



Thomas B. Morrow, PhD, P.E.

**List of Papers, Presentations and Industry  
Committee Participation**

**Papers and Presentations:**

*Minimizing Measurement Errors*, **T. B. Morrow**, Pipeline and Gas Technology, Nov./Dec. 2006, pp. 40-43.

*Installation and Operational Errors in Gas Measurement*, **T. B. Morrow**, 2006 International School of Hydrocarbon Measurement, May 16-18, 2006, Oklahoma City, OK

*Multi-Path Gas Ultrasonic Flow Meter Performance at Low Velocity*, **T. B. Morrow**, Paper FEDSM2005-77403, ASME Fluids Engineering Summer Conference, Houston, TX, June 2005.

*Expansion Factor Tests in a 75 mm (three-inch) Diameter Orifice Meter Tube*, **T. B. Morrow**, Paper FEDSM2005-77402, ASME Fluids Engineering Summer Conference, Houston, TX, June 2005.

*Metering Research Facility Program: Continuing Development of a Low Cost Inferential Natural Gas Energy Flow Rate Prototype Retrofit Module*, D.L. George, R. Burkey, **E. Kelner**, **T. B. Morrow**, T.E. Owen, Gas Research Institute Topical Report GRI-05/0135, GRI Contract No. 8743

*Gravimetric Calibration of Critical Flow Venturi Nozzles*, **T. B. Morrow**, paper HT-FED2004-56817, ASME Heat Transfer/Fluids Engineering Summer Conference, Charlotte, NC, July 2004.

*Orifice Meter Expansion Factor Experiments*, **T. B. Morrow**, paper HT-FED2004-56818, ASME Heat Transfer/Fluids Engineering Summer Conference, Charlotte, NC, July 2004

*Effects of Abnormal Conditions on the Accuracy of Orifice Measurement*, **T. B. Morrow**, 2001 International School of Hydrocarbon Measurement, Oklahoma City, Oklahoma, May 22-24, 2001. (repeated in 2003, 2004, 2005 and 2006, 2003 Non-Industry Memorial Award).

*Effects of Orifice Plates Installed Backwards and Meter Tube Roughness on Discharge Coefficients*, D. L. George, P. J. LaNasa, G. L. Morrison, and **T. B. Morrow**, 2001 AGA Operations Conference, Dallas, TX

*Minimizing Orifice Meter Installation Lengths*, **T. B. Morrow**, **E. Kelner**, E. Bowles, Pipeline & Gas Journal, July 1, 2000.

*Development of a Low Cost Inferential Natural Gas Energy Flow Rate Prototype Retrofit Module – 1999-2000*, **T. B. Morrow**, **E. Kelner**, A. Minachi, U.S.

Department of Energy Report Covering 1999-2000, DOE Cooperative Agreement No. DE-FC21-96MC-33033

*Development of a Compact Header Orifice Meter Station*, **T. B. Morrow**, **E. Kelner**, J.E. Gallagher, Paper 00-OP-20, 2000 AGA Operations Conference, Denver, CO

*Uncertainty in Flow Metering*, **T. B. Morrow**, Panel on Transient Measurement Analysis, ASME International Mechanical Engineering Congress and Exhibition, Nashville, Tennessee, November 14-19, 1999.

*Revision of ANSI-2530 Orifice Meter Standard – Basis of Recommended Meter Run Length*, W. Studzinski, U. Karnik, P. LaNasa, **T. B. Morrow**, D. Goodson, Z. Husain, and J. Gallagher, 4<sup>th</sup> International Symposium on Fluid Flow Measurement, June 28-30, 1999, Denver, CO

*Compact Orifice Meter Station Project*, **E. Kelner**, **T.B. Morrow**, 4<sup>th</sup> International Symposium on Fluid Flow Measurement, June 28-30, 1999, Denver, CO

*Effects of Meter Tube Roughness on Orifice  $C_d$* , **T. B. Morrow** and G. L. Morrison, 4<sup>th</sup> International Symposium on Fluid Flow Measurement, June 28-30, 1999, Denver, CO

*A Technology Assessment and Feasibility Evaluation of Natural Gas Energy Flow Measurement Alternatives*, K.A. Behring, **E. Kelner**, A. Minachi, C.R. Sparks, **T. B. Morrow**, S.J. Svedeman, U.S. Department of Energy Report, DOE Cooperative Agreement No. DE-FC21-96MC-33033, January, 1999

*Avoiding Installation Errors for Orifice Meters*, **T. B. Morrow**, Flow Control, Vol. IV, No. 10, November 1998

*Effects of Oil on Orifice Plates in Gas Flow Measurement*, **T. B. Morrow**, paper FEDSM98-5284, 1998 ASME Fluids Engineering Summer Meeting, Forum on Fluid Measurements and Instrumentation, June 21-25, 1998, Washington, DC

*Orifice Meter Installation Effects: Effect of Variable Spacer Length Between Two 90 Degree Ells Out-of-Plane*, **T.B. Morrow** and **E. Kelner**, Paper 98-OP-038, 1998 AGA Operations Conference – Seattle, WA.

