Optimizing Performance in Commercial Fenestration

AZON USA INC.
Kalamazoo, Michigan

- World's largest supplier of energy-saving, structural polyurethane products for the fenestration industry
- Pour and debridge thermal barrier, chemicals, machinery, service
- Maker of thermal barrier warm-edge air space material for use in commercial insulating glass

AZON

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Learning objective

1. Discuss the various comfort and performance-related topics in fenestration systems including, overall U-factor, condensation resistance factor (CRF), sound transmission OITC (Outdoor Indoor Transmission Class)
2. Compare two methods for optimizing the performance of aluminum fenestration components through the application of thermal barriers in the framing

Learning objective

3. Optimize the performance of fenestration components through the application of thermal barriers in the air space material, also known as warm-edge technology for insulating glass
4. Observe a range of measured performance outcomes, energy-savings, LEED® and Cradle to Cradle^{sm} contribution using case study data of built commercial projects in the U.S. and globally utilizing one or both types of thermal barriers in the frame and insulating glass

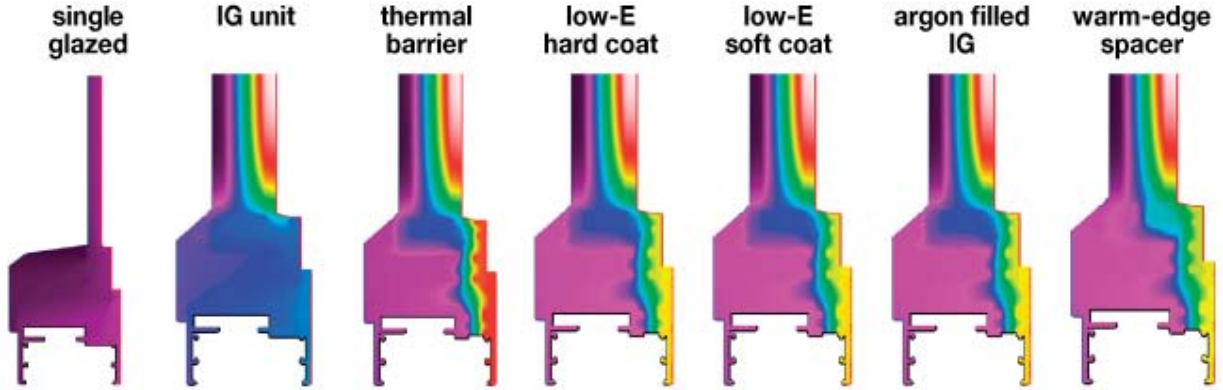
Aluminum framing for fenestration

Benefits

- Excellent structural performance
- Narrow sightlines
- Environmentally friendly (recycled content, 100-percent reusable)
- Unlimited color finish options
- LEED® certification*
- High thermal conductivity (1109 Btu-in/(hr - F°-ft²)

•The LEED® (*Leadership in Energy and Environmental Design*) Green Building Rating System

Fenestration innovation timeline



	1950	1960	1970	1980	1990	2000	2010
U-factor	1.02	0.71	0.55	0.48	0.44	0.41	0.39
Condensation Resistance*	16	28	52	54	55	56	61
U-cog (Btu/h ft²F)	1.03	0.49	0.49	0.36	0.29	0.24	0.24

Thermal graphics created with THERM 5 and Windows 5 * NFRC 500 Condensation Resistance

THERM and WINDOW are trade names of Lawrence Berkeley National Laboratory

Learning objective

Discuss the various comfort and performance-related topics in fenestration systems including, overall U-factor, condensation resistance factor (CRF), sound transmission OITC (Outdoor Indoor Transmission Class)

Performance in fenestration systems

Government, NGOs*:

Mega-trends: green awareness, sustainability, carbon footprints

EPA, DOE, USGBC, FSC, NFRC

Tools for modeling:

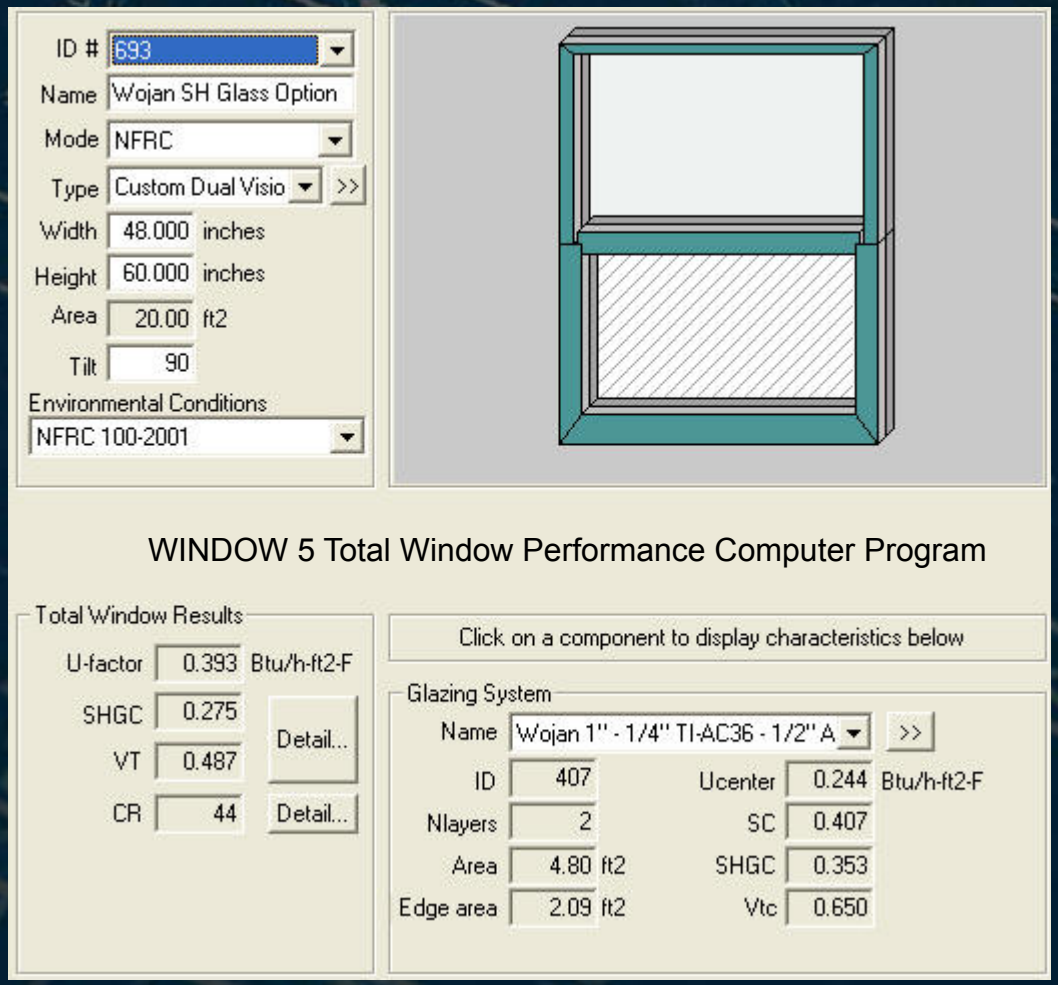
THERM, Window and RESFEN software programs** for analyzing performance of fenestration products.

*Non-Governmental Organizations
**THERM, WINDOW and RESFEN are trade names of Lawrence Berkeley National Laboratory

Performance in fenestration systems

Tools for modeling:

- U-factor
- Solar heat gain coefficient (SHGC)
- Visible light transmittance (VT)
- Condensation resistance (CR)

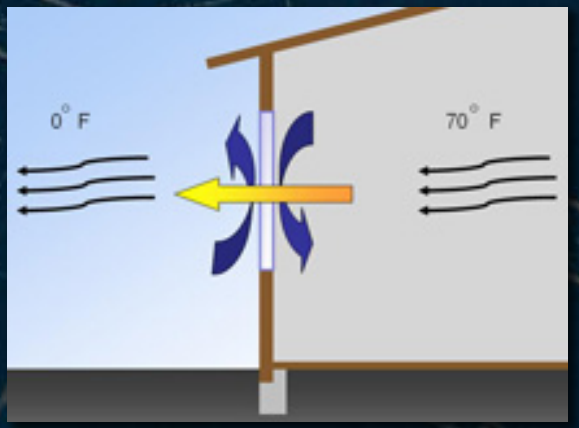


WINDOW 5 Total Window Performance Computer Program

THERM, WINDOW and RESFEN are trade names of Lawrence Berkeley National Laboratory

Performance in fenestration systems

U-Factor measures the rate of heat transfer and tells you how well the window insulates. U-factor values are measured in Btu/h·ft²·°F. The lower the U-factor, the better the window insulates



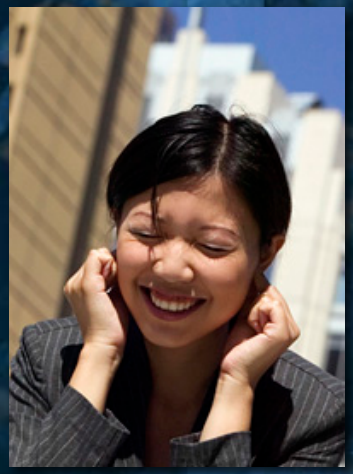
http://resourcecenter.pnl.gov/

Condensation Resistance measures how well the window resists water build-up. Condensation Resistance is scored on a scale from 0 to 100. The higher the condensation resistance factor, the less build-up the window allows.

SOURCE:http://www.energystar.gov/

Performance in fenestration systems

Solar Heat Gain Coefficient (SHGC) measures how well an opening blocks heat from sunlight. The SHGC is the fraction of the heat from the sun that enters through a window expressed as a number between 0 and 1. The lower the SHGC number, the less solar heat is transmitted.



Sound control for entire fenestration system, rather than for the individual acoustical fenestration components.

