The Elmer A. Sperry Award 2009

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 or air.

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 2009

to

BORIS POPOV

for the development of the ballistic parachute system allowing the safe descent of disabled aircraft.

by

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

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

at the
Aerospace Manufacturing and Automated Fastening Conference & Exhibition
Century II Conference Center in Wichita, KS

28 September 2010

Boris Popov

Founder, Board Director, Chairman Emeritus and currently Director of Public Affairs for Ballistic Recovery Systems (now BRS Aerospace).

Born in 1946 in Munich, Germany, Boris Popov immigrated to the USA with his parents in 1949, settling in St. Paul, MN.

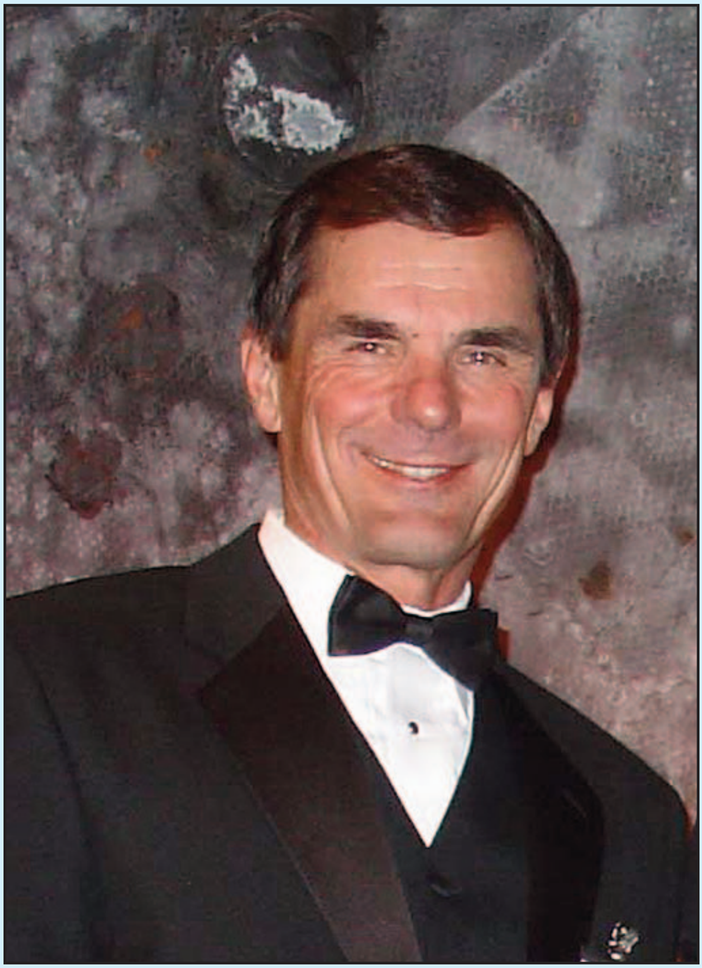
In 1967 he obtained his student pilot license while an aeronautical engineering student at the University of Minnesota. Shortly thereafter he obtained his sailplane, floatplane, and other aviation related certifications. In the early 70's, Mr. Popov took up the new sport of hang gliding. In 1977, while being towed by a boat, his hang glider suffered a structural failure and he began to spiral in from 500 feet. He recalls: "My first reaction was...My God, this can't be happening, I am falling to my death. As I fell, I became most angry at my inability to do anything. I had time to throw a parachute, but had none on board. I promised myself that if I survived, I would develop some sort of life saving parachute system for light weight aircraft". Popov survived the fall, then fulfilled the commitment he had promised himself by researching the various parachutes systems on the market, which at the time were limited to hand thrown or spring loaded chute systems. In 1981 he founded Ballistic Recovery Systems (BRS). Today, the company has saved over 250 lives and sold over 35,000 systems throughout the world, has 120 employees located in plants in St. Paul, MN, Pine Bluff, NC, and Tijuana, Mexico, is publicly traded, and is considered the world leader in whole aircraft recovery systems.

