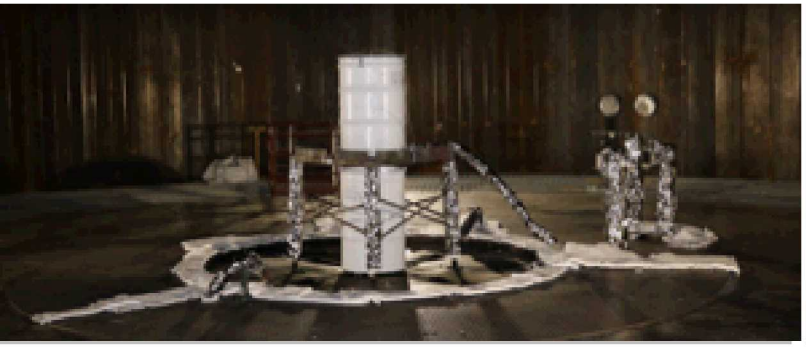
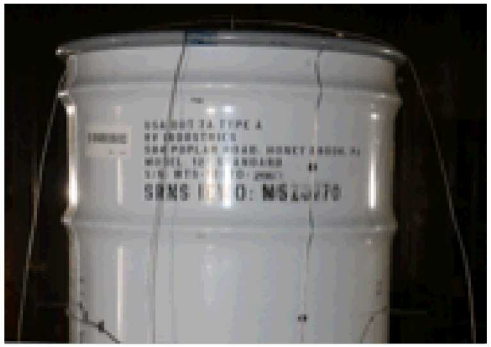
SAND2019-9153C