*Effects of Swirl and Velocity Profile Asymmetry on Flow Conditioner Performance for Orifice Meters*, **T. B. Morrow** and K. A. Behring II, FLOMEKO'98, June 15-17, 1998, Lund, Sweden

*Effects of Flow Conditioners on Orifice Meter Installation Errors*, **T. B. Morrow**, paper FEDSM97-3006, 1997 ASME Fluids Engineering Conference, Forum on flow Metering, June 22-26, 1997, Vancouver, BC, Canada

*Orifice Meter Installation Effects: Research Update for  $A' = 29 D$  Meter Tubes*, **T. B. Morrow**, Paper 97-OP-078, 1997 AGA Operations Conference, Nashville, TN

*Velocity Profile Measurements Under Field Conditions for Identification of the Cause of Orifice Metering Errors*, R. J. McKee, **T. B. Morrow** and T. A. Grimley,

1996 ASME Fluids Engineering Conference, Forum on Fluid Measurements and Instrumentation, July 7-11, 1996, San Diego, CA

*Orifice Flow Metering and Installation Effects*, **T. B. Morrow**, Tutorial at the 1996 ASME Fluids Engineering Division Summer Meeting, San Diego, California, July 7-11, 1996.

*Flows with Significant Body Forces*, **T. B. Morrow**, Chapter 13.3, Handbook of Fluid Dynamics and Fluid Machinery, edited by J. A. Schetz and A. E. Fuhs, John Wiley & Sons, New York, 1996, pp. 758-774.

*Gas Pipeline Rupture Detection and Control*, **T. B. Morrow**, C. R. Sparks, E. B. Bowles, and J. G. Gregor, International Pipeline Conference, June 9 – 14, 1996, Calgary, AL, Canada

*Orifice Meter Installation Effects*, **T. B. Morrow**, Gas Research Institute Workshop on Meter Station Design, Jan. 24-25, 1996, San Antonio, TX

*A Procedure for the Prevention of Ductile Fracture Propagation in Gas Transmission Pipelines*, M. F. Kanninen, T. S. Grant, **T. B. Morrow**, G. Demofonti, S. Venzi, 10<sup>th</sup> EPRG/PRC Biennial Joint Technical Meeting on Line Pipe Research, April 19-21, 1995, Cambridge, U.K.

*Orifice Meter Installation Effects in the GRI MRF*, **T. B. Morrow**, 3<sup>rd</sup> International Symposium on Fluid Flow Measurement, March 19-22, 1995, San Antonio, TX

*Drop-Drop Coalescence in Oil-Water Separation*, B. Hafskjold, **T. B. Morrow**, H. K. B. Celius, D. R. Johnson, 69<sup>th</sup> SPE Annual Technical Conference and Exhibition, SPE paper 28536, Sept. 25-28, 1994, New Orleans, LA

*Experimental Results of an Improved Tube-Bundle Flow Conditioner for Orifice Metering*, J. W. Stuart, J. T. Park, and **T. B. Morrow**, FLOWMEKO '94, Flow Measurement in the Mid-90s, June 13-17, 1994, Glasgow, Scotland

*Report on Research Results of Flow Conditioner Effects on Meter Performance*, **T. B. Morrow**, AGA Operating Section Proceedings, Paper 94-DT-070, Arlington, VA

*Installation Effects on Orifice and Turbine Meter Performance*, **T. B. Morrow**, Presentation at the 45th Annual SCMA/ISA Short Course & Exhibits, Long Beach, California, April 20-21, 1994.

*Progress in Gas Measurement Research*, **T. B. Morrow** and R. J. McKee, Presentation at the 45th Annual SCMA/ISA Short Course & Exhibits, Long Beach, California, April 20-21, 1994.

*Installation Effects on Orifice Meter Performance*, **T. B. Morrow** and J. T. Park, Fluid Measurement and Instrumentation Forum, ASME Fluids Engineering Conference, June 20-24, 1993, Washington, DC

*Effects of Tube Bundle Location on Orifice Meter Error and Velocity Profiles*, **T. B. Morrow** and J. T. Park, 11<sup>th</sup> International Conference on Offshore Mechanics and Arctic Engineering, Vol. V, Part A – Pipeline Technology, June 7-12, 1992, Calgary, Canada

*Fluid Flow Modeling of Gravity Separators*, E. W. Hansen, H. Heitmann, B. Lakso, A. Ellingsen, O. Ostby, **T. B. Morrow** and F. T. Dodge, 5<sup>th</sup> International Conference on Multiphase Production, June 19-21, 1991, Cannes, France

*Determination of Installation Effects for 100 mm Orifice Meter Using a Sliding Vane Technique*, **T. B. Morrow**, J. T. Park, and R. J. McKee, Flow Measurement and Instrumentation, Vol. 2, No. 1, pp. 14-20, January 1991

*Effects of Orifice Meter Installation Conditions on Orifice Coefficient Accuracy*, **T. B. Morrow**, J. T. Park, and R. J. McKee, SPE Gas Technology Symposium, Paper SPE 21509, January 25, 1991, Houston, TX

