The process we used to develop "typical" flammable vapor wa incident scenarios made use of data from many sources.

- ADL collected and reviewed 167 detailed incident reports from sources and created a PC database file
- NFIRS data analyses: Heiden Associates performed numerou and sorts of this data, results received by ADL 1/9/93
- Interviews of people with knowledge of these incidents
- Published reports and studies from several sources

The analysis of the detailed reports has provided insight into i which should be addressed in the experimental program.

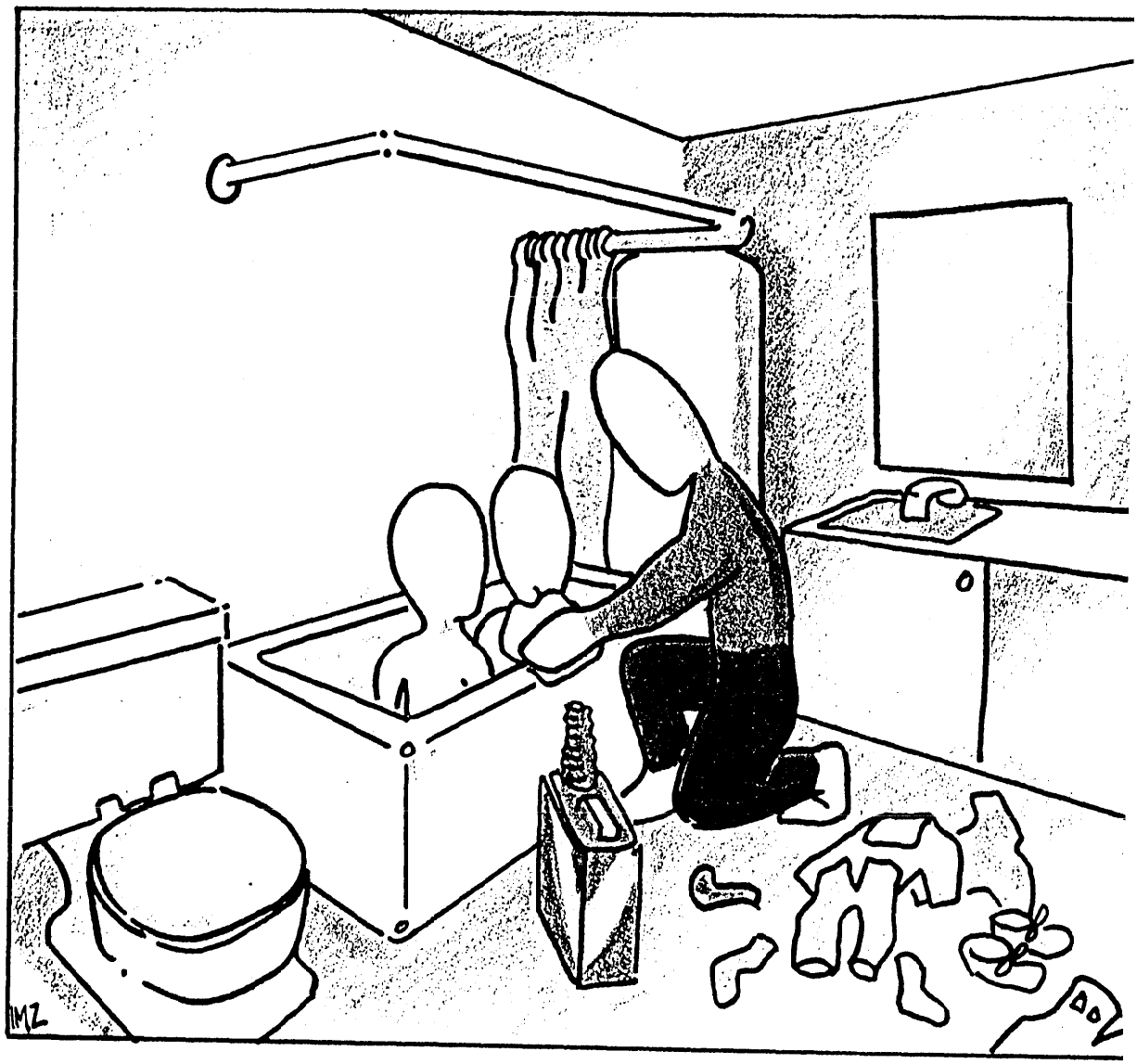
- Activity was involved in 108 of the 167 reports (65%)
- Spills were involved in 65 of the 167 reports (39%)
- Flammable liquid usage was involved in 75 of the 167 reports (
- Children were involved in 38 of the 167 reports (23%)
- Leaks were involved in 26 of the 167 reports (16%)

Note: This list does not add up to 100% due to combinations of conditions.

