Cargo MPS Task Group

10/29/2019
1:00 PM
Resorts, Atlantic City, NJ

Type of meeting: Task Group Meeting

Note taker: Dhaval Dadia

Attendees: Dhaval Dadia, Stephen Happenny, Enzo Canari, George McEachen, Pat Baker, Karsten Kirbach, Andre Freiling, Terry Simpson, Ian Campbell, Adam Chattaway, Xavier Tiger, Sidney Teixeira, Nels Olson, Knut Remer, David Shaw.

Minutes

Agenda item: Meeting Minutes

Discussion:

The meeting minutes for this task group will be available on the Fire Safety Branch website at the link mentioned below.
https://www.fire.tc.faa.gov/Systems/Cargo/TaskGroup

Conclusions:

Have meeting minutes available on the Fire Safety Branch website.

Action items	Person responsible	Deadline
✓ Update Meeting Minutes	Dhaval Dadia	July 25, 2019

Agenda item: Next Meeting

Discussion:

Next meeting will be a Webex on Nov. 19, 2019.

Conclusions:

Setup next Webex meeting for Nov. 19, 2019

Action items	Person responsible	Deadline
✓ Prepare an agenda for the next meeting	Dhaval Dadia	Sept. 24, 2019

Agenda item: Agenda for the meeting

Discussion:

Topics	Issue	
Next Meeting		19th Nov at 10 AM EST
Halon Replacement Handbook	New document layout	
Challenge Fire	Develop methods for Challenge Fire Scenario	Refer to Enzo
Alternate Agent Baselines	Develop methods and tests for alternate agent baselines	

The items tabulated above were the topics of discussion at the meeting.

Conclusions:

Summary of the agenda items for the Webex meeting.

Action items	Person responsible	Deadline
✓ None	N/A	N/A

Agenda item: Halon Replacement Handbook

Discussion:

There was a discussion to replace the current standard that is in the form of a FAA Technical Note, with a Handbook that would include all of the Halon replacement test methods. The benefit of this document is also to serve the purpose of being a living document which makes it easier to make amendments to the standard. The materials fire test handbook serves as a good example to follow.

Enzo made a case from EASA's point of perspective to have a report before writing the Halon Handbook. EASA's regulations point to a report for the standard and hence would make it harder to amend their regulations to point to a living document.

The layout of the handbook was discussed and volunteers decided to write portions of the document to then assemble it at the December task group meeting. The voluntary assignment is as follows.

Writing Teams

1. Introduction
    a. Purpose Dhaval
    b. Background Dhaval
    c. Scope Dhaval
    d. Agent Selection Guidance Dhaval George
        i. Environmental
        ii. Toxicology
2. Halon Replacement Handbook
    a. Cargo Compartment Halon Replacement
        i. Leak Rate Tests Dhaval, Karsten
            1. Natural leak rate + U-Tube
        ii. Unsuppressed Fires Adam
        iii. Halon Baseline Pat
        iv. Acceptance Criteria George, Adam
        v. Halon Simulant Baseline
        vi. Suppression System Design (Concentration Tests) Ian
        vii. ~~Suppression System Activation~~
        viii. ~~Test Duration~~
        ix. Bulk Load Fire David
            1. Toxicity Measurements Nels
        x. Containerized Fire Dhaval
        xi. Surface Burning Fire Adam
        xii. Aerosol Can Explosion Simulation Dhaval
        xiii. Battery Fire* Multiple Fuel Test* Enzo
3. Appendices
    a. FAA Regulations
    b. Approval Process
    c. Regulatory Methodology Used by Other Countries
    d. Cargo Test Cell Details and Instrumentation (U-Tube, Instrumentation, Permanent Gas Analysis) Nels
    e. Example of Water Mist Concentration Tests Karsten
    f. Toxicity Measurement Details and Sample Calculation Nels
    g. Ignition Source & Fire Load Details Pat

h. Temperature and Pressure Compensation for Agents David, Terry
i. Pan Construction Dhaval
j. Aerosol Can Simulator Construction Details Dhaval
k. LD3 Container Construction Details Dhaval
l. Cargo Test Results Analysis Example Dhaval, Karsten
m. Example calculation for leak rate calculation Dhaval
n. Long Version of Aerosol can Explosion simulation Dhaval

Conclusions:

Prepare assigned section material prior to the December meeting.