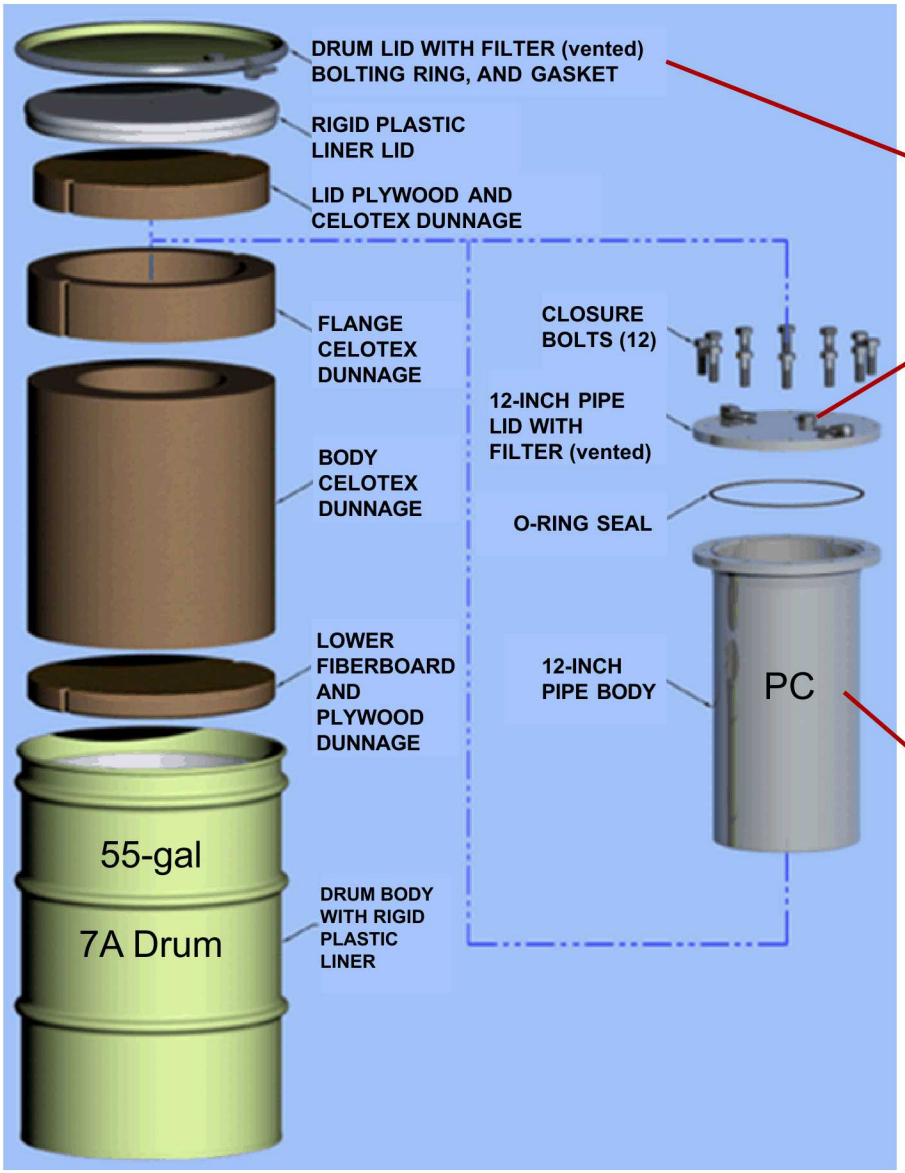


Pipe Overpack Fire Testing Program

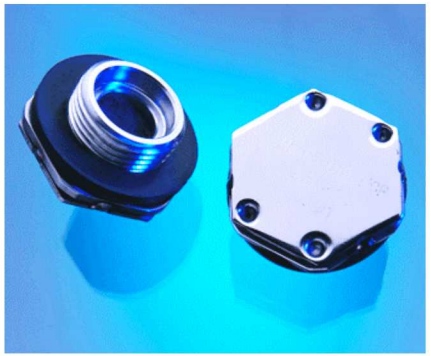
Victor Figueroa, Hector Mendoza, Scott Sanborn,
Doug Ammerman, Walt Gill, Carlos Lopez

Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525. SAND2017-XXXXP

Pipe Overpack Container (POC)



NuCFIL® 19DS
Carbon Media Filter
(hydrogen diffusivity)



Pipe Component (PC) Contents

- ❑ Cellulose
- ❑ Rubber
- ❑ Plastic
- ❑ Metal

Motivation for New POC Fire Tests

- SNL conducted test on POC type drums in 1996-7
  - Drums torqued to 40 ft-lbs
  - To certify PC with oxides and residues, not combustibles
  - One drum lid ejected late in one of the tests
    - Aerosol Release Fraction (ARF) ~ 10^{6}
- Concern that the 1996 test data is being used, but placing combustibles inside the PC
  - Jim O'Neil (NNSA Los Alamos)/Dr. Robert Nelson (DOE-EM)
  - With combustibles, the ARF could be higher than 10^{-6}
- In 2015, SNL was contracted by DOE-EM and NNSA to conduct additional fire testing of POCs
  - Repeat the 1996: Assume drum lid either remains or gets ejected early

Test Program History

- Presented at PATRAM 2016
  - Phase I fire tests were conducted to
    - Provide temperature histories of POC components with and without drum lid
  - Phase II fire tests were focused on repeating previous tests
    - With drums torqued to ~57 ft-lbs, will the drum lid stay on?
  - Phase III fire test series conducted at the Outdoor Burn Site
    - See if any aerosol released from a POC
- New Results
  - **Phase IV-A fire test series focused on new drum lid filter**
    - NuCFIL® 19DS commonly used on POC drums was replaced with a UT9424S
  - **Phase IV-B fire test series focused on drum stacking arrangement**
    - Three stacked drums with typical pallets

