



*Live Better : Save Energy*

Debra H. Fesmire, CEO

James E. Fesmire, President

The future is coming and we are here to help you create it. Evolution doesn't just happen: it takes creative input, vision, and hard work. Energy Evolution LLC is committed to helping provide a better world through better understanding and use of our global energy resources.

- We take a holistic but practical approach by thinking big and working small.
- We provide research, consultation, and training in the areas of energy efficiency, thermal insulation, novel materials, and cryogenic systems.
- We develop and apply innovative approaches for the use of energy-saving technologies.

Debra H. Fesmire is CEO of Energy Evolution LLC. She holds a Bachelor of Science degree in education from Auburn University. She has over 15 years of experience as a Media & Technology Specialist and Teacher with Brevard Public Schools in Brevard County, Florida. Her administration experience includes the deployment of teams of technology training consultants in the area medical care. She has also worked as an educator and a certified coach for childbirth. She brings a wealth of talent and abilities for bringing together the right people, choosing the optimum path for the project, and balancing all the necessary steps to achieve a successful end result.

James E. Fesmire is founder and President of Energy Evolution LLC with a focus on thermal energy systems and materials. He is also Sr. Principal Investigator and founder of the Cryogenics Test Laboratory at NASA Kennedy Space Center for novel energy technology and materials research. He holds a Master of Science in Mechanical Engineering (Materials Science) from the University of Central Florida and Bachelor of Mechanical Engineering from Auburn University.

- Over 35 years of experience in the field of cryogenics and low-temperature problem solving.
- Cryogenic systems design work for the Space Shuttle, the International Space Station, future moon and Mars exploration, experimental rocket programs, commercial space launch vehicles and facilities, superconducting power, hydrogen storage and delivery, and a wide range of commercial and industrial applications.
- Extensive publications and patents in the area of thermal insulation systems, novel materials, and cryogenic testing.



- Recipient of NASA medals for Distinguished Service, Exceptional Technology Achievement, Silver Achievement, and Exceptional Service; R&D 100 award and Space Technology Hall of Fame medal for aerogel insulation technology.

Our combined expertise of training, research, and engineering, with a professional network approach, will help define and solve your problem. *What are the barriers to implementation of new technology?* There are many, but we work to bring together the three essential ingredients for success: knowledge, value, and motivation.

#### **Services:**

- Consulting, teaching, and technical training
- Research and development (thermal systems, materials, and cryogenics)
- Litigation consulting and expert witness
- Marketing, product development, and patents
- Design, prototype construction, and physical testing
- Writing, technical reports, and proposals

#### **Target Areas:**

- Energy efficiency in construction and end product applications
- Engineering and technical consensus standards for thermal systems and materials
- Hydrogen for transportation and multi-use energy infrastructure
- Heat management for superconducting power cables, magnets, and devices
- Cold chain shipping and distribution of food and pharmaceuticals
- Thermal management in biological systems and medical equipment
- Commercial space launch systems, vehicles and facilities

#### **Contact Us:**

Phone: 1.321.385.7505

Email: [debra@321energy.us](mailto:debra@321energy.us)

Email: [james@321energy.us](mailto:james@321energy.us)

#### **Technical Publications:**

[https://www.researchgate.net/profile/James\\_Fesmire/contributions](https://www.researchgate.net/profile/James_Fesmire/contributions)

***Energy Efficient Cryogenics – We're cold but we care!***



# JAMES E. FESMIRE

President, Energy Evolution LLC

Telephone: 1.321.385.7505 Email: [james@321energy.us](mailto:james@321energy.us)

**OBJECTIVE:** Cryogenic Systems, Materials Research, Experimental Testing, and Problem-Solving

## AREAS OF EXPERTISE:

- Cryogenic storage, transfer, and process control (LHe, LH<sub>2</sub>, LN<sub>2</sub>, LO<sub>2</sub>, and LNG)
- Low temperature (from 4 K to 400 K) materials science and problem-solving
- Experimental research, approach, methodology, and apparatus
- Thermal insulation systems research, testing, and application
- Specialty in non-metallic materials including polymers, coatings, composites, and aerogels
- Energy efficient solutions for propellant/cryofuel systems, construction, and refrigerated transport
- Cryocoolers and cryogenic refrigeration for transportation, power, and scientific applications
- Prototype design, fabrication, testing, and analysis
- Pressure vessels and piping systems design, fabrication, testing, ASME Codes
- High vacuum, leak detection, and flow measurement technologies & methods
- Team leadership and technical management
- Research and writing of proposals, patents, and papers
- Education and training in cryogenics and vacuum systems design and operation
- Technology strategy, implementation, marketing, and business case development
- Communications, outreach, and policy in energy efficiency and technical standards

