ORCA ROOFING EXPO

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Roofing industry technical update

presented by

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NRCA

Topics

- OK code adoptions
- Polyisocyanurate insulation
  - R-value testing
  - Physical property testing
- Modified bitumen sheet products
  - MB sheet testing
- The NRCA Roofing Manual
- Questions

www.ok.gov/oubcc

Code Adoption History

The OUBCC created technical committees comprised of individuals in the respective trades to review the codes and make recommendations to the Commission. Each committee recommended modifications to change the codes to meet the needs of the State. Those recommendations were then reviewed and voted on by the OUBCC. Once the vote was complete, the rules process to adopt the codes was started.

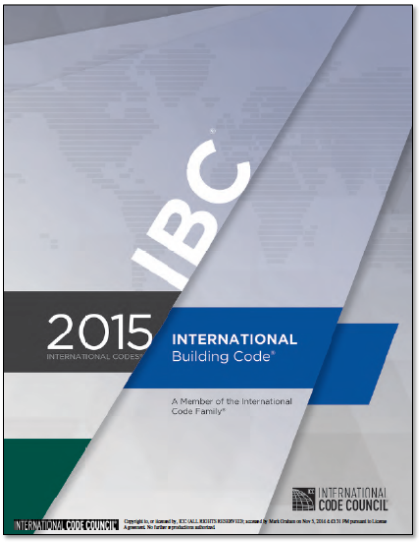
The International Residential Code®, 2009 Edition, (IRC, 2009®) was adopted with modifications by the OUBCC with an effective date of July 15, 2011. The IRC®, 2009 addresses residential dwellings defined as one- and two-family homes and town houses. This was the first time a residential code had been adopted by any state agency for use as a construction code.

The OUBCC adopted commercial codes to address all structures other than one- and two-family homes and town houses. Those codes were modified and had an effective date of November 2, 2012. Several state agencies had previously adopted several of these codes in one fashion or another to address the needs of their agencies. Updated versions of these codes have been published, reviewed and have been adopted by the Commission. The updated commercial codes adopted with modifications by the OUBCC are:

International Building Code®, 2015 Edition (IBC, 2015®)
International Existing Building Code®, 2015 Edition (IEBC, 2015®)
International Fire Code®, 2015 Edition (IFC, 2015®)
International Fuel Gas Code®, 2015 Edition (IFGC, 2015®)
International Mechanical Code®, 2015 Edition (IMC, 2015®)
International Plumbing Code®, 2015 Edition (IPC, 2015®)
National Electrical Code®, 2014 Edition (NEC, 2014®)

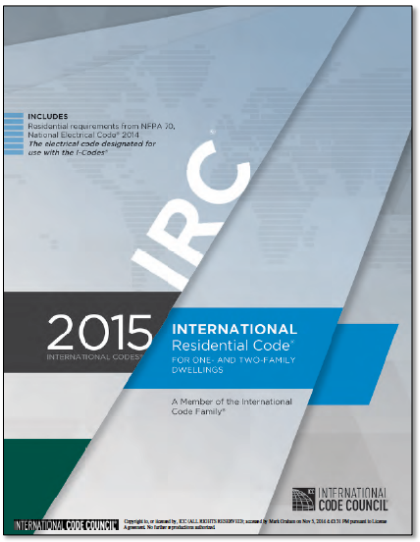
The modifications for all codes can be found under the "Codes and Rules"/"Adopted Building Codes" tab.

International Building Code, 2015 Edition



- Applicable to all buildings and structures, except those where IRC 2015 applies
- Roofing-related requirements:
  - Wind uplift resistance
  - Fire resistance
  - Manufacturers' installation instructions
  - Prescriptive requirements
  - Reroofing

