

# USING LOW-CONCENTRATION HYDROGEN PEROXIDE VAPOR TO DECONTAMINATE A HOME FROM *BACILLUS ANTHRACIS* *SURROGATES*

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# Problem Statement

- There are limited resources to respond to a large *Bacillus anthracis* release.
- Many efficacious response resources
  - Produce highly toxic environments
  - Require specialized equipment and expertise
- As a near-the-zone business or home owner what remediation options do you have?



# Overview

- An EPA, NHSRC study found that hydrogen peroxide (HP) vapor concentration as low as 5 ppm for four to seven days was efficacious, >6 log reduction for both *Bacillus anthracis* and surrogate spores. And that HP vapor could be disseminated with vaporizers.
- This present work reports field evaluations of this technique using:
  - a 3-bedroom home w/ central HVAC
  - off-the-shelf humidifiers
  - 3% liquid HP
  - spores on carpet and galvanized metal coupons to evaluate efficacy

## Concept:

- Fill with 3% HP liquid
- Turn it on
- Walk away
  
- Return when it's done.



# Efficacy Testing in Each Room

- 3 carpet test coupons
- 3 galvanized metal test coupons
- *Bacillus atrophaeus*: 20,000,000 colony-forming unit (CFU)/coupon
- 1 negative control for each material
- 3 biological indicators (BIs) in Tyvek
- *Geobacillus stearothermophilus*: 2,000,000 CFU/BI on steel disks
- Temperature & humidity HOB0
- Hydrogen peroxide indicator strip

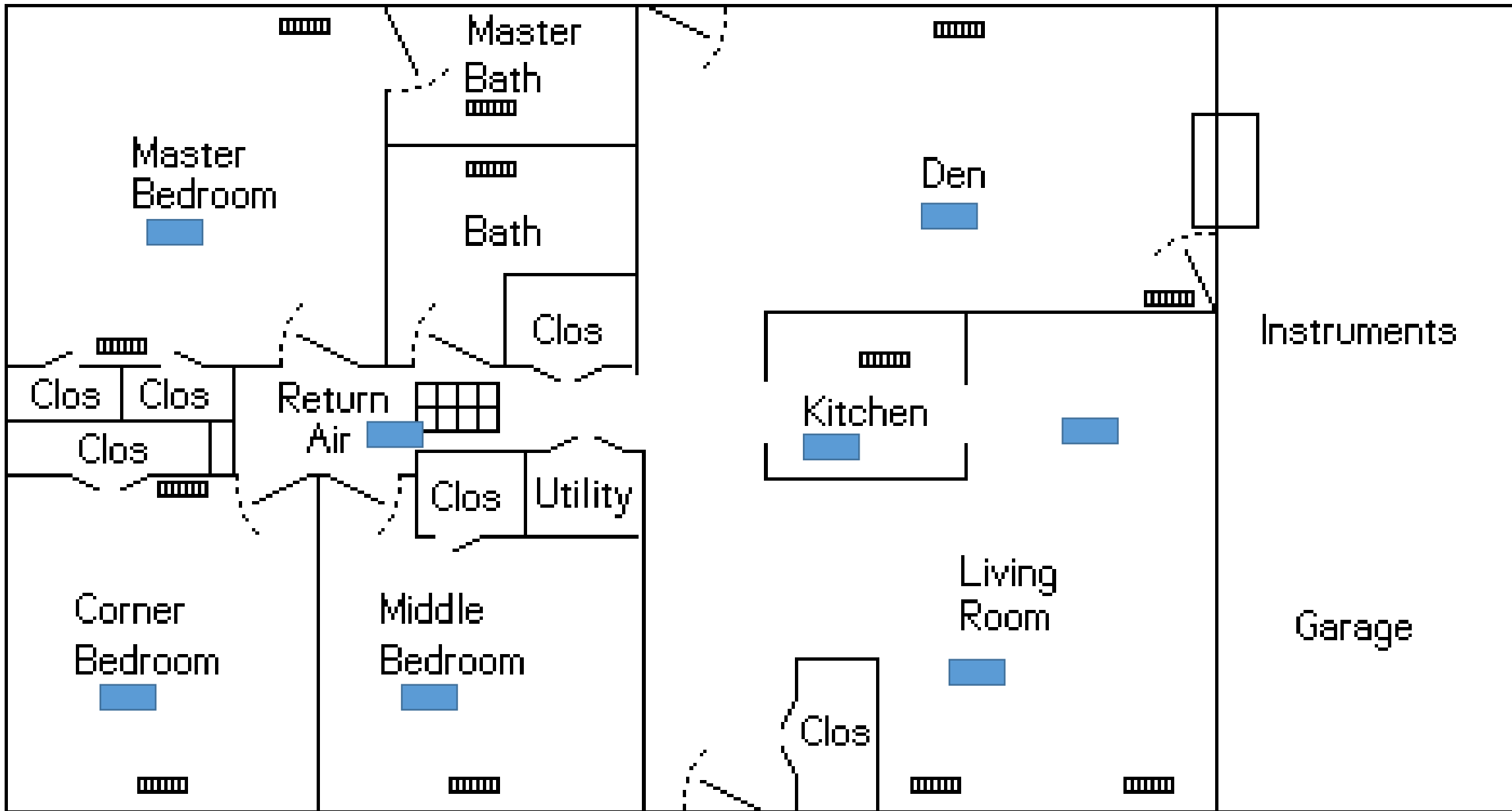




# Test Matrix

Test Number	Number of Humidifiers	Amount of 3% Liquid HP (gallons)	Description
0	7	0	Water only
1	7	14	Two gallons 3% liquid HP in each humidifier
2	7	14	Same as Test 1 plus furniture and clothing added One humidifier was moved to hallway
3	2	6.8	Used fewer humidifiers and less HP liquid
4	2	12	Same as Test 3 humidifiers refilled at 72 hours

