JGi JAIN DEEMED-TO-BE UNIVERSITY | FIRE & COMBUSTION RESEARCH CENTER

DEFENCE RESEARCH AND DEVELOPMENT ORGANISATION

6TH Prof. P. J. PAUL MEMORIAL
COMBUSTION RESEARCHERS' MEET
and Workshop on Combustion Science in Biomass Fire and Instability- Science in the Aid of Practice

1st - 2nd MARCH 2019

Testing Methods for Fire Fighting Foams - Experience at UL-JFL

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About UL-JFL

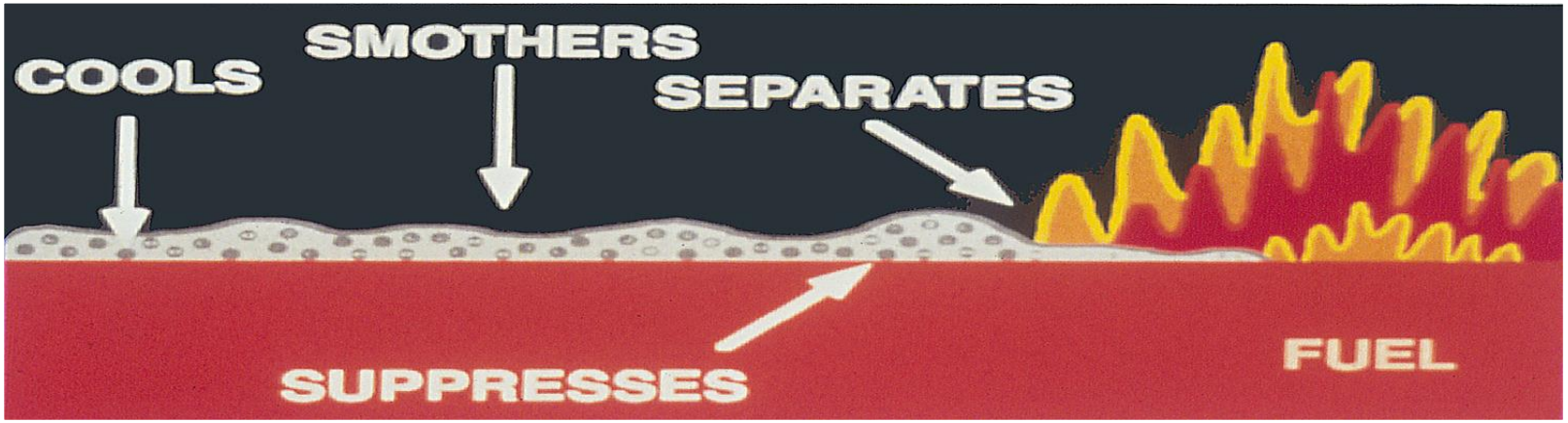
- The State-of-art indoor fire testing lab was inaugurated on Aug 2016 to carry out testing and certification of extinguishing agents and products.
- From 2010 to 2016 testing was carried at outdoor.
- The indoor fire lab with porous wall configuration is designed and architected by Prof Mukunda and Dr Dixit.

Fire fighting foam

A fire fighting foam made by mechanically mixing air with a solution consisting of fresh or salt water to which a foam liquid concentrate has been added.

How it works in fire fighting?

- Separate the fuel from the oxidizing agent
- Remove heat at a faster rate than it is released
- Dilute the vapor-phase concentration of the fuel &/ or oxidizing agent below that necessary for combustion



- What do we test ?

Fire suppression agents like Foam, Dry chemical powder and suppression products like foam – water sprinkler, foam inductors.

As of now majority of test are carried out on Foams.

- Which are the standards UL-JFL is capable of testing?

- UL 162:Foam equipment and liquid concentrates
- UL 299: Dry chemical fire extinguishers
- UL 711: Rating and fire testing of fire extinguishers
- The international civil aviation organisation (ICAO)
- BIS 4989 : Foam Concentrate for Producing Mechanical Foam For fire Fighting
- BIS 15683: Portable Fire Extinguishers
- BIS 14609 : Dry Chemical Powder For Fighting A,B, C, Class Fires
- BIS 4308:Dry Chemical Powder For Fighting B, C Class Fires

Testing Method for foam:

Foam is tested for Sealability, flowability and Stability

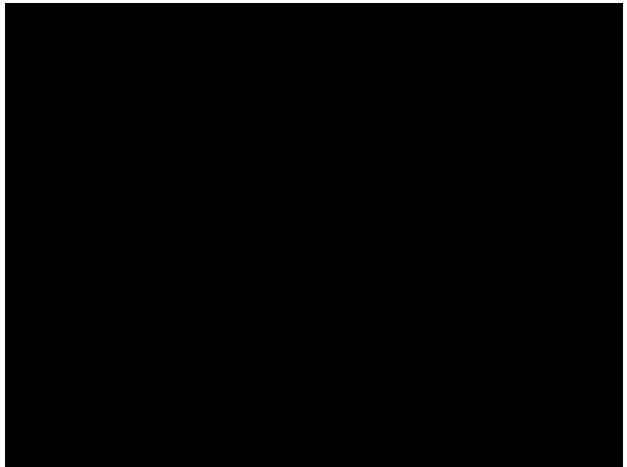
UL 162

1) Flow rate calibration :Application rate- 2gpm
2) Foam quality : a) Quarter Drain time - The time required for a 25 percent volume of liquid foam solution to drain from the foam sample. (minimum 1 min)

   b) Expansion ratio- The ratio of final foam volume to original foam solution volume before adding air. (6 to 10)

