SAVIAC
Shock and Vibration Information Analysis Center
Current Awareness
April 2003

Rear Admiral Kenneth D. Slaght, USN to Keynote at 74th Shock & Vibration Symposium

Rear Admiral Kenneth D. Slaght, Commander of the Space and Naval Warfare Systems Command (SPAWAR), has accepted an invitation to deliver the Keynote Address at the Opening Session of the 74th Shock & Vibration Symposium. This year's Symposium, featuring SPAWAR, Naval Systems Warfare Center (NSWC) Crane Division, and ENDEVCO Corporation, will be held at the Red Lion Hanalei Hotel in San Diego the week of October 27-31, 2003.

Rear Admiral Ken Slaght has previously served as the Vice Commander for SPAWAR, Chief Engineer, and Program Manager for the Joint Maritime Communications System Program Office. Other shore duty assignments have included Project Officer for the Communications Support System, Deputy Director for Information Transfer Systems Directorate at SPAWAR, Division Director for Automated Plans and Programs in the Office of the Joint Chiefs of Staff, Division Director for Automation at the Navy Recruiting Command, and Deputy Director for Material Professional Policy at the Naval Military Personnel Command. The Admiral is currently responsible for development, acquisition, and life cycle management of command, control, communications, computers, intelligence, surveillance and reconnaissance systems for the United States Navy, and select Marine Corps and joint service programs.

RADM Slaght has commanded the ammunition ship USS Flint (AE-32). Other sea duty included tours as

Admiral Kenneth D. Slaght, USN
Commander
Space & Naval Warfare Systems Command

Executive Officer aboard the guided

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The Drop Shock

Anthony Chu, Director of Product Marketing, Endevco

Endevco is the Commercial featured agency at the 74th Shock & Vibration Symposium, to be held October 27-30, 2003 in San Diego, California. Endevco is the world's leading manufacturer of dynamic instrumentation for vibration, shock, inertial motion and dynamic pressure measurements. In addition to its well-known component and system calibration expertise, Endevco has decades of experience working with a broad range of piezo-electric, variable capacitance and piezoresistive technologies. For more information on Drop Shock contact Anthony Chu at 949-493-8181 or anthony@endevco.com. For more information on Endevco visit http://www.endevco.com.

When dropped from a height of one meter, objects may impact rigid surfaces with very large accelerations. Relatively speaking, lower mass objects tend to result in greater accelerations. As an example, an accelerometer, with a normal mass of only 10 grams, may easily be subjected to 30,000 g when dropped from one meter onto a rigid steel plate. If the interface on impact is flat-to-flat, the level may exceed 80,000g.

The amount of acceleration imparted to a dropped object is proportional to the square root of the drop height, and the inverse of the pulse width.

The Drop Shock

Consider an object dropped onto a horizontal surface. For the purpose of this evaluation, the object starts at rest, and free-falls to impact a rigid surface after traveling a distance, d_1, as shown in Figure 1. After impact, the object rebounds upward to some height d_2.

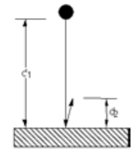

Figure 1

An object in free-fall experiences constant acceleration due to gravity, and the velocity increases in the downward (negative)

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Endevco, continued from Page 1

direction as:

$$v(t)=g\,t \quad \textbf{(1)}$$

The distance traveled is:

$$d(t)=\frac{1}{2}g\,t^2 \quad \textbf{(2)}$$

These two equations may be combined to determine the velocity of the object immediately prior to impact:

$$V_1=-\sqrt{2\,g\,d_1} \quad \textbf{(3)}$$

Likewise, the upward velocity immediately after impact is:

$$V_2=\sqrt{2\,g\,d_2} \quad \textbf{(4)}$$

Immediately before impact, the object is still in free-fall. If the object were a piezoelectric accelerometer, it would have zero output. The same is true immediately after impact. During impact, the object must stop its downward course, and reverse its direction. This is where the high level acceleration occurs. Acceleration is, by definition, the rate of change of velocity. The faster the object changes from downward velocity to upward velocity, the greater the acceleration:

$$a=\frac{Äv}{Ät} \quad \textbf{(5)}$$

When dropped from the same height, lighter objects will tend to exhibit shorter pulse widths and greater acceleration levels. The force imparted to the floor is greater with a more massive object, but the acceleration is less. The mathematics to follow further substantiates this.

