ITEA

NEWSLETTER

INTERNATIONAL TEST & EVALUATION ASSOCIATION

July/October 1982 **Volume III** **Number 2**

THE "NEW" NEW ENGLAND CHAPTER

Left to right: James D. Selman, John H. James, Steve L. Kramer, Nancy Martin, Shashi Phoha, William M. Stein, Isabel J. Meyer, Mary Jean Hayes, Walter R. Sharpe. (See page 32)

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Manuscripts. Submission of unsolicited articles or news items of interest to the T&E community is welcomed and encouraged. Articles should be typed, double spaced. A brief biography and a small black and white glossy photograph of article authors are desired. Only original (or quality reproduction) art and black and white photographic prints can be accepted. All submissions are subject to approval and editing by the ITEA Editorial Board. Authors assume full responsibility for submitting unclassified and/or non-proprietary articles approved by proper authority. Mail submissions to Mr. B. S. Granum, 9508 Seddon Court, Bethesda, MD 20817. Tel. (703) 379-5404.

Advertising. For details, including rates, see page next to back cover.

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INTERNATIONAL TEST AND EVALUATION ASSOCIATION ITEA

BACKGROUND. ITEA is a non-profit corporation. It was incorporated in Washington, D.C., on the 18th of January, 1980. The principal organizers were Dr. Allen R. Matthews, currently serving as President of the Association, COL Floyd A. McLaurin, USAF, and COL Robert A. Klimek, Jr., USAF (Ret). The three served as the initial Board of Directors, which has since been expanded.

PURPOSE. From the Articles of Incorporation, as amended:

"Third: The purpose or purposes for which the Corporation is organized are: To provide an organization for individuals who have a common interest in the discipline of test and evaluation and who wish to foster, preserve and advance the art of test and evaluation; to provide the exchange of ideas and information in the field of test and evaluation; to conduct professional meetings as well as symposia and seminars, and courses in the practice of test and evaluation; to support and promote the development and advancement of the state-of-the-art in test and evaluation in allied branches of science, technology and management; to support similar objectives in related organizations including government, industry, academia and professional societies; to recognize the advances and contributions to testing and evaluation; to document contributions and the history of test and evaluation; and to commemorate fittingly the memory of persons who have made substantial contributions in the field of test and evaluation."

CALENDAR

ITEA International Symposium

The first ITEA International Symposium is moving forward as a result of the ground work and lessons learned in formulating the symposium we hoped would have occurred this summer. Many of the issues that delayed us are now being resolved and the plans are being made for the Symposium which will be held June 21, 22 and 23, 1983, at the Defense Systems Management College, Fort Belvoir, Virginia.

The three-day format is planned to consist of a two-day technical program focusing on the issues concerning the test and evaluation community and a one-day professional enhancement seminar. Specific sessions and activities are being planned and the Symposium committee expects many of the details to be provided in the next issue of the ITEA Newsletter. If you have a specific area that you believe would benefit the attendees at the Symposium, please forward your suggestions to ITEA SYMPOSIUM, P.O. Box 1748, Vienna, Virginia 22180-8748, ATTN: TECHNICAL PROGRAM COMMITTEE.

Members interested in assisting the Symposium committee or working on a subcommittee should contact Frank Smith at (703) 281-6561 or Walt Finklestein at (301) 258-5130. We need assistance in the areas of word processing, graphics, printing and reprographics. In addition, we need specialized skills in DoD security procedures and protocol, editing, pencil press and electronic media, writing, banquet planning, registration and reception. Most of all, we need your help as a member to fill in the various subcommittee staffs and spread the work load. The subcommittees are: (1) Technical Program, (2) Professional Seminar, (3) Entertainment, (4) Exhibits, (5) Banquet/Luncheon, (6) Registration, (7) Publicity, (8) Security/Protocol, and (9) Reception.

Related Events

Call for papers
13th Annual Symposium
Society of Flight Test Engineers
Grand Hyatt Hotel
New York City, N.Y.
September 19-22, 1982
Technical Program chairman:
Mr. Warren M. Dodson
Director, Flight Test Technology
Flight Test Department
Grumman Aerospace Corp.
MSF04-07
Calverton, NY 11933

Government Microcircuit Applications Conference
Sheraton Twin Towers
Orlando, Florida
November 2-4, 1982
Advance registration material, contact:
Robert Weck
USAERADCOM
DELET-MH-W
Fort Monmouth, N.J. 07703
(201) 544-4489

Call for papers:
29th Annual Technical Meeting
Institute of Environmental Sciences
Marriott Hotel
April 18-21, 1983
Send abstracts to:
ATM 83 Technical Program Committee
Institute of Environmental Sciences
940 East Northwest Highway
Mount Prospect, Illionois 60056
(312) 255-1561

20th Annual Reliability Engineering and Management Institute
Ramada Inn
Tucson, Arizona
November 15-19, 1982
Advance registration material, contact:
Dr. Dimitri Kececioglu
Aerospace and Mechanical Engineering Dept.
Bldg #16, Room 200B
University of Arizona
Tucson, Arizona 85721

DSMC T&E Management Course

The Defense Systems Management College (DSMC) conducts a one -week Test and Evaluation course. The following is the FY 83 schedule:

83-1R	15-19 Nov 82
83-2	24-28 Jan 83
83-3	25-29 Apr 83
83-4	6-10 Jun 83
83-5R	18-22 Jul 83
83-6	22-26 Aug 83

Course 83-1R will be at Hanscom AFB, MA; 83-5R will be at Warren, Michigan. The other courses are at DSMC, Ft. Belvoir, VA.

Attendance is open to U.S. Government employees (military and civilian) and industrial employees. For information, contact DSMC, phone (703)-664-3120.

President's Corner

Dr. "Matt"

ITEA has made great progress in two years of operations. Our membership (individual, honorary and corporate) has grown. ITEA is recognized and honored by other professional socities. I frequently hear that a T&E professional society is urgently needed.

We see T&E as a major specialty of modern society and seek to provide the basic education and leadership for T&E. ITEA has accomplished the intended goals of organization and purpose. We now need to face the realities of life and financially advance while rendering a service to our nation and all mankind.

ITEA growth has slowed. Many members continue from '80, '81 and '82, but we need more from individuals and corporations to provide the knowledge and resources needed to accomplish the purposes of ITEA.

We operate on the basis of volunteers and need a full-time Executive Director to administer the many activities of ITEA. The voluntary, more or less, full-time service of one individual is not sufficient even with the enhusiastic voluntary support of many members. ITEA members are professionals in T&E and require, as all organizations, the support of an administrator with secretarial assistance. Volunteers should not be expected to assume a combination of roles that fragment execution of centralized policies or effectively consolidated administrative office functions.

Therefore, the time has come to establish a full-time administrative office responsive to the officers, BOD and members. ITEA could easily do this except for financial limitations during its growth. I hope that each of you will continue your support while arranging ITEA services for financial support from various sources such as your corporation. This support will permit ITEA to proceed on a professional basis to enhance T&E without an excessive burden or dependency on individuals.

All professional societies are created for the common good by the contributions of supporters. Various national foundations would probably offer financial assistance but is this approach necessary? Current membership dues and donations are not sufficient sources of funds. Corporate memberships and Newsletter advertising are needed to provide initial capital funds for the 1983 symposium as well as an administrative office.

ITEA has assumed the role of fostering recognition and development of T&E technology and management. Education is the key and is accomplished by professional meetings, publications, and symposia held by both the chapters and ITEA Headquarters. ITEA members assisted in the establishment of the DSMC T&E Management Course and have been active with both governmental and civilian educational institutions. ITEA has also received the support of other professional societies like IES and SOLE, and participated in an AIAA T&E Symposium with other T&E societies.

Arrangements have been completed for ITEA to be listed in the following 1983 publications available to libraries and purchasers:

1. Encyclopedia of Associations by the Gale Research Company.

2. National Trade and Professional Associations of the United States by Columbia Books, Inc.

The growth of ITEA corresponds with the current emphasis on T&E in both government and industry. ITEA is pleased to be of service so will expand its professional activities in accordance with sound business practices.

Editor's Notes

Brad Granum, for the past year, has been serving as Editor for the Newsletter. He's been elected to the Board of Directors and has passed the editor's baton to me.

Now, as in the past, the quality, as well as the growth, of the Newsletter is dependent upon the membership. We can always find space for featured articles which throw light on any of the many facets of T&E, and we welcome personal viewpoints. If you have a suggestion or an idea, or you just want to get something off your chest, but you don't feel like writing a multipaged article, jot down your thoughts and sent them in as a personal viewpoint.

One of the many purposes of ITEA is the exchange of information and ideas. Chapter meetings and the annual symposia offer opportunities for such exchange. The Newsletter offers another.

Mail Newsletter contributions to me:

Lee M. Hand
703 Ridge Drive
McLean, VA 22101

Who's Who in T&E

CAPTAIN MASON TO TAKE VX-1 HELM

Captain John A. Mason, USN, relieved Captain F. Howard Stoodley as Commanding Officer of Air Test and Evaluation Squadron One in ceremonies at 11:00 am August 16, 1982.

VADM Edward C. Waller, Superintendent of the U.S. Naval Academy, was guest speaker for the change of command ceremony.

Captain F. Howard Stoodley's new assignment is in the Office of Naval Research, Washington, D.C.

Captain Mason has a long and distinquished naval career beginning in 1962 with his commissioning after completing Naval Aviation Candidate Training. No stranger to Naval Air Station, Patuxent River, Captain Mason has had two previous tours of duty here, one with Fleet Tactical Support Squadron One and later as a member of Patrol Squadron Twenty-Four. Captain Mason has also had tours as Commanding Officer, U.S. Naval Facility, Bermuda, with Patrol Squadron Sixteen, and as Commanding Officer of the "World Famous Blue Sharks" of Patrol Squadron Six. He is a graduate of the Naval War College.

Captain Mason reported to VX-1 from the staff of Commander, Patrol Wing Five, where he has served since July 1980 as the Chief of Staff.

EDITORIAL

James T. Luttrell, Jr.
Mr. Walter Finkelstein

Universities in general offer little instruction in Test and Evaluation (T&E). Consequently, many of their graduates start their careers poorly prepared to adequately perform or interface with members of the T&E profession.

Among ITEA's membership are persons of great stature, experience, and expertise in T&E methodology and in its important and necessary application to academia, Government, and industry. Using these strong and extremely capable assets, a select committee should be established and an immediate effort should be launched to study the problem. The study should develop recommended additions or changes to present college and university curricula which would include T&E courses.

What additions need to be recommended? Which disciplines need to be changed? These are valid and timely questions which are difficult to answer. Let us attempt to answer them by suggesting study and discussion topics.

Some of the suggested topics for study requirements are that the graduate be trained to:

- o write a test plan,
- o know the tests appropriate to the system or situation,
- o determine the frequency of the tests,
- o specify the types of test instruments,
- o identify the parameters to be measured, and
- o establish the testing environment.

When the test is completed, the graduate should be able to evaluate the test by:

- o ascertaining that the test data are complete and accurate;
- o verifying that the test was conducted according to the test plan, and, if there were variations, determining their effectiveness;
- o analyzing the results to determine the success or failure of the system's ability to meet the test specifications;
- o recommending changes to the test plan; and
- o recommending system design changes.

At the very least, the disciplines which require change are Engineering, Physics, Mathematics, Operations Research, and Systems Management. Other disciplines may require changes. The previously recommended study would be useful for determining this and for recommending how the topics could be added to current curricula.

To summarize, the authors have identified a pressing problem, a group of experts who could conduct a study, and possible study topics which could be added to current courses of instruction. Further, the authors have recommended some disciplines to study for possible changes. What is next? Action!

Every member needs to assist the study committee in disseminating its results.

Some suggested methods are to contact one's alma mater, either through the alumni association or directly through the appropriate department heads. Universities and colleges near local chapters could be contacted by the chapter education committee or president. The guest speaker program is an excellent method for bringing

(continued on page 23)

NAVY ELECTRONIC WARFARE TEST AND EVALUATION

The following is a condensation of a presentation made 23 June 1982 by RADM A. A. Gallotta, Jr., Director, Electronic Warfare, Department of the Navy, to a luncheon meeting of the George Washington Chapter, ITEA.

