CELLULOSE INSULATION AND TYPE HT CHIMNEYS

Presented at:

I.A.A.I. Arkansas Chapter
October 9, 2014
Eureka Springs, Arkansas

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PRESENTED BY:

Todd Metzger, P.E., CFI, CFEI
- BS in Mechanical Engineering.
- Licensed PE in Missouri, Illinois, Kansas and Arkansas.
- IAAIL Certified Fire Investigator
- NAFI Certified Fire and Explosion Investigator
- Employed by Schaefer Engineering, Inc. located in the St. Louis, Missouri area.
- 6 Years Experience in Industry as Mechanical Engineer.
- 4 Years Experience in Fire Service & Law Enforcement.
- 5+ Years in Fire & Mechanical Investigation Service.

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PRESENTED BY:

Mitch Rackers, P.E., CFEI
- BS in Mechanical Engineering.
- Licensed PE in Missouri, Illinois, Kansas and Arkansas.
- NAFI Certified Fire and Explosion Investigator
- Employed by Schaefer Engineering, Inc. located in the St. Louis, Missouri area.
- 6 Years Experience in Industry as Mechanical Engineer.
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This training session needs YOU!
Interaction is essential.
You have experience... you have ideas... you have questions!
We want and need your input!!!
PLEASE do not wait until the end to ask questions... let's discuss ideas as we go.

ARE YOU READY FOR A WORKSHOP?

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COURSE OBJECTIVES

• Background
  – Type HT Factory Built Chimneys
  – Cellulose Insulation
  – Industry Standards
  – Chimney System and Cellulose Insulation Installation

• Discussion
  – The Scientific Method
  – Ignition and Combustion Characteristics of Cellulose Insulation
  – Type HT Chimney as a Competent Ignition Source

• Case Study
• Conclusions

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NFPA 921 – GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS

• The purpose of this document is to establish guidelines and recommendations for the safe and systematic investigation or analysis of fire and explosion incidents.
• As every fire and explosion incident is in some way unique and different from any other, this document is not designed to encompass all the necessary components of a complete investigation or analysis of any one case. The scientific method, however, should be applied in every instance.

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BACKGROUND:
TYPE HT
FACTORY BUILT
CHIMNEYS

• Common Chimney Types
  — Double Wall, Air Cooled Chimney
  — Triple Wall, Air Cooled Chimney
  — Mass Insulated, Type HT Chimney

• UL 103 2100 °F Flue-Gas Temperature Test vs. 1700 °F Flue-Gas Temperature Test
• Construction
  — Double Wall
  — Mass Insulated
• Part of a manufactured system
BACKGROUND: CELLULOSE INSULATION

- ASTM C 739, Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation
- Construction
  - Shredded Paper
  - Chemically Treated
- ASTM C 739 Tests
  - Radiant Flux Panel
  - Lit Cigarette
- Installation
  - Do It Yourselfers
  - Dusty

BACKGROUND: INDUSTRY STANDARDS

Multi-Layer System:
- NFPA 211, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
  - Manufacturer’s Instructions & Listing Requirements
- ICC International Mechanical Code
  - Listed Product & Manufacturer’s Instructions
- ASTM C799, Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation
  - Blocking
- CIMA Technical Bulletin #2, Standard Practice for Installing Cellulose Building Insulation
  - Blocking and 5” Air Space
- Code of Federal Regulations
  - Product Package/Warning Labels, Installer to remove label and give to consumer
BACKGROUND:
INDUSTRY
STANDARDS
Chimney System and Cellulose Insulation Installation

DISCUSSION:
THE SCIENTIFIC
METHOD
• Identify Problem
• Collect and Analyze Data
• Develop a Hypothesis
• Test the Hypothesis
• Select Final Hypothesis
• Present Findings/Conclusions

DISCUSSION:
CELLULOSE
INSULATION
Ignition and Combustion Characteristics of Cellulose Insulation
• Oven Testing, Gradual Increase – 475°F & Constant – 460°F
• Samples Consistent
Ignition and Combustion Characteristics of Cellulose Insulation
Cellulose Insulation Demonstration (Timed Lapse) – ~1.5 hrs visible charring, ~2.5 hrs 12” diameter charred circle and ~5.5 hrs to propagate across box.
DISCUSSION:
TYPE HT CHIMNEY

