The Elmer A. Sperry Award 2007

FOR ADVANCING THE ART OF TRANSPORTATION

The Elmer A. Sperry Award

The Elmer A. Sperry Award shall be given in recognition of a distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea, air, or space.

In the words of Edmondo Quattrocchi, sculptor of the Elmer A. Sperry Medal:

"This Sperry medal symbolizes the struggle of man's mind against the forces of nature. The horse represents the primitive state of uncontrolled power. This, as suggested by the clouds and celestial fragments, is essentially the same in all the elements. The Gyroscope, superimposed on these, represents the bringing of this power under control for man's purposes."

Presentation of

The Elmer A. Sperry Award for 2007

to

ROBERT F. COOK

PETER T. MAHAL

PAM L. PHILLIPS

JAMES C. WHITE

in recognition of their seminal work and continuing contributions to aviation through the development of the Engineered Material Arresting System (EMAS) and its installation at many airports.

by
The Elmer A. Sperry Board of Award
under the sponsorship of the:

American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
SAE International
Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics
American Society of Civil Engineers

at the
International Air Transport Conference
Irving, Texas

20 August 2007

Mr. Robert F. Cook – Aircraft Dynamic Loads Consultant

Robert Cook received his BS degree in Aeronautical Engineering from the University of Illinois and an MS degree in Aeronautical Engineering from the Ohio State University.

He served as a US Navy aviator and enjoyed a 30-year career as an engineer with the Air Force at Wright Patterson AFB in Dayton, Ohio. After leaving the Air Force, Mr. Cook worked at the University of Dayton Research Institute.

His engineering work covered several technical areas including helicopter vibration, helicopter mechanical instability, aircraft acoustics and sonic fatigue of aircraft structure, aircraft ground loads due to operation on both paved and unpaved airfields.

Bob Cook is a consultant to Engineered Arresting Systems Corporation (ESCO). Bob performed all the original analytical work and the test planning for the Federal Aviation Administration to bring EMAS to a working system and holds three patents related to aircraft arrestor bed systems.

Ms. Pam L. Phillips – Port Authority of NY & NJ

Pam Phillips has been professionally involved in aviation since 1978, including some 20 years with the Port Authority of NY and NJ. While working as an engineer in the Aviation Technical Services Division of the Aviation Department, she began to work on the development of the EMAS system.

She is currently the Manager of Aeronautical Operations at JFK for the Port Authority with a staff of 50 responsible for airside operations and the operation of the airport's general aviation terminal. Ms. Phillips graduated from the Florida Institute of Technology in 1982 with a BS degree in Air Commerce/Air Transportation. She also holds a private pilot's license, holds an ACE credential from the American Association of Airport Executives and serves on the NFPA Technical Committee for Aircraft Rescue and Fire Fighting (ARFF), and the ICAO study group for ARFF.

Mr. James C. White – FAA

Jim was a civil engineer with the FAA's William J. Hughes Technical Center near Atlantic City, New Jersey. Jim received a BS in civil engineering from Rutgers in 1972 and is a registered engineer in the State of Vermont.

After joining the FAA in 1973, he spent more than 12 years "on the road" as a resident engineer for the construction of numerous approach lighting systems, navigational aids and airport control towers. He then spent seven years with the US Army Corps of Engineers building Fort Drum near Watertown, NY. Jim worked for ten years at the FAA Technical Center on airport safety issues such as winter operations on slippery runways, passive methods to arrest overrunning airplanes, and infrared systems for deicing aircraft.

In July 2003, Jim was selected as Program Manager for the FAA's Airworthiness Assurance Center of Excellence. He also co-managed the FAA's weather-in-the-cockpit research portfolio. Jim retired from the FAA on May 3, 2007.

Mr. Peter T. Mahal – ESCO

Peter Mahal has more than 30 years experience in the design, production, and sales of aircraft arresting systems for military and civilian aviation. He earned a BS from Pennsylvania State University and an MBA from Temple University.

His entire career has been spent with Engineered Arresting Systems Corporation (ESCO). In 1994, Mr. Mahal was assigned the responsibility to develop a commercial aircraft arresting system product for ESCO. The product was tested and validated between 1994 and 1996 under a Cooperative Research and Development Agreement between ESCO and the FAA William J. Hughes Technical Center. In 1999, Mr. Mahal was appointed to his current position as President of the ESCO EMAS Division, which was established for this new commercial product. Mr. Mahal is a named inventor on four patents related to aircraft arrestor bed systems.