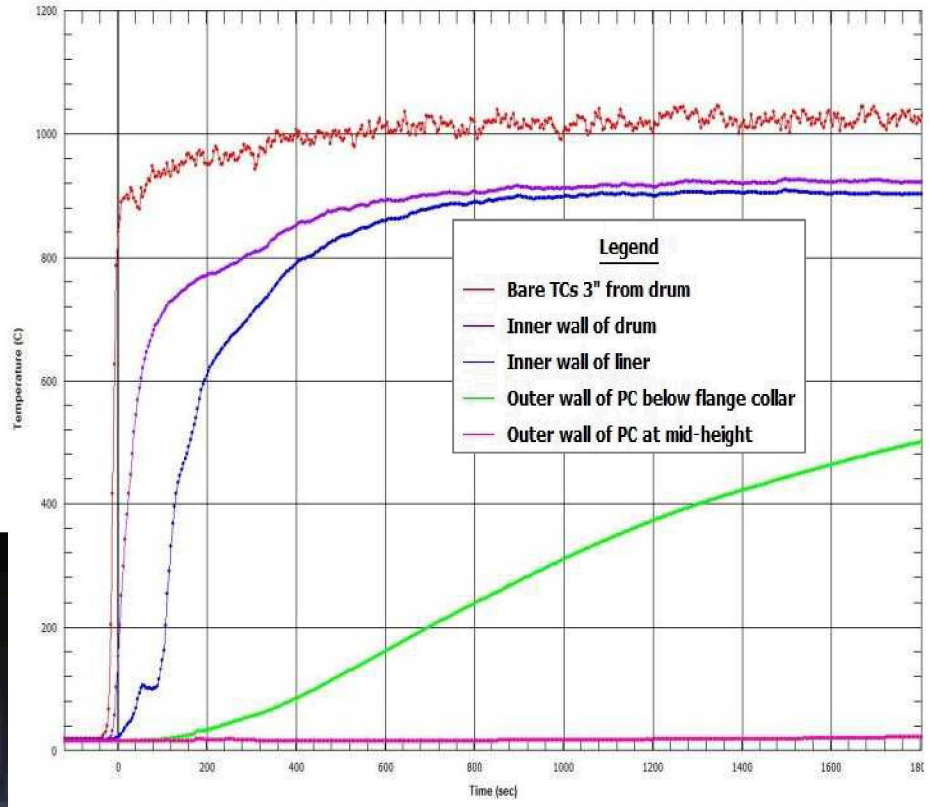
SNL THERMAL TESTING FACILITIES

INDOOR FLAME FACILITY

OUTDOOR BURN SITE

Phase I – 2015

- Two tests, POC with and without a drum lid (indoor tests)
  - Drum lid torqued below specification in one of the test
  - Measured center drum temperature



Plastics/Rubber/Cellulose start to decompose less 400°C

Phase II – 2016

- Insulation inside the PC to simulate its thermal response
- Repeat Phase 1 with lid torqued to specification in all drums (indoor)
  - No instrumentation
- Drum lid, plastic lid liner, and Celotex/plywood dunnage get ejected

