

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

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## ***REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY***

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## REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

### SECTION 08100 – METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.

##### 1.2 SYSTEM DESCRIPTION

- A. [Aluminum] [Steel] [Glazing panel] doors installed to maintain specified thermal performance.

##### 1.3 SUBMITTALS

###### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

##### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

##### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Description: [Insulated] metal doors.
- B. Performance Requirements:
  1. All opaque doors, including swinging doors and non-swinging doors shall have the following thermal performance criteria. (*Note 1.1*).
    - a. U-factor for metal non-swinging doors shall not be greater than 1.45 (Btu/hr. sq. ft. °F)
    - b. U-factor for metal swinging doors, including fire-rated doors, insulated access hatches, and insulated smoke vents shall not be greater than 0.50 (Btu/hr. sq. ft. °F).
  2. Swinging doors shall have an insulated core. (*Note 1.2*)

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- C. Recycled Content: *(Note 1.3)*
  - 1. Aluminum doors: Minimum 75% post-consumer recycled content.
  - 2. Steel doors: Minimum 17% post-consumer recycled content, 35% total recycled content.
- D. Door: [Steel] [Aluminum]
  - 1. All joints shall be continuously welded to create a smooth unbroken surface. *(Note 1.4)*
  - 2. All points of contact between the operable and non-operable components of the door shall be weatherstripped. If weatherstripping is not used, the edge shall be welded using laser technology. *(Note 1.5)*
  - 3. Door frame shall have continuous thermal break between the interior and exterior surfaces. *(Note 1.6)*
  - 4. Thermally broken sections shall not be assembled by means of screws or other fasteners. *(Note 1.7)*
  - 5. Where thermally broken welded frame product is specified, welds shall not cause thermal transfers between exterior and interior surfaces. *(Note 1.7)*
- E. Finish and primer:
  - 1. Refer to Section 01350 – Special Environmental Requirements.
  - 2. Refer to Section 9910 – Paints.
- F. Recyclability: Project goal is to provide products that are installed and maintained to ensure reusability.

### **2.2 SOURCE QUALITY CONTROL**

- A. Indoor Air Quality Issues:
  - 1. Doors shall be shop primed and finished. *(Note 1.8)*
  - 2. For touch-up in field refer to Section 01350 – Special Environmental Requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Product shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination shall be rejected. *(Note 1.9)*
- B. Gaskets with gaps or other visible installation irregularities on door units that are delivered to site shall be corrected by manufacturer. *(Note 1.9)*
- C. Examine door frame opening before product is installed to verify that they are installed plumb, true and level. *(Note 1.10)*
- D. Wall space around the frame shall be filled with batt insulation. *(Note 1.11)*

### **3.2 INSTALLATION**

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.10)*

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- B. [Vinyl] nailing fins shall be used on clad doors, and on frame exterior to form a weather tight perimeter. *(Note 1.5)*
- C. Door seal members shall be set in a bed of sealant to provide weather tight conditions. *(Note 1.5)*

3.3 CLEANING

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

## SECTION 08100 – METAL DOORS AND FRAMES – NOTES

## JUSTIFICATION

- 1.1 Doors specified in this section ensure that the thermal performance specified in ASHRAE standard 90.1 - 2001 are met. Doors with low thermal transmittance (u-factor) lower energy consumption in a building.
- All opaque doors with U-factors determined, certified, and labeled in accordance with NFRC 100 as specified in 5.2.2 shall be assigned those U-factors. Unlabeled opaque doors shall be assigned the following U-factors:
- a. Uninsulated single-layer metal swinging doors or non-swinging doors, including single-layer uninsulated access hatches and uninsulated smoke vents: 1.45.
  - b. Uninsulated double-layer metal swinging doors or non-swinging doors, including double-layer uninsulated access hatches and uninsulated smoke vents: 0.70.
  - c. Insulated metal swinging doors, including fire-rated doors, insulated access hatches, and insulated smoke vents: 0.50.
  - d. No credit shall be given for any other features, including thermal breaks in metal door slabs (the operable part of the door) or frames, other than as determined in accordance with 5.2.2.
- 1.2 Metal doors would typically have higher thermal transmittance than wood. Metal doors with insulated cores have better energy performance than many wood doors, resulting in long-term energy benefits.
- 1.3 Manufacturing process for metal products is energy intensive. Recycled content saves resources and lowers energy consumed during production. Sheet steel from Nucor has up to 75% post-consumer recycled content.
- 1.4 Having an unbroken seam is critical in eliminating air/moisture penetration into the insulating core. A smooth precise edge ensures a tight fit between the door panel and the frame, minimizing energy loss through air infiltration between the outside and the inside when the door is closed.
- 1.5 Reducing air infiltration reduces heating and cooling energy. Weather stripping or using sealants ensures a weather tight system. The laser weld does not use filler material and is more uniform. It also ensures the most precise edge in the market. Both these factors ensure that there is minimal energy loss through infiltration. The laser edge does not use any grinding and stays stronger for a longer period of time, which maximizes the usability of the product.
- 1.6 Metal frames have high conductance. Thermal breaks reduce energy consumption by reducing thermal conduction between the interior and exterior surfaces.
- 1.7 Fastening screws or using other conductive fasteners form thermal bridges and increase thermal conduction between the indoor and outdoor.
- 1.8 Field painting is not desirable due to indoor air quality issues.
- 1.9 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. Moisture penetration into the insulation core will reduce thermal

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performance of the assembly. Both these factors will contribute to increase in heating and cooling energy.

- 1.10 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration
- 1.11 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and door.

**APPLICABILITY**

- 2.1 Metal doors installed in commercial buildings.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Steel doors and frames by Amweld Building Products, Inc. <http://www.amweld.com/>
- 4.2 Steel doors and frames by S. W. Fleming Limited. <http://www.flemingdoor.com/>
- 4.3 Insulated steel doors by Loewen Windows
- 4.4 Insulated steel doors by Castlegate , Inc.
- 4.5 Insulated steel doors by Ducana Windows & Doors Ltd. <http://www.ducana.com/>
- 4.6 Insulated steel doors by Ambico Ltd. <http://www.doors-ambico.com/>

**REFERENCES FOR MORE INFORMATION**

- 5.1 ASHRAE/IESNA. 2001. Standard 90.1 – 2001. ASHRAE. (Recommended U-factors for door assemblies).
- 5.6 Malin, Nadav. 1994. Environmental Building News. Vol. 3. Number 4. pp. 14-17. (Recycled content).
- 5.7 <http://www.afsonl.com/products>. (Building product information).

**RELATED SPECIFICATION SECTIONS**

- 6.1 08810 Glass (Use only if door has a glass panel)
- 6.2 08200 Wood and Plastic doors
- 6.3 08331 Overhead Coiling doors

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## **SECTION 08200 – WOOD DOORS**

### **PART 1 - GENERAL**

#### **1.1 DEFINITIONS**

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft °F.

