



Welding & Joining Management Group

FORENSIC EXPERTS • METALS TESTING

Dr. Jesse A. Grantham Curriculum Vitae

EDUCATION:

Ph.D. Engineering, The Ohio State University, 1992.
M.S. Welding Engineering, The Ohio State University 1988.
M.B.A. University of Southwestern Louisiana, 1982.
B.S. Industrial Engineering and Management, Oklahoma State University, 1969.

EXPERIENCE:

1978 to Present

Expert in welding, brazing, soldering, cutting, metallurgy, corrosion, bolts and alloy verification. Welder and technician examinations and testing; develops metal testing instructions; and compliance reviews of cutting, welding, brazing and testing specifications. Welding Engineer for an ISO 9001:2000 certified metallurgical testing laboratory. Forensic welding specialist nationally recognized. Analyzes and explains complex technical issues in clear, understandable terms.

1975–1978 & 1990-1992

Welding Supervisor manufacturing offshore petroleum equipment and surface mining machinery.

1969 - 1975

Industrial Engineer for processes, products, labor management and safety programs.

REGISTRATIONS:

Senior Member #597 of the National Academy of Forensic Engineers (NAFE).
Registered Professional Engineer in 5 states with current NCEES records.
American Welding Society (AWS) Certified Welding Inspector (CWI) 98041061.
AWS Certified Welding Educator (CWE) 9807029E.
American Society of Nondestructive Testing (ASNT) Level III 95605.

SPECIALTIES:

Expert testimony, litigation support and subrogation specialist in welding codes, contract compliance, construction defects, weld fractures, weld failures, accident investigations, product liability, corrosion assessments, warning labels, workplace safety, and hazards communications. Forensic cases include propane tank failures, acetylene cylinder explosions, refinery explosions, boiler failures, electrical failures, pipeline defects, industrial accidents, ladder failures, welding fumes and gases, welded equipment guards, pre-cast concrete defects, airplane component examinations, robot fixture defects, transmission tower collapse, personal injuries (burns), and OSHA interpretations.

TEACHING:

Active author and presenter.

Instructor – WJMI for AWS-CWI exam preparation, Magnetic Particle Testing (MT), Liquid Penetrant Testing (PT), Ultrasonic Testing (UT), and Radiographic Interpretations.

Instructor - ASM Int'l for metallurgy, processes, safety, and nondestructive testing (ndt).

Instructor - The Ohio State University for underwater welding, design, processes, safety and ndt.

Instructor - Columbia Basin College for metallurgy, welding processes, safety and ndt.

Instructor - Washington State University for manufacturing processes, welding, safety and ndt.

HONORS:

American Welding Society - Private Sector Instructor Membership Award; 2002, 2003, 2004, 2006
American Welding Society - Dalton E. Hamilton Memorial CWI of the Year District Award; 1998, 2001
American Welding Society - District Director Certificate Award; 1999
American Welding Society - Arsham Amirikian Memorial Maritime Welding Award; 1995
Also serves on numerous collegiate welding advisory committees and welding handbook committees.

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AFFILIATIONS:

Active member, locally and nationally, of professional societies, Colorado Bar Association, Colorado Safety Association, World Safety Organization, and Colorado Claims Association.
Treasurer AWS (American Welding Society) Colorado Section 2007 - present
Treasurer NAFE (National Academy of Forensic Engineers) 2009 -2010
President, Ohio State University Welding Engineering Alumni Society 2010
Member, National Association of Subrogation Professionals (NASP)

PUBLICATIONS, ARTICLES & PAPERS:

PUBLISHED BOOKS:

- CONTRACT, ISBN 978-1-934918-03-6, 1-934918-03-2, Denver, Colorado, Scudder Press, December 2010
- Spoliation, ISBN 978-1-934918-02-9, 1-934918-02-4, Denver, Colorado, Scudder Press, December 2009
- Light, ISBN 978-1-934918-01-2, 1-934918-01-6, Denver, Colorado, Scudder Press, December 2008
- Choices, ISBN 978-1-934918-00-5, 1-934918-00-8, Denver, Colorado, Scudder Press, December 2007