The Half Sine Pulse

When describing the output of an accelerometer during a drop shock, the wave shape is often referred to as a half sine. Few impact wave shapes are truly half sine, but the resemblance is usually close enough. The half sine is also a simple function to treat mathematically, and it will be used as a model to predict the behavior of drop shock phenomena. A plot of acceleration versus time of a half sine shock will look something like that shown in Figure 2.

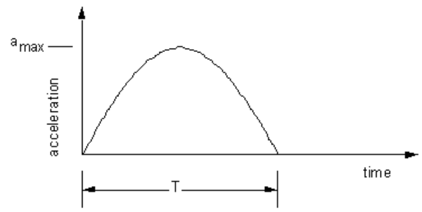

Figure 2

The velocity is the integral of the acceleration, plus an integration constant. Integrating the half sine results in a 'half cosine', and would look something like that shown in Figure 3, below. Keep in mind that the curve can be shifted vertically to match the boundary conditions of the drop (thanks to the integration constant).

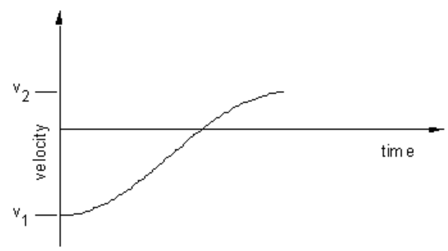

Figure 3

To set the boundary conditions of the velocity curve, first realize that v_1 is simply the velocity immediately before impact.

$$V_1=-\sqrt{2\,g\,d_1} \quad \textbf{(6)}$$

And v_2 is the velocity immediately after impact

$$V_2=\sqrt{2\,g\,d_2} \quad \textbf{(7)}$$

The curve of Figure 3 with the above two boundary conditions is described by

$$v(t)=\cos\left(\frac{ðt}{T}\right)\left(\frac{v_1-v_2}{2}\right)+\frac{v_1+v_2}{2} \quad \textbf{(8)}$$

where T is the pulse width of the impact. Taking the derivative of the velocity function yields the acceleration function:

$$a(t)=\frac{d}{dt}v(t)=\frac{d}{dt}\left(\cos\left(\frac{ðt}{T}\right)\left(\frac{v_1-v_2}{2}\right)\right) \quad \textbf{(9)}$$

$$a(t)=-\frac{ð}{T}\sin\left(\frac{ðt}{T}\right)\left(\frac{v_1-v_2}{2}\right) \quad \textbf{(10)}$$

such that

$$a(0)=0 \quad \textbf{(11)}$$

$$a\left(\frac{T}{2}\right)=\frac{ð}{T}\left(\frac{v_1-v_2}{2}\right) \quad \textbf{(12)}$$

$$a(T)=0 \quad \textbf{(13)}$$

all which describe the characteristics of a half sine acceleration pulse. The peak acceleration occurs at time T/2, as seen in equation (12). Substituting the velocity variables,

$$a_{peak}=a\left(\frac{T}{2}\right)=a\,\frac{ð}{T}\left(\frac{v_1-v_2}{2}\right) \quad \textbf{(14)}$$

$$a_{peak}=a\,\frac{ð}{T}\left(\frac{\sqrt{2\,g\,d_2}-\left(-\sqrt{2\,g\,d_1}\right)}{2}\right) \quad \textbf{(15)}$$

$$a_{peak}=\frac{ð}{T}\sqrt{\frac{g}{2}}\left(\sqrt{d_2}+\sqrt{d_1}\right) \quad \textbf{(16)}$$

From equation (16) it can be seen that the peak acceleration in a drop shock is primarily dependent on two things:

1. The inverse of the pulse width. Shorter pulse widths result in higher accelerations.

2. The square root of the drop and rebound distance. Assuming minimal rebound, doubling the drop height results in a 41% higher shock.