After review of the flammable vapor incident reports compiled NFIRS, NFPA FIDO, CPSC NEISS and IDI data, seven represen scenarios have been developed.

- 1 Bathroom Scenario
- 2 Utility Room Scenarios
- 3 Garage and Basement Scenarios
- 1 Garage Scenario

Bathroom Scenario



Bathroom Scenario: Although bathroom installation of fuel fir heaters is prohibited, flammable vapor ignition by water heate bathrooms do occur, and the injury ratio is more than twice th

A common scenario involves a person becoming "soaked" with gas some activity such as cleaning parts, car repair or fueling operation person goes to the bathroom and removes their clothing to take a l shower. Upon exiting the tub, there is a flash fire.

A similar scenario involves children becoming covered in paint and brought into the bathroom to have the material removed using gasc children are usually in the tub with a guardian using a gasoline soa clean them. In this case there is also water being used for rinsing t

Spillage of gasoline was not reported as a contributing factor in mo reviewed cases.

Bathroom Scenario

Location: Small bathroom, 10 ft x 7 ft x 8 ft

Features:
- Combination bathtub and shower unit
- Sink, Toilet, Window, 3ft x 4ft
- 40 gallon gas fired water heater, located in corn

Quantity: 1 gallon of gasoline in container

Source: Evaporation of liquid from clothing in center of room

Activity: 1 to 2 persons moving within the room. water heater

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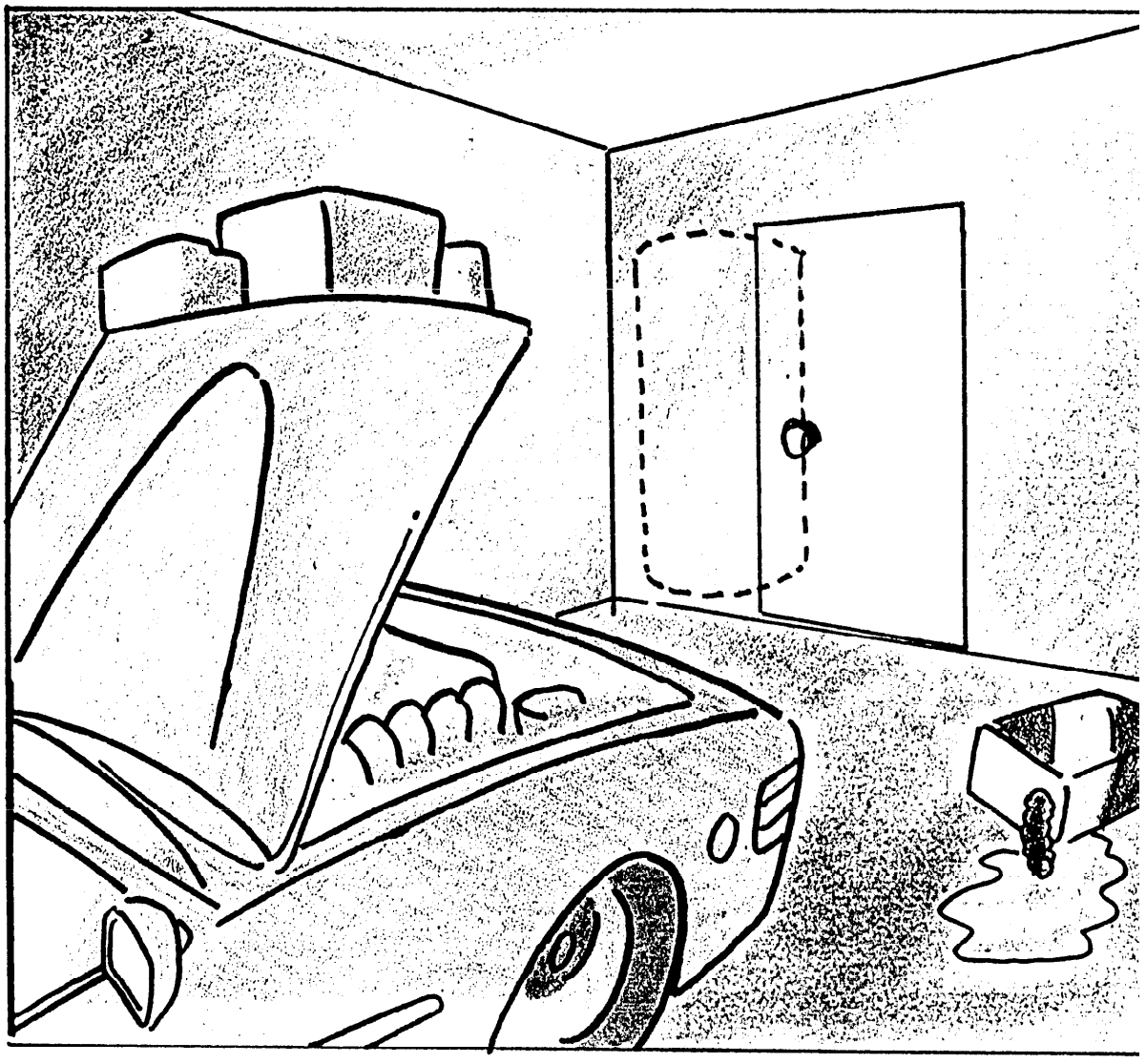
Utility Room Scenario 1: Spill outside of room



