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Evaluating Asphalt Shingles: A Comparison of Test Methods

Helene Hardy Pierce
Vice President, Technical Services
GAF Materials Corp.

Mark S. Graham
Associate Executive Director
NRCA

Where We're Going…

- Overview of Asphalt Shingles
- Asphalt Shingle Standards
- Code Compliance in General
- Code Compliance – Traditional Path
  - D3462, Wind, & Fire
- Code Compliance – Alternative Acceptance Criteria Path
- Summary/Concluding Thoughts
- Questions

Asphalt Shingles…

Certainly, Style is in the Eye of the Beholder…

Regardless of Style, Today's Asphalt Shingles

- Wide Range of Styles and Colors
- Affordable
- Easy to Maintain
- Lightweight
- Easy to Install
- Title 24 Options/Cool Roofing Options

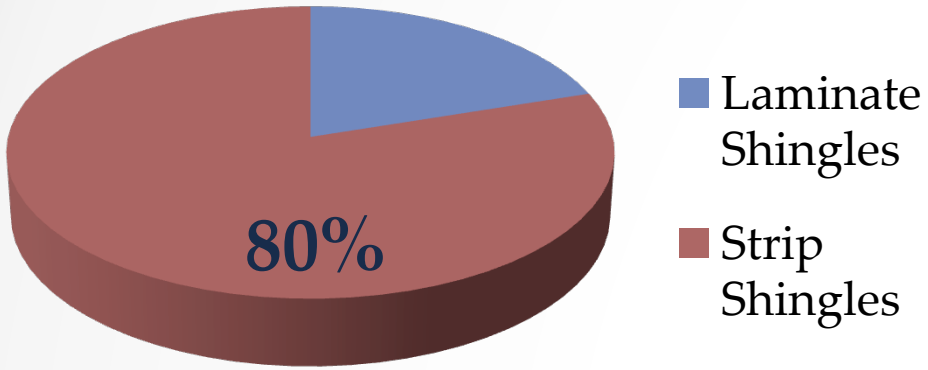
Asphalt Shingles…
Historically Speaking

- Reinforcement
  - Organic Felt to Fiberglass
- Composition
  - Strip to Laminate
  - Refinement in Product Offerings
- Sealant Advancements
- Impact Resistance

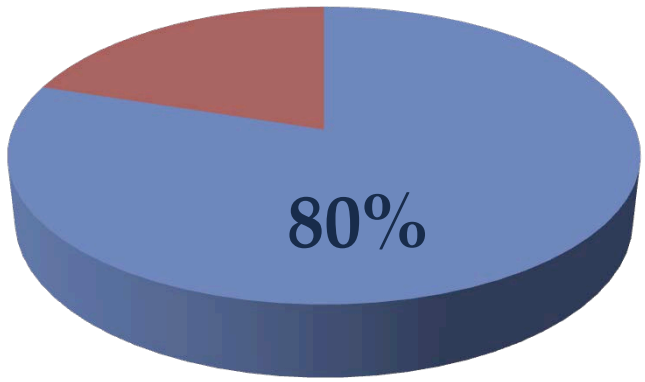
Asphalt Shingles…

Historically Speaking

1980



2012



Asphalt Shingles…

Regardless of Style or Color

- Shed Water
- Fire Resistant
- Durable
- Wind Resistant
- Code Compliant

Mark Graham

Code compliance

International Building Code, 2012 Edition:

1507.2.5 Asphalt shingles. Asphalt shingles shall comply with ASTM D 225 or ASTM D 3462.

International Residential Code, 2012 Edition:

R905.2.4 Asphalt shingles. Asphalt shingles shall comply with ASTM D 225 or ASTM D 3462.

