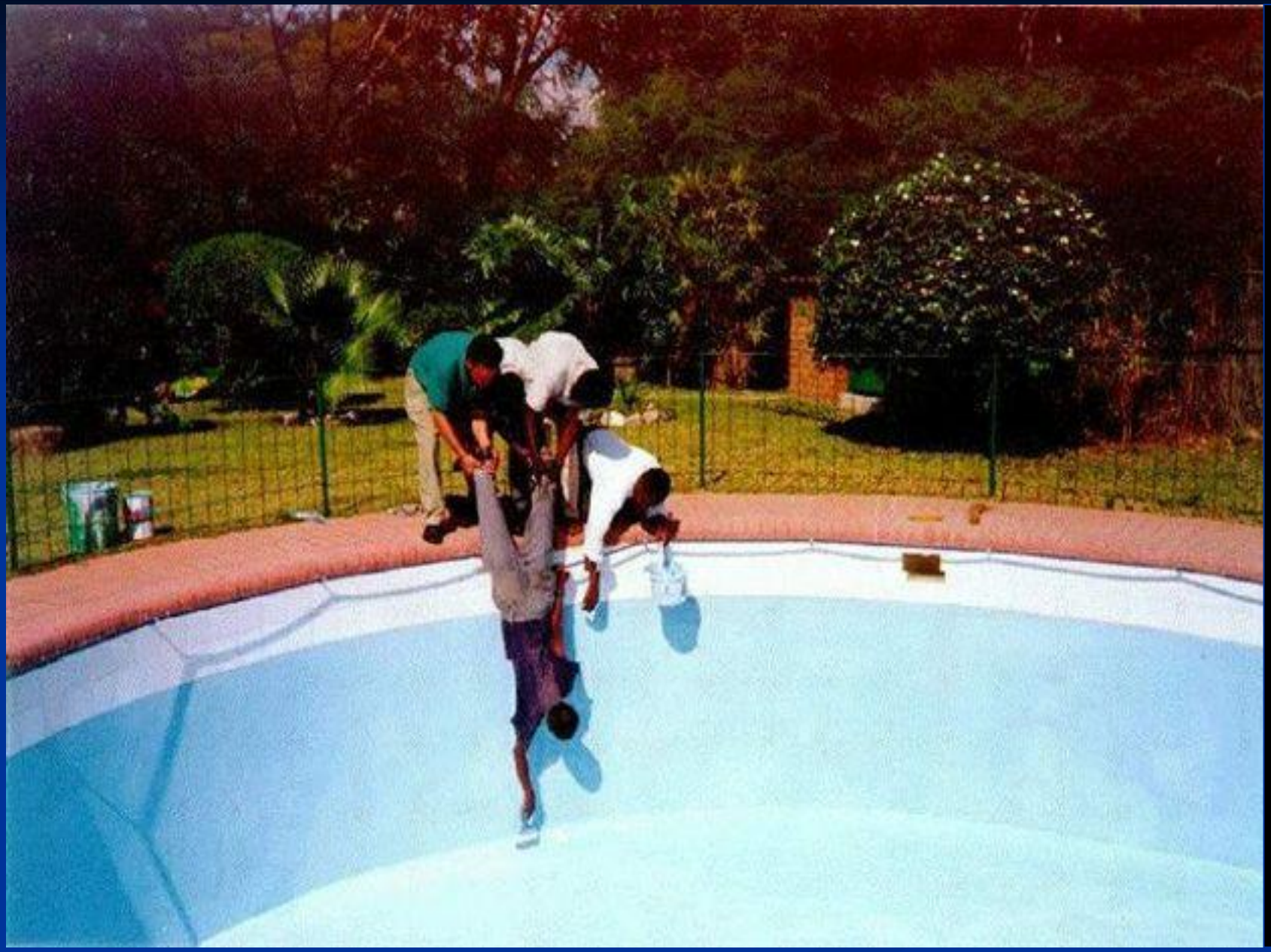
CONFINED SPACE

- **CONFINED SPACE DEFINITION**
- Is large enough & so configured that a worker can bodily enter and perform tasks, ***plus***
- Has limited or restricted means for entry or exit, ***plus***
- Is not designed for continuous worker occupancy

