Test & Balance Seminar for CxAs, Engineers, & TAB Professionals

Tuesday, April 24, 2018

8:30 a.m. – 4:00 p.m.

Cx ENERGY 2018 CONFERENCE & EXPO
APRIL 23-26
LAS VEGAS, NV

AABC

CONTINUING EDUCATION AIA

Kitchen Hood Capacity & Performance Testing

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Topics covered will include:

Kitchen hood design intent. Kitchen Hood variations. Field inspections and impact on performance. Implementation and use of the K-Factor Model for hood performance verification. Kitchen dynamics that affect hood performance.

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Course Description

- Kitchen Hoods

- Design Intent
- Kitchen Layout
- Hood Types
- Inspection of Installations
- Capacity Testing
- Performance Verification

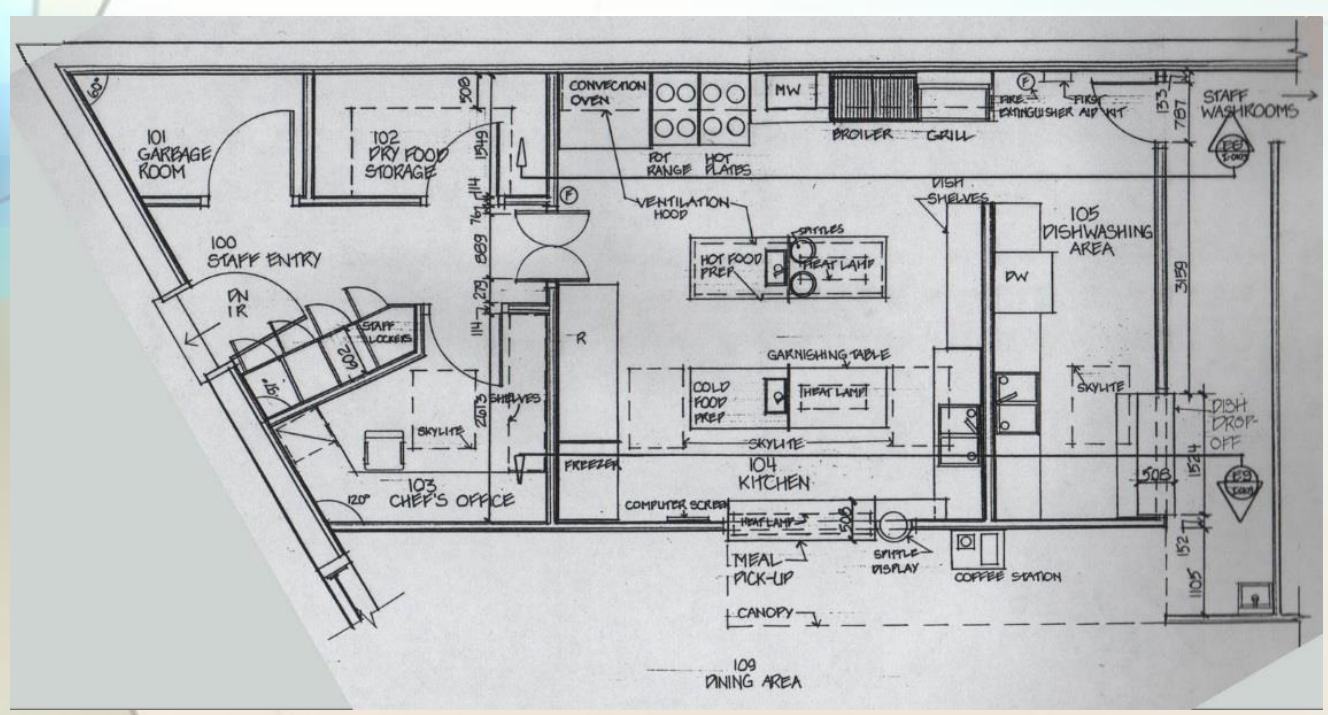
Learning Objectives

- To understand the intent of the kitchen hood system
- The types of hoods that the TAB professional will be exposed to and be expected to test
- Capacity testing and the K-Factor Model
- Performance testing and field dynamics that affect capture.
- Pressurization and air migration

Kitchen Hood Design Intent

- Capture Effluent
  - Grease
  - Fumes
  - Heat
- Indoor Environments
  - Maintain pressure relationships to prevent odor migration
  - OA/ventilation requirements
- The kitchen hood system operates in conjunction with the overall HVAC system to accomplish these goals
- Outside Air relationships
- Make-up Air relationships

General Kitchen Layout



- Pass-through opening(s)
- Swinging Doors
- Delivery access
  - All potential locations for impact on kitchen hood performance

Types of Kitchen Hoods

- Type I/Class I
  - Grease/smoke removal
  - Various types of extractors
  - Listed/Non-Listed
- Welded ductwork
  - Fire wrapping
  - Fire rated enclosures
  - Testing through cleanouts (discussed later)
  - MUA introduction (discussed later)
  - HVAC/Kitchen layout (Continued discussion)

Types of Kitchen Hoods

- Type I/Class I
  - Wash-down/ Extractors
  - Baffle Filters
  - Serve char-broilers, sauté stations, deep fryers
  - Normally not island types
- Welded ductwork
  - Fire suppression

