FIREPLACE EMISSIONS STANDARDS DEVELOPMENT

South Coast Air Quality Management District

Wood Smoke Control Technology Forum and Roundtable Discussion

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WHY HAS THE DEVELOPMENT OF A SPECIAL EMISSION STNADARD FOR FIREPLACES BECOME SO IMPORTANT?

- EPA's promulgation and subsequent tightening of ambient air quality standards for PM-2.5 (fine particulates < 2.5 μm) may trigger the designation of numerous areas in the country as non-attainment for PM – Particularly in fast growing areas

WHY ARE FIREPLACES IMPACTED BY THIS?

- At present, fireplaces considered uncontrolled sources of PM-2.5.
- Presently no AP-42 emission factor available for “clean-burning” fireplaces, nor any test method for developing them,
- Only current options for SIP planners are: EPA certified Woodheaters (woodstoves), or Gas fireplaces

New Type Appliance Needed

- Cleaner than traditional fireplaces-
- Not a “Woodheater” as defined by EPA-
- Appliance that Looks Like a Fireplace, and “costs out like a Fireplace, Also.
- THIS HAS BEEN THE DRIVING FORCE BEHIND THE WORK THAT HAS BEEN GOING ON FOR THE LAST 3+ YEARS.

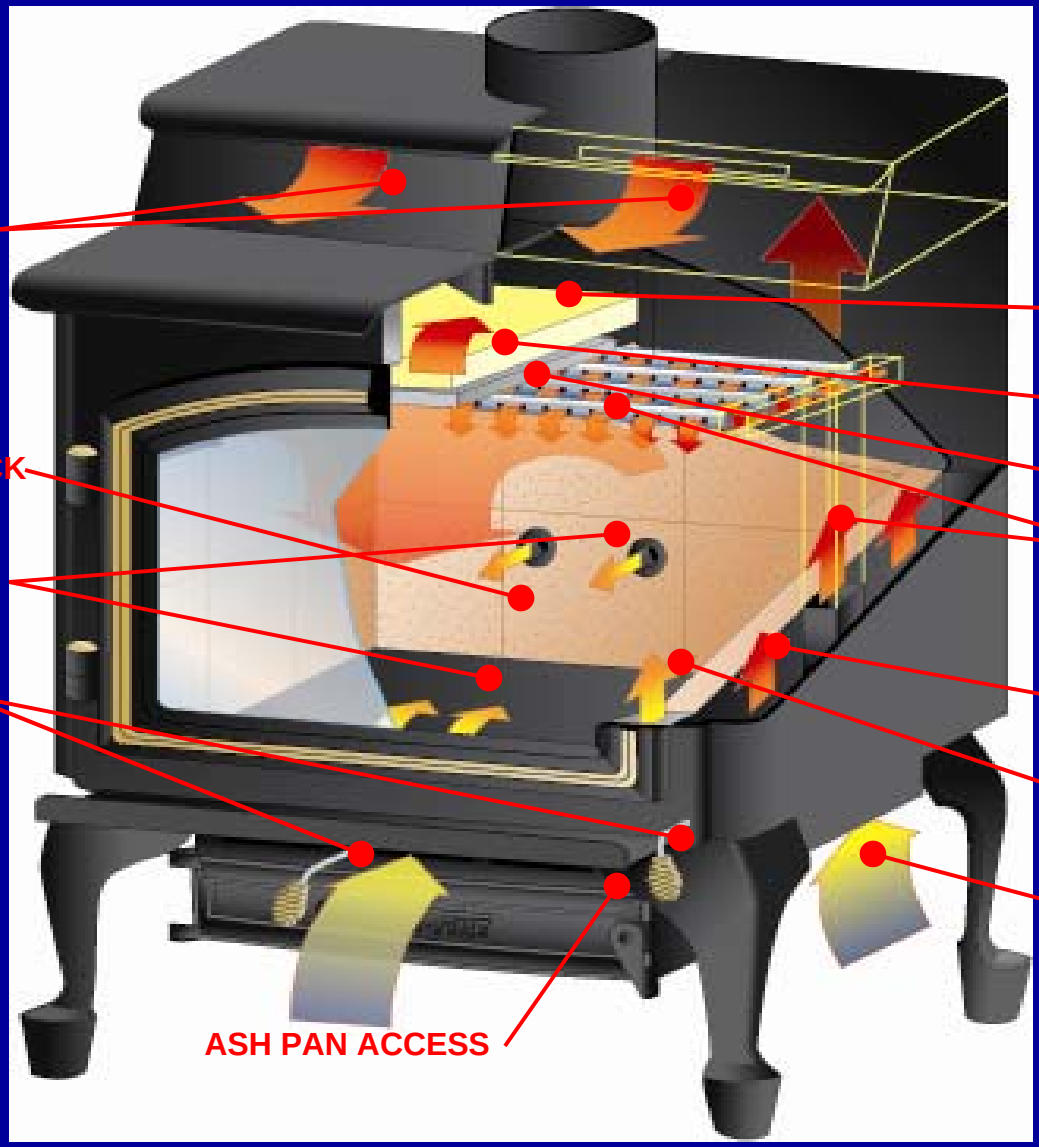
The Fireplace Industry

- Part of a larger category – the **Hearth Products Industry**
- Over 400 manufacturers overall
- 3 “Major” & 25 “Large” companies -
  - EPA certified woodheaters
  - Pellet stoves
  - Gas Fireplaces
  - Gas Logs

Woodheaters Regulated in 1988

- EPA's NSPS standardized
- Specifically Regulates "WoodHeaters"
  - i.e. Products which are burned 24/7 for H<u>eat</u>
  - Test method is based on products where homeowner controls both Fuel & Air,
- Fireplaces were excluded from this Rule
- Results – Products that Heat, & can burn clean at Low, or High Burn rates

EPA Phase II Certified Controlled



EPA Phase II Certified Controlled Combustion

- Low Stack Flow Rate
  - High Burn under 20 cu. ft/ min
- Air Limited, Controlled Combustion
  - Air to Fuel ratios 10 - 14:1
- High Firebox Temperatures
  - Helps to Initiate & Sustain Secondary Combustion
- Limited Firebox Volume
  - 1 - 5 Cu. Ft.
- Woodstoves are Heating Appliances
  - Less Frequent Fueling with Full Firebox Loads
  - Typically 24/7 Burning Cycle

EPA NSPS Reflects Oregon Method

- Method has led to development of 100's of Clean Burning, Woodheating products since promulgation in 1988,
- EPA certified woodstoves available in many different configurations,
  - Free Standing,
  - Inserts, (for existing Fireplaces),
  - Factory built ("Zero-clearance" Woodstoves)

