

Educational Publications

- Aherin, R. A. (1987). *Suffocation hazards associated with stored grain (Safety in grain elevators)*. (Pm-1293i). Ames, Iowa: Iowa State University Cooperative Extension.
- Aherin, R. A., Christianson, L. L., Day, D. L., & Riskowski, G. L. (1996). Using sensors to detect potentially hazardous atmospheres in production agriculture. *Transferring Technologies for Industry*, 6.
- Aherin, R. A., & Dimos, J. (1997). *Confined space entry training for agriculture*. Chicago: University of Illinois-Chicago.
- Aherin, R. A., & Schultz, L. (1981). *Safe storage and handling of grain*. (Extension folder 568). St. Paul, MN: University of Minnesota Cooperative Extension Service.
- Allen, J. P., & Noyes, R. T. (1994). *Grain bin entrapment: What if it happens to you?* (CR-1726). Stillwater, OK: Oklahoma Cooperative Extension.
- Beaver, R. L. (2005). *Assessing the nature, frequency, and causation of entrapments and fatalities associated with on-farm storage and handling of livestock manure*. West Lafayette, IN: Purdue University.
- Campbell, I., & Zronik, S. (1993). *How does safety rate on your farm?* Guelph, Ontario, Canada: Farm Safety Association.
- Centre for Agricultural Medicine. (1998). *The farm safety checklist*. Saskatoon, SK: University of Saskatchewan.
- Colud, H. A., Van Fossen, L. D., Backer, L. F., Brook, R. C., Brooks, L. A., Hellevang, K. J., McKenzie, B. A., Peterson, W. H., & Pierce, R. O. (1987). *Grain drying and handling storage handbook*. Midwest Plan Service. AMES, IA: Iowa State University.
- Cyr, D. L., & Johnson, S. B. (2002). *Rescuing a person trapped in grain*. Orono, ME: University of Maine Cooperative Extension.
- Cyr, D. L., & Johnson, S. B. (2002). *Upright silo safety*. Orono, ME: University of Maine Cooperative Extension.
- Cyr, D. L., & Johnson, S. B. (2003). *Grain storage safety*. Orono, ME: University of Maine Cooperative Extension.
- Drake, B., Kulkarni, S., & Vandervender, K. (2010). *Suffocation hazards in grain bins*. (FSA1010). Fayetteville, AR: University of Arkansas Cooperative Extension Service.
http://www.uaex.edu/Other_Areas/publications/PDF/FSA-1010.pdf

Purdue University Agricultural Safety and Health Program

- Edwards, W. (2010). *Grain storage alternatives: an economic comparison*. (A2-35). Ames, IA: Iowa State University Extension. <http://www.extension.iastate.edu/agdm/crops/html/a2-35.html>
- Farm Safety Association. (1985). *Flowing grain entrapment*. Fact sheet F-004. Guelph, Ontario: Farm Safety Association.
- Field, W. E. (1980). *Beware of on-farm manure storage hazards*. (S-82). West Lafayette, IN: Purdue University Cooperative Extension Service. <http://www.extension.purdue.edu/extmedia/S/S-82.html>
- Field, W. E. (1990). *The dangers of flowing grain*. (S-77). West Lafayette, IN: Purdue University Cooperative Extension Service. <http://www.extension.purdue.edu/extmedia/s/s-77.html>
- Field, W. E. (1993). *Grain storage problems are increasing the dangers to farm operators*. Grain Quality Task Force No. 8. West Lafayette, IN: Purdue University Cooperative Extension Service. <http://www.extension.purdue.edu/extmedia/GQ/GQ-8.pdf>
- Fletcher, W. J., & Burke, J. (1973). *Safety hazard checklist for agriculture*. Chicago, IL: National Safety Council.
- Fulhage, C., Hoehne, J., Jones, D., & Koelsch, R. (2001). *Manure Storages*. (MWPS-18, Section 2). Ames, Iowa: Iowa State University.
- Hanna, M., & Van Fosson, L. (1989). *Don't drown in a grain wagon*. (PM-1334a/Revised). Ames, IA: Iowa State University Cooperative Extension Service.
- Health and Safety Executive. (1996). *Preventing access to effluent storage and similar areas on farms*. (Agricultural Information Sheet No. 9.) United Kingdom. <http://www.hse.gov.uk/pubns/ais9.pdf>
- Hellevang, K. (2009). *Don't get caught in grain*. Fargo, ND: North Dakota State University Extension. <http://www.ag.ndsu.edu/news/newsreleases/2009/jan-8-2009/don2019t-get-caught-in-grain>
- Hill, D., Murphy, D. J., Steel, J. S., & Manbeck, H. B. (2011). *Confined space manure storage emergencies*. (Fact Sheet E54). University Park, PA: Penn State Extension. https://psusurveycenter.qualtrics.com/CP/File.php?F=F_3afg7pktk56jm3G
- Loewer, O. K., & Loewer, D. H. (1975). *Suffocation hazards in grain bins*. (AEN-39). Lexington, KY: University of Kentucky Cooperative Extension. <http://www2.ca.uky.edu/agc/pubs/aen/aen39/aen39.pdf>