Types of Kitchen Hoods

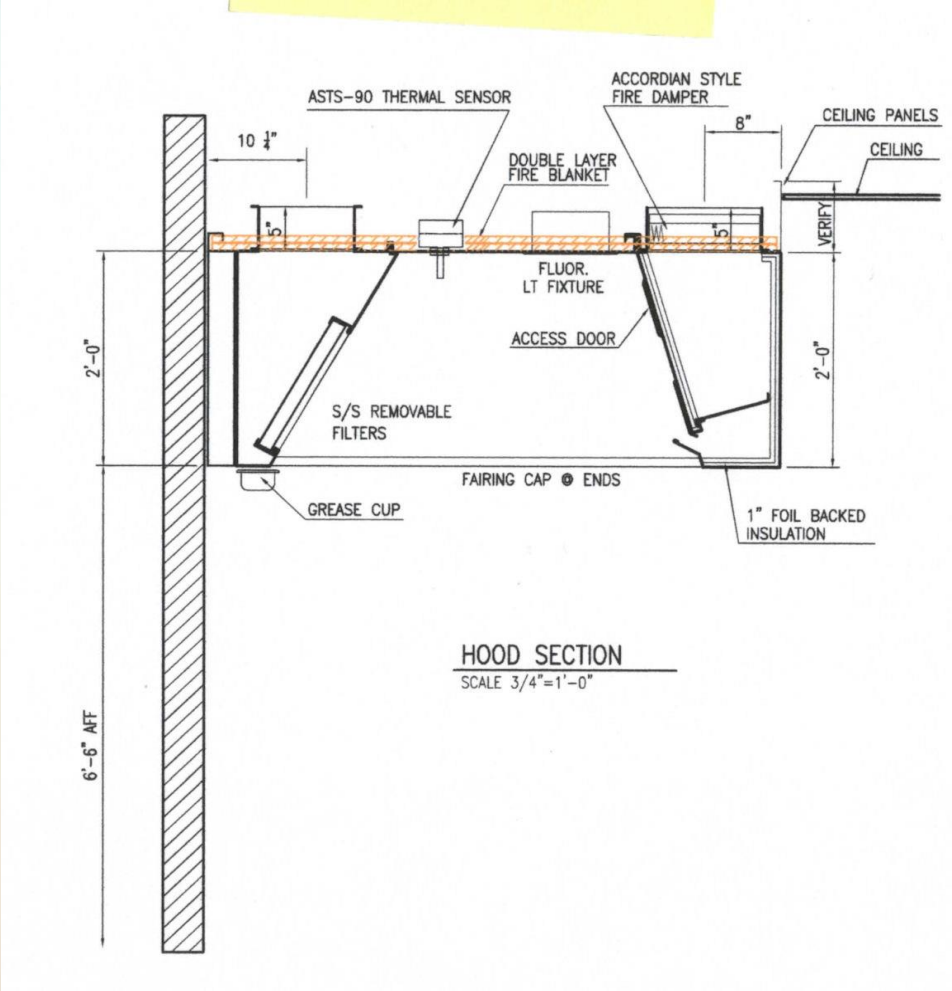
- Type II
  - Heat and moisture applications
  - Convection ovens
  - Large steam pots
- Can be Non-welded ductwork
  - May/May not have fire suppression

Types of Kitchen Hood Filter Systems

- Baffle Filters
  - Filters configured with over-lapping baffles
  - Create centrifugal air movement
  - Grease removed and allowed to collect on interior surfaces of the baffles
  - Drain out the frame
  - Normally low static losses