EPA-Certified, “ZERO-CLEARNACE” WOODSTOVE

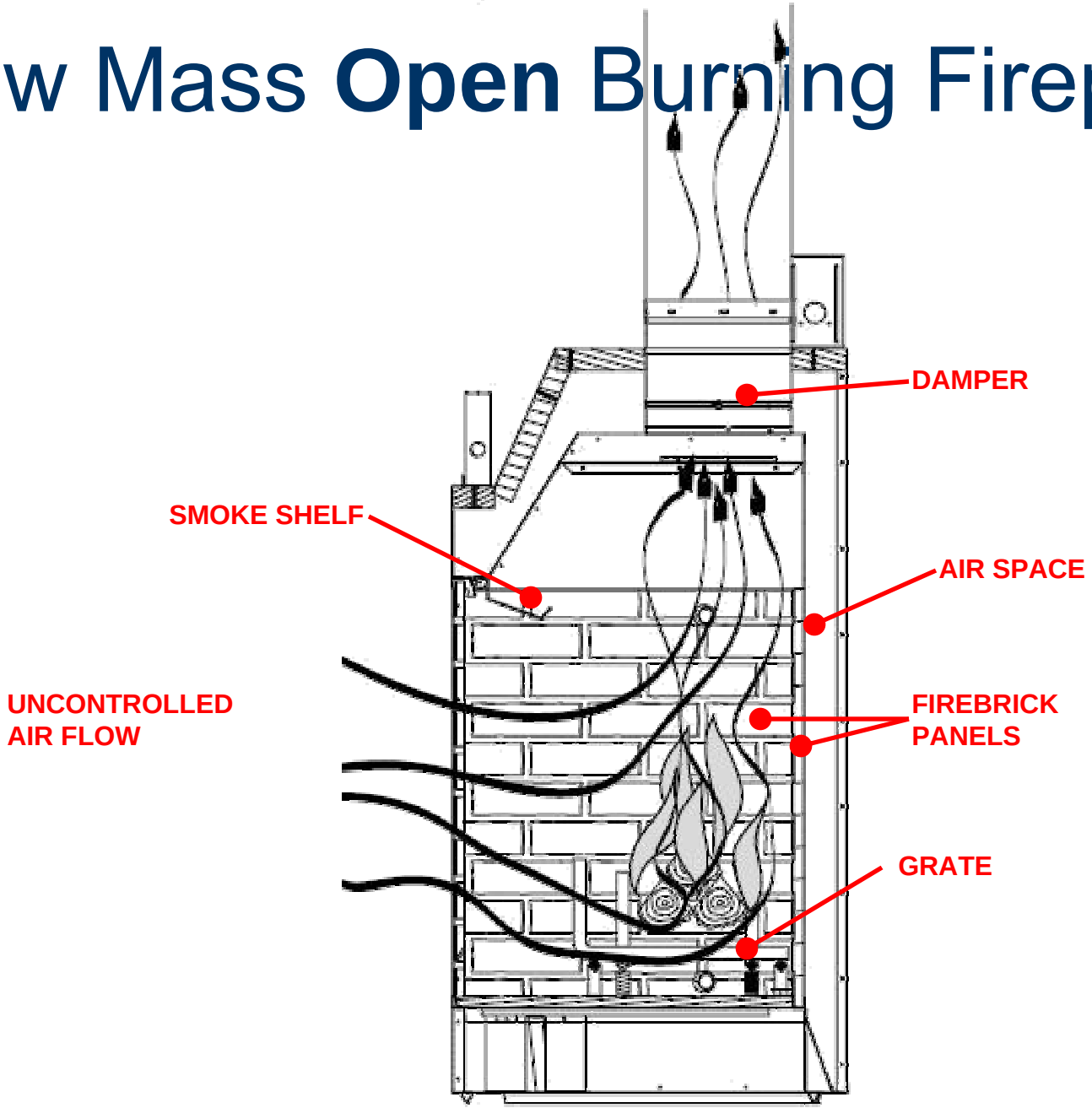
Open Burning Fireplace - Masonry or "Factory Built" Fireplace (Zero-Clearance)

- High Stack Flow Rate
  - Can be in Excess of 200 cu. ft/ min
- Free Air Flow, Uncontrolled Air Flow Paths
  - Air to Fuel Ratios above 40 - 50:1
- Relatively Low Firebox Temperatures
  - Almost Impossible to Initiate and Sustain Controlled Secondary Combustion
- Large Firebox Volume
  - Often > 10 Cu. Ft.

Fireplaces are Aesthetic Devices

- Small Fuel Load -Relative to Firebox Volume
- More Frequent Fueling with One or Two Fuel Pieces Added
- Infrequent Use Pattern (if used at all!)
- Typically 3 – 4 Hour Burn Cycle
- This is why Fireplaces Excluded from NSPS
- Must cost less than EPA Woodheater to be included in new homes

Low Mass **Open** Burning Fireplace



Factory Built Fireplace

New Product & New Test Method - Needed

- Method must –
  - Reflect way Homeowners Burn a Fireplace—Not a Woodstove
  - Result in product that Looks like Fireplace—Not a Woodstove
  - Allow Creation of product that costs Homebuilders & Homeowners what a “about” what a Fireplace Currently Costs

How to Create New Method?

- Multiple Step Process
  - Industry met with EPA in 2004 – both agreed to move forward with a Voluntary clean-burning fireplace program.
  - Industry leaders began to fund research looking at all available fireplace data and to create new data.

TEST METHOD DEVELOPMENT

- All parties agreed - first critical milestone was to develop a particulate test method fireplaces, -- a baseline,
- It was **recognized that the test method must provide a** realistic assessment of fireplace performance.
- test method must be repeatable and reproducible.

TEST METHOD DEVELOPMENT

- Under the auspices of ASTM (American Society of Testing of Materials), task group assembled.
  - Included representatives from:
    - USEPA
    - HPBA Manufacturers
    - Test Laboratories
    - State and Local Regulators
    - HPBA Staff

Test Method Developed Through ASTM Process

- ASTM - internationally recognized consensus-based organization.
- ASTM standards are used to evaluate thousands of products and materials.
- ASTM utilizes a methodical (often time-consuming) process to reach true consensus.

INDUSTRY FUNDED PROGRAMS

- Review of Fireplace Emission Literature- Develop Baseline Target
- Emission Sampling Procedures for Dilution Tunnel Method
  - Testing at 2 EPA recognized labs
    - Dilution Tunnel Flow Rate Evaluated
      - 5000 CFM vs. 1500 CFM
    - Conclusions
      - 1500 CFM ADEQUATE COLLECTION & DILUTION AT LOWER COST
      - FLEXIBLITY IN TUNNEL FLOW NEEDED AS NEW FIREPLACE TECHNOLOGIES EMERGE - ALL TESTING TO-DATE CONDUCTED ON “STANDARD” FIREPLACES

- During ASTM Process, Emission Measurement Method was Separated from the Fueling & Operation procedures (with concurrence of USEPA/ORD)
  - Intent evolved to create Dilution Tunnel Based PM measurement method that could be used in future for <u>ALL</u> Solid Fuel Burning devices,
    - LOW MASS FIREPLACES (FACTORY BUILT)*
    - OUTDOOR HYDRONIC HEATERS
    - MASONRY HEATERS
    - MASONRY FIREPLACES (HIGH MASS)*
    - WOODSTOVES

*HIGH MASS - LOW MASS FIREPLACES WERE SEPARATED TO ALLOW WEIGHT-BASED FUELING PROCEDURES FOR LOW MASS FIREPLACES.

