

Overview of Fire Testing of Plastic and Composite Intermediate Bulk Containers

Joseph L. Scheffey

Director, R&D



HUGHES ASSOCIATES, INC.
FIRE SCIENCE & ENGINEERING

Problem

- IBCs used to store combustible and flammable liquids
 - DOT DOT Packaging Group II (IB Flammable Liquid)
 - UN31H1 - All Plastic
 - UN31HA1 -Plastic/Steel

NFPRF Industry Program

- Scope failure mechanisms
- Test palletized arrays
- Identify protection criteria
- Develop test methods
- Test rack storage arrays



Failure Mechanisms

- Doghouse/Valve Area
- Ullage
- Structural Stability



Palletized Array Testing

- 10 gal. heptane spill + 2 gpm running fuel fire
- “Nested” location (interior of array)
- 30 ft ceiling
- 1 and 2 high arrays
- 2x2 array and 2x4 with target array
- 30 minute exposure



Performance Parameters – Palletized Arrays

- No involvement of adjacent units
 - No liquid leakage
 - Holing in ullage permitted if liquid doesn't spill
- Structural stability
 - No collapse
- Maintain ceiling structural steel below critical temperatures



Conclusions – Palletized Arrays

- IBCs are designed and perform differently
- For the best performing IBCs, liquid leakage from the container could be prevented by overhead water sprinkler protection:
 - One-high storage - 0.45 gpm/sq.ft.
 - Two-high storage – 0.60 gpm/sq.ft.

Scaling Using Intermediate Test Method



Reduced Scale Tests

- Acceptable for “composite” units
 - 1:1 — 2:1 scaling factor
 - Established minimum time in reduced scale test, e.g., 20 min.
- Questionable for all-plastic units
 - Adjust intermediate-scale test parameters (sprinkler pressure)
 - Fallback — Approval test using 2 x 4 array

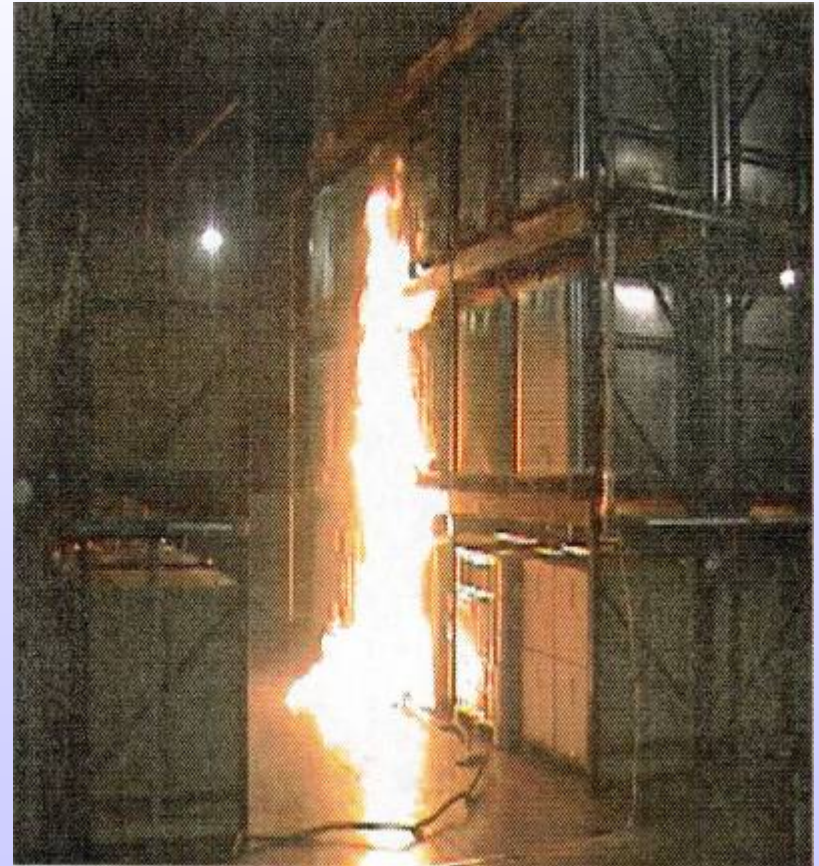
Rack Storage Tests

- 5 high storage, 8 ft. aisle
- 10 gal heptane spill + 2gpm running fuel fire
- 30 ft.ceiling
- In rack sprinklers
 - Flue and/or face
 - With and without barriers
 - Water or foam



Conclusions - Rack Storage Tests

- Need horizontal barriers
- “Surround and drown” water suppression
 - Face sprinklers at uprights
 - Flue sprinklers 4 ft O.C.
 - 50 gpm/sprinkler



Status

- Changes to NFPA 30
 - Palletized and rack storage protection criteria
 - Tables 6.8.2(i) and 6.8.2(j)
 - Listed containers
 - Class II and III liquids
- UL 2368 test standard (60-793 gal.)
 - Alternative test methods
 - No loss of liquid
 - Structural stability
 - Currently there are 2 Classified containers
 - ul.com/regulators/ibcfaq
- Other tests have been performed - proprietary

Current Issues

- There appears to be a significant amount of warehouse hazardous liquid storage in non-classified IBCs
- Class IB and IC liquid storage
- DOT approval vs NFPA listing requirement
- Importing of IBCs storing liquids