Here are some simplified approximations:

$$g_{peak}=.71\,\frac{\sqrt{d_2}+\sqrt{d_1}}{T} \quad \textbf{(17)}$$

for d_1, d_2 in meters: T in seconds

$$g_{peak}=.39\,\frac{\sqrt{d_2}+\sqrt{d_1}}{T} \quad \textbf{(18)}$$

for d_1, d_2 in feet: T in seconds

The pulse width 'T' is dependent on the shape and material properties of the

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"Vibration and Shock Testing, Measurement, Analysis and Calibration, also ESS, HASS and HALT": An Excerpt Part IV

The following is part IV and the final excerpt from Chapter 29 (of 31) of Wayne Tustin's forthcoming text "Vibration and Shock Testing, Measurement, Analysis and Calibration, also ESS, HASS and HALT". Parts I, II, and III may be read in the January, February, and March 2003, respectively, editions of Current Awareness. *Wayne describes the book as "A minimal-mathematics introduction," and says it "has applications in the fields of aeronautical, automotive, seismic and shipboard testing". Adjacent chapters are 28 "Measuring and Quantifying Mechanical Shock" and 30 "Mechanical Shock Testing". Further details are available from tustin@equipment-reliability.com.*

Chapter 29 is entitled "SRS - The Shock Response Spectrum". This month we bring you section 29.8 "Electronic SRS analysis".

29.8 Electronic SRS analysis

The following is credited to A Proposed Method to Standardize Shock Response Spectrum (SRS) Analysis by Strether Smith and Bill Hollowell, then with Lockheed Martin Advanced Technology Center Palo Alto, California. It appeared in the May/June 1996 IES Journal.

The authors digitally recorded a pyroshock event onto hard drive in the early 1990's. Figure 29-24 suggests the accelerometer signal they recorded on tape. Their electronic SRS analysis is shown by Figure 29-25.

Figure 29-24 Pyroshock event

Then they made several copies of the tape. They sent a duplicate tape to each of several recognized laboratories. They asked each lab to perform an electronic SRS analysis and to send their results to Lockheed. The results from various labs are shown in the composite graph, Figure 29-26. This kind of exercise is often called a "Round Robin".

Low frequency disagreement was caused by such differences (between laboratories) as the use (or non-use) of a

Figure 29-25 Resulting SRS

blocking capacitor at the analyzer input. High frequency disagreement was caused by such differences (between laboratories) as in choice of anti-aliasing filters.

Figure 29-26 SRSs from various labs

But note quite good agreement from say 200 to 8,000 Hz. The various laboratories all used a scheme that is suggested by Figure 29-27. I believe this method was developed by David Smallwood of Sandia, Albuquerque.

Figure 29-27 Bank of Filters

You will recall that SRS (Shock Response Spectrum) is defined as the response of a series of SDoF systems, as suggested by Figure 29-13. In the electronic model of Figure 29-27, each SDoF has a different natural frequency f_n. All have the same percentage of critical damping (the same "Q"). You will recall that reeds are easier to build. Remember Biot? See Figures 29-2 and 29-10. But there is a limit to how many reeds of reasonable size a mechanical analyzer can contain.

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Free Summer
Shock & Vibration Seminar

SAVIAC invites you to attend a FREE seminar on Shock & Vibration. The course will be held on Wednesday, June 18, 2003 at the Red Lion Hanalei in San Diego, CA, the site of the 74th Shock & Vibration Symposium. This seminar will coincide with the June Program Committee Meeting. SAVIAC and the featured experts in their disciplines have organized this seminar to introduce you to the SAVIAC community, while providing a valuable educational experience.