ASTM D225

- "Standard Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules"
- First published in 1925
- "mass"-based
- Other tests: behavior on heating, pliability, saturant/coating compatibility
- Wind resistance: Class A (60 mph)
- Fire resistance: Class C
- ASTM has withdrawn ASTM D225

ASTM D3462

- "Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules"
- First published in 1978
- Prescriptive-based
- Wind resistance: Class A (60 mph)
- Fire resistance: Class A

ASTM D3462

TABLE 2 Masses of Asphalt Shingles Made from Glass Felt

	max	min
Minimum net mass per area of shingles (individual bundle), g/m^2 (lb/100 ft^2)	...	3418 (70.0)
Average net mass per area of shingles (total sample), g/m^2 (lb/100 ft^2)	...	3564 (73.0)
Mass per area of mat, g/m^2 (lb/100 ft^2)	...	65.9 (1.35)
Mass per area of asphalt, g/m^2 (lb/100 ft^2)	...	732 (15.0)
Mass per area of mineral matter passing a No. 6 (3.35-mm) sieve and retained on a No. 70 (212-μm) sieve, g/m^2 (lb/100 ft^2)	...	1221 (25.0)
Mass percent of mineral matter passing a No. 70 (212-μm) sieve based on the total asphalt and mineral matter passing the No. 70 (212-μm) sieve	70.0	...

ASTM D3462

TABLE 1 Physical Requirements of Asphalt Shingles Made from Glass Felt

	max	min
Behavior on heating:		
Loss of volatile matter, %	1.5	. . .
Sliding of granular surfacing, mm (in.)	2 (1/8)	. . .
Tear strength, g	. . .	16.7 N (1700)
Fastener pull-through resistance at 23 ± 2°C (73 ± 4°F), newtons (lbf)		
Single-layer product	. . .	90 (20)
Multi-layer product	. . .	135 (30)
Fastener pull-through resistance at 0 ± 2°C (32 ± 4°F), newtons (lbf)		
Single-layer product	. . .	104 (23)
Multi-layer product	. . .	180 (40)
Wind resistance	. . .	Class A
Fire resistance	. . .	Class A
Penetration of asphalt, 0.1 mm[A] (tested without mineral stabilizer)	. . .	15
Pliability at 23 ± 2°C (73± 4°F)		
Weather side up machine direction	. . .	4 of 5 shall pass
Weather side up cross direction	. . .	4 of 5 shall pass
Weather side down machine direction	. . .	4 of 5 shall pass
Weather side down cross direction	. . .	4 of 5 shall pass
Asphalt softening point, °C (°F)[A] (tested without mineral stabilizer)	113 (235)	88 (190)
Asphalt softening point for polymer modified products, °C (°F)[A] (tested without mineral stabilizer)	160 (320)	88
Weight of displaced granules	1.0 g	. . .

[A] The requirements are to be tested for by the manufacturer of the shingles. They cannot be determined on the finished product.

Code compliance - Wind

International Building Code, 2012 Edition:

Table 1507.2.7.1(1)

Classification of Asphalt Roof Shingles

Per ASTM D7158a

Nominal Design Wind Speed, V_{asd} (mph)	Classification
85	D, G or H
90	D, G or H
100	G or H
110	G or H
120	G or H
130	H
140	H
150	H

Code compliance - Wind

International Building Code, 2012 Edition:

Table 1507.2.7.1(2)

Classification of Asphalt Roof Shingles

Per ASTM D3161

Nominal Design Wind Speed, V_{asd} (mph)	Classification
85	A, D or F
90	A, D or F
100	A, D or F
110	F
120	F
130	F
140	F
150	F

Wind testing

Comparison of ASTM D7158 and ASTM D3161:

Wind speed	ASTM D7158	ASTM D3161
60 mph	--	Class A
90 mph	Class D	Class D
110 mph	--	Class F
120 mph	Class G	--
150 mph	Class H	--

Documentation of code compliance

Third-party certification:

An alternative method

International Building Code, 2012 Edition:

[A] 104.11 Alternative materials, designs and methods of construction and equipment. …

[A] 104.11.1 Research reports. …

[A] 104.11.2 Tests. …

ICC-ES Evaluation Reports

ICC Evaluation Services

- Subsidiary of ICC
- Technical evaluations of building products, components, methods and materials
- Acceptance criteria
- Evaluation reports
- Roofing: underlayment, modified bitumen sheets, thermoplastic membranes, wood shakes and shingles, and asphalt shingles
- www.icc-es.org – and – IRE Booth 454