First, let's look at the goal of T&E. T&E is more than the test of equipments and comparison of performance to specifications. Suitability of equipment to support missions is the goal. However, as you know, T&E requires a nice sense of balance. Too stringent criteria deny our operating forces the tools they need for warfare. Loose criteria result in inadequate equipment which may be worse than none. The acid test (in most situations) is that test and evaluation should not impose new performance rquirements on systems once contracts are negotiated, since we certainly do not want to stop the procurement of necessary equipment that will not handle every possible contingency.

The test size, scenario adequacy, test criteria, and the standards used to arrive at estimates of effectiveness should be established when system designs are frozen. Approval should be based on fleet requirements that are much larger than the technical issues. Many times, the most basic need is to get equipment fielded in order to accumulate experience .... which may be the only way we will ever determine specific design parameters.

I want to be the first to recognize the inconsistency in these statements, i.e., freeze the test envelope but evaluate suitability beyond technical capabilities. This is the great challenge in T&E.

The Navy's mission is worldwide. The Chief of Naval Operations (CNO) has recently emphasized that we must first be prepared to fight and win battles at sea. In support of our roles and missions (including crisis response), we have battle groups consisting of ships, aircraft, submarines and, with the Marines, an amphibious strike capability.

Electronic Warfare (EW), by intercepting, exploiting, or degrading threat emissions, contributes to the Navy mission, functions or warfare areas. EW also protects our emissions from the threat. The thread that ties this enormous set of possible actions to a role is the contribution of EW to a battle group.

In a textbook scenario, needs are said to originate from the fleet as they: (1) arise in response to deficiencies, (2) are exposed in operational exercises, (3) replace obsolescent equipments; or (4) answer threat changes. CNO's staff (OPNAV) then defines these needs as requirements. The Naval Material Command, (acting through the laboratories, field activities, or contractors) develops, builds, and installs the equipment .... assists the Operational Test and Evaluation Force (OPTEVFOR) in test and evaluation .... and develops equipment needed for training.

Even though all of the parties concerned have the best interest of the Navy in mind, the importance of differences in the objectives of the major players and the effect of the program and charter contraints on the resulting systems must not be understated.

By the time a requirement has been validated and issued as a program for development, it is normally a compromise of capability versus cost and available resources. All three players (CNO, the developer and OPTEVFOR) have, in effect, agreed to a constrained program that has a specific cost, a realizable schedule, and an acceptable performance specification. What really happens is that the cost/schedule limitations dominate and drive the Navy acquisition side, (i.e., the sponsor (CNO), and the developer) while the independent tester (OPTEVFOR) tries to obtain the maximum operational performance possible, without the same sensitivity to cost and schedule as the other players.

Methods for evaluating the effectiveness of electronic warfare may be categorized in six levels. These are battle, operational effectiveness in exercises, operational test and evaluation, technical evaluation in realistic scenarios and computer modeling. Obviously, the most satisfactory proof comes from combat, either showing how EW enabled victories or how EW saved lives or reduced the costs of warfare. Exercises, operational tests and technical evaluation give us useful insight into effectiveness. However, the most difficult but extremely important method, since we can sensitize capability extremes and simulate threats better, is to perform analytical studies to arrive at predictions.

Let's look for a moment at the uniqueness of EW T&E. Note that electronic elements of the threat, which are the targets of electronic warfare, are often hidden from us and therefore not clearly understood. The extent of our real understanding must be kept from the enemy, lest he change threat characteristics and place his electronic parameters beyond the reach of our countermeasurers, or even our intercept capability. This factor sometimes prevents us from simulating and radiating realistic signals.

The interactions of EW with active weapons, the so-called soft and hard kill, are needed to fully understand the cooperative effects of EW and to give better operational effectiveness values. However, the prohibitive cost and the enormous area needed to simulate a fully realistic EW environment complicate thorough evaluation of EW systems.

Thus, a compromised environment best describes the military test and evaluation situation and the T&E facilities essential to the EW acquisition process.

Simulation needed for test and exercise is critical to an extant EW capability. Threat simulation is expensive and fraught with security risks. As to computer modeling in the labs, even the largest computer cannot cope with many of the scenarios needed to evaluate our systems in a representative environment. In fact, neither exercises nor computer simulations provide a complete story and extrapolation from one to the other involves uncertainty.

Navy EW T&E has problems that stem from: a changing threat; the long time required to develop systems; the need to accommodate test schedules to ship installations; and problems with the adequacy of test criteria and measures of effectiveness needed to evaluate the utility of EW systems as part of a total battle group.

By reading the open literature and by examining the exploding changes in electronic technology, we can anticipate some of the threat trends. For instance, in addition to the sophisticated radar transmitter and antenna designs which include millimeter wave sensors, frequency diversity, polarization diversity, spread spectrum, dual frequency, pulse doppler and infrared/electro-optical, there will be wider agility in frequency and pulse repetition frequency, increased use of countinuous wave multimode seekers, and use of some form of monopulse antenna processing in almost all tracking radars.

As modern navies become more and more dependent on electronic sensors, we expect a large increase in the number of threats we will face that use electronics extensively. These will present even more challenges to EW and to its test and evaluation.

We are all familiar with the length of the acquisition process. It takes too long to go from concept to initial operational capability. There are too many tests, too many decision points. The fast-moving EW technology is better tuned to quick reaction capability type planning, i.e., two and a half to three years, than to a rigid acquisition process, which sometimes results in first articles that are obsolescent when deployed.

A constant problem in getting from the lab to the field is the poor meshing of the acquisition process, T&E, and availability of platforms for installation. A lack of synchronization of these three areas can result in delays measured in years. Approximately one-third of our ships are deployed in the forward areas of the 6th and 7th fleets, another one-third are in the 2nd and 3rd fleets, and about one-third are in shipyards for major alteration. Ship schedules involve long distances, major assets, and many people. Thus, ship schedules drive any priority system. Therefore, the developing agency, the contractor, and the test and evaluation agency must avoid delays in achieving new capabilities.

We do not have the assets to stress our equipments in realistic exercises with all the emissions of a Soviet battle group. Consequently, predictions of how our new systems will work together, and a "real world" assessment of equipment capabilities, must come from a combination of computer simulated environments and large-scale exercises.

The Navy has recently published an electronic warfare master plan. This plan brings together in one document all of the elements of EW and is intended to serve as a guide for operators, planners, managers and evaluators.

In the electronic warfare master plan, areas for indicated action to improve our test and evaluation capability were highlighted. In general, they revolve around the difficulty in stating measures of effectiveness that will be agreed upon by all of those concerned with the acquisition of EW material.

In any review of the effectiveness of EW, the impact of error looms large. We know that in the past, EW has presented the major if not the only adequate defense against some new threat initiatives. However, intellectual honesty compels us to constantly question the adequacy of some of our countermeasures in the presence of a determined enemy. We must find a way to extrapolate from the electronic warfare Methods of Effectiveness (MOEs) found in sterile testing and exercises, to the cold hard EW capabilities in the only arena that counts .... battle. When we have done this, our position must be stated in the language of the educated layman, not in the arcane language of old crows, spooks, and professionals. We may well understand the problem, but proving the solution will always be difficult and convincing decision makers in the military, DOD, Congress, and the public is really the task.

WHY THE RANGES ARE CONSIDERING GPS SYSTEMS FOR TSPI IN TEST AND EVALUATION

BY
CARL E. HOEFENER
INTERSTATE ELECTRONICS

The Global Positioning System (GPS) is a satellite based precision navigation system. When all 18 satellites are in place (scheduled for 1987), precise position at any location on the earth can be determined by receiving four satellites simultaneously. The satellites transmit at "L" band, so the GPS receiving systems consist of an "L" band receiver and a signal processing and computing system to derive precise position. These receiving systems tend to be too complex, large, and expensive to be flown on the targets in range tracking applications. For small and particularly for expendable targets, a small lightweight frequency translator is flown on the target. This translator simultaneously receives the "L" band signals from all visible satellites and retransmits them over a single "S" band channel, which is then received at a master station and routed to the GPS processing system. A brief description of the Global Position System follows:

The first GPS satellite was launched in February 1978. There are currently six satellites up, and a total of 18 are now planned. Each satellite is in a semisynchronous, circular prograde orbit at an altitude of 20,000 kilometers, making two revolutions for every single revolution of the earth and thus providing a repeatable ground track. When the 18 satellites are up, there will be six in each of three orbital planes displaced 120 degrees with respect to each other.

Each GPS satellite contains a precision clock and a memory containing its ephemeris data, which is regularly updated. It periodically (once every 30 seconds) transmits the ephemeris data along with spread-spectrum coded signals. The receiving stations lock onto the coded signals and receive the ephemeris data. With four satellites in view, the stations can determine precise time along with satellite position and velocity. The satellites must, however, contain information on their own position and time. This is accomplished by the use of a network of ground stations that includes a master uplink and monitoring station at Vandenberg Air Force Base in California, and monitoring stations in Guam, Alaska, and Hawaii.

The satellites transmit at two L-band frequencies: one at 1575 MHz, and the other at 1228 MHz. Two transmission frequencies are utilized to correct for ionospheric delays. Each frequency transmits C/A-code, P-code, and telemetry data from the satellites. All satellites transmit on the same frequency with different codes. In order to obtain precise position information, precise time measurements must be made at all receiving sites. This is accomplished through the precision C/A and P-codes transmitted by the satellites. The pseudorandom codes are bi-phase-quadrature-modulated on the L_1 and L_2 carriers. The P-code is at 10.23 megabits per second, and the C/A-code is at 1.023 megachips per second. (The P-code is essentially a vernier for the C/A code). Although the P-code was intended to give more precise timing and hence more accurate position determination, in practice we have found that the C/A code alone is generally sufficient for position determination and more accurate for measuring velocity.

Position is determined at the receiving site as follows: Each satellite transmits its corrected ephemeris data continuously so that we know, at the receiving site, the exact position of each of the four satellites being received. Through the use of the C/A and P-codes, we derive precise time-of-arrival information of the data from each satellite. From this we can determine our position relative to the satellites. When receiving data from four satellites simultaneously, we essentially solve four equations with four unknowns. They are X, Y and H positions and precise time. This solution is mechanized in a software Kalman filter that has an update rate of 10 times per second. In addition, precise velocity information is obtained through precise frequency measurement. Because the system uses both a target and reference receiver in the ground station (differential GPS), most bias errors generally encountered with a conventional GPS navigation system are cancelled out. The target tracking errors anticipated with a translator-based GPS tracking system are generally less than $\pm$ 7 meters rms.

At the same time, the ground system is relatively simple, requiring only a few racks of equipment which could easily be made portable. This would enable any location to become a precision tracking range. The system can easily be expanded to multitarget tracking capability by frequency-multiplexing the "S" band downlinks from the translator.

A system of the type described has many advantages over alternate systems for obtaining Time, Space and Position Information (TSPI). The principle advantages over an instrumentation radar are as follows:

1. Portability - any location can easily become a tracking range.
2. Accuracy - more accurate than radars, particularly at extended ranges.
3. Less cost - about 1/3 (or less) the cost of tracking radars.
4. Unaided - the system does not need any tracking acquisition aids if the targets are close enough so a directional telemetry antenna is not required.
5. Target discrimination - the system can separate targets flying in close formation and can simultaneously track up to four targets. The maximum number of targets is limited by available bandwidth for frequency multiplexing.
6. Low-altitude, close range - the system can track low-altitude and extremely close-range targets.

These advantages accrue to a GPS tracking system whether a complete GPS receiver is flown in the target or a translator is used with position computation taking place at a ground station. Flying a GPS translator, however, has significant advantages over flying a GPS receiver. These advantages are as follows:

1. Smaller - the translator is much smaller than a GPS receiver.
2. Expendable - the translator can be made expendable.
3. Lighter - the translator is lighter than a GPS receiver.
4. Differential GPS - use of the translator tends to cancel out system bias errors.
5. Data aiding - tracking gain of a phase lock loop over a costas loop can be appreciated by using a translator.
6. Costs less - a translator is less expensive than a GPS receiver.

