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2012 IMC Code and Commentary

Code and Commentary

Internationally, code officials recognize the need for a modern, up-to-date mechanical code addressing the design and installation of mechanical systems through requirements emphasizing performance. The International Mechanical Code is designed to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small.

ventilation rate for kitchens is 0.7 cfm/ft^2 of exhaust, so to apply this rate, each individual recirculating appliance is considered as occupying 100 square feet. The purpose of this requirement is to provide a minimal amount of exhaust in the area where one or more of these appliances is installed. If a recirculating appliance is installed in a typical commercial kitchen where the kitchen ventilation rate is being applied to the whole space, then the area of the kitchen would be used to determine the ventilation rate without adding the additional 100 square feet for each recirculating appliance. Note however, if the kitchen is small and the number of recirculating appliances multiplied by 100 square feet is greater than the area of the kitchen, the exhaust rate for the kitchen must be based on the area calculated in accordance with this section.

Exception 3 allows reduction of the exhaust rate of commercial hoods when no cooking is taking place. Net exhaust volumes are based on the assumption that full-load cooking is taking place. In fact, part-load cooking conditions or appliances operating in standby mode represent the majority of time for most food service operations. Although the hoods should obviously be designed for maximum load, this should not prevent operating the hoods at a reduced exhaust rate when the actual load is less than maximum provided that the intent of the code is still satisfied (i.e., capture and removal of effluents). Reducing the exhaust rates during reduced cooking periods can improve system performance (fire safety, occupant health, energy efficiency and kitchen comfort).

The majority of gas-fired cooking appliance installations use the exhaust hood as a means of venting the combustion byproducts of the cooking appliances. Commercial cooking appliances are either connected to a vent or chimney or the flue outlet discharges into the exhaust hood. The exhaust hood system must be operating when appliances that depend on the exhaust system to vent combustion byproducts are in use. Gas-fired appliances must be interlocked with the hood system if combustion gases are vented by that system (see the definition of "Interlock" in Chapter 2 and Section 505.1.1 of the IFGC).

All hoods, listed and unlisted, must capture and confine cooking vapors within the hood to prevent spillage into the room (see commentary, Section 507.16).

507.2 Where required. A Type I or Type II hood shall be installed at or above all *commercial cooking appliances* in accordance with Sections 507.2.1 and 507.2.2. Where any cooking *appliance* under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed.

Exception: Where cooking appliances are equipped with integral down-draft exhaust systems and such appliances and exhaust systems are listed and labeled for the applica-

Figure 507.1(2)
ELECTRIC DEEP FAT FRYER
WITH RECIRCULATING HOOD

Figure 507.1(3)
ELECTRIC GRIDDLE WITH RECIRCULATING HOOD

tion in accordance with NFPA 96, a hood shall not be required at or above them.

❖ An exhaust system is required for "Commercial cooking appliances," as defined in Chapter 2. In addition to the specific cooking appliances, which are identified in the definition, further examples of commercial cooking appliances that require a commercial kitchen exhaust system are: griddles (flat or grooved); tilting skillets or woks; braising and frying pans; roasters; pastry ovens; pizza ovens; charbroilers; salamander and upright broilers; infrared broilers; and open-burner stoves and ranges. Furthermore, the definition of "Commercial cooking appliances" defines a food service establishment as "any building or portion thereof used for the preparation and serving of food." Within the context of Section 507, the "preparation and serving of food" includes operations such as preparing, handling, cleaning, cooking and packaging foodstuffs of any sort. The obvious examples of a food service establishment are restaurants and school cafeterias. A less obvious example is a church with a fellowship hall that holds fund-raising events, such as spaghetti dinners, fish fries or pancake breakfasts. Even a child day care facility may be loosely classified as a food service establishment if a hot breakfast or lunch is served to the children as part of their care. For a discussion on where a Type I versus Type II hood is required, see the commentary to Section 507.2.1.

A Type I hood must always be installed above a cooking appliance that produces grease or smoke (see commentary, Section 507.2.1). Grease and smoke go hand-in-hand such that where one is present, the other is likely present. The last sentence of this section simply states that either a Type I or II hood may be installed above a cooking appliance that requires only a Type II hood.