3) Fire test performance: Pan details 20B-50ft^2 (square),12 inches height, (fuel- 2”(n-heptane), water – 2”, FB- 8”)

- Preburn -60s
- Foam application (3 min) which involves 90 % control(A reduction in fire intensity of approximately 90 percent) and fire extinguishment.
- 2 Torch tests (to check seal ability) – within 7 min after foam application
- Burn back test (Flowability and Stability):10min after foam application, Restrict the spread of fire during a 5 minute duration to a total area of not more than 10 square feet

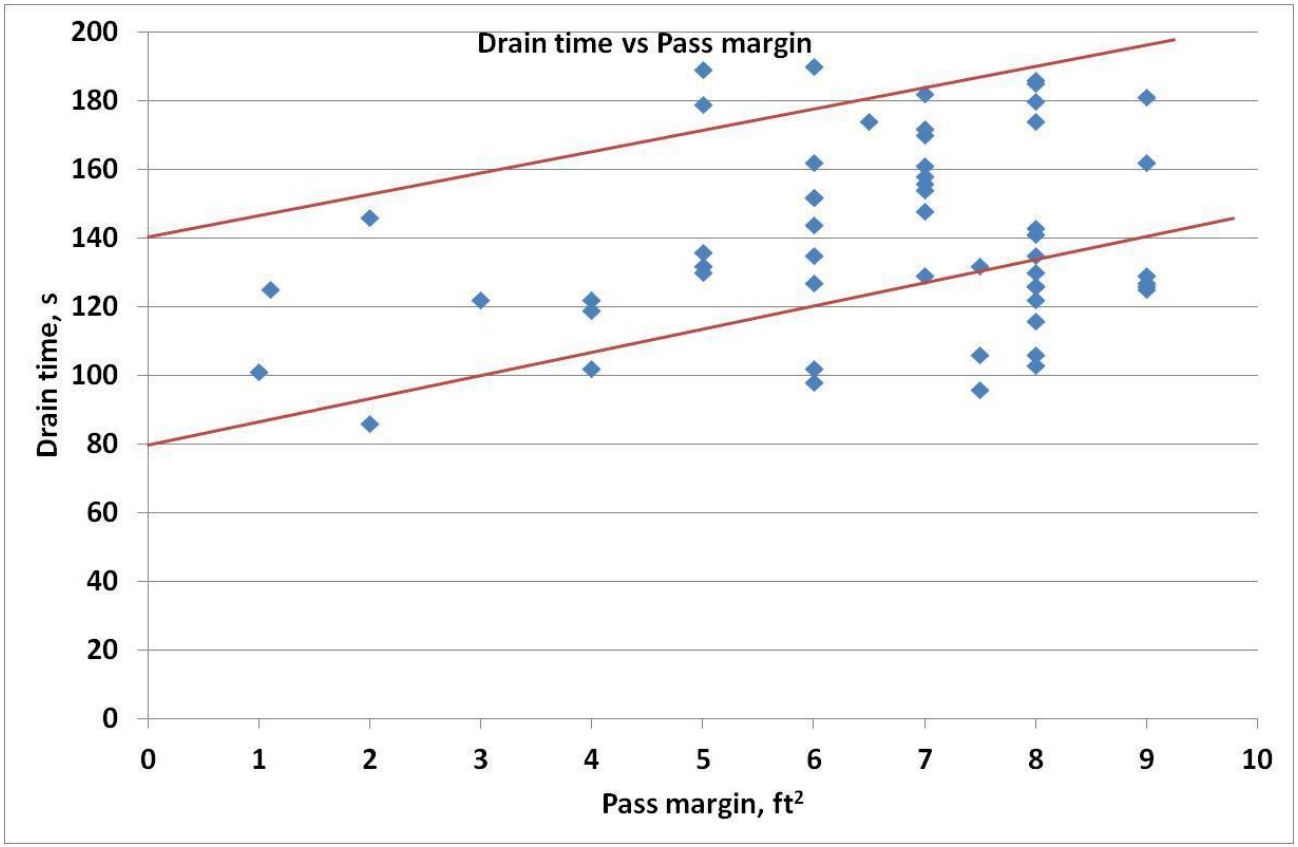


Analysis of test data

Over 67 (56 –passes, 11 –Failed) fire test has been carried out for the foam concentrate AFFF 3% with 2GPM as per UL 162, the statically analysis of test data as:

