Envelope Requirements & Compliance Documentation

2015
International Energy Conservation Code

American Institute of Architects
Connecticut

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Sections R101 & C101

Scope and Intent

- **Scope**
  - Buildings
  - Building Sites
  - Associated systems and equipment
- **Intent**
  - Regulate design and construction
  - Effective use and conservation of energy
  - Over useful life of each building

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Definitions

IECC - Buildings

Residential building (definition for this code)

- Detached one- and two-family dwellings
- Multiple single-family dwellings (townhouses)
- R-2, R-3 and R-4 buildings three stories or less in height above grade plane

Commercial building (definition for this code)

- All not included in residential building definition

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Responsibilities

- Design professionals / Designer
  - Develop construction documents that comply
  - Provide compliance documentation
- Building Officials
  - Agree construction documents comply
  - Inspect as built conditions for compliance
- Contractors
  - Complete project that functions as intended and is in compliance with energy code

Sections R303.1.3 & C303.1.3

Default U-factors, SHGC and VT

Default Glazed Fenestration U-factor				
Frame Type	Single Pane	Double Pane	Skylight	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Default Door U-factors	
Door Type	U-factor
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

Default Glazed Fenestration SHGC and VT					
	Single Glazed		Double Glazed		Glazed
	Clear	Tinted	Clear	Tinted	Block
SHGC	0.80	0.70	0.70	0.60	0.60
VT	0.60	0.30	0.60	0.30	0.60

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2015 IECC

Residential Provisions

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Section R103.2

Information on Construction Documents

- Insulation material and their R-values
- Fenestration U-factors and SHGCs
- Area-weighted U-factor and SHGC calculations
- Mechanical system design criteria
- Mechanical and service water heating system and equipment types, sizes and efficiencies
- Equipment and system controls
- Duct sealing, duct and pipe insulation and location
- Air sealing details
- Thermal envelope depiction

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Section R401.2

Residential Energy Efficiency

New construction must comply with **one** of

1. Sections R401 through R404
2. Simulated performance alternate **and** "mandatory" provisions of Sections R401 through R404
3. Energy Rating Index (ERI) approach in Section R406

Existing buildings covered in Chapter 5

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Section R502

Additions - Existing Building

Prescriptive compliance of addition

- Addition's new envelope assemblies
  - Exception for conversion to conditioned space
    - UA of addition and UA of existing building with alterations ≤ UA of existing building alone
- Addition's heating, cooling & duct systems
  - Exception for testing of <40' new duct extensions in unconditioned space from existing system
- Addition's new service hot water systems
- Addition's new lighting systems

Simulated performance of existing plus addition

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Section R503

Alterations - Existing Building

Altered building envelope assembly compliance

- Insulation criteria or U-factor alternative
- Specific insulation requirements
- Fenestration U-factor requirements
- Fenestration air leakage rate
- Exceptions:
  1. Storm windows over existing fenestration
  2. Existing cavities exposed during construction filled with insulation
  3. Existing cavities not exposed
  4. Roof recover
  5. Roofs without cavity insulation and insulation or sheathing is exposed shall be insulated either above or below the sheathing
  6. Surface-applied window film on existing single pane fenestration

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Section R503

Alterations - Existing Building

Compliance with code

- New heating, cooling & duct systems
  - Exception for testing of <40' new duct extensions in unconditioned space from existing system
- New Service hot water systems
- New Lighting systems

Change in space conditioning

- Any nonconditioned or low-energy space altered to become conditioned space must be bought into full compliance

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Section R401.3 (Mandatory)

Certificate

- Predominant insulation R-value in/on:
  - Ceiling/roof
  - Walls
  - Foundation (slab, basement walls, crawlspace walls, floors and/or ducts outside conditioned space)
- Fenestration U-factors and SHGC
- Results from required duct system air leakage testing
- Results from building envelope air leakage testing
- Types and efficiencies of heating, cooling and service water heating equipment

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Section R402 (Prescriptive)

Residential Thermal Envelope

Table R402.1.1 Requirements by Component	
Fenestration U-factor	0.32
Skylight U-factor	0.55
Glazed Fenestration SHGC	NR
Ceiling R-value	49
Wood Frame Wall R-value	20 or 13+5
Mass Wall R-value	13/17
Floor R-value	30
Basement Wall R-value	15/19
Slab R-value & Depth	10, 2 ft
Crawl Space Wall R-value	15/19