Outdoor–Indoor Transmission Class (OITC) primarily for aircraft, rail, truck traffic noises

Learning objective

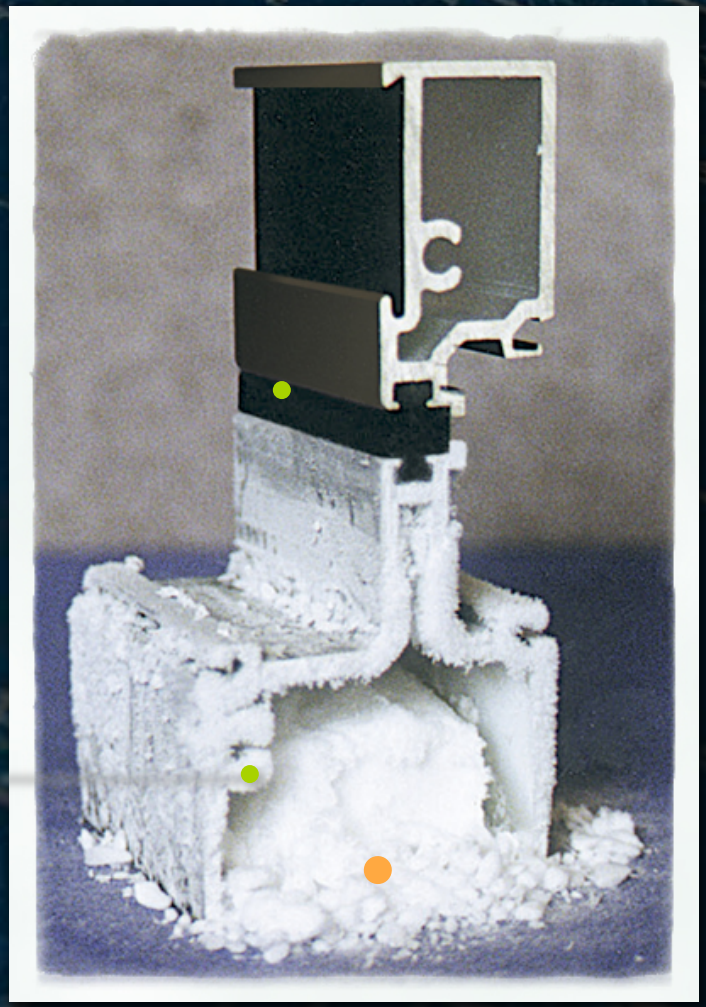
Identify two methods for optimizing the performance of aluminum fenestration components through the application of thermal barriers in the framing

Thermal barriers for aluminum framing

frost free at 72ºF (22C)

thermal barrier

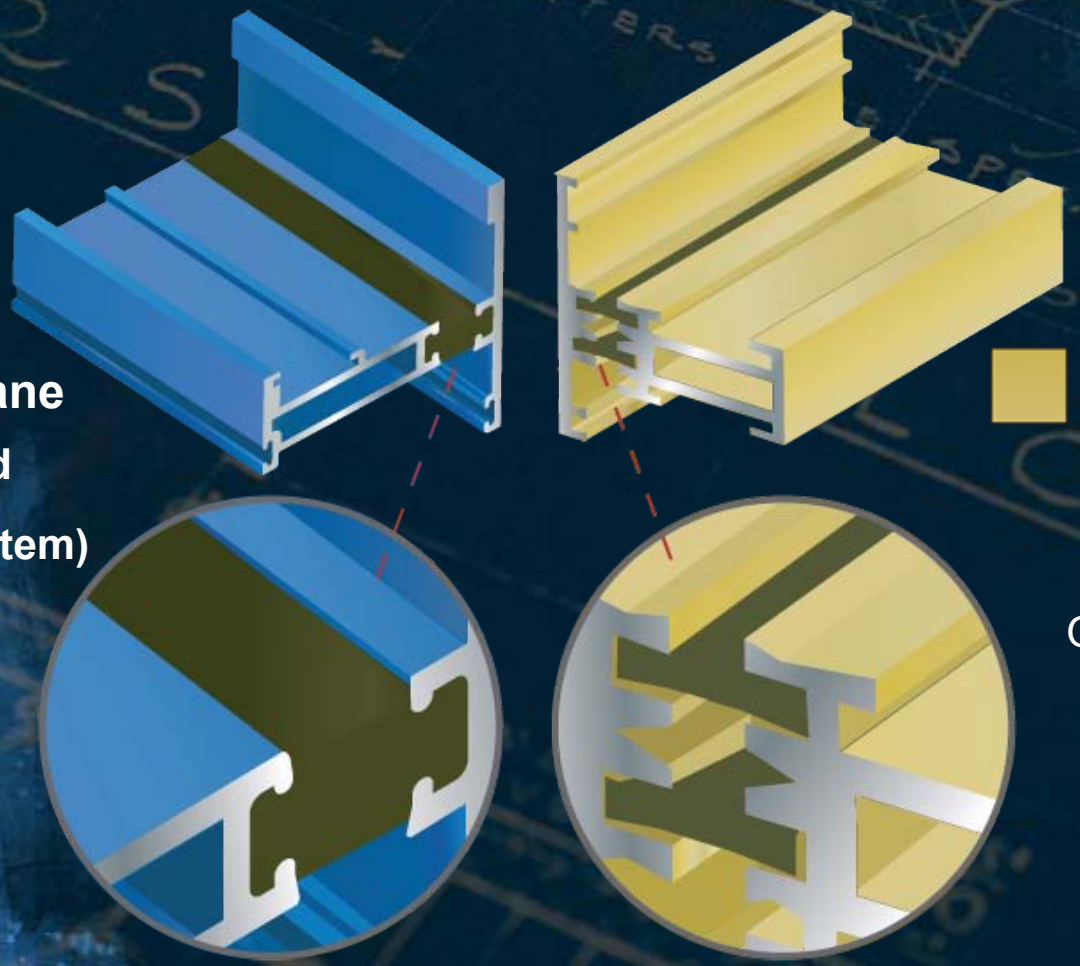
frost forms easily on the aluminum frame



dry ice at -148ºF

(-100°C)

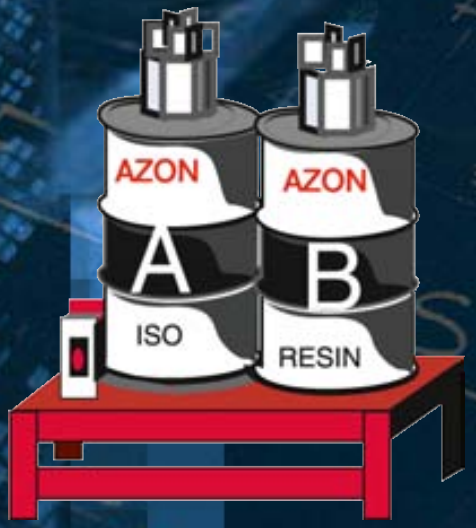
Choices in thermal barrier material



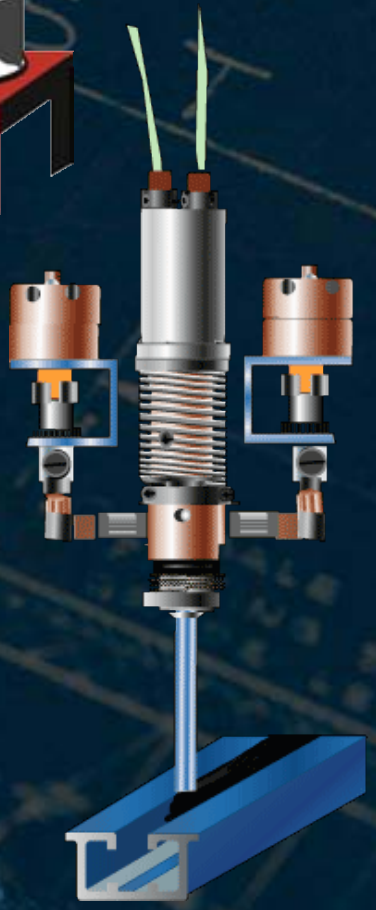
Polyurethane (pour and debridge system)
USA-1970s