ARTICLES, TECHNICAL ARTICLES:

- *The Forensic Engineer Caught "Holding Harmless"*, The Welding Leader.com, June 29, 2010
- *Trends in Nondestructive Testing of Infrastructure*, NAFE – InterACTION, Spring/Summer, 2010, Vol. 21, No. 1, pages 4-8.
- *The Value of a Forensic Engineer*, NAFE – InterACTION, Fall/Winter, 2009, Vol. 20, No. 2, pages 2-4.
- *Certified Nondestructive Testing of Infrastructure*, NAFE – InterACTION, Spring/Summer 2009, Vol. 20, No. 1, pages 5-8.
- *No Nonsense with NDT, Nondestructive Testing Methods in Infrastructure*, Welding Update for Infrastructure, a Supplement to Practical Welding Today, May/June 2009, Jesse A. Grantham and Andrew McGoldrick, pages W12-W14.
- *Hazard Communication and Hazard Determination for Brazing and Soldering*, 2009 International Brazing and Soldering Conference, Orlando, Florida, April 2009
- *History: METALS a guide for the Forensic Engineer*, NAFE – InterACTION, Spring/Summer 2008, pages 2-5
- *Welding Design, a Guide for the Forensic Engineer*, InterACTION, Fall/Winter 2007, pages 5-7
- *The History of Welding*, InterACTION, Spring/Summer 2007, pages 3-5
- *First Line of Defense – Educating Welders to Achieve Quality Welds*, The Fabricator, April 2007, pages 48-49
- *Lines of Defense Against Weld Defects*, Fabricating & Metalworking, May 2006, Phil Walters, page 58
- *Quality as Part of the Contract, Blending NDT into the Welding Business*, Jesse A. Grantham Ph.D., P.E. Contributing Writer, Practical Welding Today, October 24, 2002
- *Forensic Engineering Analysis of Welding Process – Refinery Explosion*, Journal of the National Academy of Forensic Engineers, Volume XVIII, No. 1, page 25, June 2001.
- *Principles of Welding Productivity*, Practical Welding Today, March/April 2001.
- *Dealing with Warranty Costs in Welded Products*, Practical Welding Today, July/August 1999.
- *Supporting Welders with Sales, Estimating and Cost Accounting*, Practical Welding Today, March/April 1999.
- *Using the Correct Materials and Consumables Solves Welding Problems*, Practical Welding Today, January/February 1999.
- *Expanding Core Competency of Your Managers*, Practical Welding Today, 1999.
- *How to Estimate Direct Arc Welding Costs*, Practical Welding Today, September/October 1998.

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- *The Welding Manager's Role in EHS Issues*, Practical Welding Today, July/August 1998.
- *Following Welding Codes and Standard in Part Design*, Practical Welding Today, May/June 1998.
- *Breaking the Rework Cycle, Identifying Factors for Improvement*, Practical Welding Today, April/May 1998, May/June 1998.
- *Eliminating Rejects and Rework. Reducing Cost by Doing it Right the First Time*, Practical Welding Today, March/April 1998.
- *Training the Welding Manager*, Practical Welding Today, January/February 1998.
- *Renewing Manager Involvement in Welding Leadership*, The Fabricator, November 1997.
- *Providing Welders with Authority and Support*, The Fabricator, November 1997.
- *Fitness-for-Service Design for Underwater 'Wet' Welds*, American Welding Society, Welding Journal, January 1994. C.L. Tsai, J. Grantham, Z. Feng, L. Soisson, L. Zirker, J. Papritan.
- *Effect of Surface Tension on SMAW Weld Profile*, American Welding Society, Welding Journal, Research Supplement, December 1992. L. Jiang, J. Grantham, C.L. Tsai, Z. Feng.
- *Development of an Electrode for Improved Fatigue and Impact Strength in Wet Welded Joints*, American Welding Society, Granjon International Award for Student Research, October 15, 1991.
- *Design of Connection Pad for Underwater Welding Tubular Structure Using Finite Element Method*, American Welding Society, Welding Journal, 1991. J. Grantham, C.L. Tsai, Z. Feng, L. Soisson.
- *Wet and Weld*, OSU News in Engineering, featured research report, The Ohio State University, College of Engineering, Columbus, OH, Fall 1989. C.L. Tsai, J. Grantham, L. Zirker, B. Boyce.
- *Welding Predictability*, OSU News in Engineering, The Ohio State University, College of Engineering, Columbus, OH, Summer 1989.
- *Evaluation of Design and Fabrication Methods for Underwater Welding*, The Welding Innovation Quarterly, Volume VI, No. 1, Cleveland, OH, 1989. J. Grantham, C.L. Tsai, Z. Feng.
- *OSU Proficiency in Submerged Arc Welding*, American Welding Society, Welding Journal, page 50, October 1988.

