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Commercial Kitchen Ventilation

Part three of three

Model mechanical codes establish acceptable exhaust hood air volumes using formulas that are based upon the hoods square footage. National manufacturers of commercial exhaust hoods engineer type I hoods that are then subjected to the rigors of the UL 710 testing methodology in the pursuit of a *listing*. Each specific hood design is listed for a specific minimum volume CFM (cubic feet of air per minute) per lineal foot of hood for cooking equipment at a specific rated surface temperature. Model mechanical codes classify cooking equipment in four distinct categories each with a different required volume. The classifications are low, medium and high temp, and then solid fuel. The are exceptions to mechanical code that are shown directly below the specific requirement in the code document. Hoods listed to UL 710 are exceptions to the air movement requirements of the code. The owner of food service facility can benefit greatly by making sure that the hood they install is listed as the exhaust and related make up air (MUA) volumes can be significantly lower volumes than those required by code. The UL 710 standard test method is a very rigorous, worst case test of a hoods ability to perform under disastrous conditions. The following excerpts give a glimpse at the extremes imposed in testing. Chapter 26 of UL 710 is found on page 31 of the UL 710 document:

Test Installation

26.1 The minimum and maximum lengths of each style of exhaust hood are to be tested in a room that complies with the requirements described in 26.2
The room or building in which exhaust hoods are tested shall be free of drafts with the exception of replacement (make-up) air directed into the room.

The exhaust hood shall be installed at the maximum specified distance between the cooking surface and front lower edge of the exhaust hood for the Cooking Smoke and flare-up Test, Section 31, with the minimum specified overhang between the exhaust hood's sides and front panels, and the cooking surface.

Exhaust hoods intended for installations with the front edge of cooking appliance extending outside the front edge of the exhaust hood shall be tested with the cooking surface at the maximum specified distance from the front of the exhaust hood.

26.4 The cooking appliance is to be installed at the minimum specified clearance between the exhaust hood and the cooking surface for the tests described in Sections 30 and 32 – 35.

26.5 The exhaust duct used during the tests is to be connected to a power ventilator and are to be sized so that the velocity through the exhaust collar is at least 1500 feet (457 m) per minute, except during the Fan Failure Test, Section
33. Either the duct is to be provided with a damper or a ventilator is to be used to permit adjustment of the air velocity.

From these brief excerpts, you can see the extent to which hoods are tested. The UL 710-test methodology examines everything from the temperature in the room to the temperature of the cooking surfaces and the exact specs for the food products cooked during the tests. *Cooked* is putting it lightly...hamburgers are more or less incinerated on a grill by being cooked at 204C (400F) for 5 minutes, *each side.* This is done to create the greatest thermal plume possible given the 70% lean (30% fat!) beef that is specified. In this way, researchers are able to identify the worst case capture volumes for that particular hood design and list the hood accordingly. Keep in mind that this worse case testing is designed to determine BASE LINE exhaust requirements and it does not account for turbulence from outside sources. Designers must ***ALWAYS*** add volume to the base line listing exhaust values to arrive at volumes that will capture grease ladened vapors regardless of load.

Many operators of short-circuit hood systems wish they could convert them to direct draw hoods. These types of hoods are more popular in Southern States due to the design climate. Unfortunately, duct velocity requirements will frequently prevent operators for making the conversion. When they shut down the short circuit fan, the total exhaust volume drops. Since the duct remains the same size, the velocity of exhaust air will probably drop below the 1500FPM minimum velocity code requirement. Short circuit hoods have no net effect on the space and serve only one purpose; they enable operators to meet code requirements for volumes by providing cheap, untempered air into the capture area of the hood. This minimizes the amount of expensive tempered or A/C air that needs to be brought in to replace exhaust air.

Safety in listings

Hoods tested to be in compliance to UL 710 are unequivocally safer than the un-tested hoods built to mechanical code minimums. Additional safe guards are often passed into law by State legislatures as amendments. For example, the State of Minnesota has many such amendments that go beyond the UMC or NFPA requirements. Two that come to mind are the need for listed filters to be Stainless Steel and the reversal of the 20/80% short circuit requirements. Aluminum has a very low melting point compared to SS, and aluminum burns very hot.

