MEMORANDUM

DATE: July 10, 2009 (updates July 14, 2008 memo)

TO: North Carolina Approved Third Party Agencies, Modular Manufacturers, and Other Interested Parties

FROM: Joseph H. Sadler, P.E.
Building Code Consultant
Manufactured Building Division

SUBJECT: Return Air Plenums in Modular Homes

We have received complaints from local inspection departments concerning the sealing of return air plenums in modular homes and buildings. We have found that, in many cases, the building spaces that are used as plenums within the air distribution systems are not sealed as required by Code. Plenums are considered part of the duct and air distribution systems. The following definitions as defined in Section 202 of the 2009 North Carolina Mechanical Code are important in understanding the requirements for air distribution systems.

**AIR DISTRIBUTION SYSTEM.** Any system of ducts, plenums and air-handling equipment that circulates air within a space or spaces and includes systems made up of one or more air-handling units.

**DUCT.** A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

**DUCT SYSTEM.** A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

**PLENUM.** An enclosed portion of the building structure, other than an occupiable space being conditioned, that is designed to allow air movement, and thereby serve as part of an air distribution system.

The *2009 North Carolina Mechanical Code requires in Section 603.2* that supply and return air ducts installed in a single dwelling unit shall be sized in accordance with ACCA Manual D or other approved methods. Although plenums are not ducts, they are an integral part of the air distribution system and subject to leakage affecting the efficiency of the system. Section 12, *Return and Discharge Plenums*, of ACCA Manual D states the following:
“Return and Discharge Plenums

Return plenums and discharge plenums that are attached to the central air handling equipment tend to leak at the seams and joints. These seams and joints should be sealed.

In some cases, an air handler is mounted on top of a plenum that is fabricated out of wood framing and plasterboard. These plenums have been found to have serious leakage problems when the seams and the pipe penetrations are not sealed. And, they can be outrageously leaky if one or two of the plenum walls are coincident with a partition or exterior wall. For example, if this type of plenum is fabricated before plasterboard is applied to the wall studs (partition of exterior wall), the plasterboard will stop at the top of the plenum and the inside of the plenum will be open to the wall cavity. Since this cavity extends to the ceiling and to the floor, it can create a leakage path between the plenum and the attic, garage, basement or a crawl space. These leakage paths can be eliminated if the inside surfaces of this type plenum are paneled and thoroughly sealed with a suitable mastic.

Any building cavity (chase, ceiling space, crawl space or stairwell) that is used as a plenum will cause serious leakage problems when these cavities are not completely isolated from the ancillary spaces (attic, basement, garage and crawl spaces) and the outdoors. The insides of these types of plenums must be paneled and thoroughly sealed with mastic.

Note that the leakage that is associated with plenums that are close to the air handler will be larger than the leakage that occurs at some remote point in a duct run. That larger leakage rate occurs because the pressure differences near the air handler are larger than the pressure differences at son remote point in the duct system.”

The negative pressure in the plenum will pull outside air into the return. For examples see the pictures below:

Note 1: Pictures 1 through 4 show a plenum against an exterior wall. As a plenum, it would require sealing as described above. These pictures show another Code violation regarding insulation materials in the wall assembly. The 2009 North Carolina Residential Code, Section R316.1, requires that “Insulation materials, including facings, such as vapor retarders or vapor permeable membranes installed within floor-ceiling assemblies, roof-ceiling assemblies, wall assemblies, crawl spaces and attics shall have a flame-spread index not to exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E 84.”. Exception 1. allows insulation with facings not meeting the requirements in Section R316.1, if the facing is in substantial contact with the exposed surface of the wall finish (i.e. gypsum wall board, etc.). Pictures 1 through 4 show insulation that would require the insulation to substantially contact the surface of a wall finish such as gypsum board, when installed in any constructed wall, ceiling or floor assembly in a one or two family dwelling unless the facing meets or exceeds the flame spread and smoke developed requirements listed above.
Note 2: Pictures 5 through 9 show a plenum that is not sealed as required under a stairway with areas exposed to the outdoors (i.e. uncovered wall cavity), attic and crawl space.
In order to prevent future conflicts between local building departments, dealers, contractors and manufacturers, the sealing of the air distribution system including ducts, duct systems and plenums, must be completed in the manufacturer’s facility. This directive is effective immediately and should be reflected in future construction. If you have any questions, please call this office. Thank you for your immediate attention to this matter.

cc: C. Patrick Walker, P.E. - Technical Services Manager
    Alan D. Greene, P.E. - Chief Building Code Consultant (Mfg. Bldg. Division)
    Michael J. Hamm, P.E. - Building Code Consultant
    John P. Stoppi, P.E. - Building Code Consultant
    Henry M. Webster, P.E. - NCDOI Plumbing Engineer
    Billy Hinton, P.E. - NCDOI Mechanical Engineer
    Barry Gupton, P.E. - NCDOI Chief Building Code Consultant