#### **1.2 SYSTEM DESCRIPTION**

- A. Provide [wood] [MDF] doors installed to maintain the specified thermal performance.

#### **1.3 SUBMITTALS**

##### **A. SPECIAL ENVIRONMENTAL REQUIREMENTS**

Submit the following in accordance with the requirements of Section 01350:

1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, Forest-Stewardship Council-certified sustainable harvested wood products, and product recyclability.  
Resource efficient product data:
2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.
3. Indoor Air Quality: Submit Material Safety Data Sheets (MSDS) and emission test data. For doors where the finish material is installed over a substrate, either with or without the use of adhesives, individual components shall be tested separately. If all components meet the criteria established in Section 01350, no further testing shall be required. If one or more of the components of a system does not meet the criteria, the material may be tested again as an assembly. If this option to re-test is selected, then the specimen preparation must be constructed following manufacturer's recommended procedures for application of wet components and assembly of the system. If there is a difference between the manufacturer's recommended procedures and procedures required by the project specifications, request clarification from the Architect.

#### **1.4 QUALITY ASSURANCE**

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Keep certified wood products separate from non-certified wood products, for auditing purposes (as mandated by the certifier).
- B. Keep wood products dry.
- C. Refer to Section 01350 – Special Environmental Requirements.
- D. Refer to Section 01565 – Site Waste Management Program.

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### 1.6 SITE CONDITIONS

- A. Keep wood products dry.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Description: Opaque [wood] [composite] doors.
- B. Performance Requirements:
  - 1. All opaque doors, including swinging doors and non-swinging doors shall have the following thermal performance criteria. *(Note 1.1)*.
    - a. U-factor for non-swinging doors shall not be greater than 1.45 (Btu/hr. sq. ft. °F)
    - b. U-factor for wood swinging doors, including fire-rated doors, insulated access hatches, and insulated smoke vents shall not be greater than 0.50 (Btu/hr. sq. ft. °F).
- C. Indoor Air Quality Criteria:
  - 1. Use products with low-VOC sealers and adhesives. *(Note 1.3)*
  - 2. Only low odor/low-VOC-emitting core boards, composite wood products, and MDF shall be used on the project. No exposed particleboard will be allowed. *(Note 1.3)*
- D. Recycled Content: *(Note 1.4)*
  - 1. MDF doors: Minimum 94% total recycled content, at least 10% of which shall be post-consumer recycled content.
- E. All points of contact between the operable and non-operable components of the door shall be weatherstripped. *(Note 1.5)*
- F. Wood Door and Frame
  - 1. Use FSC-certified sustainably harvested woods from well-managed forests. *(Note 1.6)*
  - 2. Shall not contain particleboard.
  - 3. Use core board, composite wood products, and MDF.
- G. MDF Door
  - 1. Provide FSC-certified MDF where possible. *(Note 1.6)*
- H. Frame: [Wood]
  - 1. Cladding [Optional]: Frames with aluminum cladding shall be of premium grade tempered aluminum.
    - a. Cladding shall be mitered at the head corners
    - b. Cladding shall be durable and weather-tight.
    - c. Aluminum shall be [anodized] or have [polyvinylidene flouride] [siliconized polyester] finish.
- I. Finish: [Specify] [Paint] [Fiberglass Face Sheet] [Wood veneer]:
  - 1. Paint and primer:
    - a. Refer to Section 01350 – Special Environmental Requirements.

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- b. Refer to Section 9910 – Paints.
  - 2. Wood veneer:
    - a. Use FSC-certified sustainably harvested wood from well-managed forests. *(Note 1.6)*
    - b. Veneer shall be manufactured in a facility approved by an agency accredited by the Forest Stewardship Council.
  - J. Recyclability:
    - 1. Project goal is to provide products that are installed and maintained to ensure reusability.
    - 2. MDF shall be recyclable.
- 2.2 SOURCE QUALITY CONTROL
- A. Indoor Air Quality Issues:
    - 1. Doors shall be shop primed and finished. *(Note 1.7)*
    - 2. For touch-up in field refer to Section 01350 – Special Environmental Requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Product shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation shall be rejected. *(Note 1.8)*
- B. Gaskets with gaps or other visible installation irregularities on door units that are delivered to site shall be corrected by manufacturer. *(Note 1.8)*
- C. Examine all door frames opening before product is installed to verify that they are installed plumb, true and level. *(Note 1.9)*
- D. Wall space around the frame shall be filled with pieces of batt insulation. *(Note 1.10)*

### **3.2 INSTALLATION**

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.9)*
- B. [Vinyl] nailing fins shall be used on clad doors, and on frame exterior to form a weather tight perimeter. *(Note 1.5)*
- C. Door seal members shall be set in a bed of sealant to provide weather tight conditions. *(Note 1.5)*

### **3.3 CLEANING**

- A. Final cleaning shall be as described in Section 01350.
- B. Remove and recycle excess material as required by the site waste management program, Section 01565.

**END OF SECTION**

**SECTION 08200 – WOOD DOORS – NOTES****JUSTIFICATION**

- 1.1 Doors specified in this section ensure that the thermal performance specified in ASHRAE standard 90.1 - 2001 are met. Doors with low thermal transmittance (U-factor) lower energy consumption in a building.

All *opaque doors* with *U-factors* determined, certified, and labeled in accordance with NFRC 100 as specified in 5.2.2 shall be assigned those *U-factors*.

*Unlabeled opaque doors* shall be assigned the following *U-factors*:

- a. *Wood doors*, minimum nominal thickness of 1 3/4 in., including panel *doors* with minimum panel thickness of 1 1/8 in., solid core flush *doors*, and hollow core flush *doors*: 0.50.
  - b. Any other wood *door*: 0.60.
  - c. No credit shall be given for any other features, including thermal breaks in metal door slabs (the operable part of the door) or frames, other than as determined in accordance with 5.2.2.
- 1.2 Wood doors have lower thermal transmittance than metal doors and would typically consume less energy than uninsulated metal doors.
- 1.3 Low VOC products have a lower impact on indoor air quality.
- 1.4 Recycled content saves resources and lowers energy consumed during production.
- 1.5 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system.
- 1.6 Wooden doors theoretically use a renewable source when they are sourced from a well-managed forest and have low embodied energy. Wood products that are not sourced from well-managed forests have a huge environmental impact. Assemblies made from salvaged wood also conserve resources.
- 1.7 Field painting is not desirable due to indoor air quality issues.
- 1.8 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. This will contribute to increase in heating and cooling energy.
- 1.9 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration.
- 1.10 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and door.

**APPLICABILITY**

- 2.1 Exterior and interior application of wood doors in commercial buildings.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Energy Efficient Doors by Andersen Windows, Inc.