The Achievement

BACKGROUND

Flying is an inherently dangerous activity. Inventors have long attempted to make it safer. The parachute was first used successfully in 1617 and was frequently used by balloonists from the beginning of balloon aviation in the 18th century. An ejection seat to get a pilot quickly out of an aircraft was demonstrated in 1929.

In that same year, master showman and aviation promoter of the day, Roscoe Turner, bought an interest in the Russell Parachute Company and rigged a Russell parachute in the center



Boris Popov

section of the top wing of his Thunderbird biplane. Turner's installation utilized coil springs to push the parachute package away from his aircraft. Turner successfully demonstrated that a whole aircraft parachute recovery system could work when he deployed the parachute during an air show at 5,000 feet above the Santa Ana California airport on April 19, 1929.

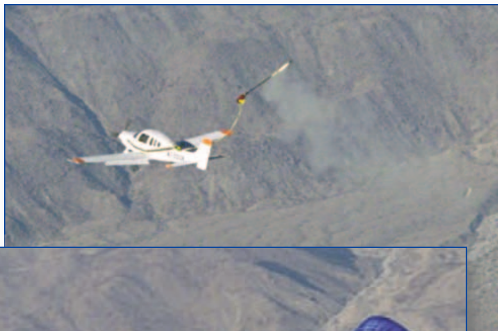
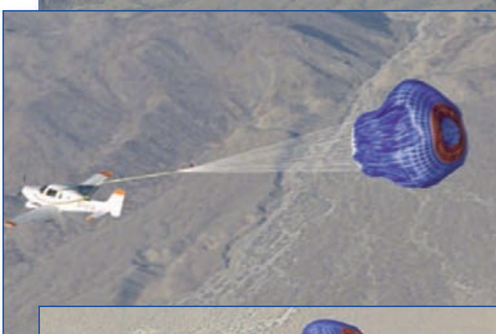
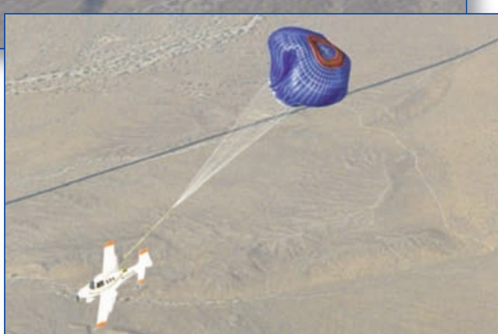
Turner was unhurt after the aircraft came to rest in a farmer's field, but the aircraft suffered a smashed landing gear and splintered propeller. Unfortunately, because of massive bulk, excessive weight, low reliability and high altitude required for a successful deployment, the aviation community generally considered Turner's demonstration a "daredevil stunt" and the idea did not "catch on" as Turner had hoped. The concept was not given consideration as a viable aircraft safety system until many years later.

When hang gliders and other ultra light aircraft became popular in the 1970s, pilots thought that since their aircraft were so light, they could readily be equipped with a vehicle parachute. They began to equip their aircraft with modified hand deployed whole aircraft parachute recovery systems and experienced a degree of success when they were used. Half a dozen parachute recovery system suppliers emerged to offer their designs to the fledgling "ultra-light" fleet. However, Mr. Popov well understood the limitations on the pilot of a spinning broken aircraft to quickly and effectively deploy a hand deployed chute in such a confusing and high G environment, as well as the marketability problems of existing parachute systems for the emerging heavier ultralights, homebuilts, experimental and general aviation aircraft. After experimenting with spring, compressed gas, slug gun and other deployment methods, it soon became apparent that only stored energy components such as solid fuel propellants could offer the power, low weight, low volume and effectiveness needed to rapidly deploy a main parachute.

Once the ballistic device had been established, Popov and his engineers turned their attention to the parachute. It also had to be re-invented to be lighter, of lower pack volume, higher drag co-efficiency and capable of deploying at both low speed and high speed without sacrificing reliability. Thus, this combination of an innovative parachute and deployment method resulted in the creation of a marketable and effective life saving product that led to the first ever Federal Aviation Administration (FAA) certified aircraft recovery system for the Cessna 150/152 aircraft in 1993.