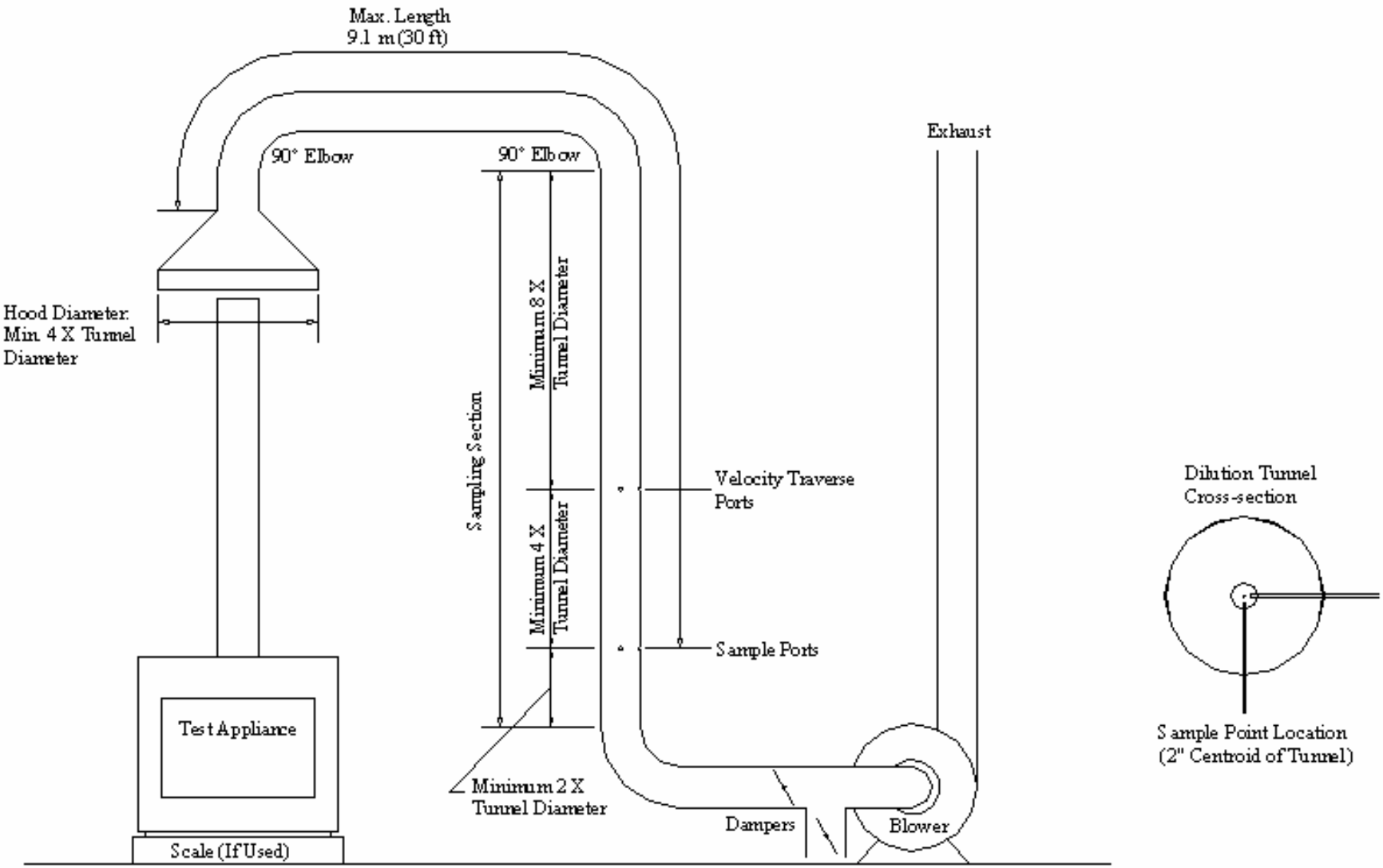
ASTM E251-07

– Successfully Balloted through ASTM

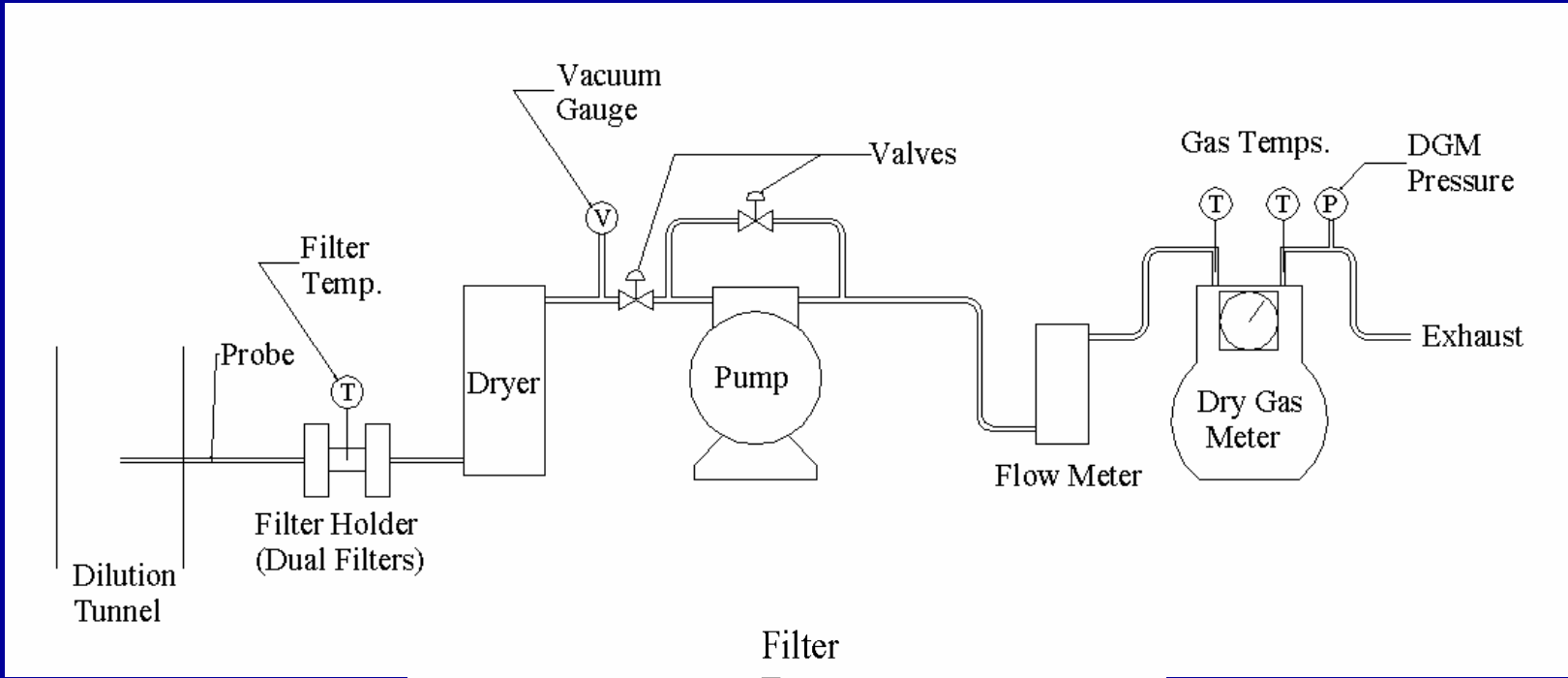
- Dilution Tunnel method
- Dual 47 mm Filer trains
- No Alternative Procedures (original EPA method burdened with several alternatives)