The Achievement

Background

Although commercial air travel remains a very safe method of transportation, in terms of overall accident statistics, runway overruns occur more commonly than may be thought generally. The statistical picture was recently put in perspective by a study by the Australian Transport Safety Board (ATSB) that found that between 1970 and early 1998 there were at least 111 landing overrun accidents worldwide involving Western-built jet airline aircraft. These figures do not include those events in which a mechanical failure, such as a landing gear collapse, led to the overrun. The accidents included:

- 42 overruns in which the aircraft landed long and/or fast on a water-affected runway.
- 36 overruns in which there was an apparent or assumed normal touchdown on a water-affected runway.
- 33 overruns in which the landing was long and/or fast on a dry runway.

In fact, the number of overrun accidents has averaged out at over 43 per annum over the past 10 years. There is no upward or downward trend, just a cyclic variation about this mean value. The number of fatal overrun accidents closely follows the same cycle – one in every 15 overrun accidents results in a fatality. These overruns often occur with fully serviceable aircraft and fully qualified and alert flight crews, and they are mostly avoidable. The factors that lead to an overrun are often many and varied, and they usually start to accumulate well before the approach is even started. So it is often difficult to pinpoint and address one particular cause. A tailwind, slick runway, slightly higher approach speed, slightly high glide slope, long landings due to floating or de-crabbing in crosswinds, or a host of other factors can result in a normally adequate runway being too short to stop. And flight crews are often reluctant to abort and go-around once mentally committed to landing.

Until recently, the primary method of mitigating the effects of overrun accidents has been to extend the runway to provide a safety zone of extra emergency stopping distance. Where possible, the Federal Aviation Administration (FAA) requires that commercial airports have a standard Runway Safety Area (RSA). At most commercial airports, the standard RSA is 500 feet wide and extends 1000 feet beyond each end of the runway. The RSA is designed to handle incidents in which an aircraft overruns, undershoots, or veers off the side of the runway. Since many airports were built before the 1000-foot extension was adopted some 20 years ago, however, the area beyond the end of the runway may not be available. Often, the ends of runways are blocked by obstacles such as bodies of water, highways, railroads and populated areas or severe drop-off of terrain. These physical or economic barriers have prevented many runway ends from having the RSA.

Although the military has used arresting systems or barriers for a long time, none of the systems used for an errant fighter-sized military aircraft were transferable to civilian commercial aircraft. Recognizing the seriousness of the problem and the need for a new and innovative solution, a group of regulators, operators, researchers and manufacturers worked together during the 1990s to develop an Engineered Material Arresting System (EMAS) that uses materials of closely controlled strength and density placed at the end of a runway to stop or greatly slow an aircraft that overruns the runway. The best material found to date is a lightweight, crushable concrete. When an aircraft rolls into an EMAS arrestor bed, the tires of the aircraft sink into the lightweight concrete and the aircraft is decelerated by having to roll through deepening layers of the crushing material. This action results in a deceleration rate that is safe to both passengers and to the aircraft structure.

Benefits of the EMAS Technology

The EMAS technology provides safety benefits in cases where land is not available or where it would be very expensive for the airport sponsor to buy the land off the end of the runway.

The EMAS technology also provides an added measure of safety at airports where it is not possible to have the standard 1,000-foot overrun. This technology is now in place at 21 airports with installations under contract at ten additional airports.

A standard EMAS installation extends 600 feet from the end of the runway. Even if less than 600 feet of land is available, an EMAS arrestor bed can still be installed to help slow or stop an aircraft that overruns the runway. The Office of Airports prepared its RSA improvement plan for the runways at approximately 575 commercial airports in 2005. This plan allows the agency to track the progress and to direct federal funds for making all practicable improvements, including the use of EMAS technology. Presently, the system using crushable concrete is the only system that meets the FAA standard.

The Development of EMAS Technology

In 1984, an SAS DC-10 overran JFK's runway 04R and ended up in the waters of Thurston Basin. This incident prompted the Port Authority of New York and New Jersey to explore new methods of preventing overruns. Pam Phillips managed a study by Robert Cook (then of the University of Dayton) which identified cellular cement as a best option for an overrun ramp. The PANYNJ then went to FAA for support. Jim White and Pam Phillips were instrumental in conducting the actual physical testing and development of technical specifications and standards to allow the application to actual airports.