The exception recognizes the hoodless griddle type of cooking appliance that is becoming very popular in restaurants. These types of cooking appliances are often referred to as hibachi tables where food is prepared for the customers in front of them at the table where they are dining [see Commentary Figure 507.2(1)]. These cooking tables have a built-in integral down-draft exhaust system that is designed to capture the cooking vapors by drawing the air across the table into exhaust inlets located at the edge of the cooking surface. The cooking vapors are routed to grease filters located under the cooking surface and then to the grease duct that is under the floor [see Commentary Figure 507.2(2)]. The grease duct must be installed in accordance with Section 506.3.10 (see commentary, Section 506.3.10). These hoods must be listed and labeled for this application. Chapter 15 of NFPA 96 contains specific requirements for integral down-draft exhaust systems. It should be noted that other sections of NFPA 96 are referenced in this chapter and Section 102.8.2 of this code addresses such references.

507.2.1 Type I hoods. Type I hoods shall be installed where cooking *appliances* produce grease or smoke as a result of the cooking process. Type I hoods shall be installed over *medium-duty*, *heavy-duty* and *extra-heavy-duty cooking appliances*. Type I hoods shall be installed over *light-duty cooking appliances* that produce grease or smoke.

Exception: A Type I hood shall not be required for an electric cooking appliance where an approved testing

Figure 507.2(1)
HIBACHI TABLE WITH INTEGRAL DOWN-DRAFT EXHAUST SYSTEM
(Photo courtesy of Roaster Tech, Inc.)

agency provides documentation that the appliance effluent contains 5 mg/m^3 or less of grease when tested at an exhaust flow rate of 500 cfm (0.236 m^3/s) in accordance with Section 17 of UL 710B

❖ This section requires Type I hoods for cooking appliances that produce grease or smoke as a result of the cooking process (see definition of "Hood, Type I"). The term "grease" refers to animal and vegetable fats and oils that are used to cook foods or that are a byproduct of cooking foods. Cooking appliances are used for commercial purposes when the appliance is primarily used for the preparation of food for compensation, trade or services rendered. When the nature of the cooking produces grease or smoke then a Type I hood is required. A Type I hood is required where smoke is produced as part of the cooking process. The intent is not to require a Type I hood where there is a possibility of food being burned and producing smoke. For example, smoke that is produced when toast is burned does not mean that a Type I hood is required over a toaster. This section makes it clear that a Type I hood is required over medium-duty, heavy-duty and extra-heavy-duty cooking appliances. If there exists a light-duty cooking appliance that produces grease or smoke, a Type I hood is required for that appliance.

Cooking appliances installed in cafeterias, restaurants, dormitory kitchens, hotels, motels, schools and institutional occupancies are examples of appliances that typically require Type I exhaust hood systems. Some examples of commercial cooking appliances that require a commercial kitchen exhaust system are: deep fat fryers; griddles (flat or grooved); tilting skillets or woks; braising and frying pans; charbroilers; salamander and upright broilers; infrared broilers; open burner stoves and ranges; and barbecue equipment.

A common question that is asked is, what type of hood is required for conveyor and deck-style pizza ovens? Conveyor-type pizza ovens are listed in the definition of "Medium-duty cooking appliances." Type I hoods are required to be installed over medium-duty cooking appliances. Deck-type ovens are listed in the definition of "Light-duty cooking appliances." A Type I hood is required over a light-duty cooking appliance that produces grease or smoke. There is no longer a specific reference to deck-style pizza ovens, just the reference to deck-type ovens. Considering that a deck pizza oven is an enclosed oven and that the primary byproducts given off are heat and moisture, deck pizza ovens have commonly been approved for use under a Type II hood.