## PROJECTS AND INITIATIVES:

- Leader of two international industry teams in technical standards development under ASTM International Committee C16 for cryogenic thermal insulation systems data, test methods, and equipment, and engineered applications resulting in comprehensive standard guides, ASTM C1774 & C740.
- Founder, team-builder, mentor, educator, academia collaborator, industry consultant, innovator, and technical leader of the Cryogenics Test Laboratory at NASA Kennedy Space Center.
- Co-Principal Investigator for Department of Energy three-year grant to advance hydrogen fuel cell technologies by a novel cryogenic composite tank approach and technologies to build an integrated insulation system prototype to meet heat leak targets of cryogenic hydrogen storage tanks for commercially produced fuel cell powered automobiles.
- Technical guidance and key contributor to the *Simulated Propellant Loading System* team for field testing new cryogenic components and operations technologies and utilization as a test bed for developing health monitoring and autonomous control software for launch pad control systems.
- Technical guidance and key contributor to the *Ground Operations Demonstration Unit for Liquid Hydrogen* team for advanced, energy-efficient cryogenic operations with large-scale integrated refrigeration for zero boiloff storage, liquefaction of gaseous hydrogen, and densification of LH<sub>2</sub>.
- Multilayer insulation (MLI) systems testing and materials research for cryogenic spacecraft tanks and launch complex piping resulting in an extensive library of thermal data and technical know-how.
- Designing, developing, and testing different thermal insulation system prototypes and materials for Earth, Moon, and Mars surface cryogenic storage & transfer resulting in over 3,000 reported test data points dozens of publications for a wide range of Government, academic, and industry customers.
- Team leader (including US Navy and Department of Energy personnel) under a Department of Homeland Security grant to develop cryogenic insulation systems and advanced manufacturing for long flexible cryostats in high-temperature superconducting power applications.



- Principle Investigator of \$3M multi-center research project for the NASA Space Operations Mission Directorate, *New materials and technologies for cost-efficient storage and transfer of cryogenics*, to develop innovative thermal insulation systems for large-scale tanks and pipelines.
- Co-Principle Investigator of \$2M multi-center research project for the NASA Space Operations Mission Directorate, *Technologies to increase reliability of thermal insulation systems*, to develop integrated high temperature to low temperature material systems. Leader of NASA-wide team *Thermal Insulation Systems Group* for integrated thermal systems development.
- Developed extensive, active laboratory capability based on a family of cryogenic boiloff calorimeters (cryostats) for thermo-physical properties of materials, fluid properties and control, two-phase transport, surface effects, evaporation processes, and heat transfer measurements.
- Founded the Cryogenics Test Laboratory at Kennedy Space Center for applied research & development and cryogenic technology innovation through national and global collaboration.
- Built a unique Government-Academia-Industry partnership approach, with a discipline area strategy, to collaboration for near-term problem-solving and long-term research goals.
- Leader of joint research programs with industry companies including 3M, Chart-MVE, Cabot, Lydall, Aspen Aerogels, Technip, Polyglass, and many others to develop thermal materials or systems for higher performance, reduced life-cycle costs, or to enable new capabilities.
- Team leader under a Department of Energy grant to develop cryogenic multilayer insulation systems for high-temperature superconducting power applications.

#### ACCOMPLISHMENTS AND PROBLEM-SOLVING:

- Designed and tested proof-of-concept for a new hybrid thermal insulation system for space launch vehicle upper stage, liquid hydrogen (LH<sub>2</sub>) tanks, windward side, showing dramatic performance improvements for long-term on-orbit storage of cryogenic propellants (one week versus hours).
- Designed and built a cold helium heat exchanger inside a liquid hydrogen tank (125,000 liters) for integrated refrigeration system in future cryofuels applications.
- Co-inventor of hybrid aerogel composite materials for multifunctional thermal and structural applications in passive thermal management architectures (5 US Patents).
- Designed and constructed multiple cryostat instruments for insulation materials testing, pipelines, and tanks thermal performance testing (8 US Patents).
- Pioneer in aerogel technology development, *Flexible Aerogel Superinsulation*, through research partnership with Aspen Systems, resulting in R&D 100 Award and Space Technology Hall of Fame.
- Inventor of layered composite insulation systems for extreme environments which was successfully implemented on space launch facility cryogenic piping as well as the *Shuttle ET Liquid Hydrogen Vent* umbilical disconnect.
- Developed breakthrough aerogel-based insulation system to eliminate liquid nitrogen formation within *Shuttle ET Liquid Hydrogen Intertank* and help solve foam loss problems in flight
- Developed novel aerogel-based insulation system for reducing ice formation on the *Shuttle ET Liquid Oxygen Feedline* bellows
- Developed aerogel-based insulation system for reducing ice formation on the *Shuttle ET Liquid Hydrogen Vent* umbilical disconnect.
- Inventor of test method for determining moisture uptake in foam materials subjected to below-ambient temperature conditions and showed that closed cell foams can double their weight in water in a cryogenic tank space launch vehicle configuration.
- Designed cryogenic umbilical panel layouts (LO<sub>2</sub>, LH<sub>2</sub>, GN<sub>2</sub>, and GHe) for the X33 vehicle along with new functional interface approach to cryogenic supply systems for efficient fluid servicing.
- Developed cryogenic system concepts for servicing new launch vehicles such as Shuttle-C, HLLV, SEI, NLS, Shuttle LRB, EELV, and RLV/X-33.
- Technical leader, fluids, of RLV/X-33 propellant densification (LO<sub>2</sub> and LH<sub>2</sub>) technology development.
- Designed, developed, and tested a wide range of cryogenic valves, connectors, and devices for propellant loading systems (1 US Patent).
- Leader of Center-wide study of propellant system interface connections for safety improvements.