Mr. Cook was primarily responsible for the mathematical modeling of the deceleration characteristics of candidate materials and aircraft. He also developed the plans for the physical testing to validate the performance of the EMAS system and conducted oversight review of the technical specifications and standards for the installation of the EMAS system.

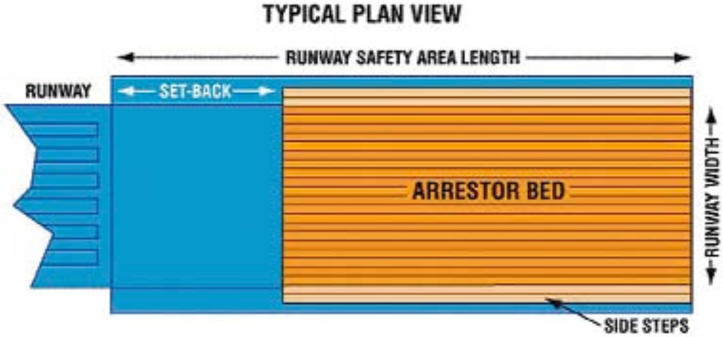
Peter Mahal, President of the ESCO EMAS Division, committed the company to the development of materials and a system that could actually be employed at commercial airports.

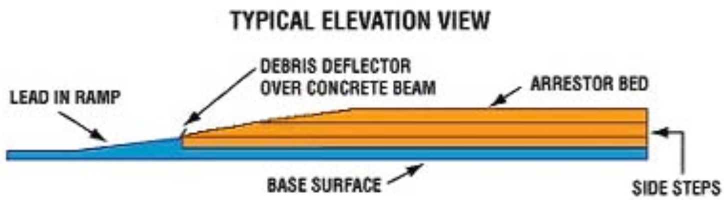
The first Engineered Materials Arresting System (EMAS) was installed at the northeast end of JFK International's runway 04R in 1996. The bed is 392 feet long and 227 feet wide with a 114 foot runway setback and consists of cellular cement material, which can safely decelerate and stop an aircraft that overruns the runway.

Over the last 10 years, the same team has worked on a number of product improvements incorporated into the EMAS technology. One of the key enhancements has been the development of the JBR (jet blast resistant) coating that allows EMAS to be placed as close as 35 ft from the runway end, which would allow airports with space constraints to install the arresting system.

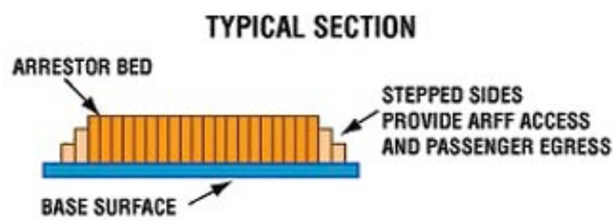
How EMAS Works

An Engineered Material Arresting System (EMAS) consists of a bed of lightweight concrete blocks installed just past the end of an airport runway. Its optimal length is around 600 feet (in contrast to the FAA's 1000 feet Runway Safety Area) but EMAS as short as 150 ft are effective if the runway lacks more space. Each EMAS bed is customized to runway conditions using ESCO's FAA validated computer program originally developed by Robert Cook and refined over the last 10 years. Available length, aircraft size, and soil and weather conditions are taken into account in the EMAS design. The strength of the EMAS blocks is selected based on performance requirements of the aircraft fleet mix.





The individual EMAS blocks vary in heights starting with the shorter blocks and then transitioning to the tallest blocks in the rear. As an aircraft leaves the runway, its landing gear crosses a paved set back, rises slightly and then encounters the face of the crushable concrete bed. As the aircraft wheels continuously crush the concrete, the energy of their forward motion is dissipated into the concrete material. The aircraft and passengers experience an average deceleration of only 0.6 g. Damage, if any, is usually minor and limited to the landing gear. The EMAS bed is repaired by replacing only those concrete blocks that have actually been crushed.