The ranges are seriously looking at alternate precision tracking techniques for a number of reasons. Primarily the radars are getting old and wearing out. They require extensive maintenance and many trained operators. In addition, there may be an advantage of precision tracking capability beyond existing range boundaries, such as in the case of the cruise missile. Also, there may be the requirement for operational testing of weapon systems in their actual operating environment. With the cost of
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AUTOMATIC TEST EQUIPMENT: THE CRITICAL NEED FOR EARLY PLANNING

George W. Neumann

Job satisfaction for the manager of a major defense system acquisition program lies in the successful deployment of that system. The fielding of the first production units may even be considered a cause for celebration. But how do things look a year later? Has the fielded system been fully accepted by the operational forces, or is it the subject of headlines, tagged as a system its operators would rather do without? Does the new system have problems because some vital logistics element was ignored? Is the system consistently "non-operable" as a result of the non-glamorous "ilities" (reliability, availability, maintainability) having received only token attention during development? This has all too often been the case, with predictable results.

Early planning for logistic support is vital for all modern systems. One of the more important elements of early support planning involves planning for the automatic test equipment used for the maintenance of complex electronic equipment. Such early planning is essential if field support of the system is to be adequate. This paper addresses the early planning and decision-making processes as they relate to automatic test equipment, and discusses some tools available for use by the acquisition manager. The potential payoffs to the program are a significant reduction in life-cycle costs and a gain in system readiness.

Need for Automatic Test Equipment

Electronic components are being used more and more frequently in all types of military systems, and with each succeeding generation the circuit complexity increases. This increased complexity, coupled with decreases in skill and retention levels among military recruits, makes manual troubleshooting of sophisticated electronic circuits infeasible. Such testing cannot be done by junior enlisted technicians with a minimum of training; it can only be done through the use of automatic test equipment. By making equipment maintenance more effective, automatic test equipment reduces equipment down time, reduces the number of maintenance personnel required, and generally eases the logistical burden.

The Cost of ATE

The Industry/Joint Services Automatic Testing Report states that the services spend more than $3 billion annually on automatic test equipment. This includes computers, test station hardware, test programs, interface devices, and software. The versatile avionics shop test (VAST) system used in support of carrier-based aircraft costs $4 million each, with four systems required for each carrier. Other test equipment ranges in size down to units as small as a desk-top console.

The ATE costs for support of a system depend upon the type of circuitry used in the prime unit (digital, analog, hybrid), the complexity, fault isolation requirements, and other vital factors such as:

— Quality, completeness, and availability of prime unit design data package;
— Maturity of the ATE type to be used;
— The engineers employed to produce the test program sets.

The primary cost of ATE software lies in the development of the test program set (TPS). This consists of a test program tape, an interconnection device, test program instructions, and related documentation. The high cost results from the many sets needed for each weapon system. For example, more than 64 different test program sets support one Navy aircraft at the weapons-replaceable-assembly (WRA) level at an average cost of $150,000 per TPS. Shop-repairable assemblies (SRAs) average $60,000 each for the 529 SRA test program sets for the aircraft.

As the weapon system undergoes change during its service life, changes will be required in the automatic test equipment and attendant software. Unless strict configuration control is invoked, an uncontrolled situation with excessive costs can occur. Configuration management is a necessary discipline that should be an integral part of the weapon system management process. A difficulty that must be overcome is a tendency for ATE development to lag behind system development. Further problems and costs mount as changes to the weapon system require delays and modifications to the support systems. These problems must be recognized.

Early Planning for ATE

A significant percentage of the cost of automatic test equipment can be cut, but only if automatic testing is considered early in the system development cycle. The object is to reduce system down time in the least costly way. The danger that awaits the program is that ATE considerations can be buried under the problems of design and engineering for the prime system, and do not become major conerns until it is too late. If the decisions regarding future support are delayed, the system life-cycle costs are already heavily committed. The natural tendency to try to save on acquisition costs by deferring spending to the deployed operation and maintenance funding stages must be recognized and combatted by using total life-cycle cost as a system selection factor.

Early planning can help eliminate costly and complex interfaces by making available optional early design techniques that can optimize the testability of a circuit, component, or system without reducing performance. Good testability is an effective route to enhanced system maintainability.

One early decision that must be made involves the division of testing between built-in test (BIT) methods and separate automatic test equipment. How much BIT? How much ATE? Both have their roles and they operate synergistically when properly integrated. The integration of on-line (BIT) and off-line (ATE) testing can provide high levels of reliability, maintainability, and operational readiness at the lowest cost when proper trade-off techniques are used. The manager must know what is desired and the costs of accomplishing his goals, and must act early. Decisions regarding the division between BIT and off-line ATE must be made as early as the concept-formulation stage.

Sample Case

Automatic testing is an integral part of the missile launch control system of the Trident submarine. After ensuring that each missile is properly pressurized, that outer doors are open, and that all missile and launch functions are satisfactory, the launch control system launches the missile automatically.

The missile launch system automatically conducts the missile tests. When the "no-go" condition is found, built-in-test circuitry isolates the problem to either the launch system or the missile itself. Twenty-four equipment drawers (one per missile) containing 100 standard electronic modules (SEMs) of 16 differing types (2,400 modules in all) make up the launch control system. The BIT isolates the fault to a specific drawer, which can be removed and replaced in a test slot where it is checked by a special test computer. The test computer identifies the specific faulty card in the drawer. Thus, the combination of BIT and the built-in-test equipment (BITE) easily meets the established system requirment of 20 minutes or less for mean time to repair/replace.

The cost of this system was a million dollars for BIT, 10 percent of the $10 million total system cost. Costs of BIT are often, as in this example, reduced because the contractor would have spent $500,000 for identical equipment required for in-house testing. The key to success and maximization of cost savings requires starting the design of BIT concurrently with prime system design, and considering the BIT for use during production testing. If costs are to be minimized, BIT must be an integral part of the prime system, and not just an afterthought.

ATE Acquisition Process

The ATE acquisition process is a systematic series of actions to acquire the ATE and associated items necessary to support the system. The process is adaptable to acquiring items at the platform (ship, tank, plane), system (weapon system), or equipment level. Each major system is a composite of related units that are themselves candidates for automated testing. The ATE set that satisfies the needs of the overall system is viewed as part of the total support system. The subsystem relationships are established through a work breakdown structure of the major system. This provides a broad look at the overall ATE requirements (including BIT) and permits consolidation of test equipment requirements. Interface relationships must be identified early in the acquisition process and must provide a framework for managing the acquisition.

Automatic test equipment acquisition is identical to major system acquisition (conceptual, validation, full-scale development, and production phases). It is based on the realization that the effort is executed by a contractor or a combination of contractual inputs. The procedures are, of course, tied to the Defense Department's acquisition policy with emphasis on matching DSARC milestones. In a major prime-system acquisition, the process would include all DSARC review milestones.

The conceptual phase provides a basis for selecting a system that satisfies operational needs and provides options for further development. Management activities in the conceptual phase are in the disciplines of ATE acquisition, system engineering, integrated logistic support, configuration management, test and evaluation, and procurement.

The system engineering process transforms operational needs into specific performance parameters and a preferred system configuration. The main system performance influences affecting ATE are the reliability and maintainability requirements. The time to repair or maintain a system defines the level of testing and the time to isolate faults for a test system such as VAST. Design engineering decisions concerning overall system configuration (especially decisions defining replaceable and repairable units) are the major drivers of ATE design parameters. The major system engineering elements involved are the operational and logistic requirements analysis, design trade-off analysis, system functional configuration, and the system characteristics.

Integrated logistic support activities are performed before system engineering to provide inputs and criteria for design trade-offs. The maintainability/maintenance interface is of primary importance to ATE at this stage of system procurement (maintenance planning includes requirements, design criteria, repair policy, test philosophy, and cost analysis while maintenance includes the concept, procedure, personnel skills, training, support equipment, provisioning, and documentation). Alternative system support concepts are developed based on the requirements and a preliminary maintenance concept can be developed by using simulation techniques.

The objective of the ATE acquisition activity in the conceptual phase is the ATE support concept. The related ATE applications for a prime system are aggregated and provide the ATE support concept. The ATE support concept includes all interdependencies of the automatic testing application requirements. Applications range from operational monitoring (using BIT information) to circuit-board testers. A simplified framework of the automatic testing support concept can be developed by using a table listing the system functional elements from top-level down, vs. the automatic testing applications (readiness monitoring, BIT, off-line, etc.), performance/fault isolation levels (system, equipment assembly, etc.),maintenance level (organizational, intermediate, depot), and ATE candidates. The intersections of the matrix are expanded into a full-fledged ATE support concept covering all important issues.

Configuration management uses technical and administrative directives and monitoring to identify and document configuration item characteristics and control changes, and to maintain the change status. Specific configuration items are designated by the program manager and consist of hardware, software, or any of their discrete portions that provide an end-use function. Usually, all hardware elements of a system selected for ATE support are designated as configuration items (CI). The functional equipment, made up of the replaceable units to be tested off-line, is also designated CI. Preliminary system specifications are used to identify and document the CI characteristics.

Test and demonstration events conducted during conceptual design must prove that the system and its support elements function as designed, and highlight weaknesses. The ATE acquisition is influenced through the demonstration and test of the design requirements for testability, reliability, and maintainability. Automatic test equipment compatibility itself is part of the maintainability program requirements. The key document involved in demonstrating ATE is the integrated test plan, a part of the request for proposal (RFP) —appropriate portions are included in the preliminary system specification.

Most procurements with ATE acquisition impact are competitive and follow the normal sequence of preparing an RFP, evaluating proposals, selecting a source, negotiating a contract, then awarding the contract. The program manager or his ILS manager should participate in the preparation of the RFP and its eventual evaluation to ensure that ATE requirements are satisfied. Key documents involved include the acquisition plan (AP), and the advanced development RFP, which must be critically scrutinized at this time.

The validation phase verifies the result of the conceptual phase and allows system definition to the extent that the program manager can proceed to develop the detailed design. Significant events take place in ATE acquisition - system engineering, integrated logistic support, configuration management, test and evaluation, and procurement. Two distinct activities occur: (1) evaluation of alternative approaches, and (2) subsystem design. The key event for the program manager in this, as in every phase, is the DSARC milestone review. Several key documents must be prepared to support DSARC, including the following:

— Specifications
— Logistic support analyses
— Integrated logistic support plans
— Procurement requests
— Requests for proposal
— Budget requests
— Acquisition plans

Specifications must be reviewed to ensure that items vital to automatic testing are addressed. These include such cost drivers as testability, built-in-test, compatibility, documentation requirements, test language, and guidance for the critical test program sets. The logistics support analysis (LSA) must be updated to provide the latest information on sparing, configuration, storage requirements, manpower, personnel, and training. The LSA provides the guidance for optimized support and is a key document used in life-cycle costing.

The integrated logistic support plan provides milestone information needed to implement the support concept. It is concerned with test equipment procurement, test program set development and validation efforts, publications, sparing, and training. It is imperative that the milestone dates and plans for system support match the key dates for the system supported. Key integrated logistic support work statements are included in the full-scale development RFP, and a wide variety of topics must be covered by the acquisition manager at this time. The program manager should ensure that the bidder responds to items such as the following:

— General ILS approach (milestones, schedules, management)
— Specific ILS task identification (in terms of results)
— Integrated ILS network and flow
— Criteria for system selection and equipment for analysis
— Costing techniques
— Management plans
— Required documentation
— Installation, checkout, fitting-out plans
— Manpower plans

The better the RFP, the better the response. The program manager must tread a fine line between guidance and mandate to obtain everything he needs while simultaneously allowing room for contractor innovation. Particular attention should be given to development of the design requirements for testability and on-line test requirements. These will be included in the development specifications and the plans for off-line ATE support. Testability must be considered at this time. If it is not, there will be no testability considerations, or testing techniques with high costs will result. Testability includes functional modularization, test-point assignments, test-point access and arrangements, fault-isolation ambiguities, and disposal-on-failure criteria.

Full-scale development begins with DSARC Milestone II and the development contract award. This phase will ensure engineering design completion, major problem resolution, and satisfactory completion of performance testing. The system, including support items, is designed, fabricated, and tested during engineering development. The output is a preproduction system similar to the final product, and test results that show the system meets the specifications. In the ATE area, the logistics support analysis provides the heart of the design process. Operational testing is used to assess the integration of the hardware and the logistics support system. Failure can be corrected, but once a system has proceeded this far, correction becomes a costly process. Therefore, the ongoing test and support development are critical. The process of finalizing design and development of hardware must consider and firm up designs for testability and the optimum support philosophy. By the time DSARC III is scheduled, documentation must be complete and available to support the system. In addition to the system and the contractual requirements produced by the contractor, the program manager is responsible for several other key documents and plans. They are as follows:

— Integated logistic support plan (incorporating logistics element life-cycle costing, logistics support concepts, LSA)
— Logistics element test and development requirements (for test and evaluation)
— Test and evaluation master plan
— Provisioning and allowance documentation
— Logistics budgets
— Training plans
— Logistics support plan summary
— Procurement requests

Specific guidance has been published by the individual services to assist program managers in ensuring complete coverage of the required documentation. At this stage of acquisition, all loose ends must be tied. Confidence in the performance, operation, and support of the system should be beyond doubt, because any modifications could prove costly.