Polyamide ("strut" or "strip" system)
Germany-1970s

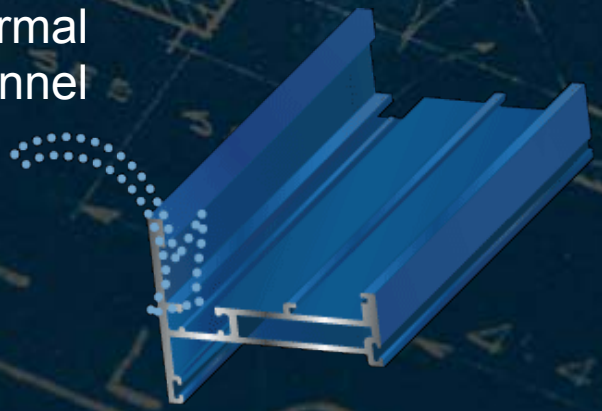
Filling the profile



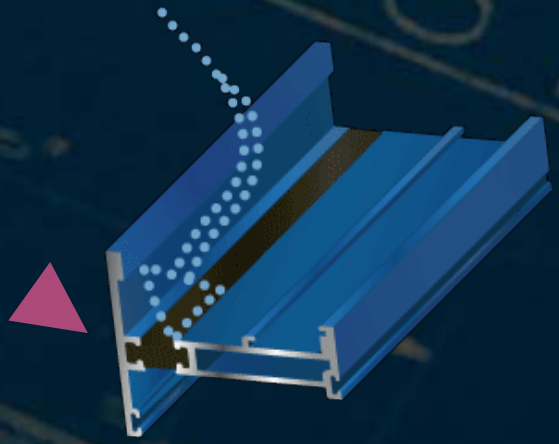
two-component thermal barrier

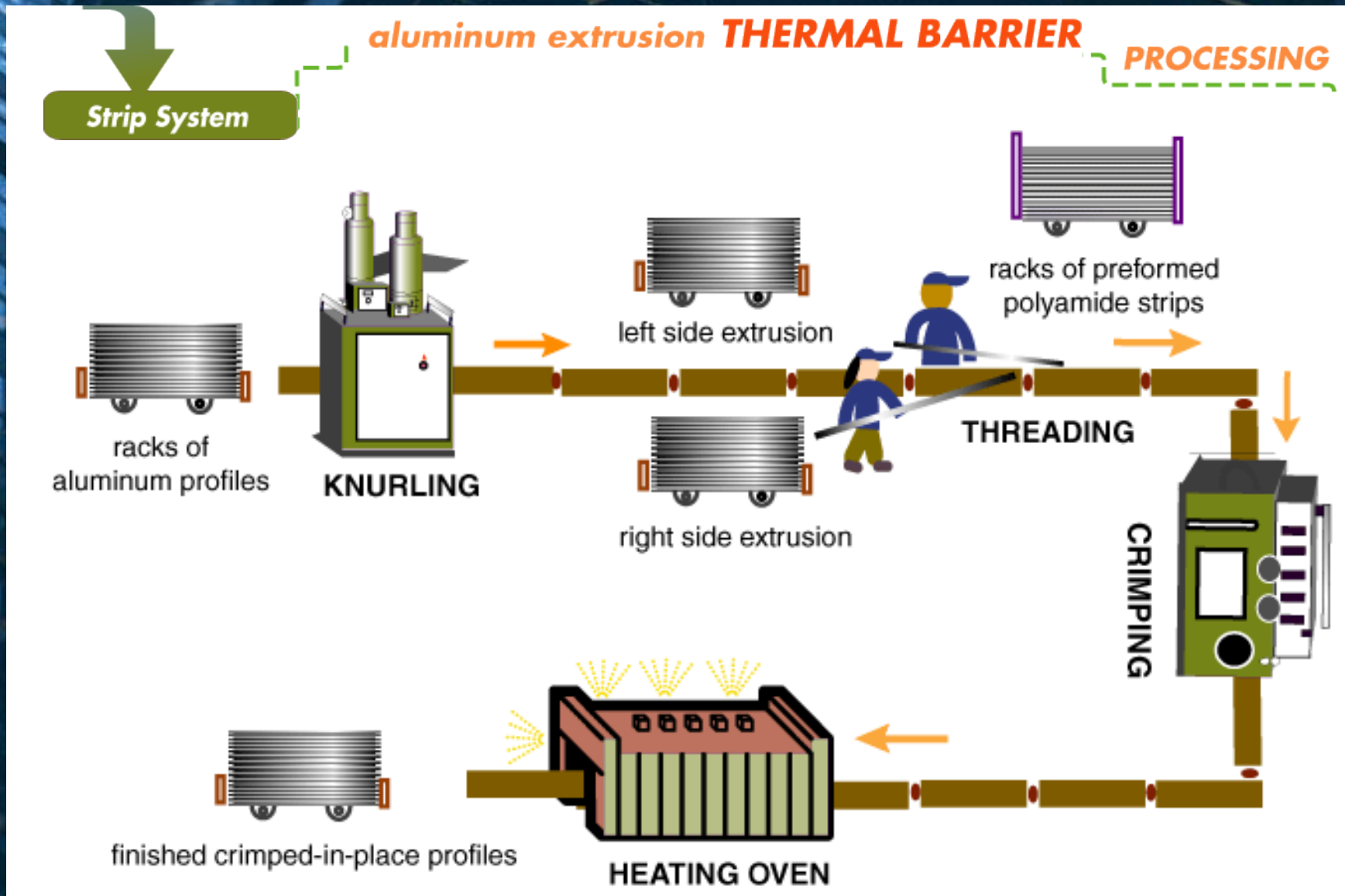


extruded profile with thermal barrier channel



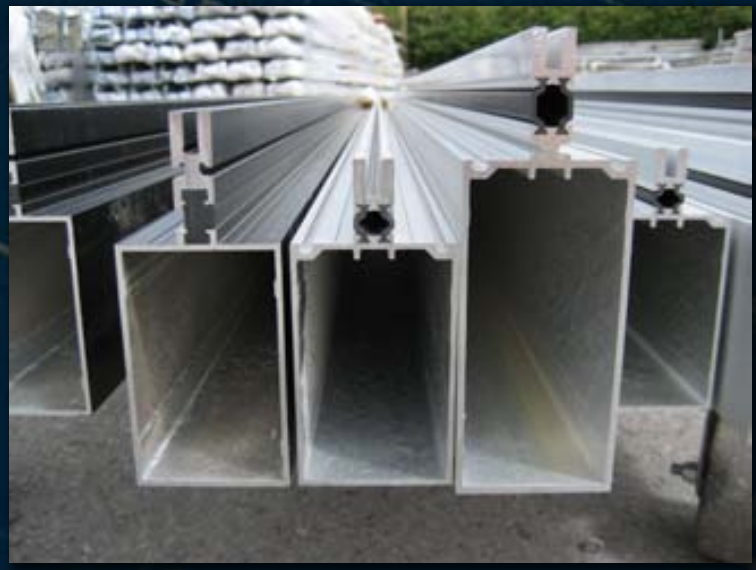
Poured and debridged thermal barrier




Strip System
aluminum extrusion THERMAL BARRIER PROCESSING
racks of preformed polyamide strips
left side extrusion
racks of aluminum profiles
KNURLING
THREADING
right side extrusion
CRIMPING
finished crimped-in-place profiles
HEATING OVEN

Comparing thermal barrier systems

1. Thermally
2. Structurally
3. Cost (manufacturing)
4. Warranty



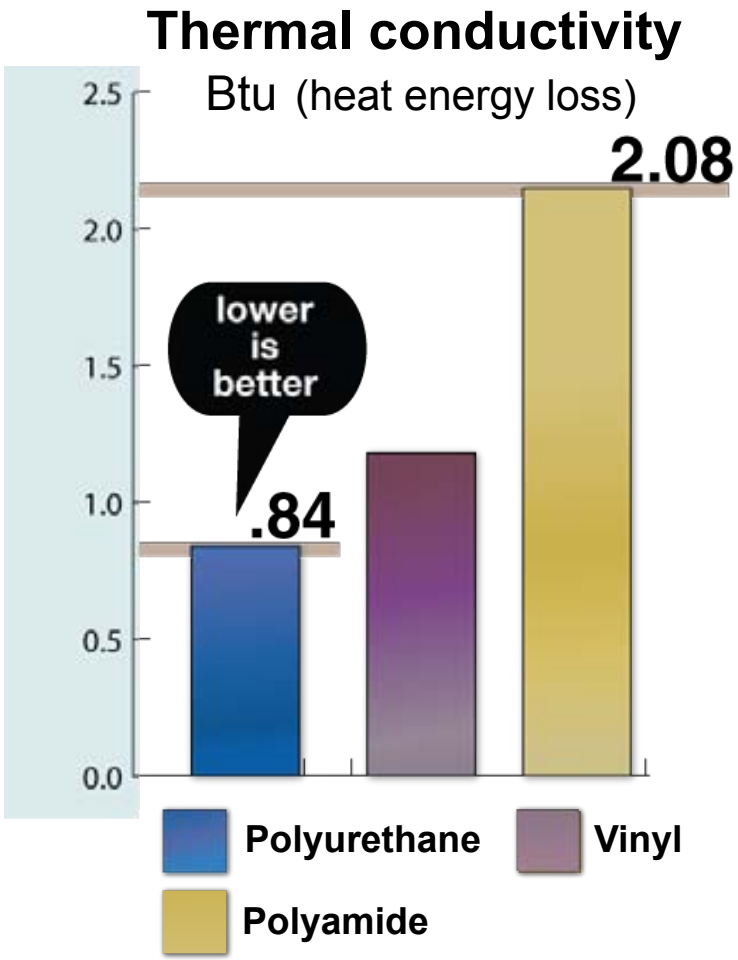
Thermal performance comparison

Material	Conductivity
Polyurethane*	0.84
Vinyl (plastic)	1.18
Polyamide (FG**)	2.08

*polyurethane pour and debridge

**polyamide 6.6 with 25% glass fiber

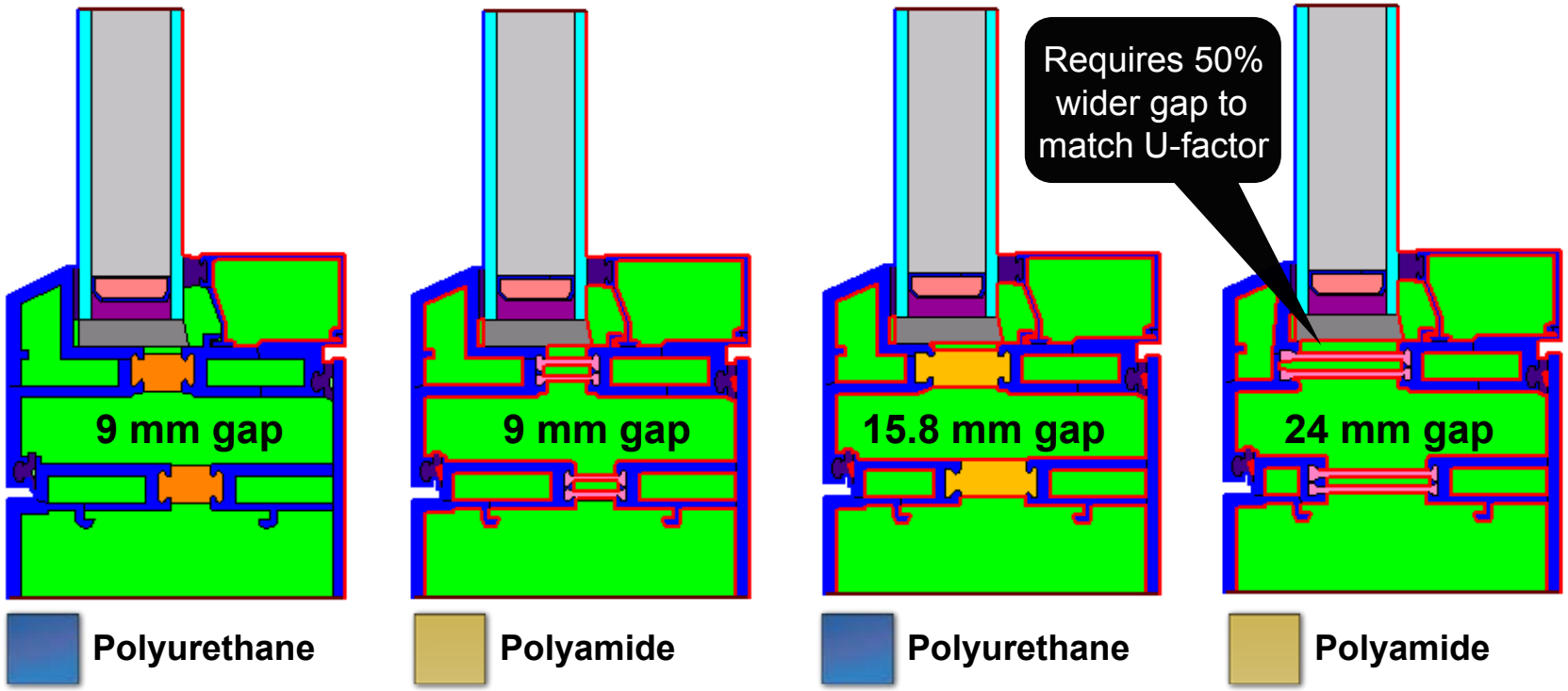
Btu-in/(hr - F°-ft² the lower the thermal conductivity, the better the insulator)



Thermal barrier gap comparison

Similar thermal gap:

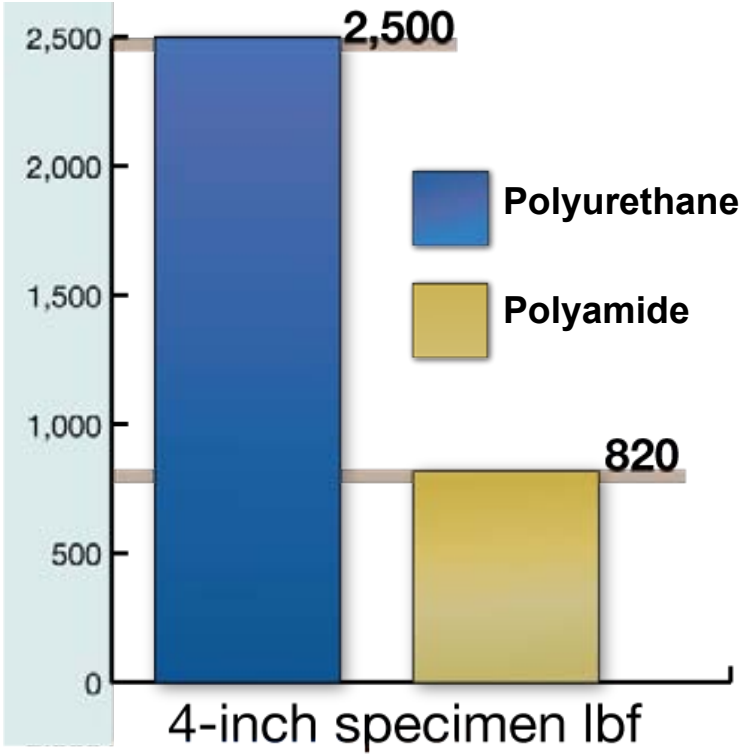
Same U-factor, dissimilar gap:



U-factor=0.49 U-factor=0.50 U-factor=0.45 U-factor=0.45

Structural performance

Typical shear strength



Shear strength is the ability of the thermal barrier material to resist slippage or tearing parallel to the line of application loading

AAMA TIR-A8-08

American Architectural Manufacturers Association standards

Structural performance

Polyurethane

Polyamide

Polyurethane • 4-inch specimen

- Torsion: 1,519 lbf
- Shear: 1,901 lbf
- Deflection 2,206 lbf

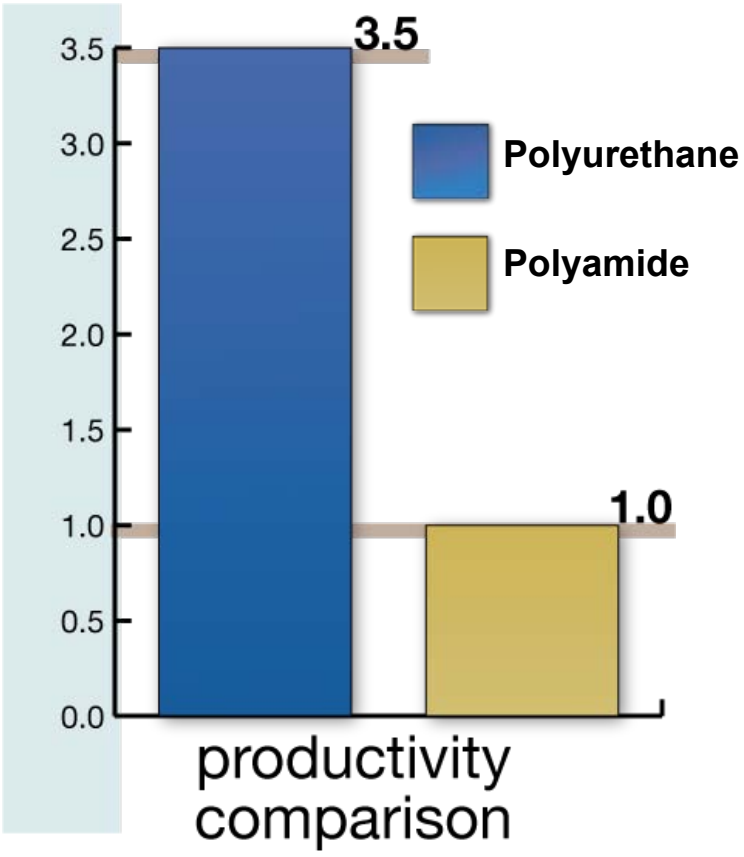
Polyamide • 4-inch specimen

- Torsion: 519 lbf
- Shear: 1,437 lbf
- Deflection 1,821 lbf

(Deflection weight (force) required to deflect an 84-inch extrusion 1/2-inch)

Manufacturer cost comparison

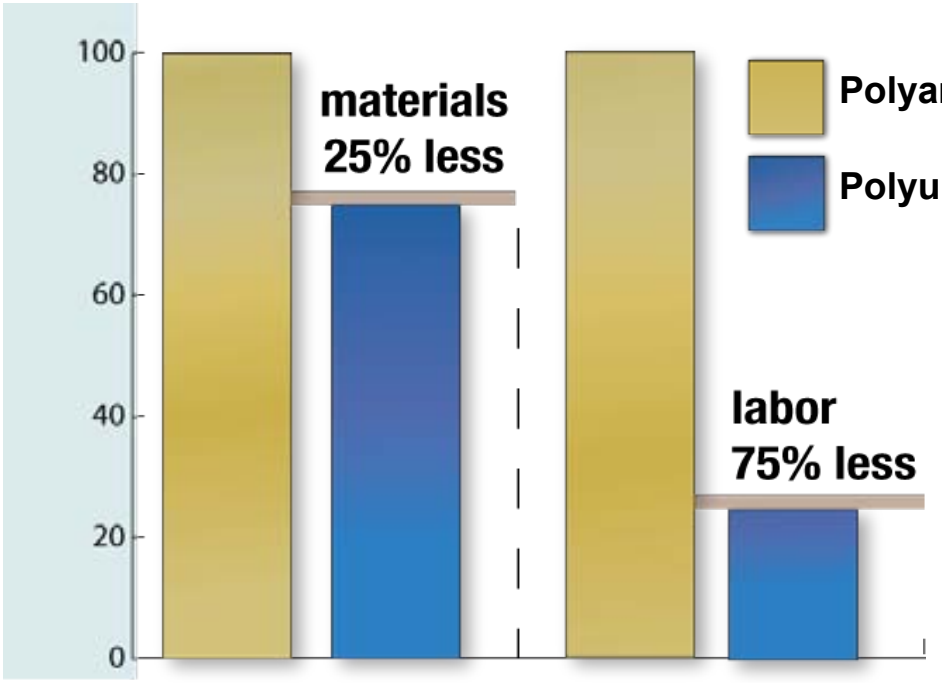
Throughput ratio



The **throughput ratio** is the number of extrusions that can be processed during the same time period

Manufacturer cost comparison

Material and labor



Material and labor impact the cost of fenestration products

Warranty

What type of warranty can be expected from a thermal barrier system?


Approved applicators of pour and debridge systems offer a 10-year warranty

Comparison summary

Thermal performance

- Polyurethane is 2.5 times better insulating than polyamide strips based on thermal conductivity

Structural performance

- Polyurethane up to 3 times stronger shear strength and torsion strength (versus polyamide)

Cost

- Polyamide is more labor intensive and more materials are required when compared to manufacturing polyurethane thermal barrier extrusion profiles

Two-color (wood grain) with polyurethane thermal barrier

Learning objective

Optimize the performance of fenestration components through the application of thermal barriers in the air space material, also known as warm-edge technology for insulating glass

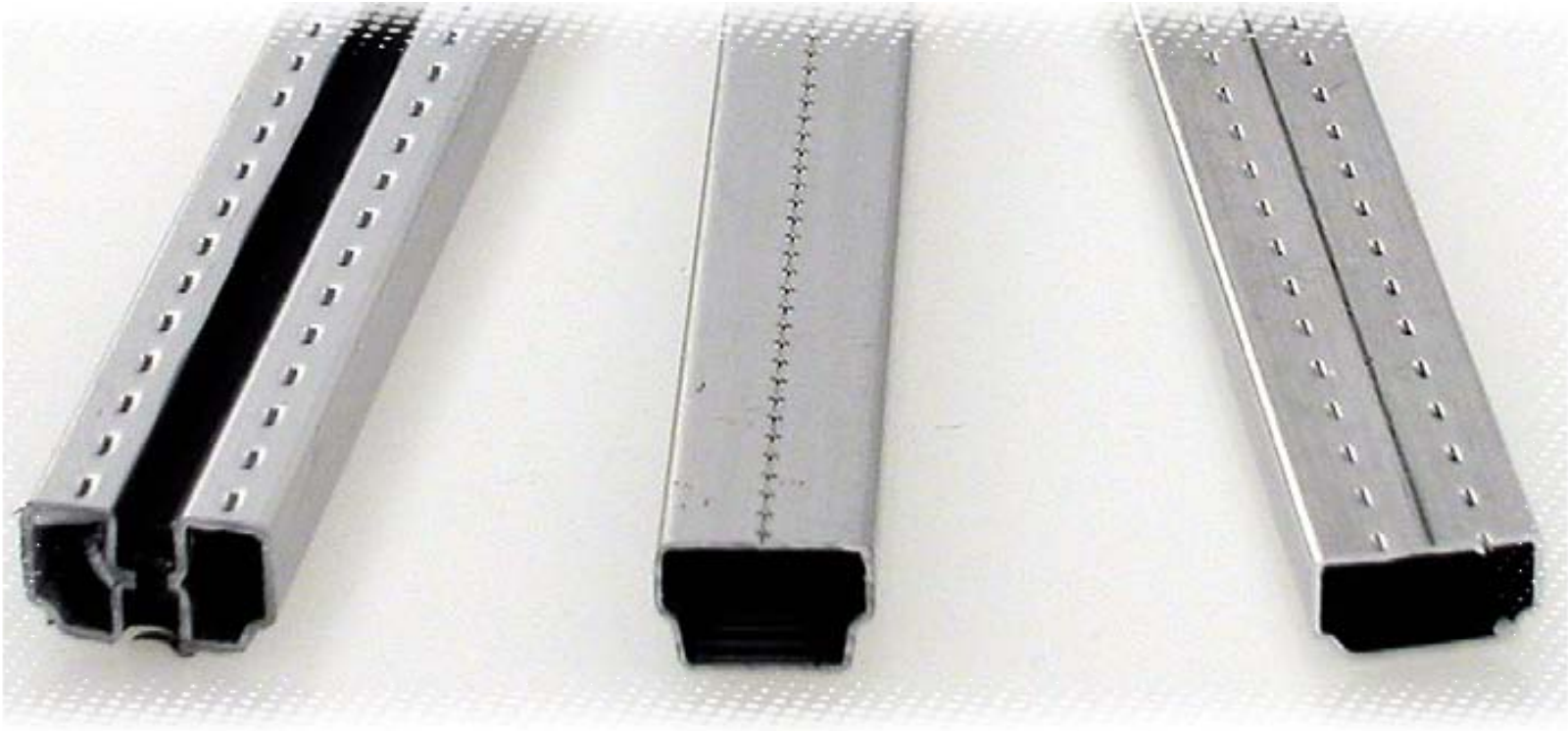
Warm-edge technology for insulating glass

Optimizing both thermal performance and condensation resistance

Maintaining the benefits of daylighting while increasing the pathway to health and comfort