International Residential Code, 2015 Edition

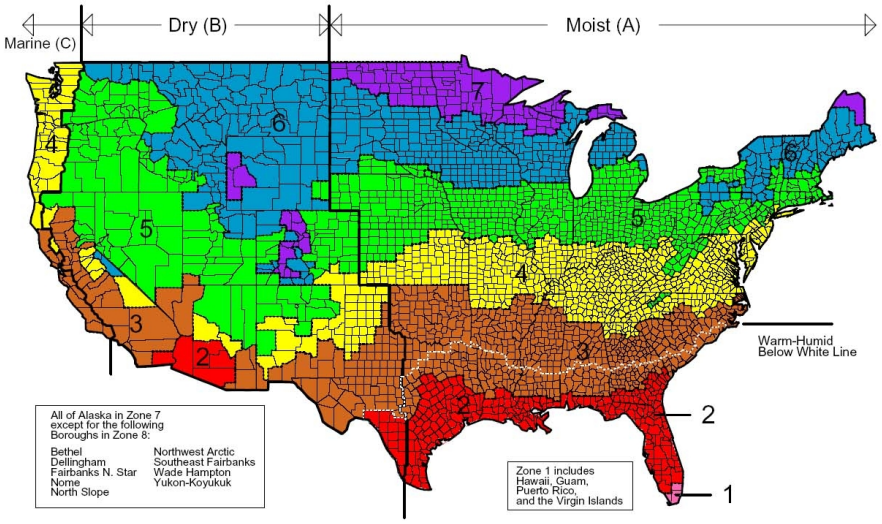


- Applicable to one- and two-family dwellings and townhouses no more than three stories in height
- Roofing-related requirements:
  - Ch. 8-Roof/ceiling construction
  - Ch. 9-Roof assemblies

Energy Code

IECC 2015, Fig. C301.1-Climate zones

Fig. R301.1 (residential climate zones) is similar



Comparison of IECC's various editions

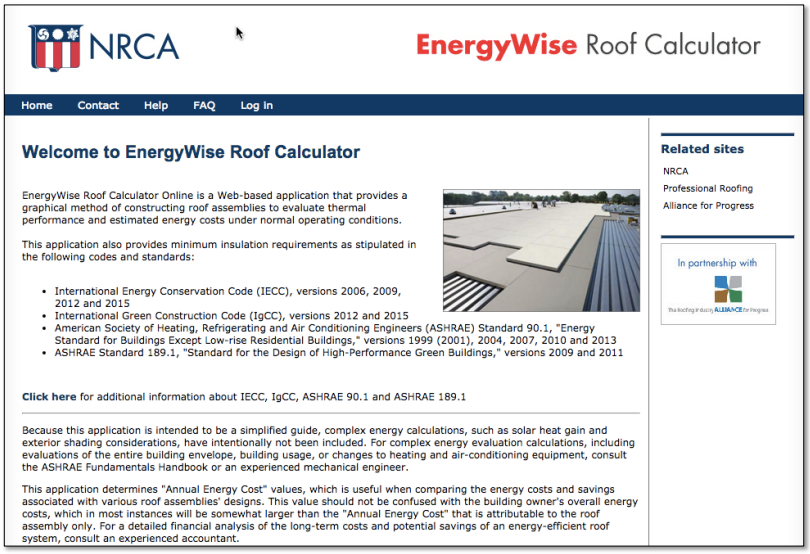
Commercial Buildings (Insulation component R-value-based method)

Climate Zone	IECC 2006	IECC 2009	IECC 2012*	IECC 2015*
1	R-15 ci	R-15 ci	R-20 ci	R-20 ci
2		R-20ci		R-25 ci
3				
4			R-25 ci	R-30 ci
5	R-20 ci			
6				
7	R-25 ci	R-25 ci	R-30 ci	R-35 ci
8				

* Applies to roof replacement projects
ci = continuous insulation

EnergyWise

energywise.nrca.net



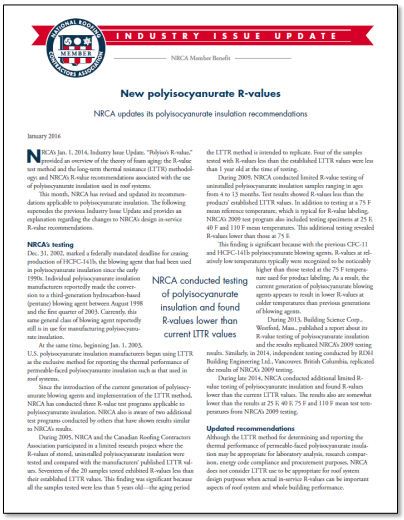
NRCA energy code adoption database

www.nrca.net/Technical/EnergyCodes

Click here to access this web page

Polyisocyanurate insulation

NRCA's revised polyiso. R-value recommendation



INDUSTRY ISSUE UPDATE

NRCA Member Benefit

New polyisocyanurate R-values

NRCA updates its polyisocyanurate insulation recommendations

January 2016

NRCA's Jan. 1, 2014, Industry Issue Update, "Polyiso's R-value," provided an overview of the theory of foam aging, the R-value test method and the long-term thermal resistance (LTTR) methodology and NRCA's R-value recommendations associated with the use of polyisocyanurate insulation used in roof systems.