The thrust of ATE acquisition during full-scale development is establishment of the required off-line capability for each identified configuration item to be supported. Off-line ATE decisions are based on selection of the best options available. These are developed by matching test requirements with available test hardware. The priorities of choice are: (1) existing militarized equipment, (2) existing commercial equipment, (3) modification of existing equipment, and (4) design and development of new equipment. These are, of course, generalized priorities. Guidance manuals are available dealing with selection of ATE equipment, and the individual services are currently involved in developing officially sanctioned ATE inventory lists for program managers. In addition to the equipment, the test requirements data are developed, and finally the test program sets are generated. Generation of test programs is the most costly and complex aspect of off-line ATE and significantly affect not only the original acquisition cost, but recurring life-cycle costs. Test program set maintenance is approximately 35 percent of total ATE life-cycle cost.

The production phase commences with DSARC Milestone III and the awarding of production contracts. The production phase provides the deployable systems, including their logistics support. Once full production begins, the principal efforts of the contractor center around engineering changes and change processing. Early establishment of configuration control management is a major concern, as is system installation, deployment, and production scheduling. Major ATE acquisition activities in the production phase center around test program set changes. Configuration control of the TPS is involved with the test program tapes, the interconnection devices, the test program instructions, and their related documentation. Configuration control is a major task in the TPS area and, if neglected, costs can become astronomical. Experience and use of TPS and the testers themselves will surface problems requiring modification and change, especially in the early years of deployment. Much of the program manager's time will then be spent solving short-term problems and modifying logistic plans to reflect real-life experience.

Support Organization for ATE

The program manager has help in handling ATE acquisition. The services have organizations to provide advice and assistance in all phases of the ATE life cycle: The Navy Test and Monitoring Systems (TAMS) Program Office (ELEX 08T in the Naval Electronic Systems Command); the Headquarters, Air Force Logistics Command Directorate of Equipment, Munitions and Electronics through the AFLC Automatic Testing Systems Manager at San Antonio Air Logistics Center (SA-ALC/MMI); the Air Force Systems Command (Aeronautical Systems Division) at Wright-Patterson AFB, Ohio; and the Army Communications Electronics Command (CECOM), Product Manager for Test, Measurement and Diagnostic Systems at Fort Monmouth, N. J.

These organizations are aware of past problems and the latest technology. They provide resources, tools and people, and are capable of identifying, implementing, and monitoring solutions. Review of program plans by experienced ATE personnel can prevent headaches for the new program manager. The services not only produce handbooks, policies, and acquisition assistance, but also function as intimate parts of the Joint Logistics Commanders (JLC) Panel on Automatic Testing, providing guidance and identifying and attacking ATE problems. The JLC Panel publishes documents to save the acquisition manager time and money. Some are the Navy Test Equipment Inventory Status, Acquisition Guide, Automatic Test Program Generation Guide, a BIT Design Guide, and Weapon System Acquisition Review Guidelines. The Air Force has been developing a full set of guidance documents under the Air Force Systems Command modular automatic test equipment (MATE) program. The Army has developed Test and Monitoring Diagnostic Equipment (TMDE) Acquisition Guides, Cost Analysis Guides, BIT Design Guide, TPS Acquisition Guide, TPS Design Guide, and others.

Summary

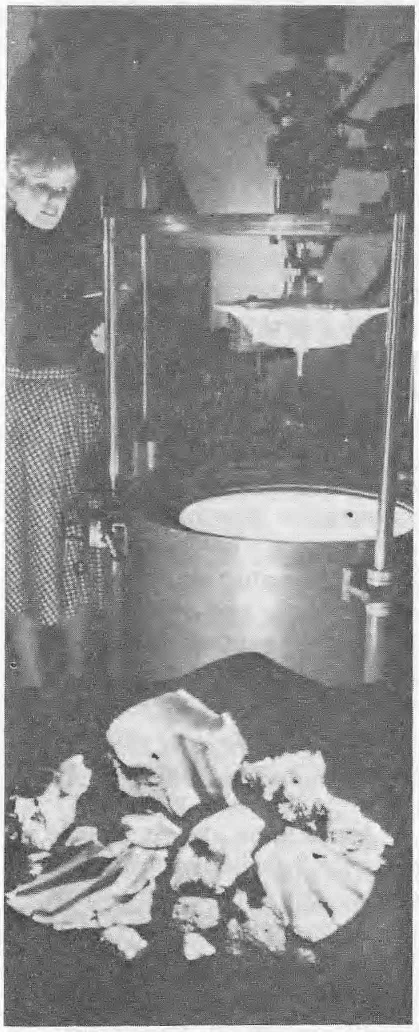
The acquisition/program manager is confronted with myriad problems; central to his concern are costs, schedule, and performance. With the emphasis on total life-cycle costs, the manager is driven, by necessity, into active involvement with high-cost, but high-payoff, automatic testing. Successful use of automatic testing can help to ensure the success of today's sophisticated systems dependent upon electronics. The use of automatic testing for nonelectronic systems is also rapidly expanding, and significant new advances from successful R&D programs will soon be available. Awareness of the procedures and attention to automatic testing at the earliest possible time in a program can be a stepping-stone toward a successful system. Assistance is available from the automatic testing community but, as always, the manager must shoulder final responsibility for the quality of the system. (Spring, 1982, issue of "CONCEPTS", Vol V, No. 2, Defense Systems Management College)

REPRINTED FROM TEST

Spin Testing Used to Prove Integrity of Rotating Parts

By Donald K. Belcher, president
The Balancing Company, Inc.
Vandalia, Ohio

COVER PHOTO



Precautionary spin/burst testing helps to prevent field disasters. Evelyn Chinn of The Balancing Company, Inc., notes results of a spin/burst test on a new turbocharger design. One of the 16.75-inch diameter aluminum castings is shown mounted on quill shaft and ready to be lowered into a 24-inch spin test chamber. Designed for 22,500 rpm operating speed, the piece was expected to withstand a test speed of 27,000 rpm. The rubble in the foreground resulted when one of these castings failed at 25,000 rpm.

SPIN TESTING is the verification of the structural integrity and safety of rotating parts by spinning them at high speeds in controlled environments. It is a fast-growing technology. The need for spin testing has been accelerated in recent years by industrial and military efforts to improve operating efficiencies through increased power-to-weight ratios of rotating components and assemblies.

Spin tests are used to monitor production line quality of high speed rotating parts—to pre-stress material in order to increase fatigue strength of a part—and for low-cycle fatigue testing.

Many components of modern machinery operate at speeds approaching the limits of the materials from which they are fabricated. The high centrifugal stress that results can cause parts literally to explode, propelling high-energy shrapnel into the surrounding area. The consequences of a centrifugal burst can be so disastrous that no company should risk testing new designs **in the field.**

Because the design and safety of any highly-stressed rotating part should be determined and documented before the part is put into service, spin/burst testing logically needs to be integrated into the research and development phase. As indicated above, it also is advisable to continue verification of the manufacturing process as an ongoing non-destructive test in production.

Spin/Burst Testing: What It Is

Spin testing is the process of rotating components and assemblies at high speed to create centrifugal stress.

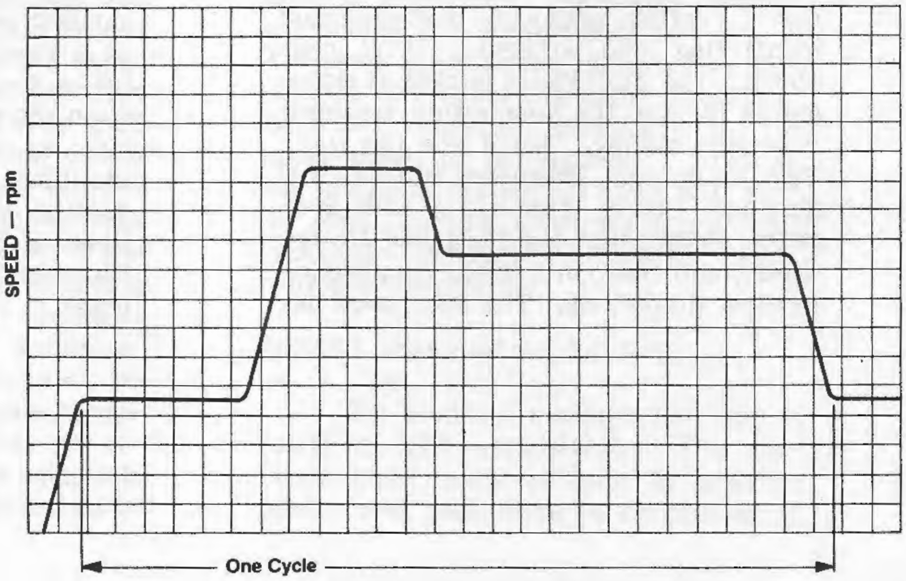
Elementary spin tests are the most common and are performed as simple proof tests in which the component is spun to some speed above the maximum value anticipated in service in order to establish whether or not there is structural integrity. Generally, dimensions are checked before and after a test—or a non-destructive evaluation is made by means of x-ray, Magnaflux, Zyglo, or a die penetrant, in order to determine test results.

This kind of proof spin testing has been a routine step in the production of aircraft and industrial turbine engines since the time of World War II. Many other pieces of modern machinery also operate at speeds close to their centrifugal stress limits and must be spin tested.

Prototype Testing

Spin testing is an important step in the development process of high-speed equipment. Again, the consequences of a design mistake are so serious that prototype parts must be spin tested before equipment is released to production. Often it is advisable to conduct burst tests—in which the speed is increased until failure occurs—in order to establish safety margins and fatigue limits of prototype parts.

Procedures more sophisticated than the simple burst test are available for detailed investigation of centrifugally-stressed components. For instance, strain gages are applied in areas of particular interest, with data read-outs by means of electrical impulses transmitted from the



Figure, 1. TYPICAL LOW CYCLE FATIGUE TEST

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Corporate membership in ITEA offers employees an excellent opportunity to publish in official ITEA publications where their professional views and expertise will be recognized by leaders in the T&E field. This recognition and professional growth of the employee will both be of benefit to the corporation.

Demonstrate your corporate support by subscribing to a $300 per year Corporate Membership in ITEA that will enhance your RDT&E approach, quality assurance, and employee rewards. Complete the application form in the name of the corporation at a $300 annual membership fee and receive corporate recognition in all ITEA International Publications.

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- Two individual memberships in ITEA to be selected by corporate member with no additional dues
- The two selected individual members will have all rights and privileges including the right to vote and to hold office.

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Circulation: 3000 copies printed and distributed by mail and hand delivery; current computerized mailing list of approximately 1000. Over 200 members receive five copies each for distribution to key T&E associates. Published quarterly in 8½" x 11" format. Distribution primarily domestic.

Policies: Limited advertising to ten pages or 20 percent of total pages per issue. Technical data, products, services, employment and educational advertising preferred. Copy subject to approval of publisher. Advertising prices based upon restricted space available in publication and to cover ITEA costs. Advertising not mixed with editorial articles unless required.

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Deadline: Receipt at least by the fifteenth of the publication months of January, April, July and October.

Prices: $300 per full page per issue or $200/page for three issues.

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Payment: Payment by check required at time of submission of material for publication in specified issues. Publisher reserves the right to refund or publish on first-come basis within (plus or minus) one issue of desired issue(s). Costs are based upon Newsletter publication and distribution costs to a non-profit corporation.

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Name Title	Name Title
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workpiece through slip ring or telemetry arrangements. Also, brittle lacquer can be used for mapping stress fields.

Spin testing is performed to evaluate *complete mechanisms* that function at high rotational speeds. Perhaps the most common spin test of this type is done on proximity fuse mechanisms for artillery shells.

