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**MEMORANDUM**

DATE: December 10, 2012

TO: Building Inspectors, Third Party Agencies, Manufacturers and Other Interested Parties

FROM: Joseph H. Sadler, Jr., P.E.  
Deputy Director - Manufactured Building Division

RE: Thermal Envelope Air Sealing/Duct Tightness Testing Requirements for Residential Occupancies  
*NC Residential Code, 2012 Edition and NC Energy Conservation Code, 2012 Edition*

Several questions have arisen concerning air leakage and duct sealing requirements in the *2012 editions of the NC Energy Conservation Code (NCECC) and NC Residential Code (NCRC)*. (The following requirements do **not** apply to HUD labeled units)

**Thermal Envelope Air Sealing:**

**NCECC Section 402.4** and **NCRC Section N1102.4** address the requirements for sealing the thermal envelope to limit air infiltration. There are two methods that can be used to demonstrate compliance with the sealing requirements:

1. Visual Inspection Option (**Section 402.4.2.1 of the NCECC** and **Section N1102.4.2.1 of the NCRC**)- Allows the builder, permit holder, or registered design professional to verify the building has been sealed by a visual inspection of the items via the certificate in **Appendix 1.1 of the NCECC** and **Appendix E-1 of the NCRC**. The items that must be inspected are listed in **Section 402.2.12 and Table 402.4.1 of the NCECC** and **Section N1102.2.12 and Table N1102.4.2 of the NCRC**.
2. Testing Option (**Section 402.4.2.2 of the NCECC** and **Section N1102.4.2.2 of the NCRC**)- Allows the permit holder, a NC licensed general contractor, a NC licensed HVAC contractor, a NC licensed Home Inspector, a registered design professional, a certified BPI Envelope Professional, or a certified HERS rater to perform a pressure test in accordance with ASTM E 779-03. This section lists requirements that have to be performed during testing as well as the testing criteria.

Either method listed above is acceptable. If modular manufacturers decide to use the visual option, then a checklist identifying what items were checked in the plant and what items must be checked in the field using the items listed **Section 402.2.12 and Table 402.4.1 of the NCECC** and **Section N1102.2.12 and Table N1102.4.2 of the NCRC** should be used. It is recommended to create a certificate to match **Appendix 1.1 in the NCECC** or **Appendix E-1 in the NCRC**, but change the section that indicates “Visually inspected” to include an area to check off visually inspected in the plant and visually inspected on site. Attached is a checklist and certificate that can be used as a guide and modified to fit each manufacturer’s individual needs. It is strongly recommended to revise the visually inspected portion of the certificate to include a factory built check-box and a site built check-box that can be checked off as they are completed.

The plans must include set-up instructions and details for the set-up contractors and building inspectors to follow on-site. The plans must also include details illustrating how the units are constructed in the plant to be in compliance with **Section 402.2.12 and Table 402.4.1 of the NCECC** and **Section N1102.2.12 and Table N1102.4.2 of the NCRC**. The appendices (**Appendix 1 for Residential** and **Appendix 2 for commercial in the NCECC** as well as **Appendices E1 thru E4 in the NCRC**) provide sample checklists, illustrations, etc. as a guide.

Regardless of which method above is used, **Section 402.4.1 of the NCECC and Section N1102.4.1 of the NCRC** must also be satisfied and is important to air leakage control.

**Duct Tightness Testing:**

**NCECC Section 403.2.2** and **NCRC Section N1103.2.2** require all ducts, air handlers, filter boxes, and building cavities used as ducts to be sealed. Duct tightness shall be verified by the duct leakage testing procedures in this section. This test shall be performed and reported by the permit holder, a NC licensed general contractor, a NC licensed HVAC contractor, a NC licensed Home Inspector, a registered design professional, a certified BPI Envelope Professional, or a certified HERS rater. The duct leakage results shall be recorded on the certificate described in **Section 401.3 of the NCECC** and **Section N1101.9 of the NCRC**.

The duct tightness test will have to be performed on site after the entire system is installed and ready to operate. It is recommended for manufacturer's that are installing any portion of the duct system to test that part of the system before the unit is shipped. The system will still have to be tested again on-site and the manufacturer is still responsible for the factory installed portions.

Contact one of the Code Consultants below if you have any questions.

attachments

cc: C. Patrick Walker, P.E. – Technical Services Manager  
Alan D. Greene, P.E. - Chief Building Code Consultant  
Michael J. Hamm, P.E. – Building Code Consultant  
P. Shane Phelps – Building Code Consultant

**NC RESIDENTIAL CODE  
APPENDIX E-1: RESIDENTIAL REQUIREMENTS  
Energy Efficiency Certificate (Section N1101.9)**

<b>MODULAR HOME ENERGY EFFICIENCY CERTIFICATE N1101.9</b>	
<b>Manufacturer:</b>	
<b>Model no.:</b>	
<b>Serial no.:</b>	
<b>Builder, Permit Holder or Registered Design Professional</b>	
<b>Print Name:</b>	
<b>Signature:</b>	
<b>Property Address:</b>	
<b>Date:</b>	
Insulation Rating - List the value covering largest area to all that apply	R-Value
<b>Ceiling/roof:</b>	R-
<b>Wall:</b>	R-
<b>Floor:</b>	R-
<b>Closed Crawl Space Wall:</b>	R-
<b>Closed Crawl Space Floor:</b>	R-
<b>Slab:</b>	R-
<b>Basement Wall:</b>	R-
Fenestration:	
<b>U-Factor</b>	
<b>Solar Heat Gain Coefficient(SHGC)</b>	
Building Air Leakage	
_____ Plant                      _____ Field Visually inspected according to N1102.4.2.1 OR	
_____ Building Air Leakage Test Results (Sec. N1102.4.2.2) ACH50 [Target: 5.0] or CFM50/SFSA [Target: 0.30]	
<b>Name of Tester / Company:</b>	
<b>Date:</b>	<b>Phone:</b>
Ducts:	
<b>Insulation</b>	R-
<b>Total Duct Leakage Test Result (Sect. N1103.2.2) (CFM25 Total/100SF) [Target: 6]</b>	
<b>Name of Tester or Company:</b>	
<b>Date:</b>	<b>Phone:</b>