Purdue University Agricultural Safety and Health Program

- Maher, G. (1995). *Caught In the Grain!* (AE-1102). Fargo, ND: North Dakota State University Extension. <http://www.ag.ndsu.edu/pubs/ageng/safety/ae1102.pdf>
- Maier, D. E., Field, W. E., & Freeman, S. A. (1999). *Don't go with the flow educational resource kit*. West Lafayette, IN: Purdue University Agricultural Safety and Health Program.
- Manbeck, H. B., Murphy, D. J., & Steel, J. S. (2011). *Confined space manure storage ventilation systems*. (Fact Sheet E53). University Park, PA: Penn State Extension. http://www.manurepitsafety.psu.edu/pdfs/E53ventsyst.pdf?SID=SV_8HejhbzhiSL3FBO
- Mason, L. J., Maier, D. E., & Woloshuk, C. P. (1996). *Post harvest pocket guide*. (ID 215). Post Harvest Education and Research Center, Purdue Grain Quality Liaison Committee. West Lafayette, IN: Purdue University Cooperative Extension Service.
- McKenzie, B. A. (1971). *Suffocation hazards in flowing grain*. West Lafayette, IN: Purdue University Cooperative Extension Service. <http://www.fficorp.com/docs/pdfs/page15.pdf>
- Michigan Commission of Agriculture. (2014). *Generally accepted agricultural and management practices for manure management and utilization*. Lansing, MI: Michigan Department of Agriculture & Rural Development.
- Midwest Plan Service. (1983). *Structures and environment handbook*. Ames, IA: Iowa State University.
- Mills, J. T. (1989). *Spoilage and heating of stored agricultural products*. Winnipeg, Manitoba: Research Station. <http://ia600800.us.archive.org/34/items/spoilageheatingo00mill/spoilageheatingo00mill.pdf>
- Murphy, D. J. (1992). *Safety and health for production agriculture*. (ASAE Textbook No. 5). St. Joseph, MI: American Society of Agricultural Engineers.
- Myers, J. R. (1998). *Injuries among farm workers in the United States*. (DHHS Publication No. NIOSH 98-153). Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health.
- National Institute for Occupational Safety and Health. (1987). *Preventing entrapment and suffocation caused by the unstable surfaces of stored grain and other materials*. (DHHS Publication No. NIOSH 88-102). Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Services, Centers for Disease Control. <http://www.cdc.gov/niosh/docs/88-102/>
- National Institute for Occupational Safety and Health. (1990). *Preventing deaths of farm workers in manure pits*. (DHHS Publication No. NIOSH 90-103). Cincinnati, OH: U.S.

- Department of Health and Human Services, Centers for Disease Control.
<http://www.cdc.gov/niosh/docs/90-103/>
- National Institute for Occupational Safety and Health. (1993). *NIOSH warns: Manure pits continue to claim lives*. (DHHS Publication No. NIOSH 93-114). Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control.
<http://www.cdc.gov/niosh/updates/93-114.html>
- National Institute for Occupational Safety and Health. (1993). *NIOSH warns famers of deadly risk of suffocation*. (DHHS Publication No. NIOSH 93-116). Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control.
<http://www.cdc.gov/niosh/updates/93-116.html>
- National Institute for Occupational Safety and Health. (1994). *Truck driver suffocates after being engulfed in shelled corn inside grain storage bin in Ohio*. (FACE 91-12). Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control.
<http://www.cdc.gov/niosh/face/in-house/full9112.html>
- National Institute for Occupational Safety and Health. (1995). *Safe grain and silage handling*. (Pub No. 95-109). Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control.
- Ontario Farm Safety Association. (2002). *Beware of manure gas, confined space hazards. Farmsafe*. 27(1). <http://www.farmsafety.ca/public/farmsafe/vol27-no1.pdf>
- Penn State Cooperative Extension. (2001). *Agricultural safety and health best management practices manual*, CD-ROM. University Park, PA: The Pennsylvania State University.
- Pettit, T., & Linn, H. (1987). *A guide to safety in confined spaces*. (DHHS Publication No. NIOSH 87-113). Morgantown, WV: Department of Health and Human Services, Centers for Disease Control. <http://www.cdc.gov/niosh/docs/87-113/>
- Safety and Technical Rescue Association. (2006). *Grain-bin entry and technical rescue course*. Minneapolis, MN: Grain Elevator and Processing Society.
- Schwab, C. V., Miller, L. J., & Goering, D. H. (2008). *Tug-of-war with grain: A grain safety curriculum*. Farm Safety 4 Just Kids. Urbandale, IA: Iowa State University Extension.
- Schwab, C. V., Hanna, M., & Miller, L. J. (2004). *Handle your grain harvest with care*. (Safe farm: PM-1265I). Ames, IA: Iowa State University Cooperative Extension.
<http://www.extension.iastate.edu/Publications/PM1265I.pdf>
- Steel, J. S., Murphy, D. J., & Manbeck, H. B. (2011). *Confined space manure storage hazards*. (Fact Sheet E51). University Park, PA: Penn State Extension.
https://psusurveycenter.qualtrics.com/CP/File.php?F=F_3sfzN4O7YeOaNeI

Steel, J. S., Murphy, D. J., & Manbeck, H. B. (2011). *Confined space manure gas monitoring*. (Fact Sheet E52). University Park, PA: Penn State Extension.

https://psusurveycenter.qualtrics.com/CP/File.php?F=F_869wSHR7w7cnpAw

Sund, J. M., Niedermeyer, R. P., & Burris, R. H. (1964). *Watch out for silo gas*. Madison, WI: University of Wisconsin Extension Service.

University of Illinois Extension. (2000). *Illinois farm related fatalities 1986-1992*. Urbana-Champaign, IL: University of Illinois.

Wilcke, W., & Wyatt, G. (2002). *Grain storage tips: Factors and formulas for crop drying, storage, and handling*. (FS-M1080). St. Paul, MN: University of Minnesota Extension.

Zhao, L. (2007). *How to work safely around manure storages*. Columbus, OH: The Ohio State University Extension. <http://ohioline.osu.edu/aex-fact/pdf/0739.pdf>