- Designed and tested liquid oxygen pumping and transfer system modifications for Space Shuttle Return-to-Flight (Challenger) with Space Shuttle Main Engine experts in vibration analysis.
- Designed, tested, and analyzed new vehicle interface flexhose assembly for Space Shuttle LH<sub>2</sub> vent umbilical system including use of new Hastelloy material and manufacturing methodologies.
- Lead engineer for Space Station Freedom design project, Cryo Carrier Loading System.
- Co-inventor of novel cryogenic umbilical quick disconnect targeted for robotic resupply in space.

#### PROFESSIONAL AFFILIATIONS:

- Board of Directors member and Past-President, Cryogenic Society of America
- Member of Commission A1 (cryophysics/cryoengineering), International Institute of Refrigeration (IIR)
- Past Board of Directors member and past Program Chair, Cryogenic Engineering Conference (CEC)
- Member of ASTM International, Committee C16 on Thermal Insulation (chair of 3 Task Groups)
- Member of International Standards Organization ISO TC67/SC9 Liquefied natural gas equipment
- Member of *Tau Beta Pi*, *Pi Tau Sigma*, and *Phi Kappa Phi*, Auburn University

#### AWARDS & RECOGNITIONS:

- NASA Silver Achievement Medal, 2017
- ASTM International, Committee C16 on Thermal Insulation, Award of Appreciation, 2016
- NASA Space Flight Awareness Award, Densified Propellant Tiger Team, 2016
- NASA Group Achievement Award, Ground Operations Demonstration LH<sub>2</sub> Team, 2015
- International Space Foundation, Space Technology Hall of Fame, Flexible Aerogel Technology, 2012
- NASA Distinguished Service Medal, 2011
- NASA Exceptional Technology Achievement Medal, 2009
- NASA Exceptional Service Medal, 1999
- NASA Engineering & Safety Center (NESC) Director's Award for Engineering Excellence, 2005
- NASA Kennedy Space Center Director's Gold Dollar *Ace* Award, 2005
- R&D 100 Award, Flexible Aerogel Superinsulation, with Aspen Aerogels, 2003
- NASA Silver Achievement Medal, Space Technology Mission Directorate, 2014
- NASA Engineering & Safety Center, LOX Feedline Bellows Ice Prevention Team, 2005
- NASA Kennedy Space Center, Certificate of Commendation, 2008
- United States delegate to the 20th International Congress of Refrigeration, Sydney AUSTRALIA, 1999
- NASA KSC Director's Gold Dollar Award, Thermal Insulation Systems patent, 2006
- NASA KSC Director's Gold Dollar Award, Thermal Insulation Testing Method and Apparatus patent, 2005
- NASA KSC Director's Gold Dollar Award, Apparatus for Thermal Testing of Pipelines patent, August 2004
- NASA KSC Director's Gold Dollar Award, Methods of Testing Thermal Insulation patent, 2004
- NASA KSC Director's Gold Dollar Award, Multi-purpose Insulation Test Apparatus patent, 2003
- NASA Kennedy Space Center, Certificate of Commendation, 2003
- NASA KSC Director's Gold Dollar Award, Continual Improvement, Cryogenics Testbed team, 1999
- NASA KSC Cryogenics Test Laboratory Team, STS-114 return-to-flight, 2006
- One NASA Peer Award, Maptis II Team, Marshall Space Flight Center, 2006

#### PUBLICATIONS AND PATENTS: (see listings A-G)

- Author or co-author of over 200 papers, publications, and patents
- Author or co-author of 16 US Patents and 7 Patents Pending (see listing A)
- Author or co-author of 73 refereed articles in the area of cryogenic engineering (see listing B)
- Author or co-author of 69 non-refereed articles in technical magazines or conference proceedings (see listings D & E)
- Author or co-author of 45 articles in NASA Research & Technology Report publications (see listing F)
- Presentations, university lectures, and seminars given worldwide including United Kingdom, The Netherlands, Japan, South Korea, Poland, Australia, France, Canada, and USA (see listing G)



- Best Paper Award, *Cryogenics* journal, Space Cryogenics Workshop 2007, for the paper entitled *Aerogel insulation systems for space launch applications*
- Author or co-author of dozens of NASA-accepted New Technology Reports (15 in the last 2 years)

**PROFESSIONAL EXPERIENCE:**

- 03/2015 to present, NASA Exploration Research & Technology Programs, Kennedy Space Center, Sr. Principal Investigator – Cryogenics, Head Researcher – Cryogenics Test Laboratory
- 11/2011 to present, Energy Evolution LLC, President and Founder
- 02/2008 to 03/2015, NASA Engineering & Technology Directorate, Kennedy Space Center, Sr. Principal Investigator, Cryogenics Test Laboratory
- 10/2005 to 01/2008, NASA Applied Technology Directorate, Kennedy Space Center, Principal Investigator, Cryogenics Test Laboratory
- 05/2000 to 10/2005, NASA Spaceport Engineering & Technology Directorate, Kennedy Space Center, Florida, Lead Engineer, Cryogenics Testbed
- 01/1988 to 05/2000, NASA Engineering Development, Kennedy Space Center, Florida, Senior Engineer in the Cryogenic Systems Group
- 03/1983 to 12/1987, NASA Design Engineering, Kennedy Space Center, Florida, Engineer-trainee in the Propellants and Gases Branch, Cryogenics Section

