MECHANICAL CODE DISCUSSION

Combustion Air from Inside a Newer Building

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Recently, I've become aware of a couple of troubling conditions where new apartment buildings have water heaters installed within the units, using the indoor combustion air, drawn from the living space. These units are experiencing high carbon monoxide conditions and sooting in the heat exchangers. Apparently, the design professionals, jurisdictions, and contractors notice the code allows indoor combustion air, but have *failed* to carefully read and correctly apply the code section.

Back in the mid 1980s, fuel gas codes introduced the term unusually tight construction to the building construction industry. Through testing and experience it was determined home building practices and codes produced structure significantly tighter than earlier construction. Subsequently, there was insufficient leakage to provide the air required for gas appliance combustion. In the opinion of many including myself, an over-reaction occurred, resulting in the ridiculous excessive two pipe combustion air requirements mandated for all newly constructed homes. An example of this absurdity is a 100,000 BTU/hr. furnace with a 40,000 BTU/hr. water heater:

Considering horizontal CA ducts with 2 sq. in. per 1,000 BTU/hr. per opening: 140 ÷ 2 = 70 sq. in. or *two 10″ pipes to outside.* Several years later the fuel gas codes introduced the 1 sq. in. per 3,000 BTU/hr. single opening option, an obvious improvement.

Jump forward to 2003, the International Fuel Gas Code re-introduced/modified *indoor combustion air options* for any building—See IFGC 404.5, IRC G2407.5. The code recognizes ***if we know the air infiltration rate into a building [air changes per hour (ACH)]***, calculations can be made to identify an interior volume sufficient to satisfy the combustion air needs of a gas appliance. The key here is ***knowing our infiltration rates.*** FYI, the building codes no longer include the term *unusually tight construction.*

Manual J Table 5B, simplified Infiltration Rates for one or two exposures, a typical multi-family building:

> 1000 sq. ft. apartment unit of tight construction; Heating ACH = 0.18 and Cooling ACH = 0.09

Please notice during heating seasons the air infiltration rate is higher due to stack action or heat rising through ceilings, pulling outside air into the building to replace ceiling leakage. Water heaters of course operate in the summer, when the ACH is lowest. Let's consider a calculation for the required interior volume if the indoor combustion air option is selected.

> IFGC Equation 3-1 for nat. draft, where I = 40,000 input BTU/hr. water heater, ACH cooling = 0.09:
>
> $$Required\ Volume_{other} \geq \frac{21\,ft^3}{ACH}\left(\frac{I_{other}}{1{,}000\ Btu/h}\right)$$
>
> Required Volume = 21 ÷ 0.09 X 40 = 9333 cubic feet. Divide by 8′ ceiling hgt. = 1167 sq. ft.

Recalling the volume used in any indoor CA calculation is based on open areas that cannot be closed off with doors. The total volume of the apartment is too small to use indoor combustion air. Considering bedroom, bathroom and laundry room doors may be closed, typically no more than half the volume is available for combustion air. Volume is insufficient for both heating and cooling conditions.

Other conditions which might compound the problem include continuously operating fans, dryer and range hood operations, and extra-ordinary sealing practices resulting in even lower ACH rates.

Conclusion: combustion air for gas furnaces, boilers, and water heaters for virtually all buildings built today must come from outside. Either provide an outside combustion air duct, to a room sealed/separated from the living space or install direct vent appliance. I strongly recommend the later.

Please feel free to contact me for further information or if you have other questions. Best wishes for a joyful and successful 2020! —Brent ■