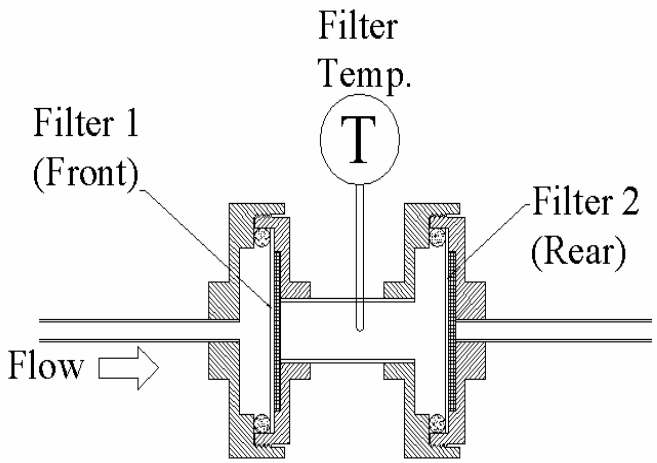
– PUBLISHED AND IS READY FOR USE!

DILUTION TUNNEL SYSTEM



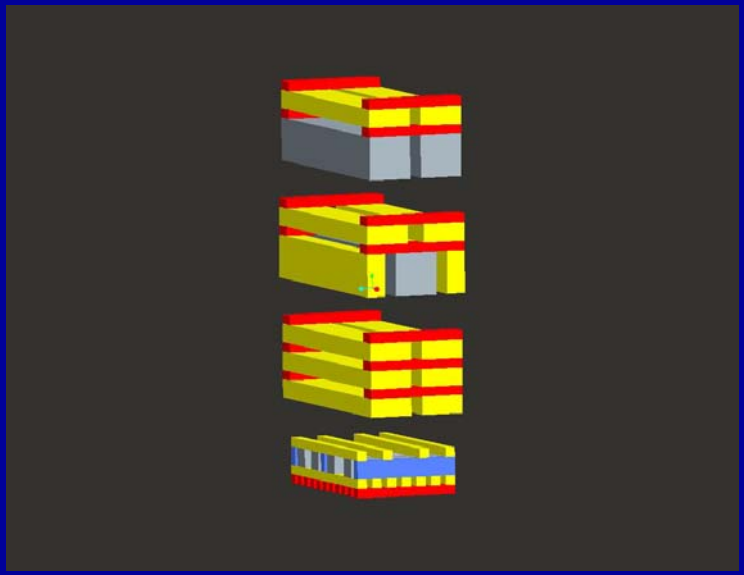
SAMPLING TRAIN AND FILTER HOLDER

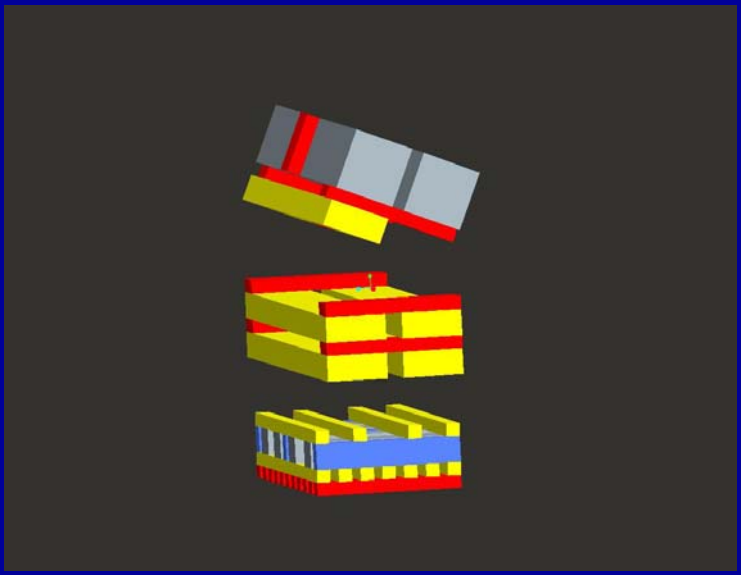


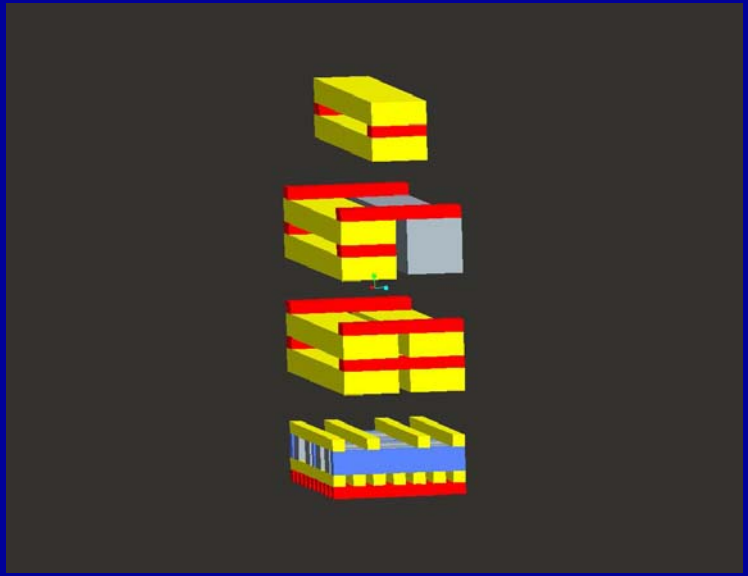


Industry Funded Programs

- Fueling Protocol
  - Crib Development –Initial Concept
    - Newspaper & Kindling Start-Up
    - Use 3 crib loading protocol to simulate High, Medium, & Low firing rates,
    - Each crib is to be added once previous crib substantially consumed
  - Conclusion – based on extensive testing,
    - The initial crib fires burned Differently than a cordwood fire,
      - Slower to ignite due to large mass,
      - Large fire results once the crib "takes off"
      - Results in "Spiked" Burn Profile
  - **Fire Not Representative of Cordwood Fire,**