The University of Minnesota has been awarded another research study commissioned by ASHRAE. This one is titled: Effects of Air Velocity on Grease deposition in Exhaust Ductwork. Set to begin in the Fall of 1998, the study will document any relationship between duct velocity and grease accumulation in ducts. Many kitchen ventilation professionals expect this study will quantifiably prove opinions derived from common sense observations ie., aerosols and VOC's condense and precipitate due to temperature change and corresponding air pressures/densities. One would expect that the revelation that temperature change is responsible for condensation and precipitation of grease ladened vapors would motivate code writers to revisit ventilated shaftwall enclosure requirements. Ventilating the shaftwall cools the grease duct causing grease deposits that could otherwise be prevented. Since grease deposits in ducts are to be avoided and there is a direct correlation between temperature change and condensation, it would seem to make sense to insulate the duct. Duct wraps are effective insulators and they are fire rated. Since type I ducts are always in a vacuum condition, there is no fear of saturating a duct wrap with grease (a fire hazard) since a small hole or penetration would draw air in rather than push grease out. Another approach to effective and safe duct design in a listed, pre fabricated duct. Metal Fab, Inc. is one such manufacturer or a prefabricated UL listed duct. Their new product has 4" of ceramic insulation providing tremendous protection from fire and outstanding thermal insulation. Exhaust temps at the duct collar will be within a degree (or less) of those temps at the duct outlet (roof curb). Future grease extraction strategies will involve removing the grease by reclaiming the energy from the exhaust air stream and in so doing cooling it, enabling the extraction of the grease. What a great deal...save energy while reducing the risk of fire.

Food Code relationships

The FDA Food Code was recently passed into law, with each State adopting it legislatively as is, or with a few enhancements or clarifications. A performance-based code, it focuses operations and enforcement on documented public safety hazards, and employee education. The code addresses hazards associated with food temperatures, sanitation, health and hygienic issues. NSF Std 7 is the performance standard for refrigerated equipment including prep tables and buffet counters. Health code authorities want to assure that refrigerated food items in an exposed prep table or buffet counter are held at temperature of 41^0F(5^0C) or less. These food items are exposed to room temperature air and unless you can induce a blanket of cold air to form on top of the food item, there

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is little chance of meeting food temperature maintenance requirements. Improperly balanced exhaust hoods are often responsible for refrigerated and heated holding equipment's inability to keep food at required temperatures. Turbulence also inhibits the hoods ability to capture smoke, grease ladened vapors and the by-products of combustion. I would estimate that 70-80% of the installed hoods I have seen in the past (10) years are not properly balanced and/or do not comply with volume requirements. Surprisingly few contractors even have the right instrumentation let alone use the correct methodology for type I exhaust hood volume measurements. This is complicated by the fact that specifier's select fans by looking at a chart (psychometric) that shows the fans peak performance curve. The target volume is always less than the total possible volume for a fan. The problem is that fan manufacturers ship their fans ready for max output. If someone does not measure the volumes and then adjust the drive pulleys, then there is no chance of getting a proper balance between exhaust and MUA

Summary:

A multi-disciplined approach is needed for optimization of food service facility design, and commercial kitchen ventilation plays an important part. Safe, efficient and effective commercial kitchen ventilation is within reach. New ideas and technologies are evolving as facts from research shed light on what used to be pure magic. Avtec Industries in Oswego Illinois was recently purchased by Randell Manufacturing, a Dover Industries Company. Avtec is the patent holder for the "Invent" type I exhaust system that was a radical departure for traditional type I hoods. They partnered with the manufacturer of a conveyor broiler to custom engineer a ventilation solution for that specific piece of equipment. Rather than using an overhead canopy, the piece of cooking is encased in a SS hood. All heat and thermals are captured very close to the source. The result is incredibly low exhaust volumes that pretty much match only what is needed given the process. Another promising new technology is offered by PureChoice, Inc. Their patented PureTrac systems consists of sensors (called a nose) that are placed in each room of a building. Each "nose" measures CO, CO_2, dry bulb, wet bulb and humidity, along with a total count of VOC's (volatile organic compounds) at up to 200 times per second. Acquired data is gathered by a central system where it is securely stored and then reported to the building owner. A new software upgrade will enable these BACnet compliant sensors to assume a pivotal role in controlling HVAC and maintaining compliance with ASHRAE Std 62 and 55 as it relates to IAQ and thermal comfort.

Optimization can only come from a thorough, multi-disciplined approach to engineering and design. ASHRAE research is yielding new facts that will demand lawmakers attention and action. Our knowledge of the processes involved has dramatically outpaced the statutory adoption of model codes into law. Owners, regulators, manufacturers and the public need to know that everyone wins when our laws match the laws of physic and science. Code requirements need to vary to match the variability of the application. **Once our laws match those of science, we will not have to change them anymore.** Public safety will be protected and environmental impact will be mitigated. Optimization is within our reach. Research and education are the keys.

tomj@jdpinc.com

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