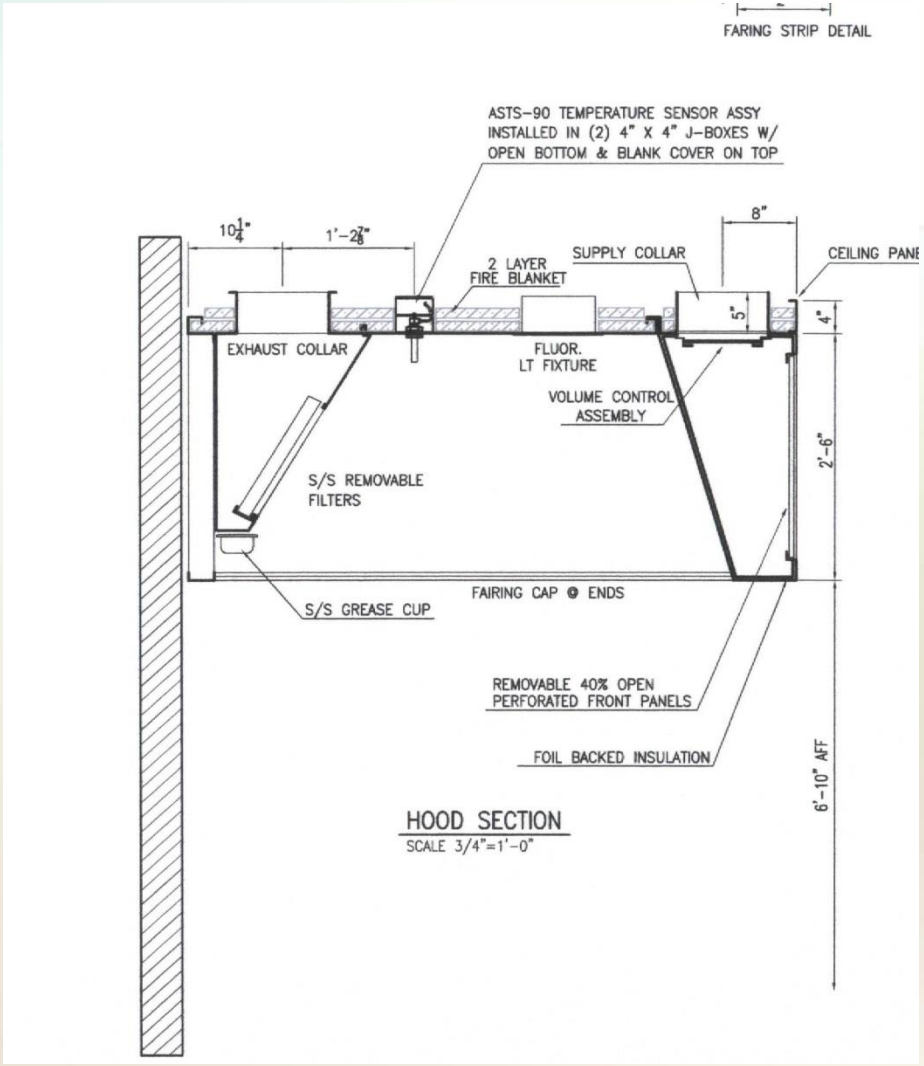
Configuration of Kitchen Hoods

- Short-Circuit (Internal Make-up)
  - Make-Up Air introduced into the hood canopy
  - Limits EF-to-MUA relationships depending upon equipment
  - Make-Up Air remains in the confines of the hood canopy



Configuration of Kitchen Hoods

- External Make-up
  - Make-Up Air introduced into the kitchen
  - Expand EF-to-MUA relationships potentially 100%
  - Make-Up Air may need to be treated

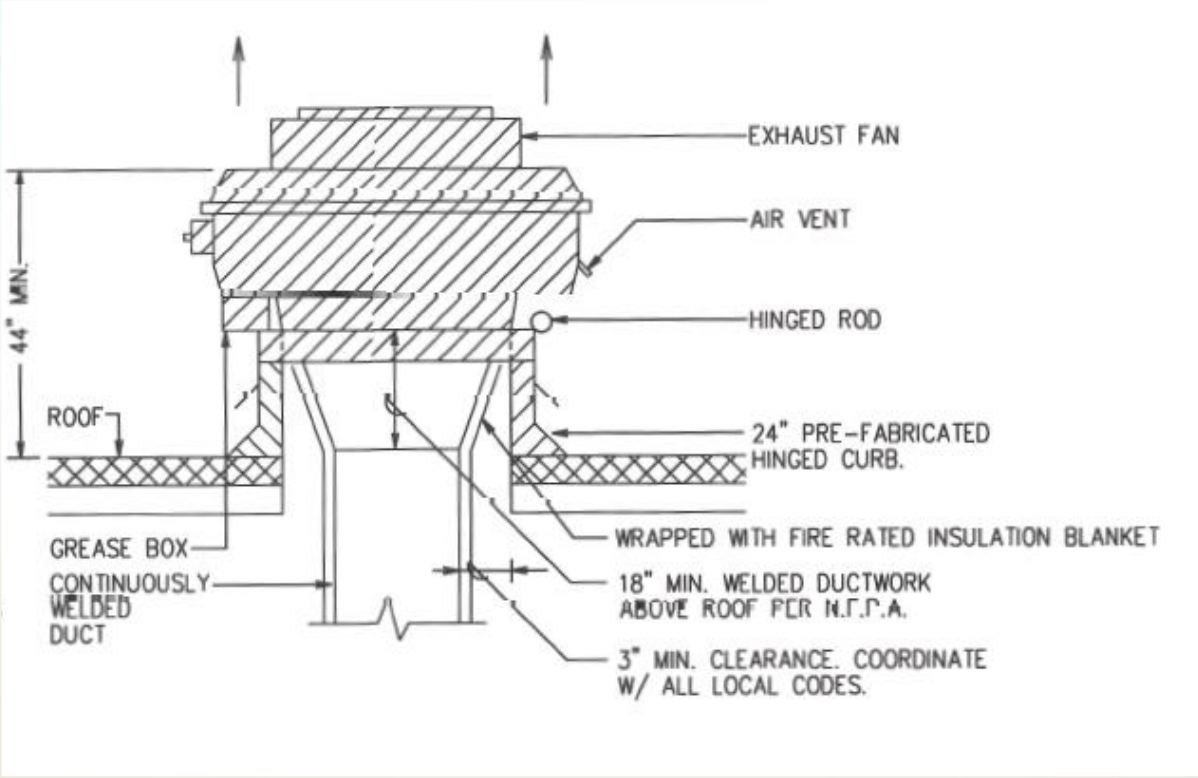


Inspecting the Installation

- Ductwork installation
  - Clean Welds
  - Consider “light” test to inspect the welds