Table R402.1.3 Equivalent U-factors	
Fenestration U-factor	0.32
Skylight U-factor	0.55
Ceiling U-factor	0.026
Frame Wall U-factor	0.06
Mass Wall U-factor	0.082
Floor U-factor	0.033
Basement Wall U-factor	0.050
Crawl Space Wall U-factor	0.055

R-15 for heated slab in footnote d

Or R402.1.4 Total UA alternative

Table R402.2.6 Steel-Frame Insulation R-value

	Wood Frame Requirement	Cold-Formed Steel Equivalent R-Value
Steel Truss Ceilings	R-49	R-38 + 5
Steel-Framed Wall, 16" O.C.	R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5
Steel-Framed Wall, 24" O.C.	R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9

Continuous insulation (ci): Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings.

Yellow indicates change from 2012 IECC

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Section R402.2 (Prescriptive)

Specific Insulation Requirements

- R402.2.1 Ceilings with attic spaces
  - R-38 full height uncompressed insulation extending over wall top plate at eaves satisfies R-49 requirement
  - (Does not apply to U-factor alternate approach or total UA alternative)
- R402.2.2 Ceilings without attic spaces
  - R-30 ceiling/roof insulation, up to the lesser of 500 sq. ft. or 20% of total insulated ceiling area, where sufficient space for R-30 exists satisfies above R-30 requirement
  - (Does not apply to U-factor alternate approach or total UA alternative)

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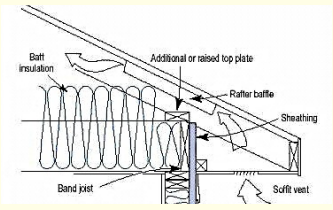
Section R402.2 (Prescriptive)

Specific Insulation Requirements

R402.2.3 Eave Baffle

For air permeable insulation adjacent to soffit and eave vent in vented attic



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Section R402.2 (Prescriptive)

Specific Insulation Requirements

- R402.2.4 Access hatches and doors
- R402.2.5 Mass walls (above grade walls)
- R402.2.6 Steel-frame ceilings, walls and floors
- R402.2.7 Walls with partial structural sheathing
- R402.2.8 Floors

  Insulation in permanent contact with underside of sub-floor decking

- R402.2.9 Basement walls

  Insulated from top of basement wall down to 10' below grade or to basement floor, whichever is less

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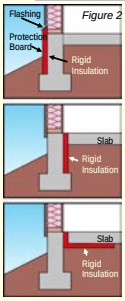
Section R402.2 (Prescriptive)

Specific Insulation Requirements

- R402.2.10 Slab-on-grade floors
  - R-10 for unheated slabs
  - R-15 for heated slabs
  - Floor surface <12" below grade
  - Insulation shall extend from top of slab to 2' below grade
  - Can be interior or exterior and any combination of vertical or horizontal
    - Exterior horizontal insulation protected by pavement or 10" soil



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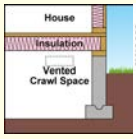
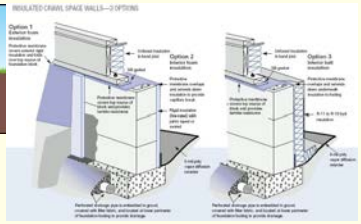
Section R402.2 (Prescriptive)

Specific Insulation Requirements

- R402.2.11 Crawl space walls





- R402.2.11Masonry veneer

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Section R402 (Prescriptive)

Sunrooms

- R402.2.13 Sunroom insulation
  - Code requirements or
  - Exception for thermally isolated sunrooms
    - ≥R-24 Ceiling insulation
    - ≥R-13 Wall insulation
- R402.3.5 Sunroom fenestration
  - Code requirements or
  - Exception for thermally isolated sunrooms
    - ≤U-0.45 for fenestration
    - ≤U-0.70 for skylight

Thermal Isolation (definition). Physical and space conditioning separation from conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

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Section R402

Fenestration

Section R402.3 (Prescriptive)

U-factor Exceptions

(does not apply to U-factor alternative approach)

- R402.3.3 Glazed fenestration:
  Up to 15 sq. ft. per dwelling unit
- R402.3.4 Opaque door
  1 side-hinged door assembly up to 24 sq. ft.