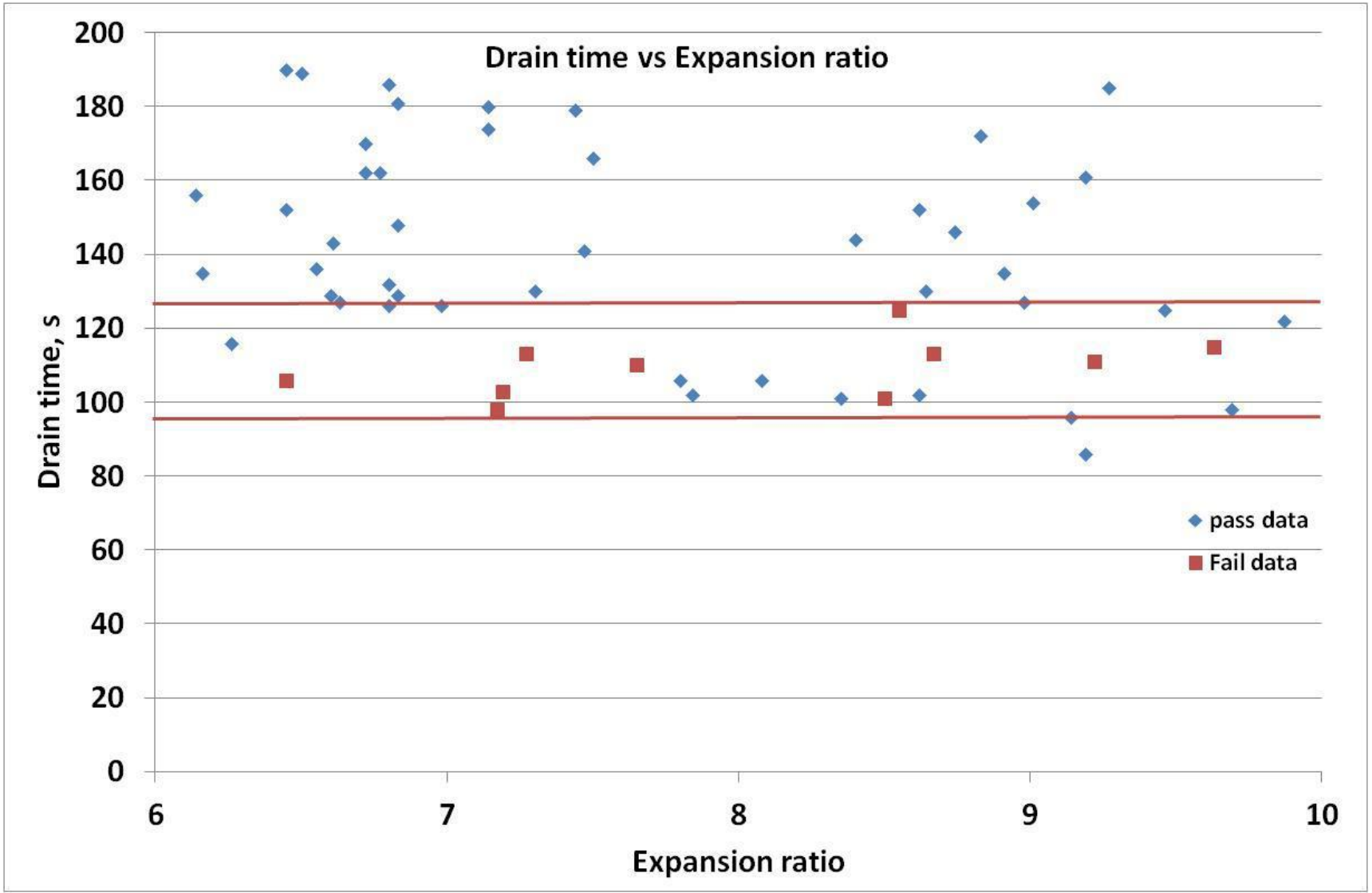
- **Effect of Drain time on Pass margin**

Foam with higher drain time have higher pass margin



- Effect of Drain time range on passed and failed foams

Average drain times for certified foams is about 150 s, and for failed foams it is 110 s.



Which standard is more Rigorous?

Standard/ Parameters	IS 4989 part-1	UL-162
Type of Pan	Circular pan	square pan
Pan Surface area, ft^2	27(d=5.78ft)	50(7.07*7.07 ft)
Application density, gpm/ft^2	0.074	0.04
Preburn, s	30	60
Foam application, min	3	3
sealability(Torch test), min	Not done	4th & 10th
Burn back ignition, min	8	5
stove pipe dia/Burn pot dia, mm	120 mm(1 ltr of fuel)	305
Compliance criteria for burn back	should not exceed 25 % of area	should not exceed 20% of area

Summary

- Foam with higher drain time and optimal expansion ratio have higher pass rate.
- Foam which has qualified have average DT of 150 s and for failed foam it is 110s.
- UL 162 has square pan where flowability of foam to the corners of pan is critical, while others standards has circular pan in which flow ability of foam is much easier.
- The foam which has qualified UL 162 will also qualify IS 4989 but vice versa is rarely to happen.
- Overall, it appears UL test criteria is more Rigorous compare to other standards.

Thank you