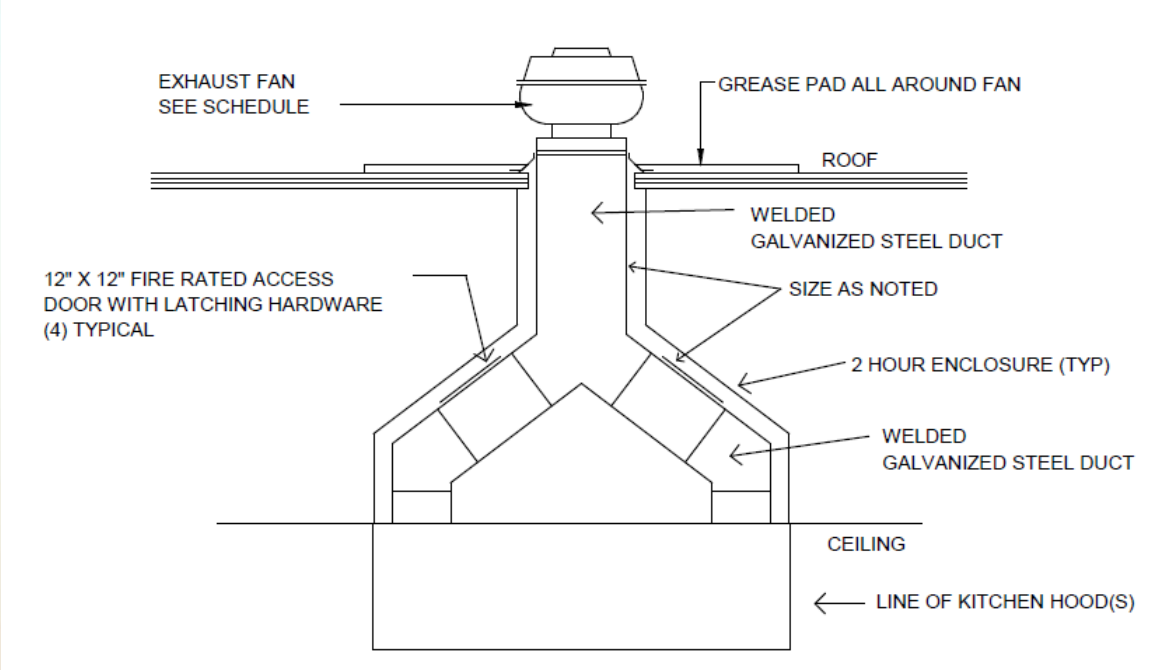
Inspecting the Installation

- Ductwork installation
  - Transitions to the fan



Inspecting the Installation

- Ductwork installation
  - Transitions to the fan
  - Transitions to the hood



Inspecting the Installation

- Ductwork installation
  - Transitions to the fan
  - Transitions to the hood
  - Proper location of cleanouts

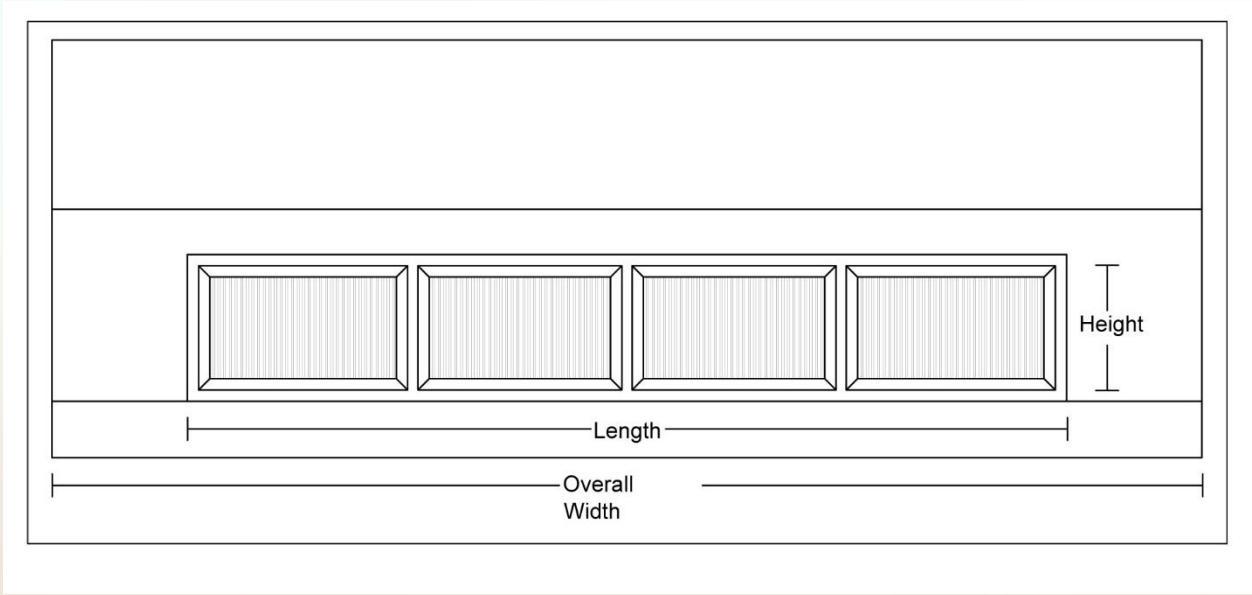
Inspecting the surrounding Installation

- Supply diffuser layout
- Diffuser type
- Pass through openings
- Exit doors
- Hood configuration –
  - Wall
  - Island
- Air drafts along hoods cause disruption to the capture performance
- Velocity moving from seating into kitchen impact hood capture performance
- Air pathways into the space disrupt hood capture