Another use for spin test equipment is to test materials and structures that do not necessarily rotate at high speed in service. Centrifugal stress provides a convenient way to apply loads that would be difficult to achieve by other means. For example, electric motor comutators are spin tested to determine armature bar adhesion. Although these comutators normally do not rotate at high speeds, spin testing is an efficient way to prove the strength of the bond between the comutator body and the copper bars of its armature.

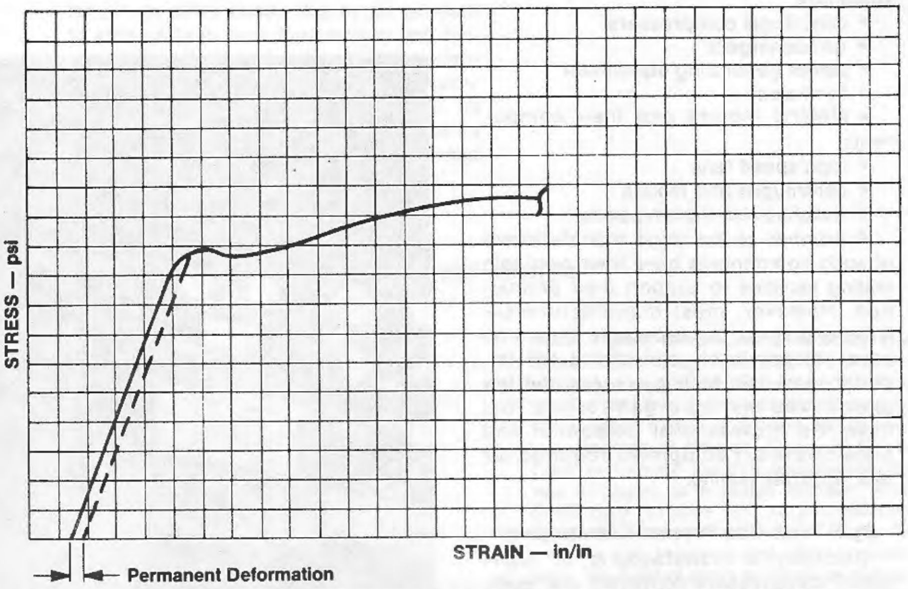


Figure 2. ROTATIONAL STRESS IMPOSED ON WORKPIECE

Classic fatigue data produced by rapidly alternating stress—for example, a rotated beam test rig—does not accurately predict failure under low frequency loadings. Because of this problem, unpredicted jet engine failures have occurred, resulting in injury and death.

To make accurate measurements of low-frequency fatigue properties it is necessary to apply stress, maintain that stress for a period of time long enough to allow crystal dislocation, then relax the stress for a similar time period.

Several aircraft engine manufacturers repeatedly test sample production turbines and compressors under cyclic spinning conditions. Simple full-scale tests of production components seem to be the best way to determine very low cycle fatigue integrity.

Low cycle fatigue spin testing also is used in metallurgical research to define the fatigue life of new alloys. By contouring test discs properly, metallurgists can apply a variety of tri-axial stress states and explore low-cycle fatigue behavior under complex loadings.

Kinds of Equipment That Need Spin Testing

The following are typical rotating assemblies and components that should be spin tested to assure their safe performance:

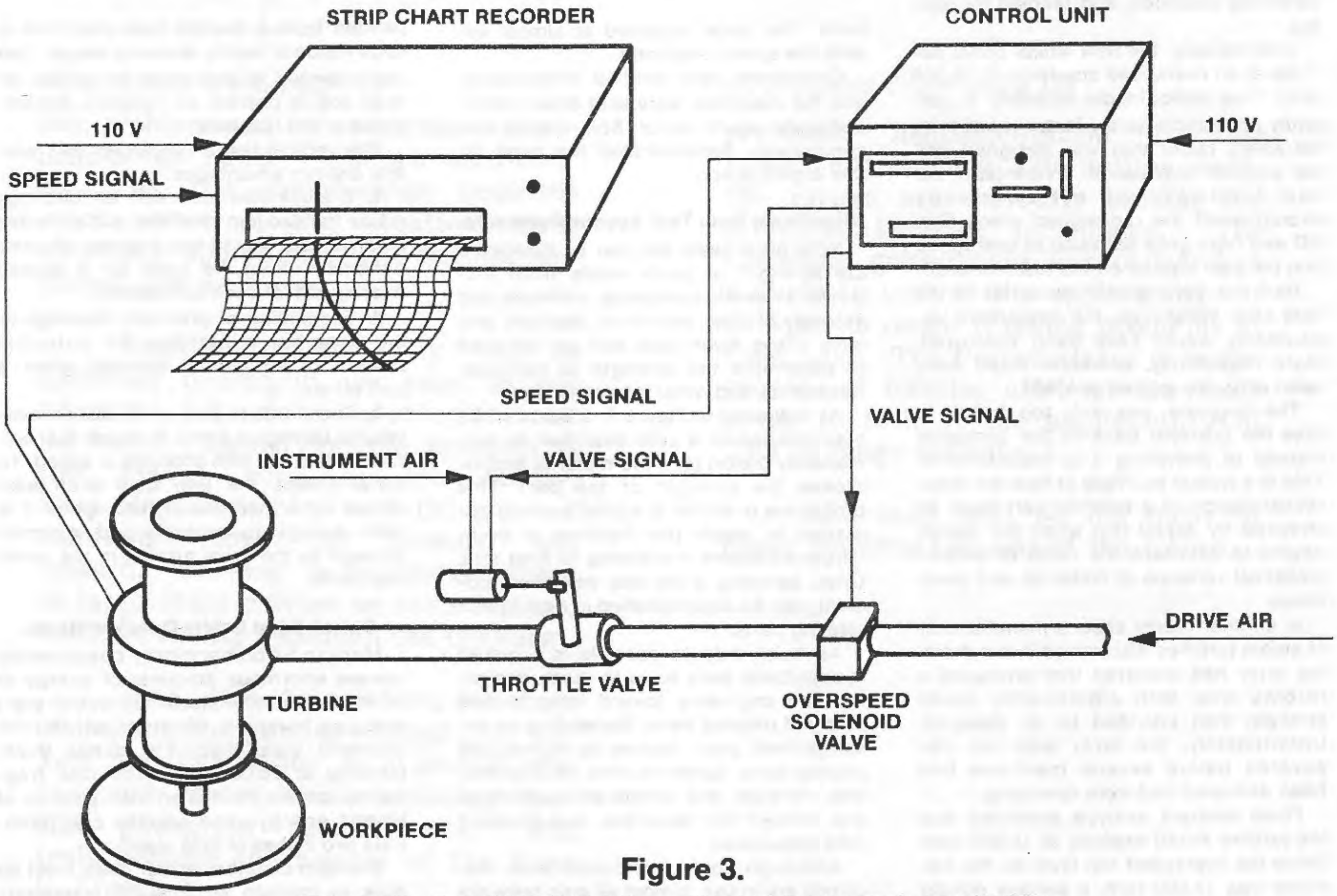
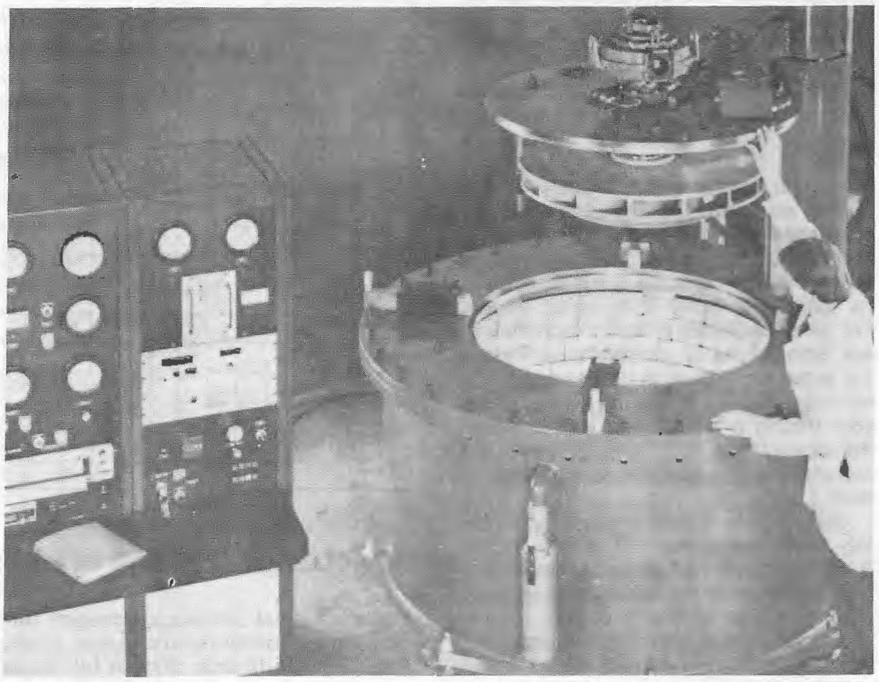


Figure 3.
TURBINE GOVERNOR — TACHOMETER SYSTEM

• turbine engines, both mobile and stationary
• centrifugal compressors
• turbochargers
• power generating equipment
• flywheels
• electric motors and their components
• high speed fans
• centrifuges and mixers
• clutches and transmissions

A number of the large manufacturers of such components have their own spin testing facilities to support their production. However, most manufacturers—large and small, but especially those who have not previously considered the importance of spin testing—rely on the few specialized testing organizations that have the professional personnel and state-of-the-art equipment required for fast, accurate testing.



This new spin/burst testing system at The Balancing Company, Inc., expands the company's contract testing capabilities. These tests are used to find out whether or not engineering calculations are correct and help establish design factors to prevent costly and dangerous field failures of turbines, fans, rotors, and other high-speed rotating components. Depending upon physical criteria, the new spin test chamber accommodates test parts up to 48 inches in diameter, up to 36 inches in length, and up to 1500 pounds in weight. Speed is controlled to 150,000 rpm.

Spin Tests Can Prevent Catastrophes

Recently, a manufacturer of high-speed compressors contacted our company with regard to spin testing a newly-produced centrifugal wheel. Design of the wheel had been borrowed from the design for a lower-speed turbine and had been adapted, through heat treatment, for the 44% higher stress of a new application with 20% greater speed.

The manufacturer's delivery schedule was so tight that an engineer decided to drive to Vandalia, Ohio, from New England with the test piece rather than wait an additional six hours for a plane flight. As soon as the engineer arrived, the test piece was mounted on a spin arbor, dynamically balanced, and readied for testing.

Theoretically, the new wheel could operate at an overspeed condition of 55,000 rpm. This undoubtedly included a currently acceptable safety factor lower than the safety factor that was designed into the original application. Evidentally, the heat treatment had not sufficiently strengthened the redesigned piece. The OD and bore grew so much at overspeed that the part slipped off the test mandrel!

Had this bore growth occurred in the field after installation, the equipment undoubtedly would have been destroyed. More importantly, someone might have been seriously injured or killed.

The engineer was only too happy to take the problem back to the computer instead of delivering it to his customer. This is a typical example of how the theoretical design of a rotating part must be checked by actual test when the design begins to approach the limits of defined statistical variance of materials and processes.

In another recent case, a manufacturer of steam turbines discovered that a drawing error had occurred that produced a turbine disc with significantly lower strength than intended by its designer. Unfortunately, the error was not discovered before several machines had been delivered and were operating.

Finite element analysis predicted that the turbine would explode at 15,000 rpm. Since the overspeed trip level on the machine was 13,500 rpm, a serious danger seemed to exist. To verify reality of the problem, a sample disc was spun to burst. The burst occurred at almost exactly the speed predicted.

Customers were notified immediately, and the machines were shut down before a disaster could occur. Spin testing had conclusively demonstrated the need for this urgent action.

Significant Spin Test Accomplishments

Spin/burst tests are run to determine the strength of parts made from dissimilar or exotic composite materials and a variety of steel, aluminum, titanium, and other alloys. Such tests also can be used to determine the strength of castings, weldments, and other fabrications.

As indicated in Figure 2, a part can be overspeeded in a spin chamber to permanently distort (set) the material and increase the strength of the part. This procedure is similar to a cold working operation in which the material is work-hardened before machining to final size. Often, spinning is the only way this hardening can be accomplished in high-speed rotating parts.