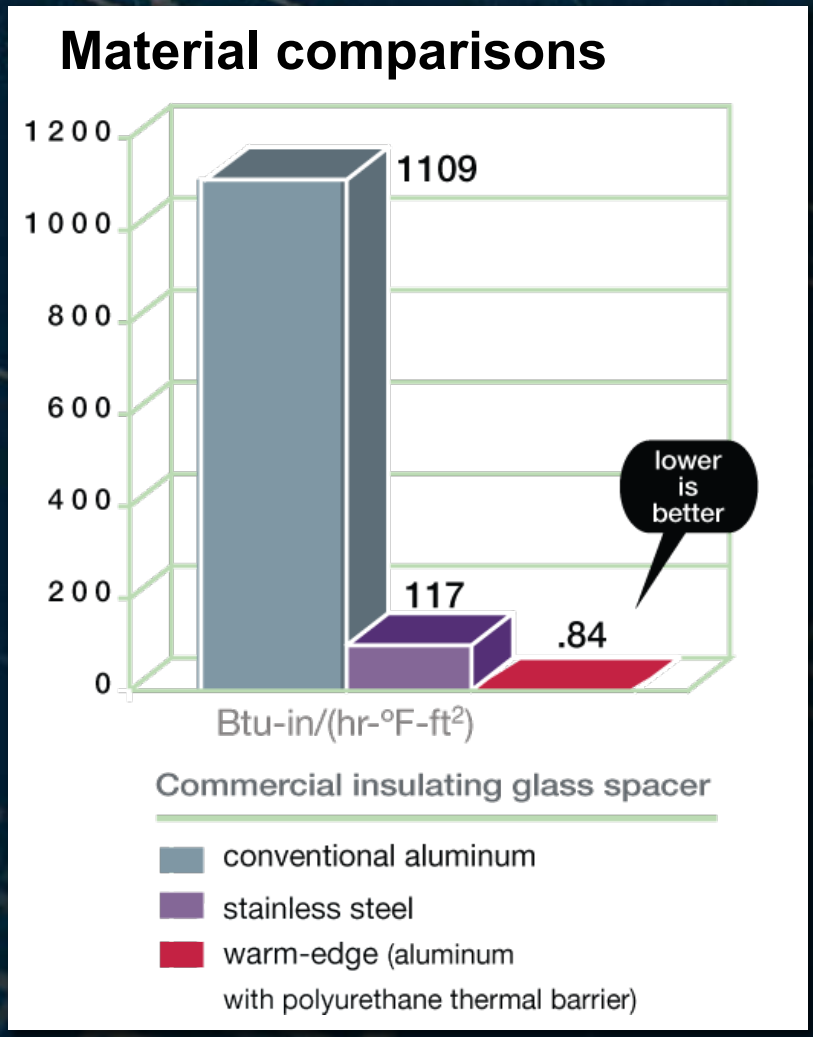
How spacer materials make a difference

Architectural spacer material types



thermal barrier stainless steel aluminum

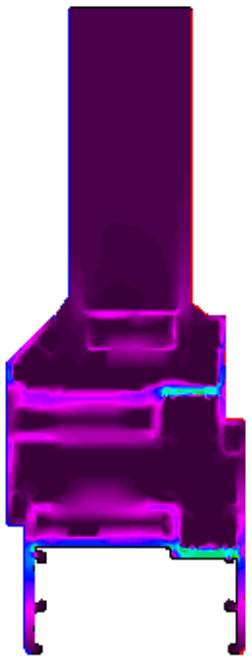
Thermal conductivity



Values from NFRC 101: Procedure for determining Thermo-Physical Properties for materials for use in NFRC-approved Software

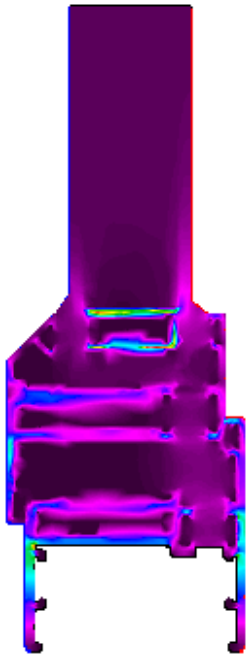
Effects of thermal barriers and spacer in frame

- **Low-E IG unit**
- **aluminum spacer**
- **aluminum frame**



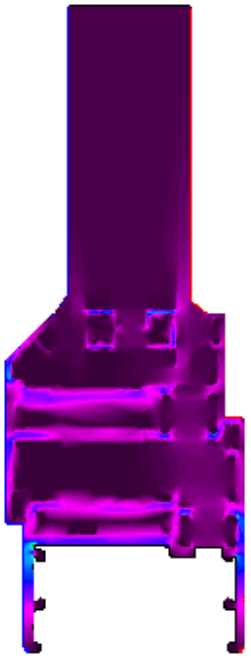
U-factor
0.62

- **Low-E IG unit**
- **aluminum spacer**
- **thermal barrier frame**



U-factor
0.41

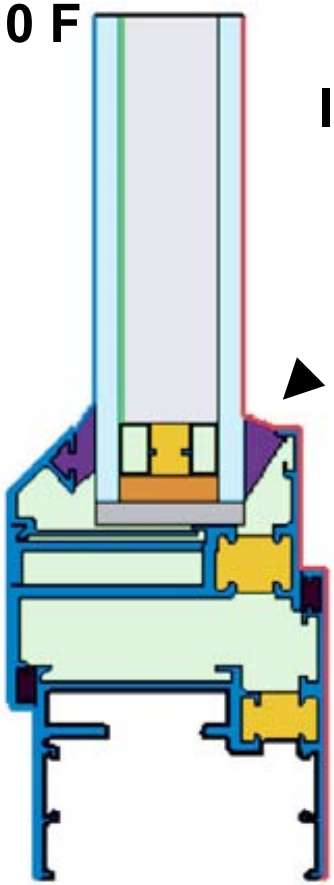
- **Low-E IG unit**
- **warm-edge spacer**
- **thermal barrier frame**



U-factor
0.39

Condensation resistance factor calculations

Outside
0 F



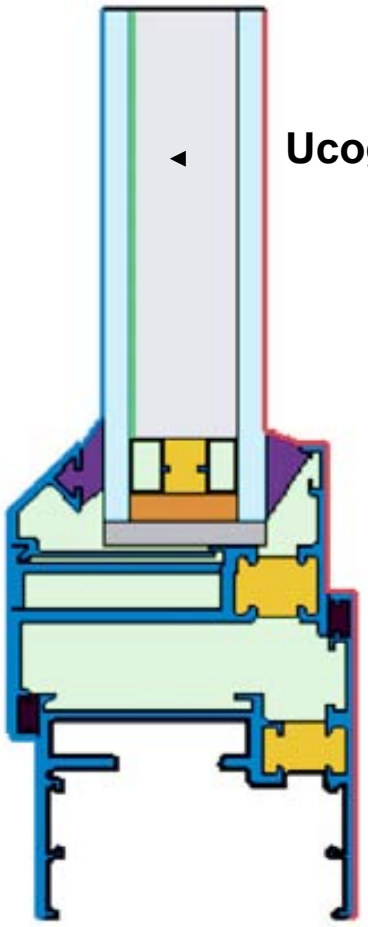
Inside
70 F

	Low-E glass aluminum spacer	Low-E glass steel spacer	Low-E glass thermal barrier spacer
Sight Line Temp	**31.2F**	**33.9F**	**38.7F**
Sight Line CRF	**44.5**	**48.4**	**55.3**

$$\textbf{CRF} = \frac{\text{(Temp at sight line - Outside temp)}}{\text{(Inside temp - Outside temp)}} \times 100$$

Thermal analyses conducted using Therm 5 and WINDOWS 5

U-Value calculations



Ucog

U-edge = weighted average of Ucog and sight line properties (spacer)

U-factor = weighted average of Ucog + Uedge + Uframe

U-frame = heat transfer below the sight line (spacer)

	Low-E aluminum spacer	Low-E steel spacer	Low-E thermal barrier spacer
Ucog	0.29	0.29	0.29
U-edge	0.47	0.45	0.42
U-frame	0.62	0.60	0.58
U-factor	0.45	0.44	0.43

Thermal analyses conducted using Therm 5 and WINDOWS 5

Warm-edge technology for insulating glass

- Polyurethane thermal barrier incorporated into roll-formed aluminum
- A thermally improved, structurally stronger, air space material for commercial insulating glass
- First major advance in spacer technology for commercial applications in thirty years

Constructing the most *efficient window*

Performance components:

Argon gas filling — U-factor improvement: 0.02

Low-E coating — U-factor improvement: 0.14

Warm-edge spacer — U-factor improvement: 0.02

Thermal barrier — U-factor improvement: 0.19

Learning objective

Observe a range of measured performance outcomes, energy-savings, LEED® and Cradle to Cradle℠ contribution using case study data of built commercial projects in the U.S. and globally utilizing one or both types of thermal barriers in the frame and insulating glass

Willis Tower

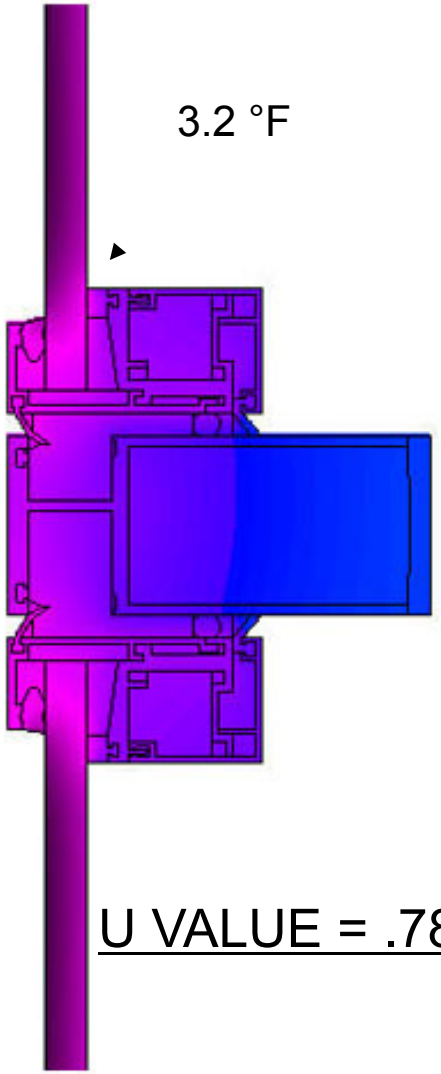
- Completed in 1973
- Tallest building in Western Hemisphere
- High-tech for it's time, but low-tech compared to today's available technology
  - Non-thermal aluminum framing
  - Very high thermal conductivity
  - 9/16-inch laminated glass (non-thermal)
  - High energy consumption & carbon emissions
  - Frost & condensation
  - **U-Value 0.78**