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<http://commercial.andersenwindows.com>

- 4.2 Caridon Peachtree Doors and Windows, Inc.
- 4.3 “Elite Exterior” by Jeld-Wen. <http://www.JELD-WEN.com/>
- 4.4 Resource efficient glazed wood doors by Norco Window Company. <http://www.norcomfg.com/>
- 4.5 Ecocolors (Agriculture fiber waste board ) by Architectural Forest Enterprises Inc. <http://www.ecoforest.com>
- 4.6 Reuse and total recycling systems by Urban Ore, Inc. Berkeley, CA
- 4.7 “Renewal” program for retrofitting existing buildings and reusing old materials by Andersen Windows, Inc. <http://www.renewalbyandersen.com/flash/index.html>

**REFERENCES FOR MORE INFORMATION**

- 5.1 <http://www.afsonl.com/products>. (Building product information).

**RELATED SPECIFICATION SECTIONS**

- 6.1 06070 – Wood Treatment
- 6.2 06080 – Factory Applied wood coating
- 6.3 08100 – Metal doors and Frames
- 6.4 08810 – Glass

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### SECTION 08331 – OVERHEAD COILING DOORS

#### PART 1 - GENERAL

##### 1.1 SYSTEM DESCRIPTION

- A. Provide [steel] [aluminum] overhead coiling doors and frame, which have installed to maintain the specified thermal performance. *(Note 1.1)*

##### 1.2 SUBMITTALS

###### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

##### 1.3 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Description: [Insulated] overhead doors.

1. U-factor shall not be greater than 1.45 (Btu/hr. sq. ft. °F). *(Note 1.1)*

- B. Doors shall have an insulated core. *(Note 1.2)*

- C. Recycled Content: *(Note 1.3)*

1. Aluminum doors: Minimum 75% post-consumer recycled content.
2. Steel doors: Minimum 17% post-consumer recycled content, 35% total recycled content.

- D. Door: [Steel] [Aluminum]

1. The perimeter shall have a continuous weather strip. *(Note 1.4)*
2. Metal doors shall have continuous thermal break between the interior and exterior surfaces. *(Note 1.5)*
3. Thermally broken sections shall not be assembled by means of screws or other fasteners. *(Note 1.6)*

- E. Finish and primer:

1. Refer to Section 01350 – Special Environmental Requirements.

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2. Refer to Section 9910 – Paints.
  - F. Recyclability: Project goal is to provide products that are installed and maintained to ensure reusability.
- 2.2 SOURCE QUALITY CONTROL
- A. Indoor Air Quality Issues:
    1. Doors shall be shop primed and finished. *(Note 1.7)*
    2. For touch-up in field refer to Section 01350 – Special Environmental Requirements.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Product shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination shall be rejected. *(Note 1.8)*
- B. Gaskets with gaps or other visible installation irregularities on door units that are delivered to site shall be corrected by manufacturer. *(Note 1.8)*
- C. Examine all door frames opening before product is installed to verify that they are installed plumb, true and level. *(Note 1.9)*
- D. Wall space around the frame shall be filled with batt insulation. *(Note 1.10)*

#### 3.2 INSTALLATION

- A. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.9)*
- B. Door seal members shall be set in a bed of sealant to provide weather tight conditions. *(Note 1.4)*

#### 3.3 CLEANING

- A. Final cleaning shall be as described in Section 01350.
- B. Remove and recycle excess material as required by the site waste management program, Section 01565.

**END OF SECTION**

## SECTION 08331 – OVERHEAD COILING DOORS – NOTES

## JUSTIFICATION

1.1 Doors specified in this section ensure that the thermal performance specified in ASHRAE standard 90.1 - 2001 are met. Doors with low thermal transmittance (u-factor) lower energy consumption in a building.

All *opaque doors* with *U-factors* determined, certified, and labeled in accordance with NFRC 100 as specified in 5.2.2 shall be assigned those *U-factors*. *Unlabeled opaque doors* shall be assigned the following *U-factors*:

- a. Uninsulated single-layer metal *non-swinging doors*: 1.45
  - b. Uninsulated double-layer metal *non-swinging doors*: 0.70
  - c. No credit shall be given for any other features, including thermal breaks in metal door slabs (the operable part of the door) or frames, other than as determined in accordance with 5.2.2.
- 1.2 Metal doors typically have higher thermal transmittance than wood. Metal doors with insulated cores have better energy performance than many wood doors, resulting in long-term energy benefits.
- 1.3 Manufacturing process for metal products is energy intensive. Recycled content saves resources, lowers energy consumed during production.
- 1.4 Reducing air infiltration reduces heating and cooling energy. Weather stripping or using sealants ensures a weather tight system.
- 1.5 Metal frames have high thermal conductivity. Thermal breaks reduce energy consumption by reducing thermal conductance between the interior and exterior surfaces.
- 1.6 Fastening screws or using other conductive fasteners form thermal bridges and increase thermal exchange between the indoor and outdoor.
- 1.7 Field painting is not desirable due to indoor air quality related issues.
- 1.8 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. Moisture penetration into the insulation core will reduce thermal performance of the assembly. Both these factors will contribute to increase in heating and cooling energy.
- 1.9 Checking that the door frame opening is set plumb and the frame is installed plumb and level will ensure a tight fit and reduce air infiltration.
- 1.10 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and door.

## APPLICABILITY

## COST IMPACT

## EXAMPLE PRODUCTS AND MANUFACTURERS

- 4.1 Insulated Overhead Steel doors by Overhead Doors.  
<http://www.overheaddoor.com/>

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- 4.2 Thermacore Insulated doors by Overhead Doors. <http://www.overheaddoor.com/>  
4.3 Insulated Overhead doors by Armalite. <http://www.armrlite.com/>

**REFERENCES FOR MORE INFORMATION****RELATED SPECIFICATION SECTIONS**

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08410 – METAL-FRAMED STOREFRONTS

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.
- C. Visible Light Transmittance ( $T_{VIS}$ ): Percentage of incident light energy transmitted by glazing.

#### 1.2 SYSTEM DESCRIPTION

- A. Metal-framed storefront assembly installed to maintain specified thermal performance.

#### 1.3 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

- 1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
- 2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

#### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: Metal-framed storefront wall with [insulated] glass. (*Note 1.2*)
- B. Performance criteria:
  - 1. Metal framed storefront assembly (including glass and frame): U-factor shall be rated, certified and labeled in accordance with NFRC 100.