Action items	Person responsible	Deadline
✓ Write assigned section materials.	Task Group	Dec. 17, 2019

Agenda item: Challenge Fire

Discussion:

The following bullets summarize the discussions regarding this topic.

- Characterize sample battery with performance tests
- Define P/F for the sample batteries that would pass this characterization
- G27 has a benign battery/cell requirement
- Specify the type of ethanol
- Define SOC
- Conduct this test instead of the Bulk load test?
- Either use Bulk load criteria or conduct Halon baseline test
- IATA Box - have a fire resistant box

Conclusions:

Further discuss this issue at the next meeting.

Action items	Person responsible	Deadline
✓ Further discuss this topic.	Task Group	Nov., 19, 2019

Appendix

Special notes: Raw information used during discussions

Draft Material for new Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems

Proposal to include in the EXECUTIVE SUMMARY the following description of the Challenge Fire Test:

For the Challenge fire scenario, the acceptance criteria is no flames may be visible 1 minute after discharge of the high rate discharge bottle and the average of the five test peak temperatures shall not exceed 710°F (377°C). In addition, the average of the five test areas under the time-temperature curve shall not exceed 9850°F-min (4974°C-min). The test times when the average peak temperature cannot be exceeded and when the time-temperature area should be computed is the 28-minute interval from 2 to 30 minutes after the activation of the suppression system.

Proposal to include in the body of the test the following description of the Challenge Fire Test:

Challenge Fire Test. The intent of these tests is to ensure that halon replacement agents/extinguishment mechanism can address a complex fire that could be present in today's cargo compartments. The fire load for the Challenge fire scenario consists of material that when combusted produces a complex fire (i.e., after ignition, the resulting fire consists of Class A surface burning, Class B flammable liquid fire, and combustion of some lithium batteries). These materials will be loaded in cardboard boxes and placed on a pallet, and the entire pallet will be completely covered with plastic rain wrap.

Description of the Challenge Fire Test Fire Load:

For the Class A fire material, single-wall corrugated cardboard boxes, with nominal dimensions of 18 by 18 by 18 inches (45.7 by 45.7 by 45.7 cm) are used. The weight per unit area of the cardboard is 0.11 lb/ft^2 (0.5417 kg/m^2). The boxes are filled with 2.5 pounds (1.1 kg) of loosely packed standard weight office paper shredded into strips (not confetti). The final weight of the box and shredded paper is 4.5 ±0.4 pounds (2.0 ±0.2 kg). The boxes are conditioned to room standard conditions. The flaps of the boxes are tucked under each other without using staples or tape. The boxes are stacked in two layers in the cargo compartment in a quantity representing 30% of the cargo compartment empty volume. For a 2000-cubic-foot (56.6-m^3) compartment, this requires 178 boxes. The boxes touch each other to prevent any significant air gaps between boxes. The fire inside the ignition box is started by applying 115 volts alternating current (VAC) to a 7-foot (2.1-m) length of Nichrome wire. The wire is wrapped around four folded (in half) paper towels. The resistance of the Nichrome igniter coil is approximately 7 ohms. The igniter is placed into the center of a box on the bottom outside row of the stacked boxes. Several ventilation holes are placed in the side of the box to ensure that the fire does not self-extinguish. Ten 1.0-inch (2.5-cm) -diameter holes have been shown to be effective.

For the Class B fire, two containers of ethanol (95% purity) are used. These consist of 500 ml of ethanol placed in a balloon in one box with lithium batteries present; and, 1 gallon (4546 ml) of ethanol in an IATA approved plastic container in a box with lithium batteries. Ignition will be achieved in the box with the 500 ml of ethanol via the use of a Nichrome wire.