Research Publications

Published Articles

- Arogo, J, Zhang, R. H., Riskowski, G. L., & Day, D. L. (1999). Mass transfer coefficient for hydrogen sulfide emission from aqueous solutions and liquid swine manure. *Transactions of the ASAE*, 42(5), 1455-1462. <http://elibrary.asabe.org/abstract.asp?aid=13309>
- Beaver, R. L., & Field, W. E. (2007). Summary of documented fatalities in livestock manure storage and handling facilities: 1975-2004. *Journal of Agromedicine*, 12(2), 3-23. http://www.tandfonline.com/doi/abs/10.1300/J096v12n02_02#.U6B4DXfLJ8E
- Brewer, S.K. & Costello, T.A. (1999). In-situ measurement of ammonia volatilization from broiler litter using an enclosed air chamber. *Transactions of the ASAE*, 42(5), 1415-1422. <http://elibrary.asabe.org/abstract.asp?aid=13305>
- Brubaker, J. E., & Pos, J. (1965). Determining static coefficients of friction of grains on structural surfaces. *Transactions of the ASAE*, 8(1), 53-55. <http://elibrary.asabe.org/abstract.asp?aid=40423>
- Bucklin, R. A., Thompson, S. A., & Ross, I. J. (1991). Flow patterns in model flat bottom grain bins. *Transactions of the ASAE*, 34(2), 577-585. <http://elibrary.asabe.org/abstract.asp?aid=31702>
- Chang, C. S., Converse, H. H., C. R., & Lai, F. S. (1984). Flow rate of corn through orifices as affected by moisture content. *Transactions of the ASAE*, 27(5), 1586-1589. <http://elibrary.asabe.org/abstract.asp?aid=33008>
- Chang, C. S., Converse, H. H., & Steele, J. L. (1991). Flow rates of grain through various shapes of vertical and horizontal orifices. *Transactions of the ASAE*, 34(4), 1789-1796. <http://elibrary.asabe.org/abstract.asp?aid=31802>
- Chénard, L., Lemay S. P., & Laguë, C. (2003). Hydrogen sulfide assessment in shallow-pit swine housing and outside manure storage. *Journal of Agricultural Safety and Health* 9(4), 285-302. <http://elibrary.asabe.org/abstract.asp?aid=15458>
- Crapo, R. O. (1989). Toxic gases from manure pits. In J.A. Dosman, Cockcroft, D. W. (Eds.), *Principles of health and safety in agriculture*. (pp. 55-57). Boca Raton: CRC Press, Inc.
- Donham, K. (1982). Acute toxic exposure to gases from liquid manure. *Journal of Occupational Medicine*, 24(2), 142-145.

- Donham, K. J., Rubino, M., Thedell, T. D., & Kammermeyer, J. (1977). Potential health hazards to agricultural workers in swine confinement buildings. *Journal of Occupational Medicine*, 19(6), 383-387.
- Duffy, S. P., & Puri, V. M. (1999). Measurement and comparison of flowability parameters of coated cottonseeds, shelled corn, and soybeans at three moisture contents. *Transactions of the ASAE*, 42(5), 1423-1428. <https://elibrary.asabe.org/abstract.asp?aid=13306>
- Fedler, C. B., & Gregory, J. M. (1989). Material property effects of granular flow through orifices. *Transactions of the ASAE*, 32(1), 263-272. <http://elibrary.asabe.org/abstract.asp?aid=30993>
- Fedler, C. B., & Gregory, J. M. (1989). Mathematical models describing the flow of grain materials. *Mathematical and Computer Modeling*, 2, 510-513.
- Freeman, S. A., Kelley, K. W., Maier, D. E., & Field, W. E. (1998). Review of entrapments in bulk agricultural materials at commercial grain facilities. *Journal of Safety Research*, 29(2), 123-134.
- Ge, T., Zhang, Q., & Britton, M. G. (2000). Predicting grain consolidation caused by vertical vibration. *Transactions of the ASAE*, 43(6), 1747-1753. <http://elibrary.asabe.org/abstract.asp?aid=3077>
- Giunta, J. S. (1969). Flow patterns of granular materials in flat-bottom bins. *Transactions of the ASME, Series B91*, 406-413. <http://www.engr.usask.ca/societies/csae/protectedpapers/C9904.pdf>
- Gregory, J. M., & Fedler, C. B. (1987). Equation describing granular flow through circular orifices. *Transactions of the ASAE*, 30(2), 529-532. <http://elibrary.asabe.org/abstract.asp?aid=31982>
- Hankey, W. L., & Thomas, S. K. (1991). The flow of granular material. *Computers and fluids*, 20(3), 333-342. <http://www.sciencedirect.com/science/article/pii/004579309190049N>
- Irtwange, S. V., & Igbeka, J. C. (2002). Selected moisture dependent friction properties of two african yam bean (*sphenotyliis stenocarp*) accessions. *Applied Engineering in Agriculture*, 18(5), 559-565. <https://elibrary.asabe.org/abstract.asp?aid=10143>
- Jenike, A. W., & Johanson, J. R. (1969). On the theory of bin loads. *Journal of Engineering for Industry*, 91(2), 339-344. <http://manufacturingscience.asmedigitalcollection.asme.org/article.aspx?articleid=144077>
[2](#)
- Jiang, S., Barber, E., Meiering, A., & Jofriet, J. (1991). Toxic gas production and silo ventilation. *Canadian Agricultural Engineering*, 33, 151-159.

- Johanson, J. R. (1966). The use of flow-corrective inserts in bins. *Journal of Engineering for Industry* 88(2), 224-230.
<http://manufacturingscience.asmedigitalcollection.asme.org/article.aspx?articleid=143947>
[6](#)
- Johanson, J. R. (1982). Controlling flow patterns in bins by use of an insert. *Bulk Solids Handling*, 2(3), 495-498.
- Johanson, J. R. (1967). The placement of inserts to correct flow in bins. *Power Technology*, 1, 328-333.
- Kelley, K. W. & Field, W. E. (1996). Characteristics of flowing grain-related entrapments and suffocations with emphasis on grain transport vehicles. *Journal of Agricultural Safety and Health*, 2(3), 143-156. <https://elibrary.asabe.org/abstract.asp?aid=19446>
- Kelsey, T. W. (1994). The agrarian myth and policy responses to farm safety. *American Journal of Public Health*, 84(7), 1171-1177.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1614759>
- Kedan, G., Spielholz, P., Sjostron, T., Trenary, B., & Clark, R. E. (2007). An assessment of gases in oxygen-deficient hay silos and the effects of forced ventilation. *Journal of Agricultural Safety and Health*, 13(1), 83-95.
<http://elibrary.asabe.org/abstract.asp?aid=22314>
- Kingman, D. M. (2004). Liberty Tube™ prototype plastic grain rescue tube. *Resource Magazine*, 11(7).
- Kingman, D. M., Deboy, G. R., & Field, W. E. (2003). Contributing factors to engulfments in on-farm grain storage bins: 1980 through 2001. *Journal of Agromedicine*, 9(1), 39-63.
http://www.tandfonline.com/doi/abs/10.1300/J096v09n01_06
- Kingman, D. M., & Field, W. E. (2001). Buried alive. *Resource Magazine*, 8(1).
- Kingman, D. M., & Field, W. E. (2005). Using fault tree analysis to identify contributing factors to engulfment in flowing grain in on-farm grain bins. *Journal of Agricultural Safety and Health*, 11(4). <http://elibrary.asabe.org/abstract.asp?aid=19718>
- Kingman, D. M., Field, W. E., & Maier, D. E. (2001). Summary of entrapments in on-farm grain storage bins, 1966-1998. *Journal of Agricultural Safety and Health*, 7(3), 169-184.
<https://elibrary.asabe.org/abstract.asp?aid=5441>
- Kingman, D. M. & Muller, J. E. (2007). Evaluation of plastic grain engulfment rescue device. *Journal of Agriculture Technology, Management, and Education*, 22, 727-741.
http://jastm.org/legacy/2007%20JASTM%20Articles/3%20Kingman_JASTM_2007_p727_741.pdf