Agenda

8:00 - 8:30	Registration & Continental Breakfast	
8:30 - 8:45	Introduction to SAVIAC	Joel Leifer, SAVIAC
8:45 - 9:00	Using SAVIAC to Address Your S&V Problems	Joel Leifer, SAVIAC
9:00 - 9:30	Blast Resistant Connections	Ted Krauthammer, Protective Technology Center
9:30 - 10:00	Test Fixture Design	Allen Parkes, NSWC/Crane
10:00 - 10:15	Break	
10:15 - 11:15	Fluid Structure Interaction	Rudy Scavuzzo, Consultant
11:15 - 11:45	Pyroshock	Vesta Bateman, Sandia National Labs
12:00 - 1:00	Lunch	(no host)
1:00 - 1:30	Statistical Analysis of Shock Sources	Tom Paez, Sandia National Labs
1:30 - 2:00	Extreme Environments Testing	Rick Smith, Wyle Labs
2:00 - 2:30	System Damping Modeling	Young Shin, Naval Postgraduate School
2:30 - 2:45	Break	
2:45 - 3:15	Shock Accelerometer Selection	Anthony Chu, Endevco
3:15 - 3:45	Launch Loads	Dan Worth, NASA/GSFC (Invited)
3:45 - 4:15	TBD	David King & Dennis Booth
4:15 - 4:45	Measurement Systems Considerations	Jon Wilson, The Dynamic Consultant (Invited)
4:45 - 5:00	Wrap-up & Questions	All

Please forward this invitation to anyone you know who may be interested in attending this program.

The seminar is free, but you must register to attend. Please RSVP to Lauren Yancey, (301) 596-0100 or lauren.yancey@saviac.org to assure your space and note packet. SAVIAC reserves the right to substitute topics and/or instructors when necessary. This schedule is subject to change. For more information about SAVIAC and directions to the Red Lion Hanalei Hotel, please visit our website at www.saviac.org.

Endevco, continued from Page 4

dropped object and the impact surface.

SIMPLE PREDICTION MODEL OF DROP SHOCKS

For generalization purposes, consider the dropped object a solid mass of some material. When the dropped object impacts a rigid surface, the object deforms (compresses), and may rebound back upwards. For simplicity, assume no rebound.

The dropped object has mass m, and modulus E. The distance the object compresses is x. From basic formulae

$$F = m\,a \quad (19)$$

$$F = k\,x \quad (20)$$

we can find the acceleration imparted at the maximum compression distance, x. This is what we want:

$$a = \frac{k\,x}{m} \quad (21)$$

During the shock,

$$v = \sqrt{2\,a\,x} \quad (22) \qquad x = \frac{v^2}{2\,a} \quad (23)$$

Substituting (23) into (21) yields

$$x = \frac{k\,\frac{v^2}{2\,a}}{m} \quad (24) \qquad a^2 = \frac{k\,v^2}{2\,m} \quad (25)$$

The spring constant of a bulk spring can be expressed in terms of the modulus, the area being compressed and the height.

$$k = \frac{E\,A}{h} \quad (26)$$

Substituting (22) and (26) into (25) yields

$$a^2 = \frac{\frac{E\,A}{h}\left(2\,g\,d_1\right)}{2\,m} \quad (27)$$

which simplifies to

$$a = \sqrt{\frac{E\,A\,g\,d_1}{h\,m}} \quad (28)$$

From this basic equation, a number of conclusions can be deduced:

1) Greater acceleration levels will be achieved when the surface area, A, is increased. Specifically, if an object is dropped onto its most flat surface (flat-on-flat impacts) the acceleration is the greatest. Conversely, if dropped onto a sharp corner, the acceleration will be minimized.

2) Greater acceleration levels will be achieved with a higher drop (this should be obvious).

3) Greater acceleration levels will be achieved with a lower mass object.

4) Greater acceleration levels will be achieved with a stiffer object (higher modulus).

Call For Papers

74th Shock and Vibration Symposium

October 27-31, 2003
Red Lion Hanalei Hotel
San Diego, CA

Planning for the 74th Shock and Vibration Symposium is underway, with the selection of NSWC/Crane and SPAWAR as the Government Featured Organizations, Endevco as the Commercial Featured Organization, and the Red Lion Hanalei Hotel in San Diego as the location.

The Shock & Vibration Symposium is the oldest continuously held meeting dealing specifically with the structural dynamic behavior of air, sea, space, and ground vehicles and structures. The Symposium was established as a mechanism for the exchange of information among Government activities, private industry, and academia on current work and new developments. Presentations on work in progress are encouraged. Separate sessions are held for presentation of classified or limited-distribution material.

