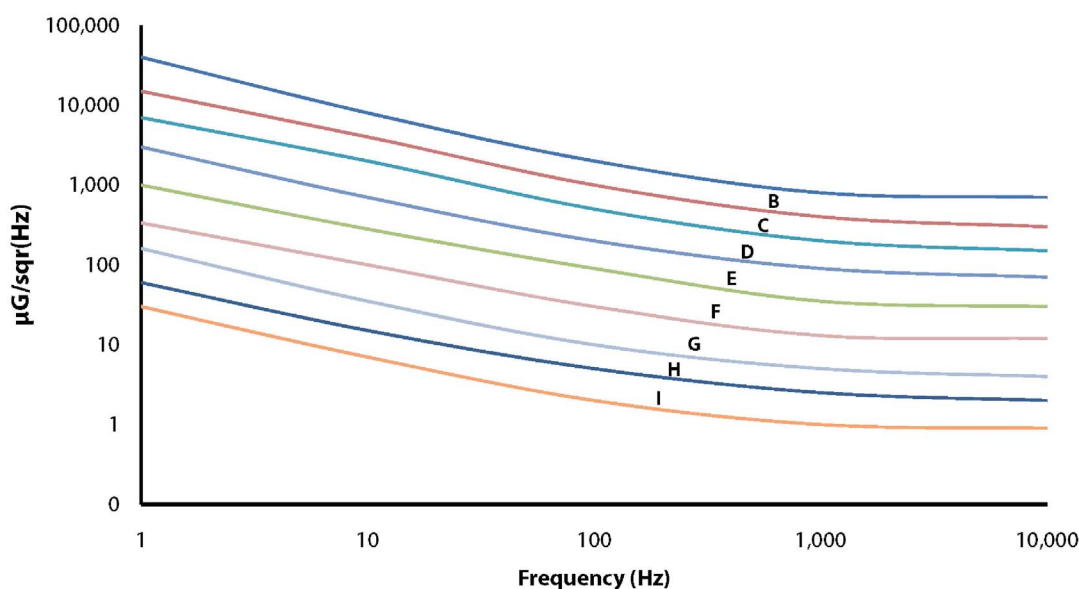
**Triboelectric Noise**

The unwanted generation of electrical charges by the chafing together of insulation layers inside electrical cables during flexing caused by vibration and shock induced motion.

**Zero Shift**

The change in baseline level of the output voltage of an accelerometer immediately after a mechanical shock.

This plot shows generalized spectral noise curves of Dytran IEPE accelerometers. The provided data is typical and calculated based on the nominal values of a discharge time constant and sensitivity. It can only be used as a comparison tool from model to model. Actual results may vary. To determine the appropriate curve for a specific model, please go to the Spectral Noise reference under the model's specifications.



## APPENDIX

## Useful Formulae and Conversion Factors

### LOW FREQUENCY RESPONSE, Piezoelectric Sensor

Lower corner Frequency (-3dB Frequency) 1st Order High Pass

$$f_c = \frac{1}{2\pi} \cdot \frac{1}{\tau} = \frac{1}{2\pi} \cdot \frac{1}{TC} = \frac{.16}{TC} \text{ (Hz)}$$

Note:  $\tau = TC =$  Discharge Time Constant, Seconds

Lower -5% Frequency, 1st Order, High Pass

$$f_{(-5\%)} = 3 f_c \text{ (Hz)}$$

### SINUSOIDAL WAVEFORMS

Average Value = .637 x Peak Value

RMS Value = .707 x Peak Value

Peak Value = 1.14 x RMS Value

Peak to Peak Value = 2 x Peak Value

Peak to Peak Value = 2.828 x RMS Value

### ACCELERATION

Multiply	by	to obtain
acceleration of gravity (g)	9.80665	m/sec <sup>2</sup>
	32.174	ft/sec <sup>2</sup>
cm/sec <sup>2</sup>	0.010	m/sec <sup>2</sup>
ft/sec <sup>2</sup>	0.3048	m/sec <sup>2</sup>
in/sec <sup>2</sup>	0.02540	m/sec <sup>2</sup>

### VELOCITY

Multiply	by	to obtain
ft/min	5.080	mm/sec
ft/sec	0.3048	m/sec
in/sec	0.0254	m/sec
km/hr	0.6214	mi/sec
kn	0.5144	m/sec
	1.151	mi/hr (U.S.)
m/sec	3.2808	ft/sec
	2.237	mi/hr (U.S.)
mi/hr	88.0	ft/min
	0.447 04	m/sec
	1.6093	km/hr
	0.8684	kn

