PRACTICAL APPLICATION
OF THE
2009 RESIDENTIAL ENERGY CODE

PRESENTED BY

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NEEP
Office of Education & Data Management / DCM

OCTOBER 2012

NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS
"Accelerating Energy Efficiency"

MISSION
Accelerate the efficient use of energy in the Northeast and Mid-Atlantic Regions

APPROACH
Overcome barriers to efficiency through
Collaboration, Education & Advocacy

VISION
Transform the way we think about and use energy in the world around us.

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What's Changed From IECC 2006?

- **Thermal envelope improvements – Table 402.2.1**
- **Mechanical trade-offs for envelope values no longer allowed**
- **A few performance path assumptions changed (T405.5.2)**
- **New requirements added:**
  - **Building envelope air tightness verification (402.4)**
  - **Duct leakage pressure test (403.2.2)**
  - **Snow melt controls (403.8)**
  - **Pool controls and covers (403.9)**
  - **Lighting efficacy limits (404.1)**
- **Moisture control requirements (vapor retarders) missing -moved to IBC & IRC**

SEPARATE BUT NOT EQUAL

- IRC and IECC Energy requirements similar, BUT:

REQUIREMENT	IECC	IRC
SHGC Glazing Factor Z 1-3	0.30	0.35/0.40
Foundation Insulation Z 5	R 13/17	R 10/13
Equipment Maintenance Info	YES	NO
U-factor limits (& SHGC Z 1-4)	YES	NO
Performance Option	YES	NO
MANDATORY Requirements	YES	NO

- DOE deems these differences make IRC 2009 not equivalent

Identified Problems

DIFFERENCES BETWEEN IRC AND IECC

- **N1101 Scope – Exempts unconditioned building from code but IECC 101.5.2 exempts only the building envelope**
- **R202 –"conditioned space" – temperature criteria different between "space" and "area" internally; differs from IECC**
- **N1102.1 - (R-10 ci) v. 402.1.1 (R-15 ci) in Z6-8 walls**
  - (R-30 ci) v. (R-38 ci) in Z7-8 ceilings/roofs
- **N1102.2.2 the 500sf ceiling has no 20% limitation (402.2.2)**
- **N1102.5.1 Maximum fenestration U-factor eliminated in IRC; but IECC 402.5 mandates average maximum U-factor/SHGC**
- **IECC 402.4.2 Air permeable insulation is not allowed outside of the air barrier plane (no requirement in IRC – problem in attic)**

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MAKING SENSE OF Chapter 11

Information
- Code Review
- Documents*/Details*
- Compliance Software

Field Work
- Phased Checklists*
- Visual Inspections
- Testing / Results
- Certificates

FIRST LESSON PLAN

YOU DON'T EVER GET
TO NOT BE
THE TEACHER

ARE YOU THE TEACHER IN THIS PROCESS?

CHOOSE WHAT LESSONS YOU SHARE

- Help your applicant learn – but don't spoon-feed
- Have the right tools – let them work for you

CHOOSE HOW LESSONS WILL GET LEARNED

- Get essential information – on the documents
- Don't settle for incomplete documents
- Make the counter an encounter

MAKE IT WORK FOR THE APPLICANT – AND YOU

- Be prepared to give homework
- Recommend RES*Check* wherever it will work

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INFORMATION – Get What You Need

ON THE PLANS:

- All insulation types and R-values
- Fenestration U-factors, Solar Heat Gain, area-weighted calculations
- Air sealing details (Table N1102.4.2)
- Vapor retarder details (R601.3) (R806.4 for unvented attics)
- ACCA J load calcs, plus ACCA S equipment sizes; (M1401.3)
  ACCA D duct sizing*
- Service Hot Water type, size, efficiency
- Equipment controls
- Duct sealing (M1601.4)
  -insulation (N1103.2.1)
  -testing (N1103.2.2)

INFORMATION – Get What You Need

IN THE FIELD:

- Materials specs/sheets and MSDS where needed
- Insulation ratings/labels
- Door and window (NRDC) ratings / labels
- Equipment labels and installation information
- Testing information and specific results
- Duct sealing labels or material lading bills
- Required mechanical, ductwork and equipment control testing info
- Equipment controls info
- Electric service panel listing and labeling

UNDERSTAND THE BUILDING SCIENCE

YOU WILL GET BLAMED FOR THEIR LACK OF UNDERSTANDING

ROUGH FRAMING / ROUGH-INS*

CONVENTIONAL

- Air Sealing Table 402.4.2 (but see Handout)
- Openings/holes
- Caulking/foam

ENERGY STAR etc.