Since that historic event, 243 lives have been saved by the Ballistic Recovery System (BRS) throughout the world. The BRS system is standard equipment on the industry leading Cirrus aircraft and has recently been offered as an option on the new Cessna 162 Sky Catcher, a milestone for the company's efforts to gain the endorsement of the major aircraft manufacturers.

Benefits of the Ballistic Parachute Technology


Conventional aircraft safety systems (parachutes and ejection seats) protect the pilot but offer less protection for passengers and they offer no protection for the aircraft or for persons and structures on the ground. A properly deployed ballistic parachute will save passengers and reduce damage to the aircraft and objects on the ground.

A number of situations are best suited for ballistic parachute use:

- A mid-air collision that disables the aircraft.
- A structural failure that disables the aircraft.
- Loss of control which can't be restored.
- Pilot incapacitation: If passengers have been briefed on the ballistic parachute location and operation, they could use it to land the plane.
- Stall/Spin on approach: With its low altitude recovery capability, a ballistic parachute could save some occurrences from becoming fatalities.
- Engine-Out over hostile terrain: If safe landing is not possible. A majority of fatal crashes are associated with poor pilot decision-making and/or technique; ballistic parachute systems do not require technique… the only decision involved is whether or not to deploy the system.

The Development of the Ballistic Parachute Technology

The challenge was to develop a parachute system for installation on general aviation aircraft that would ensure a safe descent of the whole aircraft. This requires a parachute made of extremely lightweight material, capable of being packed into a small container. It has to deploy quickly without causing structural failure. The key to the success of the system was the ingenious development of the parachute reefing system. The patented "slider ring" has been instrumental in saving the lives of many pilots and their passengers throughout the world.

This innovation has enabled the use of larger chutes for faster, more technologically advanced aircraft. It needs to deploy quickly at slow speeds to allow for low altitude emergencies, but more slowly at high speeds to prevent structural failure in high-speed diving emergencies. The purpose of the system is to slow an aircraft to a descent speed that is conducive to a safe touchdown.

Each aircraft is unique – Physical restraints, weight of aircraft, cruising speed, aerodynamic loads. Parachute system must be light weight and rugged enough to consistently withstand the forces acting on the parachute and suspension lines.

The first documented life saved was in 1983 – Jay Tipton of Colorado. So far 243 lives have been saved due to the installation of the BRS whole-airplane parachute system.

- 1980: Ballistic Recovery System was founded.
- 1982: First products were introduced.
- 1983: First (documented) life saved.
- In 1993, after seven years of engineering research, BRS was granted the first Federal Aviation Administration approval (STC) to install a parachute on a certificated aircraft, the Cessna 150/152 aircraft.
- In 1996 BRS received a contract to provide a recovery system to AlliantTech for use on a prototype unmanned aircraft.
- 1996: BRS received a grant from NASA to develop thin film parachute material designed to reduce the chute weight by up to 50 percent.