Willis Tower Project
(thermal barrier frame / insulating glass)

OPTIONS	DESCRIPTION	U VALUE
#1	POUR and DEBRIDGE FRAME WITH WARM-LIGHT GLASS SPACER	.335 Btu/hr-ft²-F
#2	POUR and DEBRIDGE FRAME WITH STAINLESS STEEL GLASS SPACER	.342 Btu/hr-ft²-F
#3	POUR and DEBRIDGE FRAME WITH ALUMINUM GLASS SPACER	.353 Btu/hr-ft²-F
#4	POLYAMIDE FRAME WITH WARM-LIGHT GLASS SPACER	.373 Btu/hr-ft²-F
#5	POLYAMIDE FRAME WITH STAINLESS STEEL GLASS SPACER	.378 Btu/hr-ft²-F
#6	POLYAMIDE FRAME WITH ALUMINUM GLASS SPACER	.386 Btu/hr-ft²-F

U-Factor current building 0.78

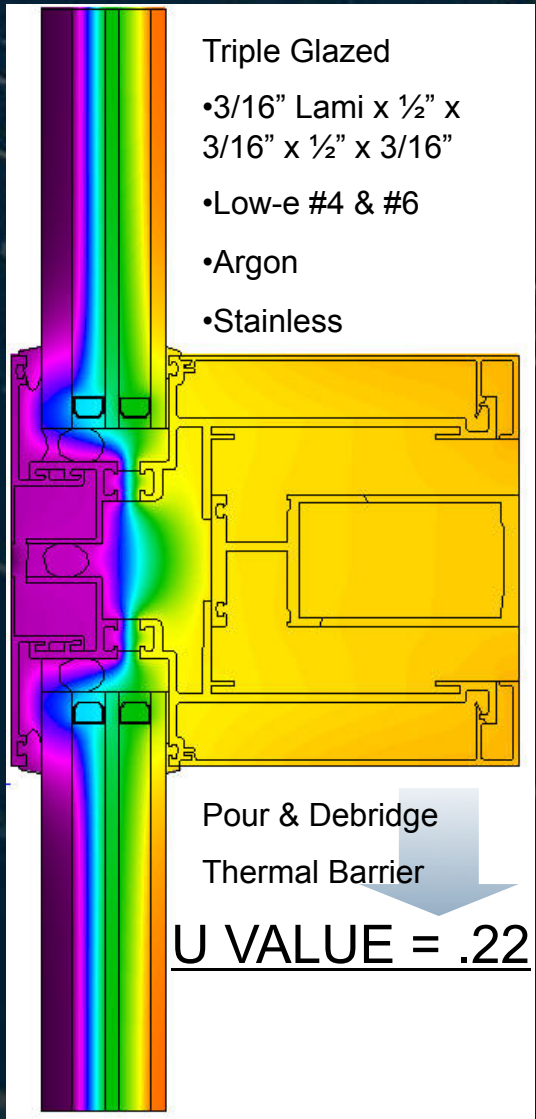
Current



U VALUE = .78

Using modern thermal barrier technology, we can transform the existing building from a cold and inefficient building to a thermally efficient warm building

New



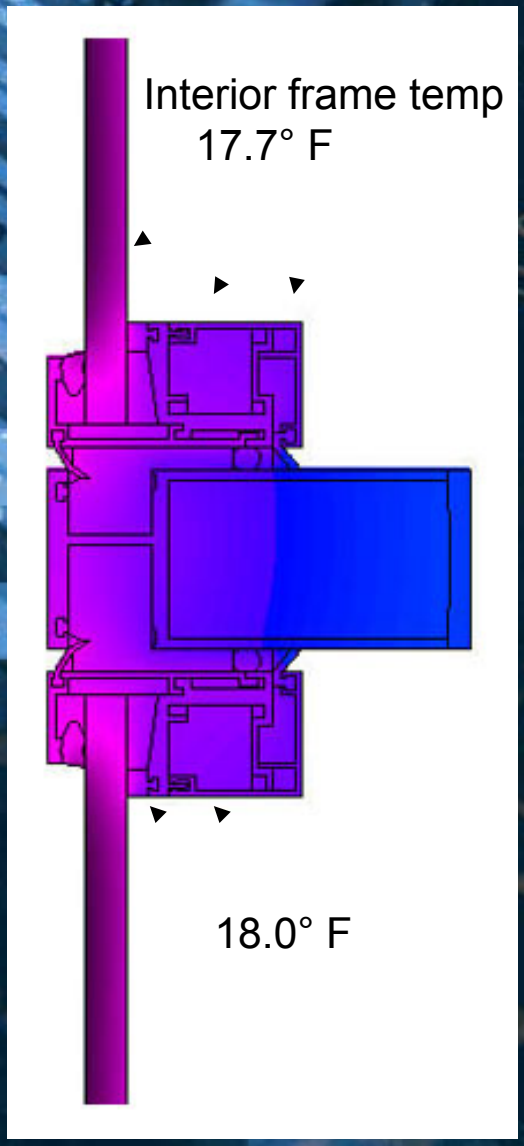
Triple Glazed

- 3/16” Lami x ½” x 3/16” x ½” x 3/16”
- Low-e #4 & #6
- Argon
- Stainless

Pour & Debridge Thermal Barrier

U VALUE = .22

Current

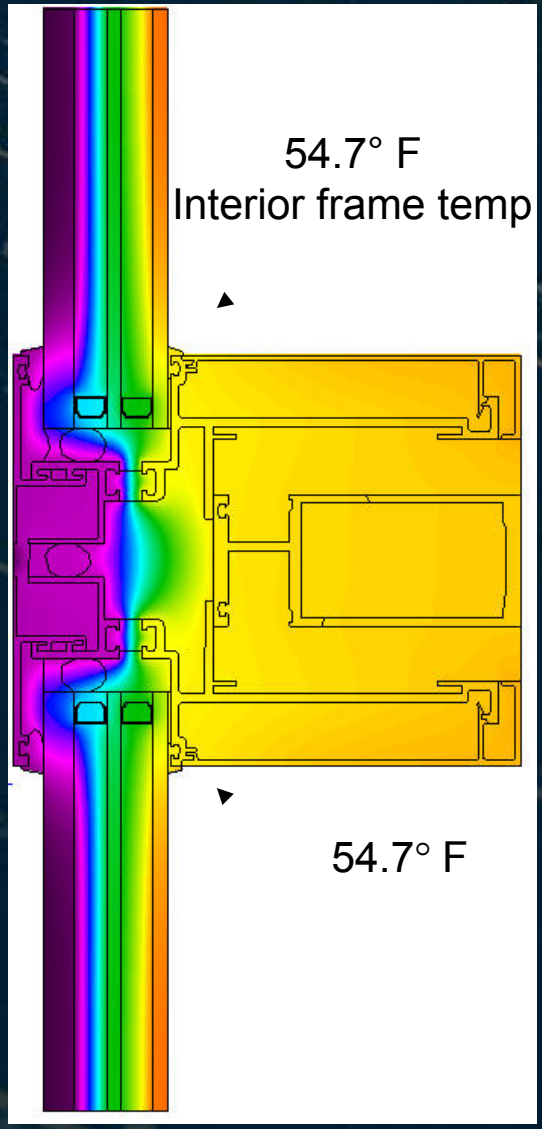


WINTER

EXTERIOR TEMP. = -5 °F

INTERIOR TEMP = 70 °F

New



The Willis Tower
Modernization Project

- Reduced electricity usage by 80%
- Savings of 150,000 barrels of oil per year
- Savings of 60% of heating energy
  - Equivalent to planting 6 million trees
  - Or removing 13,200 cars per year
  - Or powering 10,000 homes
- Eliminates 72 million pounds of carbon dioxide

- www.willistower.com/icon

CASE STUDY

Hyundai-Kia Automotive Group

World headquarters • Seoul, Korea

First building completed in 2000 with polyamide thermal barrier, aluminum spacer, clear IGU (26,530 m²)

Second building planning began in 2005 with pour and debridge thermal barrier, warm-edge spacer and low-E IGU (43,194m²)

Annual heating and cooling savings $91,000+

CASE STUDY

High solar heat gain requirement

Goal was increased daylighting

Warm-edge spacer provided improved overall U-factor while using medium performance low-E product

Improved condensation resistance

Improved building performance and occupant comfort

Shady Grove Adventist Hospital

Rockville, Md.

CASE STUDY

Structural glazing — minimal sightlines

Living Shangri-La

Tallest building in Vancouver

Architect: James K.M Cheng

Glass Fabricator: Garibaldi Inc.

Construction 2005-2008

Four-sided, structural-glazed fenestration

Stringent building code

Improved sightline temperature

Warm-edge offered 5 degrees higher edge temperature than stainless steel type spacer

CASE STUDY

Wausau Window and Wall Systems HQ

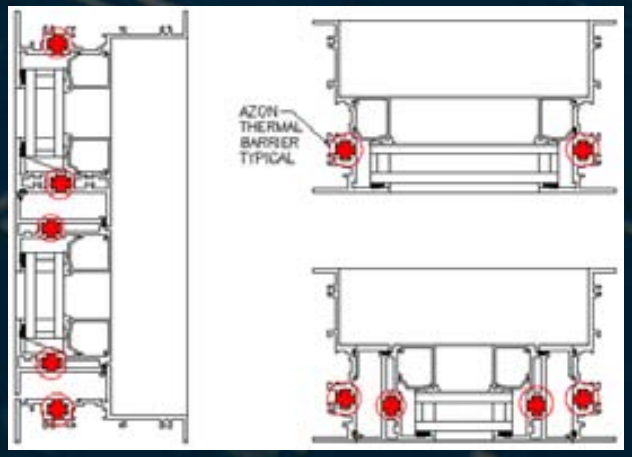
"Thermal barriers provide condensation resistance at expected relative humidity levels, and reduce conductive heat loss"

LEED® Silver Certification*

Polyurethane thermal barrier chosen for windows

Higher recycled content, aluminum framing material

Manufacturer: Wausau Window and Wall Systems



*The LEED® (*Leadership in Energy and Environmental Design*) Green Building Rating System

CASE STUDY

Cradle to Cradle^{sm}

Dormitory, 5-stories

Holy Family University, Philadelphia, Pa.

Architect: Metro Architects, Narberth, Pa.

Gen. Contractor: TN Ward, Ardmore, Pa.

Glazing Contractor - U.S. Plate and Mirror

CERTIFIED cradle to cradle SILVER

Manufacturer: YKK AP

CASE STUDY

Museum of Modern Art

New York, N.Y.