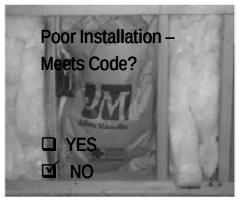
- Insulation location(s)
- Taped sheathing
- Drainage plane

**How do you resolve air vs. insulation inspections?*

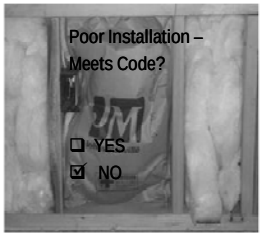
Photo by HUBER *ZIPsystem*

SNAP QUIZ - Anybody See Any Problems Here?

SNAP QUIZ - What are the Problems?

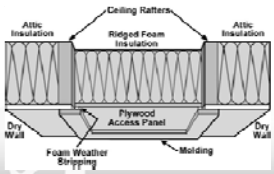


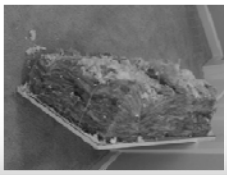
SNAP QUIZ - What's Still Wrong?



Access Hatches and Doors (Prescriptive)

- Weatherstrip and insulate doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces)
  - Insulate to level equivalent to surrounding surfaces
    - e.g., required ceiling insulation = R-38, then attic hatch must be insulated to R-38
- Provide access to all equipment that prevents damaging or compressing the insulation
- Install a wood framed or equivalent baffle or retainer when loose fill insulation is installed over ceiling access





Cavity vs. Continuous (c.i.)

Closed cell foam:

- Boards need tape
- Foamed XPS seals

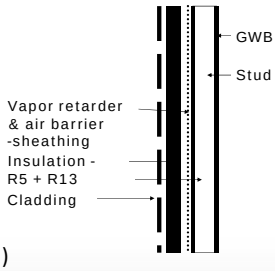
Table N1102.1.1 - R20? or R13+5 Alternative?

"OUT-SULATION"

- Insulates the structure
- Provides/protects:
  - Drainage plane
  - Air barrier
  - Vapor retarder
  - Thermal break

The **Perfect Wall** needs:

- Non-ventilated attic (insulate roof not ceiling)
- Sealed sill plate



CONTROLLING FENESTRATION

- **WINDOWS**
- **SKYLIGHTS**
- **DOORS**

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U-Factors and SHGC

TRADE-OFF LIMITS

- Hard limits on window U-factors in northern U.S. (cannot be exceeded, even in trade-offs)

Climate Zones	U-Factor Maximum
4-5	0.48
6-8	0.40

  - U-0.60 for skylights in Zones 4-8
  - Based on building average; U-factors of individual windows or skylights can be higher if maximum area-weighted average is below these limits
  - No SHGC requirements, **but** RES*Check* requires entering a value

SKYLIGHTS – What Changed?

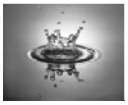
- No more separate glass versus plastic U-factors
- Lower U-factors
- Coordination for wall slope with ASHRAE does not happen until 2012

MORE BUILDING SCIENCE

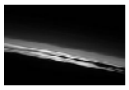
TAKE CONTROL OF

WATER AIR VAPOR

ENVELOPE: Control Priorities

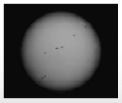


- WATER



- AIR

- WATER VAPOR

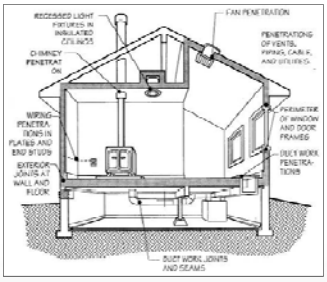


- THERMAL

www.buildingscience.com

Sealing Air Leakage (Infiltration)

- Joints, seams, penetrations
- Windows and doors, jambs & framing
- Utility penetrations
- Dropped ceilings and chases; knee walls
- Walls/ceilings adjacent to unconditioned garage
- Exterior walls at tubs and showers
- Common walls at dwelling units
- Attic access openings
- Rim joist junction
- Other leakage sources



OTHER LEAKS (plus combustion air effects)

- Access doors to eaves
- Open eave joist cavities
- Kitchen cabinet soffits
- Kitchen exhausts
- Clothes dryers
- Central vac systems
- Gravity-vented equipment
- Wood stoves / air supply
- Bathroom vents
- Plumbing traps & vents
- Pet doors