Section R402.5 (Mandatory)

Maximum Fenestration U-factor

- Maximum area weighted U-factor when using Section R402.1.4 or R405
  - 0.48 for vertical fenestration
  - 0.75 for skylights

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Section R402.4 (Mandatory)

Air Leakage

Building thermal envelope

- General requirements
- Ceiling/attic
- Walls
- Windows, skylights & doors
- Rim joists
- Floors (including above garage and cantilevered floors)
- Crawl space walls
- Shafts, penetrations
- Narrow cavities
- Garage separation
- Recessed lighting
- Plumbing and wiring
- Shower/tub on exterior wall
- Electrical/phone box on exterior walls
- HVAC register boots
- Concealed sprinklers

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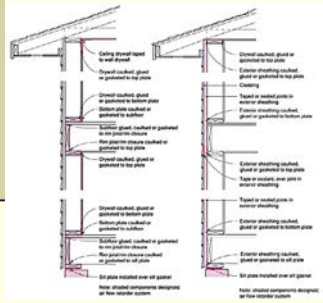
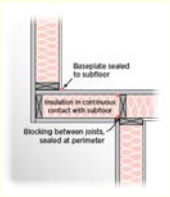
Air Sealing





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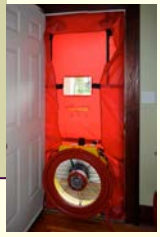
Section R402.4 (Mandatory)

Air Leakage



- R402.4.1.2 Testing
  - Conducted at any time after creation of all penetrations
  - Verified ≤3 air changes per hour @ 0.2" w.g.
    - **Connecticut Building Code for <u>unguarded tests</u>**
      - ≤5 ach for multi-family
      - ≤6.5 ach for multifamily ≤850 sq. ft.
  - Signed written report provided by party conducting the test

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Section R402.4 (Mandatory)

Air Leakage

- R402.4.2 Fireplaces (new wood burning)
  - Tight-fitting flue dampers or doors
  - Outdoor combustion air
- R402.4.3 Fenestration air leakage rates
  - ≤0.3 cfm per sq. ft. for windows, skylights & sliding glass doors
  - ≤0.5 cfm per sq. ft. for swinging doors
  - Exception: Site-built windows, skylights and doors
- R402.4.5 Recessed lighting (in thermal envelope)
  - IC-rated and ≤2.0 cfm rated air leakage
  - Sealed between housing and interior wall/ceiling covering

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Residential Documents at Completion

- Posted certificate
- Blower door test results
- Duct tightness test results, if required
- Equipment and systems maintenance instructions

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Sample Residential Project

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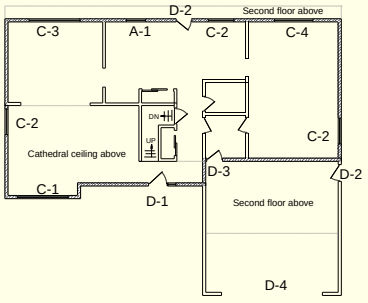
Sample Residential Project

First Floor Plan



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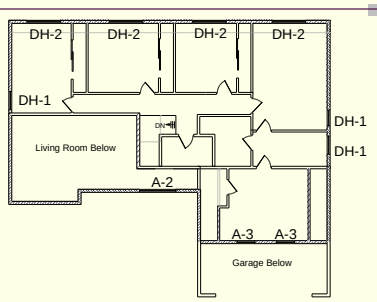
Sample Residential Project

Second Floor Plan



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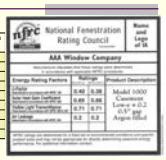
Sample Residential Project