Project Type: Renovation

Architect: Kohn, Pederson & Fox

Warm-edge spacer

Completed: 2005

Overall sightline CRF (condensation resistance factor) improved 22.1% by using warm-edge spacer versus standard metal spacer

Fabricator: J.E. Berkowitz

CASE STUDY

The Elysian

11 East Walton Street, Chicago, Ill.

Construction start: 2006

Construction finish: 2009

60-stories

Architect: Lucien Lagrange

Developer: Elysian Development

Maximum Height: 700 feet

Mechanical lock, lanced method

Qualifies for 10-year warranty

Manufacturer: Kawneer

CASE STUDY

Energy savings

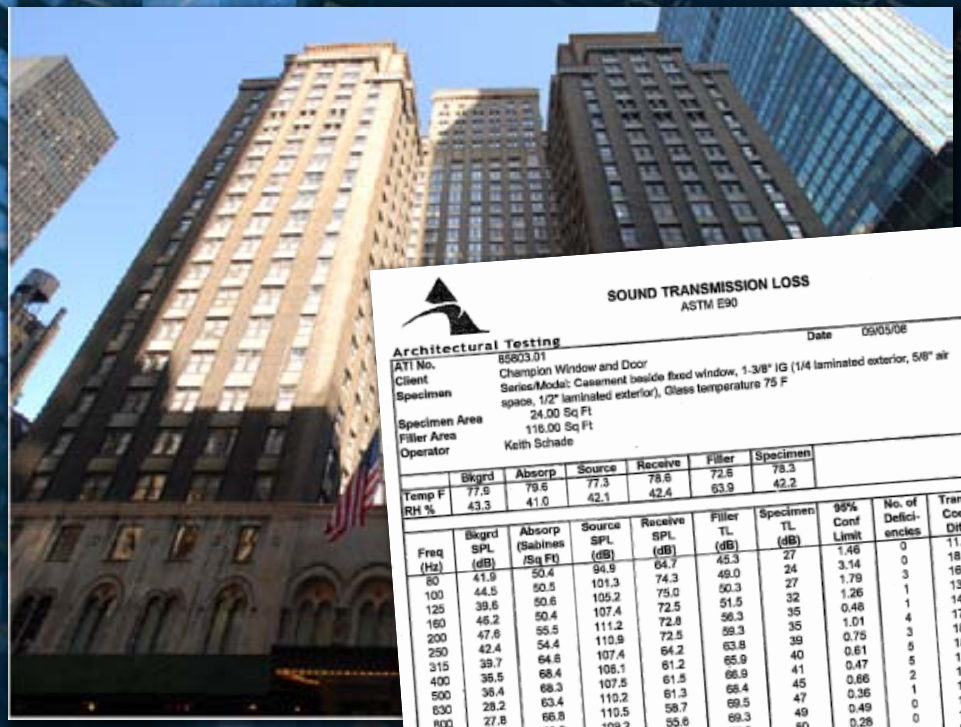
For the Empire State Building, we used a computer program to calculate the savings in heating and cooling costs with the polyurethane system versus the non-thermal barrier windows.

(102 stories with 6,400 windows)

Manufacturer: TRACO

Original steel windows, single glaze		**$1,000,000/yr**
New, TR-9000 windows with polyurethane thermal barrier		**$ 222,230/yr**
ENERGY SAVINGS	►	**>$ 777,770/yr**
Lifespan (30 years)	►	**>$23,000,000**

Sound control



PARK CENTRAL
New York

SOUND TRANSMISSION LOSS
ASTM E90

Architectural Testing — Date 09/05/08

ATI No.	85803.01
Client	Champion Window and Door
Specimen	Series/Model: Casement beside fixed window, 1-3/8" IG (1/4 laminated exterior, 5/8" air space, 1/2" laminated exterior). Glass temperature 75 F
Specimen Area	24.00 Sq Ft
Filler Area	116.00 Sq Ft
Operator	Keith Schade

	Bkgrd	Absorp	Source	Receive	Filler	Specimen
Temp F	77.6	79.8	77.3	78.6	72.6	78.3
RH %	43.3	41.0	42.1	42.4	63.9	42.2

Freq (Hz)	Bkgrd SPL (dB)	Absorp (Sabines /Sq Ft)	Source SPL (dB)	Receive SPL (dB)	Filler TL (dB)	Specimen TL (dB)	95% Conf Limit	No. of Defici-encies	Trans Coef Diff
80	41.9	50.4	94.9	64.7	45.3	27	1.46	0	11.5
100	44.5	50.5	101.3	74.3	49.0	24	3.14	0	18.4
125	39.6	50.6	105.2	75.0	50.3	27	1.79	3	16.5
160	45.2	50.4	107.4	72.5	51.5	32	1.26	1	13.0
200	47.6	55.5	111.2	72.8	56.3	35	0.48	1	14.7
250	42.4	54.4	110.9	72.5	59.3	35	1.01	4	17.6
315	39.7	64.8	107.4	64.2	63.8	39	0.75	3	18.0
400	35.5	68.4	108.1	61.2	65.9	40	0.61	5	18.7
500	36.4	68.3	107.5	61.5	66.9	41	0.47	5	18.6
630	28.2	63.4	110.2	61.3	68.4	45	0.66	2	16.8
800	27.8	66.8	110.5	58.7	69.5	47	0.36	1	15.3
1000	26.2	69.3	109.2	55.6	69.3	49	0.49	0	13.5
1250	26.6	75.0	111.1	56.1	76.3	50	0.28	0	19.5
1600	22.5	77.0	115.3	60.5	80.4	50	0.26	0	23.8
2000	16.1	82.9	107.2	51.2	78.1	51	0.20	0	20.7
2500	9.3	94.5	104.3	46.1	76.7	52	0.31	0	17.7
3150	8.6	107.9	104.3	44.2	79.9	54	0.41	0	19.5
4000	7.5	130.1	101.8	39.9	81.6	55	0.21	0	20.2
5000	7.7	166.2	98.1	32.5	81.2	57	0.37	0	17.2

STC Rating = 46 (Sound Transmission Class)
Deficiencies = 25 (Number of deficiencies versus contour curve)
OITC Rating = 36 (Outdoor/Indoor Transmission Class)

Fenestration system components affect outdoor-indoor sound transmission in the exterior wall

Sound transmission OITC (Outdoor Indoor Transmission Class)

Manufacturer: Champion Window and Door

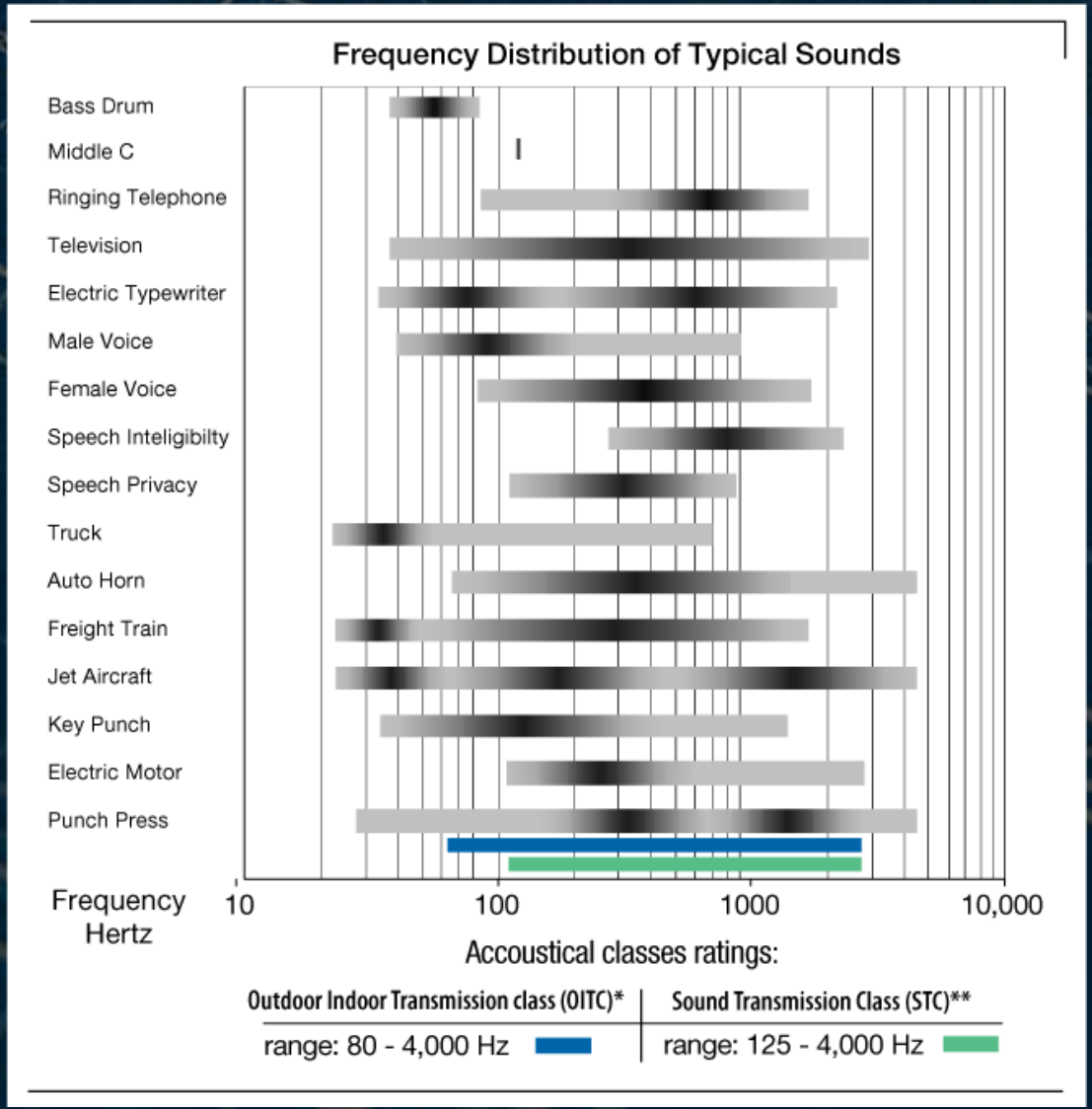
Sound control

Glazing variations affecting acoustics

- type of air spacer
- glass thickness
- air space dimension)
- dual or triple glazing
- physical dimension of window (or glass)
- air infiltration
- glass type (annealed or laminated)

*ASTM E 1332 **ASTM E 413

Typical noise spectrums



Condensation resistance — large glass spans

Zankel Music Center - Skidmore College

- Saratoga Springs, New York
- Triple insulating glass units weighing 12 lbs/ft
- Large size units for outdoor view
- Condensation resistance factor 81
- Overall U-factor improvement