Utility Room Scenario 1: Spill outside of room

A common scenario involves a person using gasoline outside of the
for some purpose such as cleaning or fueling. The fuel is either spi
vapors from evaporation of the puddle or vapors from gasoline use
water heater located on the utility room. There is no activity or mov
the direct vicinity of the water heater. Possible operation of other e
the room at the time of the release.

Utility Room Scenario 1: Spill outside of room

Location: Utility Room, 10 ft x 10 ft x 8 ft

Features:
- Other appliances such as:
  - gas fired furnace
  - washer and dryer (electric or gas fired)
  - gasoline utilizing equipment such as lawn n motorcycles
- 40 gallon gas fired water heater, located in corn

Quantity: 1 gallon of gasoline in container

Source: Evaporation of liquid from use outside of utility room, to the water heater

Activity: No activity or movement in the direct vicinity of the wa
– Possible operation of other equipment in the room of the release

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Utility Room Scenario 2: Spill inside of room

A common scenario involves a person using gasoline inside of the for some purpose such as cleaning or fueling. The fuel is either spi vapors from evaporation of the puddle or vapors from gasoline use water heater located in the utility room. There is activity or moveme direct vicinity of the water heater. Possible operation of other equip room at the time of the release.

A version of this scenario involves children playing in the utility roon spilling a large amount of gasoline (1-5 gallons) in the vicinity of the heater.

Garage and Basement Scenario 1: Gasoline Usage

A common scenario involves a person using gasoline inside a basel garage for some purpose such as parts cleaning, auto repair, clean removal stains/rubber backed carpet from the floor. The vapors from use travel to the water heater located in the vicinity. There is activity movement in the direct vicinity of the water heater.

Only a small amount of gasoline used at any one time.

Garage and Basement Scenario 1: Gasoline Usage

Location: Garage or Basement, 20 ft x 10 ft x 8 ft

Features:

- Other appliances such as:
  - gas fired furnace
  - washer and dryer (electric or gas fired)
  - gasoline utilizing equipment such as lawn m motorcycles
- 40 gallon gas fired water heater, located in corne