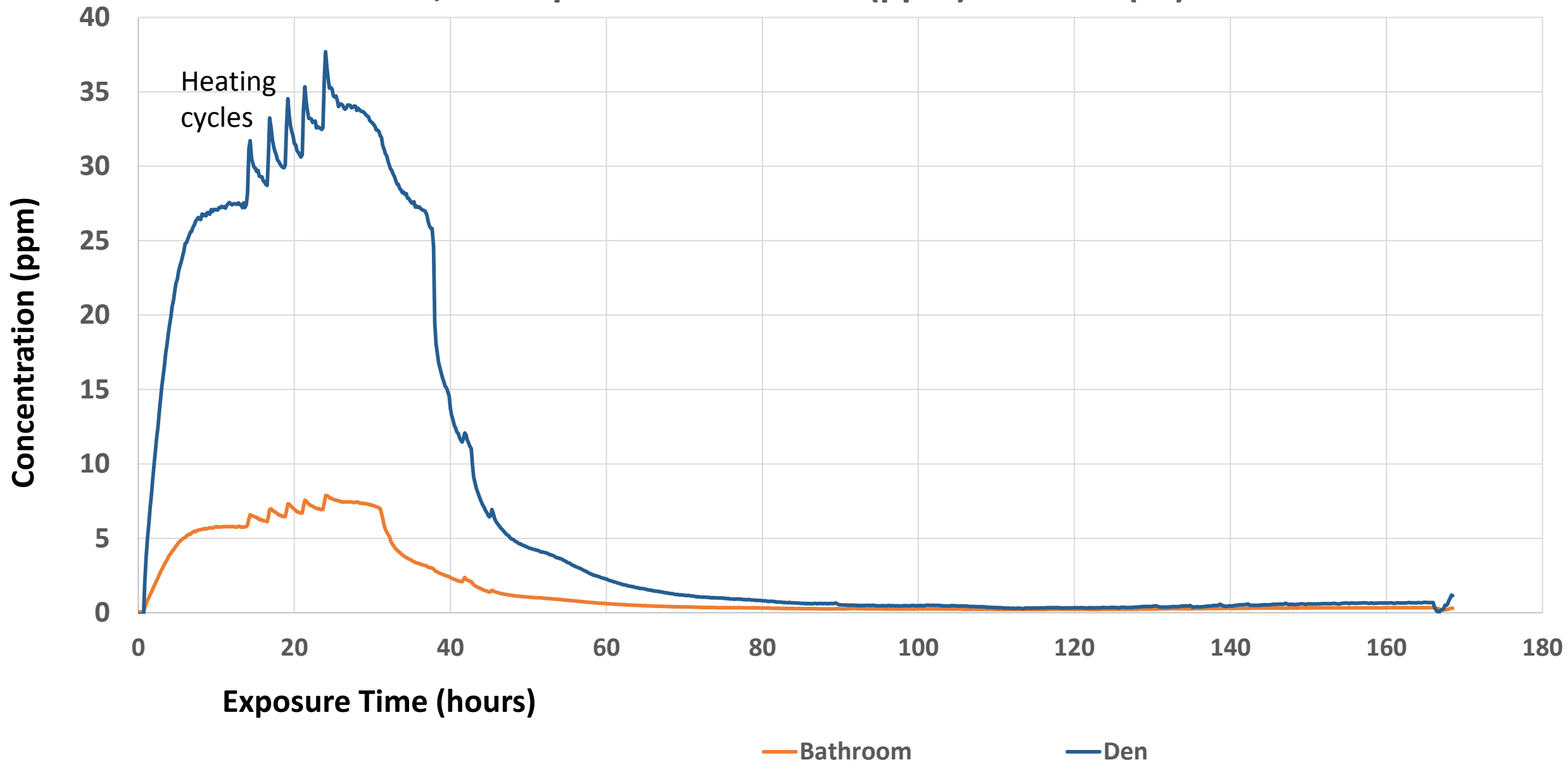
# Test House Humidifier Placement, Test 0, 1 & 2



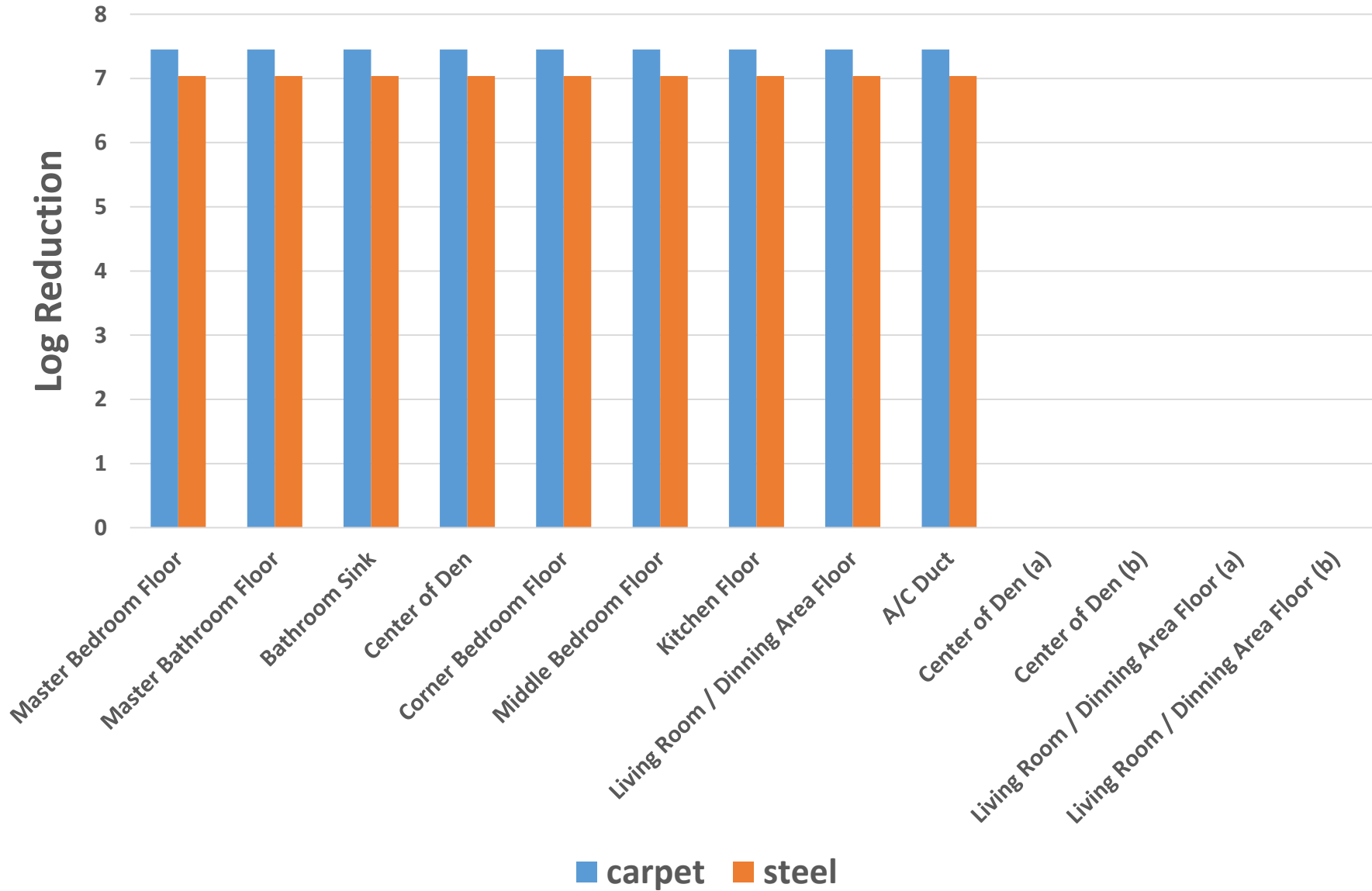
■ Humidifier      ■ = Registers (HVAC)