- Kingman, D. M., Spaulding, A. D., & Field W. E. (2004). Predicting the potential of engulfment using an on-farm grain storage hazard assessment tool. *Journal of Agricultural Safety and Health*, 10(4), 235-243. <http://elibrary.asabe.org/abstract.asp?aid=17638>
- Kmita, J. (1991). An experimental analysis of internal silo loads. *Bulk Solids Handling*, 11, 459-468.
- Lavoie, J. Marchand, G. & Gingras, G. (1997). Pit ventilation in pig-housing facilities. *Canadian Agricultural Engineering*, 39(4), 317-326.
- Legault, M. L., & Murphy, D. J. (2000). Evaluation of the agricultural safety and health best management practices manual. *Journal of Safety Research*, 6(2), 141-153. <https://elibrary.asabe.org/abstract.asp?aid=3026>
- Lim, T. T., Heber, A. J., Ni, J. Q., Kendall, D. C., & Richert, B. T. (2004). Effects of manure removal strategies on odor and gas emissions from swine finishing. *Transactions of ASAE* 47(6), 2041-2050. <http://elibrary.asabe.org/abstract.asp?aid=17801>
- Marinelli, J., & Carson, J. W. (1992). Solve solids flow problems in bins, hoppers, and feeders. *Chemical Engineering Progress*, 88(5), 22-28.
- McNeill, S. G., Thompson, S. A., & Montross, M. D. (2004). Effect of moisture content and broken kernels on the bulk density and packing of corn. *Applied Engineering in Agriculture*, 20(4), 475-480. <http://elibrary.asabe.org/abstract.asp?aid=16477>
- Morse, D. L. (1981). Death caused by fermenting manure. *Journal of the American Medical Association*, 245(1), 63-64.
- Nguyen, T. V., Brennen, C. E., & Sabersky, R. H. (1980). Funnel flow in hoppers. *Transactions of the ASME*, 47, 729-735. <http://authors.library.caltech.edu/133/1/NGU041.pdf>
- Ni, J.-Q., Heber, A. J., Sutton, A. L., & Kelly, D. T. (2009). Mechanisms of gas releases from swine wastes. *Transactions of ASABE* 52(6), 2013-2025. <http://elibrary.asabe.org/abstract.asp?aid=29203>
- Ni, J.-Q., Hendriks, J., Vinckier, C. & Coenegrachts, J. (2000). A new concept of carbon dioxide accelerated ammonia release from liquid manure in pig house. *Environment International* 26, 97-104.
- Pahwa, P., Zasda, M., McDuffie, H. H., McNeil, G., & Dosman, J. (1994). Results of a survey on farm accidents in saskatchewan. In H.H. McDuffie, J.A. Dosman, L.M. Semuk, S.A. Olenchock & A. Senthilselvan (Eds.), *Agricultural Health and Safety: Workplace, Environment, Sustainability*. (pp. 275-282). Boca Raton: CRC Press, Inc. <http://books.google.com/books?id=8pdpZKR6fWAC&pg=275>

- Pesce, E. P., Zhao, J., Manbeck, H. B., & Murphy, D. J. (2008). Screening ventilation strategies for confined-space manure storages. *Journal of Agricultural Safety and Health*, 14(3), 283-308. <http://elibrary.asabe.org/abstract.asp?aid=24564>
- Reid, W. S., Sabourin, H. M., Turnbull, J. E., & Ihnat, M. (1985). Silo gas: Ventilation of tower silo headspaces. *Canadian Agricultural Engineering*, 27(2), 127-136. <http://www.csbe-scgab.ca/publications/cbe-journal/browse/5726-silo-gas-ventilation-of-tower-silo-headspaces>
- Reid, W. S., Turnbull, J. E., Sabourin, H. M. & Ihnat, M. (1984). Silo gas: Production and detection. *Canadian Agricultural Engineering*, 26(2), 197-208. <http://www.csbe-scgab.ca/publications/cbe-journal/browse/5755-silo-gas-production-and-detection>
- Riedel, S. M., & Field, W. E. (2013). Summation of the frequency, severity, and primary causative factors associated with injuries and fatalities involving confined spaces in agriculture. *Journal of Agricultural Safety and Health*, 19(2), 83-100. <http://elibrary.asabe.org/abstract.asp?aid=42706>
- Riley, M. W., Cochran, D. J., & Ballard, J. L. (1982). An investigation of preferred shapes for warning labels. *Human Factors*, 24(6), 737-742.
- Roberts M. J., Deboy, G. R., Field, W. E., & Maier, D. E. (2011). Summary of prior grain entrapment rescue strategies. *Journal of Agricultural Safety and Health*, 17(4), 303-325. <http://elibrary.asabe.org/abstract.asp?aid=39804>
- Roberts M. J., & Field, W. E. (2010). A disturbing trend: U.S. grain entrapments on the increase. *Resource Magazine*, 17(4), 10-11. <http://elibrary.asabe.org/abstract.asp?aid=31919>
- Roberts M. J., Field, W. E., Maier, D. E., Stroshine, R. L. (2012). Determination of effort required to insert a rescue tube into various grain types. *Journal of Agricultural Safety and Health*, 18(4), 293-308. <http://elibrary.asabe.org/abstract.asp?aid=42331>
- Rowntree Darragh, A., Stallones, L., Sample, P. L., & Switzer, K. (1998). Perceptions of farm hazards and personal safety behavior among adolescent farm workers. *Journal of Agricultural Safety and Health, Special Issue*(1), 159-169. <http://elibrary.asabe.org/abstract.asp?aid=15366>
- Runesson, K., & Nilsson, L. (1986). Finite element modeling of the gravitational flow of a granular material. *Bulk Solids Handling*, 6(5), 877-884.
- Schmechta, V. H., & Matz, A. (1971). Zum versinken im getriede. *Zeitschrift fur die gesamite hygiene unde Ihre grensgebiete* 17, 565-567.