Presentations in the following subject areas are welcomed:

901D Case Studies
Active Vibration Control
Ballistic Shock
Biodynamics
Blast Design
Combined Environments
Computational Structural Dynamics
COTS
Crash Dynamics
Damage Identification
Damping
Data Analysis
Dynamic Analysis Methods
Dynamic Measurement
Dynamic Scale Modeling

Dynamic Testing
Environmental Databases
Finite Element Analysis
Fluid-Structure Interaction
Ground Shock
Seismic Shock
Impact/Penetration Mechanics
Instrumentation
Isolation Systems
Large Structures
Live Fire Testing
Machinery Diagnostics
Machinery Vibration
Material Dynamic Properties
Modal Analysis and Testing

Product Announcement/Facility Description
Pyrotechnic Shock
Shock Characterization
Shock Hardening
Shock Qualification by Extension
Shock Test/Equipment Failure Modes
Simulation Methods
Specifications and Standards
System Identification
Test Criteria
Test Tailoring
Underwater Shock Testing
Vibroacoustics

Two categories of presentations will be accepted: full papers, suitable for publication in the Symposium Proceedings; and short discussion topics, consisting of viewgraphs with no written paper. Full papers will have a 15 minute technical presentation time plus 5 minutes for questions, while short discussion topics will have a 10 minute presentation time with no question period.

Presentations will be accepted on the basis of their abstracts, which must be submitted by May 30, 2003. You are encouraged to submit online at www.saviac.org, click on 74th S&V Symposium Abstract Submittal. The Program Committee will review the abstracts during the June Program Committee meeting and authors will be notified of acceptance by June 26, 2003. The full paper presentations must meet the following standards: They must be previously unpublished and unpresented, must be appropriate to community interests and must not be overtly commercial, except for papers in the Product/Facility session. Standards for short discussion topics are similar except that they may include previously presented or published material.

The Proceedings will be published on CD-ROM.
The paper due-date is October 17, 2003.
Questions should be directed to Joel Leifer, 301.596.0100 or joel.leifer@saviac.org.

ABSTRACT SUBMITTAL FORM
74TH SHOCK & VIBRATION SYMPOSIUM
SAN DIEGO, CA
OCTOBER 27-30, 2003

Unclassified Title: ____

Sponsor: ____

(Note: It is the author's responsibility to obtain authorization from the Sponsor to present/publish. This abstract will be published on the SAVIAC Web Site and in the Abstract Volume.)

Presentation:
____ **Full Paper (15-min talk, 5-min discussion)**
____ **Short Topic (10-min talk, no discussion)**

Classification:
____ **Unclassified/Unlimited Distribution**
____ **Confidential**
____ **Unclassified/Limited Distribution**
____ **Secret**

Principal Author: ____

Affiliation: ____

Mailing Address: ____
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Phone Number: ________________ Fax Number: ________________ E-mail: ________________

Has this work been published or presented elsewhere? _______ If yes, where? ________________

What is the approximate date of the initiation of this work? ________________

Choose one subject area: ____ **Pyroshock** ____ **Vibration** ____ **UNDEX** ____ **Ballistics**
____ **Acoustics** ____ **Human** ____ **Blast** ____ **Other:** ________________

Choose one application area: _____ **Test Methods** _____ **Test Applications** _____ **Test Facilities**
_____ **Num. Applications** _____ **Num. Methods**
_____ **Other:** ____________________

We would prefer that you submit your abstract on-line via our web site http://www.saviac.org. If you do not have web access, please type your abstract (unclassified/unlimited only, 300 words or less, no equations or graphics) on a blank sheet and submit it with this form to:

SAVIAC/HI-TEST Labs, Inc.
Attn: Joel Leifer
5136 Celestial Way
Columbia, MD 21044
301 596-0100
FAX (301) 596-6400

Abstracts are due May 30, 2003 !!

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Another limit, at low frequency: the length of a reed. Another limit, at high frequency, tiny response displacements.