- 1102.4.3 New wood-burning fireplaces shall have gasketed doors and outdoor combustion air source

Building Thermal Envelope

Section R402.4.2 – Air Sealing & Insulation

- Two options to demonstrate compliance
  - Whole-house pressure test
    - Air leakage <7 ACH (air changes/hour) when tested at pressure differential of 0.2 inches water column. Testing may occur any time after rough in and installation of all building envelope penetrations
    - ENERGY STAR testing occurs at completion of all construction and equipment / appliances installation
  - Field verification of air barrier and insulation installation listed in Table 402.4.2.
    - HANDOUT - to revise Table 402.4.2 to separate air leakage from insulation inspections

SPIDER WEBS & DUST BUNNIES

WHAT'S THE PROBLEM?
A THOUSAND TINY CRACKS

- Siding expansion tolerances
- Ventilated *cladding*
- Attic batt/blown insulation
- Convenience outlet leaks
- Framing wall intersections
- DWV traps & penetrations
- Inaccessible framing cavities

WHAT'S THE CURE?
SEAL 'EM UP

- Tape or caulk joints
- Air barrier material
- *Wind-wash* barriers
- Gaskets or rated foams
- Offset wall & seal behind
- Fit shields, then seal
- Provide materials on job for trades to place while open

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Measuring Leaks - Blower Door Test

- Calculate home volume
- Set pressure (0.2"wg)
- Measure air flow
- Calculate ACH50

IRC SECTION R601.3 - Vapor retarder

New vapor retarder requirements allow the use of a coat of vinyl paint to satisfy the requirement in Zone 5 when:

- An **impermeable insulating sheathing** with a minimum value of **R-5** is located **outside** of a 2x4 stud wall with **cavities insulated to R-3.4 per inch**;
- An **impermeable insulating sheathing** with a minimum value of **R-7.5** is located **outside** of a 2x6 stud wall with **cavities insulated to R-3.4 per inch**;

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SNAP QUIZ Is water vapor:

- ❑ Heavier than air
- ❑ Lighter than air
- ❑ No difference
- ❑ Is not a gas: only water suspended in the air;

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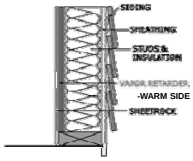
INSULATION – VAPOR RETARDER

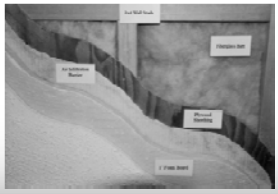


BEST PRACTICES

- Use R-601.3/Tbl.601.3.
  - R 5 on 2x4; R 7.5 on 2x6
- Midpoint air/VR barrier

CONVENTIONAL

- Full cavity R-20; face stapled
- Fitted at boxes
- Class 1 V/R warm side
- Air barrier at exterior



Moisture diffusion in materials

MATERIAL	PERM RATING	VAPOR RETARDER(?)
½" GWB	38 -42	NO
EPS, FIBERGLASS INSULATION	??-??	NO
TYVEK	52	NO
Latex Primer	7.0 – 10.0	NO
7/16" OSB (*w/exterior glue)	0.77* – 3.48	SOMETIMES
1" XPS	0.40 – 1.60	SOMETIMES
7/16" Plywood (exterior glue)	0.70	YES
Kraft Paper Facing	1.0	YES
2 mil polyethylene	0.06 – 0.22	YES
Alkyd-base or V/R paint	< 0.05	YES
1 mil aluminum foil laminate	< 0.05	YES
½" GWB + VWC	0.05 – 0.80	YES

WHAT ARE THE HVAC PRIORITIES?

- LOADS
- EQUIPMENT
- SYSTEMS
- CONTROLS

EQUIPMENT STRATEGIES

RUN LONG

RUN SLOW

RUN SMART

DESIGN LOADS, EQUIPMENT SIZING

ACCA Standards

- J – Load Calculations
- S – Equipment Selections
- D – Duct Design
- M1401.3 "Heating and cooling *equipment shall be sized* in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other *approved heating and cooling calculation methodologies"*

http://www.acca.org/store/product.php?pid=97

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ACCA SYSTEM DESIGN PROCESS

AGGREGATES LOADS FOR INDIVIDUAL SPACES

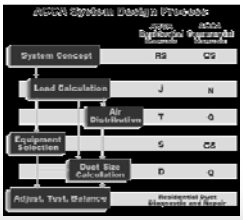
- Sensible: envelope, air leakage & exhausts, equipment, occupants & activities
- Latent (A/C): cooking, bathing, occupants, (humidity-related)