Certificate to be displayed permanently

NC Modular Residential Homes					
NC Residential Code – Building Envelope Air Barrier Visual Inspection Check Sheet					
N1102.4.2.1 Visual Inspection Option, Residential Code					
<b>Manufacturer:</b>					
<b>Model no.:</b>					
<b>Serial no.:</b>					
Instructions:					
1	The modular manufacturer will sign off for each item inspected in the plant.				
2	The manufacturer will place an "N/A" in each Plant and Field check block for each item which does not apply for this particular model.				
3	The contractor or responsible party will inspect and sign off for each Field item which has an open check block.				
4	Once completed, the contractor or responsible party will sign off the Visually Inspected Field Check Block on the Energy Efficiency Certificate				
5	The contractor or responsible party will provide the local building official a copy of the completed Visual Inspection Check Sheet				
6	The contractor or responsible party will affix the completed, signed Energy Efficiency Certificate to the Modular Home.				
Item no.	Plant	Field	Code Ref.	Component	Item Visually Inspected
1			N1102.2.12	Framed Cavity Walls	The exterior thermal envelope wall insulation is installed in substantial contact and continuous alignment with the building envelope air barrier.
2			N1102.2.12	Framed Cavity Walls	The exterior thermal envelope wall insulation is substantially free from insulation gaps, voids, or compression.
3			N1102.2.12	Framed Cavity Walls	All framed wall cavity insulation is enclosed on all sides with rigid material or an air barrier material.
4			N1102.2.12	Framed Cavity Walls	All exterior wall insulation has been enclosed with rigid material or an air barrier material prior to being covered with tubs, showers, stairs or fireplace units installed at exterior walls consistent with details in Appendix E-2.3, Residential Code.
5			N1102.2.12	Framed Cavity Walls	All cavity insulation in walls that adjoin attic spaces is enclosed with rigid material or an air barrier material on the attic space side of the wall.
6			N1102.2.12	Framed Cavity Walls	All exterior wall insulation in walls which adjoin an attic space is enclosed on the attic space side of the wall with rigid material or an air barrier material.
7			N1102.4.1	Building Thermal Envelope	The building thermal envelope is durably sealed with an air barrier system to limit air infiltration.
8			N1102.4.1	Building Thermal Envelope	The sealing methods used between dissimilar materials allows for differential expansion and contraction.
9			N1102.4.1	Building Thermal Envelope	All floor/ceiling systems and spaces under knee walls which open to an unconditioned or exterior space are caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, or solid material consistent with details in Appendix E-2.4 Residential Code.
10			N1102.4.1	Building Thermal Envelope	All shafts, chases including flue shafts which open to unconditioned or exterior space are capped and sealed with caulking, gaskets, weather-stripping or otherwise sealed with an air barrier material, or solid material consistent with details in Appendix E-2.4, Residential Code.
11			N1102.4.1	Building Thermal Envelope	All soffits or dropped ceiling areas which open to unconditioned or exterior space are capped and sealed with caulking, gaskets, weather-stripping or otherwise sealed with an air barrier material, or solid material consistent with details in Appendix E-2.4, Residential Code.
12			Table N1102.4.2	Ceiling/Attic	The top plate of all exterior framed walls are sealed or gasketed to either the ceiling drywall or the top edge of the wall drywall to provide a continuous air barrier system to prevent air leakage.
13			Table N1102.4.2	Ceiling/Attic	All top plate penetrations are sealed with sealants or gaskets
14			Table N1102.4.2	Ceiling/Attic	For ceiling finishes that do not provide an air barrier system (such as tongue-and-groove planks) an air barrier systems (such as a taped house wrap) has been installed above the finished ceiling.
15			Table N1102.4.2	Walls	All exterior wall sill plates are sealed or gasketed to the subfloor or slab
16			Table N1102.4.2	Windows & Doors	All spaces between window and exterior door jambs and framing are sealed
17			Table N1102.4.2	Floors	An air barrier system is installed at any exposed edge of insulation (this includes above garage floors and cantilevered floors)
18			Table N1102.4.2	Penetrations	All utility penetrations through the building thermal envelope are sealed (this includes all penetrations for plumbing, electrical wiring, ductwork, security/fire alarm wiring, and control wiring)
19			Table N1102.4.2	Garage Separation	Air sealing is provided between the garage and conditioned spaces.
20			Table N1102.4.2	Garage Separation	An air barrier system is installed between the ceiling system above the garage and the ceiling system of interior spaces.
21			Table N1102.4.2	Duct Boots	All HVAC register boots and return boxes have been sealed to the subfloor or drywall.
22			Table N1102.4.2	Recessed Lighting	All recessed light fixtures penetrating the building envelope are air tight, IC rated, and are sealed to the drywall