Exterior Vinyl Profiles of Windows, Doors and Skylights

Customer Confidence Through Certifying Vinyl Profiles
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Learning Objectives

Upon completion of the course, attendees will understand:

- Reasons for Profile Certification
- Process of Profile Certification
- Testing of the Vinyl Compound
- Weathering and Testing of Profiles
- Profile Certification and Quality Control
Profiles

Frame & Sash
Typical Profile Spec Sheet
What is Vinyl?

- Largest volume plastic used in building & construction
- 2/3 of vinyl manufactured for building and construction applications
- Versatility - flexible, rigid and customized applications can be made into a variety of colors, patterns or textures
- Combines many characteristics of traditional materials with advanced technologies
The Beginning
While working at BF Goodrich, Dr. Waldo Semon invents modern day vinyl

1926

WWII - Vinyl jacketed wiring replaces rubber insulation and textile jacketing on naval ships

1940

The 1950’s
Windows improved for U.S. market; PVC pipe critical to clean water delivery

1950

Post War Era
Material shortages lead to vinyl window frames; wallpaper coating, durable flooring emerge

1945
Vinyl Timeline

1955
B.F. Goodrich independently develops Koroseal PVC storm window extrusion in U.S.

1960’s
The Rise of Vinyl
Vinyl siding introduced and improved as aluminum costs rise

1964
First U.S. PVC Replacement Window
Single glazed side-load double hung by Thermal Industries

1970’s
Effective Material
Single-ply roof membranes alternative to built-up roofs as asphalt costs rise
Vinyl Timeline

**Demand for Vinyl**
Oil embargo and high aluminum prices spur demand for energy saving products

**1973**

**Vinyl Advances**
Vinyl overtakes top market share position from wood and aluminum

**1980’s**

**A New Market**
Vinyl fencing - new market for recycled post-industrial waste; decking and railing evolve

**1990’s**

**Here to Stay**
- Vinyl has a vital role in the built environment; technology advances, new uses discovered rapidly

**2000**
Blending of the Compound

- The blending of the compound is a very critical step
  - Calibrated scales are used to weigh each ingredient
- Then the material is added in a special sequence to the blender – which is a big version of your household blender
- The material is then cooled in a cooler
High Intensity Blenders
Coolers
Profile Extrusion

1. Specially formulated vinyl compound

2. Twin Screws within the extruder convey compound through the extruder

3. High speed dies define the shape of the profile

4. Calibration tables and water-baths remove the heat from the extrusions to ensure performance and design tolerances

5. Advanced technology monitors the process to assure quality assurance

6. Vinyl Profile

Vinyl Extrusion Line
Case Studies

1. Art Installation, “The Gates”
2. Up-House, energy-saving home design
“The Gates” art installation in New York City, by artist Christo and his wife Jeanne-Claude. Vinyl was selected due to its recyclability and durability.
Case Study

Up-House – new home design first shown at the National Design Triennial at the Institute of Contemporary Art in 2007. A key feature of the design was the way in which vinyl contributed to the energy-saving qualities of the entire house.
Why Certification?

- Certification standards on vinyl profiles were developed to insure the quality and integrity of vinyl windows in the market.

- This process assures customers that tested certified vinyl profiles meet specific performance requirements to help ensure performance in the intended end-use applications.
1988
AAMA “101” standard for aluminum windows and doors is updated from 1985 document and released.

1986
AAMA “101” standard for vinyl windows and doors was released.

1993
AAMA “101” standards for aluminum and vinyl windows and doors combined and released.

1994
AAMA and NWWDA begin work to consolidate the two major U.S. standards for windows and glass doors.

1997
ANSI/AAMA/NWWDA 101/I.S. 2-97 was released, encompassing products made of aluminum, vinyl, fiberglass or wood, as well as those with aluminum- or vinyl-clad wood framing members.