Unusual circumstances sometimes arise that may warrant a close evaluation of a cooking appliance or a cooking appliance installation before determining whether a Type I hood is required. For example,

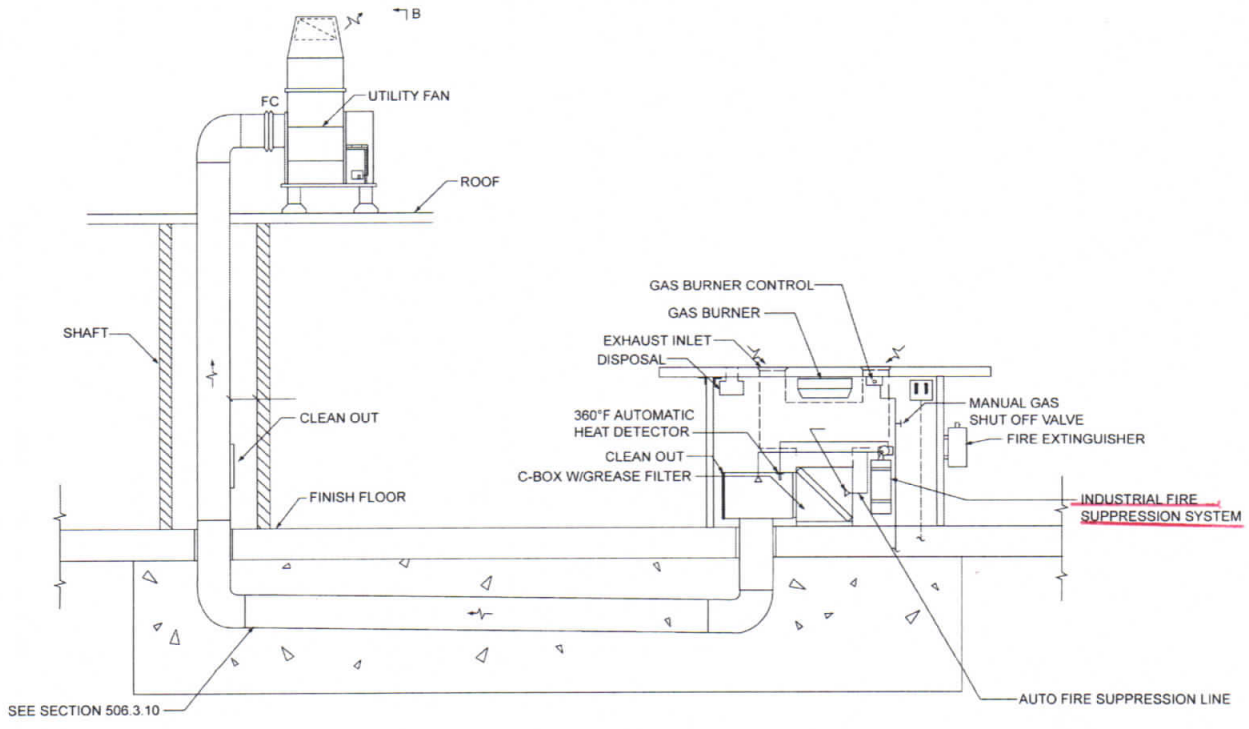

Figure 507.2(2)
DOWN-DRAFT EXHAUST SYSTEM
(Figure courtesy of Roaster Tech, Inc.)

cooking appliances used in a way that does not produce grease or smoke may need to be equipped only with a Type II hood or, depending on the occupancy where the cooking appliance is located, a residential hood or no hood at all. The key issues in making such determinations are the frequency of use and whether grease or smoke is produced by the cooking appliance and the cooking operation. The following are examples of kitchens serving occupancies that, depending on the nature of the cooking and the code official's interpretation of this section, might require only a Type II hood, a residential-type hood or no hood at all for the cooking appliances: church assembly halls; child care facilities; office or factory lunch rooms; employee break rooms; police and fire stations; bed-and-breakfast lodgings; VFW and similar halls; domestic-type kitchens in institutional occupancies; classrooms used to teach cooking; cooking demonstration displays and charity soup kitchens.

The code official should examine the nature of cooking operations before determining whether a Type I or II hood is required for a particular cooking appliance or a cooking appliance installation. Note that this section has been tightened up by stating that a Type I hood must be installed over medium-, heavy- and extra-heavy-duty cooking appliances. Bear in mind the primary purpose of a Type I hood is to control a potential fire hazard associated with grease and the purpose of a Type II hood is to control waste heat and moisture that burden HVAC systems and promote an unhealthy workplace. Excess moisture can deteriorate building components, promote the growth of mold and fungi, and create unhealthy and uncomfortable working conditions for employees.