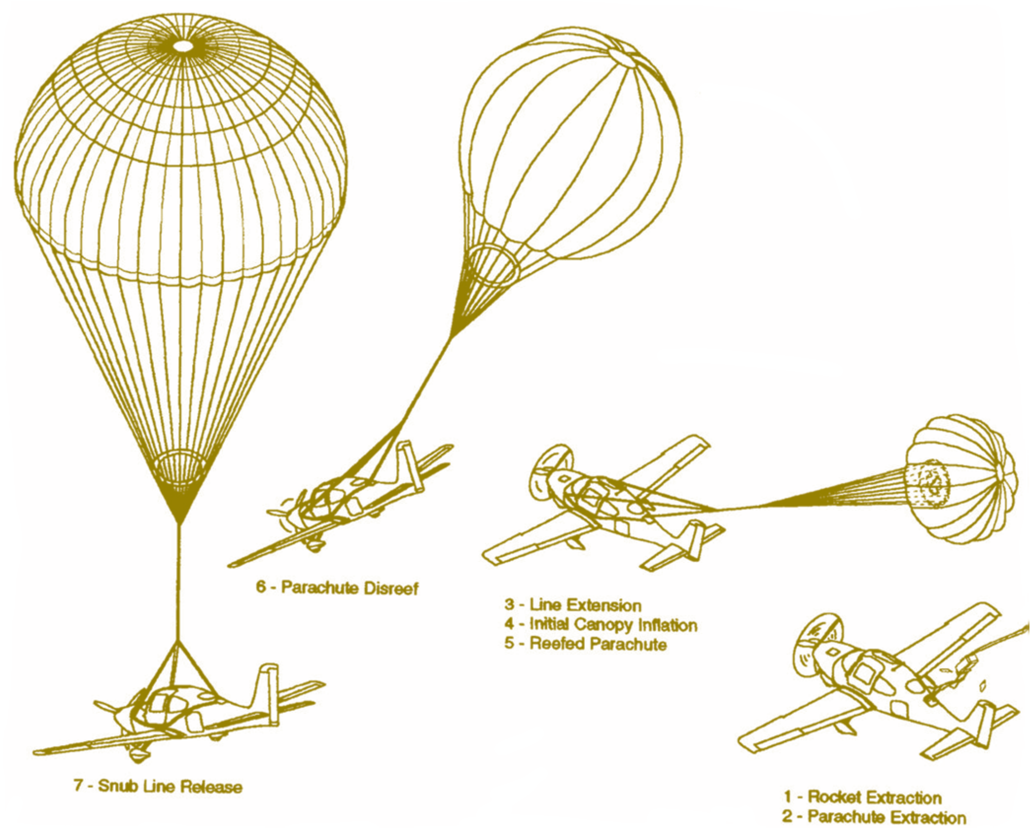
- In 1998 a joint effort between BRS and Cirrus Design resulted in the first ever FAA-Certified emergency parachute recovery system to be installed as standard equipment.
- In 2004 BRS received European Aviation Safety Agency (EASA) approval for European installation on Cessna 182 models.
- In 2007 Cessna offered BRS as option on Light Sport Aircraft and began offering 172/182 Retrofit.
- Over 30,000 systems sold - for approximately 4,000 aircraft.

Round, non-steerable parachutes are used for aircraft recovery because their purpose is simple, to slow an aircraft to a descent speed that is conducive to a safe touchdown. It is this simplicity that enhances their reliability.

Parachutes are fabricated from woven textiles in the form of fabrics, tapes, webbing, and thread. The basic structure of a round parachute (shown in Fig. 1) consists of the canopy and suspension lines. The canopy, which creates the aerodynamic drag, is made up of a series of fabric panels or "gores" sewn together to form its desired shape. The canopy has a vent at its center to allow some air to escape in a controlled manner and thus reduce oscillations and provide a stable descent. Vent lines are attached to the perimeter of the vent and routed symmetrically across its center to provide structural support and maintain its shape.

The suspension lines are attached to the "skirt" of the canopy and converge to a riser or set of risers at the opposite end. The canopy structural integrity is enhanced by a "skeleton" of tapes and webbings sewn nearly perpendicular to each other to the top surface of the canopy fabric. Radial bands run from opposite suspension line attachment points, across the top of the canopy. The skirt band, vent band, and circumferential bands run around the circumference of the canopy. The precise geometry of the canopy shape, positioning of the structural reinforcement and choice of materials are all adjusted for each particular application, striking a balance between opening characteristics, strength, stability and rate of descent.