As much data as possible is acquired in spin/burst tests so as to guide designers and engineers toward integrity and safety of rotating parts. Depending on the assignment, such devices as high-speed photography, speed-vs-time strip charts, and vibration and temperature readings are utilized for accurate, documented data acquisition.

Although some horizontal-axis machines are in use, almost all spin tests are conducted with a vertically oriented axis of rotation. The piece to be tested is suspended from a flexible quill shaft that is spun inside a heavily armored vessel. The test chamber is evacuated to reduce air drag and to prevent air dynamic disturbances of the test part.

The vertical test arrangement has several distinct advantages:

1. It eliminates the need for bearings inside the vacuum chamber and provides a convenient way to test a variety of components without the need for a special bearing set for each component.
2. Elimination of precision bearings in the chamber minimizes the potential amount of equipment damage when a part bursts.
3. The flexible quill shaft allows successful testing of parts in which the balance axis shifts with changes in speed. To some extent, the thin quill shaft also serves as a mechanical fuse, since it is weak enough to separate and minimize damage to the drive turbine in the event of a burst.

Out-of-Sight Safety Considerations

Modern turbomachinery components release enormous amounts of energy at burst. As an example of the out-of-sight energies involved, consider an 18-inch diameter steel disc, 1½ inches thick, bursting at 20,000 rpm. The disc fragments contain 24 million inch-pounds of kinetic energy—and usually can penetrate two inches of mild steel!

The spin chamber armor plate must be able to contain such burst fragments without being permanently deformed. Proper armor design requires careful

Spin Testing

consideration of material properties and of fabrication techniques.

Typical modern chambers use several layers of high toughness steel for burst protection. An inner liner of shaped lead blocks helps capture burst fragments and also absorbs impact, reducing the stress applied to the outer plate.

In addition to the obvious need for containing burst fragments, the spin test chamber must be carefully constructed to prevent accidents from a less obvious source. When metal test particles explode in the chamber, a significant quantity of metallic dust can be generated. If the chamber vacuum should fail simultaneously with the burst, admitting air into the chamber, a violent metallic dust explosion could occur. The chamber must be constructed to contain such an explosion—and the vacuum system must be designed to prevent the possibility of this type of explosion.

The Strong Case for Spin Testing

The potentials for catastrophic field failure of high speed rotating parts have become so great that no manufacturer dare risk unknown safety factors in design. A company cannot afford the legal and economic consequences of a high-speed, high-energy failure.

In some cases, parts can be tested prior to machining, to reduce the cost of any failure. In other cases, it may be prudent to spin parts in their housings to test failure containment and safety of the assembly. In all cases, comprehensive spin/burst testing is the only safe way to be sure that highly stressed components have the rotational strength they will need to operate safely in the real world.

THE AUTHOR

Since starting his own business in 1967, **Donald K. Belcher** has become an internationally known authority on the diagnosis and solution of all types of industrial balancing and vibration analysis problems. He heads a group of companies, including The Balancing Company, Inc. (BALCO), that are engaged in special machining, tool building, welding and fabrication, machinery leasing, and complete balancing services. Mr. Belcher is a graduate of Missouri School of Mines. Prior to forming his own organization, he was employed as a design engineer with Sundstrand Aviation and as a production and value engineer with TRW Globe. In working with balancing and vibration problems, Mr. Belcher came to recognize the increasing need for comprehensive spin/burst testing of rotating components—particularly in research and development stages—to determine their structural integrity. His company's spin/burst testing facilities, which have expanded rapidly in the last three years, are a logical extension of balancing services, since each test part is carefully balanced before spinning. BALCO's spin/burst testing activity is directed by Mr. Belcher's son Mike, a mechanical engineering graduate of Ohio State University with concentration in spin test research.

(Continued from page 7)

this problem and its recommended solutions to light. We are confident that, as the membership becomes more aware of the situation, many alternate approaches will become apparent and well used.

Positive results may not be achieved overnight nor even in our lifetimes. However, an attempt must be made. Identifying the problem is the lowest rung of the ladder. Proposing workable, well-thought-out solutions moves us forward and upward. Working to implement them (a large step) carries us even further, until we finally approach the top rung.

Then, this Association, which is dedicated "to gaining recognition for Test and Evaluation as a unique professional career field, including special education requirements," will truly become the Keeper of the Keys to Knowledge.

(Continued from page I2)

precision instrumentation tracking radars approaching $20 million each, the ranges are seriously looking for alternate tracking techniques. The Canadian government has undertaken a study to look at the applicability of GPS to its range tracking problems at Cold Lake. The United States is in the process of forming a tri-service study group to look at the applicability of GPS to range tracking.

GPS may well be the basis of range tracking systems of the future.

ASSOCIATION NEWS

A.R. Matthews

Board of Directors (BOD) Meeting:

The April 1982 Newsletter (page 13) summarized all prior BOD meetings. The meeting scheduled for 26 May 1982 was held in Falls Church, Virginia, at Tracor, Inc., in line with the policy to rotate geographic areas and hosts. The President was ill and confined to quarters during the prior BOD meeting and by the fortunes of serendipity, was in surgery during this meeting. Health is now normal with a very interesting test and evaluation after recovery! Carl Cooper did an outstanding job as VP, Acting President, and BOD Chairman. The following BOD members were in attendance on 26 May and are listed to give credit for their outstanding voluntary contributions and to show the scheduled year for future elections based upon initial arrangement of a 3 year term for three members each to provide overlapped rotation per bylaws.

Carleton R. Cooper, 1983
(Acting Pres/VP/Chairman of BOD)

Edward D. Connor, 1983

Richard G. Cross, Jr., 1983

Walter Finkelstein, 1984

Bradford S. Granum, 1985

Franklyn P. Smith, 1984

Carl Smith, 1983
(Secretary/Treasurer)

Allen R. Matthews, 1985
(Absent)

Charles K. Watt, 1985
(Nominated to replace DR. E.W. Ivy)

The BOD addressed a long series of items including: (1) financial matters, (2) individual memberships, (3) corporate memberships, (4) resignation of Dr. Ivy from BOD due to other pressures (our deepest thanks to Webb for his contributions since 1980), (5) Senior Advisory Board report by Dick Cross. His members include Howard W. Leaf and James A. Stone (they will keep us straight!), (6) selection of candidate new BOD member, (7) BOD members tenure (8) membership certificates (9) mailing list, (10) updated computer rosters for existing and candidate chapters, (11) Newsletter, (12) byLaws, and (13) others. The details of these subjects are included by subject in the overall news.

Membership

The official membership log and computer printout of members shows a total of 370 members as of 1 August 1982.

ITEA is pleased with this membership that has developed essentially in two years as a result of the individual efforts of many members and the Newsletter that has general distribution to over 2500 individuals and organizations. Thanks to each of you, particularly Major Dave Herrelko, USAF, for your leadership. Frank Smith is developing a program as the new Membership Chairman.

Although the membership is across the U.S. with a few foreign and Canadian members, it is widely dispersed with concentrations at the five ITEA chapter locations. We expect a major membership increase during the 1983 International Symposium in Washington, D.C. Inquiries have come from Japan, Europe, Saudi Arabia and elsewhere.

We are honored to have 13 distinguished Honorary Members and five Corporate Members, including the latest which is the ITT Avionics Division in Nutley, N.J. We welcome ITT and Neil Hansen, Vice President, with his associates.

Registered attendance at the 1983 Symposium is expected to be near the 400 attendee limitation. You can be sure that the registration fee will be reduced for members who will have priority. Therefore, it behooves all those interested in T&E to join ITEA and participate in the development of T&E as well as ITEA by receiving the symposium announcements which permit your voice to be heard in the symposium as a speaker or panel member.

Five potential new chapters are still evolving and will not only serve existing local members but will add new members as well. Normal summer vacation doldrums will soon be over, so we expect intense fall 1982 advancement by both existing and new chapters.

Membership Dues for 1982

Seventy 1980 and 1981 members have not paid the 1982 dues as a result of first-class invoice mailings sent in March 1982. However, note that 10 were received as late as June-July 1982. There may be more enroute. In any event, a second selective mailing to some past due members will be made in the near future since many of those members have verbally indicated their intent to renew.

If we assume that 60 prior members from 1980 and 1981 drop their membership in 1982 due to transfer, retirement, or other reasons, ITEA is very fortunate in having a net loss of only seven percent per year. Such figures are normally not published but ITEA takes great pride in such a small turn-over of memberships.

Current dues are modest: civilian \$25, military \$15, corporate \$300 and foreign address \$40. We hope to maintain these low annual dues to maximize participation. Good T&E will help reduce inflation and dues in 1983. Military dues will be changed to the standard \$25 in calendar year 1983.

Newsletter

Brad Granum requested that he be relieved as Editor and that Lee Hand, the Associate Editor, be appointed Editor. This was approved by the BOD. It is, therefore, appropriate to review the process in the hope of securing additional inputs from members.

In general, the Editor publishes, one or two months in advance, a table of contents with specific sectional assignments. Each of us, as seen by prior Newsletters, contributes specific sections more or less by the deadline. This involves all the offices and chapters, plus committees. The Editor and others help to secure the editorials, feature articles, and featured facilities.

In the end, the Editor pulls it all together for word processing and layout into a camera-ready copy which is sent to the President for review and contract printing. Mailing labels and quantity to be printed are finalized. Rotating members of the Southern Maryland chapter then hold a "mailing party" to affix labels per Zip Code non-profit postal requirements. Finally, the 3000 copies (750 pounds) are packaged and the President delivers to the Post Office for inspection, payment and mailing.

This process requires the voluntary assistance of many members for which ITEA is grateful. All members should assist by submitting technical/management articles for publication. Please include appropriate proprietary and non-classified security release as is customary for similar publications. Use black and white photographs.

The Newsletter is most cost effective when printed with 16, 32 or 48 pages and can have an additional colored center fold. New postal regulations permit use of the 4.9 cents per ounce for mailing. A 32 page (our standard) newsletter with center-fold weighs about 3 ounces. Printing and mailing costs total approximatly 40 cents per copy delivered or 1 cent per page. Total cost means the order of $1,000.00 which is supported by members dues.

Advertising, as solicited in the Newsletter, would help defray publication costs and possibly enable ITEA to build up needed funds for routine operating costs and essential costs to conduct the planned symposium.

Please solicit modest advertising as outlined herein to provide essential financial support for achieving the purpose of ITEA. It is planned to ultimately translate the Newsletter into a T&E Journal with commercial assistance thus relieving member volunteers for concentration on advancement of the SOA in T&E.

Advertising

ITEA has previously announced the availability of a special three inch diameter ITEA decal. We hoped to see these in wide use and recover our costs. Many of you have received this colored decal on your membership certificate.

The decal is not only useful for personal identification, but also for advertising ITEA to new members. Order at $3.00 for 6 decals from:

ITEA DECAL
P.O. Box 203
Patuxent River, MD 20670

Corporate members are now indicating their intentions of advertising in the Newsletter in accordance with the offer contained in the center fold. Be sure your corporation has budgeted this item and/or can provide funding from existing sources. ITEA needs additional funds to continue the Newsletter and initiate the planned symposium.

The 1983 International Symposium

The DoD has formally agreed to sponsor the 1983 ITEA Symposium, planned to be held at the Defense Systems Management College (DSMC) 21, 22, 23 June 1983.

Staffing is underway and includes selection of: (1) a General Chairman from industry, (2) Franklyn P. Smith as Executive Director, (3) Charles K. Watt as Professional Program Chairman, (4) a DSMC Chairman of the Seminar/Workshop, and (5) Walt Finkelstein as head of the secretariate for general administration.

Many plans made during the past year have been developed and will now be finalized. The program of speakers, session titles, and panel will be created around the theme for 1983.

We hope to have a DoD Advisory Group to complement the professional committee which will include industry and consumer representatives. Case studies are being considered along with a variety of educational subjects.

Financial Report

As of 1 August 1982, ITEA had a carry-over of $2,000 and received $6,800 income. Expenses were $4,700, so the balance on hand is $4,100 which is just enough to publish two Newsletters with $2,000 carry-over to 1983. In other words, ITEA is paying current costs but not accumulating capital to seed the symposium or pay for a centralized administrative office.

ITEA needs 3,000 members to operate effectively. This figure is based upon the current average of 300 members producing a net of $4,000 by August 1982 or $13 per member. The needed members of 3,000 times $25 is an annual base of $75,000 which will permit the establishment of a central adminstration office with Executive Director and Secretary at modest salaries plus overhead.