Quantity: 1 gallon of gasoline in container

Source: Evaporation of liquid from use of gasoline, vapor trave water heater

Activity: Activity or movement in the direct vicinity of the water

Arthur D Little

Garage and Basement Scenario 2: Refueling

A common scenario involves a person refueling a piece of equipme
uses gasoline such as a lawn mover, weed wacker or motorcycle.
tank is accidentally overfilled or the opening is missed. This results
moderate quantity of gasoline being spilled on the floor. The vapors
gasoline use travel to the water heater located in the vicinity. There
movement in the direct vicinity of the water heater. (Examples of fl
from just refueling and no spillage were not identified directly in our

Garage and Basement Scenario 2: Refueling

Location: Garage or Basement, 20 ft x 10 ft x 8 ft

Features:

- Other appliances such as:
  - gas fired furnace
  - washer and dryer (electric or gas fired)
  - gasoline utilizing equipment such as lawn m
    motorcycles
- 40 gallon gas fired water heater, located in corne

Quantity: 1 quart of gasoline spilled

Source: Spill and evaporation of liquid during refueling operati

Activity: Activity or movement in the direct vicinity of the water

Garage and Basement Scenario 3: Children Playing

A common scenario involves children playing in the garage or base
tipping over a container of gasoline. They generally knock the can
allowing the container to empty a steady rate, or they attempt to fu
the container of gasoline. In both scenarios, there is a large amou
gasoline spilled near the water heater and activity.

Garage and Basement Scenario 3: Children Playing

Location: Garage or Basement, 20 ft x 10 ft x 8 ft

Features:

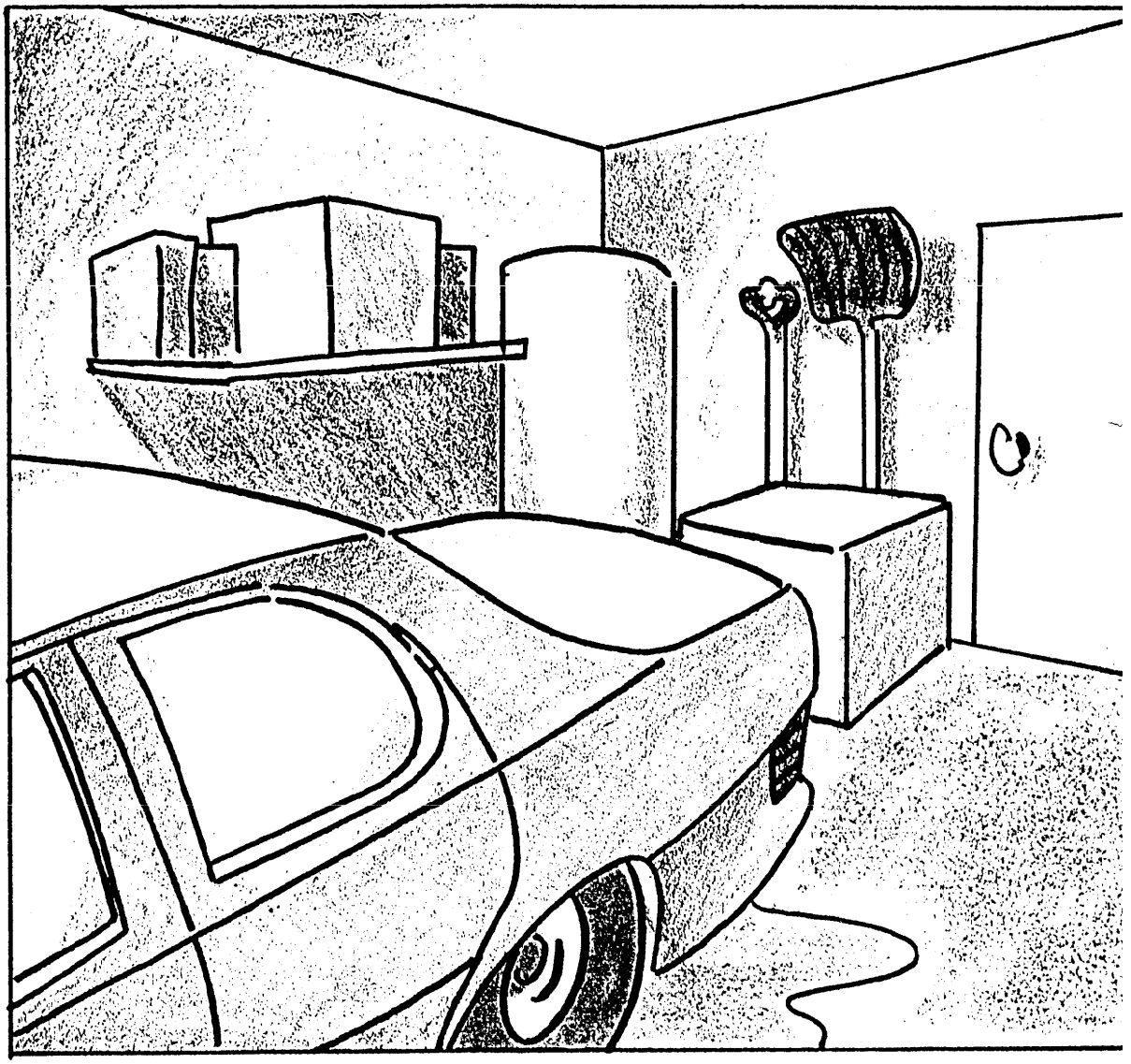
- Other appliances such as:
  - gas fired furnace
  - washer and dryer (electric or gas fired)
  - gasoline utilizing equipment such as lawn m
    motorcycles
- 40 gallon gas fired water heater, located in corne