*Upstream Installation Requirements for Accurate Orifice Measurements*, **T. B. Morrow**, R. J. McKee and J. T. Park, 2<sup>nd</sup> International Symposium on fluid Flow Measurement, Session 8, Systems Effects, American Gas Association, June 6-8, 1990, Calgary AL, Canada

*A Metering Research Program for Systems Effects in Gas Flow Measurement*, **T. B. Morrow** and R. J. McKee, paper no. 50-D, AIChE Spring National Meeting, April 2-6, 1989, Houston, TX

*The ONDEK Vapor Dispersion Modeling Program*, **T. B. Morrow** and W. J. Astleford, Symposium on Toxic Vapor Cloud Dispersion Modeling, Paper No. 87-D, AIChE Summer National Meeting, Denver, Colorado, August 21-24, 1988.

*Development and Experimental Verification of HACS Models for Chemical Spills in Waterways*, G. R. Colonna, F. T. Dodge, **T. B. Morrow**, J. C. Buckingham, and J. A. Havens, Proceedings, 1984 Hazardous Material Spill Conference, Nashville, Tennessee, April 1984, pp. 286-293.

*The Spreading and Dispersion of Buoyant, Soluble Chemicals Spilled in Navigable Rivers*, **T. B. Morrow**, F. T. Dodge, and J. C. Buckingham, ASME Winter Annual Meeting, Symposium on Modeling of Environmental Flows, Boston, Mass., November 13-18, 1983, FED-Vol. 8, ASME, New York, pp. 77-78, 1983.

*Analysis and Measurement of Chemical Vapor Concentration During Cargo Transfer Operations*, **T. B. Morrow**, W. J. Astleford, R. J. Magott, and R. L. Bass, III, Fourth International Symposium on Loss Prevention and Safety Promotion in the Process Industries, Volume Two -- Hazardous Chemicals and Liquefied Gases -- Safe Transport by Sea, Harrogate, England, September 1983, Institution of Chemical Engineers Symposium Series No. 81, pp. C22-C34.

*Water Channel Tests of Dense Plume Dispersion in a Turbulent Boundary Layer*, **T. B. Morrow**, J. C. Buckingham, and F. T. Dodge, IUTAM Symposium on Atmospheric Dispersion of Heavy Gases and Small Particles, The Hague, Netherlands, September 1983

*Mixing and Dilution of Water Soluble Hazardous Chemicals Released in Navigable Rivers*, **T. B. Morrow**, F. T. Dodge, E. B. Bowles, Jr., and W. J. Astleford, ASME Fluids Engineering and Applied Mechanics Division 1981 Spring Meeting, Boulder, Colorado, June 1981

*Design and Operational Considerations for Liquid Bulk Carrier Inert Gas and Ventilation Systems to Provide Safe Tank Gas Concentrations*, R. L. Bass, III, **T. B. Morrow**, and R. J. Magott, Transactions of the Society of Naval Architects and Marine Engineers, 89, 1981, pp. 107-126.

*The Dispersion of Chemical Vapors Emitted from Marine Chemical Carriers*, **T. B. Morrow**, W. J. Astleford, R. J. Magott, and R. L. Bass, III, Third International Symposium on Loss Prevention and Safety Promotion in the Process Industries, pp. 1040-1051, European Federation of Chemical Engineering (EFCE), Basle, Switzerland, September 1980

*Improvements in Tank Atmosphere Control for Liquid Bulk Cargo Carriers*, R. L. Bass, III, and **T. B. Morrow**, Transactions of the Society of Naval Architects and Marine Engineers, 87, 1979, pp. 180-205.

*Prediction of the Aerodynamic Pressure Distribution for Vehicles Moving Near the Ground*, **T. B. Morrow**, Aerodynamics of Transportation, edited by Thomas Morel and Charles Dalton, The American Society of Mechanical Engineers, New York, 1979, pp. 153-163.

*A Wind Tunnel Investigation of the Dispersion of Chemical Vapors Emitted from Marine Chemical Carriers*, **T. B. Morrow**, Fifth International Conference on Wind Engineering, Colorado State University, Fort Collins, Colorado, July 1979.

*The Performance of Hot-wire and Hot-film Anemometers Used in Water*, **T. B. Morrow** and S. J. Kline, Flow -- Its Measurements and Control in Science and Industry, Volume 2, Part 2, edited by R. E. Wendt, Jr., Instrument Society of America, Pittsburgh, 1974, pp. 555-562.

*Effects of Dirt Accumulation on Hot-wire and Hot-film Sensors*, **T. B. Morrow**, Fluid Dynamics Measurements in the Industrial and Medical Environments, edited by David J. Cockrell, Leicester University Press, Great Britain, 1972, pp. 122-124.

#### **Standards Committee Participation:**

American Petroleum Institute Committee on Gas Fluids Measurement, MPMS Chapter 14.3, Part 2 Working Group

American Society of Mechanical Engineers, B 31.4, Technical Committee for Liquid Pipelines