

Manure Storage Pit Dangers: Hazardous Gas Awareness

Agricultural Workers Should Take Precautions Prior to Entering Manure Pits

People entering manure pits without taking proper precautions are at risk of dying from high exposures to hydrogen sulfide gas. Guidance on manure pit operations from ASABE specify the need to monitor these spaces prior to entry. This alert provides general guidance on risks of entering manure storage pits.



Access point into manure pit where two died after entry, Iowa FACE IA024, 025.

Do not enter manure storage areas without ventilating and measuring gas concentrations.

Farmers who have died from gas exposures when entering manure pits:

- St. Henry, Ohio: Three brothers were fixing manure pumps and died in a manure pit midday on August 10, 2021. <https://www.dailystandard.com/archive/2021-08-11/stories/43492/three-die-in-farm-accidentv>
- Millington Township, Michigan: A 55-year old dairy farmer died in a 12-foot manure pit with 16 inches of liquid manure in the bottom. <https://www.freep.com/story/news/local/michigan/2016/08/13/man-55-dies-after-being-found-dairy-farms-manure-pit/88675690/>
- Amherst, Wisconsin: Wisconsin beef farmer died from hydrogen sulfide exposure when agitating the outdoor manure storage basin during a temperature inversion on August 15, 2016. <https://www.cdc.gov/mmwr/volumes/66/wr/mm6632a6.htm>
- Palo Alto County, Iowa: Son entered manure pit to make repairs, and father entered to rescue him. Both died July 25, 2015. http://www.siouxlandmatters.com/story/d/story/palo-alto-co/38089/L8vsp-TP00OoWIs_n4MX-g
- Chippewa County, Wisconsin: Son entered manure pit to retrieve equipment, and father entered to rescue him. Both died July 2, 2015. <http://www.jsonline.com/news/wisconsin/2-wisconsin-men-die-after-falling-into-manure-pit-b99532179z1-311646871.html>

People cannot smell hazardous concentrations of hydrogen sulfide (H₂S) and methane (CH₄), but concentrations may be high enough to decrease oxygen or paralyze breathing. Concentrations change over time, and understanding how much gas is in the manure storage pit before each entry is important to prevent death. Monitors for measuring gas concentrations are available and should be used prior to entry into any manure storage area.

It is important to pre-plan for entering these pits. Developing, training, and following a confined-space program is important to make sure that no one enters a manure storage pit without taking proper precautions. Critical steps to follow in this plan include:

1. Identification and communication of risks inside the manure pit
2. A plan to evaluate the air quality prior to entry and actions to take based on the readings: prohibit entry when dangerous concentrations exist
3. Designated observer, outside the manure pit, to watch and communicate with the entrant and to respond in an emergency
4. A plan of what to do in a crisis (knowing how to direct emergency responders to the location, notifying local responders ahead of entry in the event of an emergency, not to attempt a rescue without supplied breathing air)
5. A checklist of what equipment is needed and actions to take to prepare for and conduct an entry (communications, gas monitors, rescue equipment or local emergency responder support, ventilation fans)

Additional Information

The table below provides guidance on hazardous concentrations of manure gases. The “High Alarm” typically results in louder alarm than the low, or first, alarm. If you don’t have two alarm set points, choose the low alarm setting in the table. IDLH is the concentration that is “immediately dangerous to life and health,” which is established by NIOSH (the National Institute of Occupational Safety and Health). The IDLH values identify concentrations that are ACUTELY hazardous (Danger!). If the monitor displays concentrations that are at or above the IDLH, *immediately leave the area*. The actions indicated are for the **acute hazards to the person conducting monitoring**. To safely work in the area, concentrations need **to be below the alarm set points**, as indicated.

Contaminant	Set Alarm Levels to:		IDLH	Notes
	Low	High		
Oxygen, % (at sea level)	19.5	19	No IDLH: Leave if reach 19.5%	LEL may not read correctly if <19.5%. This presumes no O ₂ generation sources
LEL, %*♦	5	10	Asphyxiant, watch Oxygen% changes	Remove all workers, animals from room if pit>50% LEL as methane (25,000 ppm)**
CO, ppm	25	50	1000	Headache at 100-400 ppm. If develop flu-like symptoms quickly, get out
H ₂ S, ppm	1	5	100	Remove all workers, animals, from room if pit gas > 80 ppm
NH ₃ , ppm	25	35	300	Eye irritation may prevent safe action above 140 ppm; lung irritation at 100 ppm.
CO ₂ , ppm	5000	-	40,000 (4%) will displace oxygen	Remove all works, animals from room if pit gas >32,000 ppm.**

*Note: If you do not calibrate the LEL sensor with methane, you need to know how the response to the calibration gas relates to methane. For example, calibration with pentane typically gives you %LEL readings higher than the true LEL of methane. Check the operation manual for the sensor and monitor you have.