Quantity: 1-5 gallons of gasoline in container

Source: Spillage of gasoline, vapor travel to the water heater

Activity: Activity or movement in the direct vicinity of the water

Garage Scenario 1: Leakage



Garage Scenario 1: Leakage

A common scenario involves the slow leak of gasoline from the fue
vehicle stored in the garage. The rate of gasoline loss is relatively
gasoline vaporizes and steadily buildup a flammable concentration
until ignited by the water heater.

Garage Scenario 1: Leakage

Location: Garage, 20 ft x 10 ft x 8 ft

Features:
- Vehicle
- Cement floor
- 40 gallon gas fired water heater, located in corn

Quantity: Slow leakage of gasoline from the fuel tank

Source: Evaporation of liquid from the spill of gasoline, vapor
water heater

Activity: No activity or movement in the direct vicinity of the w

The Analytical Modeling Task will be presented in the following

- Objective
- Description of the Model
- Results of Verification Experiment for the Source Component
- Dispersion Component Results
- Status

The objective of the Analytical Modeling Task is to provide ins the selection of key parameters for testing:

- Verification and/or identification of scenario patterns
- Assess parameter sensitivity for experimental tests
- Evaluate incident scenarios
- Provide theoretically based extension of experimental results

The model is comprehensive and consists of two major comp source and the dispersion. Source features include:

- Prediction of simultaneous spreading of liquid, diffusion, and e
- Both convective mass transfer and diffusion limited regimes ar
- A comprehensive energy balance for varying spill surface ther properties as well as source characteristics
- Includes effects of multicomponents

The dispersion component describes how vapor disperses fro

- The dispersion component is transient, two-dimensional, and s relevant conservation equations.

- Pool emissions are grouped either as a single (lumped) vapor species.