ICC-ES – Asphalt Shingles

Report Number	Org./Code	Manufacturer	Product	Codes
ESR-1372	ICC-ES	Owens Corning Roofing and Asphalt, LLC	Owens Corning Asphalt Shingles	09 06 LC
ESR-1389	ICC-ES	CertainTeed Corporation	CertainTeed Asphalt Shingles	12 09 06
ESR-1475	ICC-ES	GAF	GAF Shingle Roof Covering Systems	12 09 06
ESR-1501	ICC-ES	TAMKO Building Products, Inc.	TAMKO Asphalt Shingles: Elite Glass-Seal, Heritage 30/Heritage, Heritage 50/Heritage Premium, Heritage® XL/Heritage Woodgate and Heritage® Vintage™	09 06 LC
ESR-1717	ICC-ES	PABCO Roofing Products, A Division of PABCO Building Products	PABCO Asphalt Shingles GG-20, SG-30, Premier, Premier Radiance, Premier Professional, Premier Elite, Premier Radiance Elite, Premier Advantage, Paramount, Paramount Advantage and Cascade	09 06
ESR-3150	ICC-ES	Malarkey Roofing Products	Malarkey Engineered and Polymer-Modified Asphalt Shingles	09 LC
ESR-3267	ICC-ES	GAF	GAF Shingle Roof Covering Systems	12 09 06
ER-5796	UBC	IKO Industries Limited	IKO Marathon 20, CRC Superglass, Marathon 25, CRC Magnum 25, Cambridge 25, CRC Biltmore 25, Cambridge 30, CRC Biltmore 30, Cambridge 40 and CRC Biltmore 40 Asphalt Shingle Roof Covering Systems	LC

Helene Hardy Pierce

ICC-ES Evaluation Reports

http://www.icc-es.org/Evaluation_Reports/

- Dates
- Evaluation Scope
- Products

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1475*

Reissued October 1, 2011

This report is subject to renewal October 1, 2013.

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DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 31 13—Asphalt Shingles

REPORT HOLDER:

GAF
1361 ALPS ROAD
WAYNE, NEW JERSEY 07470
(800) 365-7353
www.gaf.com

EVALUATION SUBJECT:

GAF SHINGLE ROOF COVERING SYSTEMS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Properties evaluated:

- Weather resistance
- Fire classification
- Wind resistance

asphalt on both sides, and surfaced with mineral roofing granules on the weather side and a mineral release agent on the underside.

3.1.3 Laminated Shingles: Laminated shingles are composed of multiple thicknesses of coated and surfaced fiberglass mat, cut and bonded together in different patterns. The weather side is surfaced with mineral roofing granules, and the underside is surfaced with a mineral release agent.

3.1.4 Ridge Cap Shingles: Ridge cap shingles consist of fiberglass mat, impregnated and coated with asphalt on both sides and surfaced with mineral roofing granules on the weather side and a mineral release agent on the back side for use in covering hips and ridges. See Table 2 for product sizes, exposure to the weather and manufacturing locations. See also Figure 2.

3.1.4.1 Royal Sovereign® Ridge Cap Shingles: These ridge cap shingles are field-cut from Royal Sovereign® three–tab strip shingles. The field-cut ridge cap shingles are compatible with any of the GAF shingles recognized in this report. See Figure 2.

3.1.4.2 Z® Ridge: These shingles are strips that are scored for separation into four ridge cap shingles. See Figure 2.

3.1.4.3 Seal–A–Ridge®: These shingles are strips that are scored for separation into three or four ridge cap shingles. Seal-A-Ridge® ridge cap shingles are also

ICC-ES Evaluation Reports

http://www.icc-es.org/Evaluation_Reports/

- Take Care… May Contain Specific Instructions

4.1.2 Application:

4.1.2.1 Fastening: Fasteners are as described in Section 3.2. Shingles must be fastened to the roof deck with a minimum of four fasteners or as shown in the Standard Nailing Pattern in Figure 1. Spacing of fasteners must be as shown in Figure 1, and each course of shingles must be offset from the preceding course as shown in the manufacturer's published installation instructions.