H. INSULATING LAMINATED GLASS UNIT 1 (IG-1): Insulating Glass with laminated interior lite fabricated in accordance with ASTM C 1172, ASTM E 773, and E 774. Insulating Glass units are certified through the Insulating Glass Certification ASTM E2190 (class "CBA") or to ASTM E2188. Provide safety glazing as required by the Safety Glazing section of IBC. is one interlayer product

Insulating Glass Unit Makeup:

a. Outboard Lite

1. Glass Type: Guardian Sun-Guard SN-68
2. Glass Tint: Clear
3. Nominal Glass Thickness: ¼"
4. Glass Strength: (Annealed, Heat-Strengthened, Tempered, Heat Soak)
5. Low-E Coating Orientation, Surface # 2

b. Airspace

1. Nominal Thickness: 7/16:
2. Thermally-Broken Aluminum , Azon Warm Edge,

On Line Gas Fill: 90 %Argon

c. Second Lite

1. Glass Type: Guardian Sun-Guard SN-68
2. Glass Tint: Clear
3. Nominal Glass Thickness: ¼"
4. Glass Strength: (Annealed, Heat-Strengthened, Tempered, Heat Soak)
5. Reflective Low-E Coating Orientation: Surface # 4

d. Airspace

1. Nominal Thickness: 7/16":
2. Thermally-Broken Aluminum , **Azon Warm Edge**,

On Line Gas Fill: 90 %Argon

e. Laminated Third Lite (LG)

1. Glass Type: Guardian Clear
2. Glass Tint: Clear
3. Nominal Glass Thickness: ¼"
4. Glass Strength: (Annealed, Heat-Strengthened, Tempered, Heat Soak)
5. Laminate: Monsanto's *Saflex* polyvinyl butyral plastic (PVB) 0.060 Clear
6. Glass Type: Guardian Clear
7. Glass Tint: Clear
8. Nominal Glass Thickness: ¼"
9. Glass Strength: (Annealed, Heat-Strengthened, Tempered, Heat Soak)

Performance Characteristics (Center of Glass):

a. Visible Transmittance 50 %
b. Visible Reflectance (in) 12 %
c. Visible Reflectance (out) 13 %
d. Solar Energy % transmittance 19 %
e. Solar Energy % Reflectance Out 31 %
f. Winter U-value: 0.12
g. Shading Coefficient (SC): 0.33
h. Solar Heat Gain Coefficient (SHGC): 0.283
i. Relative Heat Gain: 68
j. Condensation Resistance Factor 81

3. Provide hermetically sealed IG units with dehydrated airspace, dual air seal of black polyisobutelyene (PIB), and a secondary seal of black silicone.

CASE STUDY

Blast hazard mitigation

MacDill Air force base in Tampa Florida

Schoefield Army barracks Oahu Hawaii

Manufacturer: Graham Architectural Products

Heritage building preservation

Historic Project

Two Mellon Bank

(Union Trust Building)

Pittsburgh, PA

Project Details: 1,345 windows
Model: TR-9000 (DH)
TR-9500 (SH)
TR-10,000 (Dual Action)
TR-10,500 (Fixed)
TR-7000 (Fixed)

Finish/Color: Saturian grey Duranar xl paint finish

Description of Project: Flemish gothic structure. Historic panning and curves also used to compliment exterior. This building is listed in the National Register of Historic places.

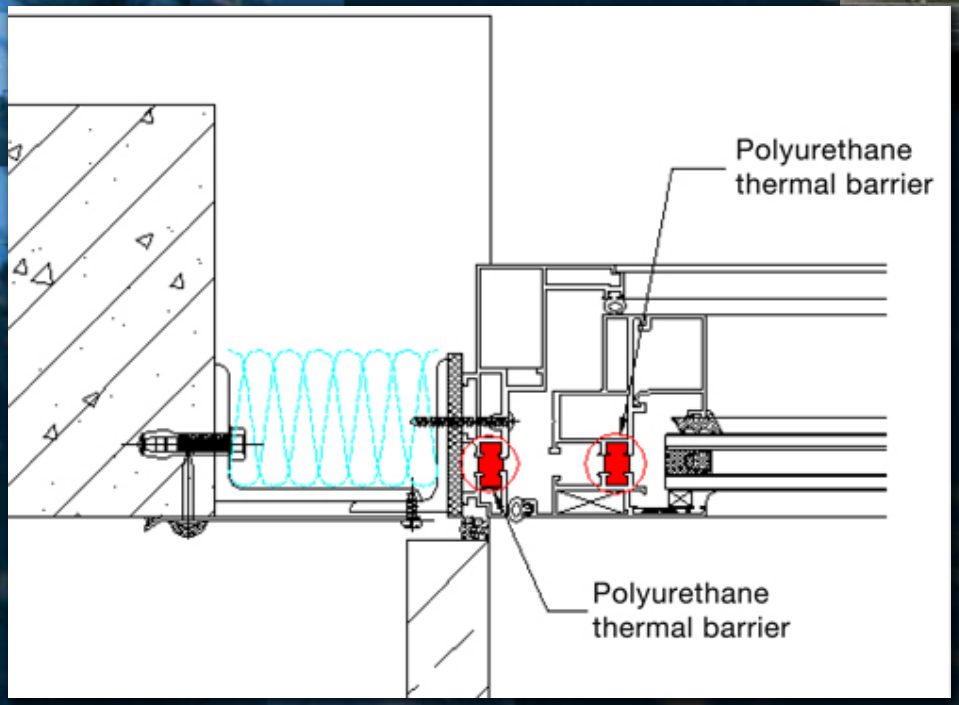
Manufacturer: TRACO

Manufacturer: Graham Architectural Products

Historical: Park Central Hotel
St. Louis, Mo.
Series 2000 / 2200 / 7000

In North America 80% of the thermal barrier projects use pour and debridge

Government office



Chinese Public Security Bureau
(Chinese FBI)
Beijing – Tieneman Square

Window Supplier – Beijing NanLong Window Co.

Grand scale

Songdo IBD
A GALE INTERNATIONAL & POSCO E&C PROJECT

Master Plan

New Songdo City - Incheon, Korea

New Songdo City

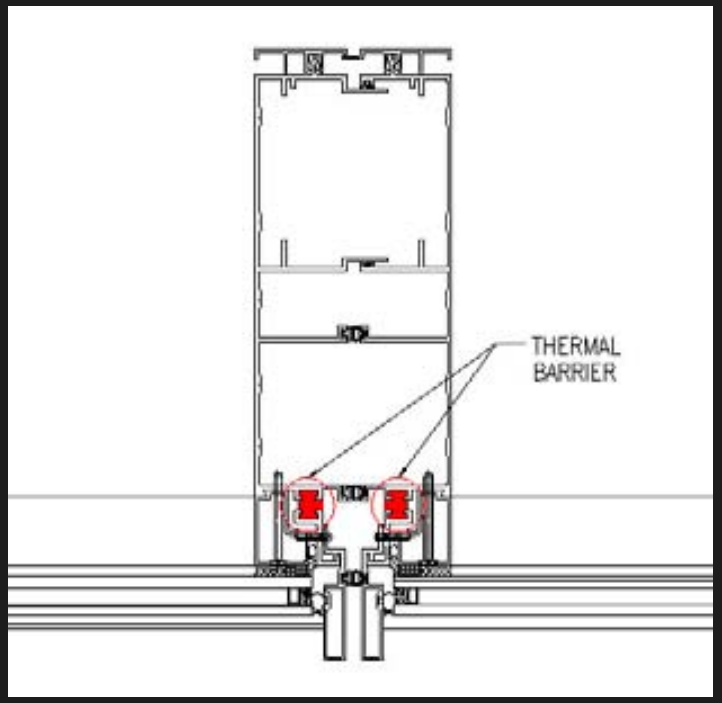
Project Overview

- Located 40 miles southwest of Seoul
- Built on 1,500 acres of reclaimed land
- Estimated cost: $25 billion
- Largest privately developed project ever undertaken anywhere in the world
- Master Plan by world-renowned architects Kohn Pederson Fox
- Urban *Energy Smart* development, destined to be environmentally sustainable
- One hundred twenty of the buildings, including the Northeast Asia Trade Tower Building (NEATT), are registered for LEED® certification
- Project is scheduled for completion in 2014

Registered for LEED®

Songdo IBD
A GALE INTERNATIONAL & POSCO E&C PROJECT

New Songdo City - Incheon, Korea



Northeast Asia Trade Tower (NEATT)

Office, hotel and shopping.
67 floors – 984 feet

Aluminum curtain wall using pour and debridge technology

Completion date - 2010

*The LEED® (*Leadership in Energy and Environmental Design*) Green Building Rating System

1st World Towers

New Songdo City - Incheon, Korea

First residential block to be completed for project.

Covers 125 Acres

Aluminum curtain wall using pour and debridge technology

Warm-edge spacer

The Central Park

Songdo IBD
A GALE INTERNATIONAL & POSCO E&C PROJECT

New Songdo City - Incheon, Korea

Office, hotel and shopping located adjacent to Central Park with three, 47-story buildings (designed like Central Park in New York)

Aluminum curtain wall using pour and debridge technology

Warm-edge spacer

Outcomes

Participants in this continuing education program have learned about the benefits of:

1. Thermal barriers for aluminum window framing
2. Warm-edge spacer technology for insulating glass

Conclusion

Thermal barrier aluminum fenestration and structural warm-edge insulating glass spacers improve the overall U-factor, condensation resistance factor (CRF), sound transmission OITC (Outdoor Indoor Transmission Class), and qualify for performance points toward LEED® certification and other green benchmarks, such as Cradle to Cradle^{sm} .

Leed® contribution of Azon fenestration products

Azon and LEED® Certification

Our main purpose is to provide high-performance fenestration components that meet our customers' sustainability goals and expectations.

LEED® contribution	Azon thermal barrier	Warm-Light® By Azon
Energy & Atmosphere		
EA Credit 1: Optimize Energy Performance (1-10 points; 2 points required)	√	√
Materials & Resources		
MR Credit 3.1: Materials Reuse, 5% (1 point)		√
MR Credit 3.2: Materials Reuse, 10% (1 point)		√
MR Credit 4.1: Recycled Content, 10% (post-consumer + 1/2 pre-consumer) (1 point)		√
MR Credit 4.2: Recycled Content, 20% (post-consumer + 1/2 pre-consumer) (1 point)		√
MR Credit 5.1: Regional Materials, 10% Extracted, Processed & Manufactured Regionally (1 point)	√	
MR Credit 5.2: Regional Materials, 20% Extracted, Processed & Manufactured Regionally (1 point)	√	
Indoor Environmental Quality		
EQ Credit 7.1: Thermal Comfort, Design (1 point)	√	√

*Credits are taken from the *Green Building Rating System For New Construction & Major Renovations Version 2.2.*

Thank you for your time!

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This concludes the American Institute of Architects Continuing Education Systems Program