**EDUCATION:**

- Master of Science in Mechanical Engineering (Materials Science), University of Central Florida, 1992
- Bachelor of Mechanical Engineering, with *High Honor*, Auburn University, 1987



## **JAMES E. FESMIRE**

### **ATTACHMENTS**

#### **PATENTS, PUBLICATIONS, AND PRESENTATIONS**

- A. Patents**
- B. Refereed Publications**
- C. Refereed Publications Pending**
- D. Non-Refereed Journals / Technical Magazines**
- E. Papers / Conference Proceedings / Software**
- F. NASA/KSC Research & Technology Annual Reports**
- G. Selected Presentations and Seminars**



## A. Patents

1. Fesmire, J. E. and Johnson, W. L., "Guarded flat plate cryogenic test apparatus and calorimeter (C-600)," US Patent 10,024,812, July 17, 2018.
2. Trigwell, S., Fesmire, J.E., Gibson, T., and Williams, M.K., "Passive Thermal Management Systems Employing Shape Memory Alloys," US Patent 9,982,661, May 29, 2018.
3. Williams, M.K., Smith, T.M., Fesmire, J.E., Roberson, L.B., and Clayton, L.M., "Aerogel / Polymer Composite Materials," US Patent 9,777,126, October 3, 2017.
4. Fesmire J and Johnson W, "Guarded flat plate cryogenic test apparatus and calorimeter," US patent 9,678,025 B1, June 13, 2017.
5. Fesmire J. E., "Thermal insulation system for non-vacuum applications including a multilayer composite," US patent 9,617,069 B2, April 11, 2017.
6. Fesmire, J.E., and Dokos, A. G., "Insulation Test Cryostat with Lift Mechanism," US Patent 9,488,607, November 8, 2016.
7. Fesmire, J.E., and Dokos, A. G., "Insulation Test Cryostat with Lift Mechanism," US Patent 8,628,238 B2, January 14, 2014.
8. Williams, M.K., Smith, T.M., Fesmire, J.E., Weiser, E.S., and Sass, J.P., "Foam / Aerogel Composite Materials for Thermal and Acoustic Insulation and Cryogen Storage," US Patent 7,977,411 July 12, 2011.
9. Williams, M.K., Smith, T.M., Fesmire, J.E., Roberson, L.B., and Clayton, L.M., "Aerogel / Polymer Composite Materials," US Patent 7,790,787 September 7, 2010.
10. Williams, M.K., Smith, T.M., Fesmire, J.E., Weiser, E.S., and Sass, J.P., "Foam / Aerogel Composite Materials for Thermal and Acoustic Insulation & Cryogen Storage," US Patent 7,781,492 August 24, 2010.
11. Augustynowicz, S.D. and Fesmire, J.E., "Thermal Insulation Systems," US Patent 6,967,051 B1 November 22, 2005.
12. Fesmire, J.E. and Augustynowicz, "Thermal Insulation Testing Method and Apparatus," US Patent 6,824,306 November 30, 2004.
13. Fesmire, J.E. and Augustynowicz, "Methods of Testing Thermal Insulation and Associated Test Apparatus," US Patent 6,742,926 June 1, 2004.
14. Fesmire, J.E., Augustynowicz, and Nagy, Z.F., "Apparatus and Method for Thermal Performance Testing of Pipelines and Piping Systems," US Patent 6,715,914 April 6, 2004.
15. Fesmire, J.E. and Augustynowicz, S.D., "Multi-purpose Thermal Insulation Test Apparatus," US Patent 6,487,866 December 3, 2002.
16. Buehler, K. and Fesmire, J.E., "Quick-Disconnect Inflatable Seal Assembly," US Patent 4,772,050, September 20, 1988.
17. Fesmire, J.E., Williams, M.K., et al., "A material system with improved lateral and transverse thermal conductivity," KSC-13956, 11/2018.
18. Swanger, A.M. and Fesmire, J.E., "Cryogenic flux capacitor for solid-state storage and on-demand supply of fluid commodities," US Patent application 16/104,824, KSC-14075, 09/2018.
19. Fesmire, J.E., "Cup Cryostat Thermal Conductivity Analyzer," US Patent application, KSC-14030, 10/2016.
20. Fesmire, J.E., and Swanger, A.M., "Feedthrough Assembly for Conveyance of a Feed Element," US Patent application, KSC-13956, 09/2016.
21. Fesmire, J.E., "A thermal insulation system for non-vacuum applications including a multilayered composite," International patent application, publication number WO2014164591A1, October 9, 2014.
22. Clayton, L.M., Fesmire, J.E., Roberson, L.B., Smith, T.M., and Williams, M.K., "Aerogel/polymer composite materials," International patent application, publication number WO2007130315A8, August 7, 2008.
23. Fesmire, J.E., Sass, J.P., Smith, T.M., Weiser, E.S., and Williams, M.K., "Foam/aerogel composite materials for thermal and acoustic insulation and cryogen storage," International patent application, publication number WO2008054551A3, July 31, 2008.