Therefore let us model classical SDoF response (see Figure 3-7) digitally, as in Figure 29-27. Let us build a large number of these filters and space them Δf apart (our frequency resolution). This gives the details of each of the filters as shown in Figure 29-28. The damping factor (and resulting "Q") of the filters can collectively be changed. 10 is a popular value for Q.

$$a=\sqrt{\frac{E A g d_1}{h m}}$$

Figure 29-28 Details, example of filters

Then let us apply to the filter inputs the signal (such as Figure 29-24) to be analyzed. Let the computer interrogate each filter in turn, in effect asking "What was the peak acceleration that you experienced?" The answers are plotted against filter peak response frequency, resulting in a graph such as Figure 29-25 and 29-26.

CRITIQUE

I asked Dave Smallwood to comment on Chapter 29. Here is what he said:

"The slides look good. However a little more history. The first method for performing electronic calculation of the SRS was direct integration of the convolution integral. This method probably was used in the late 50's or early 60's. The impulse response of the SDoF filter was convolved with the digitized input time history. This is still used today. It's only disadvantage is computation time. The first use of a recursive filter to simulate the SDoF system was O'Hare (G. J. O'Hare, "A Numerical Procedure for Shock and Fourier Analysis," U.S. Naval Research Laboratory Report 5772, June 1962). This method was good but had some flaws. I introduced an improved version in 1981 (Smallwood, D. O., "An Improved Recursive Formula for Calculating Shock Response Spectra," S&V Bulletin, No. 51, Part 2, p 211, May 1981). Howard Gaberson published essentially the same method in a U.S. Naval Research Laboratory Report about the same time, but for some reason I get the credit, probably because more people read the S&V Bulletin than U.S. Naval Research Laboratory Reports. This has become the defacto standard. So I was not the first but the latest. You can use my name, but the others also deserve credit.

"One more item. I don't know if you want to mention it or not given the level of the text. But when you have a multiple degree of freedom system (which we almost always do, just like we usually do not have simple shocks) methods to add the responses at the various degrees of freedom to arrive at a composite peak response for design purposes is not straightforward or standardized. At least 6 methods are used and all do not give the same answer (sometimes not even close to the same answer).

"Remind the students that when they use the SRS, they are assuming a SDoF system, and damage is related to peak response of that system. Neither assumption is usually true, but many times a useful approximation. However it is an approximation. Just because you run a test that envelopes the SRS does not guarantee success in the field. Experience has suggested we are usually ok."

Would you like to comment on this article?

E-mail your comments to **admin@saviac.org** and, if appropriate, SAVIAC will publish them in an upcoming issue of *Current Awareness*. Please include "Tustin Excerpt" in the subject line of your e-mail.

Slaght, continued from Page 1

missile cruiser USS Gridley (CG-21), Engineer Officer aboard the USS Tulare (LKA-112), Operations Officer aboard the frigate USS Edward McDonnell (FF-1043), and Combat Information Center Officer aboard the frigate USS Garcia (FF-1040).

RADM Slaght was born in Chicago, Illinois, and received his commission in 1970 after graduating from the US Naval Academy in Annapolis, Maryland. He then attended the Defense Systems Management College, received a Masters Degree in Computer Systems Management at the Naval Post Graduate School, and was also a student of the Naval Destroyer School.

For continuously updated information about this and other speakers and events at the 74th Shock & Vibration Symposium, visit http://www.saviac.org/upcoming_events.htm.

Industry News

IEST Announces New Working Group on Vibration and Shock Data Storage

IEST announces the formation of a new Design, Test, and Evaluation Working Group, WG-DTE-042, Vibration and Shock Data Storage. Dan Worth, NASA/Goddard Space Flight Center, serves as Chair. The Working Group's (WG) first meeting will be Monday, May 19, from 8-9:30 AM at ESTECH 2003, held at the Hyatt Regency, Phoenix, Arizona. ESTECH is the 49th annual meeting and exposition of IEST.

The new WG will focus on establishing a standard for the storage of large binary files used mainly in vibration and acoustic testing. New standards will enhance future retrieval and promote the growth of interagency databases.

IEST members from Spectral Dynamics, m+p international, DSPcon, NSWC, Intespace, iABG, and Northrop-Grumman have committed to serve on the WG. Additional WG members are needed. Interested parties may contact IEST by e-mail (technicaldept@iest.org), by fax (847-255-1699), or by phone (847-255-1561).