# Test 1, HP Vapor Concentration (ppm) vs. Time (hr)

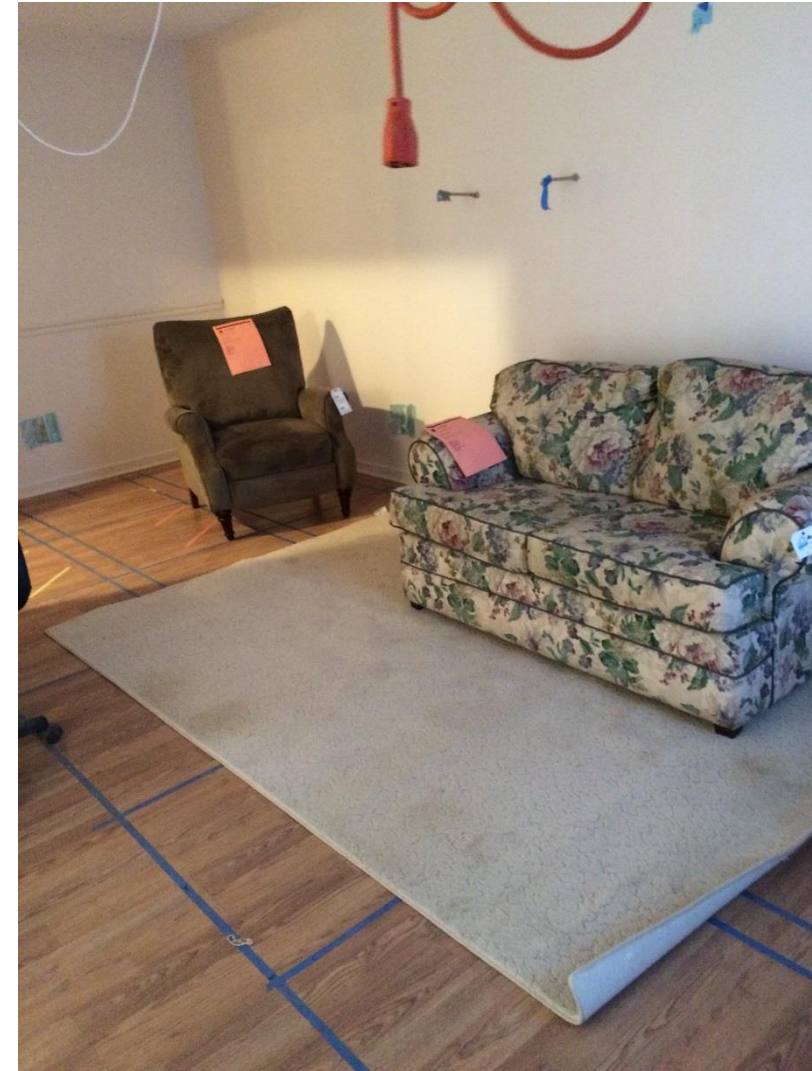


# Test 1, Coupon Results (Average of three coupons)

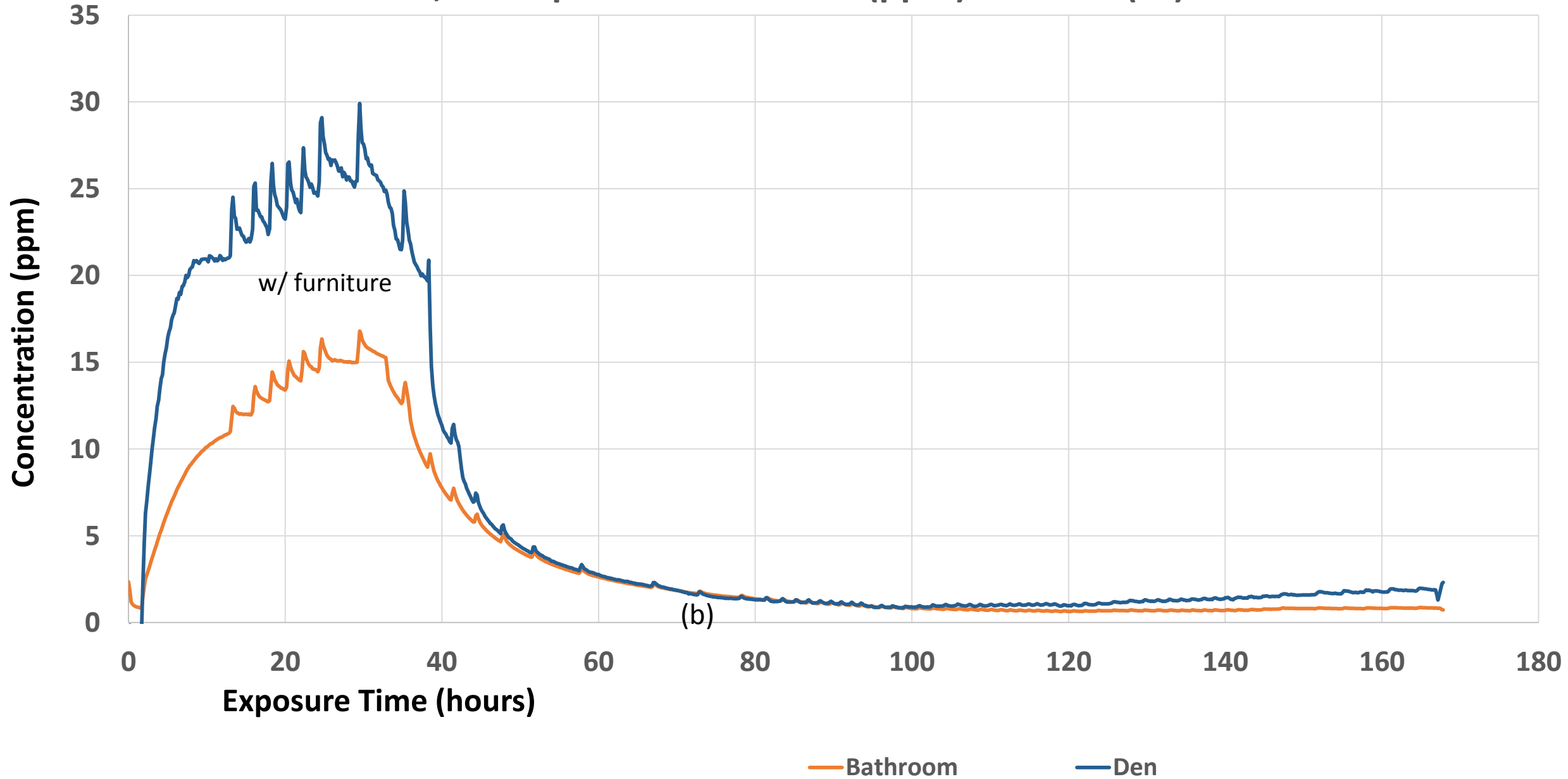


# Furniture Added:

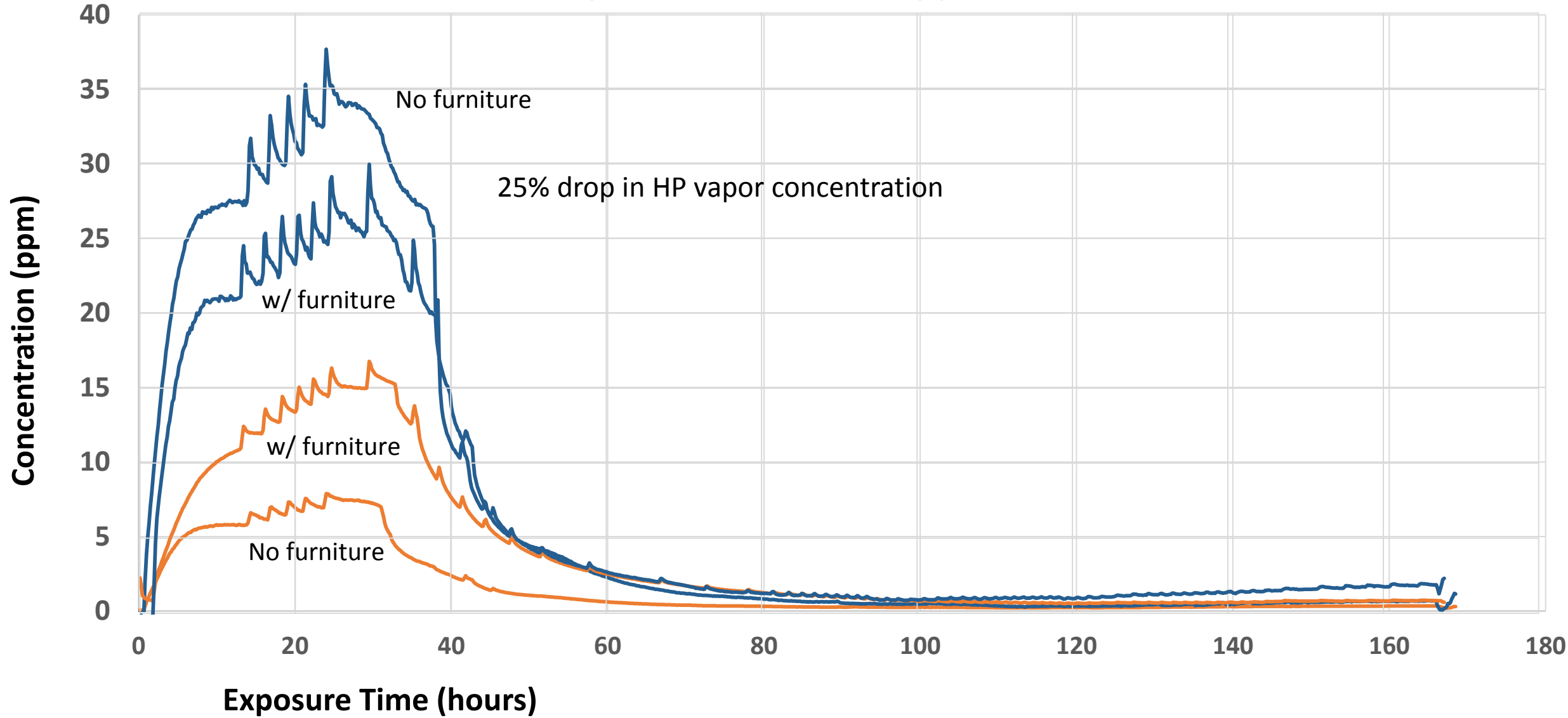