REPORTS, TECHNICAL PAPERS:

- *Forensic Engineering Assessments of a Robotic Welding System*, Journal of the National Academy of Forensic Engineers, Vol. XXIV No. 2, pages 91-98, December 2007
- *Forensic Engineering Investigations of Welding Code Compliance*, Journal of the National Academy of Forensic Engineers, Vol XXIV No. 1, pages 121-130, June, 2007.
- *Interfacial Tension Effects on Weld Bead Profiles*, American Welding Society, International Welding and Fabricating Exposition and Annual Convention, Professional Program, Technical Sessions, Session 17A, Process Physics II, Chicago, IL, April 27, 1996.
- *Strain Gauge Pressure Transducer Utilization*, A study for measuring internal rod pressure to 1000 psig in nuclear fuel rods. Proprietary for Siemens Power Corporation – Nuclear Division, 1996.
- *Alternative Manufacturing Process Concepts for fuel rod welding, the effects of end cap multiple welds on Zircaloy-2 and Zircaloy-4 nuclear fuel rods*. Proprietary for Siemens Power Corporation – Nuclear Division, 1995.
- *Qualification of Strain Gauge Pressure Transducer for Measuring Internal Rod Pressure in Nuclear Fuel Rods*, Siemens Power Corporation – Nuclear Division, EMF-PTA-574, November 11, 1994.
- *An Investigation of Alternative Manufacturing Processes used for Fuel Rod Welding*, Siemens Power Corporation – Nuclear Division, EMF-94-127 (P), Richland, WA, June 1994.
- *Development of Flux-Coated Electrodes for Underwater 'Wet' Welding*, ISOPE, Second International Offshore and Polar Engineering Conference, San Francisco, CA, June 14-19, 1992. C.L. Tsai, L. Jiang, J. Grantham, Z. Feng, W. Svekric, R. Holdren, L. Soisson.
- *Development of an Electrode for Improved Fatigue and Impact Strength in Wet Welded Joints*, American Welding Society, Convention and Exposition, International Award for Student Research, Chicago, IL, March 26, 1992.
- *Fundamental Study of Interfacial Tension Effects on Weld Bead Profile in the Shielding Metal Arc Welding Process*, publishing of dissertation, in-process, for the American Welding Society, Welding Journal. January