IEST Working Groups develop Standards and Recommended Practices providing standardized procedures in contamination control; design, test, and evaluation; and product reliability. These are based on peer-approved applications of environmental science and technology. The WGs determine what issues will be addressed and what procedures will be included. WG members meet annually at ESTECH and continue to work throughout the year as they communicate through IEST member-only Web Boards.

IEST is an international professional organization serving members and the industries they represent through education and the development of recommended practices and standards. Industries served are contamination control in electronics manufacturing and pharmaceutical processes; design, test, and evaluation of commercial aerospace and military equipment; and product reliability issues associated with commercial and military systems.

Model 7293A Variable Capacitance Accelerometer Offers Special for EMI/RFI Shield and Filtering

SAN JUAN CAPISTRANO - March 27, 2003 - The Endevco Model 7293A MICROTRON® accelerometer family utilizes unique variable capacitance microsensors and incorporates special filtering and shielding for EMI and RFI exposure. Designed for measurement of steady-state or low frequency, low level accelerations, the Model 7293A is ideal for aerospace and factory environments where EMI and RFI are a particular concern.

The Model 7293A's anisotropically-etched silicon microsensors can withstand high shock (up to 10,000g's) and acceleration loads. The use of gas damping on the sensors results in very small thermally-induced changes in frequency response.

The Model 7293A can operate from 9.5Vdc to 18.0Vdc. It provides a high level, low impedance +2 volt differential output, which is de-coupled at a dc bias of approximately 3.6Vdc. Endevco's Model 136 Three-Channel System or OASIS 2000 Computer-Controlled System are recommended as signal conditioner and power supply.

Endevco is the world's leading designer and manufacturer of dynamic instrumentation for vibration, shock and pressure measurement. The company's comprehensive line of piezoelectric, piezoresistive, SOTRON® and variable capacitance accelerometers are used to solve measurement problems in a wide variety of industries including aerospace, automotive, defense, medical, industrial and marine. Other products include pressure transducers, microphones, electronic instruments, and calibration systems.

Endevco has a factory-direct sales force in the U.S. and is represented in the rest of the world by Brüel & Kjær. Brüel & Kjær has offices in 55 countries and 7 accredited calibration centers worldwide. Endevco is a subsidiary of U.K.-based Meggitt PLC, an international group of companies renowned for their specialized engineering skills.

Industrial Accelerometer Kits Survive up to 900° F

March 3, 2003, Depew, NY - New Industrial Accelerometer kits from the IMI Sensors Division of PCB Piezotronics, Inc., monitor vibration levels of rotating machinery operating at elevated temperatures or in high-temp environments. Series 600 High-Temperature Industrial Charge Mode Accelerometer Kits include charge mode accelerometer, low-noise, hardline, Teflon, or armor jacketed cable, and signal conditioning.

Accelerometers included in kits are hermetically sealed and designed to withstand temperatures up to 900° F (482° C). Signal conditioning options include a differential charge amplifier for improved signal to noise ratio, resulting in 100mV/g sensitivity.

When the vibration of bearings, gears, and running speed is monitored, excessive wear can be identified and catastrophic failure or unscheduled downtime may be prevented.

For additional information, contact the IMI Division of PCB Piezotronics at 800.959.4464 (U.S. and Canada), 716.684.0003 (outside North America), fax 716.684.3823, e-mail: imi@pcb.com, or visit our website at www.imi-sensors.com.

Conference Announcements

SAE Noise & Vibration Conference & Exhibition
Society of Automotive Engineers
May 5-8, 2003
Traverse City, MI
The purpose of the SAE Noise & Vibration Conference and Exhibition is to present the latest worldwide developments in vehicle and component noise and vibration control, analysis, subjective evaluation, acoustic materials, and measurements as applied to the mobility industry.

This gathering of engineers, analysts, product manufacturers, and other mobility professionals explores the physics of noise, vibration, and harshness, the relationship between the three and their implications. Technical presentations cover the solutions and experimental approaches to system problems, reverberations, pressure fluctuations, engine component noises, on-road data acquisition, and much more. For more information on this and other events, visit the SAE website, http.www.sae.org.