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- a. U-factor of storefront assembly shall not be greater than \_\_\_\_ (Btu/hr. sq. ft. °F). *(Note 1.3)*
  2. Metal framed storefront assembly (including glass, sash and frame): SHGC shall be rated, certified and labeled in accordance with NFRC 200.
    - a. Storefront assembly shall have a solar heat gain coefficient equal to or less than \_\_\_\_\_. *(Note 1.4)*
  3. Glass: Visible light transmittance shall be rated, certified and labeled in accordance with NFRC 300.
    - a. Visible light transmittance shall not be less than \_\_\_\_\_. *(Note 1.5)*
  4. Metal framed storefront assembly (including glass, sash and frame): Air leakage shall be rated, certified and labeled in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. *(Note 1.6)*
- C. Recycled Content: *(Note 1.7)*
1. Aluminum frame: Minimum 75% post-consumer recycled content.
  2. Steel frame: Minimum 17% post-consumer recycled content, 35% total recycled content.
- D. Mullions: Shall be thermally broken. *(Note 1.8)*
- E. Frame: [Steel] [Aluminum]
1. All points of contact between the operable and non-operable components of the curtain wall shall be weatherstripped. If weatherstripping is not used, the edge shall be welded using laser technology. *(Note 1.6)*
  2. Storefront frame shall have continuous thermal break between the interior and exterior surfaces. *(Note 1.8)*
  3. Thermally broken sections shall not be assembled by means of screws, gammets or other fasteners. *(Note 1.9)*
  4. Where thermally broken welded frame product is specified, welds shall not cause thermal transfers between exterior and interior surfaces. *(Note 1.9)*
- F. Glazing Panel: [Insulated] [Monolithic] glass *(Note 1.2)*
1. Glass type: [Clear] [Tinted] [high performance tint] [Low-e coating]. Refer Section 8810 – Glass. *(Note 1.5)*
  2. Color of tint: [Specify only if applicable] Refer Section 8810 – Glass
  3. Center of Glass U-factor: Refer Section 8810 – Glass.
  4. Solar Heat Gain Coefficient: Refer Section 8810 – Glass.
  5. Visible Transmittance: Refer Section 8810 – Glass
  6. Glazing panel shall have a double weather seal.
- G. Finish and primer:
1. Refer to Section 01350 – Special Environmental Requirements.
  2. Refer to Section 9910 – Paints.
- H. Storefront system shall have adequate drainage channels to drain the water entering the joints and condensation occurring within the system through drain holes and gutters of adequate size to the exterior surface of the wall. There shall be no moisture or air penetration through the storefront.
- I. Recyclability: Project goal is to provide products that are 100 percent recyclable or

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reusable.

### **2.2 SOURCE QUALITY CONTROL**

#### **A. Indoor Air Quality Issues:**

1. Store front shall be shop-primed and painted. *(Note 1.10)*
2. For touch-up in field refer to Section 01350- Special Environmental Requirement.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Metal storefront components shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation shall be rejected. *(Note 1.11)*
- B. Gaskets with gaps or other visible installation irregularities on framing delivered to site shall be corrected by manufacturer. *(Note 1.11)*
- C. Examine all wall openings before product is installed to verify that they are installed plumb, true and level. *(Note 1.13)*
- D. Wall space around the frame shall be filled with batt insulation. *(Note 1.13)*

### **3.2 INSTALLATION**

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.12)*
- B. Sill members shall be set with joint fillers or gaskets to provide weather tight construction. *(Note 1.5)*

### **3.3 CLEANING**

- A. Final cleaning shall be as described in Section 01350.
- B. Remove and recycle excess material as required by the site waste management program, Section 01565.

**END OF SECTION**

## SECTION 08410 – METAL-FRAMED STOREFRONTS – NOTES

## JUSTIFICATION

- 1.1 Windows are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has also been associated with health and productivity benefits.
- 1.2 Insulated (dual-pane) glazing has lower thermal conductance than monolithic glass.
- 1.3 Metal framed storefronts typically have very high conductivity and can increase energy consumption in a building. Storefronts with low thermal conductance (U-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks reduce thermal transmission from the exterior to the interior.
- 1.4 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC is beneficial in a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.5 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.6 Reducing air infiltration reduces heating and cooling energy. Weather stripping or using sealants ensures a weather tight system.
- 1.7 Manufacturing process for metal products is energy intensive. Recycled content saves resources and lowers energy consumed during production.
- 1.8 Thermal breaks reduce energy transfer between the interior surface and the exterior.
- 1.9 Fastening screws or using other conductive fasteners form thermal bridges and increase thermal conduction between the indoor and outdoor.
- 1.10 Field painting is not desirable due to indoor air quality issues.
- 1.11 Any irregularity or damage to the edges will prevent a tight fit, and increase

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infiltration. This will contribute to an increase in heating and cooling energy.

- 1.12 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration.
- 1.13 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and the storefront.

**APPLICABILITY**

- 2.1 Metal framed storefront walls installed in commercial buildings.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Thermally broken aluminum Entrances & Storefronts by Arch Aluminum & Glass Co., Inc. <http://www.arch.amarlite.com>
- 4.2 Series 403 (thermally broken) Aluminum Storefront by EFCO® Corporation. <http://www.efcocorp.com>
- 4.3 Thermally broken aluminum Entrances & Storefronts by The Baut Studios, Inc. <http://www.baut.com>
- 4.4 Thermolite® Insulated Composite Glazing Panel by Laminators, Inc. <http://www.omegapanels.com>
- 4.5 The 14000 Series Framing System by Tubelite® Inc. <http://www.tubelite.com>

**REFERENCES FOR MORE INFORMATION**

- 5.1 California Energy Commission. 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000).

**RELATED SPECIFICATION SECTIONS**

- 6.1 08520 - Aluminum-framed storefronts
- 6.2 08550 – Wood framed Windows
- 6.3 08560 - Plastic-framed Windows
- 6.4 08565 - Glass-Fiber-Framed Windows
- 6.4 08620 - Unit Skylights
- 6.6 08630 - Metal-framed skylights
- 6.7 08810 – Glass

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08520 – ALUMINUM WINDOWS

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.
- C. Visible Light Transmittance ( $T_{VIS}$ ): Percentage of incident light energy transmitted by glazing.

#### 1.2 SYSTEM DESCRIPTION

- A. Aluminum frame window installed to maintain specified thermal performance.

#### 1.3 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

- 1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
- 2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

#### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: Aluminum framed windows.
- B. Performance Requirements:
  - 1. Aluminum framed window assembly (including glass, sash and frame) U-factor shall be rated, certified and labeled in accordance with NFRC 100.
    - a. U-factor of window assembly shall not be greater than \_\_\_\_ (Btu/hr. sq. ft. °F).