This month, NRCA has revised and updated its recommendations applicable to polyisocyanurate insulation. The following supersedes the previous Industry Issue Update and provides an explanation regarding the changes to NRCA's design in-service R-value recommendations.

NRCA's testing

Dec. 31, 2002, marked a federally mandated deadline for ceasing production of HCFC-141b, the blowing agent that had been used in polyisocyanurate insulation since the early 1990s. Individual polyisocyanurate insulation manufacturers reportedly made the conversion to a third-generation hydrocarbon-based (pentane) blowing agent between August 1998 and the first quarter of 2003. Currently, this same general class of blowing agent reportedly still is in use for manufacturing polyisocyanurate insulation.

At the same time, beginning Jan. 1, 2003, U.S. polyisocyanurate insulation manufacturers began using LTTR as the exclusive method for reporting the thermal performance of permeable-faced polyisocyanurate insulation such as that used in roof systems.

Since the introduction of the current generation of polyisocyanurate blowing agents and implementation of the LTTR method, NRCA has conducted three R-value test programs applicable to polyisocyanurate insulation. NRCA also is aware of two additional test programs conducted by others that have shown results similar to NRCA's results.

During 2005, NRCA and the Canadian Roofing Contractors Association participated in a limited research project where the R-values of stored, unfaced polyisocyanurate insulation were tested and compared with the manufacturers' published LTTR values. Seventeen of the 20 samples tested exhibited R-values less than their established LTTR values. This finding was significant because all the samples tested were less than 5 years old—the aging period the LTTR method is intended to replicate. Four of the samples tested with R-values less than the established LTTR values were less than 1 year old at the time of testing.

During 2009, NRCA conducted limited R-value testing of uninstalled polyisocyanurate insulation samples ranging in age from 4 to 15 months. Test results showed R-values less than the products' established LTTR values. In addition to testing at a 75 F mean reference temperature, which is typical for R-value labeling, NRCA's 2009 test program also included testing specimens at 25 F, 40 F and 110 F mean temperatures. This additional testing revealed R-values lower than those at 75 F.

This finding is significant because with the previous CFC-11 and HCFC-141b polyisocyanurate blowing agents, R-values at relatively low temperatures typically were recognized to be noticeably higher than those tested at the 75 F temperature used for product labeling. As a result, the current generation of polyisocyanurate blowing agents appears to result in lower R-values at colder temperatures than previous generations of blowing agents.

NRCA conducted testing of polyisocyanurate insulation and found R-values lower than current LTTR values

During 2013, Building Science Corp., Westford, Mass., published a report about its R-value testing of polyisocyanurate insulation and the results replicated NRCA's 2009 testing results. Similarly, in 2014, independent testing conducted by RDH Building Engineering Ltd., Vancouver, British Columbia, replicated the results of NRCA's 2009 testing.

During late 2014, NRCA conducted additional limited R-value testing of polyisocyanurate insulation and found R-values lower than the current LTTR values. The results also are somewhat lower than the results at 25 F, 40 F, 75 F and 110 F mean test temperatures from NRCA's 2009 testing.

Updated recommendations

Although the LTTR method for determining and reporting the thermal performance of permeable-faced polyisocyanurate insulation may be appropriate for laboratory analysis, research comparison, energy code compliance and procurement purposes, NRCA does not consider LTTR use to be appropriate for roof system design purposes when actual in-service R-values can be important aspects of roof system and whole building performance.