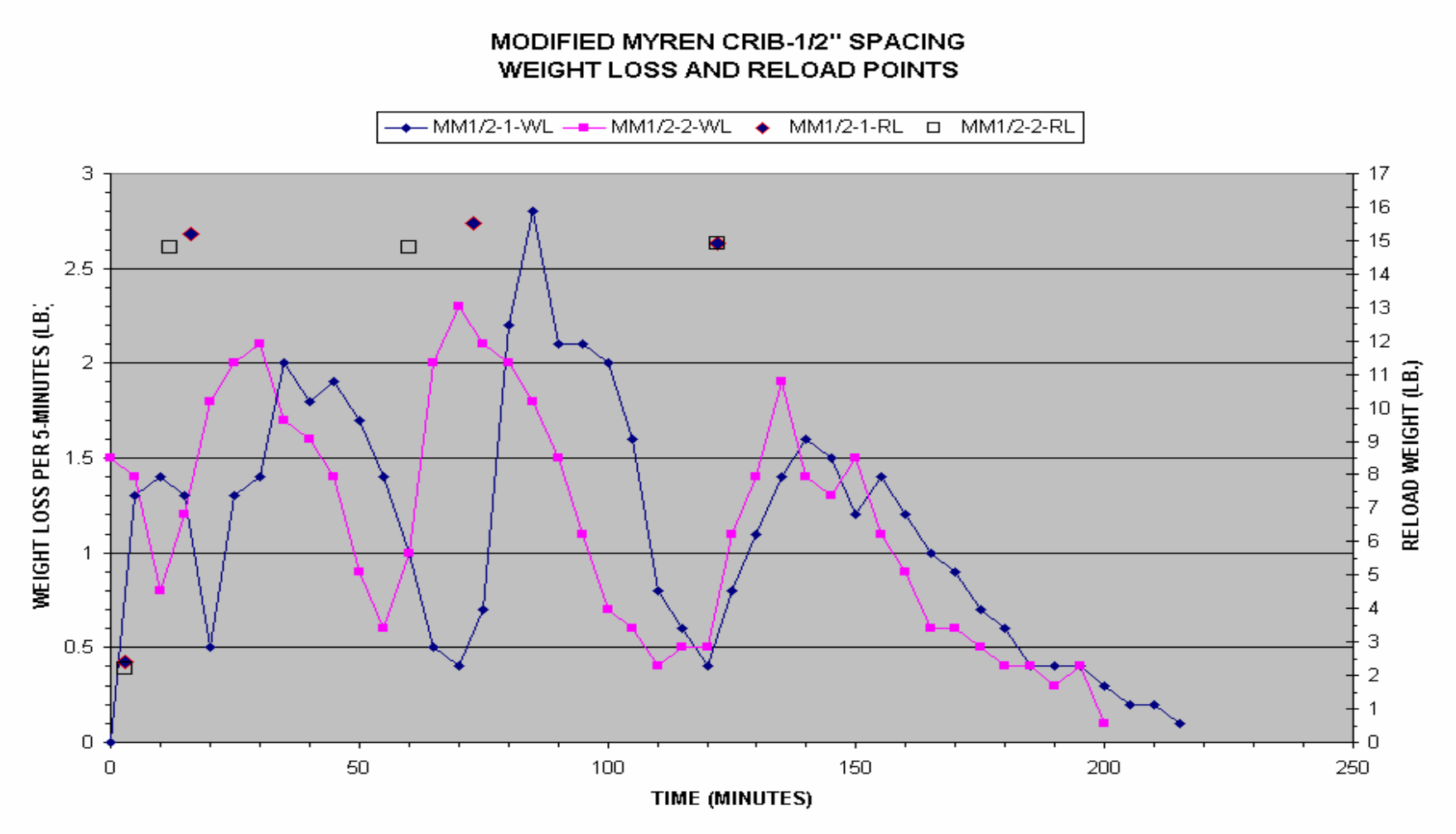




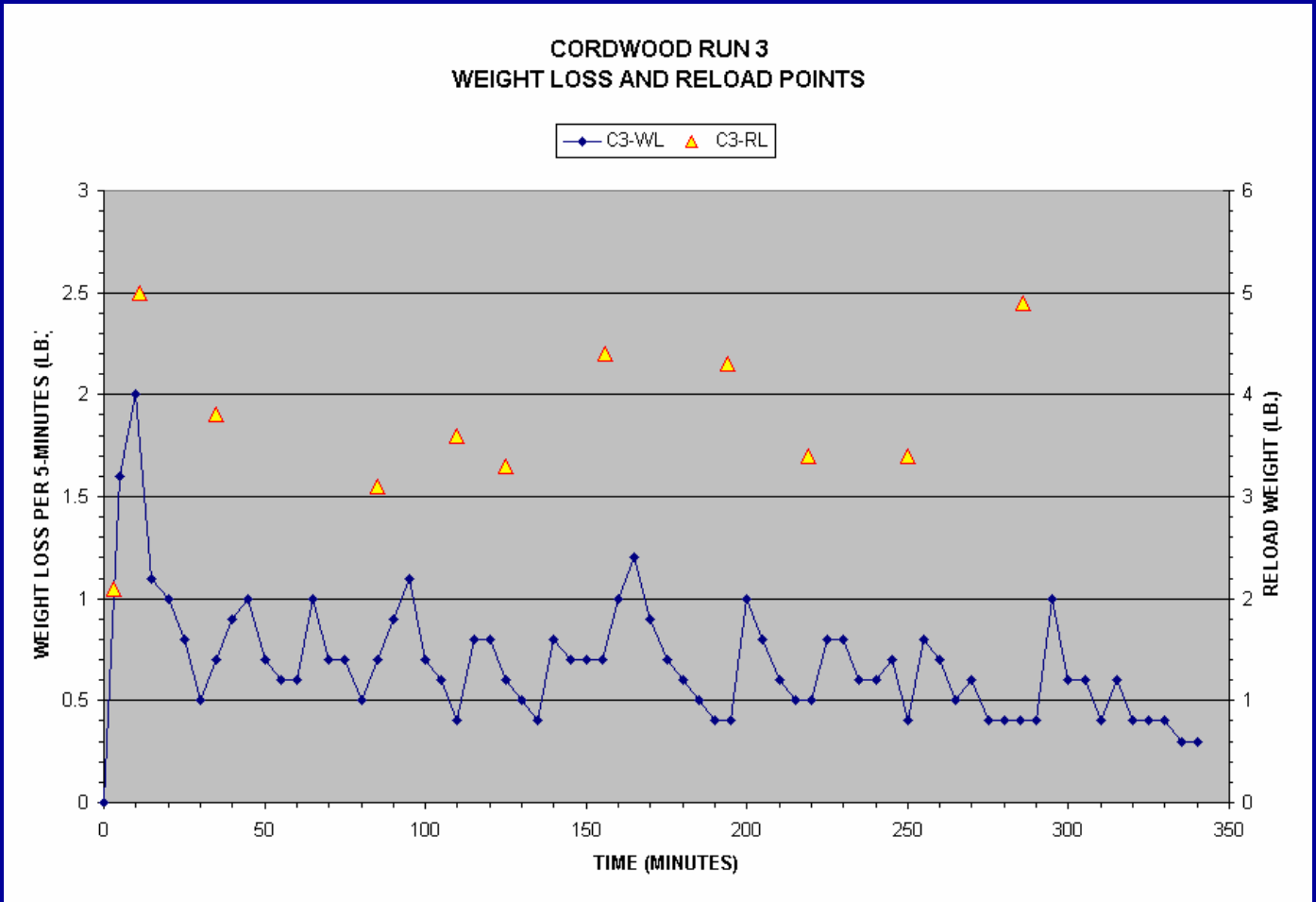


CRIB CONFIGURATIONS TESTED DURING INITIAL TEST METHOD DEVELOPMENT

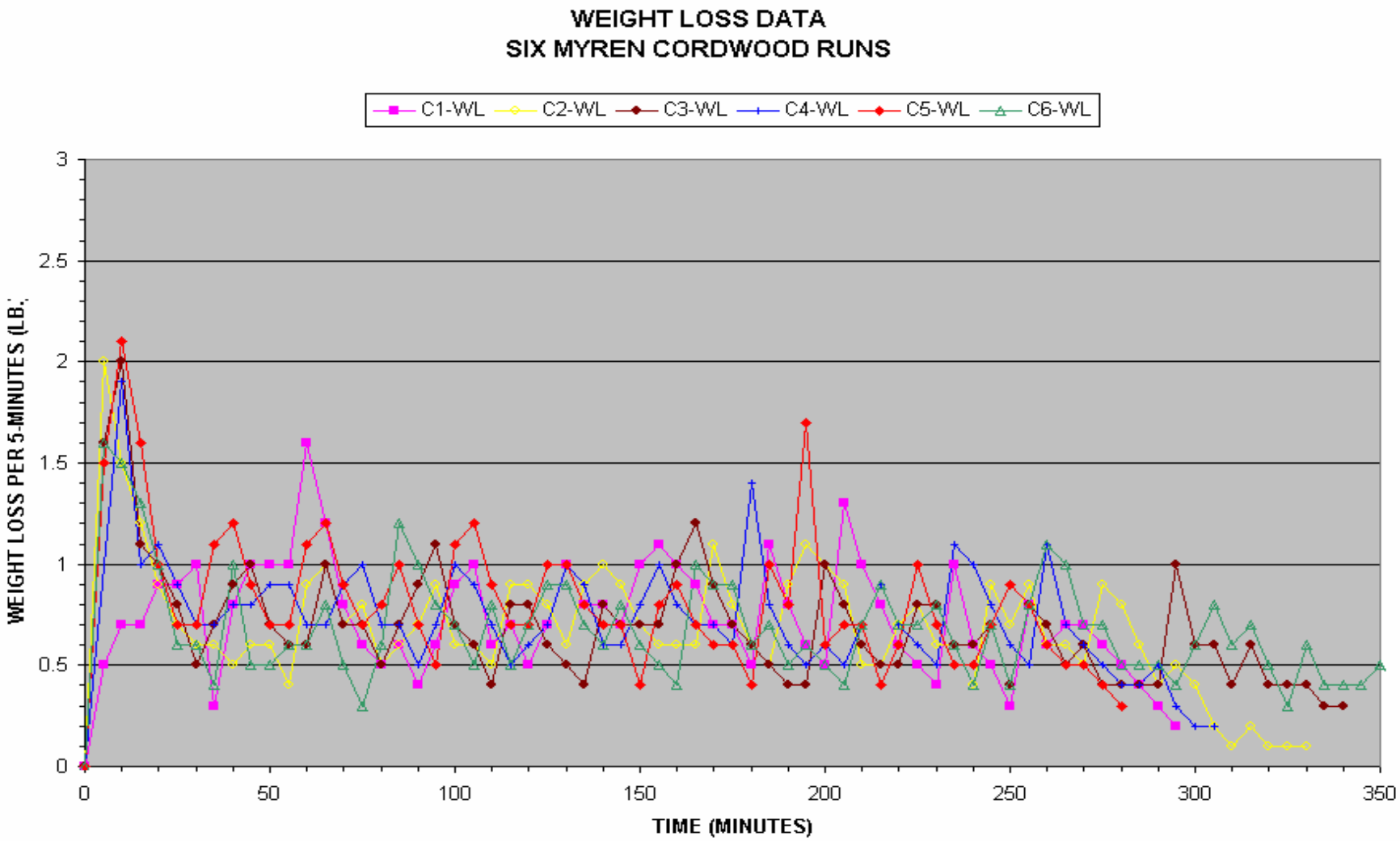
Early Crib Fires-"Short Large Fires"-(Bon fires) & "Spiky"



Cordwood Runs – More Typical of Fireplace Use- Fewer "Spikes"



6 Cordwood Fires- Real World



Crib vs. Cordwood–Adding Fuel

- Critical issue in replicating “real” FP usage
- Crib Fuel Loads Added at Specific Points Determined by Weight Loss
- Cordwood Loads Added when tester felt they were needed based on instructions to operate Fireplace as you might in home, i.e. Don’t let the fire go Out!