EXAMPLES

- Bins
- Boilers
- Crawl Spaces
- Ducts
- Excavations/Trench
- Furnaces
- Manholes
- Pipe Lines
- Pits
- Scrubbers
- Sewers
- Silos
- Tanks
- Tunnels
- Vaults
- Vessels



TYPES OF CONFINED SPACES

- **Non Permit Required**
- **Permit Required**

CONFINED SPACE Non-Permit

- ***Non-permit confined space means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.***

NON-Permit Confined Space Procedures

- Evaluate space
  - atmospheric and other hazards
- Fill out non permit required form
  - document atmospheric readings
  - turn in to supervisor, forward copy to safety

Compound	Acceptable Reading
Oxygen	19.5% - 23.5%
Flammables	zero
Hydrogen sulfide	one or less
Carbon monoxide	ten or less

NON-Permit Confined Space Procedures

- Continuous air monitoring
  - required if ventilation is required to reduce atmospheric hazards
  - recommended in other cases
- Recheck atmosphere
  - > Within 1 hours since last entry
- Recommended attendant

CONFINED SPACE–PERMIT REQUIRED

Permit-required confined space has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard

CONFINED SPACE–PERMIT REQUIRED

JOB PLANNING

1. What is the nature, type, and size of the confined space?
2. What work is to be performed in the confined space?
3. Is all necessary equipment available (air monitoring, tripod/harness, ventilation, lighting communication, and etc.)?
4. Are there any hazardous sources of energy that require lockout/tagout?

JOB PLANNING

5. Are there any chemical hazards in the confined space or are any chemicals being introduced into the space (welding, grouts, sealers, and etc.)?

6. Are there any physical hazards present in the confined space (heat, noise, slips, trips, and etc.)?

ENTRANT SHALL:

1. Know the hazards that may occur during the entry.
2. Understand the proper use of equipment and follow those guidelines.
3. Communicate with the attendant to enable the attendant to monitor entrant status and alert entrant of the need to evacuate.

ENTRANT continued

4. Alert the attendant when:

   a. Entrant recognizes and warning sign or symptoms of exposure to a dangerous situtation.

   b. Entrant detects a prohibited condition.

ENTRANT continued

5. The entrant shall exit permit space when:

   a. an order to evacuate is given.

   b. entrant recognizes any warning signs of dangerous situations.

   c. entrant detects a prohibited condition.

   d. evacuation alarm is activated.

ATTENDANT SHALL:

1. Know the hazards that may occur during entry including signs and symptoms.
2. Is aware of behavioral effects of hazard exposure in entrants.
3. Continuously and accurately maintains identity and count of entrants in space.
4. Remains outside the permit space during entry operations until relieved by another attendant.

ATTENDANT SHALL:

5. Communicate with entrant to monitor status and alert entrant of the need to evacuate.
6. Monitor activities in and outside the space to determine if it is safe for entrant to remain.
7. Orders entrant to evacuate space if:

   a. Attendant detects prohibited condition.

   b. Attendant detects behavioral effects of hazard exposure in entrant.

ATTENDANT SHALL:

7. c. Attendant detects a situation outside space that could endanger entrant.

   d. Attendant can not effectively and safely perform all duties.

8. Initiate rescue procedures as soon as a entrant needs assistance to evacuate.

9. Performs non-entry rescue or other rescue services as part of rescue procedure.

ATTENDANT SHALL:

1. When an unauthorized person approaches the space, the attendant shall:
   a. Warn them to stay away from space.
   b. Advise unauthorized persons to exit the space if they enter
   c. Inform entrant and entry supervisor if unauthorized person has entered the space.

ATTENDANT SHALL:

11. Perform no duties that might interfere with monitoring and protecting entrant.

SUPERVISOR SHALL:

1. Know the hazards that may occur during entry including signs and symptoms.
2. Verifies that all tests specified by permit have been conducted.
3. Verifies that all procedures and equipment specified by permit are in place before entry begins.