Capacity Testing of the Kitchen Hood System

- Implementation of the K-Factor Model method as outlined in the National Standards
  - All inspections are complete and installation meets construction documents
  - Begin with the physical measurements of the kitchen hood and the grease extractors

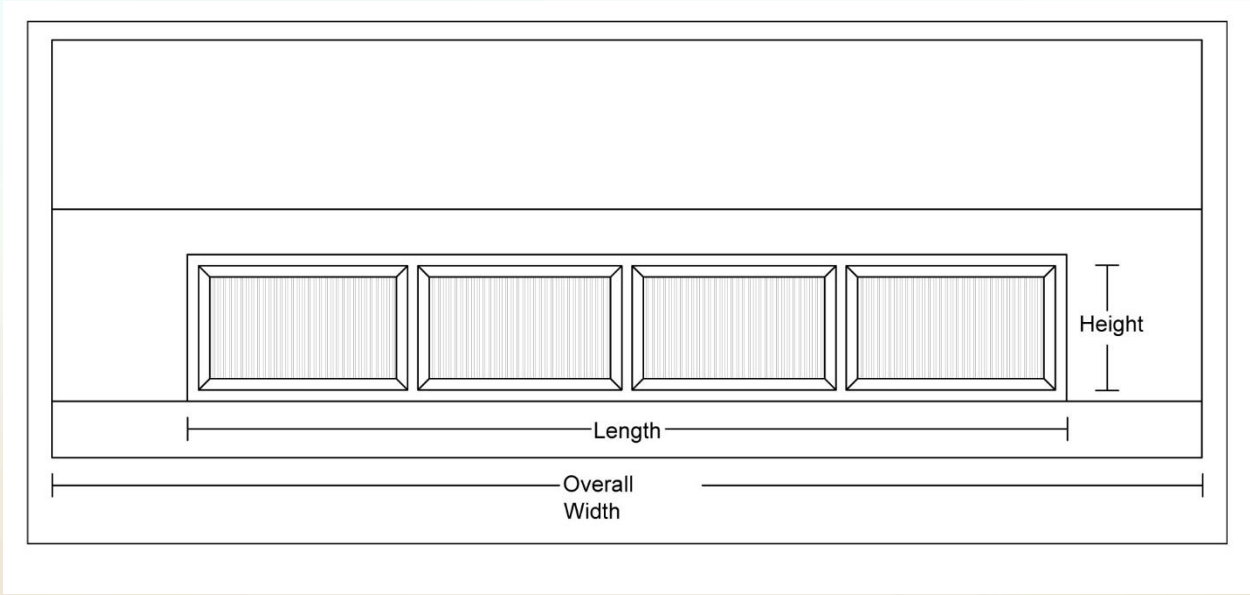
The first measurement is the overall size of the kitchen hood canopy. This dimension would be from the outside edges of the hood