## B. Refereed Publications

1. Fesmire, J.E. and Johnson, W.L., "Cylindrical Cryogenic Calorimeter Testing of Six Types of Multilayer Insulation Systems," *Cryogenics*, Vol. 89, pp. 58-75 (2018).
2. Notardonato B, Swanger A, Fesmire J, Jumper K, Johnson W, and Tomsik T, "Final test results for the ground operations demonstration unit for liquid hydrogen," *Cryogenics*, Vol 88, pp. 147-155 (2017).
3. Shu Q, Demko J, and Fesmire J, "Heat Switch Technology for Thermal Management in Cryogenic Devices," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012133.
4. Fesmire J, Ancipink J, Swanger A, White S, and Yarbrough D, "Thermal conductivity of aerogel blanket insulation under cryogenic-vacuum conditions in different gas environments," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012198.
5. Johnson W, Fesmire J, "Heat Loads Due to Small Penetrations in Multilayer Insulation Blankets," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012197.
6. Hooks J, Demko J, Fesmire J, and Matsumoto T, "Investigations of Heat Transfer in Vacuum Between Room Temperature and 80 K," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012199.
7. Swanger A, Notardonato B, Fesmire J, Jumper K, Johnson W, and Tomsik T, "Large Scale Production of Densified Hydrogen to the Triple Point and Below," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012013.
8. Notardonato B, Swanger A, Jumper K, Fesmire J, Johnson W, and Tomsik T, "Zero Boil-Off Control Methods for Large Scale Liquid Hydrogen Tanks using Integrated Refrigeration and Storage," *Advances in Cryogenic Engineering*, IOP 278 (2017) 012012.
9. Fesmire, J.E., Johnson, W.L., Meneghelli, B., and Coffman, B.E., "Cylindrical boiloff calorimeters for testing of thermal insulations," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012056 doi:10.1088/1757-899X/101/1/012056.
10. Fesmire, J.E., Johnson, W.L., Swanger, A., Kelly, A., and Meneghelli, B., "Flat plate boiloff calorimeters for testing of thermal insulation systems," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012057 doi:10.1088/1757-899X/101/1/012057.
11. Shu, Q.S., Demko, J.A., and Fesmire, J.E., "Developments in advanced and energy saving thermal insulations for cryogenic applications," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012014 doi:10.1088/1757-899X/101/1/012014.
12. Demko, J., Fesmire, J., Dookie, J., and Bickley, J., "Comparison tests of cellular glass insulation for the development of cryogenic insulation standards," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012016 doi:10.1088/1757-899X/101/1/012016.
13. Johnson, W.L., Fesmire, J.E., Frank, D., and Nast, T., "Thermal Performance Testing of Cryogenic Multilayer Insulation with Silk Net Spacers," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012018 doi:10.1088/1757-899X/101/1/012018.
14. Johnson, W.L. and Fesmire, J.E., "Demonstration of Hybrid Multilayer Insulation for Fixed Thickness Applications," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012015 doi:10.1088/1757-899X/101/1/012015.
15. Swanger, A., Jumper, K., Fesmire, J.E., and Notardonato, B., "Modification of liquid hydrogen tank for integrated refrigeration and storage," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012080 doi:10.1088/1757-899X/101/1/012080.
16. Swanger, A., Fesmire, J.E., Trigwell, S., Gibson, T., and Williams, M., "Apparatus and method for low-temperature training of shape memory alloys," IOP Conf. Series: Materials Science and Engineering 102 (2015) 012008 doi:10.1088/1757-899X/102/1/012008.
17. Krenn, A., Starr, S., Youngquist, R., Nurge, M., Sass, J., Fesmire, J.E., Cariker, C., and Bhattacharya, A., "Safe removal of frozen air from the annulus of an LH2 storage tank," IOP Conf. Series: Materials Science and Engineering 101 (2015) 012031 doi:10.1088/1757-899X/101/1/012031.
18. Fesmire, J.E., "Standardization in cryogenic insulation systems testing and performance data," *Physics Procedia* 67 (2015) 1089 – 1097.