SUPERVISOR SHALL:

4. Terminates the entry and cancels the permit when:
   a. Operations covered by permit are completed.
   b. A condition that is not allowed arises in or near the space.
5. Verifies that rescue services are available and means of summoning additional services is operable.

SUPERVISOR SHALL:

6. Removes unauthorized persons who enter or attempt to enter space during operations.
7. Ensures that entry operations remain consistent with terms of the entry permit.
8. Ensures acceptable entry conditions are maintained during entry operations.

Permit Required Confined Space - Procedures

- Evaluate space
  - atmospheric and other hazards
- Fill out permit required form
  - document atmospheric readings
- Continuous ventilation required
- Written emergency procedure
- Authorized attendant required - direct communication with entrants

Permit Required Confined Space - Procedures

- Continuous air monitoring
  - required for O_2 and flammables, and for toxics if present in initial monitoring
- Additional standby required if attendant enters space
- Post signs (DANGER - Confined Space, Enter by Permit Only), and copy of permit.

Permit Required Confined Space Procedures - continued

Authorized attendant

- Stays in contact with entrants from outside the space
- Controls Access to the space
- Orders entrants out of space when:
  - hazard or warning signs/symptoms of exposure are present
  - he or she cannot carry out duties
- Contacts rescue team in emergency
- Does not perform rescue

Permit Required Confined Space procedures cont.

- **Emergency Procedures**
  - **Call dispatch (5955), advise "there is an injury at (give location) confined space, or we have a confined space injury" and make sure dispatch notifies 911 that this is a confined space incident**

Permit Required Confined Space procedures cont.

- Where injury is result of atmospheric hazards, or of an unknown cause try to remove the victim from inside the confined space (use harness, etc.) NON ENTRY RESCUE ONLY
- If you cannot remove the victim, place a blower in area to provide clean air, and wait for confined space rescue team
- If employee is severely injured, for example a potential spinal injury, do not move them unless there is an imminent life threatening hazard.

GENERAL CONFINED SPACE Procedures

Ventilation

- Equipment must be explosion proof (look for UL or FM label)
- Properly ground equipment
- Don't exhaust to occupied areas
- Don't suck in contaminated air
- Place blower away from vehicle exhaust

GENERAL CONFINED SPACE Procedures

- Warning devices placed for pedestrians and traffic
- Fire suppression systems - disable in accordance with district policy
- Vaults, manholes, etc with energized cable
  - employee stationed at surface
  - automatic reclosers on circuit made non-automatic when: operating a energized switch from inside structure, splicing or patching cable equipment is being energized where newly installed, rebuilt, or modified

ATMOSPHERIC HAZARDS

- Oxygen Concentration -
  - < 19.5%, or > 23.5% (deficient - enriched)
- Flammable Gas, Vapor, Mist or Dust-
  - 10% LEL (lower explosive limit)
- Air Contaminants -
  - Air concentration > PEL-IDLH - created by
    - Hot work (welding fumes, gases, NO_2, ozone),
    - Decomposition of organic matter (H_2S, methane), Engine exhaust (CO)
    - Fire suppression systems (CO_2)

ATMOSPHERIC TESTING

- Users must be trained on the instrument
- Confirm calibration, and do functionality check
- When possible test prior to opening space
- Take readings at top, middle, and bottom of space
  - Take measurements in 4 foot increments Measure
  - Oxygen & Flammables
  - Toxics - hydrogen sulfide, carbon monoxide etc.