Shingles & ICC-ES Evaluation Reports

- Traditional Path

2.0 USES

The asphalt shingles described in this report comply with IBC Section 1507.2 and IRC Section R905.2 and are Class A roof coverings when installed as described in this report.

3.0 DESCRIPTION

3.1 Shingles:

3.1.1 General: The asphalt shingles comply with ASTM D3462, and have been qualified for wind resistance as noted in Section 4.1.2 and Table 1. The shingles are available as three–tab, five–tab and laminated asphalt shingle roof coverings. See Table 1 and Figure 1 for recognized product names and classifications, shingle types, manufacturing locations, overall dimensions, maximum exposure to the weather and fastening details. The shingles are self-sealing by means of adhesive strips located on either the weather side or the underside. See Figure 1 for dimensions, nailing locations and adhesive strip location for field shingles.

ICC-ES Evaluation Reports

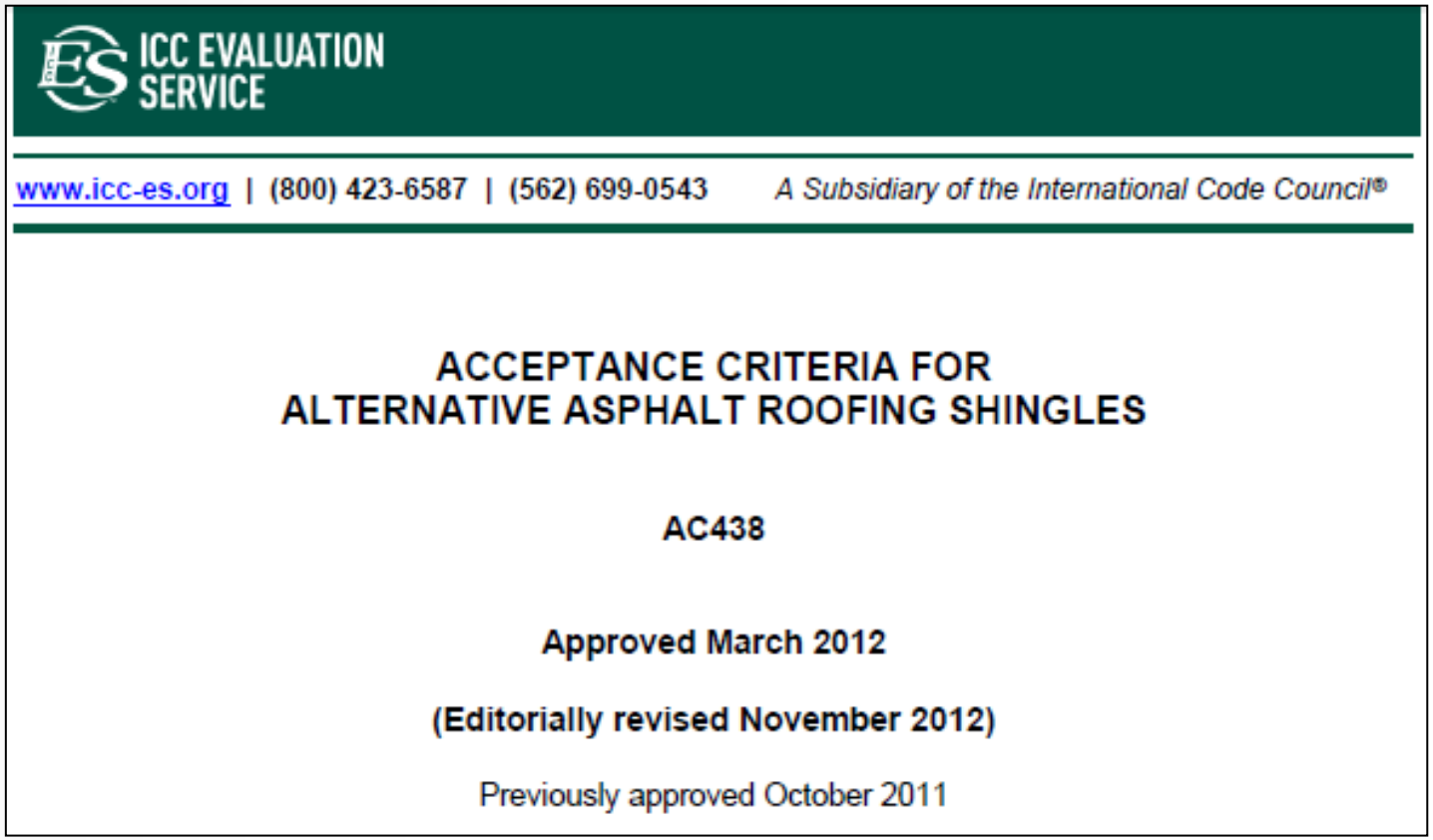
ICC-ES Acceptance Criteria

Generally, it is necessary for ICC-ES to develop acceptance criteria for products and systems that are alternates to what is specified in the code, or that fall under code provisions that are not sufficiently clear for the issuance of an evaluation report.

- "Acceptance Criteria" are developed for products to demonstrate that they meet the "intent" of the code

Acceptance Criteria for Asphalt Shingles

- AC438



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ACCEPTANCE CRITERIA FOR ALTERNATIVE ASPHALT ROOFING SHINGLES

AC438

Approved March 2012

(Editorially revised November 2012)

Previously approved October 2011