19. Fesmire, J.E., "Layered composite thermal insulation system for non-vacuum cryogenic applications," *Cryogenics*, Vol. 74 (2015).
20. Fesmire, J.E., Tomsik, T.M., Bonner, T., Oliveira, J.M., Conyers, H.J., Johnson, W.L. and Notardonato, W.U., "Integrated Heat Exchanger Design for a Cryogenic Storage Tank," *Advances in Cryogenic Engineering, AIP Conf. Proc.* 1573, 1365-1372 (2014).
21. Demko, J.A., Fesmire, J.E., Johnson, W.L., and Swanger, A.M., "Cryogenic insulation standard data and methodologies," *Advances in Cryogenic Engineering, AIP Conf. Proc.* 1573, 463-470 (2014).
22. Johnson, W.L., Kelly, A.O., Heckle, K.W., Jumper, K.M., and Fesmire, J.E., "Calorimeter Testing of Thermal Degradation of Multilayer Insulation Due to the Presence of Penetrations," *Advances in Cryogenic Engineering, AIP Conf. Proc.* 1573, 701-707 (2014).
23. Johnson, W.L., Kelly, A.O., and Fesmire, J.E., "Thermal Degradation of Multilayer Insulation Due to the Presence of Penetrations," *Advances in Cryogenic Engineering, AIP Conf. Proc.* 1573, 463-470 (2014).
24. V. Ganni and J.E. Fesmire, "Cryogenics for Superconductors: Refrigeration, Delivery, and Preservation of the Cold," Plenary Paper, *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1434, pp. 15-27 (2012).
25. D. Knoll, D. Willen, J. Fesmire, W. Johnson, J. Smith, B. Meneghelli, J. Demko, D. George, B. Fowler and P. Huber, "Evaluating Cryostat Performance for Naval Applications," *Cryogenic Engineering Conference, Spokane, June 2011, Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1434, pp. 39-46 (2012).
26. Werlink, R.W., Fesmire, J.E., and Sass, J.P., "Vibration Considerations for Cryogenic Tanks Using Glass Bubbles Insulation," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1434, pp. 265-272 (2012).
27. Johnson, W.L., Fesmire, J.E., and Meneghelli, B.E., "Cryopumping Field Joint Can Testing," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1434, pp. 15-27 (2012).
28. Johnson, W.L. and Fesmire, J.E., "Thermal Performance of Low Layer Density Multilayer Insulation Using Liquid Nitrogen," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1434, pp. 1527-1533 (2012).
29. Fesmire, J. E., Coffman, B. E., Meneghelli, B. J., Heckle, K. W., "Spray-On Foam Insulations for Launch Vehicle Cryogenic Tanks," *Cryogenics*, doi:10.1016/j.cryogenics.2012.01.018.
30. Fesmire, J.E., Williams, M.K., Smith, T.M., Coffman, B.E., Sass, J.P., and Meneghelli, B.M., "Cryogenic Moisture Uptake in Foam Insulation for Space Launch Vehicles," *Journal of Spacecraft and Rockets*, Vol. 49, No. 2, March/April 2012, pp. 220-230.
31. Kogan, A., Fesmire, J., Johnson, W., and Minnick, J., "Cryogenic vacuum thermal insulation systems," *Proceedings of the Twenty-Third International Cryogenic Engineering Conference and International Cryogenic Materials Conference, Wroclaw University of Technology, Wroclaw, Poland, 2010.*
32. Sass, J.P., Fesmire, J.E., St. Cyr, W.W., Lott, J.W., Barrett, T.M., Baumgartner, R.G., "Glass bubbles insulation for liquid hydrogen storage tanks," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1218, pp. 772-779 (2010).
33. Johnson, W.L., Fesmire, J.E., Demko, J.A., "Analysis and testing of multilayer and aerogel insulation configurations," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1218, pp. 780-787 (2010).
34. Johnson, W.L., Fesmire, J.E., "Cryogenic testing of different seam concepts for multilayer insulation systems," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1218, pp. 905-907 (2010).
35. Coffman, B.E., Fesmire, J.E., Augustynowicz, S.D., Gould, G., White, S., "Aerogel blanket insulation materials for cryogenic applications," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1218, pp. 913-920 (2010).
36. Koravos, J.J., Miller, T.M., Fesmire, J.E., Coffman, B.E., "Nanogel aerogel as a load bearing insulation material for cryogenic systems," *Advances in Cryogenic Engineering, AIP Conference Proceedings*, Vol. 1218, pp. 921-927 (2010).
37. Smith, T.M., Williams, M.K., Fesmire, J.E., Sass, J.P., and Weiser, E.S., "Fire and Engineering Properties of Polyimide-Aerogel Hybrid Foam Composites for Advanced Applications," *Fire and Polymers V*, Chapter 10, pp 148-173, American Chemical Society, 2009.



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32. Fesmire, J.E., "Liquid Nitrogen Feed System and Subcooler for the Cryostat," NASA Technical Memorandum 208545, 1998, p. 16.
33. Fesmire, J.E. and Nagy, Z.F., "Liquid Nitrogen Flow Test Area," NASA Technical Memorandum 208545, 1998, p. 17.
34. Fesmire, J.E. and Augustynowicz, S.D., "Cryogenic Insulation Systems for Soft Vacuum," NASA Technical Memorandum 208545, 1998, pp. 68-69.
35. Fesmire, J.E., Ynclan, M.J., and Augustynowicz, S.D., "Cryostat Test Apparatus for Thermal Insulation System Development," NASA Technical Memorandum 207196, 1997, pp. 46-47.
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37. Fesmire, J.E., Ynclan, M.J., and Augustynowicz, S.D., "Dewar Test Apparatus for Thermal Insulation System Development," NASA Technical Memorandum 207196, 1997, pp. 54-55.
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39. Fesmire, J. E., "Liquid Nitrogen Boiloff Calorimeter," NASA Technical Memorandum 112650, 1996, pp. 80-81.
40. Fesmire, J.E., Pringle, M., and Koss, R., "Cryogenic Shutoff Valve Testing," NASA Technical Memorandum 112650, 1996, p. 82.
41. Ernst, E.W., Fesmire, J.E., and Rigney, J.L., "Cryogenic Test Bed," NASA Technical Memorandum 112650, 1996, p. 83.
42. Werlink, R.J., and Fesmire, J.E., "Two-Phase Quality/Flowmeters," NASA Technical Memorandum 112650, 1996, p. 84.
43. Fesmire, J.E. and Ryu, J., "Flexible Insulation System Using Ultralow-Density Aerogels," NASA Technical Memorandum 109200, 1993, p. 16.
44. Fesmire, J.E., "Design of Vacuum-Jacketed Flexhose Assemblies," NASA Technical Memorandum 103825, 1991, pp. 57-58.
45. Moore, W.I. and Fesmire, J.E., "Clamshell Bellows Repair Technique with Hastelloy C-22 Material," NASA Technical Memorandum 100986, 1988, p. 83.