- Schwab, C. V., Ross, I. J., Piercy, L. R., & McKenzie, B. A. (1985). Vertical pull and immersion velocity of mannequins trapped in enveloping grain flow. *Transactions of the ASAE*, 28(6), 1997-2002. <http://elibrary.asabe.org/abstract.asp?aid=32555>
- Sheldon, E. J., Field, W. E., & Tormoehlen, R. L. (1994). Fatal farm work-related injuries involving children and adolescents in Wisconsin and Indiana. In H.H McDuffe, J.A. Dosman, K.M. Semchuk, S.A. Olenchock & A. Senthilselvan (Eds.), *Agricultural Health and Safety: Workplace, Environment, Sustainability*. (pp. 355-362). Boca Raton: CRC Press, Inc. <http://books.google.com/books?id=8pdpZKR6fWAC&pg=355>
- Shenoi, S., Chang, C. S., Converse, H. H., & Fan, L. T. (1991). An expert system for grain elevator hazard prevention. *Applied Engineering in Agriculture*, 7(6), 701-704. <http://elibrary.asabe.org/abstract.asp?aid=26289>
- Tuzun, U., & Nedderman, R. M. (1983). Gravity flow of granular materials round obstacles. *Bulk Solids Handling*, 3(3), 507-517.
- Wilcke, W. F., Chang, C. S., & Hetzel, G. H. (1992). Grain flow through guarded horizontal orifices. *Applied Engineering in Agriculture*, 8(1), 65-75. <http://elibrary.asabe.org/abstract.asp?aid=26035>
- Xue, S. K., Chen, S., & Hermanson, R. E. (1998). Measuring ammonia and hydrogen sulfide emitted from manure storage facilities. *Transactions of ASAE*, 41(4), 1125-1130. <http://elibrary.asabe.org/abstract.asp?aid=17259>
- Xue, S.K., & Chen, S. (1999). Surface oxidation for reducing ammonia and hydrogen sulfide emissions from dairy manure storage. *Transactions of ASAE*, 42(5), 1401-1408. <http://elibrary.asabe.org/abstract.asp?aid=13303>
- Ye, Z., Zhang, G., Li, B., Strøm, J. S., & Stahl, P. J. (2008). Ammonia emissions affected by air flow in a model pig house: Effects of ventilation rate, floor slat opening, and headspace height in a manure storage pit. *Transactions of ASABE*, 51(6), 2113-2122. <http://elibrary.asabe.org/abstract.asp?aid=25393>
- Zhao, J., Manbeck, H. B., & Murphy, D. J. (2008). Computational fluid dynamics simulations of gas evacuation and O₂ recovery times for ventilated confined-space manure pits. *Transactions of ASABE*, 51(6), 2135-2149. <http://elibrary.asabe.org/abstract.asp?aid=25395>
- Zhao, J., H.B. Manbeck and D.J. Murphy. (2007). Computational fluid dynamics simulation and validation of H₂S removal from fan ventilated confined-space manure storages. *Transactions of ASABE*, 50(6), 2231-2246. <http://elibrary.asabe.org/abstract.asp?aid=24098>

Zhao, J., Manbeck, H. B., & Murphy, D. J. (2008). Computational fluid dynamics modeling of ventilation of confined-space manure storage facilities: applications. *Journal of Agricultural Safety and Health*, 14(4), 405-429.

<http://elibrary.asabe.org/abstract.asp?aid=25279>

Technical/Conference Papers

- Aherin, R. A., Murphy, D. J., & Westaby, J. D. (1990). *Changing farm workers behavior: A literature review of injury control strategies*. (ASAE Paper No. 90-1620). St. Joseph, MI: ASAE.
- Baker, L. D., & Aherin, R. A. (1987). *Creating effective product safety messages*. (ASAE Paper No. 87-5515). St. Joseph, MI: ASAE.
- Benninga, D. A. (1988). *Safety update—grain handling equipment*. (ASAE Paper No. 88-5522). St. Joseph, MI: ASAE.
- Benninga, D. A. (1991). *Grain bin unloading—a review*. (ASAE Paper No. 91-5504). St. Joseph, MI: ASAE.
- Carpenter, T. G., & Bean, T. L. (1992). *A portable modular grain rescue tube*. (ASAE Paper No. 92-4010). St. Joseph, Michigan: ASAE.
- Field, W. E. & Bailey, R. W. (1979). *Entrapments and suffocation in flowing grain*. (ASAE Paper No. 79-5535). St. Joseph, MI: ASAE.
- Field, W. E., & Tormoehlen, R. L. (1982). *Analysis of fatal and non-fatal farm accidents involving children*. (ASAE Paper No. 82-5501). St. Joseph, MI: ASAE.
- Fletcher, W. (1971). *Safety hazards associated with livestock wastes*. (ASAE Paper No. 71-911). St. Joseph, MI: ASAE.
- Foote, D. D., Aherin, R. A., & Geralski, G. L. (1995). *Fall and suffocation prevention system for grain bins*. (ASAE Paper No. 95-5283). St. Joseph, MI: ASAE.
- Jenkyn, R. T. (1994). *Investigation of the shape of flow channels in a funnel flow bin*. (ASAE Paper No. 94-4031). St. Joseph, MI: ASAE.
- Jekyn, R. T., & Bengston, K. E. (1994). *Observations of the shapes of flow channels in funnel flow bins*. (ASAE Paper No. 94-4031). St. Joseph, MI: ASAE.
- Kelley, K. W., & Field, W. E. (1995). *Characteristics of flowing grain-related entrapments and suffocations in on-farm grain storage facilities and grain transport vehicles*. Saratoga Springs, NY: National Institute for Farm Safety Conference.
- Kingman, D. M. (2004). *Prototype plastic grain rescue tube—Liberty Tube™*. (ASAE Paper No. 045027). Ottawa, Ontario: ASAE/CSAE Annual International Meeting. doi: 10.13031/2013.16913
- Kingman, D. M., Maier, D. E., & Field, W. E. (2006). *Liberty Tube™: engulfment rescue device*. Portland, OR: ASABE Annual International Meeting.