Symptoms of Oxygen Deficiency

% Oxygen	Physiologic Effects
< 19.5	OSHA legal limit.
16 - 12	Increase breathing rate. Accelerated heartbeat. Impaired attention, thinking, and coordination.
14 - 10	Faulty judgement and poor muscular coordination. Muscular exertion causing rapid fatigue, intermittent respiration
10 – 8	Nausea, vomiting, inability to perform vigorous movement, or loss of the ability to move. Unconsciousness, followed by death.
< 6	Instantaneous unconsciousness. Death in minutes

Symptoms of Carbon Monoxide Exposure

PPM Level (CO)	Physiological Effects
<25	OSHA Permissible Exposure Limit – no adverse effect
100 ppm – 3 hours 600 ppm – 1 hour	Headache and discomfort
500 ppm – 1 hour 1000 ppm – 1/2 hour	Pounding of heart, dull headache, dizziness, flashes before eyes, ringing in ears, nausea.
1200 ppm - 1 hour	Dangerous to life (IDLH)
4000 ppm	Rapid collapse, unconsciousness and death within a few minutes

Symptoms of Hydrogen Sulfide Exposure

PPM Level (H_2S)	Physiological Effects
< 10 ppm	OSHA Permissible Exposure Limit – no adverse effect
15 – 25 ppm	Headache and discomfort
50 ppm	Slight eye irritation, respiratory irritation, odor
100 ppm	Marked irritation. >100 OSHA IDLH
400 – 600 ppm	Unconsciousness, death
1000 ppm	Fatal in minutes

Fatal Occupational Injuries Involving Confined Spaces, 1997-2001

FIGURE 1

Number of fatal occupational injuries in confined spaces, US, 1997-2001.

	Total	1997	1998	1999	2000	2001
Fatal injuries	458	97	81	84	100	96

FIGURE 2

Number and percent distribution of fatal occupational injuries in confined spaces by worker activity, US, 1997-2001.

Worker activity	Fatal injuries	Percent
Total	458	100
Constructing, repairing, cleaning	246	54
Repair, maintenance	101	22
Cleaning, washing	57	12
Construction, assembling, dismantling	38	8
Materials handling operations	78	17
Loading, unloading materials	24	5
Materials handling, n.e.c.*	28	6
Using or operating tools, machinery	48	11
Physical activity, n.e.c.	25	6
Protective service activities	17	4
Rescuing	25	3
Vehicular and transportation operations	11	2
All other activities	23	7

* n.e.c. means "not elsewhere classified." For example, the category "Materials handling, n.e.c." is a subcategory of "Materials Handling Operations" that includes anything fitting within materials handling operations that is not elsewhere classified.

FIGURE 5

Relative risk of fatal injury due to confined spaces by occupation and industry, 1997-2001.

Characteristics	Total (all fatal injuries)	Relative risk*
Total	458	1.00
Occupation		
Managerial and professional specialty	22	0.16
Technical, sales, and admin support	16	0.12
Service occupations	13	0.21
Farming, forestry, and fishing	113	9.37
Precision production, craft, and repair	118	2.40
Operators, fabricators, and laborers	175	2.85
Industry		
Private industry	431	1.10
Agriculture, forestry, and fishing	111	9.31
Mining	19	9.71
Construction	89	3.11
Manufacturing	92	1.36
Transportation and public utilities	45	1.69
Wholesale trade	23	1.46
Retail trade	8	0.11
Services	43	0.33
Government	27	0.43

* The relative risks were calculated using the formula (n^r/$total^r$) where n^r = fatality rate for the variable in question and $total^r$ = 0.07, the fatality rate of the total confined space fatal injuries per 100,000 employed during the period 1997 to 2001. Fatality rates were calculated using the formula ((f/e)*100,000) where f = fatal occupational injuries for the variable in question and e = estimate of employment using Current Population Survey (CPS) data.