**Three Beds w Bedding and Pillows, Clothing,  
Five Rugs, Two Couches, Two Chairs, and  
Three Boxes of Papers and Books**



# Test 2, HP Vapor Concentration (ppm) vs. Time (hr)



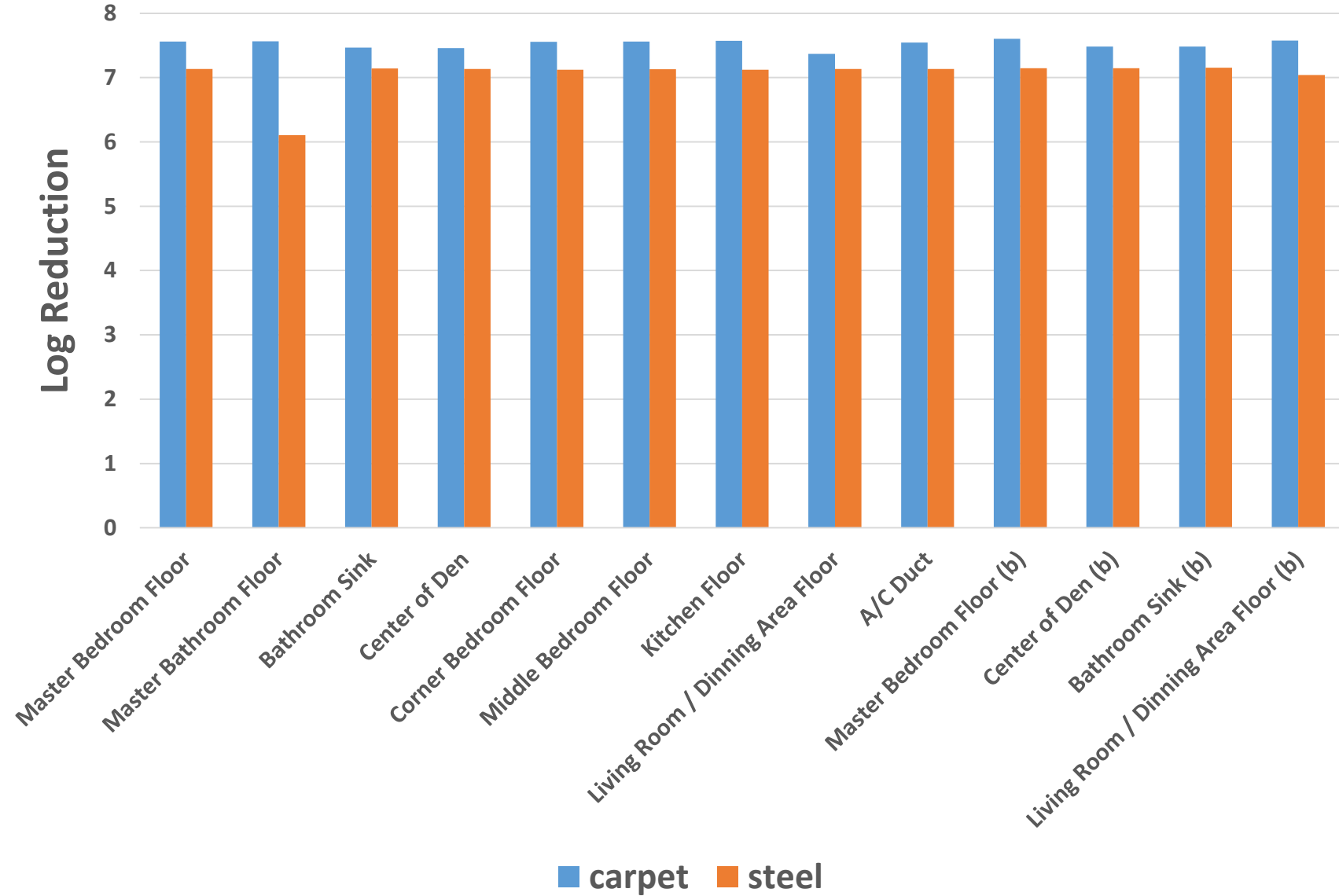
# Test 1 & 2, HP Vapor Concentration (ppm) vs. Time (hr)