- Miller, F. Y., Huang, H., Maghirang, R., Funk, T., Robert, M., & Zhang, Y. (2005). *System influences on ammonia and hydrogen sulfide concentrations inside mechanically ventilated swine finishing buildings in Illinois*. Beijing, China: Seventh International Livestock Environment Symposium. doi: 10.13031/2013.18395
- Miller, G. Y., Robert, M. J., Maghirang, R. G., Riskowski, G. L., Heber, A. J., & Cadwallader, K. R. (2001). *Characterization of odor and gas emitting potential from mechanically ventilated deep and shallow pit swine finishing buildings in Illinois*. Louisville, KY: Sixth International Livestock Environment Symposium. doi: 10.13031/2013.7130
- Negi, S. C., Rong, G., & Jofirent, J. C. (1994). *Discrete modeling of discharging silos*. (ASAE Paper No. 94-4514). St. Joseph, MI: ASAE.
- Popendorf, W. (1992). *Gases, vapors, liquids, and drugs*. Surgeon General's Conference on Agricultural Safety and Health. (Publication No. 92-105). Washington, DC: U.S. Department of Health and Human Services.
- Riedel, S. M., & Field, W. E. (2011). *Summary of over 800 grain storage and handling-related entrapments and suffocations documented in the U.S. and Canada between 1970 and 2010*. XXXIV CIOSTA CIGR V Conference: Efficient and safe production processes in sustainable agriculture and forestry. Vienna, Austria: University of Natural Resources and Applied Life Sciences.
- Schneider, R. D. (1983). *The Nebraska farm accident example 1970-1982*. (ASAE Paper No. 83-5042). St. Joseph, MI: ASAE.
- Schwab, C. V., Miller, L. J., Goering, D. H., & Riedesel, M. L. (1994). *Tug of war grain safety awareness*. (ASAE Paper No. 94-5501). St. Joseph, MI: ASAE.
- Shutske, J. M., & Purschwitz, M. A. (1994). *Implementing the Confined Space Standard in on-farm grain storage structures*. (ASAE Paper No. 94-4014). St. Joseph, MI: ASAE.
- Smith, D. L. O. & Lohnes, R. A. (1980). *Grain silo overpressures induced by dilancey upon unloading*. (ASAE Paper No. 80-3013). St. Joseph, MI: ASAE.
- Snyder, K., Bobick, T. G., Hanz, J. L., & Myers, J. R. (1992). *Grain handling fatalities in production agriculture, 1985-1989*. (ASAE Paper No. 92-5509). St. Joseph, MI: ASAE.
- Tillapaugh, J. A., Murphy, D. J., & Manbeck, H. B. (2010). *An educational program to reduce risk when entering confined-space manure storages*. Pittsburgh, PA: ASABE. doi: 10.13031/2013.29642
- Wickstrom, L. L. (1982). *ABC hydraulic sweep auger*. (ASAE Paper No. 82-3022). St. Joseph, MI: ASAE.

Research Theses

- Beaver, R. L. (2005). *Assessing the nature, frequency, and causation of entrapments and fatalities associated with on-farm storage and handling of livestock manure*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Kelley, K. W. (1995). *Flow characteristics of gravity-flow grain wagons contributing to engulfment in flowing grain and possible intervention strategies*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Kingman, D. M. (2002). *Utilizing a systems approach to develop an on-farm grain storage hazard assessment tool*. (Unpublished doctoral dissertation). Purdue University, West Lafayette, IN.
- Kingman, D. M. (1999). *Prevention strategies for flowing grain entrapments that occur in on-farm grain storage bins*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Lloyd III, W. M. (2000). *Ventilation for confined space entry into underground manure storage facilities*. (Unpublished master's thesis). The Pennsylvania State University, University Park, PA.
- O'Conner, P. S. (2012). *The economic impact of extending OSHA's grain handling standards to currently exempt agricultural worksites*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Purschwitz, M. A. (1989). *Development of a data collection system for farm-related accidents resulting in injury*. (Unpublished doctoral dissertation). Purdue University, West Lafayette, IN.
- Riedel, S. M. (2011). *Estimation of the frequency, severity, and primary causative factors associated with injuries and fatalities involving confined spaces in agriculture*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Schwab, C. V. (1982). *Inflow velocity and forces acting on a person trapped in enveloping flow of granular materials*. (Unpublished master's thesis). University of Kentucky, Lexington, KY.
- Sheldon, E. J. (1992). *Review and analysis of fatal and nonfatal farm work-related injuries involving children and adolescents through age 17*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.
- Sutherlin, N. (2000). *Summary of fatal farm work-related injuries to children and adolescents in Indiana and Wisconsin from 1970-1999*. (Unpublished master's thesis). Purdue University, West Lafayette, IN.

Zhao, J. (2006). *Simulation and validation of hydrogen sulfide removal from fan ventilated confined-space manure storages*. (Unpublished doctoral dissertation). The Pennsylvania State University, University Park, PA.