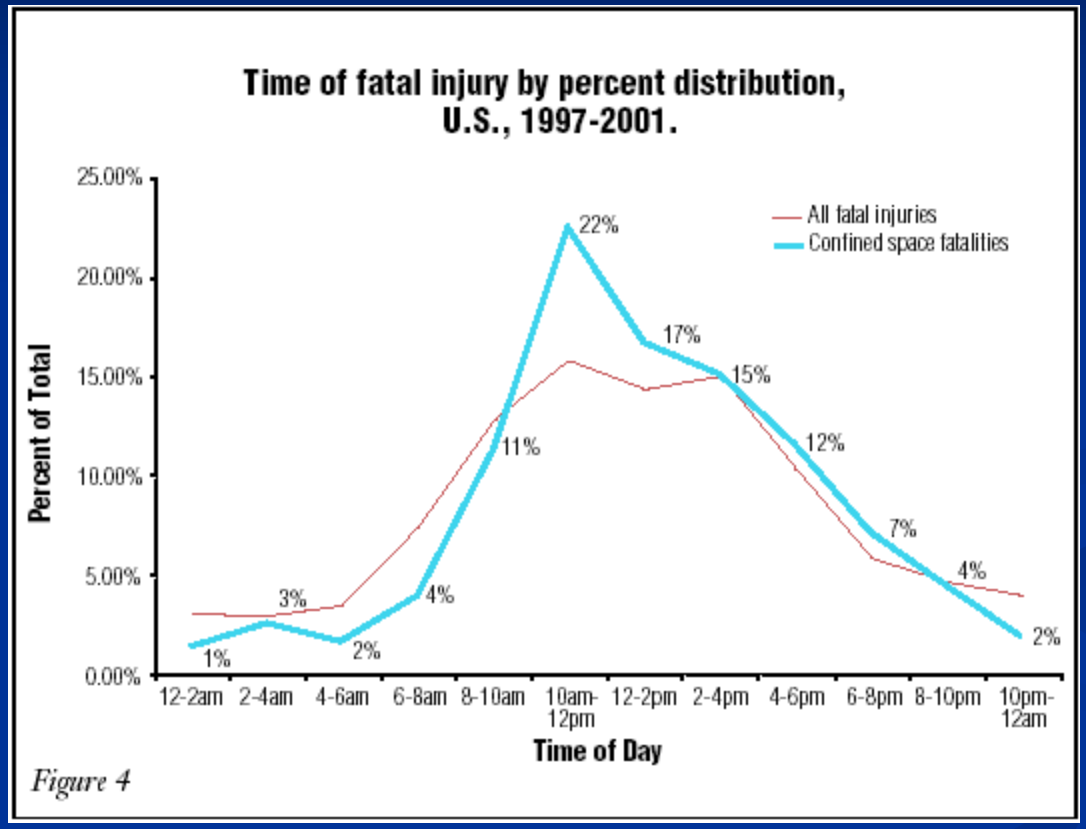

Time of fatal injury by percent distribution,
U.S., 1997-2001.
Percent of Total
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
All fatal injuries
Confined space fatalities
1%
3%
2%
4%
11%
22%
17%
15%
12%
7%
4%
2%
12-2am
2-4am
4-6am
6-8am
8-10am
10am-12pm
12-2pm
2-4pm
4-6pm
6-8pm
8-10pm
10pm-12am
Time of Day

Figure 4

Confined Spaces -Fatality Statistics

- 1980-1989:
  - Fatality occurrences: deaths/yr 100,000)
    - Trans/Utilities 77
    - Construction 90
    - Agriculture 128
    - Manufacturing 152
  - An average of 67 deaths occur annually
  - Approximately 40% of victims were rescuers

Confined Spaces
Fatality Statistics - continued

- 62% of the fatalities were due to atmospheric conditions:
  - 14% Hydrogen Sulfide
  - 10% Methane
  - 9% Inert Gases
  - 7% Sewer Gases
  - 7% Carbon Monoxide
- 38% of the fatalities were due to mechanical asphyxiation

Confined Spaces
Fatality Statistics - continued

- 95% of all entries were authorized by supervisors.
- 85% of events were in the presence of a supervisor.
- 43% of victims were “would be” rescuers.
- 31% of companies with fatalities had written confined space entry procedures.
- 29% of the fatalities were supervisors.

Confined Spaces
Fatality Statistics - continued

- 15% of all fatalities had completed confined space entry training.
- None of the fatalities followed the written procedures.
- None of the spaces were evaluated or tested prior to entry.
- None of the spaces were ventilated.
- None of the companies suffering fatalities had a rescue plan.

- Source: NIOSH, Division of Safety Research