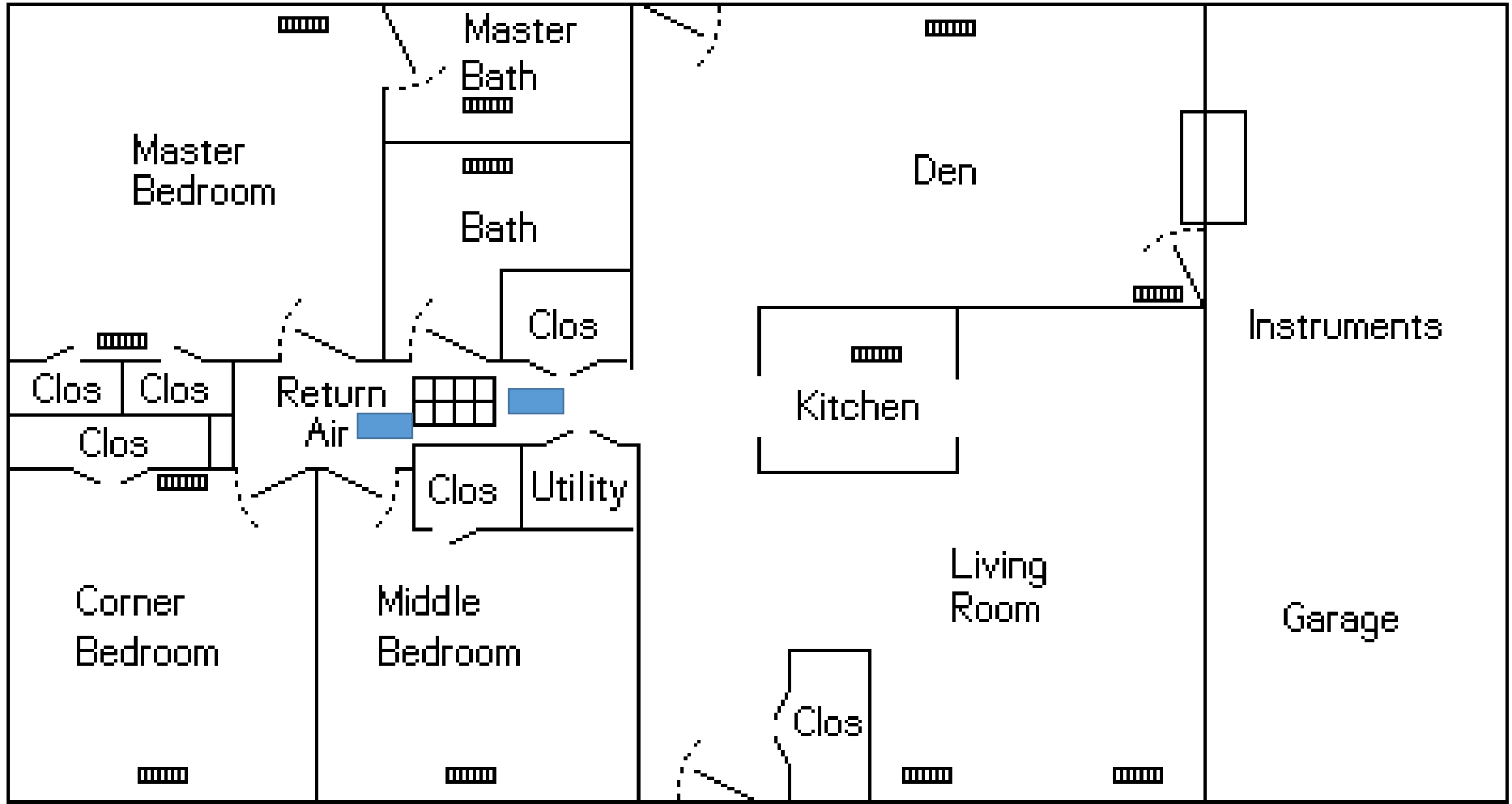
		<span style="color: orange;">—</span> Bathroom	<span style="color: blue;">—</span> Den
Test 2:	CT (ppm*hr) =	655	2784
Test 1:	CT (ppm*hr) =	271	2033



# Test 2, Coupon Results (Log Reduction)



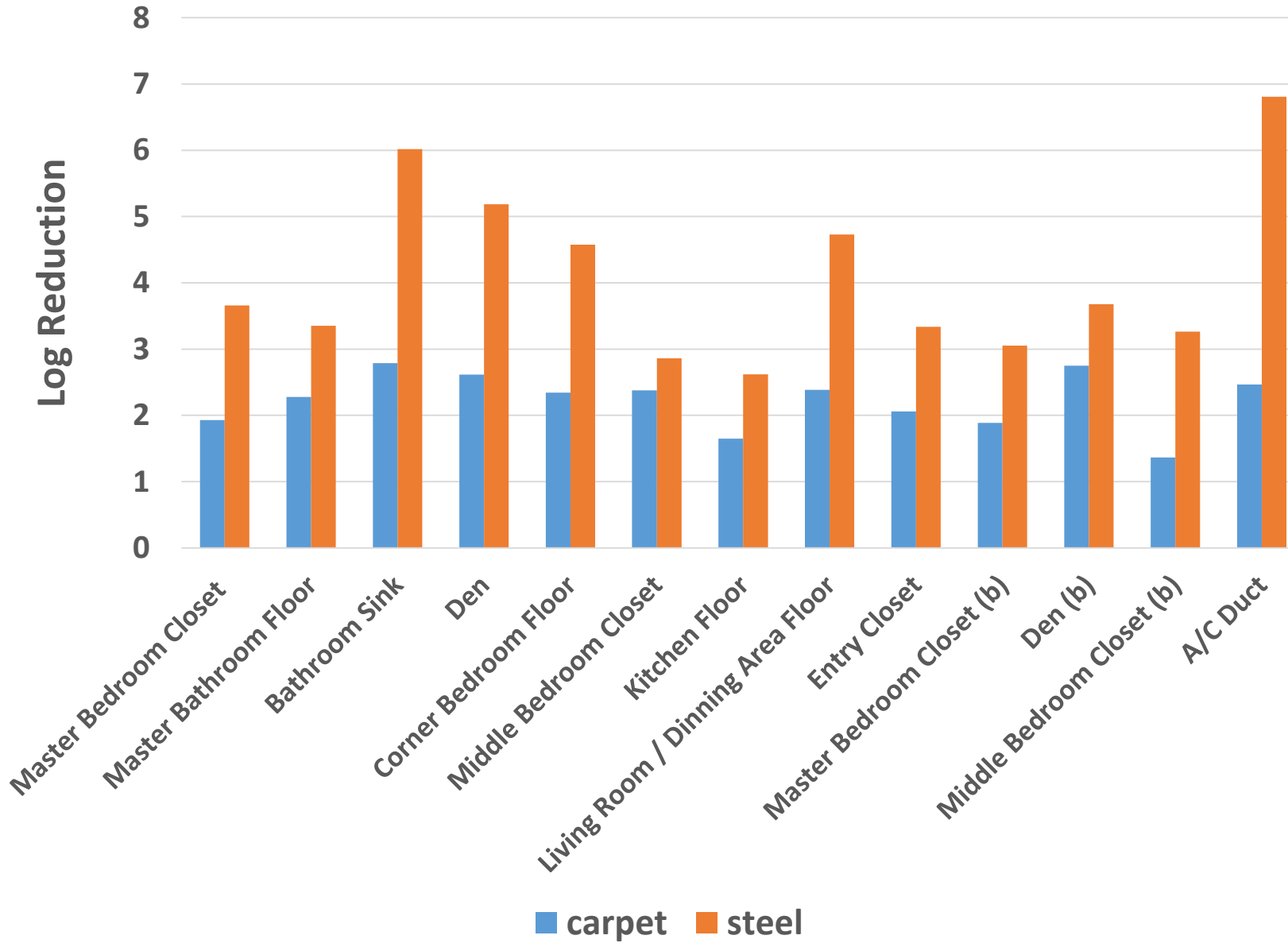
# Test House Humidifier Placement, Test 3 & 4



■ Humidifier      ▨ = Registers (HVAC)