2002
ANSI/AAMA/WDMA 101/I.S. 2/NAFS - 02, was released, which incorporates skylights, sidelights and transoms for the first time.

2005
AAMA/WDMA/CSA 101/I.S. 2/A440-05 was issued, fully consolidating U.S. and Canadian standards and adding four more operator types, eight additional materials and requirements for side-hinged doors.
Vinyl Window Durability

Vinyl is known to be an extremely durable product and is widely used in exterior applications requiring excellent weatherability

- roofing
- siding
- fencing and decking
- exterior mold & trim
- windows & doors

Some vinyl windows installed in the early 1970’s are still in active use today
AAMA Gold Label Window Certification Program

Vinyl Profile Certification is part of AAMA’s Gold Label Window Certification Program

All windows that bear the AAMA Gold Label must be made from profiles that are certified in the AAMA Profile Certification program
U.S. Residential Window Shipments

- Vinyl windows make up the largest share of the U.S. residential window market
- 65% of all vinyl window shipments are AAMA certified

Vinyl windows also have a significant share of the shop fabricated non-residential window market.

Shop-fabricated windows represent 21% of the non-residential window market.

Profile Certification Steps

1. Vinyl Compound must be tested to ensure it meets the minimum performance requirements.

2. Vinyl Profiles are also tested to required performance standards.

3. For a window to bear the AAMA Certification Program Gold Label, the manufacturer must certify that it is made from profiles listed in the AAMA Profile Certification Program.
Vinyl Compound Testing

Vinyl compound must meet minimum standards for acceptable end-use performance based on the following performance tests:

- Impact - Izod
- Impact - Drop Dart
- Tensile Strength
- Tensile Modulus
- Deflection Temperature
- Coefficient of linear expansion
Izod Impact
(Resistance to Tearing)

Impact resistance: measures the ability of the material to withstand the impact (tearing force) being applied to the object. For example, the ability of the profile to withstand being dropped during fabrication or installation.
Izod Impact
Drop Dart Impact
(Resistance to Puncture)

Measures the ability of the material to withstand the impact being applied to the object. Also indicates resistance to general abuse during transportation, storage and installation.
Drop Dart Impact
Tensile Strength & Modulus
(Resistance to forces pulling the profile apart)

Measures the strength of the material to resist forces to pull it apart.
Deflection Temperature

A ¼-inch bar, which is under an applied force, is heated. Temperature is recorded when bar bends. Profile must meet a specific minimum deflection temperature.
Expansion is measured by scoring lines a specific distance apart at room temperature and measuring the distance at an elevated temperature.

The coefficient of linear expansion per degree is then calculated.

This test is performed to mitigate possible damages that can be caused by warping.
Profile Certification Steps

1. Vinyl Compound must be tested to ensure it meets the minimum performance requirements.

2. Vinyl Profiles are also tested to required performance standards.

3. For a window to bear the AAMA Certification Program Gold Label, the manufacturer must certify that it is made from profiles listed in the AAMA Profile Certification Program.
Profile Certification

1. Applicant must sign AAMA’s Profile Certification License and other necessary documents as is clearly outlined in AAMA’s Vinyl Profile Certification Procedural Guide 109. This is a voluntary, self-certification program, administered by AAMA and validated by an independent third party.

2. Once all documentation has been properly submitted, AAMA’s independent Program Validator (Associated Laboratories Inc. (ALI)) will schedule an initial visit to the applicants plant(s).
Profile Certification, Cont’d.

- 12 month weatherability testing is required.

- During the initial and subsequent visits (2 unannounced in-plant inspections per year), Validator will sample 10% of all the listed profiles (one frame and one sash profile) of each color.