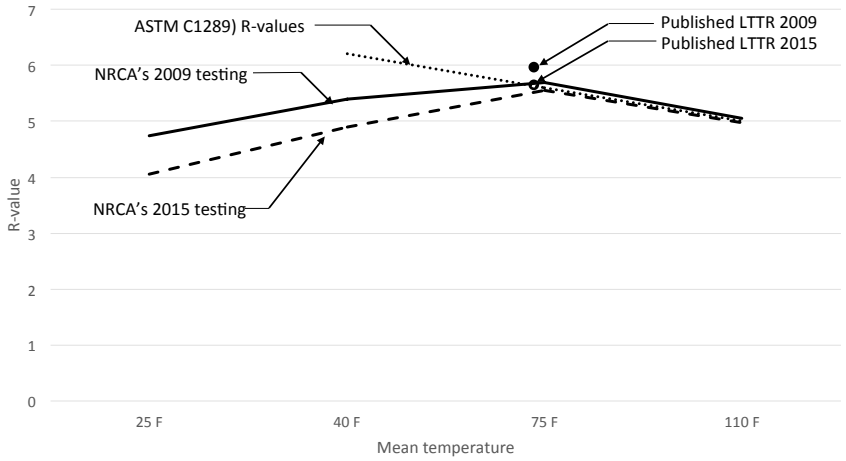
NRCA recommends designers:

- Use an in-serve design R-value of 5.0 per inch thickness for polyiso.
- Specify insulation by its thickness, not its R-value

NRCA's recommendation is based upon our own testing, and confirming replicate testing by:

- Building Science Corp.
- RDH Building Engineering, Ltd.

NRCA's R-value testing



NRCA's new polyiso. R-value recommendation is included in the January 2016 interim update to *The NRCA Roofing Manual: Membrane Roof Systems-2015* (PDF and App versions)

Polyisocyanurate insulation testing

Purpose

NRCA's polyisocyanurate insulation testing

Analyze critical physical properties of faced polyisocyanurate insulation products and compare results to applicable the ASTM product standard and past test results

Past testing

NRCA's polyisocyanurate insulation testing

2002 testing:

- HCFC-141b blowing agent
- Hydrocarbon-based blowing agent (current)

2009 testing:

- Hydrocarbon-based blowing agent (current)

2015 testing

NRCA's polyisocyanurate insulation testing

- Density (not in ASTM C1289)
- Compressive strength
- Dimensional stability
- Flexural strength
- Tensile strength
- Knit line assessment (not in ASTM C1289)

Sample	Facer type	Density (lb/ft³)	
		Apparent overall density	Apparent foam core density
1-A	Cellulosic (Class 1)	2.16	1.57
1-B	Coated fiberglass (Class 2)	3.80	1.68
2	Cellulosic (Class 1)	2.25	1.56
3	Cellulosic (Class 1)	2.26	1.65
4	Cellulosic (Class 1)	2.25	1.64
5	Coated fiberglass (Class 2)	3.16	1.79
6	Cellulosic (Class 1)	2.39	1.68

Sample	Compressive strength (psi)		
	With facers	Machine direction	Cross-machine direction
1-A	22.3	16.1	26.5
1-B	28.4	21.2	29.8
2	24.4	16.7	22.0
3	24.5	17.5	19.4
4	23.5	18.5	21.0
5	24.4	20.6	19.8
6	24.5	18.9	21.1
ASTM C1289, Type II requirement	Grade 1: 16 (minimum) Grade 2: 20 (minimum) Grade 3: 25 (minimum)	No requirement	

Sample	Dimensional stability (Percent linear change after seven days at 158 F and 97 percent relative humidity)		
	Machine direction	**Cross-machine direction**	**Thickness**
1-A	1.22	1.27	1.77
1-B	0.54	1.31	5.88
2	3.35	2.91	-1.11
3	2.42	1.53	3.19
4	2.14	2.24	1.21
5	0.56	0.75	3.74
6	2.52	1.96	1.68
ASTM C1289, Type II requirement	2.0 (maximum)		4.0 (maximum)

Shaded cells denote values in excess of maximal ASTM allowable requirement

Dimensional stability – "Edge growth"

View from board topside (top facer) looking down.