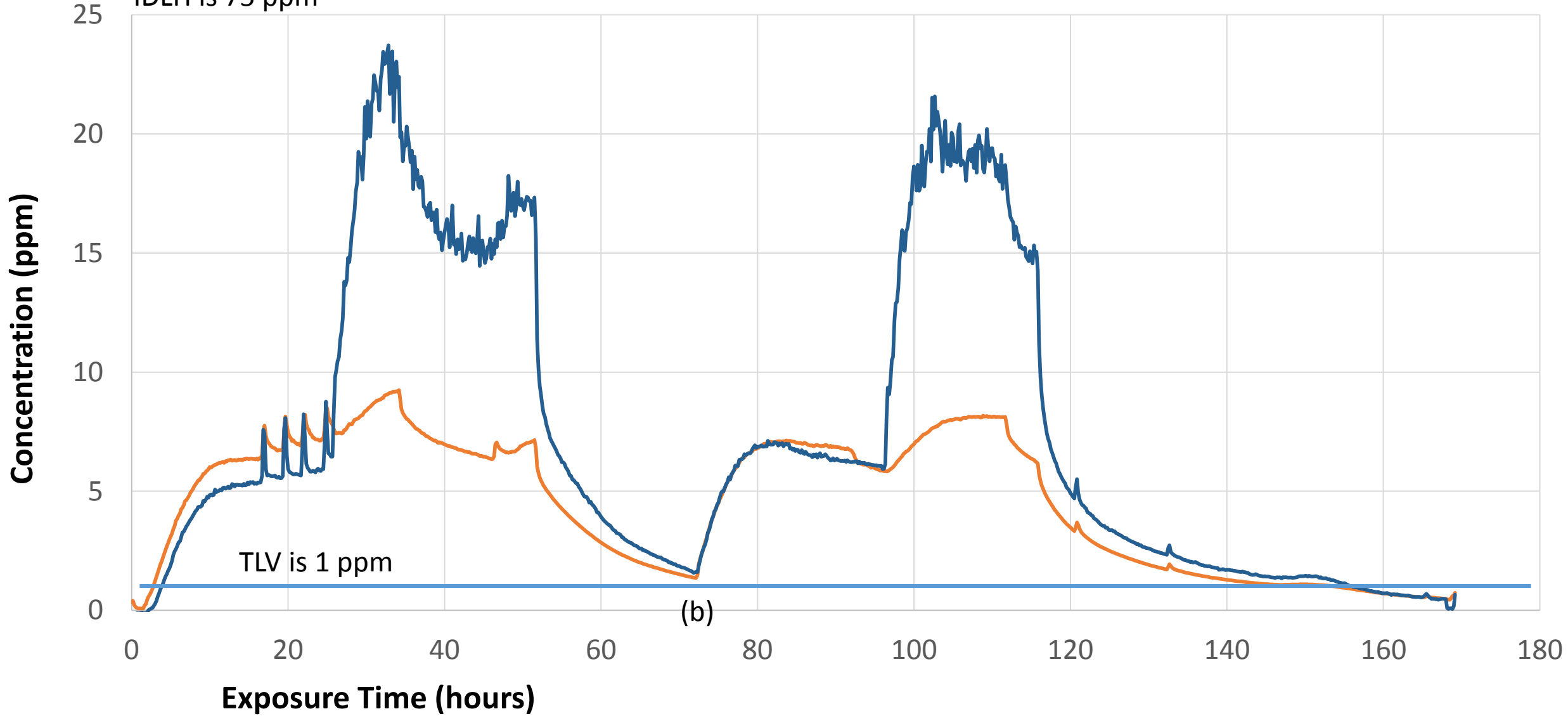


# Test 3, Coupon Results (Log Reduction)



# Test 4, HP Vapor Concentration (ppm) vs. Time (hr)

IDLH is 75 ppm



— Bathroom

— Den

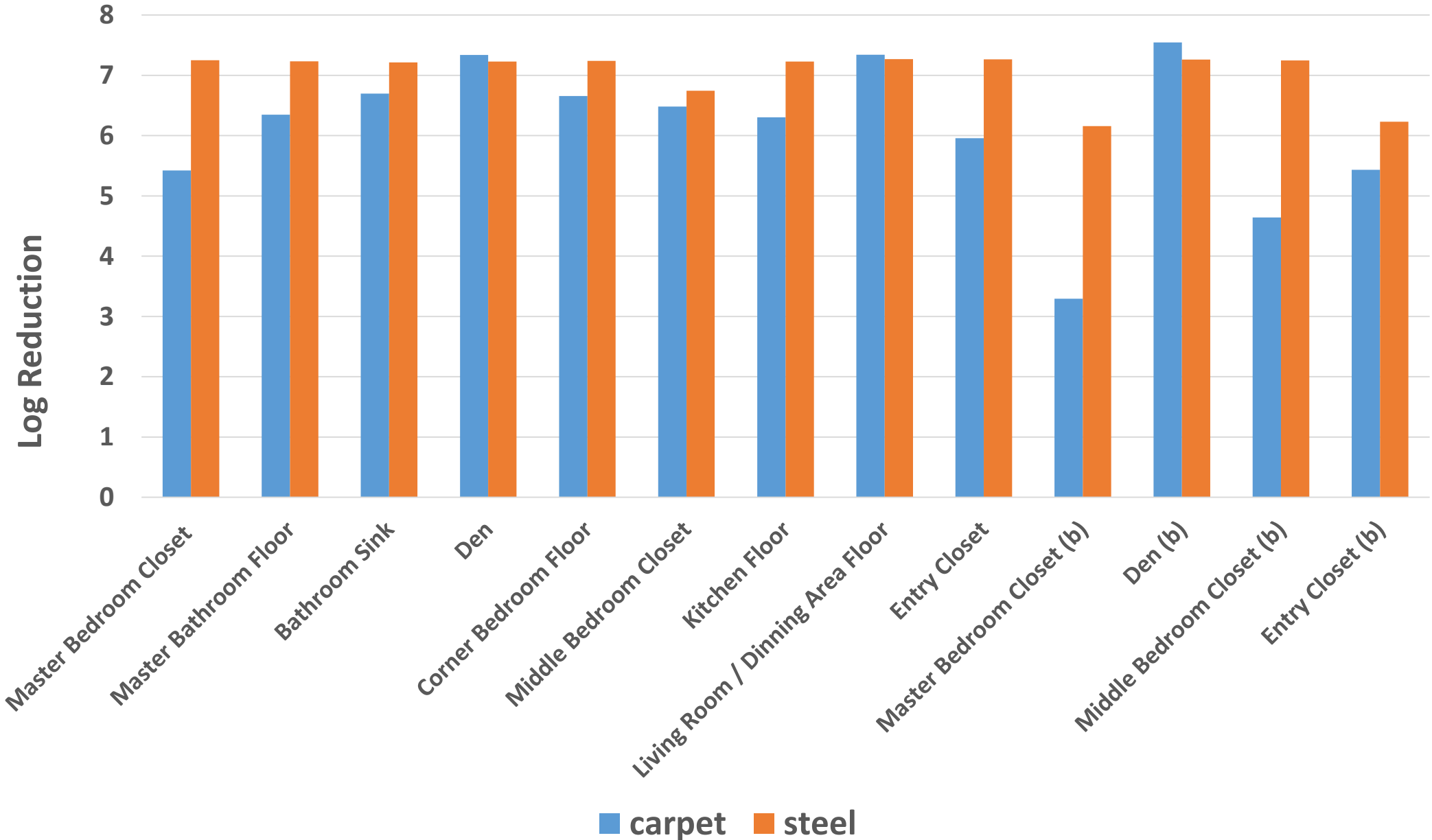