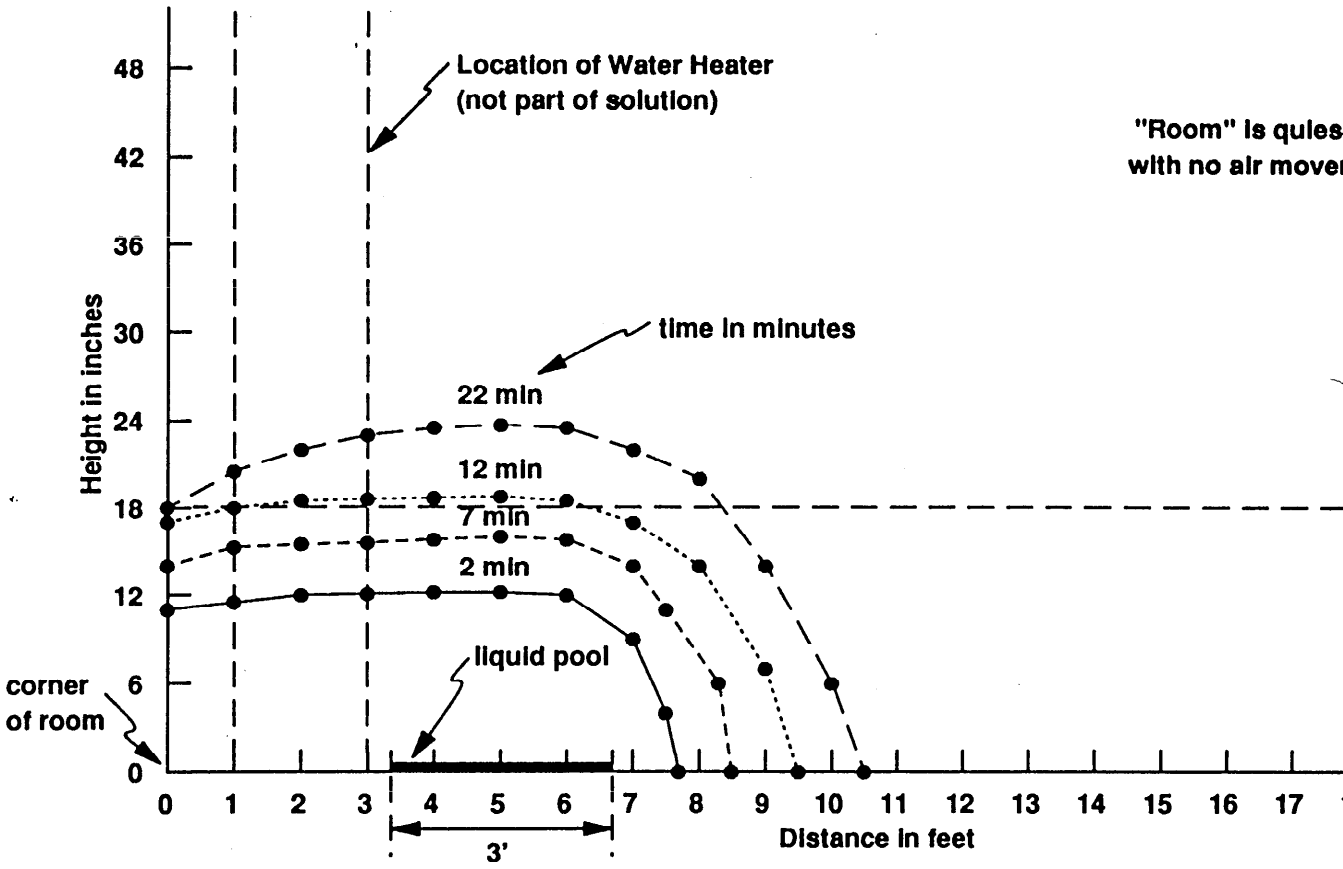
The source component of the Analytical Model is complete an verified with small-scale experiments.

Surface	Quan. (oz)	Area (in^2)	Depth (in)	Temp. (°F)	Average Mass Flux Actual (lb/ft^2s)	Predicted by Model (lb/ft^2s)	D (
Plastic	.16	35	--	45	2.09×10^{-5}	2.05×10^{-5}	
Carpet	.86	35	--	72	3.64×10^{-5}	4.31×10^{-5}	
Pyrex	1.2	10	.24	52	2.34×10^{-5}	2.67×10^{-5}	

References

1. Dehaan, J., Ph.D. Thesis, 1993
2. Arthur D. Little, Inc., Small-Scale Experiments, 1993

The lumped vapor dispersion solution indicates the position of flammable limit in space and time.



In the quiescent room, vapor "piles" up in corner and reaches I in approximately 12 minutes.

The formulation of the analytical model is complete and debug

- The source component has been verified with small-scale exper
- The results from the dispersion component with lumped pool er have been demonstrated.
- The dispersion component with emissions modeled as four spe been debugged.
- Verification of the complete model will be executed in small-scal scale experiments.
- Results from the analytical model will provide information for the matrix and theoretically evaluate incident scenarios.

Experimental Testing Task

The Experimental Testing Task will be presented in the followi

- Objective
- Small-scale Test
- Test Equipment
  - facility
  - instrumentation
- Test Plans
- Site Selection
- Status

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