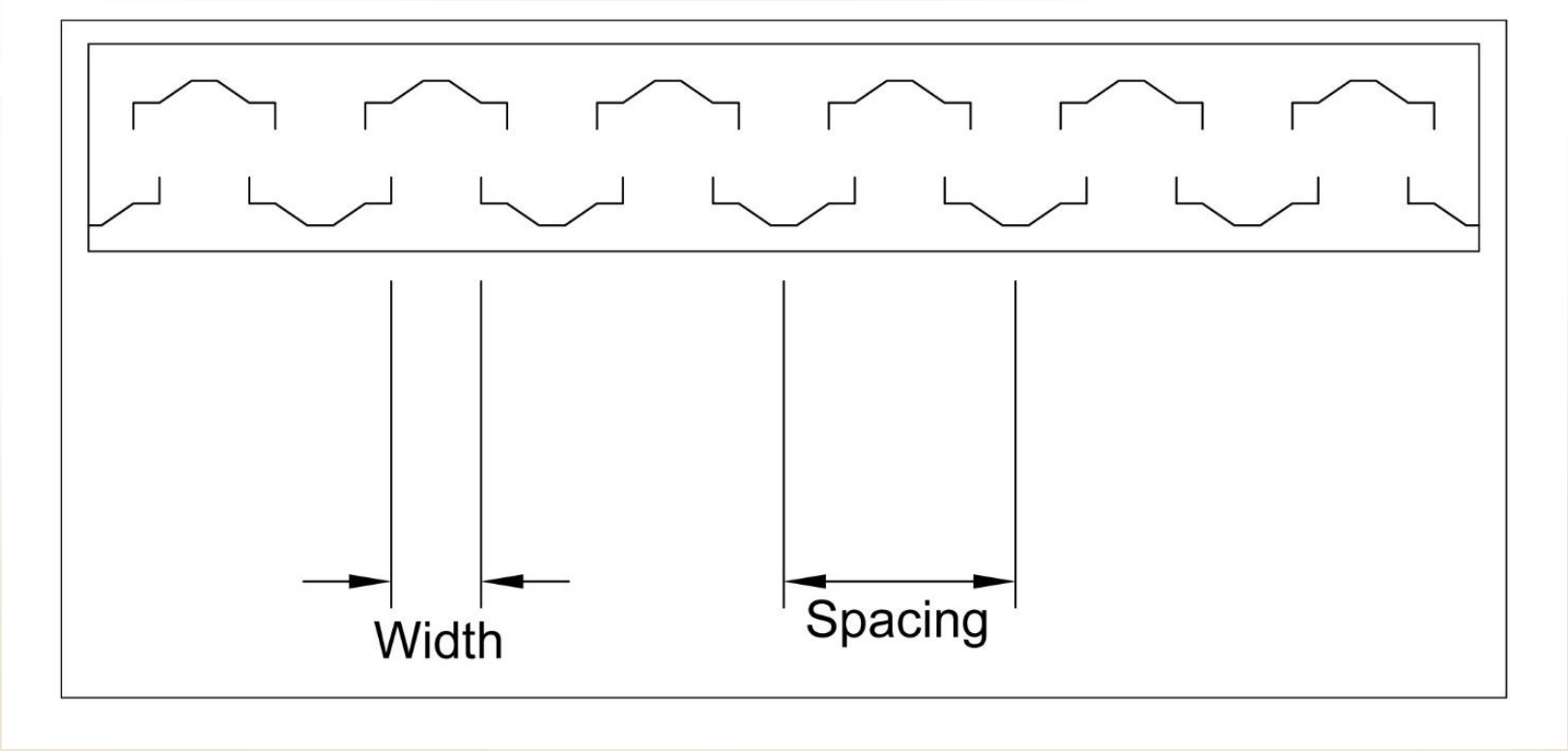
Starting Point for Hood Measurements

Microsoft Excel
97-2003 Worksheet

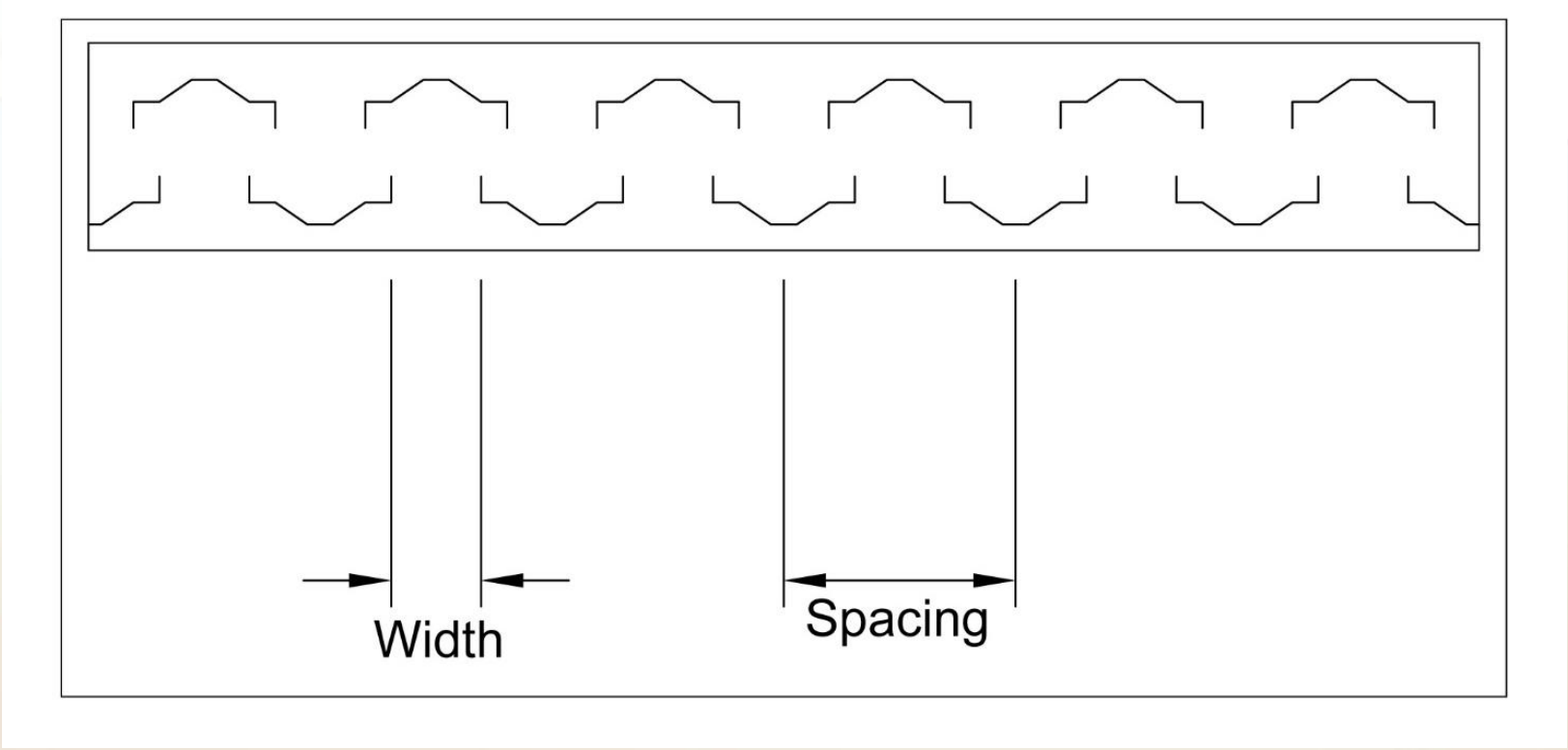
The second measurement is to determine the effective size of the grease filter bank. This is generally smaller than the overall size of the hood canopy.