Schedules

Window Schedule

ID	Type	Style	RO Width	RO Height	U-Factor	SHGC	Infiltration Rate
C-1	Casement (LSSR)	400 Series	8.083	5.000	0.28	0.32	0.1
C-2	Casement (LR)	400 Series	4.083	4.083	0.28	0.32	0.1
C-3	Casement (LSR)	400 Series	8.083	4.083	0.28	0.32	0.1
C-4	Awning	400 Series	6.000	4.083	0.28	0.31	0.1
A-1	Awning	400 Series	3.083	3.500	0.28	0.31	0.1
A-2	Twin Awning	400 Series	6.083	2.083	0.28	0.31	0.1
A-3	Awning	400 Series	3.042	2.083	0.28	0.31	0.1
DH-1	Double Hung	400 Series	2.500	4.083	0.29	0.33	0.1
DH-2	Twin Double Hung	400 Series	5.667	4.083	0.29	0.33	0.1
Certification label to remain on windows until inspection and approval by the building official							
			2015 IECCCode Requirements		0.32	NR	≤0.3



Door Schedule

ID	Type	Style	Width	Height	U-Factor	SHGC	Infiltration Rate
D-1	Opaque Entry with 15" Sidelight	Performance Grade	4.250	6.667	0.32	0.19	0.3
D-2	Entry with Window	Performance Grade	2.667	6.667	0.27	0.22	0.3
D-3	Opaque Entry	Performance Grade	2.500	6.667	0.21	-	0.3
D-4	Overhead Garage	Performance Grade	16.000	7.000			
Certification label to remain on doors until inspection and approval by the building official							
			2015 IECC Code Requirements		0.32	NR	≤0.5

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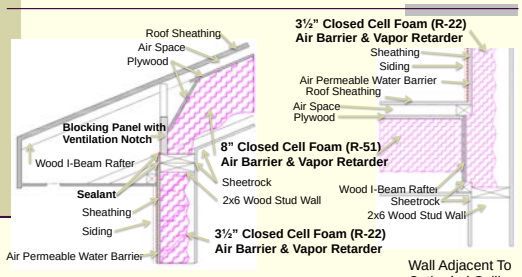
Sample Residential Project

Wall and Roof/Ceiling Sections



Wall At Cathedral Ceiling

Wall Adjacent To Cathedral Ceiling

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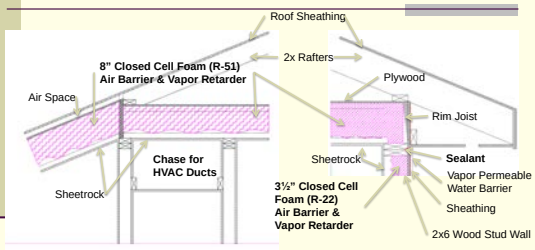
Sample Residential Project

Wall and Roof/Ceiling Sections



Cathedral & Second Floor Ceiling

Second Floor Ceiling

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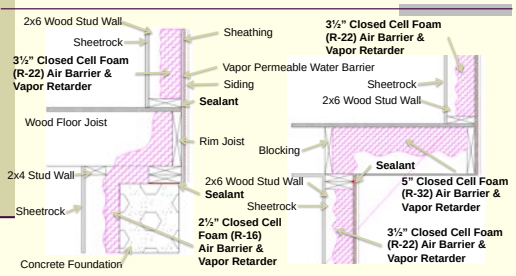
Sample Residential Project

Wall Sections



Basement Wall

Back Wall Cantilever

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Sample Residential Project

Notes in Construction Documents

- Fenestration rating certificates
- Thermal envelope leakage test
- Verified air leakage rate
- Heat loss and heat gain calculations
- All ducts and piping inside the thermal envelope
- Programmable thermostat
- Ducts and air handlers sealing
- R-3 pipe insulation
- Energy recovery system
- Fan efficiencies
- Automatic circulating service hot water system
- CFL or LED lamps

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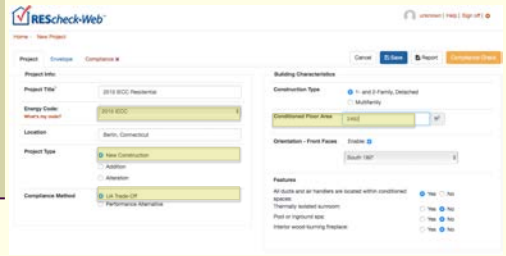
Sample Residential Project