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- 14, 1992.
- *Fitness-for-Service Design for Underwater 'Wet' Welds*, ASME Volume III-A, Materials Engineering, pages 197-204. Tenth International Conference on Offshore Mechanics and Arctic Engineering, Stavanger, Norway, June 23-28, 1991. C.L. Tsai, L. Zirker, Z. Feng, J. Grantham, L. Soisson, J. Papritan.
 - *Development of an Underwater Shielded Metal Arc Welding Electrode with Improved Fatigue Strength in Wet Welded Joints*, Submitted to Ohio's Thomas A. Edison Program, The Ohio State University, Department of Welding Engineering, State of Ohio, Columbus, OH, June 1991. C.L. Tsai, J. Grantham, L. Jiang, Z. Feng.
 - *A Proposal for the Comparison of Practical Mechanisms for Laser Beam Welding in Pressurized Argon Atmospheres*, The Ohio State University, Welding Engineering 894A, Laser Material Processing Colloquium, Columbus OH, May 24, 1991.
 - *Wet Welding Electrodes, Formulas and Rationale*, The Ohio State University, Department of Welding Engineering, State of Ohio, Department of Development, Thomas A. Edison program, Columbus, OH, 1991.
 - *Design Guide for Wet Welding the Tubular Connection Pad*, The Ohio State University Development Foundation, Sea Grant Program, Center for Lake Erie Area Research, OSU Welding Engineering Department, Columbus, OH, September 1990. J. Grantham, C.L. Tsai
 - *Development of an Improved Underwater Shielded Metal Arc Welding Electrode with Improved Fatigue Characteristics*, State of Ohio, Department of Development, Thomas A. Edison Program, Department of Welding Engineering, OHSU-RS-139, Columbus, OH, June 1990. J. Grantham, C.L. Tsai, L. Jiang, Z. Feng, L. Soisson.
 - *Evaluation of Design and Fabrication Methods for Underwater Welding in an Open Lake Environment*, American Welding Society, 71st Annual Convention, Anaheim, CA, April 22-27, 1990. J. Grantham, C.L. Tsai, Z. Feng, F. Vendetta, R. Strohl.
 - *Evaluation of Design and Fabrication Methods for Underwater Welding in an Open Lake Environment*, ASME paper number OAME-90-861, Ninth International Conference on Offshore Mechanics and Arctic Engineering, Houston, TX, February 18-23, 1990. J. Grantham, C.L. Tsai, Z. Feng, F. Vendetta, R. Strohl.
 - *Connection Pad Design for Underwater Tubular Structures*, The Ohio State University, Department of Welding Engineering, OHSU-TD-020, Columbus, OH, January 1990. C.L. Tsai, J. Grantham, Z. Feng, L. Soisson.
 - *Determination of Residual Stress and Effects in Thick Section Weldments for Hydraulic Structures*, US Army Corps of Engineers, WI, 1989 – 1990. J. Jaeger, J. Grantham, C.L. Tsai, S.G. Lee, L. Shim, Z. Feng.
 - *Evaluation of Residual Stress and Cracking in Weld Connections for Jumbo W-Shapes*, US Army Corps of Engineers, Mississippi River, Lock and Dam number 27, St. Louis, MO, December 1988 to December 1989. J. Jaeger, J. Grantham, C.L. Tsai, Z. Feng.
 - *Evaluation of Design and Fabrication Methods for Underwater Welding*, Franz Theodore Stone Laboratory, Sea Grant Program, Center for Lake Erie Area Research, College of Biological Science, OHSU-TD-020-89, Columbus, OH, May 15, 1989. J. Grantham, C.L. Tsai, Z. Feng, F. Vendetta, R. Strohl.
 - *A Comparison of Magnetoelastic Testing/Measurement for Uniaxial Stresses*, Determined by Barkhausen Noise versus Measurement of Residual Stresses by the Blind Hole Drilling Method, The Ohio State University, Welding Engineering Seminar, 1989.
 - *A Review of X-Ray versus Isotope Radiation Sources for Real Time Radiographic Imaging*, The Ohio State University, Welding Engineering 635, Columbus, OH, May 27, 1988.
 - *Laser Beam Production of Ultra-Fine Particles for Deposition of Metallic Thin Films*, The Ohio State University, Welding Engineering 704, November 15, 1987.
 - *Structural Inspection and Evaluation of the Existing Lock Gates on Inland Waterways*, US Army Corps of Engineers, Mississippi River, Lock and Dam number 27, St. Louis, MO, Columbus, OH. J. Jaeger, J. Grantham, C.L. Tsai, Z. Feng.