The third step in the data gathering process for the hood is determining specific dimensions of the grease baffle filters. The first dimension is the width of the opening between the baffles.

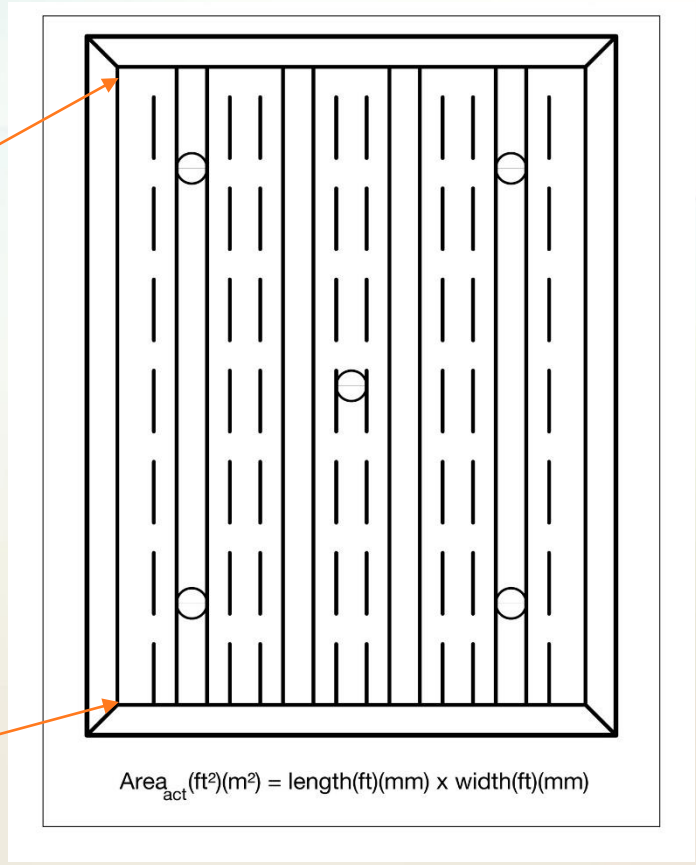


The fourth step in the data gathering process for the hood is determining the dimension of the centerline spacing of the baffles.



When measuring the size of the grease baffle filter, only measure the internal baffle components and not the filter frame.

- Assume Nominal Filter Size 20” x 16”
  - Baffle height may be reduced by as much as 1.5”; sometimes due to the hood filter retainer sleeve
  - Overall baffle width may be reduced by as much as 24”

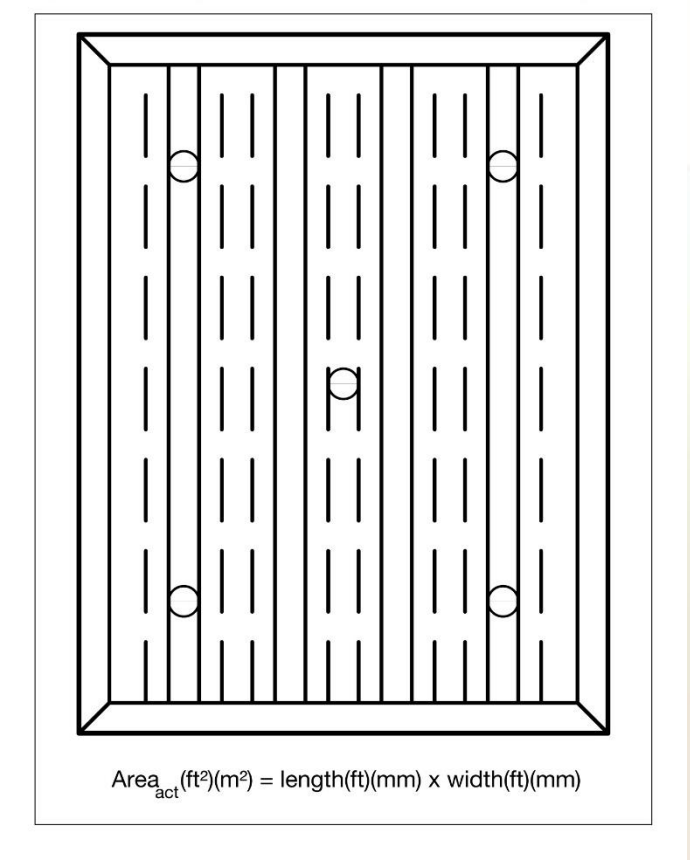


Baffle Filters Measurements

Microsoft Excel
97-2003 Worksheet

Baffle Filter Velocity Measurements

- For this presentation, we will assume Standard Air – No density corrections applied (See Pg. 271 of NS)
  - All cooking equipment should be off
  - Short-Circuit hood configuration, make-up air must be off
  - Temporary stand-off attached to the rotating vane anemometer



Measure Baffle Filter Velocities

Microsoft Excel
97-2003 Worksheet

Baffle Filter Velocity Measurements

- Position the rotating vane at the noted locations
  - Maintain offset distance – parallel to baffle filter
  - Maintain position until airflow velocities stabilize
  - Temporary stand-off attached to the rotating vane anemometer

If the results of the K-Factor testing do not appear accurate based upon the testing?