You can help in at least three ways by obtaining 10 new 1982 members for each existing member, arranging advertising in the Newsletter, and securing new corporate members. Proceeds from the symposium will net many benefits, such as a geographically broader BOD, introduction of a journal, publication of an ITEA brochure, and others, such as a consolidated membership roster.

The policy of ITEA is to retain its professional status and not become indebted to any organization or individual in order to accomplish the corporate purpose of ITEA. ITEA is prepared to spend 20 years to reach 4,000 members, but such a delay is critical to both our national defense and economy - in fact, of the world. So, be active. Set your goals to accomplish the basic financial goals and achieve the purpose of ITEA, as incorporated.

Congressional Amendment No. 952

The Honorable David H. Pryor, U.S. Senate, has proposed Amendment 952 as printed in the Congressional Record, Senate, on May 13, 1982, on pages S5215 through S5219. This amendment is titled, "Purpose: to establish a Director of Operational Testing and Evaluation in the Department of Defense." The amendment was withdrawn by Senator Pryor after initial discussion. It involves not only the DoD, but senior committees of the Congress, including the Armed Services and Governmental Affairs committees. The Congressional Record is available in most public libraries for your reference.

The BOD has studied the proposed amendment and would like to participate in the development of fundamental alternatives for consideration. The professional experience of ITEA members can be utilized in a number of ways. ITEA feels the need to contribute and is developing an approach that not only includes consideration of the Congress, Industry, DoD, and the Armed Services, but also the findings of prior Presidential studies such as the Blue Ribbon Defense Panel of 1970 and the Report of the Commission on Government Procurement of 1972.

Although the amendment was withdrawn, there is considerable interest in defining the role, organization, management and funding for T&E in DoD. As a minimum, ITEA will follow the subsequent proceedings and offer assistance as appropriate.

This edition of the Newsletter includes a reprint of the amendment for the information of all members. Although the amendment concerns OT&E, we must give consideration to the entire process, technology and management of all T&E during the total life cycle of military hardware and software including acquisition and operations from birth to grave, consisting of ET&E, DT&E, PAT&E, OT&E and others like logistics T&E or retrofit T&E that have been discussed.

All members are invited to accept the challenge of potential improvement in T&E by documenting your views and sending them to either the ITEA President for appropiate action, or, if you wish, your Congressman (preferably with a copy to ITEA).

ITEA will of course avoid any lobbying activities and will only engage in educational actions fundamental to the technical and management aspects of T&E. ITEA will participate, when invited, on a study group or express the viewpoints of members in order to be of service, considering prerogatives of all concerned.

CONGRESSIONAL AMENDMENT NO. 952

The amendment is as follows:

DEPARTMENT OF DEFENSE DIRECTOR OF OPERATIONAL TESTING AND EVALUATION

Sec. 136, (a)(1) Chapter 4 of title 10, United States Code, is amended by inserting after section 136 the following new section:

136a Director of Operational Testing and Evaluation: appointment, powers and duties

(a) There is a Director of Operational Testing and Evaluation of the Department of Defense, appointed from civilian life by the President, by and with the advice and consent of the Senate.

(b) The Director performs all duties relating to operational testing and evaluation in the Department of Defense including—

(1) being the principal adviser to the Secretary of Defense on operational testing and evaluation in the Department of Defense.

(2) monitoring, reviewing, and providing guidance to all operational testing and evaluation in the Department of Defense; and

(3) reviewing in advance for each major development program in the DOD the adequacy of the plans for, and the funds for, the relevant operational tests and evaluations.

(4) analyzing the results of the operational test and evaluation for each major development program and reporting to the Secretary of Defense on (a) whether the testing accomplished was adequate, and (b) whether the test results comfirm that the hardware actually tested is effective and suitable for combat.

(5) reviewing and making recommendations to the Secretary of Defense on all budgetary and finanical matters relating to operational testing and evaluation in the Department of Defense.

(c) The Director shall report directly, without intervening review or approval, to the Secretary of Defense. The Director and his staff are to be completely independent of any research and development agencies or offices within the Department of Defense.

(d) The Director shall

(1) transmit to the Congress annually a report on the results

of the operational test and evaluation accomplished for the year in the Department of Defense.

(2) inform Congress on operational testing and evaluation matters in the Department of Defense at such other times as the Director considers appropriate; and

(3) respond to requests from Congress for information relating to such matters.

(e) The Director shall have access to all such records and data in the Department of Defense, including the records and data of the military departments, as the Director determines necessary to carry out his duties under this section and shall have the authority to have observers designated by himself present during the preparation for and conduct of operational tests within the Department of Defense.

(f) For the purposes of this section "operational testing and evaluation" means the field testing and evaluation, under realistic combat conditions, of any item of weapons, equipment, munitions to determine its effectiveness and suitability for combat in the hands of typical military users.

(g) The Comptroller General of the United States shall have the authority to designate observers to be present during the preparation for the conduct of any operational tests within the Department of Defense.

(a) The table of sections at the beginning of such chapter is amended by insertion after the item relating to section 136 the following new item.

"136a. Director of Operational Testing and Evaluation: Appointment, powers and duties."

(b) For each fiscal year, the President shall include in the Budget transmitted to the Congress pursuant to section 201 of the Budget and Accounting Act, 1921, a separate request for new budget authority for, and an estimate of outlays by the Director of Operational Testing and Evaluation of the Department of Defense in carrying out the duties and responsibilities set forth in section 136(a) of title 10, United States Code.

(c) Section 5315 of title 5, United States Code, is amended by adding at the end thereof the following new item: "Director of Operational Testing and Evaluation, Department of Defense".

Reproduced from the Congressional Record - Senate, May 13, 1982, page S5216.

New Member's Dues

In accordance with Section 5, Article III, of the Association Bylaws, the dues paid by members joining during the last quarter of the calendar year cover that quarter and the following calendar year. Current dues are $25 for civilians and $15 for active duty military. Effective 1 January 1983, all individual memberships dues will be $25. Individuals on active duty can save $10 by joining ITEA before the end of this year.

CHAPTER NEWS

SOUTHERN CALIFORNIA SADDLEBACK

President: Jim Stone
Vice President: Marty Wartenberg
Secretary: Frank White
Treasurer: Mel Chapman

Southern California Saddleback Chapter
Interstate Electronics Corporation
707 E. Vermont Avenue
Anaheim, California 92805

The first meeting of the Southern California Saddleback Chapter was held on February 17, 1982 and the Chapter was officially accepted by ITEA on March 10, 1982. This is the fifth Chapter of ITEA and the second on the West Coast. The name was selected to indicate the Southern California area as well as some local identity with the Saddleback mountains nearby. The officers listed above were elected during this initial meeting.

As of the end of March the Chapter stood at 26 members with interest running high. A Program Committee Chairman, Joe Adrukaitis, was appointed to form a committee to investigate possible Chapter activities and to map out a program for the year. The first action was to poll the membership with a questionnaire to determine areas of interest. An Ad Hoc Committee was also formed, headed by Ed Lackey, to review the Association bylaws and determine whether Chapter bylaws or operating procedures are necessary at this time.

Chapter President Jim Stone was elected to the Senior Advisory Board of ITEA and in this capacity will assist the Board of Directors in formulating ITEA governing policy.

The Chapter is open to all Southern California residents who have had experience in T&E or who express an interest in further development of this engineering field. Those interested in joining the Chapter should contact Frank White, Secretary, Area Code 714-772-2811, Extension 1558.

TIDEWATER CHAPTER

The Tidewater Chapter of ITEA held its elections and the following people were elected to office:

President: Norman A. Anderson
Vice President: William L. Breed
Secretary: Chauncey L. Klingensmith
Treasurer: Edward P. Sierra

The Chapter held its July meeting and Jack Devlin, Vitro Laboratories, gave a presentation entitled "Software for the Common Man". Incoming President, Norman Anderson, presented his goals for the forthcoming year and tasked his Board of Directors to develop at least one goal each to improve the Chapter.

The new President appointed the following committee chairmen:

By-laws: David P. Fisher
Membership: John W. Peterson
Planning: John A. Devlin
Publicity: Henry B. Palmer
Member-at-Large: Clifton Vandersip

As the outgoing President, Jim Duff stated, "It's been a most rewarding year and I feel that the Tidewater Chapter has an unlimited potential for growth. I am looking forward to providing my continued personal suport to achieve the Chapter's goals and objectives in the coming years."

On July 28, members of the Tidewater Chapter had a tour of the USS Lamore County (LST 1194) by the Commanding Officer, CDR Harry

Henderson. The members found the ship to be fascinating and the crew most hospitable. The tour was both interesting and entertaining. The Commander was a most gracious host and has also volunteered to be the guest speaker at the September Chapter meeting.

The Tidewater Chapter sends a heartfelt "Thank You" to CDR Henderson and the crew of the USS Lamore County for its gracious hospitality.

GEORGE WASHINGTON

President: Guy Cordier
Vice President: Max Claiborne
Secretary/Treasurer: Brad Granum

C/O Brad Granum
9508 Seddon Ct., Bethesda, MD 20817

As reported in the April 1982 issue, ITEA member Matt Reynolds, Director of the Naval Sea Systems Command Test and Evaluation Office, SEA 90E, spoke on the Carlucci Initiatives. We promised to cover his talk in more detail in this issue. As is so often the case, a well-illustrated talk, as Matt's was, can be summarized and highlighted by a few slides.

To set the stage, Matt showed the following concerns as the genesis of the 32 Carlucci Initiatives:

- o Failure to stick to long-range plans
- o Burden of reporting and checking
- o Rising costs of acquisition
- o Unrealistic cost estimates
- o Weakness of industrial base
- o Length of acquisition cycle
- o High cost of ownership
- o Low readiness of fielded systems

Some specific goals of the Carlucci Initiatives to improve the acquisition cycle are:

- o Improve planning and execution of system acquisition programs
- o Strengthen the industrial base
- o Reduce administrative requirements
- o Increase systems readiness after initial deployment

One specific result of the Carlucci Initiatives has been to reduce the number of programs requiring Defense System Acquisition Review Council (DSARC) reviews from 52 to 42 by raising the thresholds from $100M for RDT&E and $500M for procurement to $200M for RDT&E and $1B for procurement (FY80 dollars).

Matt closed his well-received and informative talk with the following summary of the potential implication for T&E of the Carlucci Initiatives:

- o Emphasis on tailoring will encourage novel T&E strategies where appropriate
- o Additional "Up Front Money" will allow procurement of more adequate hardware for T&E
- o More realistic costing will allow fewer tradeoffs that result in T&E program shortfalls
- o Emphasis on reliability, supportability and system readiness will result in more formal T&E of these areas
- o Decreased reporting requirements and delegation of program review and approval authority will place greater reliance on T&E results as an indicator of program health

The George Washington Chapter was most fortunate to have an equally thought-provoking talk on Electronic Warfare Test and Evaluation by RADM Gallotta, Director, Electronic Warfare, Department of the Navy, on 23 June, 1982. Admiral Gallotta's presentation is a featured article in this issue.

NEW CHAPTER
New England Chapter of ITEA

The Organizational meeting to form the New England Chapter of the International Test and Evaluation Association was held on 16 July 1982, at the MITRE Corporation in Bedford, MA. The following officers were elected:

President	Dr. Shashi Phoha, The MITRE Corp.
Vice President	Prof. Nancy Martin, The Wang Institute of Graduate Studies
Secretary	Ms. Judith G. Shapiro, The MITRE Corp.
Treasurer	Dr. William M. Stein, The MITRE, Corp.

The name of the chapter was chosen to include all of Eastern Massachusetts, Southern New Hampshire, and also other current ITEA members residing in New England.

A petition was duly made on 19 August 1982, to the ITEA Board of Directors to formally accept the New England Chapter. Also, during the Executive Committee meeting held on 19 August 1982, the following four professional groups were formed.

System Test Methodology Group

Software Quality Assurance Group

Test Organization and Management Group

Test Evaluation Standards Group

The chapter plans to held a quarterly seminar in one or more of these professional areas.

The chapter is open to all residents of New England who have interest in the field of Test and Evaluation. Those interested in joining the chapter should contact Ms. Judith G. Shapiro, Secretary, M/S B100, The MITRE Corporation, Bedford, MA. Judy may also be reached by calling, (617) 271-2540.