SYSTEM LOAD REQUIREMENTS

SELECTIONS OF EQUIPMENT

DELIVERY SYSTEM SIZING

TESTING, LOAD BALANCING



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Equipment Sizing – M1401.3

- Use ACCA Manual S
- Don't exceed load calcs from Manual J
- Use following slide developed for Chapter 5 for equipment sizing
- Exceed only when part-load equipment is used

Chapter 5 - Equipment Sizing

UNIT	MAXIMUM OVERSIZING PERCENTAGE	MINIMUM EFFICIENCY AND TESTING PROCEDURE
Air Conditioners	15%	Table 503.2.3(1)
Multi-speed Air Source Heat pumps & GSHP	15%	Table 503.2.3(2)
Single-speed GSHP	25%	Tables 503.2.3(2) or (3)
All fuel-fired heating appliances	40%	Tables 503.2.3(4) or (5)

DUCT LOCATION - INSULATION

Location of Duct	Insulation Requirement
Attic	R-8
Conditioned Space	(inside envelope – none)
Within Exterior Walls*	R-6
Basement – Unconditioned	R-6
Basement – Conditioned	(inside envelope – none)
Vented Crawl Space	R-6
Conditioned Crawl Space	(inside envelope – none)

Duct Tightness Tests *403.2.2*

- ✓ **Post construction test** :
  ≤ 4 cfm/per 100 ft^2 conditioned floor area
  - tested at 0.1 in w.g. (25Pa) including manufacturer's air handler enclosure
  - All register boots taped/sealed
- ✓ **Rough-in test**:
  ≤4 cfm/per 100 ft^2 conditioned floor area
  - tested at 0.1 in w.g. (25Pa) including manufacturer's air handler enclosure
  - all register boots taped/sealed
  - if air handler not installed at time of test
    - » Total air leakage ≤3 cfm/100 ft^2

Exception: Duct tightness test is not required if air handler & all ducts located inside conditioned space. Ducts STILL must be sealed

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SERVICE HOT WATER

KEY

Location, Location, Location

TYPES

- Instantaneous
- Heat Pump
- Conventional / Modulating
- Combined HW / Hydronic

SYSTEMS

- Manifold distribution
- Main / Branches / Twigs

Lighting Equipment (Prescriptive)

- A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps (see definition)

REScheck™ v4.4.3.3

(v4.4.3 MAC)

Desktop Software Tools

REScheck™

Latest Windows version or Mac version

Free

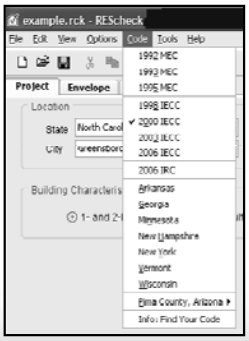
Web-Based Tools

REScheck-Web™

REScheck™ Package Generator

Appropriate Code

- Energy code applicable to your state/ jurisdiction (Code Menu)
  - Status of State Codes
- Default
- Preferences

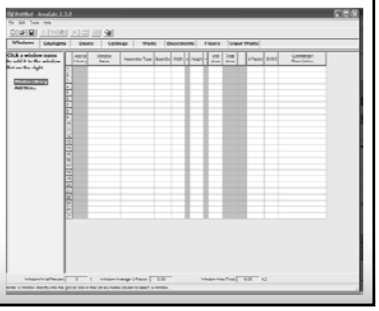


Project Information

- Project location
- Project type
- Project details for report (optional)
  - Title/Site/Permit
  - Owner/Agent
  - Designer/Contractor
  - Notes

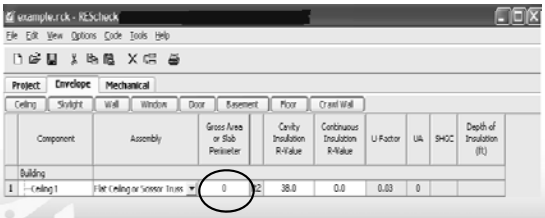
AREA CALC TOOL

- RES*check* desktop on the TOOLS
- Calculates all building areas
- Areas can be transferred into RES*check* ***IF*** *you fill out the form before you access the TABS*