REScheck Inputs



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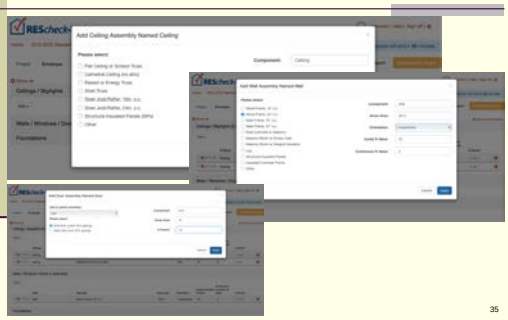
Sample Residential Project

REScheck Inputs



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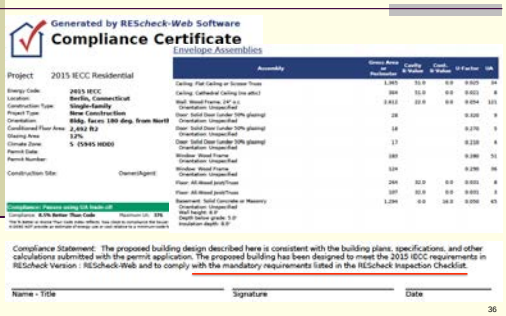
Sample Residential Project

REScheck Inputs



Generated by REScheck-Web Software

Compliance Certificate

Envelope Assemblies

Project 2015 IECC Residential

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2015 IECC requirements in REScheck Version : REScheck-Web and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

Name - Title | Signature | Date

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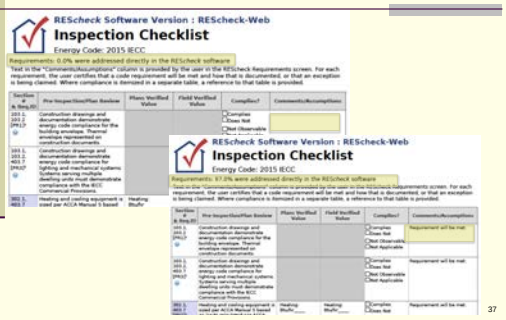
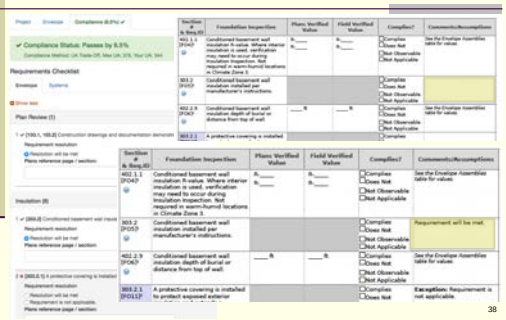
Sample Residential Project

REScheck



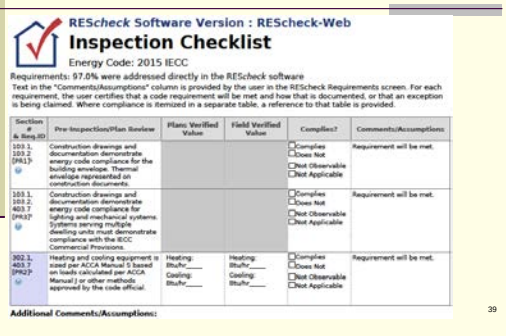
Sample Residential Project

REScheck



Sample Residential Project

REScheck



Sample Residential Project

REScheck

402.2.3 [R22]*	Vented attics with air permeable insulation include baffle adjacent to soffit and eave vents that extends over insulation.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement is not applicable.
402.2.4 [R13]*	Attic access hatch and door insulation ≥R-value of the adjacent assembly.	R-___	R-___	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
402.4.1.2 [R17]*	Blower door test @ 50 Pa. <=5 ach in Climate Zones 1-2, and <=3 ach in Climate Zones 3-8.	ACH 50 =___	ACH 50 =___	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
403.3.4 [R4]*	Duct tightness test result of <=4 cfm/100 ft2 across the system or <=3 cfm/100 ft2 without air handler @ 25 Pa. For rough-in tests, verification may need to occur during framing inspection.	___ cfm/100 ft²	___ cfm/100 ft²	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** All ducts and air handlers are located within conditioned space.
403.3.3 [R27]*	Ducts are pressure tested to determine air leakage with either: Rough-in test: Total leakage measured with a	___ cfm/100 ft²	___ cfm/100 ft²	☐Complies ☐Does Not ☐Not Observable	**Exception:** All ducts and air handlers are located within conditioned space.

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