For the lithium ion battery fire, 150 lithium ion batteries Tenergy (18650-type) in groups of 15 batteries each will be placed in 10 boxes. The batteries will be packed together without any separators. Each box will have 5 batteries at 30% state-of-charge (SOC); 5 batteries at 60% SOC; and 5 batteries at 100% SOC. Ignition will be provided in one box (Box #4) of 15 batteries via the use of a film heater placed on a corner cell with a 5-10°F/minute rate of heat generation. Ignition will also be provided in one box (Box #5) of 15 batteries and the balloon with 500 ml ethanol via the use of Nichrome wire and electrical current. The 1 gallon of ethanol in a plastic container will be located in one box (Box #8) with 15 batteries.

Additional instrumentation required for this test will consist of the following:

1 Thermocouple on the battery with the film heater (Box #4)

3 Thermocouples on 3 adjacent batteries (Box #4)

1 Thermocouple in the box above the balloon with 500 ml ethanol (Box #5)

Ignition Sources:

a) Ignition of lithium batteries in box #4 initiated by film heater
b) Ignition of flammable fluid in box #5 initiated by Nichrome wire and electrical current

The procedure for conducting the challenge fire test is as follows:

1. Initiate thermal runaway of batteries in box #4
    - Wait for thermal runaway and venting of 3rd battery in box #4
2. Then ignite flammable fluid in box #5
3. Wait for first ceiling thermocouple to reach 200ºF (similar to MPS bulk load test sequence), if this has not occurred yet
4. Wait additional one minute (similar to MPS bulk load test sequence)
5. Initiate suppression system (similar to MPS bulk load test sequence)
6. Test Length - 30 minutes from start of suppression

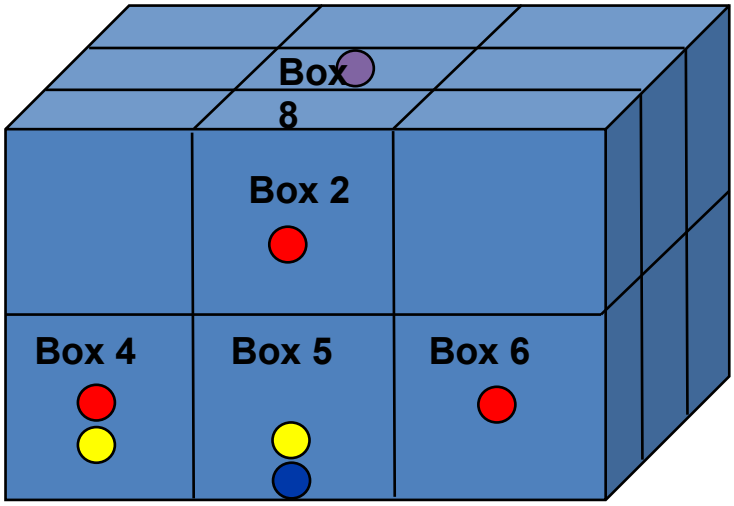
Challenge Fire Test Acceptance Criteria:

The acceptance criteria for the Challenge fire scenario is that no flames may be visible 1 minute after discharge of the high rate discharge bottle and that the average of the five test peak temperatures shall not exceed 710°F (377°C), starting 2 minutes after the suppression system is initially activated until the end of the test. In addition, the average of the five tests areas under the time-temperature curve of the compartment thermocouples shall not exceed 9850°F-min (4974°C-min). The area is computed for the 28-minute interval between 2 and 30 minutes after the activation of the suppression system.)

Figure TBD, Challenge Fire Load Setup[1]

Pallet Configuration (18 boxes)

- 150 18650 Li-Ion batteries in groups of 15 batteries per box
  1/3 at 30% SoC
  1/3 at 60% SoC
  1/3 at 100% SoC
- 500 mL ethanol
- 1 gallon (3.8 L) ethanol
- Ignition Source



18 Standard MPS boxes (total)

- Temperatures in boxes #4, #5, #6
- Oxygen concentration (2 locations)
- Carbon monoxide concentration (2 locations)
- Carbon dioxide concentration (2 locations)
- Total Hydrocarbon Concentration (1 location)
- Hydrogen concentration (2 locations)

[1] Plagiarized from "*Minimum Performance Standard Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems Testing – Challenge Fire Test*", presented to the International Aircraft System Fire Protection Working Group, by Karsten Kirbach & Dhaval Dadia, May 8-9, 2018.