How BRS Works

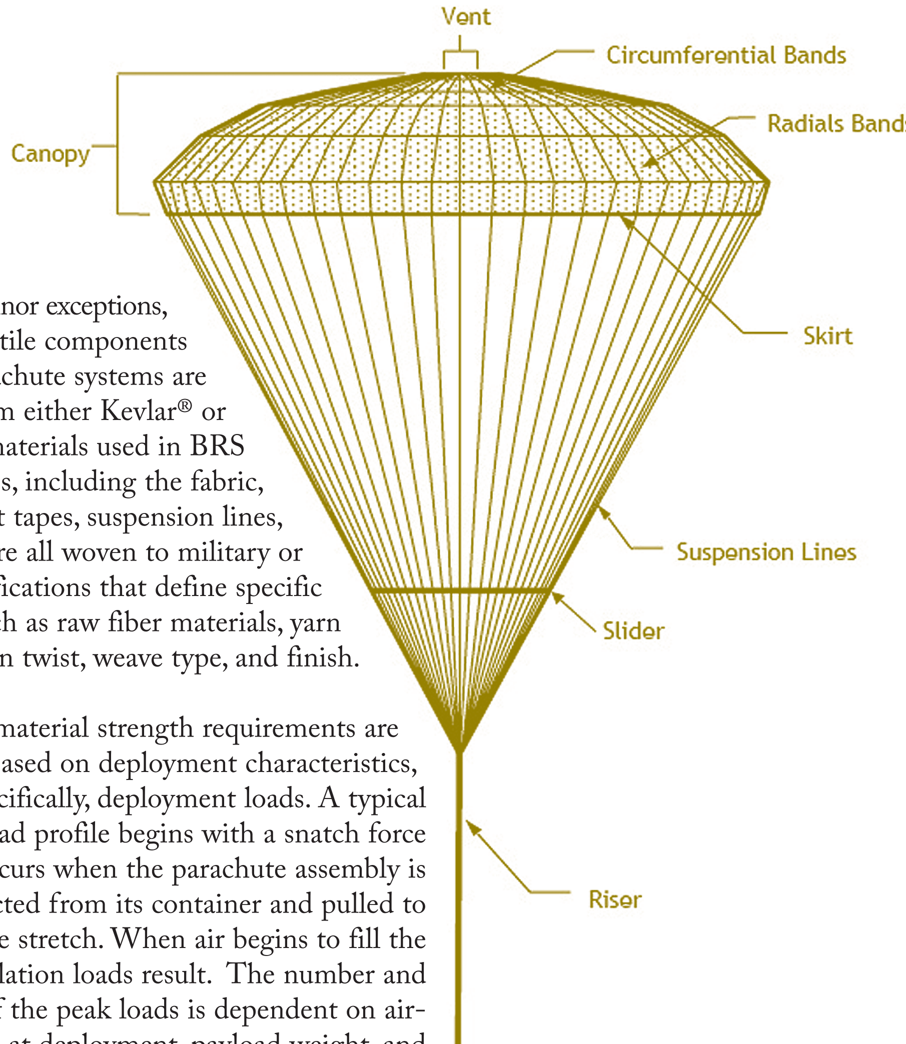


When an emergency occurs in an aircraft equipped with a ballistic parachute system, the pilot must determine if the vehicle can make a safe conventional landing. If a conventional landing cannot be accomplished, the pilot can deploy the parachute system.

The steps are:

- Kill the engine.
- Activate the system by pulling the red "T" handle.
- Pulling the handle starts a chain reaction:
  - fires two pins which ignites the rocket's solid fuel
  - once lit, the rocket accelerates to about 155 MPH
  - pushes the parachute compartment hatch open
  - pulls the parachute away from the aircraft's fuselage
  - the parachute's canopy un-stows automatically & lowers the aircraft to the ground safely.

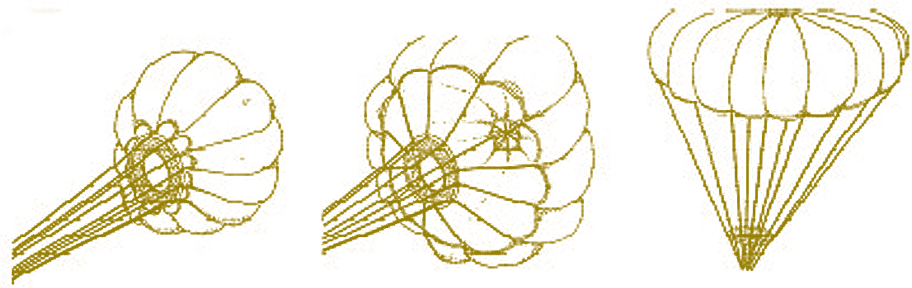
The Parachute



With a few minor exceptions, all of the textile components in the parachute systems are fabricated from either Kevlar® or Nylon. The materials used in BRS parachutes, including the fabric, reinforcement tapes, suspension lines, and threads, are all woven to military or industry specifications that define specific parameters such as raw fiber materials, yarn count, yarn twist, weave type, and finish.