AC 438 for Asphalt Shingles – the Purpose (why)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for alternative asphalt roofing shingles made from woven or nonwoven felt to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2012, 2009 and 2006 *International Building Code*® (IBC) and the 2012, 2009 and 2006 *International Residential Code*® (IRC). Bases of recognition are IBC Section 104.11 and IRC Section R104.11.

The reason for the development of this criteria is to provide guidelines for the evaluation of alternative asphalt roofing shingles, since the codes do not provide test methods and performance requirements for such alternatives.

AC 438 for Asphalt Shingles – the Scope (what it covers)

1.2 Scope: Shingles that comply with this criteria shall be recognized for use as an alternative roof covering to the asphalt shingles specified in IBC Section 1507.2.5 and IRC Section R905.2.4.

1.3.3 Alternative Asphalt Roofing Shingles: Shingles used for application on steep-slope roofs, complying with this criteria and consisting of one or more layers of felt, impregnated and coated on both sides with asphalt and surfaced on the weather side with mineral granules or an alternate surfacing material that provides protection for the asphaltic coating.

So What's Required in AC438? (What Are the Hurdles?)

- First, from D3462
  - ✓ Dimensions
  - ✓ D3161/D7158 (wind resistance)
  - ✓ Behavior on Heating
  - ✓ Tear Strength
  - ✓ Fastener Pull-Through Resistance
  - ✓ Penetration & Softening Point of Asphalt
  - ✓ Pliability

So What's Required in AC438?

(What Are the Hurdles?)

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  - ✓Fastener Pull-Through Resistance
  - ✓Penetration & Softening Point of Asphalt
  - ✓Pliability

Performance Requirements Of D3462

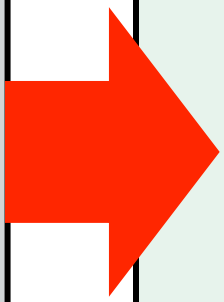
So What's Required in AC438?

(What Are the Hurdles?)