Homeland Security Summit & Exposition
May 14 - 16, 2003
Hyatt Regency Crystal City
Arlington, Virginia
The Summit will assess our current level of threat as it relates to the concept of interdependence, identify the work remaining and the opportunities emerging to ensure security on the home front. General sessions will feature the prominent political leaders who are setting the homeland security agenda and their innovative corporate partners whose firms are providing security solutions. Summit tracks will provide attendees in-depth information in three areas critical to the effort: Aviation, Transportation, and National Defense; Business Strategy and Economics; Architecture and Construction, and Energy, Utilities and Natural Resources.

The Honorable Rudolph W. Giuliani, Former Mayor, New York City and present Chairman and CEO of Giuliani Partners, LLC, will be making the keynote address on Wednesday evening.

To register by telephone call Ryan Leeds at (800) 240-7645. To sign up for exhibits or receive more information, call Beth Eddy at (561) 862-0005 or e-mail: beth_eddy@mcgraw-hill.com. For a complete program list of speakers, or to register, please visit http://www.mcgraw-hill.com/summit/index.htm.

For a summary of upcoming conferences for 2003, visit www.saviac.org/upcoming_events.htm
To receive a FREE 2003 SAVIAC Calendar, filled with the year's most important, industry-related events, e-mail Lauren Yancey at lauren.yancey@saviac.org.

Short Course Announcements

Fundamentals of Vibration Testing
Equipment Reliability Institute (ERI)
April 30-May 2, 2003, Mississauga, Ontario, Canada,
May 13-15, 2003, Bohemia, New York,
This course will focus on basic understanding of vibration and shock, on dynamic measurements in field and test lab, and on vibration and shock testing, as well as on HALT, ESS and HASS (highly accelerated life testing, environmental stress screening and highly accelerated stress screening). To register, visit http://www.equipment-reliability.com/regist_form.htm, complete the form and fax it to (805) 966-7875. Please remember to take advantage of our "early-bird" discount for registration and payment received one month before the beginning of the course. Check for details on our websites http://www.equipment-reliability.com and http://www.vibrationandshock.com, by visiting the course pages.

Vibration and Shock Test Control Techniques
Technology Training, Inc.
June 16-18, 2003
This course is an overview of vibration-testing technology with emphasis on the practical everyday problems that are encountered in testing laboratories. Emphasis is placed on the basic principles of vibration hardware, control systems, and analysis techniques used for random, sine, and shock testing. Capabilities and limitations of available systems will be discussed.

This course presents an application-oriented approach to digital computer control of random vibration and shock testing on shakers and analysis of vibration and shock data. Complex mathematical concepts are reduced to graphic form for intuitive understanding. Illustrative examples from the "real world" are used throughout.
For more information about this and other TTI courses, visit http://www.ttiedu.com/194cat.html.

21st Transducer Workshop
Vehicular Instrumentation / Transducer Committee of the Range Commanders Council Telemetry Group
June 22-23, 2004
Patuxent River, MD

The technical program committee are now soliciting papers / presentations / tutorials / demonstrations for inclusion in the program. Practical problems involving transducers, signal conditioners, read-out devices as well as systems serve as excellent topics. Engineering tests, laboratory calibrations, transducer developments, and evaluations represent other potential applications of the ideas presented. Suggestions are desired by July 15, 2003.
Contact Ray Faulstich 301-342-1553, FAX 301-342-7557 or email faulstichrj-navair.navy.mil for details.

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RADM Kenneth Slaght to Keynote 74th S&V Symposium
The Drop Shock: An Article from Endevco
FREE Shock & Vibration Seminar
74th Shock & Vibration Call for Papers
74th Abstract Submittal Form
Vibration and Shock Testing, Measurement, Analysis and Calibration, also ESS, HASS and HALT": An Excerpt, Part IV
Industry News
Conference/Symposia Announcements
Short Course Announcements

The Current Awareness newsletter is published by the Shock and Vibration Information Analysis Center, which is operated by HI-TEST Laboratories, Inc., under contract to the U.S. Army Engineer Research and Development Center.

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