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(Note 1.2)

2. Aluminum framed window assembly (including glass, sash and frame) SHGC shall be rated, certified and labeled in accordance with NFRC 200.
    - a. SHGC of window assembly shall not be greater than \_\_\_\_\_. (Note 1.3)
  3. Glass: Visible light transmittance shall be rated, certified and labeled in accordance with NFRC 300.
    - a. Visible light transmittance shall not be less than \_\_\_\_\_. (Note 1.4)
  4. Aluminum framed window assembly (including glass, sash and frame): Air leakage shall be rated, certified and labeled in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. (Note 1.5)
- C. Recycled content: (Note 1.6)
1. Aluminum frames: Minimum 75% post-consumer recycled content.
- D. Mullions: Shall be thermally broken. (Note 1.7)
- E. Frame: [Aluminum]
1. All points of contact between the operable and non-operable components of the door shall be weatherstripped. If weatherstripping is not used, the edge shall be welded using laser technology. (Note 1.5)
  2. A continuous thermal break shall be present between any two metal [or any other highly conductive material] surfaces, when one faces the external environment and the other faces the interior. (Note 1.7)
  3. Thermally broken sections shall not be assembled by means of screws, gammets or other fasteners. (Note 1.8)
  4. Where thermally broken welded frame product is specified, welds shall not cause thermal transfers between exterior and interior surfaces. (Note 1.8)
- F. Glazing Panel: [Insulated] [Monolithic] glass (Note 1.9)
1. Glass type: [Clear] [Tinted] [high performance tint] [Low-e coating]. Refer Section 8810 – Glass. (Note 1.4)
  2. Color of tint: [Specify only if applicable] Refer Section 8810 – Glass
  3. Center of Glass U-factor: Refer Section 8810 – Glass.
  4. Solar Heat Gain Coefficient: Refer Section 8810 – Glass.
  5. Visible Transmittance: Refer Section 8810 – Glass
  6. Glazing panel shall have a double weather seal.
- G. Finish and primer:
1. Refer to Section 01350 – Special Environmental Requirements.
  2. Refer to Section 9910 – Paints.
- H. Recyclability: Project goal is to provide products that are 100 percent recyclable or reusable.

### 2.2 SOURCE QUALITY CONTROL

#### A. Indoor Air Quality Issues:

1. Window shall be shop-primed and painted. (Note 1.10)
2. For touch-up in field refer to Section 01350- Special Environmental Requirement.

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### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Aluminum framed window components shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation shall be rejected. *(Note 1.11)*
- B. Gaskets with gaps or other visible installation irregularities on framing delivered to site shall be corrected by manufacturer. *(Note 1.11)*
- C. Examine all wall openings before product is installed to verify that they are installed plumb, true and level. *(Note 1.12)*
- D. Wall space around the frame shall be filled with insulation. *(Note 1.13)*

#### **3.2 INSTALLATION**

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.12)*
- B. [Vinyl] nailing fins shall be used on frame exterior to form a weather tight perimeter. *(Note 1.5)*
- C. Sill members shall be set with joint fillers or gaskets to provide weather tight construction. *(Note 1.5)*

#### **3.3 CLEANING**

- A. Final cleaning shall be as described in Section 01350.
- B. Remove and recycle excess material as required by the site waste management program, Section 01565.

**END OF SECTION**

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY****SECTION 08520 – ALUMINUM WINDOWS – NOTES****JUSTIFICATION**

- 1.1 Windows are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has also been associated with health and productivity benefits.
- 1.2 Aluminum framed windows typically have very high thermal conductivity and can increase energy consumption in a building. Windows with low thermal transmittance (U-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.3 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.4 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.5 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system.
- 1.6 Manufacturing process for metal products is energy intensive. Recycled content in each of the components saves resources, lowers energy consumed during the manufacturing process.
- 1.7 Metal frames have a high thermal conductance. Thermal breaks reduce energy loss from the interior surface to the exterior.
- 1.8 Fastening screws or using other conductive fasteners form thermal bridges and increase thermal conduction between the indoor and outdoor.
- 1.9 Insulated glass has lower thermal conductance than monolithis glass.
- 1.10 Field painting is not desirable due to indoor air quality issues.
- 1.11 Any irregularity or damage to the edges will prevent a tight fit, and increase

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infiltration. This will contribute to increase in heating and cooling energy.

- 1.12 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration.
- 1.13 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and the storefront.

**APPLICABILITY**

- 2.1 Aluminum framed windows installed in commercial buildings.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Starline commercial windows by Starline Industries.  
<http://www.starlineindustries.com>

**REFERENCES FOR MORE INFORMATION**

- 5.1 California Energy Commission. 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000).

**RELATED SPECIFICATION SECTIONS**

- 6.1 08410 – Metal-framed storefronts
- 6.2 08550 – Wood framed Windows
- 6.3 08560 – Plastic-framed Windows
- 6.4 08565 – Glass-Fiber-Framed Windows
- 6.4 08620 – Unit Skylights
- 6.6 08630 – Metal-framed skylights
- 6.7 08810 – Glass

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08550 – WOOD-FRAMED WINDOWS

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.

#### 1.2 SYSTEM DESCRIPTION

- A. Wood frame windows, which have been installed to maintain specified thermal criteria.

#### 1.3 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

[Submit the following in accordance with the requirements of Section 01350:

- 1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
- 2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.]

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Keep certified wood products separate from non-certified wood products, for auditing purposes (as mandated by the certifier).
- B. Keep wood products dry.
- C. Refer to Section 01350 – Special Environmental Requirements.
- D. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: [\_\_\_\_-clad] [Wood] framed windows.
- B. Performance Requirements:
  - 1. Wood framed window assembly (including glass, sash and frame) U-factor shall be rated, certified and labeled in accordance with NFRC 100.
    - a. U-factor of window assembly shall not be greater than \_\_\_\_ (Btu/hr. sq. ft. °F). (Note 1.2)
  - 2. Wood framed window assembly (including glass, sash and frame) SHGC shall be

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rated, certified and labeled in accordance with NFRC 200.

a. Solar Heat Gain Coefficient (SHGC) of window assembly shall not be greater than \_\_\_\_\_. *(Note 1.3)*

3. Glass: Visible light transmittance shall be rated, certified and labeled in accordance with NFRC 300.

a. Visible light transmittance shall not be less than \_\_\_\_\_. *(Note 1.4)*

4. Wood framed window assembly (including glass, sash and frame): Air leakage shall be rated, certified and labeled in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. *(Note 1.5)*

### **C. Frame**

1. Wood :

a. Use FSC-certified sustainably harvested wood from well-managed forests. *(Note 1.6)*

D. Glazing Panel: [Insulated] [Monolithic] glass *(Note 1.7)*

1. Glass type: [Clear] [Tinted] [High performance tint] [low-e coating] Refer Section 8810 – Glass. *(Note 1.4)*

2. Color of tint: [Specify only if applicable] Refer Section 8810 – Glass.

3. Center of Glass U-factor: Refer Section 8810 – Glass.

4. Solar Heat Gain Coefficient: Refer Section 8810 – Glass.

5. Visible Transmittance: Refer Section 8810 – Glass.

6. Glazing panel shall have a double weather seal.

E. All points of contact between the operable and non-operable components of the the window shall be weatherstripped. *(Note 1.5)*

1. Casement and Awning: Shall consist of two piece weatherstrip system consisting of a frame mounted, compression bulb and a secondary compression bulb on three sides of the operating sash.

2. Double-hung windows: Shall consist of a two piece weather-stripping system, including a frame mounted rigid jamb liner and compression type weather strip on the sill and head.

F. Cladding/Finishes: [Specify] [Paint] [Wood veneer]:

1. Wood veneer:

a. Use FSC-certified sustainably harvested wood from well-managed forests. *(Note 1.6)*

b. Veneer shall be manufactured in a facility approved by an agency accredited by the Forest Stewardship Council.