#### G. Selected Presentations and Seminars

1. *International Cryogenic Engineering Conference*, Oxford University, United Kingdom, "Aerogel-Based Insulation Materials for Cryogenic Applications," September 2018.
2. *NASA NESCAcademy Webinar*, "Aerogel-based thermal insulation systems for cryogenic-vacuum applications," May 2018.
3. *Insulation Expo (IEX)*, Houston, Texas USA, Learning Theater, "Layered Thermal Insulation Systems for Industrial and Commercial Applications," December 2017.
4. *International Clean Hydrogen Energy Forum*, Seoul, South Korea, "Advanced New Insulation Materials for Liquid Hydrogen Application," September 2017.
5. *Space Cryogenics Workshop*, Oak Brook, Illinois USA, "Cylindrical Cryogenic Calorimeter Testing of Six Types of Multilayer Insulation Systems," July 2017.



6. *Cryogenic Engineering Conference*, Madison, Wisconsin USA, "Thermal conductivity of aerogel blanket insulation under cryogenic-vacuum conditions in different gas environments," July 2017.
7. Florida Institute of Technology, Melbourne, Florida USA, Physics Department, Living Off the Land in Space, "Energy Considerations and Calculations for Cryogenic Storage on the Moon and Mars," invited lecture, September 2016.
8. National Insulation Association (NIA) *61st Annual Convention and World Insulation and Acoustic Organization (WIACO)*, Boca Raton, Florida USA, "Below Ambient and Cryogenic Thermal Testing," invited presentation, April 2016.
9. *NASA Tech Briefs Webinar*, "Aerogel Hybrid Composite Materials: Designs and Testing for Multifunctional Applications," April 2016, <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160005297.pdf>
10. *NASA Tech Briefs Webinar*, "Layered Thermal Insulation Systems for Industrial and Commercial Applications," August 2015, <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150018118.pdf>
11. *International Workshop on Liquefied Hydrogen Technology*, Kyoto JAPAN, "Cost Efficient Storage and Transfer of Liquid Hydrogen," Japan Ship Technology Research Association (JSTRA), invited presentation, March 2015.
12. *International Cryogenic Engineering Conference*, University of Twente, Enschede, The NETHERLANDS, "Standardization in Cryogenic Insulation Systems Testing and Performance Data," July 2014.
13. University of Central Florida, Orlando, Florida USA, Mechanical Engineering Department, for Emerging Materials course, "Aerogel Materials: Science, Technology, and Applications," November 2013.
14. South Dakota School of Mines and Technology, Rapid City, South Dakota USA, "Cryogenics and Energy at the Extremes," invited presentation, September 2013.
15. Embry-Riddle Aeronautical University, Daytona Beach, Florida USA, *NASA Thermal Fluids Analysis Workshop*, "Thermal Insulation Systems: Materials, Testing, and Applications," seminar, July 2013.
16. Florida Solar Energy Center, *Space Coast Energy Symposium*, Cocoa, Florida USA, "Space and Energy User Facilities," invited presentation, June 2013.
17. *Lunar Superconducting Applications 3rd International Workshop*, Cocoa Beach, Florida USA, "Cryogenics and Energy at the Extremes," invited presentation, April 2013.
18. *Converged Research Center for Liquefied Material Using Magnetic Refrigeration*, Jeju SOUTH KOREA, "Energy Efficient Storage and Transfer of Cryogenics," invited presentation, February 2013.
19. *International Space University* (Illkirch-Graffenstaden, France), Kennedy Space Center, Florida USA, "Cryogenics on Earth and in Space," seminar, July 2012.
20. Georgia Institute of Technology, Atlanta, Georgia USA, "Insulation 101 Workshop" for the *Academic Cold Chain Forum – Food and Pharmaceutical*, seminar, April 2012.
21. GE Global Research, Niskayuna, New York USA, "Energy Efficient Cryogenics on Earth and in Space," invited presentation, October 2011.
22. Rensselaer Polytechnic Institute, Troy, New York USA, "Future in Thermal Insulation Systems," invited lecture, October 2011.
23. *Cryogenic Engineering Conference*, Spokane, Washington USA, "Thermal Insulation Performance of Hybrid Aerogel-MLI Insulation for Cryogenic Storage in Space Applications," June 2011.
24. *Space Cryogenics Workshop*, Couer d'Alene, Idaho USA, "Aerogel Thermal Insulation for Cryogenic Space Applications," June 2011.
25. *International Cryogenic Engineering Conference 23*, Wroclaw POLAND, "Cryogenic vacuum insulation for vessels and piping," July 2010.
26. *Academic Cold Chain Pharmaceutical Conference*, University of South Florida Polytechnic, Lakeland, Florida USA, "Workshop on low-temperature thermal insulation systems," February 2010.
27. *Cryogenic Engineering Conference*, Tucson, Arizona USA, "Glass bubbles insulation for liquid hydrogen tanks," July 2009.
28. *Pharmaceutical Cold Chain Conference*, University of Florida, Gainesville, Florida USA, "Future in Thermal Insulation Systems," February 2009.
29. High Performance Materials Technology Briefing, Langley Research Center, Virginia USA, "Aerofoam," September 2007.