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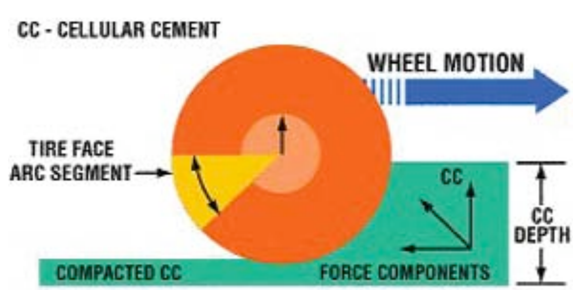

EMAS Arrestments

EMAS system stops Boeing 747 that overran the runway at JFK Airport on January 22, 2005.

To date, there have been five incidents where the technology has worked successfully to stop aircraft that overran the runway and in several cases has prevented injury to passengers and damage to the aircraft.

- May 1999: A Saab 340 commuter aircraft overran the runway at JFK
- May 2003: Gemini Cargo MD-11 was safely decelerated at JFK
- January 2005: A Boeing 747 overran the runway at JFK
- July 2006: Mystere Falcon 900 airplane ran off the runway at the Greenville Downtown Airport in South Carolina
- October 2006: Gulfstream G-II was safely arrested at the Bob Hope Burbank Airport in California

Picture Courtesy of Airport Magazine

EMAS Installations

Currently, EMAS is installed on 25 runway ends at 20 airports in the United States with plans to install 15 additional EMAS systems at seven additional airports. EMAS has also been installed internationally on two runway ends in Jiuzhai-Huanglong Airport (JZH), Sichuan Province, PRC and is planned for two runway ends at Madrid-Barajas International Airport, Spain.

AIRPORT	LOCATION	# OF SYSTEMS	INSTALLATION DATE
JFK International	Jamaica, NY	1	1996
Minneapolis St. Paul	Minneapolis, MN	1	1999
Little Rock	Little Rock, AR	2	2000/2003
Rochester International	Rochester, NY	1	2001
Burbank	Burbank, CA	1	2002
Baton Rouge Metropolitan	Baton Rouge, LA	1	2002
Greater Binghamton	Binghamton, NY	2	2002
Greenville Downtown	Greenville, SC	1	2003
Barnstable Municipal	Hyannis, MA	1	2003
Roanoke Regional	Roanoke, VA	1	2004
Fort Lauderdale International	Fort Lauderdale, FL	2	2004
Dutchess County	Poughkeepsie, NY	1	2004
LaGuardia	Flushing, NY	2	2005
Boston Logan	Boston, MA	2	2005/2006
Laredo International	Laredo, TX	1	2006
San Diego International	San Diego, CA	1	2006
Teterboro Airport	Teterboro, NJ	1	2006
Jiuzhai-Huanglong	Sichuan Province, PRC	2	2006
Midway	Chicago, IL	1	2006
Charleston	Charleston, WV	1	2007
Cordova	Cordova, AK	1	2007

Additional Projects Currently Under Contract

LOCATION	# OF SYSTEMS	EXPECTED INSTALLATION DATE
Wilkes-Barre Scranton, PA	1	Fall 2007
Telluride, CO	2	TBD
Lafayette, LA	2	TBD
JFK, NY	1	Fall 2007
Newark, NJ	1	Fall 2007/Spring 2008
Manchester, NH	1	Fall 2007
San Luis Obispo, CA	2	Spring 2008
Madrid-Barajas International Airport, Spain	2	Summer 2007
Chicago Midway	3	Summer/Fall 2007
Chicago O'Hare	2	Fall 2007

It is indisputable that lives and aircraft have been saved by the design and implementation of EMAS. As the system is installed on more runways at more airports more lives will be saved, and property damage mitigated. Using the classical engineering approach of identifying a problem and then using the art of applying scientific and mathematical principles, experience, judgment, and common sense to devise a solution, Mr. Robert Cook, Ms. Pam Phillips, Mr. Jim White, and Mr. Peter Mahal have advanced the art of commercial aviation transportation by the distinguished engineering achievement of EMAS. In recognition of this achievement, they are awarded the 2007 Sperry Award.

Elmer A. Sperry, 1860-1930

After graduating from the Cortland, N.Y. Normal School in 1880, Sperry had an association with Professor Anthony at Cornell, where he helped wire its first generator. From that experience he conceived his initial invention, an improved electrical generator and arc light. He then opened an electric company in Chicago and continued on to invent major improvements in electric mining equipment, locomotives, streetcars and an electric automobile. He developed gyroscopic stabilizers for ships and aircraft, a successful marine gyro-compass and gyro-controlled steering and fire control systems used on Allied warships during World War I. Sperry also developed an aircraft searchlight and the world's first guided missile. His gyroscopic work resulted in the automatic pilot in 1930. The Elmer A. Sperry Award was established in 1955 to encourage progress in transportation engineering.