Books (Handbooks, manuals, textbooks, etc)

- Asfahl, C. R., & Rieske, D. (2010). *Industrial safety and health management*. (6th ed.). Upper Saddle River, NJ: Prentice Hall.
- Bahr, N. L. (1997). *System safety engineering and risk assessment: A practical approach*. New York, NY: Taylor and Francis.
- Baker, L., Field, W. E., Schneider, R., Young, C., & Murphy, D. J. (1986). *Farm rescue responding to incidents and emergencies in agricultural settings*. Ithaca, NY: Natural Resource, Agriculture, and Engineering Service.
- Baker, L., Field, W. E., Schneider, R., Young, C., Parsons, R. A., Murphy, D. J., & Welch, J. (1999). *Farm accident rescue*. Ithaca, NY: Natural Resource, Agriculture, and Engineering Service.
- Geankoplis, C. J. (1983). Flow in packed beds. In F. Kreith (Ed.), *Transport processes and unit operations* (pp. 129-134). Newton, MA: Allyn and Bacon, Inc.
- Goetsch, D. (2008). *Occupational safety and health*. (6th ed.). Prentice Hall. Upper Saddle River, NJ: Prentice Hall.
- Guyton, A. C. (1991). The minute respiratory volume - Respiratory rate time tidal volume. In M.J. Wonsiewicz (Ed.), *Textbook of medical physiology* (p. 409). Philadelphia, PA: W.B. Saunders Company.
- Karnes, E. W., & Leonard S. D. (1985). Consumer product warnings: Reception and understanding of warning information by final users. In *Trends in ergonomics: Human factors, III* (pp. 995-1003). New York City, NY: Elsevier Science Publishing, Inc.
- Liberty Rescue Service, LLC. (2011). *Liberty grain rescue system, user's manual*.
- Lindley, J. A. & Whitaker, J. H. (1996). *Agricultural buildings and structures*. St. Joseph, MI: American Society of Agricultural Engineers.
- McManus, N. (1999). *Safety and health in confined spaces*. New York, NY: CRC Press.
- Molenda, M., & Horabik, J. (2005). *Mechanical properties of granular agro-materials and food powders for industrial practice*. Lublin, Poland: Institute of Agrophysics.
- Midwest Plan Service. (1988). *Grain drying, handling, and storage handbook*. (2nd ed.). Ames, IA: Midwest Plan Service.

Worsing, R. A., Jr. (Ed.). (1993). *Rural rescue and emergency care*. Rosemont, IL: American Academy of Orthopaedic Surgeons.

Regulations and Standards

American National Standards Institute. (2009). ANSI/ASSE Z117.1 Safety Requirements for Confined Spaces.

American Society of Agricultural and Biological Engineers. (1988). ANSI/ASAE EP433 Loads Exerted by Free-Flowing Grain on Bins.

American Society of Agricultural and Biological Engineers. (1990). ASAE S361.3 Safety for Portable Agricultural Auger Conveying Equipment.

American Society of Agricultural and Biological Engineers. (1990). ASAE S412.1 Ladders, Cages, Walkways, and Stairs.

American Society of Agricultural and Biological Engineers. (1999). ASAE S441.3 Safety Signs.

American Society of Agricultural and Biological Engineers. (2010). ANSI/ASAE S607: Ventilating Manure Storages to Reduce Entry Risk.

American Society of Safety Engineers. (2009). ANSI/ASSE Z117.1 Safety Requirements for Confined Spaces.

Dobson, D. (2000). Patent No. 6,062,342 Device for a Confined Space Rescue and Method of Using Thereof. United States Patent and Trademark Office.

Executive Order No. 12,866. (1993). Regulatory Planning and Review. Fed. Reg. vol. 58 no. 190.

Occupational Safety & Health Administration. (1987). 52 FR 49622 Final Regulatory Impact Analysis.

Occupational Safety & Health Administration. (1987). 29 CFR 1910.272 Grain Handling Facilities.

Occupational Safety & Health Administration. (1993). 29 CFR 1910.146 Permit-Required Confined Spaces.

Occupational Safety & Health Administration. (2008). Grain Handling Hazard Recognition.

Occupational Safety & Health Administration. (2008). Fall Protection Systems Criteria and Practices. (OSHA Publication No. 1926.502).

Purdue University Agricultural Safety and Health Program

Occupational Safety & Health Administration. (1996). Compliance Directive No. 02-01-004, Inspection of Grain Handling Facilities. (OSHA Instruction CPL 2-1.4C). Directorate of Compliance Programs.

Occupational Safety & Health Administration. (2003). Small Business Handbook. (OSHA Publication 2209-02R).

U.S. Department of Labor. (1974). Child labor requirements in agriculture under the Fair Labor Standards Act. (U.S. Department of Labor Child Labor Bulletin No. 102). Washington, DC.

U.S. Department of Labor. (1998). Enforcement exemptions and limitations under the appropriations act: Directive CPL 2-0.51J. Washington, D.C.