BROCHURES AND ARTICLES:

- *Principles of Welding Productivity*, Practical Welding Today, March/April 2001.
- *Welding Inspection for Nonwelder's*, Welding & Joining Management Group, February 2000.

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- *Welding Inspection for Nonwelder's*, Welding & Joining Management Group, August 1999.
- *Dealing with Warranty Costs in Welded Products*, Practical Welding Today, July/August 1999.
- *Tips for Managing the GMAW Process*, Welding & Joining Management Group, June 1, 1999.
- *Supporting Welders with Sales, Estimating and Cost Accounting*, Practical Welding Today, March/April 1999.
- *Using the Correct Materials and Consumables Solves Welding Problems*, Practical Welding Today, January/February 1999.
- *How to Reduce Automated Welding Costs with Real-Time Welding Data*, FABTECH, 1999.
- *How to Estimate Direct Arc Welding Costs*, Practical Welding Today, September/October 1998.
- *The Welding Manager's Role in EHS Issues*, Practical Welding Today, July/August 1998.
- *Breaking the Rework Cycle*, Practical Welding Today, May/June 1998.
- *Following Welding Codes and Standard in Part Design*, Practical Welding Today, May/June 1998.
- *Eliminating Rejects and Rework*, Practical Welding Today, March/April 1998.
- *Training the Welding Manager*, Practical Welding Today, January/February 1998.
- *Renewing Manager Involvement in Welding Leadership*, The Fabricator, November 1997.
- *Why Do I Work?*, Welding & Joining Management Group, Volume 31, IX. *Expanding Core Competency of Your Managers*, Practical Welding Today. Bulletins
- *Design Guide for Wet Welding the Flexible Connection Pad*, The Ohio State University Development Foundation, Sea Grant Program, Center for Lake Erie Area Research, OSU Welding Engineering Department, Columbus, OH, September 1990. J. Grantham, C.L. Tsai
- *Connection Pad Design for Underwater Tubular Structures*, The Ohio State University Development Foundation, Sea Grant Program, OHSU-RS-122, Columbus, OH, 1990. J. Grantham, C.L. Tsai, Z. Feng, L. Soisson.

PRESENTATIONS AND SEMINARS:

- *The Forensic Engineer Caught "Holding Harmless"*, National Academy of Forensic Engineers Conference, Orlando, Florida, July 17, 2010.
- *A Guide to Arc Welding Metallurgy of Carbon Steel Alloys*, "Weld the Rockies" Symposium at Colorado School of Mines, Denver, CO, March 12/13, 2010.
- *A Guide for Metal Assessments and Spoliation Issues*, Rocky Mountain Property Claims Association, Denver, CO, September 10, 2009.
- *Forensic Engineering Assessments of Ruptured Acetylene Cylinders*, National Academy of Forensic Engineers Conference, St. Louis, Missouri, July 18, 2009.
- *Hazard Communication and Hazard Determination for Brazing and Soldering*, 2009 International Brazing and Soldering Conference, Orlando, Florida, April 2009
- *Storage, Spoliation, Disposal & Evidence Ownership*, National Academy of Forensic Engineers Conference, Special Seminar, Austin, Texas, January 18, 2009.
- *A Guide for the Forensic Engineer*, ASM International Rocky Mountain Chapter, Denver, Colorado, November 6, 2008.
- *Forensic Engineering Use of Medical Expert Information in Welding Fume Assessment*, National Academy of Forensic Engineers Conference, San Juan, Puerto Rico, January 6, 2008.
- *Safety in Cutting, Brazing & Welding with Acetylene & Oxygen*, AWS 36th International Brazing & Soldering Symposium, Chicago, IL, November 13, 2007.
- *Forensic Engineering Assessments of a Robotic Welding System*, National Academy of Forensic Engineers Conference, Denver, CO, July 28, 2007.
- *Safety in Cutting and Welding with Acetylene and Oxygen*, World Safety Organization, 20th Annual Health and Safety Conference and Exposition, Denver, CO, May 14-16, 2007.
- *(Welding) Failures I have Known*, American Welding Society, Colorado Section 039, Denver, CO, May 10, 2007.
- *Forensic Engineering Investigations of Welding Code Compliance*, National Academy of Forensic

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Engineers, Ponte Vedra, FL, January 7, 2007.