The Elmer A. Sperry Award

To commemorate the life and achievements of Elmer Ambrose Sperry, whose genius and perseverance contributed so much to so many types of transportation, the Elmer A. Sperry Award was established by his daughter, Helen (Mrs. Robert Brooke Lea), and his son, Elmer A. Sperry, Jr., in January 1955, the year marking the 25th anniversary of their father's death. Additional gifts from interested individuals and corporations also contribute to the work of the Board.

Elmer Sperry's inventions and his activities in many fields of engineering have benefited tremendously all forms of transportation. Land transportation has profited by his pioneer work with the storage battery, his development of one of the first electric automobiles (on which he introduced 4-wheel brakes and self-centering steering), his electric trolley car of improved design (features of its drive and electric braking system are still in use), and his rail flaw detector (which has added an important factor of safety to modern railroading). Sea transportation has been measurably advanced by his gyrocompass (which has freed people from the uncertainties of the magnetic compass) and by such navigational aids as the course recorder and automatic steering for ships. Air transportation is indebted to him for the airplane gyro-pilot and the other air navigational instruments he and his son, Lawrence, developed together.

The donors of the Elmer A. Sperry Award have stated that its purpose is to encourage progress in the engineering of transportation. Initially, the donors specified that the Award recipient should be chosen by a Board of Award representing the four engineering societies in which Elmer A. Sperry was most active:

American Society of Mechanical Engineers
(of which he was the 48th President)

American Institute of Electrical Engineers
(of which he was a founder member)

Society of Automotive Engineers

Society of Naval Architects and Marine Engineers

In 1960, the participating societies were augmented by the addition of the Institute of Aerospace Sciences. In 1962, upon merging with the Institute of Radio Engineers, the American Institute of Electrical Engineers became known as the Institute of Electrical and Electronics Engineers; and in 1963, the Institute of Aerospace Sciences, upon merger with the American Rocket Society, became the American Institute of Aeronautics and Astronautics. In 1990, the American Society of Civil Engineers became the sixth society to become a member of the Elmer A. Sperry Board of Award.

Important discoveries and engineering advances are often the work of a group, and the donors have further specified that the Elmer A. Sperry Award honor the distinguished contributions of groups as well as individuals.

Since they are confident that future contributions will pave the way for changes in the art of transportation equal at least to those already achieved, the donors have requested that the Board from time to time review past awards. This will enable the Board in the future to be cognizant of new areas of achievement and to invite participation, if it seems desirable, of additional engineering groups representative of new aspects or modes of transportation.

THE SPERRY SECRETARIAT

The donors have placed the Elmer A. Sperry Award fund in the custody of the American Society of Mechanical Engineers. This organization is empowered to administer the fund, which has been placed in an interest bearing account whose earnings are used to cover the expenses of the board. A secretariat is administered by the ASME, which has generously donated the time of its staff to assist the Sperry Board in its work.

The Elmer A. Sperry Board of Award welcomes suggestions from the transportation industry and the engineering profession for candidates for consideration for this Award.

PREVIOUS ELMER A. SPERRY AWARDS

1955 To *William Francis Gibbs* and his Associates for design of the S.S. United States.

1956 To *Donald W. Douglas* and his Associates for the DC series of air transport planes.

1957 To *Harold L. Hamilton, Richard M. Dilworth* and *Eugene W. Kettering* and Citation to their Associates for developing the diesel-electric locomotive.

1958 To *Ferdinand Porsche* (in memoriam) and *Heinz Nordhoff* and Citation to their Associates for development of the Volkswagen automobile.

1959 To *Sir Geoffrey de Havilland, Major Frank B. Halford* (in memoriam) and *Charles C. Walker* and Citation to their Associates for the first jet-powered passenger aircraft and engines.

1960 To *Frederick Darcy Braddon* and Citation to the Engineering Department of the Marine Division of the *Sperry Gyroscope Company,* for the three-axis gyroscopic navigational reference.