Some common scenarios that come up are the type of hoods that are required in a life science classroom in a high school (i.e., a classroom used to teach, among other things, cooking to students) and the type of hood required over a cooking appliance(s) in a fire station. In both cases, the type of cooking is the deciding factor on the type of hood required.

Typically, students in a life science class are learning to prepare meals that are the same as those that are prepared for a family in a residential dwelling unit. In most cases, residential-type range/ovens are installed in the classroom. As such, the same byproducts that are produced in a kitchen in a dwelling unit would be produced in the classroom. Based on the residential style of cooking that is being taught, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed over the residential range/ovens used in a classroom. Therefore, a Type I or II hood would not be required and residential kitchen hoods that are ducted to the outdoors could be installed.

Note that if the high school offers a culinary arts class and uses commercial cooking appliances to teach students how to prepare meals that are normally prepared in a restaurant, then the appropriate Type I or II hood could be required based on the type of cooking operations that are performed under the hood.

In the case of a kitchen located in a fire station, once again it depends on the type of cooking and the intended use of the facility. Meals prepared in a kitchen in a fire station that has a residential-type range/oven that is only intended to be used to prepare meals for the fire fighters on that particular shift is similar, if not the same, as those prepared in a home environment. As such, the same byproducts that are produced in a kitchen in a dwelling unit would be produced in the kitchen in the fire station. Based on the residential style of cooking that is being performed, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed or, in a case where the space meets its ventilation requirements in Chapter 4 of the code, no hood at all.

It is not uncommon, however, for fire stations to have a community room with a kitchen used for preparing meals. The community room is often used to hold fund-raising events, such as spaghetti dinners, fish fries or pancake breakfasts, or used by members of the community for special events, such as parties or weddings. The kitchen may or may not have commercial cooking appliances installed. In this case, it would appear that such a situation is intended for the preparation of food for revenue generation. In this case, a Type I or II hood is required based on the cooking operations that are performed under the hood. This would also apply to VFW and other fraternal organizations, church assembly halls and other similar halls.

It is important to note that cooking appliances installed in commercial occupancies do not necessarily require the installation of a Type I or II hood. There are a number of installations in a commercial occupancy where residential-type cooking occurs that would not require a commercial kitchen hood (see the discussion above for school classrooms and fire stations). Lunchrooms and breakrooms in commercial businesses often have residential ranges/ovens installed. In addition, many multiple-family residential buildings (e.g., condominiums and townhomes) have a clubhouse or community room that the residents can reserve for special functions. Typically these are seldom used, and when they are, it is to warm food or bake frozen food like pizza, lasagna or premade appetizers. Based on the residential style of cooking that is performed on these appliances, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed or there may be no hood at all.

If multiple cooking appliances are installed under a single hood and one or more of those appliances requires a Type I hood, a Type I hood would be required to serve the entire appliance line.

With the trend for larger kitchens in new dwelling units, kitchens designed with commercial-type cooking appliances have become more popular. Although

these installations would generally not require commercial exhaust hoods, commercial appliances should be carefully evaluated for use in dwellings. Commercial cooking appliances are typically not listed for domestic use and might lack certain safety features that would be required for domestic cooking appliances. Note that Sections 917.2 and 917.3 require appliances in dwelling units to be designed and listed for domestic use (see commentary, Sections 917.2 and 917.3).

This chapter does not require exhaust hoods for cooking equipment or appliances installed outdoors where the grease-laden vapors, etc., discharge directly to the outside atmosphere, nor does this chapter intend to regulate cooking appliances installed in vehicles or towed trailers (see definition of "Commercial cooking appliances"). Note that cooking appliances installed outdoors but located under a roof should be evaluated for installation under a Type I or II hood just as if they were located inside a building having enclosing walls.

The exception recognizes the growing use of small electrical appliances used for cooking, such as in small sandwich shops and convenience stores, where little or no grease is produced. The installation of a Type I hood in these small establishments creates the expense of the hood and the energy costs of running the fan and tempering the makeup air for the owner where grease emissions are minimal or nonexistent. The grease emission threshold requirement is consistent with NFPA 96 and the testing procedure is done in accordance with Section 17 of UL 710B. In order for an appliance to qualify for use without a Type I hood it must be tested by an approved agency and shown that the effluent contains 5 mg/m^3 or less of grease when tested at an exhaust flow rate of 500 cfm. If the appliance is below the grease emission threshold, the provisions of Section 507.2.2 are still applicable and a Type II hood may still be required.