Parachute material strength requirements are ultimately based on deployment characteristics, or specifically, deployment loads. A typical deployment load profile begins with a snatch force which occurs when the parachute assembly is initially extracted from its container and pulled to full line stretch. When air begins to fill the canopy, inflation loads result. The number and magnitude of the peak loads is dependent on air-speed at deployment, payload weight, and atmospheric conditions.

The Slider

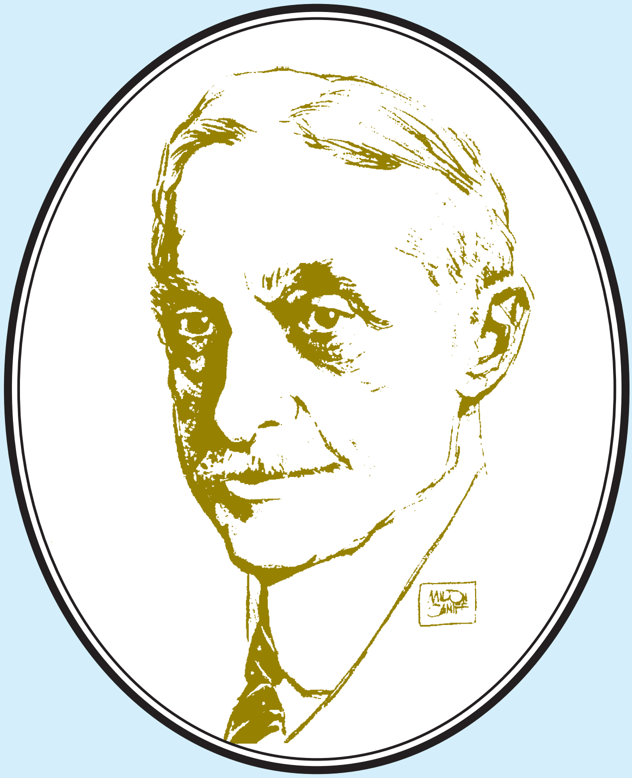


Maximum Reefed Condition | Disreefing | Full Canopy Deployment Condition

After the parachute is completely extracted and exposed to the relative wind, it begins to inflate, generating drag forces to decelerate the airplane. The magnitude of these drag forces, or inflation loads, for a particular parachute design is a function of the airplane's weight, the airspeed at deployment, and the rate of inflation.

The inflation rate of BRS parachutes is controlled by a proprietary slider, an annular shaped fabric panel with metal grommets along its perimeter. The parachute suspension lines are routed through the grommets such that the slider is free to move along the suspension lines. The parachute is packed with the slider positioned at the top of the suspension lines. Since the diameter of the slider is significantly less than the open diameter of the canopy, it limits the initial open diameter of the parachute and its rate of inflation. Once the dynamic pressure acting on the system decreases to a safe level, the slider moves down the lines, allowing the parachute to inflate to its full diameter.

Sliders can be "tuned" for a particular set of deployment conditions by adjusting their geometry. For example, increasing the size of the slider's vent will increase the airflow into the parachute and therefore increase the initial rate of inflation. Decreasing the fabric area will decrease the drag on the slider and allow it to disreef at a higher dynamic pressure, thereby increasing the final rate of inflation.



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 man 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. In 2006, the Society of Automotive Engineers changed its name to SAE International.

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 & 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 & 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.

2007 To *Robert Cook, Pam Phillips, James White,* and *Peter Mahal* for their seminal work and continuing contributions to aviation through the development of the Engineered Material Arresting System (EMAS) and its installation at many airports.

2008 To *Thomas P. Stafford, Glynn S. Lunney, Aleksei A. Leonov,* and *Konstantin D. Bushuyev* as leaders of the Apollo-Soyuz mission and as representatives of the Apollo-Soyuz docking interface design team: in recognition of seminal work on spacecraft docking technology and international docking interface methodology.

The 2009 Elmer A. Sperry Board of Award

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