- These samples will be tested to confirm performance against stringent standards:
  - Uniformity of dimensions and weight vs. specifications.
  - Heat resistance, no blistering, cracking, or flaking after 30 minutes @ 300 °F
  - Drop Dart Impact, Procedure B must be ≥ 1.2 in-Lb/mil
  - Lead content must be < 0.02%; no lead-based components are added
  - Pass stringent exterior weathering test in three different climates
Uniformity of Dimensions and Weight vs. Specification

Profiles are tested to confirm uniformity of dimensions and weight versus specification (+/-10% allowed weight variance).
Weathering

Weatherability Tests

The profiles ability to stand up to the outdoor environment.

- Color hold
- Impact resistance after weathering
Weathering

The four main factors of weathering are:

1. Solar radiation (light energy)
2. Temperature
3. Water (humidity)
4. Installation influences:
   - Shade
   - Dust
   - Clay
   - Acid Rain
   - Reflected Light
   - Extreme Temperatures
   - Snow and Ice
   - Rain and Water
   - Storms and Wind
Direct & Diffuse Light
Weathering

Three different sites are used to look at the different environmental conditions:

- Arid climate (like Arizona)
- Humid climate (like Florida)
- Northern Climate (like Ohio or Pennsylvania)

Profile Samples are mounted to a test rack
Arizona Weathering Test Site
Arizona Test Rack
Florida Weathering Test Site
Florida Test Rack
Northern Weathering Test Site
Test Racks

- Every day at the test sites the amount of solar radiation and the atmospheric temperature is measured.

- Profiles are mounted to the test rack and then pulled down and tested at testing intervals of 6, 12, 18 and 24 months.

- Profiles must pass at all intervals.
CIELAB* Color Space

L = light/dark axis

a = red/green axis

b = yellow/blue axis
Weathering

- If during the weathering process the product changes more than the allowable Delta E units based on the original color standard, then the product cannot be accepted for the certification program.

\[
\Delta E = \sqrt{L^2 + a^2 + b^2}
\]
Weathering

- Color/white profiles are tested after 6, 12, 18 and 24 months.
- Retested for drop dart impact to remain ductile after weathering.
- Profiles must pass after every interval.
- New compounds must pass 12 months of weathering before being authorized for AAMA certification.
Maintaining Profile Certification

- If using certified profiles, then the completed window can be certified with the AAMA Gold Label.

- Labels shall be affixed only at the plant location.

- The first unannounced plant inspection by the Validator is conducted either within 6 months of the initial sampling or after the initial 12-month weatherability tests confirm that the profile meets this requirement.
Profile Certification Steps

1. Vinyl Compound must be tested to ensure it meets the minimum performance requirements.

2. Vinyl Profiles are also tested to required performance standards.

3. For a window to bear the AAMA Certification Program Gold Label, the manufacturer must certify that it is made from profiles listed in the AAMA Profile Certification Program.
Maintaining Profile Certification

- Unannounced inspections
- Samples taken at each inspection
- Weathering samples are taken
- Lead testing is performed at every inspection
Quality Control

- Procedures for performing the following quality control tests must be documented and consistently implemented:
  - Impact Resistance
  - Dimensional Stability
  - Heat Stability
  - Weight Tolerance
Quality Control

- Program licensees are required to maintain permanent quality control records that include information about samples, personnel and equipment calibration.

- The results of all quality control testing and any resulting corrective action must be recorded in a Quality Control Log and maintained for review by the Validator during in-plant inspections.
Let’s Review

After completing this course, attendees have gained an understanding of:

- Reasons for Certification
- Process of Certification
- Testing of the Vinyl Compound
- Weathering and Testing of Profiles
- Profile Certification and Quality Control
AAMA
Certified Products Directory

Enter the following address into a Web browser and this will take you to the AAMA Certified Products Directory.

http://www.aamanet.org/general.asp?sect=2&id=44

The directory lists products that have been *authorized* by AAMA for certification by the manufacturer. Products must bear the *AAMA Certification Label* to be certified in this program. By placing an AAMA certification label on a product, the manufacturer certifies that the labeled product meets the requirements for certification.
Thank you for your kind attention.
May I answer any questions?

Vinyl Profile Certification