- Perform a Pitot tube traverse in the grease duct
  - Obtain approval from authorized individual(s)
  - Determine access of the ductwork – is it possible
  - Plan for re-sealing of the grease duct openings

If the results of the K-Factor testing do not appear accurate based upon the testing?

- Perform a Pitot tube traverse in the grease duct
  - Obtain approval from authorized individual(s)
  - Determine access of the ductwork – is it possible
  - Plan for re-sealing of the grease duct openings

- Perform a Pitot tube traverse through a clean out in the grease ductwork – Option #1

This door can be removed and replaced with cardboard and then a traverse performed

Exhaust Capacity Testing Complete – Performance Testing begins

- If the results of the K-Factor velocity testing are within design parameters
- The make-up airflow to the hood should be tested and balanced.
- Review hood type, equipment below the canopy, make-up relationship

Make-up Relationships

- Heavy grease laden air – short circuit hoods may not be able to handle MUA greater than 50% of exhaust.
- HVAC systems must account for MUA introduced directly into the kitchen.
- High heat producing equipment – short circuit hoods may not be able to handle MUA greater than 70%.
- It is recommended to perform hood performance with visual/objective feed back.

Typical Small Facility

- Typical small restaurant set-up:
  - 3 Kitchen hood systems
  - 1 RTU serving Kitchen
  - 3 RTU serving seating

Hoods:

Hood 1 – Type 1 8’ 3200/2560 CFM Exhaust/Supply (80%)
Hood 2 – Type 2 8’ 2000/1800 CFM Exhaust/Supply (90%)
Hood 3 – Dishwasher 1000 CFM

RTU:

Kitchen – OA 1500 CFM – Kitchen offset -340 CFM

Seating – 3 Units @ 500 CFM OA

Misc. Exhaust – Toilets – 600 CFM
Janitorial, Dry Storage – 200 CFM

– Restaurant Offset + 360

Looks reasonable on paper; Where are the challenges??

Initial Challenges

- Hood #1 does not capture all effluent and heat during operation
  - Excessive make up velocity is forcing heat/smoke out of the canopy
  - Heat plume with all equipment on cannot be captured
- Hood #2 does not capture all heat during operation
  - Hot air can be felt escaping the sides of the hood and rising from below the convection ovens

Hoods:

Hood 1 – Type 1 8’ 3200/2560 CFM Exhaust/Supply (80%)
Hood 2 – Type 2 8’ 2000/1800 CFM Exhaust/Supply (90%)
Hood 3 – Dishwasher 1000 CFM

RTU:

Kitchen – OA 1500 CFM – Kitchen offset -340 CFM

Seating – 3 Units @ 500 CFM OA

Misc. Exhaust – Toilets – 600 CFM
Janitorial, Dry Storage – 200 CFM

– Restaurant Offset + 360

Initial Changes to the System

- Hood #1 reduce make up air
  - Improves hood capture
- Hood #2 reduce make up air
  - Improves hood capture

- Kitchen RTU – increase OA?
  - Impact to the cooling coil/heat source?
  - Impact to kitchen comfort conditions
  - Maintain kitchen to seating airflow offset

Hoods:

Hood 1 – Type 1 8’ 3200/1600 CFM Exhaust/Supply (80%)
Hood 2 – Type 2 8’ 2000/1400 CFM Exhaust/Supply (90%)
Hood 3 – Dishwasher 1000 CFM

RTU:

Kitchen – OA 1800 CFM – Kitchen offset -340 CFM

Seating – 3 Units @ 500 CFM OA

Misc. Exhaust – Toilets – 600 CFM
Janitorial, Dry Storage – 200 CFM

– Restaurant Offset + 360

New Airflow Challenges

- Building now under a negative:
  - During hot/cold conditions - cannot sit patrons at tables near entry
  - Increased negative Kitchen offset – excessive velocity through pass-through
  - Velocity impacts hood performance
  - Open back door to mitigate pass-through velocity – outside drafts impact kitchen comfort conditions and hood performance
  - Increase OA to seating units
    - Get the building back into a positive offset
    - Pass through velocity elevates further

Hoods:

Hood 1 – Type 1 8’ 3200/1600 CFM Exhaust/Supply (50%)
Hood 2 – Type 2 8’ 2000/1400 CFM Exhaust/Supply (70%)
Hood 3 – Dishwasher 1000 CFM

RTU:

Kitchen – OA 1800 CFM – Kitchen offset -1400 CFM

Seating – 3 Units @ 500 CFM OA

Misc. Exhaust – Toilets – 600 CFM
Janitorial, Dry Storage – 200 CFM

– Restaurant Offset - 700

Now the kitchen works but the restaurant is operating in a negative offset

What is wrong with this picture

What is wrong with this picture??

- Just eliminate a hood and set the convection ovens ANYWHERE and all your problems are solved?

Questions / Conclusion

- The type/application of the kitchen hood should always be verified
- Installation can have an impact on fan performance
- Equipment & HVAC layout will impact hood capture performance
- MUA relationships will have the greatest impact on hood performance

- Identify/verify hood types and applications
- Impact of field adjustments to airflow and their impact on the facility