### PRESSURE

Multiply	by	to obtain
atmospheres	1.01325	bars
	33.90	ft of H <sub>2</sub> O
	29.92	in of Hg
	70.0	mm of Hg (torr)
	101.325	kN/m <sup>2</sup> (k Pa)
	14.696	lbs/in <sup>2</sup>
bar	75.01	cm of Hg
	10 <sup>5</sup>	N/m <sup>2</sup> (Pa)
	14.50	lbs/in <sup>2</sup>
dyne/cm <sup>2</sup>	0.1000	N/m <sup>2</sup> (Pa)

in of H <sub>2</sub> O	248.84	N/m <sup>2</sup> (Pa)
	0.07355	in of Hg
kg (f)/cm <sup>2</sup>	14.22	lbs/sq. inch
kg (f)/cm <sup>2</sup>	9.80665	N/m <sup>2</sup> (Pa)
mm of Hg (torr)	133.32	N/m <sup>2</sup>
	0.01933	lbs/in <sup>2</sup>
	13.595	mm of H <sub>2</sub> O
N/cm <sup>2</sup>	1.450	lbs/in <sup>2</sup>
N/m <sup>2</sup> (pascal)	1.450 x 10 <sup>-4</sup>	lbs/in <sup>2</sup>
lbs/ft <sup>2</sup>	0.19242	in of H <sub>2</sub> O
	47.880	N/m <sup>2</sup> (Pa)
lbs/in <sup>2</sup>	0.06805	atm
	2.036	in of Hg
	27.708	in of H <sub>2</sub> O
	68.948	mb
	703.77	mm of H <sub>2</sub> O
	51.72	mm of Hg
	0.68948	N/cm <sup>2</sup>
	6 8948	N/m <sup>2</sup> (Pa)
	7.031 x 10 <sup>-4</sup>	kg (f)/mm <sup>2</sup>

### FORCE/MASS

Multiply	by	to obtain
dyn	10 <sup>-5</sup>	N
g (force)	980.7	dyn
kg (force)	9.80665	N
	1.00	kip
N	10 <sup>5</sup>	dyn
	0.1020	kg (force)
	3.597	oz (force)
	0.2248	lb (force)
	7.2330	pdl
oz (force)	0.2780	N
	0.0625	lb (force)
lb (force)	16.00	oz (force)
	0.45359	kg (force)
	4.448	N
ton (force) (short)	2000	lb (force)
	8896	N
carat	0.200	g
g	0.03527	oz (avdp.)
kg	2.2046	oz (avdp.)
oz (avdp.)	28.350	g
lb (avdp.)	16.0	oz (avdp.)
	453.6	g

## Warranty

Dytran products are warranted against defects in materials and workmanship for a period of one year after delivery. Dytran, at its option, will repair and or replace products which prove to be defective. Please contact our Service Department for an RMA number prior to returning any products for repair or calibration.

## Ordering Information

### Where to Order

You may place your order directly with the factory, or through any authorized Dytran representative in the U.S. or abroad. Contact the factory for assistance in locating your local representative.

### Open Accounts

Terms of Net 30 Days are given to customers upon approval of credit. Favorable terms for early payment are negotiated.

### Methods of Payment

Dytran accepts Visa, MasterCard and American Express. We also accept payments by Electronic Funds Transfer (EFT) and ACH.

### Non-Cataloged Items

This catalog lists standard products only. Contact our Sales Department for information on modified or special products.

### Bids

We will gladly process all written Requests for Quote, Requests for Proposal or Bid Requests. RFQ's can be submitted directly through our web site: [www.dytran.com](http://www.dytran.com).

### Scheduled Order

Orders may be scheduled for delivery over a 1-year period or as negotiated.

### Samples

Demonstration samples are available on request.

### Prices

Price lists are available on request. Prices are subject to change without notice.

### Minimum Orders

A minimum order of \$50.00 is required.

## Terms and Conditions

### Trademarks and Patents

Dytran, Dynapulse, Hypershock, and Immersion Proof are trademarks of Dytran Instruments, Inc. All other trademarks are property of their respective owners.

### Shipping Charges

All orders are shipped EXW shipping point (factory). Shipping charges are prepaid and added to the invoice, unless otherwise specified. Drop-ship service is available. Please indicate preferred carrier when placing your order.

### Returns

Contact our Service Department for return authorization prior to returning any items for calibration, repair or exchange.

### Restocking Policy

A 30% restocking charge applies to all unused and returned goods. Accessories, cables, custom or modified items are not eligible for restocking.





# Trusted Expertise.

The team at Dytran Instruments has more than 30 years of experience in the successful design and manufacture of piezoelectric and DC MEMS sensing technologies to support a variety of demanding applications and program requirements. Dytran carefully monitors each aspect of our vertically integrated in-house manufacturing processes, from choice of sensing elements and housings, to connectors, soldering and cables, to ensure precision measurement accuracy of finished products within extreme environments. All models also undergo regular design reviews for continuous product improvements. Typical applications for Dytran piezoelectric and MEMS DC sensors may be found on the individual product pages highlighted in this catalog. In addition, Dytran offers custom manufacturing capabilities that include its own design and machining operations. At its AS9100 and ISO9001:2008 certified facility in Chatsworth, California, USA, the company offers the necessary expertise to custom design and package nearly any sensor, connector or cable to precise customer or program specifications with short lead times. Calibration services are also A2LA accredited to the ISO 17025 standard, ensuring the quality and uniformity of sensors and instrumentation, all tested according to rigorous in-house standards.

For assistance in evaluating your application requirements, contact a member of the Dytran Technical Sales team at [sales@dytran.com](mailto:sales@dytran.com).

AS9100 CERTIFIED • A2LA ACCREDITED TO ISO 17025 • ISO9001:2008 CERTIFIED

21592 Marilla Street • Chatsworth, CA 91311 PHONE 818.700.7818 FAX 818.700.7880 EMAIL [info@dytran.com](mailto:info@dytran.com) WEB [www.dytran.com](http://www.dytran.com)