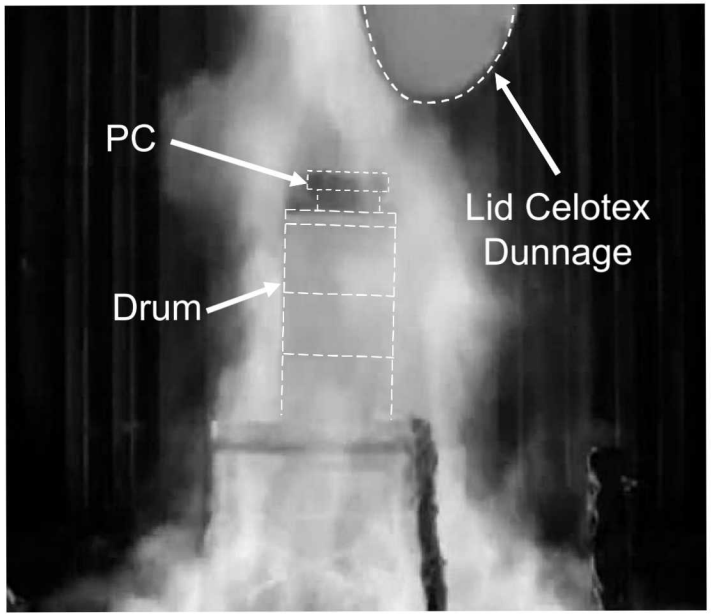
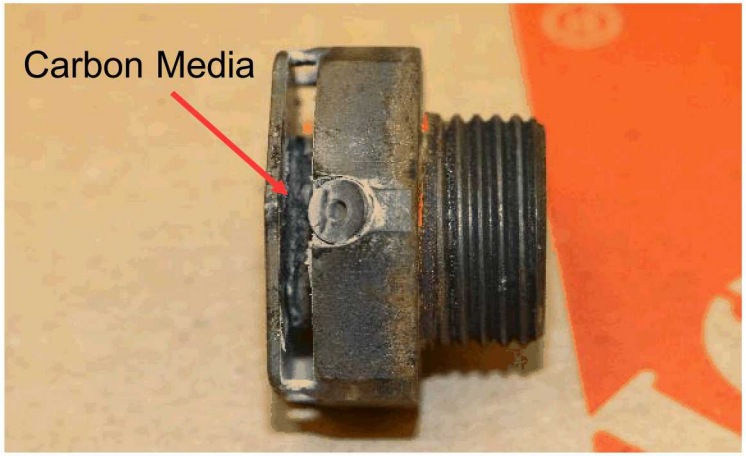


Image of fire extracted from IR Video

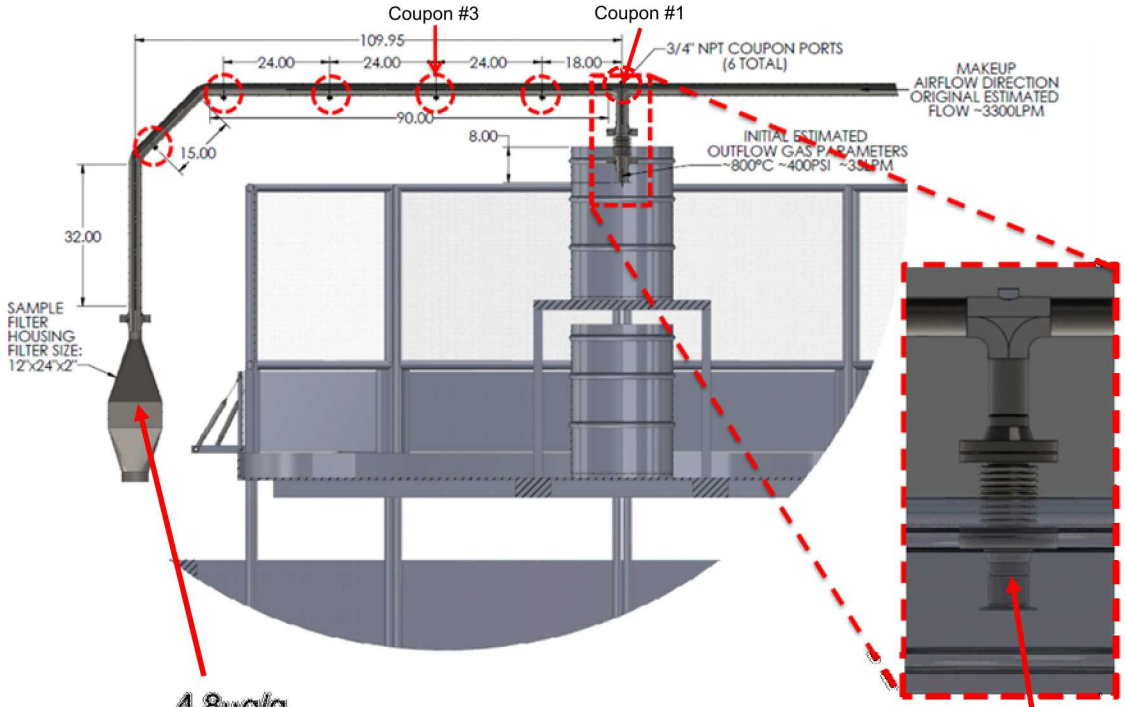
Remains inside the POC drum

Drum inside the Fire



Drum inside the Fire

Phase III – 2016



4.8µg/g (0.1g sample out of 400g digested)