Test 4: CT (ppm\*hr) = 767

2274

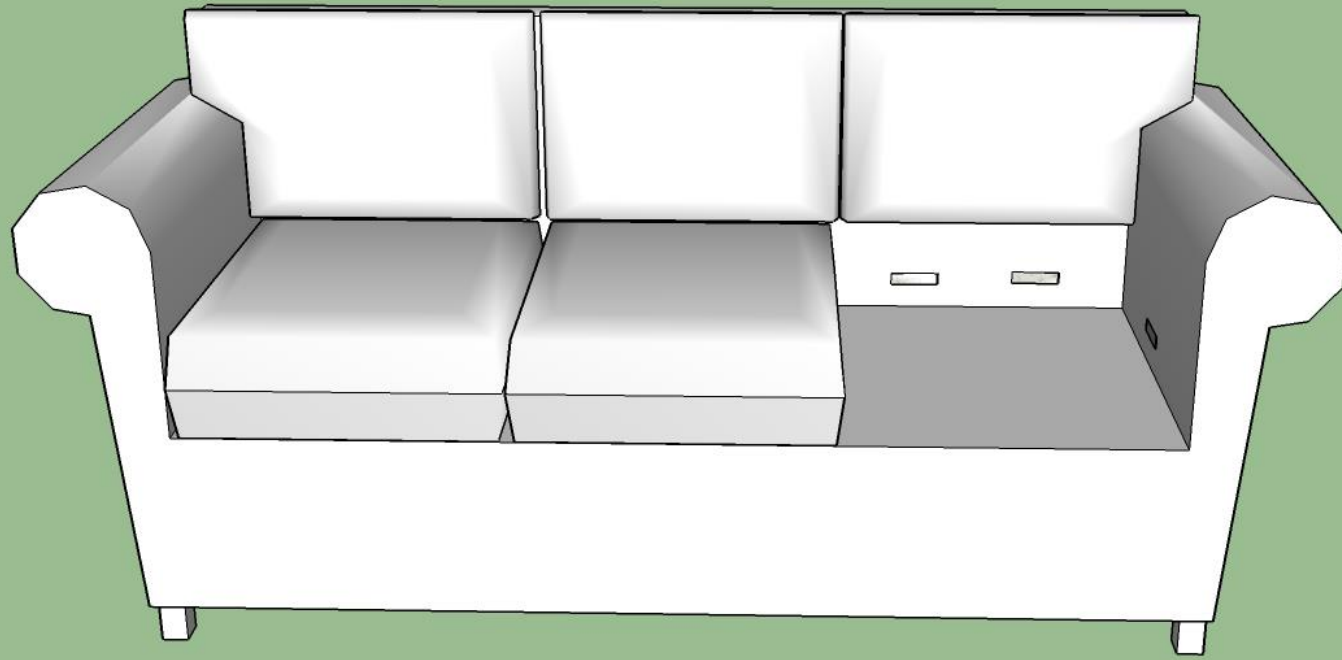
Test 1: CT (ppm\*hr) = 271

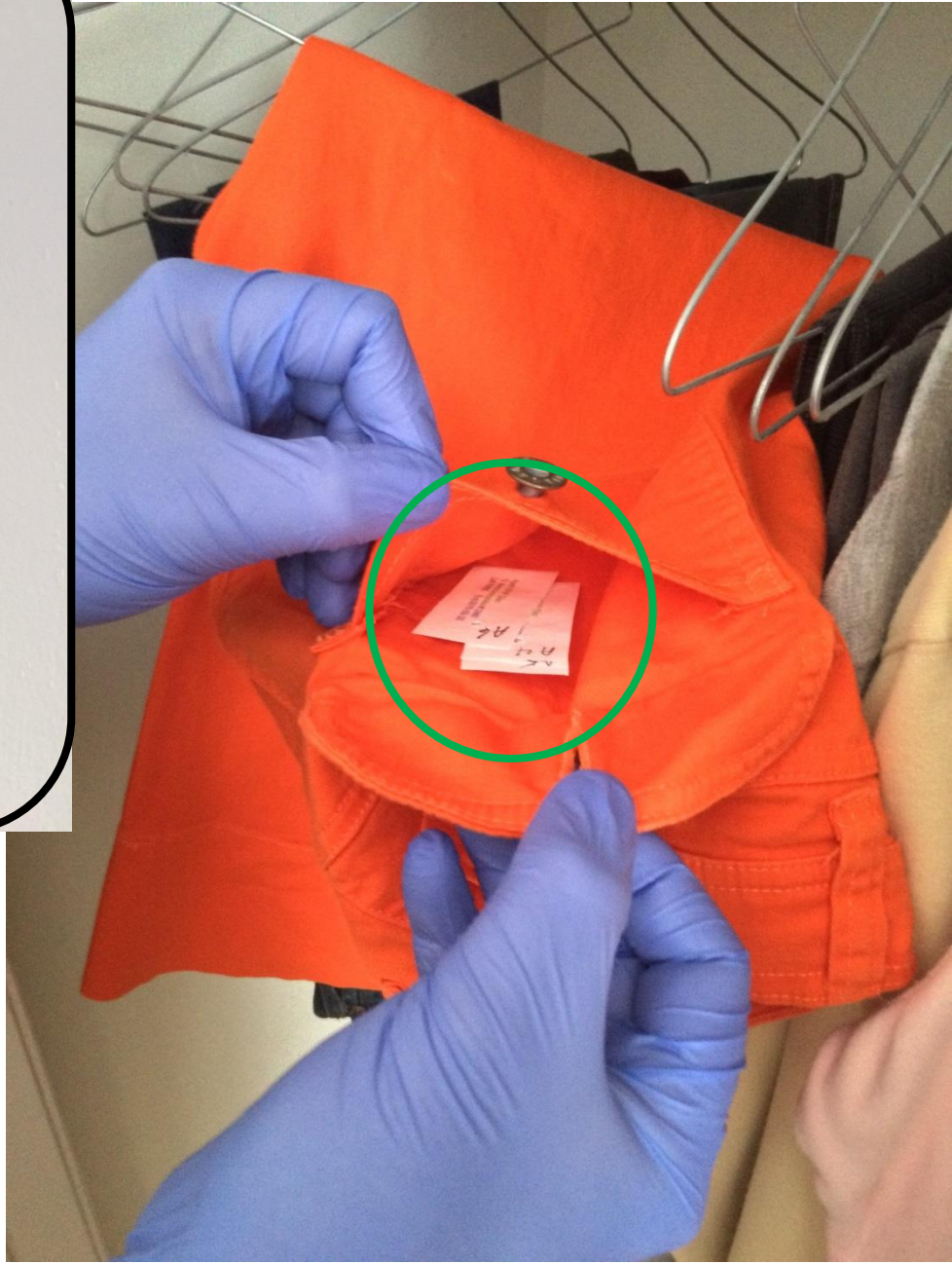
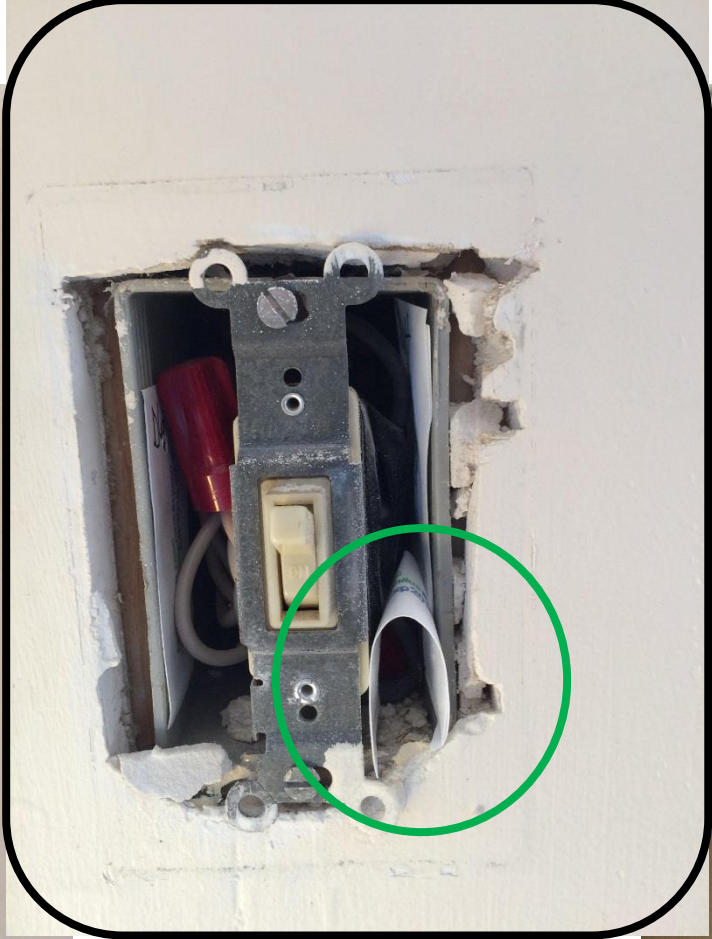
2033