Sample	Flexural strength		Tensile strength perpendicular to surface (lbf/ft³)
	Modulus of rupture (psi)	Break strength (lbf)	
1-A	MD: 79.6 XMD: 61.2	MD: 64.8 XMD: 49.3	3259
1-B	MD: 127.9 XMD: 135.5	MD: 102.4 XMD: 108.2	2590
2	MD: 93.0 XMD: 64.1	MD: 75.4 XMD: 51.1	3080
3	MD: 98.4 XMD: 59.5	MD: 75.8 XMD: 47.2	3083
4	MD: 73.0 XMD: 52.6	MD: 58.1 XMD: 42.2	2904
5	MD: 121.1 XMD: 93.6	MD: 92.9 XMD: 76.9	3668
6	MD: 96.3 XMD: 55.8	MD: 71.3 XMD: 41.7	2657
ASTM C1289, Type II requirement	40	17	500

Surface depressions—"rutting"

Correspond to knit lines

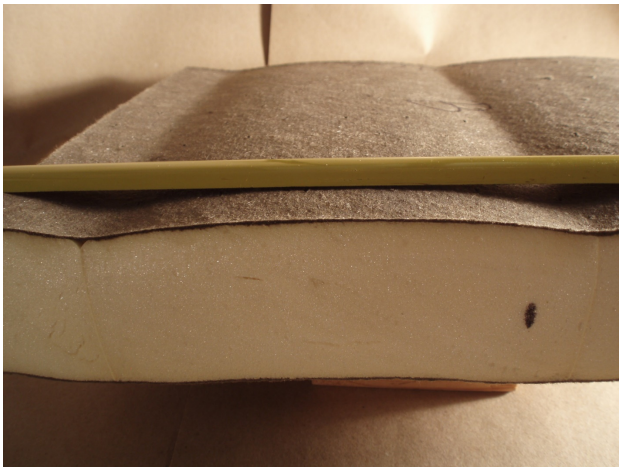
Sample	Board side indication	Knit line depth (inch)							
		Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8
1-A	None	-0.084	-0.078	-0.068	—	—	—	—	—
	"This side down"	-0.061	-0.137	-0.110					
1-B	None	-0.038	-0.030	-0.048	—	—	—	—	—
	None	-0.049	-0.085	-0.041					
2	None	-0.015	-0.059	-0.060	-0.028	-0.020	-0.028	-0.010	-0.005
	"This side down"	-0.130	-0.167	-0.161	-0.193	-0.210	-0.166	-0.171	-0.143
3	None	-0.023	-0.049	-0.046	-0.051	-0.047	—	—	—
	None	-0.015	-0.031	-0.045	-0.036	-0.021			
4	None	-0.035	-0.038	-0.068	-0.055	-0.062	—	—	—
	"This side down"	-0.091	-0.112	-0.122	-0.114	-0.072			
5	None	-0.023	-0.036	-0.045	-0.040	-0.025	—	—	—
	None	-0.013	-0.016	-0.013	-0.013	-0.012			
6	None	-0.136	-0.169	-0.189	-0.170	-0.171	-0.173	-0.165	-0.146
	None	-0.035	-0.015	-0.017	-0.007	-0.005	-0.018	-0.036	-0.037

Shaded cells denote values greater than ⅛-inch depth

Combining dimensional stability and knit lines issues

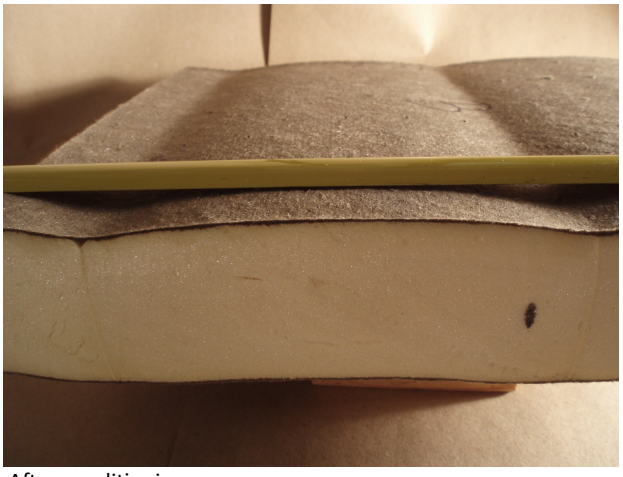
As delivered by manufacturer.

Combining dimensional stability and knit lines issues – cont.



After conditioning

Combining dimensional stability and knit lines issues – cont.