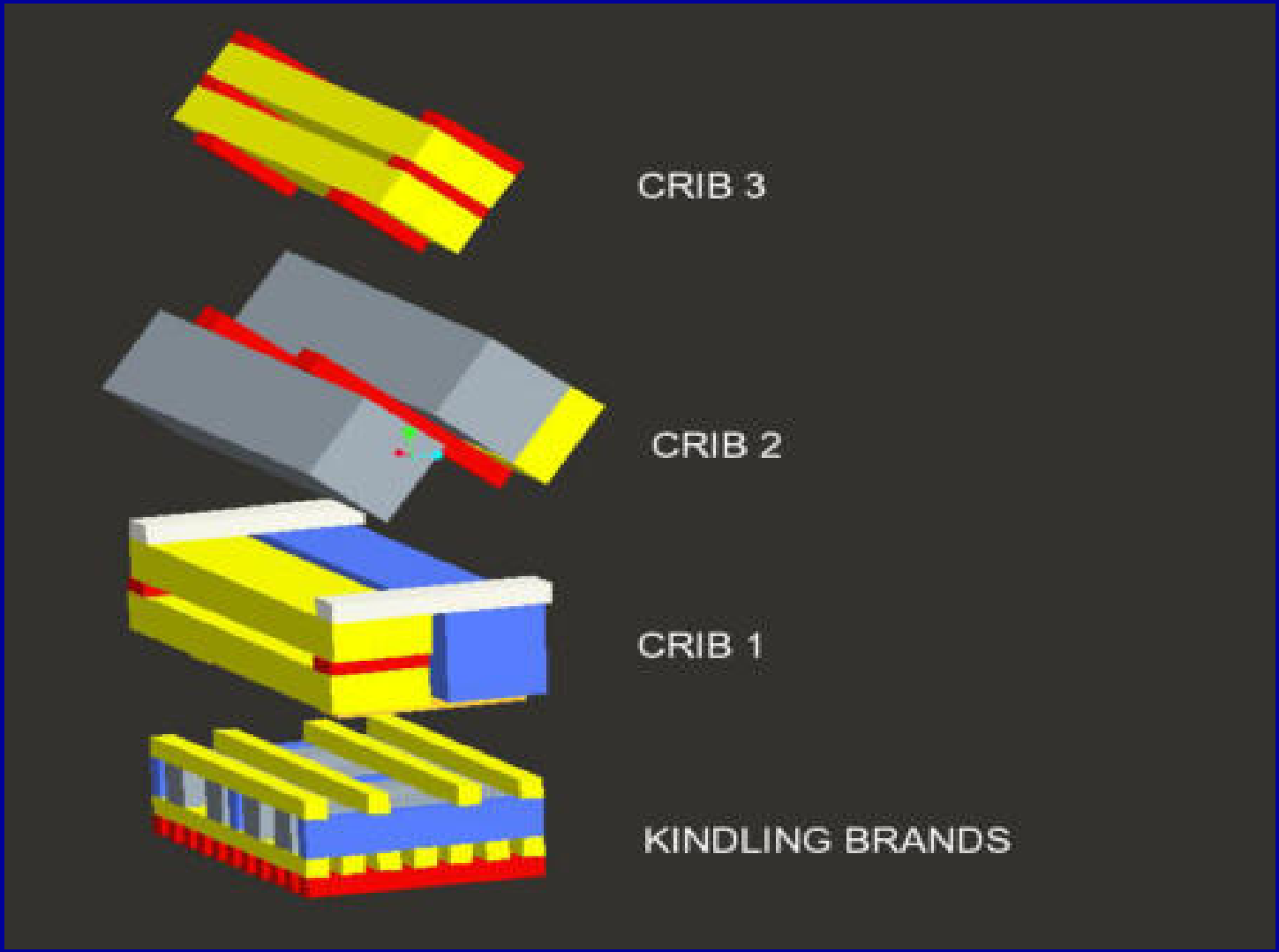
CONCLUSIONS

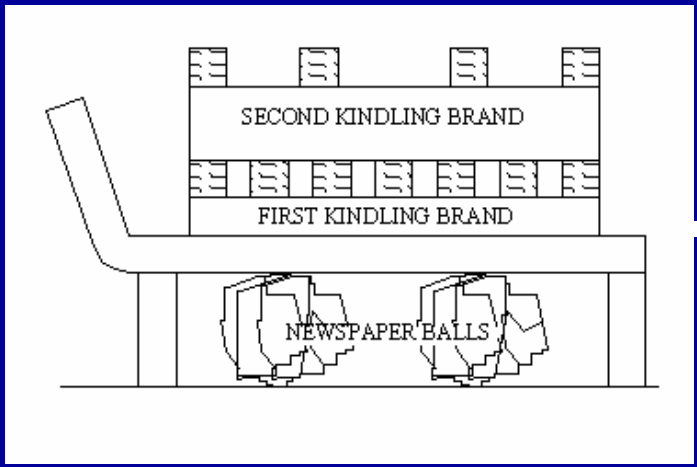
- Real Cordwood Fires Always Driven by Aesthetics
  - User desires Pleasing Fire appearance
    - **"Poking When Needed",**
    - **Adding Fuel, When Needed**,
- Pattern Confirmed by earlier study of actual fireplace users under observation,
- Compared to Crib Protocol, Consumers use,
  - Smaller Loads,
  - Larger Piece Size,
  - More Frequent Loading,

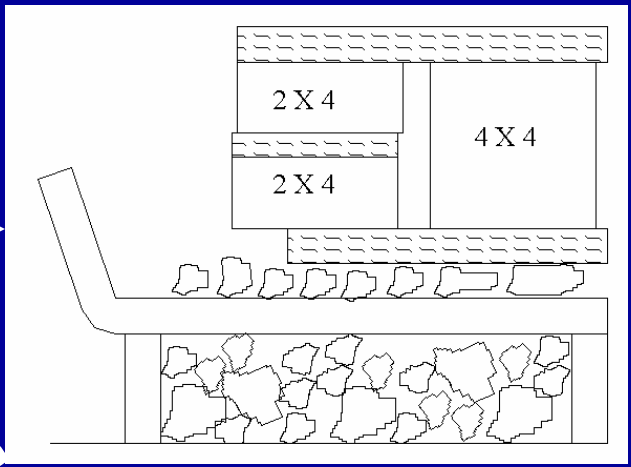
Final Crib Configuration & Fueling Protocol

- 3 (very) different Cribs added to Kindling load,
- More closely simulates way fireplace are actually burned by Homeowners,
- HIT THE TARGET EMISSION RANGE AND BURN RATE