30. *Cryogenic Engineering Conference*, Chattanooga, Tennessee USA, "Robust multilayer insulation for cryogenic systems" and "Cost-efficient storage of cryogenes," July 2007.
31. *Space Cryogenics Workshop*, Huntsville, Alabama USA, "Aerogel insulation applications for liquid hydrogen launch vehicle tanks," July 2007.
32. *International Thermal Conductivity Conference 29*, Birmingham, Alabama USA, "Thermal performance testing of cryogenic insulation systems" and "Nonflammable, hydrophobic aerogel composites for cryogenic applications," June 2007.
33. Thermal Insulation Systems (TIS) Workshop, November 2006, NASA Marshall Space Flight Center, Huntsville, AL USA, author/co-author of 14 technical presentations including Moisture Uptake Testing of SOFI Materials Under Actual-Use Cryogenic Conditions.
34. *Cryogenic Engineering Conference*, Keystone, Colorado USA, "Vibration and thermal cycling effects on bulk-fill Insulation materials for cryogenic tanks" and "Testing of prototype magnetic suspension cryogenic transfer line," August 2005.
35. *Space Cryogenics Workshop*, Colorado Springs, Colorado USA, "Aerogel insulation systems for space launch applications" and August 2005.
36. *16th Thermal and Fluids Analysis Workshop*, Orlando, Florida USA, Invited seminar "Cryogenic Insulation Technology: Recent advances and future directions in thermal insulation systems for low-temperature applications," August 2005.
37. University of Florida, Agricultural and Biological Engineering Dept., Gainesville, Florida USA, Invited seminar "Superinsulation in Cryogenic Applications," March 2004.
38. *Cryogenic Engineering Conference*, Anchorage, Alaska USA, "Equipment and methods for cryogenic thermal insulation testing" and "Thermal performance testing of glass microspheres under cryogenic-vacuum conditions," September 2003.
39. *21st International Congress of Refrigeration*, Washington DC USA, "Cryogenic Information Center (CIC)" and "Thermal performance testing of cryogenic piping systems," August 2003.
40. University Laval, Quebec City, Quebec CANADA, "Cryogenics on Earth and in Space: Cryogenics, Insulation Testing, and Aerogels," invited tutorial, October 2002.
41. *International Cryogenic Engineering Conference 19*, Grenoble FRANCE, "Performance characterization of perforated MLI blanket," July 2002.
42. *Cryogenic Engineering Conference*, Madison, Wisconsin USA, "Aerogel Beads as Cryogenic Thermal Insulation System," "Thermal Insulation Performance of Flexible Piping for Use in HTS Power Cables," and "Overall Thermal Performance of Flexible Piping Under Simulated Bending Conditions," July 2001.
43. NASA Marshall Space Flight Center, Huntsville, Alabama USA, "Thermal Insulation Systems: Conventional and Novel Materials for Cryogenic Applications," invited presentation, June 2001.
44. *6th International Symposium on Aerogels*, Albuquerque, New Mexico USA, "Aerogel beads as cryogenic thermal insulation system," October 2000.
45. NASA Marshall Space Flight Center, Huntsville, Alabama USA, "Cryogenic Insulation and Aerogels," invited presentation, February 2000.
46. *20th International Congress of Refrigeration*, Sydney AUSTRALIA, "Cryogenic Insulation Systems," September 1999.
47. Department of Energy Superconducting Program for Electric Systems, *Cryogenics Vision Workshop*, Washington DC USA, "Long Flexible Cryostat: Materials, Testing, and Manufacture," invited presentation, July 1999.
48. *Cryogenic Engineering Conference*, Montreal, Quebec CANADA, "Insulation Testing Using Cryostat Apparatus with Sleeve" and "Cryogenic Insulation System for Soft Vacuum," July 1999.
49. *5th International Symposium on Aerogels*, "Aerogel-Based Cryogenic Superinsulation," Montpellier, FRANCE, September 1997.
50. *Cryogenic Engineering Conference*, Portland, Oregon USA, "Aerogel-Based Cryogenic Superinsulation," July 1997.
51. MVE Inc., New Prague, Minnesota USA, "Aerogels for use as thermal insulation materials," invited seminar, March 1997.





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