507.2.1.1 Operation. Type I hood systems shall be designed and installed to automatically activate the exhaust fan whenever cooking operations occur. The activation of the exhaust fan shall occur through an interlock with the cooking appliances, by means of heat sensors or by means of other *approved* methods. A method of interlock between an exhaust hood system and appliances equipped with standing pilot burners shall not cause the pilot burners to be extinguished. A method of interlock between an exhaust hood system and cooking appliances shall not involve or depend upon any component of a fire extinguishing system.

❖ This section and Section 507.1 state that the hood system must operate whenever cooking operations are taking place. In order to perform the intended function, a Type I hood is required to automatically operate when cooking operations occur or must be activated in an arrangement that prevents cooking without hood exhaust system operation. There are several methods indicated to achieve this and it is left up to the designer/installer/owner and code official to determine what they all agree will be necessary to verify that fan operation will occur whenever cooking operations occur.

The activation of the exhaust fan must occur through an interlock with the appliances, by means of heat sensors or other approved methods. It should be noted that an interlock with the cooking appliances is one of the methods to accomplish this, but is not the only method. This text has been misinterpreted as meaning that all appliances must be fitted with controls that would start the hood system. This is not the case. In fact, tampering/altering with listed and labeled appliances may in itself create a code violation. However, if a cooking appliance has provisions incorporated into its listed and labeled design that included some type of interlock option, that would certainly meet the requirements of this text.

It should be pointed out that the text states that "hood systems shall be designed and installed..." and this means that the hood system needs the controls and not necessarily the actual cooking appliances. The hood system must cooperate with appliances by means of heat sensors or other approved methods. All this means is that something needs to activate the exhaust fan when a cooking operation takes place. This can be achieved through the use of controls such as heat sensors/infrared technology, light beam interference detection or through methods such as electric relays that control the branch circuit that the appliances are connected to or, in the case of gas appliances, a solenoid valve in the gas supply piping. This section does not prevent manual starting of the exhaust system, provided that there is a means to prevent cooking appliance operation when the exhaust system is not operating (e.g., hood and appliance interlock).

The part of this code text that says, "or by other approved methods" leaves the door open for many options. This leaves it up to the designer/installer/owner and code official to determine what will be necessary to verify that fan operation will occur whenever cooking operations take place. One way might be to tie the fan to the lighting control serving the kitchen area, assuming that the cooking would not be possible if the lights were off. This option may work very well because of the allowance that permits the use of variable speed exhaust fans (see commentary, Section 507.1). When the lights are turned on the fan might not even be running, but when cooking operations begin the heat created would cause the fan to begin to run on a light load condition. This variable speed technology already has the interlock incorporated into it, which is how the fan knows to automatically change speeds throughout the day. Another "approved" method may be one that some of the chain restaurants use in which the standard operating procedure is that the fan always runs when the building is occupied or upon startup of any cooking appliance. While not stating a specific method to

interlock the hood to the operation of the appliances, the code does state that the method used must not cause the pilot burners to be extinguished. For example, if the interlock method uses an electrically actuated (solenoid) main fuel valve, that valve will close when the exhaust fan system is shut down. This, in turn, will extinguish any standing pilots and necessitate the relighting of pilots each day or each time the kitchen is "off line." Besides the obvious inconvenience, there is also a safety concern with having employees and owners routinely relighting pilots that may be difficult to access. For this reason, the code prohibits a method of interlock that would cause standing pilot burners to be extinguished. Although some attempts have been made to circumvent this problem, a practical and safe solution to the standing pilot problem is not known at this time. It should be noted that in Section 505.1.1 of the IFGC, gas piping is specifically prohibited from being installed to bypass the solenoid valve (see IFGC commentary, Section 505.1.1).

The method of interlock must not involve or depend on any component of the fire-extinguishing system. Since fire-extinguishing systems provide a shutoff device for the fuel to the appliances being protected, someone might try to utilize such valve in an effort to comply with this requirement. This could pose a potential problem for the shutoff device, since it is not listed to provide this function, which might also compromise the effectiveness of the fire-extinguishing systems in an emergency situation.