- *Forensic Catastrophic Investigation of Welding, Weld Failures & Inspection. Weld Failure Analysis & Prevention*, American Society of Nondestructive Testing, Denver, Colorado, September 12, 2006.
- *Welding Hazards – Gases & Fumes*, World Safety Organization, 18th Annual Health and Safety Conference and Exposition, Denver, CO, May 2, 2005.
- *What Every Detailer, Fabricator & Erector Should Know About Welding*, Rocky Mountain Steel Construction Association, Inc., Denver, CO, January 25, 2001.
- *Forensic Engineering Analysis of Welding Process – Refinery Explosion*, National Academy of Forensic Engineers, Los Angeles, CA, January 20, 2001. J. Grantham, T. Beard
- *Business Strategies for Welding*, American Welding Society, Chicago, IL, April 26, 2000.
- *How to Reduce Automated Welding Costs with Real-Time Welding Data*, FABTECH International, Session on Automated Robotic Welding, November 14-18, 1999.
- *Business Strategies for Welding – the Nonwelder's Seminar*, The Fabricators and Manufacturers Association International, San Diego, CA, September 22, 1999.
- *Welding Inspection for Nonwelder's*, Welding & Joining Management Group, Denver, CO, August 1999 and February 2000.
- *How Welds Affect Safety*, World Safety Organization, Thornton, CO, June 25, 1999.
- *Tips for Managing the GMAW Process*, Welding & Joining Management Group, Denver, CO, June 1, 1999.
- *Six Steps to World-Class Welding Management*, Fabricators and Manufacturers Association International, Technical Conference, March 23, 1999, April 14, 1999.
- *NDT Methods for World Class Manufacturing*, American Society of Nondestructive Testing, Pueblo, CO, November 10, 1998.
- *Tips to Showcase your Welding Operations for Customers*, FABTECH International, Conference Papers, Automated Robotic Welding, Session 302, Cleveland, OH, November 3-5, 1998
- *Six Steps to World-Class Welding Management*, Fabricators and Manufacturers Association International, Technical Conference, September 24, 1998, October 5, 1998.
- *How to Evaluate Welding Contractors for Your Project*, National Society of Professional Engineers, Continuing Education Program, Tulsa, OK, July 26, 1998.
- *Welding: Land of Opportunities*, American Welding Society Colorado Section 039, Denver, CO, March 12, 1998.
- *Hot Stage Microscope Evaluations of Molten Slag and Weld Profiles*, Graduate Seminar, Colorado School of Mines, Golden, CO, January 29, 1998.
- *Stainless Steel Pipe – Root Welds*, National Association of Corrosion Engineers, Annual Corrosion Short Course, Colorado Springs, CO, January 28, 1998. J. Grantham, D. Culbert.
- *How to Totally Manage your Welding and Maximize Profit*, Welding & Joining Management Group, West, October 1997.
- *Introduction to Engineering Aspects of Underwater Welding*, Utah State University, College of Engineering, Logan, UT, May 19, 1995.
- *Managers, Engineers and Welders*, Institute of Industrial Engineers, Columbia Basin Section, Richland, WA, March 16, 1995.
- *Wet Welding Electrodes, Formulas and Rationale*, American Welding Society, 72nd Annual Convention, Granjon International Competition, Chicago, IL, 1992.
- *State of the Art Review, Fluxes and Slags in Arc Welding Carbon Steel*, Welding Engineering Design Group Seminar, The Ohio State University, Welding Engineering Department, Columbus Ohio, February 27, 1992.
- *Evaluation of Design and Fabrication Methods for Underwater Welding in an Open Lake Environment*, American Welding Society, 71st Annual Convention, Anaheim, CA, April 22-27, 1990. J. Grantham, C.L. Tsai, Z. Feng, F. Vendetta, R. Strohl.
- *Evaluation of Design and Fabrication Methods for Underwater Welding in an Open Lake Environment*, ASME paper number OAME-90-861, Ninth International Conference on Offshore Mechanics and Arctic Engineering, Houston, TX, February 18-23, 1990. J. Grantham, C.L. Tsai, Z. Feng, F. Vendetta, R. Strohl.