- Then the Offsets

From D3462

- ✓ Finished Weight
- ✓ Glass Mat Weight
- ✓ Mineral Surfacing Weight
- ✓ Filler/Stabilizer Weight
- ✓ Requirement for glass mat, granules, and sealant
- ✓ UL 790 Class A
- ✓ Weight of the Displaced Granules



- ✓ Weather Resistance
- ✓ Temperature Cycling
- ✓ Wind Driven Rain
- ✓ UL 790 Class C
- ✓ Weight of the Displaced Surfacing

Key in AC 438…

- *The Additional Performance Tests…*

- ✓ Finished Weight
- ✓ Glass Mat Weight
- ✓ Mineral Surfacing Weigh
- ✓ Filler/Stabilizer Weight
- ✓ Requirement for glass mat, granules, and sealant
- ✓ UL 790 Class A
- ✓ Weight of the Displace Granules

- ✓ Weather Resistance
- ✓ Temperature Cycling
- ✓ Wind Driven Rain
- ✓ UL 790 Class C
- ✓ Weight of the Displaced Surfacing

Weather Resistance Test Summary…

- *ASTM G155 Xenon Arc accelerated weathering*
- *2000 hours of light and water in cycles (83 days)*
- *Visual examination for evidence of surfacing loss, erosion or exposed reinforcement*
- ***80% retention of breaking strength***

Temperature Cycling Test Summary…

The test deck was subjected to twelve consecutive cycles of this test with each cycle consisting of:

Cycle Sequence	Duration, hours	Temperature, °F	Water Exposure
1	14	180	None
2	1	70	None
3	1	70	yes
4	6	-40	None
5	2	70	None

Spray nozzles for the water exposure cycle were positioned seven feet above the test deck and calibrated to deliver of 6 inches of water per hour at a water temperature of between 40° F to 60° F.

Temperature Cycling Test Summary…

- 2/12 slope
- 1 layer underlayment
- 5 X magnification
  - Signs of tearing or cracking to show glass mat
  - Butt joints in the first course – no separations greater than ¼"
  - No evidence of tearing of shingles around fasteners; no fastener pull through

Wind Driven Rain Test Summary…

- Florida Building Code Test Protocol TAS-100
- Minimum slope specified by the manufacturer
- No water infiltration through the sheathing; no blow-off/tear-off or release of the shingle or portion thereof

Wind Driven Rain Test Summary…

- 15 min wind/water
- 10 min off
- 35, 70, 90, & 110 mph
- 8”/hour rain event

Interval	Test Conditions		
	Wind Speed, MPH	Water Spray	Duration, Minutes
1	35	On	15
2	0	Off	10
3	70	On	15
4	0	Off	10
5	90	On	15
6	0	Off	10
7	110	On	5
8	0	Off	10

Wind Driven Rain Test

Wind Driven Rain Test

Weight of Displaced Surfacing…

- Surfacing must protect the asphalt coating

Surface Material Loading per 100 ft^2	Surface Material Displaced
> 18 lb. 9 – 18 lb. < 9 lb.	1 g (max.) 0.80 g (max.) 0.60 g (max.)

For Asphalt Shingles D3462 & AC438…

D3462

- Finished Weight
- Glass Mat Weight
- Mineral Surfacing Weight
- Filler/Stabilizer Weight
- Requirement for glass mat, granules, and sealant
- UL 790 Class A
- Weight of the Displaced Granules

Both

- Dimensions
- D3161/D7158 (wind resistance)
- Behavior on Heating
- Tear Strength
- Fastener Pull-Through Resistance
- Penetration & Softening Point of Asphalt
- Pliability

AC438

- Weather Resistance
- Temperature Cycling
- Wind Driven Rain
- UL 790 Class C
- Weight of the Displaced Surfacing

Why AC438?

- For products that meet D3462, demonstrates a higher level of performance than the industry "standard"
  - Accelerated aging, wind driven rain, & temperature cycling

Why AC438?

- As materials and technology advance, AC 438 allows manufacturers to pursue product development without the recipe constraints of D3462

Summary

Shingles

- Fire Resistant
- Durable
- Wind Resistant
- Code Compliant

D3462

- Prescriptive-based
- Wind resistance: Class A (60 mph)
- Fire resistance: Class A

AC438

- Acceptance Criteria for Asphalt Shingles
- Includes Performance Testing of D3462
- Requires Additional Performance Testing

Questions?

Thank you for your time and attention!