1961 To *Robert Gilmore LeTourneau* and Citation to the Research and Development Division, *Firestone Tire and Rubber Company,* for high speed, large capacity, earth moving equipment and giant size tires.

1962 To *Lloyd J. Hibbard* for applying the ignitron rectifier to railroad motive power.

1963 To *Earl A. Thompson* and Citations to *Ralph F. Beck, William L. Carnegie, Walter B. Herndon, Oliver K. Kelley* and *Maurice S. Rosenberger* for design and development of the first notably successful automatic automobile transmission.

1964 To *Igor Sikorsky* and *Michael E. Gluhareff* and Citation to the Engineering Department of the Sikorsky Aircraft Division, *United Aircraft Corporation*, for the invention and development of the high-lift helicopter leading to the Skycrane.

1965 To *Maynard L. Pennell, Richard L. Rouzie, John E. Steiner, William H. Cook* and *Richard L. Loesch, Jr.* and Citation to the Commercial Airplane Division, *The Boeing Company,* for the concept, design, development, production and practical application of the family of jet transports exemplified by the 707, 720 and 727.

1966 To *Hideo Shima, Matsutaro Fuji* and *Shigenari Oishi* and Citation to the *Japanese National Railways* for the design, development and construction of the New Tokaido Line with its many important advances in railroad transportation.

1967 To *Edward R. Dye* (in memoriam), *Hugh DeHaven,* and *Robert A. Wolf* for their contribution to automotive occupant safety and Citation to the research engineers of *Cornell Aeronautical Laboratory* and the staff of the Crash Injury Research projects of the *Cornell University Medical College.*

1968 To *Christopher S. Cockerell* and *Richard Stanton-Jones* and Citation to the men and women of the *British Hovercraft Corporation* for the design, construction and application of a family of commercially useful Hovercraft.

1969 To *Douglas C. MacMillan, M. Nielsen* and *Edward L. Teale, Jr.* and Citations to *Wilbert C. Gumprich* and the organizations of *George G. Sharp, Inc.*, *Babcock and Wilcox Company*, and the *New York Shipbuilding Corporation* for the design and construction of the N.S. Savannah, the first nuclear ship with reactor, to be operated for commercial purposes.

1970 To *Charles Stark Draper* and Citations to the personnel of the *MIT Instrumentation Laboratories,* Delco Electronics Division, *General Motors Corporation,* and Aero Products Division, *Litton Systems,* for the successful application of inertial guidance systems to commercial air navigation.

1971 To *Sedgwick N. Wight* (in memoriam) and *George W. Baughman* and Citations to *William D. Hailes, Lloyd V. Lewis, Clarence S. Snavely, Herbert A. Wallace,* and the employees of *General Railway Signal Company,* and the Signal & Communications Division, *Westinghouse Air Brake Company,* for development of Centralized Traffic Control on railways.

1972 To *Leonard S. Hobbs* and *Perry W. Pratt* and the dedicated engineers of the Pratt & Whitney Aircraft Division of *United Aircraft Corporation* for the design and development of the JT-3 turbo jet engine.

1975 To *Jerome L. Goldman, Frank A. Nemec* and *James J. Henry* and Citations to the naval architects and marine engineers of *Friede and Goldman, Inc.* and *Alfred W. Schwendtner* for revolutionizing marine cargo transport through the design and development of barge carrying cargo vessels.

1977 To *Clifford L. Eastburg* and *Harley J. Urbach* and Citations to the Railroad Engineering Department of *The Timken Company* for the development, subsequent improvement, manufacture and application of tapered roller bearings for railroad and industrial uses.

1978 To *Robert Puiseux* and Citations to the employees of the *Manufacture Française des Pneumatiques Michelin* for the development of the radial tire.

1979 To *Leslie J. Clark* for his contributions to the conceptualization and initial development of the sea transport of liquefied natural gas.

1980 To *William M. Allen, Malcolm T. Stamper, Joseph F. Sutter* and *Everette L. Webb* and Citations to the employees of *Boeing Commercial Airplane Company* for their leadership in the development, successful introduction and acceptance of wide-body jet aircraft for commercial service.

1981 To *Edward J. Wasp* for his contributions toward the development and application of long distance pipeline slurry transport of coal and other finely divided solid materials.

