Key Aspects of the CFR 1633 Gas Burner Test

Tom Ohlemiller
National Institute of Standards & Technology
Building and Fire Research Laboratory

- Assumptions:
  - The bedclothes are ignited first in a typical fire
  - The mattress/foundation is the biggest fuel load (capable of causing room flashover)
  - The mattress needs to survive the burning of the bedclothes long enough for the fire to be suppressed by a fire department
  - The CFR 1633 gas burners test the reaction of a mattress to burning bedclothes

Burning Bedclothes

Burning Bedclothes

- The stress that burning bedclothes impose on the mattress surfaces is measured in terms of heat flux
    - **How intense?**
    - **How long does it last?**
    - **On what area?**

Burning Bedclothes

- **The heat flux from bedclothes is highly variable over the mattress/foundation surfaces**
- **On average, the heat flux is less on the vertical sides than on the top surface of the mattress**
- **Heavier bedclothes combinations, on average, increase the total heat stress seen by the mattress/foundation surfaces**
- **Burning bedclothes impact all exposed surfaces eventually**
- **Burning bedclothes initiate persistent mattress/foundation crevice fires that can last many minutes**

CFR 1633 Gas Burners

- Gas burners provide a reproducible way to simulate the heat stress from burning bedclothes

- Focus is on applying “worst case” heat flux on a typical area of the mattress and foundation

    - Test this typical area for ability to withstand direct, intense fire exposure (most intense on top)

    - Initiate spreading flames on surfaces and in crevice that eventually challenge other areas of the mattress

- Differences between burning bedclothes and gas burners:
  - A bed fire will tend to develop faster with real bedclothes because the rate of flame spread is faster on bedclothes
  - The total area heated/charred is larger on average with bedclothes. This can sometimes yield a failure with bedclothes if a charring barrier is prone to splitting via char shrinkage.

Features of the Gas Burner Flame

- Dim flamelets attached to each hole in the burner
- A much brighter plume results from the combined flamelets
- Highest heat fluxes are in the jets, not in the bright plume

Critical Aspects of the Burner Exposure

<u>To Get Correct Heat Flux:</u>

- Heat content of propane
- Propane flow rate
- Burner to mattress spacing
- Minimal air flow disturbances

Critical Aspects of the Burner Exposure

- Propane Heat Content (sets flame temperature)
    - CP grade preferred
    - HD-5 grade acceptable
    - Commercial LPG is potentially too variable

Critical Aspects of the Burner Exposure

- Propane Flow Rate
  - Affects how far the flame jets project from the burner heads (e.g., low flow = low heat flux on mattress)
  - Flow meter setting and flow meter calibration are key

Critical Aspects of the Burner Exposure

- Burner Head to Mattress Spacing
  - Heat flux goes down as spacing increases
  - Jigs and stand-off feet, in combination with a prescribed set-up procedure, must be used to get the spacing right

Critical Aspects of the Burner Exposure

- Minimal Air Flow Disturbances
  - Movement of the flame jets lowers the average heat flux that the mattress sees
  - Screens around the exposure areas can help but other solutions may be required in severe cases

- Proper attention to all of the preceding items will assure that the actual burner exposure tests typical areas of the mattress/foundation as severely as intended

- The next 29 minutes of the test look at the consequences of that test exposure (esp. the response to crevice flames) as the resulting fire spreads

Summary

Gas burners provide a reproducible simulation of the heat stress from burning bedclothes BUT, they provide the intended heat flux only if all CFR 1633 procedures are followed.