Type HT Chimney as a Competent Ignition Source

- Wood Fire Inlet Flue Gas Temperatures Varied
  - Peak Temperatures Exceeded 150°F

DISCUSSION:
TYPE HT CHIMNEY

Type HT Chimney as a Competent Ignition Source

- Type HT Installation
  - 12 Feet
  - 20 Feet
- Cellulose Insulation
  - 12 Inches
- UL 103 Flue-Gas Generator

The configuration of the model is based on UL 103 Standard for Factory-Built Chimneys.

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The configuration of the model is based on UL Standard for Factory-Built Chimneys. Note the multiple thermocouples installed.

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Thermocouples were installed in nearby combustibles and at various elevations on the chimney’s surface from the ceiling penetration.

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Radiant/Air Insulation Shield installed. Thermocouples were to be buried in cellulose insulation, installed near exterior of shield.

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DISCUSSION:
TYPE HT CHIMNEY

Type HT Chimney as a Competent Ignition Source
Type HT Chimney Temperature Testing, Installed Per Manufacturer

<table>
<thead>
<tr>
<th>Chimney Height</th>
<th>Inlet Flue Gas Temperature</th>
<th>Outlet Flue Gas Temperature</th>
<th>Maximum Chimney Surface Temperature in Attic</th>
<th>Maximum Wood Surface Temperature Rise Above Ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 ft</td>
<td>990 °F</td>
<td>930 °F</td>
<td>380 °F</td>
<td>75 °F</td>
</tr>
<tr>
<td>20 ft</td>
<td>890 °F</td>
<td>850 °F</td>
<td>350 °F</td>
<td>70 °F</td>
</tr>
</tbody>
</table>
Attic insulation/radiant shield removed and cellulose insulation in contact with chimney surface. Flue gas generator started at ~0940 hrs.

Light smoke from front chimney surface/cellulose insulation interface seen at ~1125 hrs.

Light smoke around stucco collar-flashing interface seen at ~1130 hrs.
Attic completely filled with smoke, blocking interior camera view at ~1140 hrs.

Observed smoldering insulation in the area of the chimney at ~1145 hrs.

Time lapse video of attic space starting at 1125 hrs.
Total elapsed time – 30 minutes.
Area of chimney attic penetration after extinguishment and removal of cellulose insulation from area.

Chimney section removed and photographed. Red arrows denote ceiling/firestop level and insulation depth. Green arrow denotes flame pattern.
Flue Gas Generator started at 0940 hrs. Light smoke in attic space at 1125 hrs.

MECHANICAL EVALUATION:
CASE STUDY

- Single story dwelling approximately 8 years old, Single owner.
- Prior to closing, during final walkthrough, missing HT chimney.
- Builder installed HT chimney from basement to roof and chased in master bedroom closet.
- Cellulose insulation blown in the attic prior to installation of chimney system.

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MECHANICAL EVALUATION:
CASE STUDY

- Regular use of wood-burning stove from November through March each year.
- Homeowner cleaned flue annually.
- Homeowner previously worked in attic. Installed electric and TV cable for wall mounted television.
- Morning of fire, smell of smoke and investigation finds glow in master bedroom closet in area of chimney chase.

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Project Number: 14-999
Date: 10/9/2014
Location: 123 Fire Rd, Eureka Springs, AR
Exam Type: Prelim / Joint / Lab / Other
MECHANICAL EVALUATION: CASE STUDY

• Summary
  – Cellulose insulation present in attic but installed prior to chimney installation
  – Firestopping/firestop spacer present, no insulation shield
  – Chase framing reportedly installed after chimney, possible clearance issue
  – Homeowner performed work in attic in area
  – Electrical activity within area of fire

CONCLUSIONS

• Numerous Industry Standards, Guidelines and Manufacturer’s Requirements
• Ignition and Combustion Characteristics of Cellulose insulation
• Method of Transition from Smoldering Insulation to Flaming Combustion of Structural Combustibles
• Type HT Chimney can be a Competent Ignition Source for Cellulose Insulation in Contact with Heated Surface
QUESTIONS?