1982 To *Jörg Brenneisen, Ehrhard Futterlieb, Joachim Körber, Edmund Müller, G. Reiner Nill, Manfred Schulz, Herbert Stemmler* and *Werner Teich* for their contributions to the development and application of solid state adjustable frequency induction motor transmission to diesel and electric motor locomotives in heavy freight and passenger service.

1983 To *Sir George Edwards, OM, CBE, FRS; General Henri Ziegler, CBE, CVO, LM, CG; Sir Stanley Hooker, CBE, FRS* (in memoriam); *Sir Archibald Russell, CBE, FRS;* and *M. André Turcat, L d'H, CG;* commemorating their outstanding international contributions to the successful introduction and subsequent safe service of commercial supersonic aircraft exemplified by the Concorde.

1984 To *Frederick Aronowitz, Joseph E. Killpatrick, Warren M. Macek* and *Theodore J. Podgorski* for the conception of the principles and development of a ring laser gyroscopic system incorporated in a new series of commercial jet liners and other vehicles.

1985 To *Richard K. Quinn, Carlton E. Tripp*, and *George H. Plude* for the inclusion of numerous innovative design concepts and an unusual method of construction of the first 1,000-foot self-unloading Great Lakes vessel, the M/V Stewart J. Cort.

1986 To *George W. Jeffs, Dr. William R. Lucas, Dr. George E. Mueller, George F. Page, Robert F. Thompson* and *John F. Yardley* for significant personal and technical contributions to the concept and achievement of a reusable Space Transportation System.

1987 To *Harry R. Wetenkamp* for his contributions toward the development and application of curved plate railroad wheel designs.

1988 To *J. A. Pierce* for his pioneering work and technical achievements that led to the establishment of the OMEGA Navigation System, the world's first ground-based global navigation system.

1989 To *Harold E. Froehlich, Charles B. Momsen, Jr.*, and *Allyn C. Vine* for the invention, development and deployment of the deep-diving submarine, Alvin.

1990 To *Claud M. Davis, Richard B. Hanrahan, John F. Keeley*, and *James H. Mollenauer* for the conception, design, development and delivery of the Federal Aviation Administration enroute air traffic control system.

1991 To *Malcom Purcell McLean* for his pioneering work in revolutionizing cargo transportation through the introduction of intermodal containerization.

1992 To *Daniel K. Ludwig* (in memoriam) for the design, development and construction of the modern supertanker.

1993 To *Heinz Leiber, Wolf-Dieter Jonner* and *Hans Jürgen Gerstenmeier* and Citations to their colleagues in *Robert Bosch GmbH* for their conception, design and development of the Anti-lock Braking System for application in motor vehicles.

1994 To *Russell G. Altherr* for the conception, design and development of a slackfree connector for articulated railroad freight cars.

1996 To *Thomas G. Butler* (in memoriam) and *Richard H. MacNeal* for the development and mechanization of NASA Structural Analysis (NASTRAN) for widespread utilization as a working tool for finite element computation.

1998 To *Bradford W. Parkinson* for leading the concept development and early implementation of the Global Positioning System (GPS) as a breakthrough technology for the precise navigation and position determination of transportation vehicles.

2000 To those individuals who, working at the French National Railroad (SNCF) and ALSTOM between 1965 and 1981, played leading roles in conceiving and creating the initial TGV High Speed Rail System, which opened a new era in passenger rail transportation in France and beyond.

2002 To *Raymond Pearlson* for the invention, development and worldwide implementation of a new system for lifting ships out of the water for repair and for launching new ship construction. The simplicity of this concept has allowed both large and small nations to benefit by increasing the efficiency and reducing the cost of shipyard operations.

2004 To *Josef Becker* for the invention, development, and worldwide implementation of the Rudderpropeller, a combined propulsion and steering system, which converts engine power into optimum thrust. As the underwater components can be steered through 360 degrees, the full propulsive power can also be used for maneuvering and dynamic positioning of the ship.

2005 To *Victor Wouk* for his visionary approach to developing gasoline engine-electric motor hybrid-drive systems for automobiles and his distinguished engineering achievements in the related technologies of small, lightweight, and highly efficient electric power supplies and batteries.

2006 To *Antony Jameson* in recognition of his seminal and continuing contributions to the modern design of aircraft through his numerous algorithmic innovations and through the development of the FLO, SYN, and AIRPLANE series of computational fluid dynamics codes.

The 2007 Elmer A. Sperry Board of Award

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