After conditioning

Combining dimensional stability and knit lines issues – cont.

Knit line and V-groove close-up (after conditioning)

Conclusions

NRCA's polyisocyanurate insulation testing

- Only 2 of the 7 products tested comply with ASTM C1289
- Revisions to ASTM C1289 are needed:
  - Address knit lines and "rutting"

NRCA has already met with several polyisocyanurate insulation manufacturers… and we look forward to constructive individual manufacturers at ASTM International and elsewhere in the industry to address these issues.

Modified bitumen sheet testing

Purpose

NRCA's MB sheet testing

Analyze critical physical properties of popular MB sheet products and compare results to applicable ASTM product standards and past test results

Modified bitumen sheet testing

ASTM D5147-Test methods for MB sheet materials

Low-temperature flexibility test:

- 1" diameter mandrel
- 180° bend
- Visually observe cracking

Granule loss test:

- Weigh specimen
- 50 scrub cycles
- Re-weigh specimen
- Calculate difference

NRCA's 2011 MB testing

Polymer-modified bitumen test results			
Product (manufacturer and product)	Low-temperature flexibility		Granule embedment (as received)
	As received	Heat aged (90 days at 158 F)	
SBS products			
1-1	-5	+5	0.8
1-2	-15	-10	1.0
2-1	+5	+20	1.4
2-2	-20	-15	1.8
2-3	-5	+20	3.2
2-4	+10	+15	1.2
3-1	+30	+45	0.3
3-2	-5	0	0.3
3-3	+25	+40	1.5
4-1	-5	+5	1.1
5-1	+5	+10	0.5
6-1	-5	-5	0.7
6-2	+10	+20	1.7
APP products			
1-3	+30	+15	1.5
3-4	+35	+20	0.4
7-1	+15	+15	1.6

Summary of results

NRCA's 2011 MB testing

- 9 of 13 SBS products did not comply with ASTM's low-temp. flex requirement (0 F max.)
- 1 of 3 APP products did not comply with ASTM's low-temp. flex requirement (32 F max.)
- 1 of 16 products did not comply with ASTM's granule loss requirement (2 grams max.)

NRCA's 2015 MB testing

Polymer-modified bitumen test results			
Sample (manufacturers and product)	Low-temperature flexibility (F)		Granule embedment as received (grams)
	As received	Heat aged (90 days at 158 F)	
SBS products			
1-A	-25	-25	0.9
2-A	-20	-15	1.6
2-B	0	15	0.7
2-C	-35	-15	1.3
3-A	10	20	1.8
4-A	-30	-30	1.1
4-B	-15	-5	0.8
5-A	-5	0	0.6
5-B	10	10	0.7
6-A	-20	-15	1.1
9-A	-30	-15	0.6
ASTM International's maximum allowable values	0	0	2
APP products			
3-B	20	20	0.7
8-A	20	35	3.4
ASTM International's maximum allowable values	32	32	2

Summary of results

NRCA's 2015 MB testing

- 3 of 11 SBS products did not comply with ASTM's low-temp. flex requirement (0 F max.)
- 1 of 2 APP products did not comply with ASTM's low-temp. flex requirement (32 F max.)
- 1 of 13 products did not comply with ASTM's granule loss requirement (2 grams max.)

Recommendations

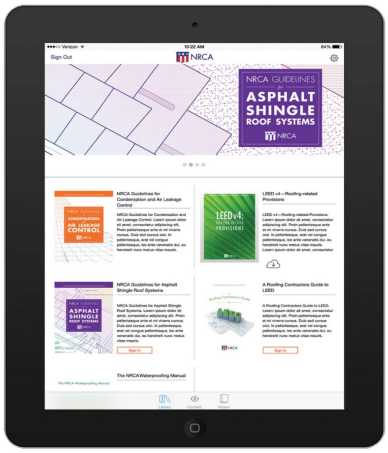
NRCA's 2011 and 2015 MB testing

Seek third-party certifications of compliance with the applicable ASTM product standard:

- UL product certification
- ICC-ES evaluation report
- Miami-Dade County product approval

The NRCA Roofing Manual

NRCA App



- NRCA App available on the Apple Store and Google Play Store for tablets
- iPhone App also available
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