ASTM E2558-07 FUEL CRIB




SECOND KINDLING BRAND
FIRST KINDLING BRAND
NEWSPAPER BALLS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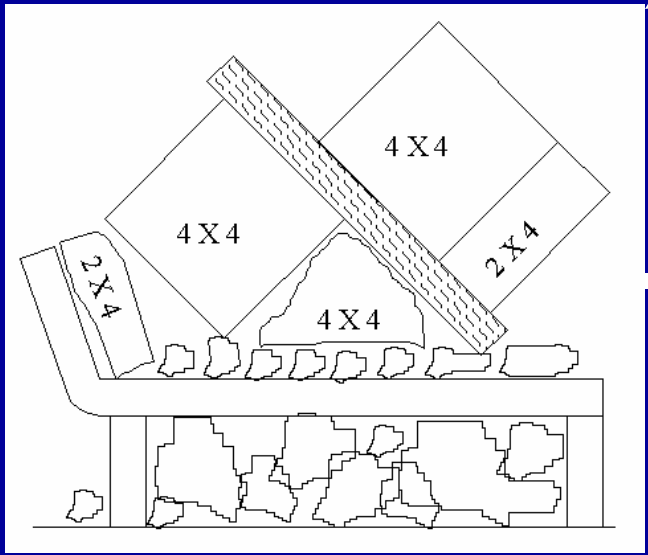
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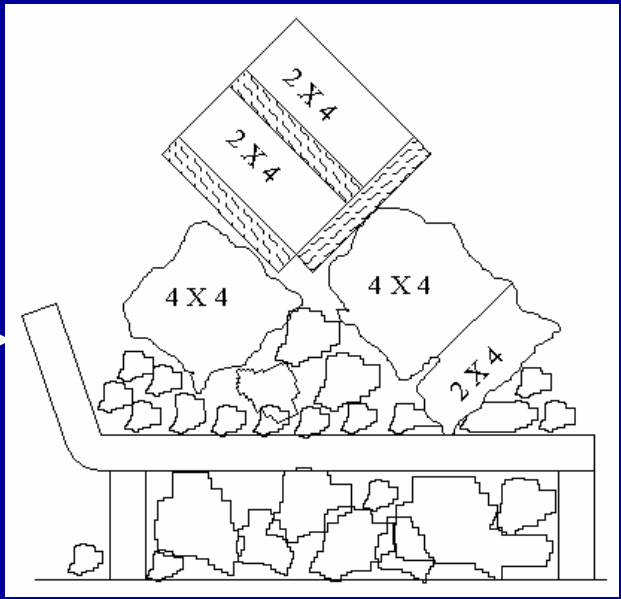
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FUELING DETAILS

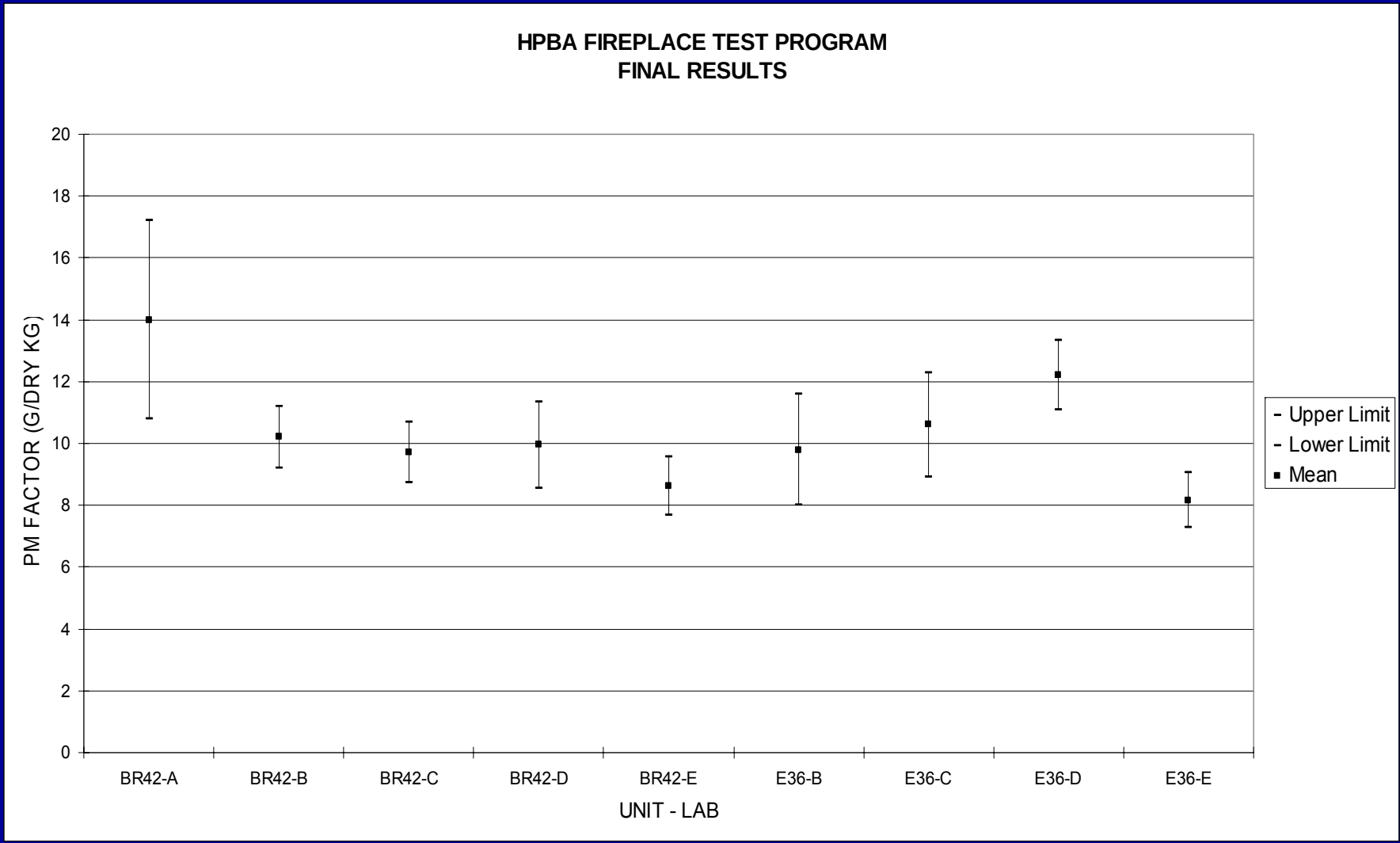
- PM emission collection begins when the newspaper is ignited (“Cold-start”)
- Subsequent fuel loads are added after the previous fuel load is substantially burned.
- Test ends when all volatile material in the fuel load is consumed.

– Draft of Fueling & Operation Test Method for LOW Mass Fireplaces was proposed to Full ASTM members for Ballot -

- Initial Balloting at ASTM Sub-committee Level
- Simultaneously – “Round Robin” Testing Initiated,
- What is the **Precision** in this new method????

  – **3 Independent Test Laboratories,**
  – **2 Manufacturer Laboratories,**
  – **2 Different Fireplaces**
    » **Different Brands**
    » **Different sizes, 36” & 42”**

Method Precision



Conclusions

- Consensus-based Test Method can be used to evaluate PM Emission of Low-Mass Fireplaces, –
- Method Allows Determination of Relative Improvement of New Control Technology,
- Method allows creation of Traditional appearing but <u>Cleaner Burning Fireplaces</u>

BUT-New Method only 1ST Step

- New Method for Fireplaces, DIFFERENT than the old 1988 Wood Heater Method,
- May allow for creation of traditional appearing Fireplace appliances that burn clean with glass doors open or closed
- Final step currently underway – USEPA convened stakeholder process to set emission "target", or passing grade – includes staff of SCAQMD
- **SCAQMD Rule 445 – 1st Rule to recognize new concept.**