2. Paint and primer:

a. Refer to Section 01350 – Special Environmental Requirements.

b. Refer to Section 9910 – Paints.

G. Recyclability: Project goal is to provide products that are 100 percent recyclable or reusable.

## **2.2 SOURCE QUALITY CONTROL:**

A. Indoor Air Quality Issues:

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1. Window shall be shop-primed and painted. *(Note 1.8)*
2. For touch-up in field refer to Section 01350- Special Environmental Requirement.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Product shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation. Products with any such damage or contamination shall be rejected. *(Note 1.9)*
- B. Gaskets with gaps or other visible installation irregularities on window units delivered to site shall be corrected by manufacturer. *(Note 1.9)*
- C. Examine all window frames opening before product is installed to verify that they are installed plumb, true and level. *(Note 1.10)*
- D. Wall space around the frame shall be filled with insulation. *(Note 1.11)*

#### **3.2 INSTALLATION**

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.10)*
- B. [Vinyl] nailing fins shall be used on frame exterior to form a weather tight perimeter. *(Note 1.6)*
- C. Sill members shall be set with joint fillers or gaskets to provide weather tight construction. *(Note 1.6)*

#### **3.3 CLEANING**

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

## SECTION 08550 – WOOD-FRAMED WINDOWS – NOTES

## JUSTIFICATION

- 1.1 Windows are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has been associated with increased productivity and better health.
- 1.2 Wood-framed windows typically have lower conductivity than metal-framed windows without thermal breaks. Windows with low thermal transmittance (u-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.3 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.4 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.5 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system. The laser weld does not use filler material and is more uniform. It also ensures the most precise edge in the market. Both these factors ensure that there is minimal energy loss through infiltration. The laser edge does not use any grinding and stays stronger for a longer period of time, which maximizes the usability of the product.
- 1.6 As with other building products made from wood, the source of that wood should be an important consideration. Theoretically wood comes from a renewable source when sourced from a well-managed forest and has very low embodied energy. Wood that is certified to be from a well-managed resource lowers environmental impact. Wood products that are not sourced from well-managed forests have an enormous environmental impact.

However, only few manufacturers offer wood framed windows made out of certified wood, or offer it as a special-order option. It is recommended that

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certified wood should be used whenever it is relatively easy and economical to incorporate them.

- 1.7 Insulated glass has a lower thermal conductance than monolithic glass.
- 1.8 Field painting is not desirable due to indoor air quality issues.
- 1.9 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. This will contribute to increase in heating and cooling energy.
- 1.10 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration.
- 1.11 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and the storefront.

**APPLICABILITY**

- 2.1 Commercial application of windows.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Energy Efficient Windows by Andersen Windows, Inc.  
<http://commercial.andersenwindows.com>
- 4.2 Energy Efficient Windows by Kolbe and Kolbe Millworks Company.
- 4.3 "Loewen Heat-Smart" extruded aluminum-clad wood windows.
- 4.4 Pella's SmartSah wood windows uses certified/fast-growing wood for the frames.  
<http://www.pella.com>
- 4.5 "Teton" series wood windows by Norco Window Company.
- 4.6 "Ariel" aluminum clad windows by Peachtree doors and windows.
- 4.7 Reuse and total recycling systems by Urban Ore, Inc. Berkeley, CA
- 4.8 "Renewal" program for retrofitting existing buildings and reusing old materials by Andersen Windows, Inc. <http://www.renewalbyandersen.com/flash/index.html>

**REFERENCES FOR MORE INFORMATION**

- 5.1 California Energy Commission. 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000).
- 5.2 <http://www.afsonl.com/products>. (Building product information).

**RELATED SPECIFICATION SECTIONS**

- 6.1 06070 – Wood Treatment
- 6.2 06080 – Factory Applied wood coating
- 6.3 06650 – Plastics
- 6.4 08410 – Metal-framed storefronts

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- 6.5 08520 – Aluminum Windows
- 6.6 08560 – Plastic-framed Windows
- 6.7 08565 – Glass-Fiber-Framed Windows
- 6.8 08620 – Unit Skylights
- 6.9 08630 – Metal-framed skylights
- 6.10 08810 – Glass

## REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

### SECTION 08620 – UNIT SKYLIGHTS

#### PART 1 - GENERAL

##### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.
- C. Visible Light Transmittance ( $T_{VIS}$ ): Percentage of incident light energy transmitted by glazing.

##### 1.2 SYSTEM DESCRIPTION

- A. Plastic-glazed unit skylights installed to maintain specified thermal performance.

##### 1.3 SUBMITTALS

###### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

##### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

##### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Description: Manufactured [insulated] unit skylights with plastic glazing. (*Note 1.2*)
  1. [Insulated] Curb-mounted Skylight.
  2. [Insulated] Roof-mounted Skylight.
- B. Performance Requirements:
  1. U-factor shall be rated, certified and labeled in accordance with NFRC 100.

## REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

- a. U-Factor of skylight assembly shall not be greater than \_\_\_\_ Btu/hr. sq. ft. °F. *(Note 1.3)*
2. SHGC shall be rated, certified and labeled in accordance with NFRC 200.
  - a. SHGC of skylight assembly shall not be greater than \_\_\_\_\_. *(Note 1.4)*
3. Glazing: Visible light transmittance shall be rated, certified and labeled in accordance with NFRC 300.
  - a. Visible light transmittance shall not be less than \_\_\_\_\_. *(Note 1.5)*
4. Skylight assembly: Air leakage shall be rated, certified and labeled in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. *(Note 1.6)*
- C. Recycled Content: *(Note 1.7)*
  1. Aluminum frames: Minimum 75% post-consumer recycled content.
  2. Steel frames: Minimum 17% post-consumer recycled content, 35% total recycled content.
- D. All points of contact between the operable and non-operable components of the skylight shall be weatherstripped. *(Note 1.6)*
- E. Corners shall be sealed against air and water infiltration.
- F. Glazing: [Double][Acrylic] [Polycarbonate] plastic glazing. *(Note 1.2)*
  1. Glazing shall have weatherproofing gaskets on both sides. *(Note 1.6)*
- G. Frame: [Metal]
  1. All junctions between glazing and frame shall be sealed with weather tight sealant. *(Note 1.6)*
  2. Inner frame shall have a continuous [rigid foam] [fiberglass batt] thermal break, to completely isolate it from exterior frame. *(Note 1.8)*
  3. A continuous thermal break shall be present between any two metal [or any other highly conductive material] surfaces, when one is faces the external environment and the other faces the interior space. *(Note 1.8)*
  4. Curb-mounted skylight: Curb frame shall be thermally broken. *(Note 1.8)*
- H. Paint and primer: [Edit to suit project]
  1. Refer to Section 01350 – Special Environmental Requirements.
  2. Refer to Section 9910 – Paints.
- I. Moisture control:
  1. Skylights shall have integral condensation gutter and weep holes for draining any moisture to the outside.
- J. Recyclability: Project goal is to provide products that are 100 percent [recyclable] [re-useable].

