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**REDUCING RISK OF ENTRY INTO CONFINED SPACE
MANURE STORAGES**

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Background Death from asphyxiation and poisoning when entering confined-space manure tanks is a serious hazard in animal agriculture. Often, multiple fatalities occur when farmers try to rescue friends or relatives overcome by the noxious gas atmosphere.

Purpose To reduce human risk of entry into confined space manure storages.

Methods This research work spanned nearly 8 years to develop computational fluid dynamics protocols to simulate removal of noxious contaminant gases, by forced ventilation, from solid and slotted floor covered confined space, on-farm manure storage tanks. These simulation protocols were then used to determine ventilation requirements (air exchange rates, fan and air outlet locations, and operation times) to reduce concentrations of contaminant gases to levels below gas specific TLVs for human entry.

Results and Outcomes This work has been published in a series of five journal articles. Subsequently, an international engineering safety standard, *Ventilating Manure Storages to Reduce Entry Risk*, was written and approved by the American Society of Agricultural and Biological Engineers (ASABE) and the American National Standards Institute (ANSI). An educational programme was developed to inform extension educators, engineers, regulators, and farmers about the standard and how to use its provisions.

Significance For the first time ever, engineers, builders, regulators and producers have a consensus standard for constructing, installing and entering confined space manure storages with a minimum level of risk.