This is an operational requirement to ensure that the ventilation is operational when the cooking appliances are in use. This requirement is not part of the operations that occur when a fire occurs. The shutoff device in the extinguishing system is listed as part of the extinguishing system and is not listed to perform this additional function.

Where solenoid gas valves are used to interlock cooking appliances with an exhaust system, a manual reset device should be considered for inclusion in such arrangements. In the event of a power outage, the solenoid valve will close and because the gas appliances are inoperative, the kitchen personnel might walk away from them leaving manual burner controls in the on position. When power is restored, personnel may not be aware that the solenoid has reopened allowing gas to escape from open burners. A manual reset device will prevent such reopening of the solenoid without a deliberate action by informed personnel.

507.2.1.2 Exhaust flow rate label. Type I hoods shall bear a label indicating the minimum exhaust flow rate in cfm per linear foot (1.55 L/s per linear meter) of hood that provides for capture and containment of the exhaust effluent for the cooking appliances served by the hood, based on the cooking appliance duty classifications defined in this code.

❖ The requirement for Type I hoods to bear a label is for factory-built commercial exhaust hoods that are listed and labeled in accordance with UL 710. Type I hoods that are not listed and labeled in accordance with UL 710 would have to meet the requirements of Section 507.13. The minimum exhaust flow rate and the cooking appliance duty classification is information that is necessary for the inspector in the field to determine that the hood has the minimum exhaust flow rate for the appliances that are installed beneath the hood. The exhaust hood must be compatible with and intended for the type of cooking appliance it will serve. Typically, the label of a factory-built hood tested in accordance with UL 710 will indicate the cfm per linear foot and the maximum temperature of cooking appliances that can be located under the hood [see Commentary Figure 507.1(1)]. However, the code references duty classifications for cooking appliances and not temperature ratings. This creates enforcement problems for the inspector in the field if he or she does not know the temperature ratings of the appliances installed beneath the hood. Requiring the cfm per linear foot and the duty classifications of the appliances will help the inspector in the field to verify that the hood system is appropriate for the appliances served.

It should be noted that the UL 710 standard is currently being updated and revised and will require that the duty classification (i.e., extra-, heavy-, medium- and light-duty) of the appliances the hood is intended to serve be indicated on the label. Note that these changes to UL 710 are still undergoing a review process and that it may take some time before this information appears on the hood label.

507.2.2 Type II hoods. Type II hoods shall be installed above dishwashers and appliances that produce heat or moisture and do not produce grease or smoke as a result of the cooking process, except where the heat and moisture loads from such appliances are incorporated into the HVAC system design or into the design of a separate removal system. Type II hoods shall be installed above all appliances that produce products of *combustion* and do not produce grease or smoke as a result of the cooking process. Spaces containing cooking appliances that do not require Type II hoods shall be provided with exhaust at a rate of 0.70 cfm per square foot (0.00033 m^3/s). For the purpose of determining the floor area required to be exhausted, each individual *appliance* that is not required to be installed under a Type II hood shall be considered as occupying not less than 100 square feet (9.3 m^2). Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot [.00356 $m^3/(s \cdot m^2)$].

❖ Type II hoods are required above dishwashers and appliances that produce heat or moisture and do not produce grease or smoke, except where the heat or moisture loads are incorporated into the HVAC system (see Commentary Figure 507.2.2). Where light-duty cooking appliances produce products of combustion and do not produce grease or smoke, they must be located under a Type II hood. Where smoke is produced as part of the cooking process, a Type I hood is required. The intent is not to require a Type I hood where there is a possibility of food being burned and producing smoke. For example, smoke that is

produced when toast is burned does not mean that a Type I hood is required over a toaster. Where a dishwasher or appliance has a separate removal system that is specific to that appliance, and it discharges the heat or moisture to the exterior, a Type II hood is not required. Any light-duty cooking appliance that produces grease or smoke must be located under a Type I hood (see commentary, Section 507.2.1).