President's Congratulations to New England Chapter of ITEA

The petition was received by ITEA on 30 August 1982. The New England Chapter, under the leadership of Dr. Shashi Phoha, not only completed the initial founding of a chapter but submitted a check for the dues of 16 new members. The check was printed with the name of the new chapter! It is clear from the above Chapter News and the official financial status that the New England Chapter is off to an outstanding start with professional groups and planned meetings.

The geographic area selected includes ZIP codes 01400 to 02799 of Eastern Massachusetts as well as ZIP codes 03000 to 03499 and 03899 of Southern New Hampshire. This area is larger than that initially proposed. Dr. Dave Herrelko should take great pride in this new Chapter which was initiated by him when he was ITEA Membership Chairman.

The BOD will formally approve the establishment of this Chapter at the next BOD meeting on 20 October 1982. In the meantime, the Executive Committee has approved the action for submission to the BOD. The board approval will be effective 16 July 1982, the date of the organization meeting.

ITEA takes great pride in the officers and members of the New England Chapter. We all look forward to an outstanding technical/management program and participation with papers or speakers for the Newsletter and Annual Symposium (21-23 June 1983 at DSMC, Fort Belvoir, VA). Thank you, Dr. Phoha.

DOD EMPHASIS ON QUALITY PRODUCTS

A.R. Matthews

The well-known and published initiatives by the Honorable Frank C. Carlucci, Deputy Secretary of Defense, have created a number of hard looks at the total acquisition process. They tend to create a new DoD program management environment. Responsibility, authority and accountability will be delegated to a greater degree than is done today. The numbers of reporting and reviewing requirements are to be reduced. Contractual incentives and realistic systems costing will be emphasized. The impact is wide spread, affecting all major weapons programs.

In subsequent action on June 18, 1982, Frank Carlucci notified all services to use the appropriate contract type. In effect, do not depend upon firm fixed-price contracts that place unreasonable risk on all parties and force higher prices. Program confidence is established by demonstrated accomplishment, past performance, cost and technical realism, program stability, and quality DoD and contractor management.

The Honorable Dick De Lauer has also taken action by correspondence with DoD organizations and a number of professional associations. Dr. De Lauer has emphasized implementation of "a sustained quality program." This includes the basic functions of: (1) quality design, (2) efficient manufacturing to prevent design degradation, and (3) establishment of a system to assure conformance. These functions are to be emphasized in future acquisitions. Dr. De Lauer has asked all industrial and professional societies to assist and has assigned specific functions to the Defense Science Board.

During the last few months, The Washington Post has carried several detailed reviews of major weapon systems. The subjects are very complex, so they must be reviewed accordingly.

It appears that the roles and responsibilities for test and evaluation should be expanded. The current T&E process has significantly developed since the 1 July 1970 Report to the President and Secretary of Defense by the Blue Ribbon Panel. The "test" of the T&E process has evolved through efforts of several Secretaries of Defense. Visability of T&E has increased along with the process, technology and management of T&E. T&E has been functionally cataloged into ET&E, DT&E, PAT&E and OT&E with definitions and responsibilities while new categories like Logistic T&E are evolving. However, T&E has grown as a collection of organizations that are only more or less independent of their diverse sources of funding and management policies.

Perhaps it is time to initiate a comprehensive study of T&E as a separate entity. Let us examine all of the T&E functions related to R&D, acquisition, logistics (including training), and operations over the life cycle of hardware including overhaul and retrofit. Consider both the functional design, performance and operational utility in respective environments. Include the T&E mission, functions, organization, modus operandi, personnel, facilities, planning and financial aspects. The results could lead to an optimum T&E contribution for the future consistent with DoD objectives.

OFFICE OF THE UNDER SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

RESEARCH AND ENGINEERING

JUL 13 1982

Mr. Carleton R. Cooper
Vice President, International Test
and Evaluation Association (ITEA)
2801 North Brandywine Street
Arlington, VA 22207

Dear Mr. Cooper:

In response to your request, this office will act as sponsor for the ITEA symposium planned for the mid-1983 time frame.

Please keep me informed of your progress and provide General Pellegrini, Commandant, Defense System's Management College, with necessary details concerning possible support for facilities.

Sincerely,

C K Watt

Charles K. Watt
Deputy Director
Defense Test and Evaluation

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NAVAL WEAPONS CENTER

Background and History

The Naval Weapons Center (NWC), China Lake, CA, is one of the Navy's major research, development, test, and evaluation organizations. Since 1943, NWC weapons and weapon technology have been an important force in this nation's defense. Most of the conventional airborne weaponry used by the free world today was developed at NWC. The Sidewinder and the Shrike guided missiles and the TV-guided Walleye are notable examples.

NWC is based in China Lake, CA, in the Indian Wells Valley, about 150 miles north of Los Angeles. Characterized as high desert, NWC covers about 1,700 square miles (over one million acres), an area larger than the state of Rhode Island. The large flat valley where NWC is located is surrounded by the Sierra Nevada, Coso, and Argus mountain ranges.

World War II brought a new era to the Indian Wells Valley, a sparsely populated stretch of the Mojave Desert that formerly had served primarily as a seasonal home for nomadic tribes, a hunting ground for desert prospectors, and a way station for workers on the Los angeles aqueduct. Combining the California Institute of Technology's urgent need for more space to test a 3.5 inch aircraft rocket, and the Navy's need for a new proving ground for aviation ordnance, Cal Tech and Navy personnel started looking for a suitable site that would meet both needs. The site selected was a vast expanse of mountainous desert near the village of Inyokern. This virtually uninhabited area had clear skies, good flying weather, and an ample water supply. It was accessible by highways and railroads, and it was close to the Los Angeles manufacturing area. The Navy and Cal Tech knew from the start that this site was close enough for convenience, yet isolated enough to carry out a vital year-round ordnance testing mission.

In November, 1943, Secretary of the Navy Frank Knox established the Naval Ordnance Test Station (NOTS) at this site. NOTS' primary function was in the research, development, and testing of weapons. Plans began immediately for ranges, technical facilities, and research laboratories. By January, 1944, an extensive building program was under way. In less than 2 years, a complex of ranges; a permanent headquarters; a pilot plant for research, development, and experimental production of rocket propellants and high exlosives; and an air facility had been built. Construction of Michelson Laboratory, the largest of a complex of offices and laboratories, had also begun.

From the very start, the Bureau of Ordnance intended NOTS to be a permanent research and development center. When Michelson Laboratory was dedicated in May 1948, it stood as a massive, completely equipped symbol of the Navy's commitment to go ahead with a scientific program, backed up with first-class laboratory facilities.

After World War II, the Navy continued to develop NOTS into an across-the-board research, development, test and evaluation laboratory. Specialized facilities and highly trained personnel were capable of carrying out all aspects of weapon development from applied research through testing to Fleet introduction.

In July, 1967, NOTS, China Lake, became the Naval Weapons Center (NWC) when the naval laboratories were reorganized into centers of excellence. In December, 1976 the Naval Air Facility at NWC was disestablished and Armitage Airfield became an administrative part of NWC. Most recently, in July, 1979, the mission and functions of the National Parachute Test Range in El Centro, CA, were transferred to NWC.

NWC philosophy is twofold. The Center's management believes that the greatest efficiency in ordnance development occurs when all the facilities and personnel needed to develop a weapon from concept to finished product are in the same organization. An integral part of this philosophy is that the most effective weapons are developed by a civilian-military team, with civilian scientists and engineers familiar with the latest technological advances working in close cooperation with military experts familiar with operational requirements. This unique and complementing civilian-military partnership has been a key part of the Center's philosophy throughout its history.

Programs and Facilities

NWC is a permanent facility of the Naval Material Command. NWC's mission is to be the principal Navy research, development, test and evaluation center for air warfare (except antisubmarine warfare) and missile weapon systems; and the national range/facility for parachute test and evaluation. The Center currently pursues over 550 separate programs or tasks encompassing aircraft and air-launched ordnance and weapon systems, application of aviation weapon and system technology to surface weapons and systems, basic research and development countermeasures systems, damage control, and technology transfer.

NWC's prime task assignments fall into four principal mission areas: strike weapon systems to attack both land and sea targets, air-to-air weapon systems to counter threats, antiradiation missiles for the suppression of enemy search and fire control radars, and antiship missile defense systems to meeet the growing need for ship protection. Upguided weapons developed at NWC include the Zuni folding-fin aircraft rocket, fuel-air-explosive weapons, the antisubmarine rocket ASROC, and the Rockeye and Snakeye bombs. Guided weapons include the infrared homing Sidewinder missile, the TV-guided Walleye glide bomb, the Shrike antiradiation missile, and the Harpoon antiship guided missile.

The technical facilities - laboratories, shops, test sites and ranges - are designed to support the total weapon development process. These facilities support every phase of work from basic scientific research and feasibility studies to design, development engineering, and prototype production. Thus, weapons, their components, and weapon systems can be extensively tested and evaluated.

Lauritsen Laboratory. Lauitsen Laboratory is fully equipped for laser and other optical research. Special features include a 30 meter laser tunnel, a rooftop facility for outdoor tests to the horizon, and provisions for propagating laser energy from inside the building to a 500 meter eye-safe laser test range.

Michelson Laboratory. Michelson Laboratory is the heart of NWC's complex of weapon research and development facilities. It contains offices and laboratories equipped for basic and applied research in physics, aerophysics, chemistry, metallurgy, and ballistics, and for research and development work on propellants, fire control, guidance systems, and fuzes for missiles and rockets. The laboratory also houses crystal growing facilities, thin-film evaporation facilities, a specimen preparation laboratory, a glass blowing shop, a machine shop, and a complete still and motion picture photographic laboratory.

Computer Center. The Computer Center contains two facilities, the Central Computing Facility and the Analog Simulation Facility. These facilities are linked to a growing network of smaller computers that are located throughout NWC. The Center's computers are used to meet a wide variety of data processing needs, including those for simulations of tactical hardware systems; test simulations; and solutions to scientific, engineering, data reduction, and management problems.

Solid State Research and Development Facility. The Solid-State Research and Development Facility provides laboratory, office, and work areas for advanced research and development of lasers, radar systems, electromagnetic interference, detector chemistry, microelectronics, and fuzes. A microelectronics laboratory contained in this facility is designed for research and development of hybrid integrated circuits, vacuum deposition of thin films, and special solid-state devices.

Propulsion Laboratories. The Propulsion Laboratories are a complex of facilities designed for research, development, test, and experimental production of solid, liquid, and air-breathing propulsion systems; pyrotechnics; explosives; warheads; and environmental testing of weapon systems. The Skytop facility, built originally for the static testing of large Polaris missile motors, consolidates all the static testing of solid and liquid propellant motors in one large, highly instrumented complex. The Warhead Research and Development Laboratory is the focal point of the Center's continuing program to develop new and more effective warheads and to improve the effectiveness of existing warheads.

Tracks. The NWC supersonic track complex is a complete testing facility consisting of two separate tracks - the supersonic naval ordnance research track (SNORT) and the terminal and exterior ballistics test tracks. The tracks are equipped to handle a wide variety of tests requiring simulated flight conditions and to furnish data on aerodynamics, vibration, acceleration, velocity, pressure, and temperature. The 4.1 mile SNORT is the longest of the tracks; speeds approaching 6,000 feet per second (approximately 4000 mph) have been attained by monorail vehicles on this facility.

Radio Frequency Measurement Facility. Extensive facilities exist for measurements of antennas and other radio frequency devices. An outdoor antenna range, two large anechoic chambers, several special-purpose smaller chambers, and a radio frequency component test area enable tests to be conducted on almost any size radio frequency device. The VHF anechoic chamber, capable of operation from 30 to 30,000 MHz, is the most sophisticated RF measurement facility in the world.

In the future, the Center expects more emphasis on tri-service (Army, Navy and Air Force) or joint service programs. These programs will involve new systems, seekers, warheads, or guidance and control units that will have a greater commonality in use among the services. Several such programs are now being pursued. Important new programs are being developed in the areas of fuzing, propulsion, and tactical air software. Applied research in various fields of energy technology is one of the Center's major non-weapon system acitivities. The Center also supports government agencies in the search for solutions to a wide variety of environmental problems.

Naval Weapons Center, China Lake

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