15µg/g (0.0268g sample collected in coupon #2)

1.2µg/g (0.1g sample out of 8.6g collected)

60µg/g (0.1g sample out of 10.4g collected)

Phase IIA – Fall of FY '17

- Four 30-minute fire tests with at least one POC drum at the center of the fire
  - PCs loaded with combustibles
- Use a different filter (UT9474S):
  - Believed the plastic sleeve would melt before ejection of the lid

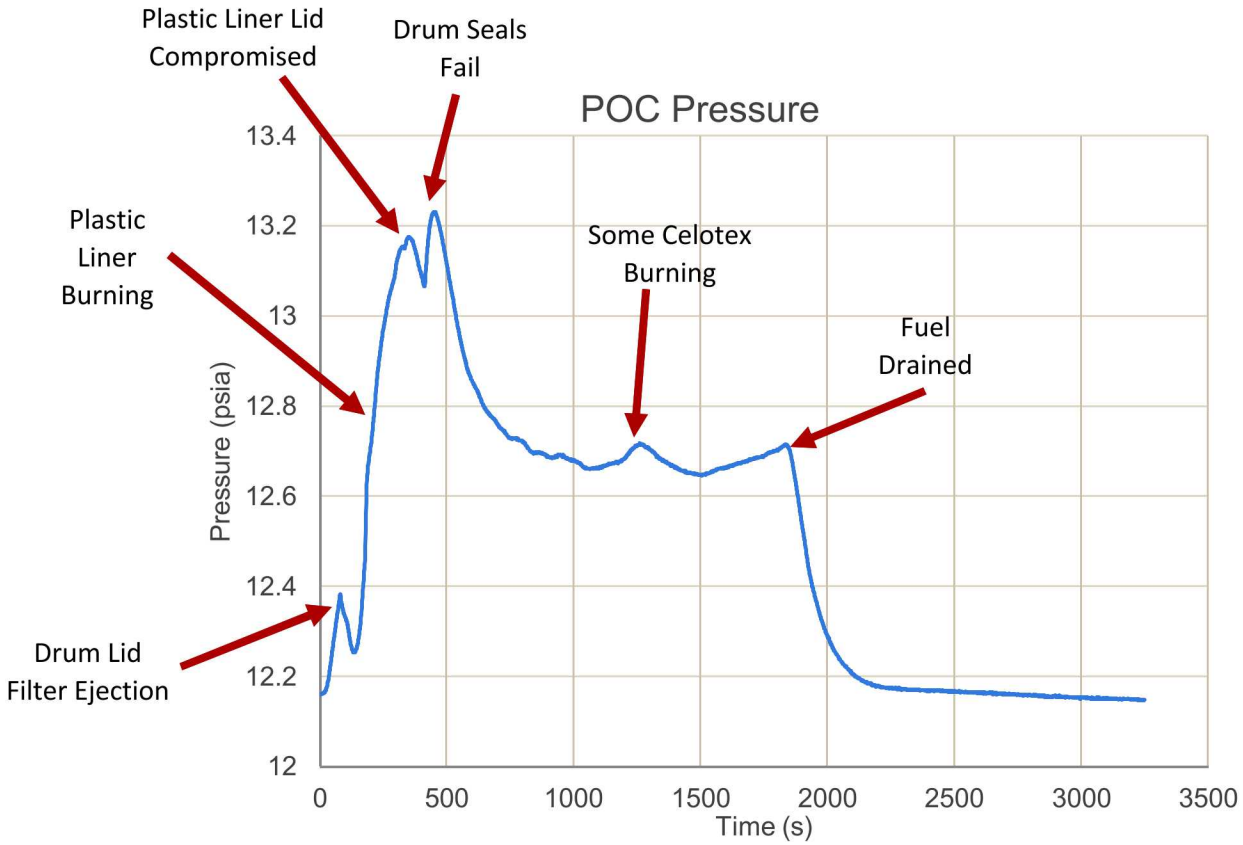
Typical setup for Tests #1 and #3

Typical setup for Tests #2 and #4

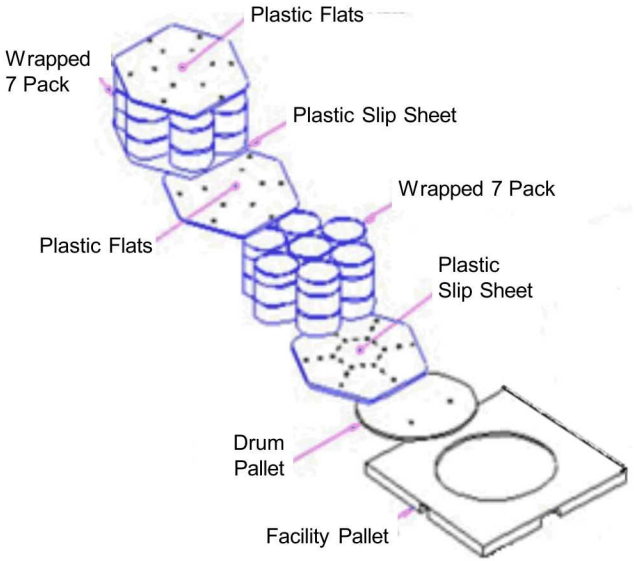
Phase IIA Fire

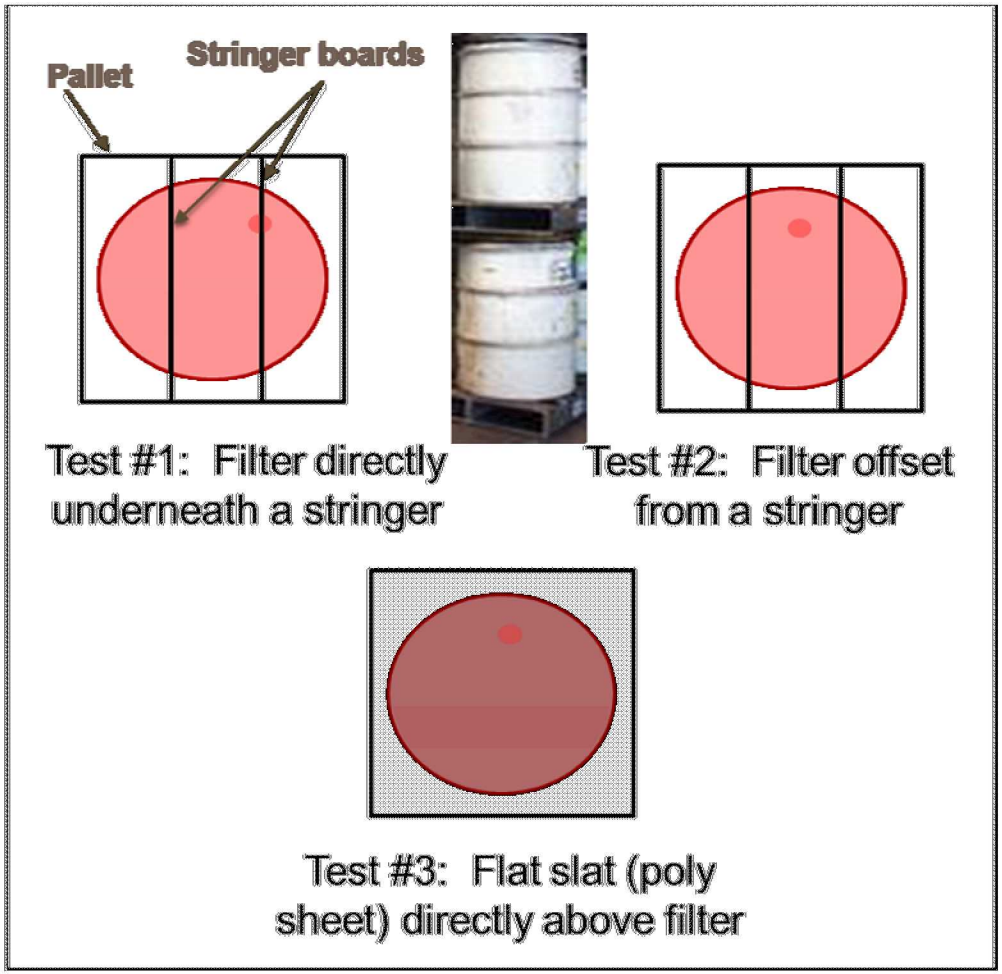
UT9474S Filter: Before and After

PC Pressure History

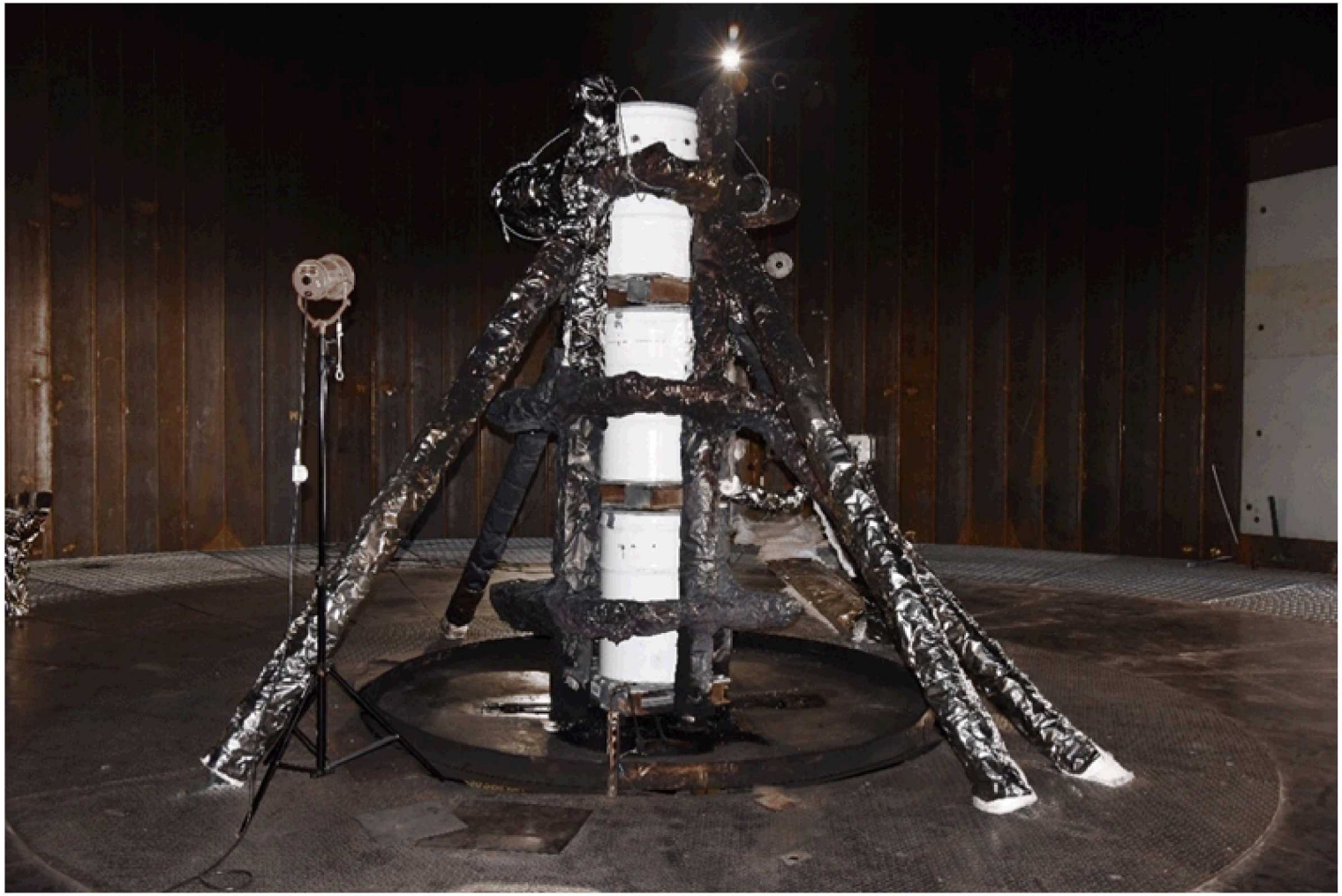


Phase III Tests: Drums Stack Arrangement





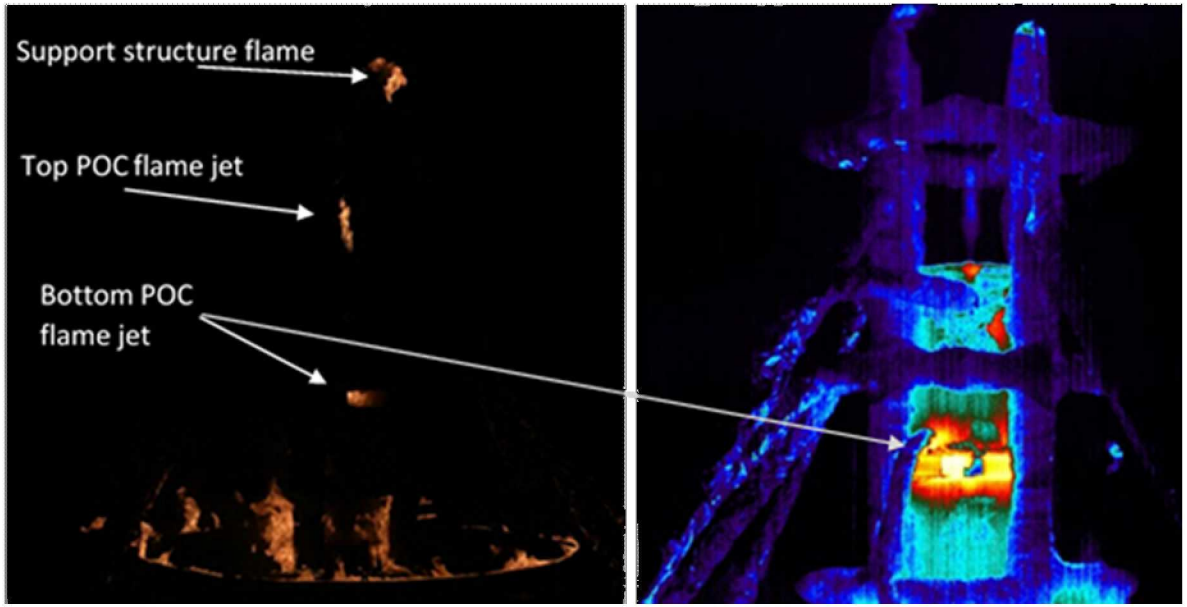
Phase III Test Setup



Phase III Results

Drum lid filters ejected, but drum lids were kept in place in all tests

PC damage ratio of zero



Summary

- With the NuCFIL® 19DS filter:
  - No issues with POC drums outside of the fire
  - Issues with POC drum is inside the fire
    - The drum lid, plastic lid, and top Celotex dunnage will be ejected
    - Very little remains of the material surrounding the PC
    - PC filter was damaged
    - Temperature inside the PC high enough to decompose materials inside PC
- With the UT9474S filter:
  - No issues with POC drums inside/outside of the fire
    - Damage Ration (DR) = 1 when the drum lid is not ejected
- Ongoing Work
  - Currently testing 7A drums with combustibles using UT9474S filter