In previous editions of the code, there were a number of exceptions that did not require a Type II hood over light-duty electric cooking appliances such as convection, bread and microwave ovens; toasters; steam tables; popcorn poppers and coffee makers, as long as the additional heat and moisture loads were accounted for in the design of the HVAC system. This laundry list of exceptions kept growing with every code change cycle until the list of appliances that did not require a hood nearly exceeded the list that required a hood. The exceptions are now gone and replaced with criteria that are twofold; (1) is heat or moisture produced? (2) are the heat and moisture loads accounted for in the design of the HVAC system? If heat and moisture are produced and the loads are incorporated into the HVAC design, then no Type II hood is required. If heat and moisture is produced and the loads are not incorporated into the HVAC design, then a Type II hood would be required. Note that if a Type II hood is not required, there is no limit to the number of electric appliances that can be installed as long as the loads from all the appliances are accounted for in the HVAC design. The designer should consider if it is more energy efficient to design the HVAC system to handle the heat and moisture loads or if it is more efficient to provide a Type II hood and makeup air. Since the code permits either option, the designer must make the decision on which design is more energy efficient. Outside weather conditions, the number of appliances, the heat and moisture loads generated and hours of operation may all be factors that help decide which option is more energy efficient.

If cooking appliances are provided and a Type II hood is not required, the space where the appliances are located must be provided with exhaust at a rate of 0.7 cfm/ft^2, which is the same rate as kitchens in Table 403.3. To apply this rate, each individual appliance is considered as occupying 100 square feet. The purpose of this requirement is to provide a minimal amount of exhaust in the area where one or more of these appliances are installed. If cooking appliances are installed in a typical commercial kitchen where the kitchen ventilation rate is being applied to the whole space, then the area of the kitchen would be used to determine the ventilation rate without adding the additional 100 square feet for each appliance. Note however, if the kitchen is small and the number of appliances multiplied by 100 square feet is greater than the area of the kitchen, the exhaust rate for the kitchen must be based on the area calculated in accordance with this section.

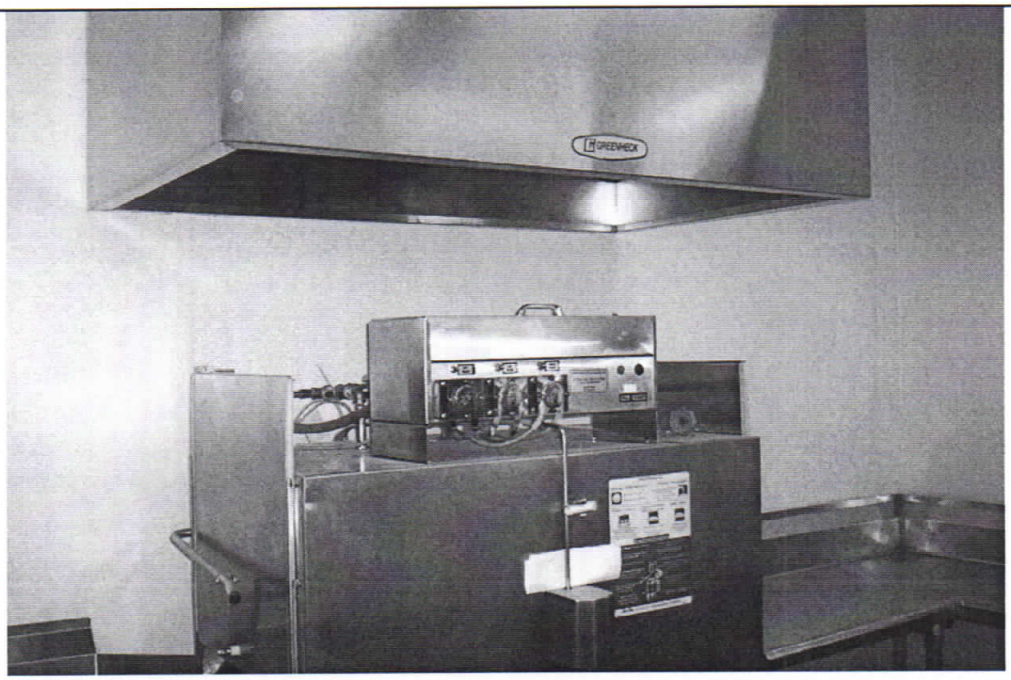

Figure 507.2.2
TYPE II HOOD ABOVE A DISHWASHER
(Photo courtesy of Guy McMann)