Harmonization and improvements to the test procedure for Fast Cook-Off (STANAG 4240)

EXPERT IMEMG WORKING GROUP

Group's goals:

- ✔ Harmonize Fast Heating test procedures and acceptance criteria
- ✔ Look for new alternative solutions
- ✔ Evaluate equivalence of liquid fuel and alternative solutions

Liquid Fuel Fire
(Courtesy of SBTC, Sweden)

POOL FIRE TESTS – How standardized?

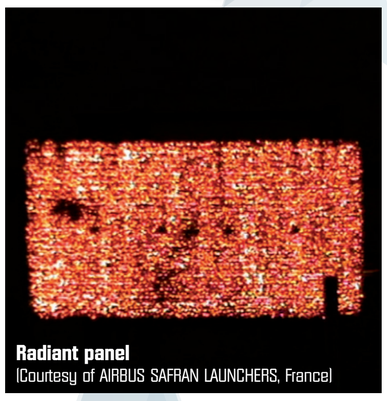
- ✔ Repeatability and uniformity are difficult to ensure
- ✔ Wind is identified as a critical test parameter

ALTERNATIVE SETUPS - An opportunity to improve test repeatability?

- ✔ The next standard for Fast Heating testing will include the possibility to perform alternative aggressions provided that they are proved to be representative of fuel fires

State of the art – Liquefied Propane Gas burners, propane jets, sand-bed burners, radiant panels,...

LPG Fire
(Courtesy of WTD91, Germany)



Radiant panel
(Courtesy of AIRBUS SAFRAN LAUNCHERS, France)

Propylene gas burners
(Courtesy of NEXTER, France)

US liquid propane fueled burners
(Courtesy of NSWC - US Navy, US)

Propane gas "hell flute"
(Courtesy of BTC, Sweden)

- ✔ Very different alternative test setups experimented with throughout the world: *WTD91 (Germany), NSWC (US), NAWCDWD (US), BTC (Sweden), TNO (Netherlands), AIRBUS SAFRAN LAUNCHERS (France), NEXTER (France), DIEHL BGT Defence (Germany), Hirtenberger DS (Austria), etc.*
- ✔ Large or small scale facilities (for representativity or research purpose)

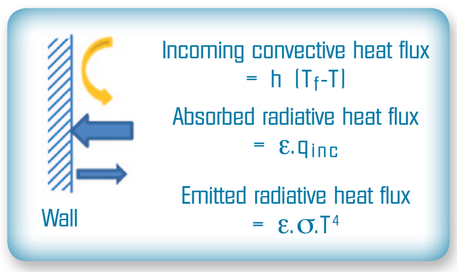
The consistency of IM test results shall be guaranteed whatever the fire test method

FUTURE CHALLENGES – IMEMG companies views:

- ✔ EQUIVALENCE between Liquid Fuel Fires and alternative setups :
  - Comparable heat flux data achieved on some tests BUT dispersions observed in both cases
  - Equivalence needs to be validated for all phases (ignition and hot phases)
- ✔ CALIBRATION DEVICES AND CRITERIA :
  - Harmonized apparatus necessary to obtain comparable measurements

Which heat flux?

Assuming the net wall heat flux density may be expressed by the following equation, a comparison of heat flux outputs expected by existing fire heat flux meters is done in the hereafter table: $\Phi\ net = h.(T_f - T) + \varepsilon.(q_{inc} - \sigma.T^4)$



Device	Expected outpout	Comment
Adiabatic Surface Temperature method (AST probe, PT, ...)	$q_{inc} = \sigma.\ T_{AST}^4 - h/\varepsilon.(T_f - T_{AST})$	Incident radiative heat flux at equilibrium, $\Phi_{net} = 0_2 T = T_{AST}$
Directional Slug Calorimeter	$\Phi_{DSC} = h.(Tf-T) + \varepsilon.q_{inc}$	Total absorbed heat flux
Bi-thermocouples	q_{inc}	Incident radiative heat flux
Calorimeter, Directional Flame Thermometer	Φ_{net}	Total net heat flux

T = wall temperature, T_f = gas temperature, h = convective heat transfer coefficient, ε = wall emissivity, q_{inc} = incident radiative heat flux

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