# Test 4, Coupon Results (Log Reduction)



# BIs Were Placed in Furniture





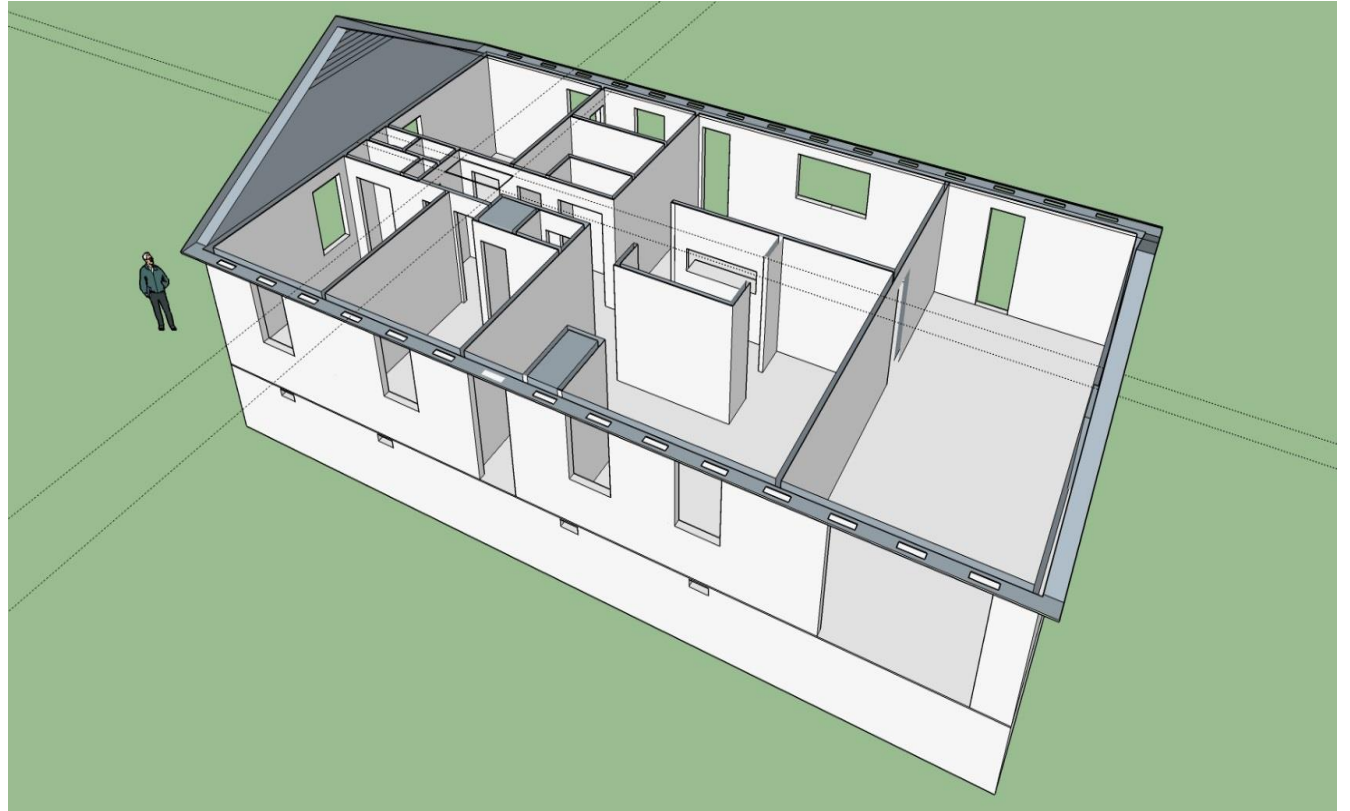
# Test 4, BI Results From Hard to Reach Places

- **Between couch cushions:** + + +
- **Under carpet (jute-backed):** + + +
- **Under entry door mat** + + +
- **Under one piece of paper:** - - -
- **Under five pieces of paper:** - - -
- **Under 10 pieces of paper:** + + +
- **Textbook** + + +
- **Pants pocket** - - -
- **Winter coat pocket** + + +
- **Switch plates (ext & ent)** + + + + + +
- **Inside pillowcase center bedroom** - - -
- **Between sheets center bedroom** - - -
- **Under comforter center bedroom** - - -
- **In light fixture center bedroom** - - -
- **Closed hall linen closet** - - -
- **Closed drawer kitchen** + + +
- **Open drawer kitchen** - - -
- **Window, bedroom** - - -
- **Door jam (front & back)** + + + + + +



# Summary: Increase in Response Capacity

- Scale up lab tests
- 1-gal 3% HP liquid/100 sq.ft., 8' ceiling
- Off the shelf equipment
  - \$180 vs. \$80,000
- Easy to use
- Low vapor concentrations
  - 10ppm vs. 400ppm
- Longer exposure times
  - Days vs. 4 hours
- Conclusions: Effective
- By-products: water & oxygen





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3	2	6.8	Used fewer humidifiers and less HP liquid
4	2	12	Same as Test 3 humidifiers refilled at 72 hours
5	2 + 5	6.8	Similar to Test 3 but with 5 water only humidifiers
6	2	5.5 (8% Liquid)	Similar to Test 3 but with 8% liquid HP No HVAC fan...only floor fans running
7	2	5.5 (8% Liquid)	Similar to Test 3 but with 8% liquid HP HVAC fan on with floor fans running

# What Next?

- **Lab: decontamination of an EPA bio lab**
- **Summer test house w/ AC on, then AC off (floor fans on)**
- **Other test ideas? Talk to me**
  
- **Desorption: When is it safe to put head to pillow?**
- **How do we convey this information for public consumption?**



# Questions?