Screen Operations

- Compliance Bar
- Status Bar
- Colors - Red : missing info, errors; failing

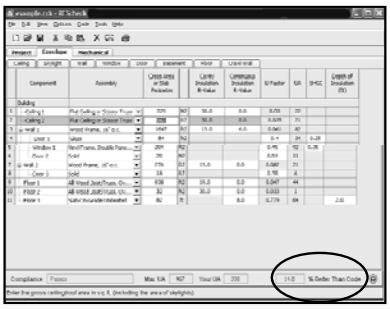


Screen Operations

Menu Bar

Compliance Bar

Status Bar



No longer shown in 2009 IECC version

Compliance Report

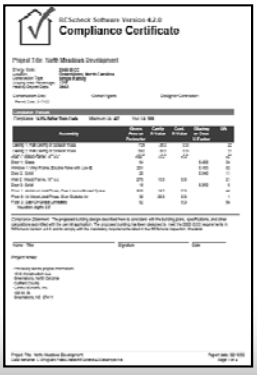
- Project complies
- View/Print Report

Project Information

Building Components

Compliance Statement

Project Notes



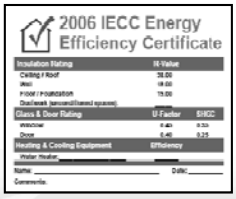
MANDATORY REQUIREMENTS

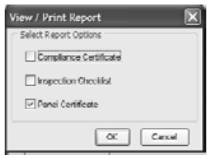
FOUND ON RES*Check* CHECKLISTS

- Air leakage N1102.4.2/402.4.2
- Moisture control R601.3
- Building mechanical systems and equipment M1401.3/403.6
- Service water heating N1103.4
- Duct construction, sealing and insulation M1601.1/403.2.1, 402.3.2

PANEL CERTIFICATE

- Under IECC 2009-based codes, panel certificate option





- N1101.???
- IECC 402.3

THANK YOU

PRACTICAL APPLICATION OF THE 2009 RESIDENTIAL CODE

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October 3, 2012

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SLIDE #26 HANDOUT

TABLE 402.4.2 / N1102.4.2
VISUAL AIR BARRIER AND INSULATION INSPECTIONS

COMPONENT	INSULATION INSTALLATIONCRITERIA	AIR BARRIER CRITERIA
General Requirements	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier.	A continuous air barrier is installed in the thermal envelope. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material.
Ceiling / attic	In any dropped ceiling/soffit, the insulation is substantially aligned with the air barrier.	Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed. Attic access, knee wall door or drop down stair to unconditioned attic is sealed.
Walls	All corners and headers are insulated. Insulation is in substantial contact and continuous alignment with air barrier.	Junction of foundation and sill plate is sealed. Junction of exterior wall and top plate is sealed. Junction of the exterior wall and floor sheathing is sealed. Knee wall is sealed.
Fenestration	Comply with narrow cavity requirements	Space between fenestration jambs and framing is sealed.
Rim joists	Rim joists are insulated.	Air barrier is installed at the rim joist.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking.	Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls.	Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
COMPONENT	**INSULATION INSTALLATIONCRITERIA**	**AIR BARRIER CRITERIA**
Shafts, penetrations	Insulation shall not extend through draft-stopping or fire-stopping openings. Use caulking rated for the application	Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit; narrow cavities are filled by sprayed/ blown insulation.	Maintain air barrier continuity
Garage separations	Insulate cavities as required for exterior walls and ceilings	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Insulation shall be fitted around IC-rated recessed lighting fixture	Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to drywall.
Plumbing Ducts, Wiring	Insulation is placed between the exterior of the wall assembly and ducts or pipes. Batt insulation is cut and fitted around plumbing and wiring or sprayed/blown insulation extends between piping and wiring to the exterior of the wall assembly.	All plumbing , ductwork and wiring air barrier penetrations shall be sealed.
Shower / tub on exterior wall	Exterior walls adjacent to showers and tubs shall have insulation filling any gaps or voids between tub or shower walls and unconditioned space.	Exterior walls adjacent to showers and tubs shall have an air barrier separating the exterior wall from the shower and tubs.
Electrical / phone box on exterior walls	Insulation completely fills voids between the box and exterior sheathing	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall	(no insulation requirement)	Air barrier is installed in common wall between dwelling units.
HVAC register boots	(no insulation requirement)	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	(no insulation requirement)	Air barrier is installed on fireplace walls. Fireplace shall have gasketed doors.

(Text of Section 402.4 remains unchanged)

SLIDE #38- Equipment Sizing

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