### 2.2 SOURCE QUALITY CONTROL

- A. Indoor Air Quality Issues:
  1. Doors shall be shop primed and finished. *(Note 1.9)*
  2. For touch-up in field refer to Section 01350 – Special Environmental Requirements.

## **REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Product shall be examined for damage, signs of warping, or denting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation contamination shall be rejected. *(Note 1.10)*
- B. Gaskets with gaps or other visible installation irregularities on skylight units delivered to site shall be corrected by manufacturer. *(Note 1.10)*
- C. [Roof mounted units with high curbs]: Skylight installer shall inspect the supporting deck for completeness and water-tightness to verify that they are properly prepared to receive the work. Any deficiencies in the substrate shall be reported and rectified. Work shall not proceed until all deficiencies have been rectified.
- D. [Curb mounted units]: Installer shall inspect the supporting curbs for completeness and water-tightness to verify that they are properly prepared to receive the work. Any deficiencies in the substrate shall be reported and rectified. Work shall not proceed until all deficiencies have been rectified.

#### **3.2 INSTALLATION**

- A. Co-ordinate installation with adjacent work such as roofing, sheet metal and other work to ensure creation of a complete weatherproof assembly.

#### **3.3 CLEANING**

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY****SECTION 08620 – UNIT SKYLIGHTS – NOTES****JUSTIFICATION**

- 1.1 Skylights are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has been associated with increased productivity and better health.
- 1.2 Insulated glazing panels have a lower thermal conductance than monolithic glass
- 1.3 Windows with low thermal transmittance (u-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.4 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.5 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.6 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system.
- 1.7 Manufacturing process for metal products is energy intensive. High recycled content reduces energy used during manufacture.
- 1.8 Thermal breaks reduce energy consumption by reducing thermal conduction between the interior and exterior surfaces.
- 1.9 Field painting is not desirable due to indoor air quality issues.
- 1.10 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. This will contribute to increase in heating and cooling energy.

**APPLICABILITY**

- 2.1 Commercial applications of skylights.

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY****COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Energy efficient unit skylight by Plasteco Inc. <http://www.plasteco.com/>
- 4.2 Energy efficient unit skylight by Wasco Products Inc. <http://www.wasco1.com/>
- 4.3 Energy efficient unit skylights by Therma-Vu. <http://www.thermo-vu.com/>

**REFERENCES FOR MORE INFORMATION**

- 5.1 California Energy Commission. 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000).
- 5.2 <http://www.afsonl.com/products>. (Building product information).

**RELATED SPECIFICATION SECTIONS**

- 6.1 06065 – Plastic Materials
- 6.2 08560 – Plastic Windows
- 6.3 08630 – Metal skylights
- 6.4 08810 – Glass

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08630 – METAL-FRAMED SKYLIGHTS

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.
- C. Visible Light Transmittance ( $T_{VIS}$ ): Percentage of incident light energy transmitted by glazing.

#### 1.2 SYSTEM DESCRIPTION

- A. Provide metal-framed skylight with [insulated] glazing which have been installed to maintain energy efficiency criteria as per 2001 Title-24 Standard without defects, damage or failure.

#### 1.3 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

#### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: Metal-framed skylights with [insulated] glass panel. (*Note 1.2*)
- B. Performance Requirements:
  1. Metal-framed skylight: U-factor shall be rated, certified and labeled in accordance

## REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

with NFRC 100.

- a. U-Factor of skylight assembly shall not be greater than \_\_\_\_ Btu/hr. sq. ft. °F. *(Note 1.3)*
  2. Metal-framed skylight: SHGC shall be rated, certified and labeled in accordance with NFRC 200.
    - a. SHGC of skylight assembly shall not be greater than \_\_\_\_\_. *(Note 1.4)*
  3. Glass: Visible light transmittance shall be rated, certified and labeled in accordance with NFRC 300.
    - a. Visible light transmittance shall not be less than \_\_\_\_\_. *(Note 1.5)*
  4. Metal framed skylight assembly (including glass, sash and frame): Air leakage shall be rated, certified and labeled in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. *(Note 1.6)*
- C. Recycled Content:*(Note 1.6)*
1. Aluminum frames: Minimum 75% post-consumer recycled content.
  2. Steel frames: Minimum 35% total recycled content, 17% of which shall be post-consumer recycled content.
- D. Glazing Panel: [Insulated] [Monolithic]*(Note 1.2)*
1. Glass type: [Clear] [Tinted] [High performance tint] [Low-e coating]. Refer Section 8810 – Glass. *(Note 1.5)*
  2. Color of tint: [Specify only if applicable] Refer Section 8810 – Glass
  3. Center of Glass U-factor: Refer Section 8810 – Glass.
  4. Solar Heat Gain Coefficient: Refer Section 8810 – Glass.
  5. Visible Transmittance: Refer Section 8810 – Glass
  6. Glazing panel shall have a double weather seal. *(Note 1.6)*
- E. Frame: [Metal]
1. All junctions between glazing and frame shall be sealed with weather tight sealant. *(Note 1.6)*
  2. Inner frame shall have a continuous [rigid foam] [fiberglass batt] thermal break, to completely isolate it from exterior frame. *(Note 1.8)*
  3. A continuous thermal break shall be present between any two metal [or any other highly conductive material] surfaces, when one is faces the external environment and the other faces the interior space. *(Note 1.8)*
- F. Finishes:
1. Refer to Section 01350 – Special Environmental Requirements.
  2. Refer to Section 9910 – Paints.
- G. Moisture control:
1. Shall be integrated with flush condensation gutters.
  2. Framing system shall be capable of collecting and draining condensation and water infiltration to the exterior through weepholes or drain tubes in the sill or perimeter framing members.
  3. All expansion joints in the sill member shall be slotted for thermal movement, and sealed against moisture and air infiltration.
  4. The sill member shall not be penetrated with either rafter connections or anchors

## **REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

to the support and adjacent construction.