♦ If CO₂ and %LEL reach significant levels, it will displace oxygen. Watch changes in Oxygen% as an indicator of significant changes in these two contaminants combined.

** See ASABE S607 Table 7.

Need more information?

An additional, detailed fact sheet (“Technical Guidance for Selection and Use of Monitors”) provides specific information on selection, use, and general operation of these gas monitors. Click on Manure Pit Gas Monitoring guidance on the GPCAH Manure Gas fact sheets page at <https://gpcah.public-health.uiowa.edu/outreach-2/topics/manure-gas-safety-2-0/>.

The faculty and staff of the Great Plains Center for Agricultural Health are able to help you with monitoring questions. Contact CPH-GreatPlainsCenter@uiowa.edu for assistance. We are glad to provide hands-on training and education to groups of interested farmers, emergency responders, and agricultural outreach organizers to develop expertise to protect farmers and those working on the farm.



Links to More Information

General Information on Manure Pit Hazards

NIOSH has been providing information to prevent asphyxiation in manure pits since 1990. See

<http://www.cdc.gov/niosh/docs/90-103/>

The ASABE is a professional and technical organization dedicated to the advancement of engineering applicable to agricultural, food and biological systems. This organization has developed standards to recommend ventilation (S607) and operation (EP470.1) of manure storage pits with safety in mind. Their recommendations include monitoring spaces prior to entry.

ASAE EP470.1: <https://elibrary.asabe.org/azdez.asp?JID=2&AID=39802&CID=s2000&T=2>

ANSI/ASABE S607: <https://elibrary.asabe.org/azdez.asp?JID=2&AID=36208&CID=s2000&T=2>

Stories of survival and prevention (webinar): <https://lpehc.org/manure-pit-death-a-preventable-tragedy/>

General Confined Space Program Information

Michigan's Department of Licensing and Regulatory Affairs has provided a sample written program for permit-required confined space entry that can be customized for farming operations:

http://www.michigan.gov/documents/dleg/deleg_wsh_cet5330_346240_7.doc.

OSHA has developed training program to outline the confined space program (although this is for another sector, the images aren't useful for agriculture, but the content is useful): <https://www.osha.gov/Publications/2254.html>

OSHA also provides assistance materials on confined spaces to all at: <https://www.osha.gov/confinedspaces/index.html>

Gas-Vapor Monitoring References

NIOSH Technical Report: Components for Evaluating Direct-Reading Monitors for Gases and Vapors

<http://www.agronext.iastate.edu/immag/manurevideos.html>

OSHA Safety and Health Information Bulletin (SHIB 09-30-2013): Calibrating and Testing Direct-Reading Portable Gas Monitors <https://www.osha.gov/dts/shib/shib093013.html>

PennState Extension – Confined Space Manure Gas Monitoring Fact Sheet: <http://extension.psu.edu/business/ag-safety/confined-spaces/manure/manure-pit-safety-fact-sheets/e-52>

GPCAH web page for forms, posters, and video instructions: <https://gpcah.public-health.uiowa.edu/outreach-2/topics/manure-gas-safety-2-0/>

FACE Reports

These comprehensive investigations provide details of what happened that caused or contributed to worker fatalities associated with manure storage pit entry. As important as the sequence of events are, these contain recommendations to prevent these from happening in your operation.

Iowa farmer and employee died after collapse and attempted rescue in manure storage pit (<http://www.public-health.uiowa.edu/face/Reports/PDF-Reports/2005IA024-025.pdf>)

Iowa hog farmer dies from asphyxiation after manure pit agitation (<http://www.public-health.uiowa.edu/face/Reports/PDF-Reports/Manure%20Pit%20Agitation.pdf>)

Minnesota farm owner and son asphyxiated in manure waste pit (<http://www.cdc.gov/niosh/face/In-house/full9229.html>)

Minnesota hog farm co-owner and employee die of hydrogen sulfide poisoning in manure pit (<http://www.cdc.gov/niosh/face/In-house/full9228.html>)

Five family members in Michigan die after entering manure waste pit on dairy farm (<http://www.cdc.gov/niosh/face/In-house/full8946.html>)

Equipment Rental Companies

Google search "Gas monitor rental" to identify monitor rental services. Ensure that the company will provide calibrated equipment, written certification of calibration in the shipment, and operation manual. Request they set the alarms to the limits you need prior to shipping.