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WORKSHOPS AND VIDEOS:

- *Underwater Welding Codes Workshop*, The Ohio Underwater Welding Center, Lake Erie, OH, August 31 – September 1, 1999
- *Underwater Welding, Cutting and Inspection Workshop, Underwater Welding Codes*, The Ohio State University, Department of Welding Engineering, Fawcett Center for Tomorrow, Columbus, OH
- *Commentary Video on Nuclear Reactor Underwater Repair at the Susquehanna Plant for Pennsylvania Power and Light*, The Ohio State University, Welding Engineering and Nuclear Engineering, Columbus, OH, Winter 1990. J. Grantham, J. O'Sullivan.
- *The Ohio State University Welding Engineering Recruitment Video*, distributed to area high schools, colleges and universities throughout the United States and abroad, The Ohio State University, Columbus, OH, Summer 1989. Production and coordination, C.L. Tsai, J. Grantham.
- *Underwater Welding Video of Lake Erie Underwater Welding Field Tests*, The Ohio State University, Columbus, OH, Winter 1989. Production and editing, J. Grantham, C.L. Tsai.
- *ASME Section VII Pressure Vessel Manufacturers and Quality Assurance Personnel*, GESI, Lafayette, LA and Tyler, TX, 1978-1987. Development of course materials and syllabus.
- *Corrosion Problems Concerning Welding*, IEEE, ASME, ASNT, Columbia Basin College, Applied Technology Division.

PATENTS:

- **Underwater SMAW electrode**, formula G4, Welding Consultants Inc. and OSU Engineering Experiment Station, in conjunction with the Thomas A. Edison Program, Ohio Department of Development, 1991. C.L. Tsai, J. Grantham, Z. Feng, L. Soisson, L. Jiang.

RESEARCH CONTRACTS:

- *Enhancing the Theoretical and Practical Competence of Welding Engineering*, Design Curriculum, International Association for Great Lakes Research, IAGLR/MOTT Fellowship Program, Ann Arbor, MI, 1989-1998. C.L. Tsai, J. Grantham.
- *Development of Designs for Mechanized Underwater 'Wet' Welding Processes*, Sea Grant, NOAA, The Ohio State University, Columbus, OH, April 16, 1994. C.L. Tsai, J. Grantham.
- *Development of an Engineering Database for New Underwater Flux-Coated Welding Electrodes for Use by Industry*, NOAA, Sea Grant Program, 1994. C.L. Tsai, J. Grantham.
- *Development of an Underwater Shielded Metal Arc Welding Electrode with Improved Fatigue Strength in Wet Welded Joints*, State of Ohio, Thomas A. Edison Program, Ohio Department of Development and Welding Consultants Inc. 1989-1990. (\$50,000 + \$50,000 in-kind)
- *Design Guide, Wet Welding, Flexible Tubular Connection Pad*, R/OE-8PD, The Ohio State University Development Foundation and Center for Lake Erie Research (CLEAR), Spring, 1990. (\$5000)
- *Evaluation of Design and Fabrication Methods for Underwater Welding in an Open-Lake Environment*, a program of research and improvements in underwater fabrication technology R/OE-5. Sponsored by Sea Grant, NOAA, Arcair Company, September 1987-August, 1989. (\$50,000)

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