Fire and Explosion Deaths in Construction

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Background

- NIOSH's National Traumatic Occupational Fatality (NTOF) database reported 220 deaths due to fire and 354 deaths due to explosion from 1980-1995 in construction, an average of 36 fire and explosion deaths per year.
- The rates were 0.2 fire deaths and 0.3 explosion deaths per 100,000 construction workers.
- For all construction, there was an average of 1,071 deaths annually, with an average annual rate of 15.3 deaths per 100,000 workers.

Methods

- Used Census of Fatal Occupational Injuries (CFOI) from Bureau of Labor Statistics for 1992-2003

- Fire and explosion deaths identified by selecting records with:
  - event code 5* (fires and explosions)
  - Keywords ”fire”, “explode” or “explosion” in narrative

Methods (Cont.)

- Deaths were classified into the following categories:
  - Chemical explosions
  - Fires
  - Pressurized container explosions
  - Arc flashes/blasts.

Results

- A total of 361 fire or explosion deaths involving 313 incidents were identified in the construction industry from 1992 to 2003, an average of 30 per year
- 32 multiple-death incidents involved 80 deaths (22% of total)

Fire and Explosion Deaths and Incidents in Construction, 1992-2003.

Type of incident	# deaths * (%)	# incidents (%)
Chemical explosions	161 (45%)	132 (42%)
Fires	97 (27%)	84 (27%)
Pressurized container explosions	60 (17%)	57 (18%)
Arc flashes/blasts	40 (11%)	40 (13%)
Total	358 (100%)	313(100%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Location of Incidents

- 167 incidents (53%) occurred in industrial places, including:
  - 59% of chemical explosions
  - 66% of pressurized container explosions
- 53 incidents (17%) occurred in homes
- 28 incidents (9%) occurred in public buildings

Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.

Occupation of Workers Killed

Trade	# Deaths *(%)
Construction laborers	51 (14%)
Welders, cutters	44 (12%)
Electrical workers	34 (9%)
Heavy equipment operators	25 (7%)
Carpenters	24 (7%)
Supervisors	24 (7%)
Mechanics	22 (6%)
Painters/finishers	22 (6%)
Managers/administrators	21 (6%)
Plumbers/pipefitters/steamfitters	20 (6%)
Other trades	69 (19%)
Total	358 **

* *Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

** *Doesn't add to 100% due to rounding*

Worker Activity at Time of Death

- Repair and maintenance activities accounted for 48% of pressurized container explosion deaths and 23% of all deaths.
- Welding accounted for 24% of chemical explosion deaths and 15% of all deaths.
- Other activities resulting in deaths included:
  - Driving/operating/riding on vehicles (10%)
  - Constructing/installing (10%)
  - Painting/ finishing (7%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Causes of Fatal Chemical Explosion Incidents

Cause	# Incidents* (%)
Welding	48 (36%)
Electrical sparks	13 (10%)
Heavy equipment struck underground pipelines	12 (9%)
Cutting/drilling	9 (7%)
Other	50 (38%)
Total	132 (100%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Causes of Fatal Fire Incidents

Cause	# Incidents *(%)
Welding	15 (18%)
Electrical sparks	14 (17%)
Open flames/pilot lights	12 (14%)
Motor vehicle accidents	10 (12%)
Other	32 (39%)
Total	83 (100%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Causes of Fatal Pressurized Container Explosion Incidents

Cause	# Incidents* (%)
Overpressurization	14 (25%)
Cutting, drilling or welding	8 (14%)
Other	35 (61%)
Total	57 (100%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Causes of Fatal Arc Flash/Blast Incidents

Cause	# Incidents* (%)
Electrical malfunctions/shorts	7 (18%)
Contact with overhead power lines	6 (15%)
Contact with other energized wires	6 (15%)
Other	21 (53%)
Total	40 **

**Does not add to 100% due to rounding.

* *Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Sources of Fatal Fire and Explosion Incidents *

Source	# Incidents* (%)
Chemical explosions	
• Open solvents/fuels	24 (18%)
• Fuel tanks	22 (17%)
• Chemical tanks or drums	20 (15%)
Fires	
• Open solvents	25 (30%)
• Vehicles/heavy equipment	13 (16%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Sources of Fatal Fire and Explosion Incidents (Cont.)*

Source	# Incidents* (%)
Pressurized container explosions	
• Vehicle tires	17 (30%)
• Pipes/pipelines	13 (23%)
• Water tanks	8 (14%)
Arc flashes/blasts	
• Switchboards, circuit breakers	15 (38%)
• Transformers	6 (15%)
• Other electrical wiring & parts	7 (18%)

** Source: U.S. Department of Labor, Bureau of Labor Statistics CFOI Research File.*

Discussion

- High number of multiple death incidents
  - Need for more attention to causes of these incidents
- Over half the deaths occurred in industrial plants with contract employees
  - Need for site-specific training
- Welding accounted for 15% of fire and explosion deaths, especially chemical explosions. Many involved welding on “empty” tanks or pipelines.
  - Need to ensure flushing of tanks has been done

Discussion (Cont.)

- 30% of the pressurized container explosion incidents involved exploding tires, with10/17 incidents involving flying tire rims.
  - Need for training and better procedures

- The major cause of arc flashes and blasts was working on or near energized wiring, power lines or electrical equipment.
  - Need for job hazard analysis to identify electric shock or arc-flash hazards

Conclusions and Recommendations

- Need for adequate training of contract employees in industrial plants
- Institution of a hot work permit system to reduce the number of explosions from welding on “empty” tanks and fires from welding around solvents.
- Maintaining rim wheel tires according to OSHA 1910.177 (Servicing multi-piece and single piece rim wheels) to reduce number of explosions of over-pressurized tires.

Conclusions and Recommendations (Cont.)

- De-energizing live equipment or isolating or insulating live parts could decrease the number of arc flashes and explosions.
- Institution of a live-work permit and following NFPA 70E could ensure that only qualified electricians work live safely, and only when necessary.

For Further Information

- Electronic Library of Construction Safety and Health (eLCOSH):
  http://www.elcosh.org

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