Media Articles and Reports

- Bureau of Labor Statistics. (1995a). *Fatal workplace injuries in 1993: A collection and analysis*. (Report 891). US Department of Labor, Bureau of Labor Statistics. June 1995.
- Bureau of Labor Statistics. (1995b). *NEWS, USDL-95-142*. (Report 891). US Department of Labor, Bureau of Labor Statistics. June 1995.
- Centers for Disease Control. (1978). Death of a farm worker associated with toxic gases from a liquid manure system-Wisconsin. *Morbidity and Mortality Weekly Report*. February 10, 1978 (p 47).Atlanta, GA.
- Centers for Disease Control. (1981). Deaths associated with liquid manure systems—United States. *Morbidity and Mortality Weekly Report*, 30(13).
- Centers for Disease Control. (1989). Epidemiologic notes and reports fatalities attributed to methane asphyxiain manure waste pits--Ohio, Michigan, 1989. *Morbidity and Mortality Weekly Report*, 38(33), 583-586.
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00001448.htm>
- Centers for Disease Control. (1993). Fatalities attributed to entering manure waste pits—Minnesota, 1992. *Morbidity and Mortality Weekly*, 42(17), 325-329.
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00020468.htm>
- Centers for Disease Control. (1994). Worker deaths in confined spaces: A summary of NIOSH surveillance and investigative findings. U.S. Department of Health and Human Services.
<http://www.cdc.gov/niosh/docs/94-103/>
- Dietz, J. (2008, March). Manure gases. *Successful Farming*.
- Field, W. E., Maier, D. E., & Roberts, M. J. (2006). Grain entrapment database. *Grain Journal*, October 2006, 42-45.
- Field, W. E., Maier, D. E., & Roberts, M. J. (2007). Grain entrapment database. *Grain Journal*, October 2007, 106-107.
- Graham, J. (2011). Drowned in corn: Grain bin deaths hit record. *Chicago Tribune*.
- Hyman, R. (2008). A Lesson learned the hard way. *Farm Journal*, Feb. 2008
- Issa, S. F., Cheng, Y.-H., & Field, W. E. (2014). 2013 summary of U.S. agricultural confined space-related injuries and fatalities. West Lafayette: Purdue University.
<http://extension.entm.purdue.edu/grainlab/content/pdf/2013SummaryFinal.pdf>

Purdue University Agricultural Safety and Health Program

Issa, S. F., Roberts, M. J., & Field, W. E. (2013). 2012 summary of grain entrapments in the United States. West Lafayette: Purdue University.

<http://extension.entm.purdue.edu/grainlab/content/pdf/2012GrainEntrapments.pdf>

Mecoy, D. (2011). Fine for auger accident deemed an 'insult to justice'. *Feed & Grain*.

Mulhern, B. (1997). Stay safe in and around confined spaces. *Gemplers Inc.*, Mt. Horred, WI.

National Institute for Occupational Safety and Health. (2011). FACE 8749 Farmer dies in

Indiana. <http://www.cdc.gov/niosh/face/in-house/full8749.html>

National Resources Defense Council. (2005). Pollution from giant livestock farms threatens public health. New York, NY: NRDC. <http://www.nrdc.org/water/pollution/nspills.asp>

National Safety Council. (1993). Accident Facts 1993 Edition. Chicago, IL: NSC.

National Safety Council. (1996). Accident Facts 1996 Edition. Chicago, IL: NSC.

Navratil, L. (2011). Feds file criminal charge against Tempel Grain in 2009 death. *Denver Post*.

http://www.denverpost.com/ci_18556066

Nebraska Department of Labor. (2000). Nebraska FACE 99NE028: Farm youth suffocated in corn bin. Centers for Disease Control. Lincoln: National Institute for Occupational Safety and Health.

Riedel, S. M. & Field, W. E. (2011). 2010 summary of grain entrapments in the United States. West Lafayette, IN: Purdue University.

<http://extension.entm.purdue.edu/grainlab/content/pdf/2010GrainEntrapments.pdf>

Roberts, M. J., & Field, W. E. (2010). 2009 Summary of grain entrapments in the United States. West Lafayette, IN: Purdue University.

<http://extension.entm.purdue.edu/grainlab/content/pdf/09grainEntrapment.pdf>

Roberts, M. J., Riedel, S. M., Wettschurack, S. W., & Field, W. E. (2012). 2011 summary of grain entrapments in the United States. West Lafayette, IN: Purdue University.

<http://extension.entm.purdue.edu/grainlab/content/pdf/GrainEntrapSum2011.pdf>

Stein, D. (2011). Enid area community rallies to help teens hurt in grain elevator. *News9.com*.

Wilcox, J. (1998). Big bins. *Successful Farming Magazine*. October, 1998, pp. 34-36.

Websites

Bauer, W. *Grain entrapment prevention*. <http://grainentrapmentprevention.com>

Farm and Ranch eXtension in Safety and Health (FReSH) Community of Practice. *Entrapment risk due to flowing grain*. <http://www.extension.org/pages/63151/entrapment-risk-due-to-flowing-grain>

Iowa Association of Municipal Utilities. *Guidelines for grain bin safety*.

<http://archive.iamu.org/services/electric/resources/GrainBinSafety.pdf>

Mill & Elevator Supply Co. *Rescue tube*. <http://millelevatorsupply.com/product/liberty-rescue-tube/>

National Safety Council. *Safety & Health Fact Sheets*.

http://www.nsc.org/news_resources/Resources/Pages/SafetyHealthFactSheets.aspx#.U5nvzXfLJ8H

Oklahoma State University Extension. *Stored products research and education center*.

<http://storedproducts.okstate.edu/>

Professional Rescue Innovations. *PRI Homepage*. <http://www.prirescue.com>

Stateline Farm Rescue. *Grain bin rescue*.

<http://www.statelinecoop.com/pages/custom.php?id=28561>

Occupational Safety & Health Administration. *Grain handling*.

<http://www.osha.gov/SLTC/grainhandling/index.html>

University of Illinois Extension, Agriculture Safety and Health. *Grain bin safety*.

<http://web.extension.illinois.edu/agsafety/equipment/grainbinsafety.cfm>

Wright, J. AGCO. *Grain safety on the farm*. <http://blog.agcocorp.com/2011/09/grain-safety-on-the-farm/>

Penn State Extension. *Manure pit safety*. <http://www.manurepitsafety.psu.edu>

Purdue University Post Harvest Grain Quality. *Post Harvest Grain Quality & Stored Product Protection Program*. <http://grainsafety.us>

Video and DVDs

National Grain and Feed Association and Purdue University. (1999). "Don't Go With The Flow." [Videocassette]. D. E. Maier, W. E. Field, and S. A. Freeman (Writers).

<http://www.ngfa.org/resources/safety/>

National Grain and Feed Foundation and National Corn Growers Association. (2011). *Grain bin safety: Protecting yourself and your family*. [Web video].

<http://www.youtube.com/watch?v=YDwJCdjZYE>

Progressive Agriculture Foundation. (2011). *Understanding the dangers of grain entrapment*.

[Web video]. <http://www.youtube.com/watch?v=S31pDpPLR-c>