H. Recyclability: Project goal is to provide skylight components that are 100% recyclable/reusable.

### **2.2 SOURCE QUALITY CONTROL**

A. Indoor Air Quality Issues:

1. Doors shall be shop primed and finished. *(Note 1.9)*
2. For touch-up in field refer to Section 01350 – Special Environmental Requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

A. In-place structure, anchors and attachments shall be adequate and properly prepared to specified tolerances prior to installing skylight. Skylight shall not be installed until defects are corrected. *(Note 1.10)*

### **3.2 INSTALLATION**

- A. Glazing shall have weatherproofing gaskets on both sides. *(Note 1.6)*
- B. All junctions between glazing and metal frame shall be sealed with a sealant or have a weatherproofing gasket. *(Note 1.6)*
- C. Rafter, purlin and sill glazing caps shall be secured with thermally broken glazing clips. *(Note 1.8)*
- D. Curb shall have continuous thermal break. *(Note 1.8)*
- E. Weatherproof sealant shall be applied to seal horizontal joints between glass panels and silicone sealant to wet seal joints between retainers and glass. *(Note 1.6)*
- F. Sealants shall be applied to all metal to metal joints. *(Note 1.6)*

### **3.3 CLEANING**

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

## SECTION 08630 – METAL-FRAMED SKYLIGHTS - NOTES

## JUSTIFICATION

- 1.1 Skylights are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has been associated with increased productivity and better health.
- 1.2 Double-glazed skylights have a lower thermal transmittance (U-factor) compared to a single glazed one.
- 1.3 Metal framed skylights have a higher thermal transmittance than those with plastic or polycarbonate frames, unless they are thermally broken. Skylights with low thermal transmittance (u-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.4 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.5 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.6 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system.
- 1.7 Manufacturing process for metal products is energy intensive. High recycled content reduces energy used during manufacture.
- 1.8 Metal framing members have very high conductivity and can increase energy consumption in a building. unless fitted with thermal break. Thermal breaks reduce energy consumption by reducing thermal conduction between the interior and exterior surfaces.
- 1.9 Field painting is not desirable due to indoor air quality issues.
- 1.10 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. This will contribute to increase in heating and cooling energy.

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY****APPLICABILITY**

- 2.1 Large scale commercial applications of skylights.

**COST IMPACT****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Photovoltaic powered daylighting system by Natural Lighting Co., Inc. <http://www.daylighting.com/>
- 4.2 Active daylighting system by So-Luminaire Daylighting System Corp.
- 4.3 Prismatic skylights by SunOptics Skylights. <http://www.sunoptics.com/>
- 4.4 Custom skylights by Super Sky Products Inc. <http://www.supersky.com/>
- 4.5 Metal skylights by Skywall Translucent systems. <http://www.skywall.com>
- 4.6 Naturalite system by Vistawall Architectural Products. <http://www.vistawall.com>
- 4.7 Metal framed skylights by TRACO Skytech Systems®, Inc. <http://www.tracowindows.com/>

**REFERENCES FOR MORE INFORMATION**

- 5.1 California Energy Commission. 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000).
- 5.2 <http://www.afsonl.com/products>. (Building product information).

**RELATED SPECIFICATION SECTIONS**

- 6.1 08620 – Unit skylights
- 6.2 08810 – Glass

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08810 – GLASS

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. ° F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.
- C. Visible Light Transmittance ( $T_{VIS}$ ): Percentage of incident light energy transmitted by glazing.

#### 1.2 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

- 1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
- 2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

#### 1.3 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: [Insulated glazing] [Monolithic glazing] (*Note 1.2*)
- B. Performance requirements:
  - 1. Glazing U-factor shall be rated in accordance with NFRC 100.
    - a. Center of glass U-factor: Shall not exceed \_\_\_\_ Btu/ hr. sq. ft. °F. (*Note 1.2*)
  - 2. Glazing Solar Heat Gain Coefficient shall be rated in accordance with NFRC 200.
    - a. SHGC: Shall not exceed \_\_\_\_ (*Note 1.3*).
  - 3. Visible light transmittance shall be rated in accordance with NFRC 300.
    - a. Visible light transmittance shall not be less than \_\_\_\_\_. (*Note 1.4*)

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Glass edges shall be protected from moisture by using either suitable impervious weather seal, or an adequate weep hole system. *(Note 1.5)*

**3.2 CLEANING**

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

## SECTION 08810 – GLASS – NOTES

## JUSTIFICATION

- 1.1 Apart from providing a visual connection to the external environment, glazing also provides daylighting in buildings. However, glazing can also increase the cooling load in a building considerably by transmitting and trapping solar gains inside the building.
- 1.2 Insulated glass (double-pane) has a lower thermal transmittance than monolithic glass. Glass with low thermal transmittance (U-factor) reduce energy consumption in a building. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.3 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.4 Daylighting contributes towards significant energy savings in commercial buildings by reducing energy consumption and internal loads due to artificial lighting. High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones.
- Tinted glass is glazing that is not clear and has a color to it – such as blue, green, gray etc. A dark tint typically has a lower SHGC and VLT than a lighter tint. High performance tinted glass reduces solar heat gain to below that of a dark tint (such as bronze or gray tint) but has a [visible transmittance](#) closer to clear glass. High-performance or spectrally selective tinted glass products are typically light green or light blue. The tint has no effect on the [U-factor](#) but reduces solar gain, which is a benefit in the summer and a liability in the winter depending on local climate conditions.. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance. Spectrally selective coatings/glazing controls the type of solar radiation admitted and blocked from the inside to the outside. Selecting glazing type that most effectively filters out the ultra violet and infra red radiation (and even eliminates some of the extreme ends of the visible solar spectrum) is best suited for cooling dominated climates select. The best spectral selectivity for heating dominated climates is one that has a high transmittance over the entire solar spectrum, admitting the most solar radiant heat, and a low emissivity (high reflectivity) over the long-wave infra red radiation spectrum, to reflect radiant heat

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

from the walls and room furnishings back into the building.

**TABLE 1 - OPTICAL AND THERMAL PROPERTIES OF GLAZING**

| Glazing Type   | VLT | ASHRAE U-Value |        | SHGC | VLT/SHGC |
|--|-----|----------------|--------|------|----------|
|  |     | Winter         | Summer |      |          |
| Clear Uncoated monolithic glass  | 85% | 1.09           | 1.09   | 0.81 | 1.05     |
| Tinted Uncoated Monolithic Glass (Gray)                                      | 44% | 1.09           | 1.10   | 0.57 | 0.77     |
| Tinted Uncoated Monolithic Glass (Bronze)                                    | 54% | 1.09           | 1.09   | 0.62 | 1.19     |
| Tinted Uncoated Monolithic Glass (Green)                                     | 74% | 1.09           | 1.09   | 0.58 | 0.95     |
| Tinted Uncoated Monolithic Glass (Blue)                                      | 55% | 1.09           | 1.10   | 0.58 | 1.29     |
| High Performance Tinted Uncoated Monolithic Glass (Blue-green)               | 75% | 1.09           | 1.09   | 0.62 | 1.15     |
| High Performance Tinted Uncoated Monolithic Glass (Azurlite)                 | 71% | 1.09           | 1.11   | 0.51 | 1.39     |
| Tinted Uncoated Monolithic Glass (EverGreen)                                 | 66% | 1.09           | 1.11   | 0.51 | 1.29     |
| Clear Uncoated Insulated Glass   | 78% | 0.48           | 0.57   | 0.70 | 1.11     |
| Tinted Uncoated Insulated Glass (Gray)                                       | 39% | 0.48           | 0.57   | 0.47 | 0.83     |
| Tinted Uncoated Insulated Glass (Bronze)                                     | 48% | 0.48           | 0.57   | 0.45 | 1.07     |
| Tinted Uncoated Insulated Glass (Green)                                      | 66% | 0.48           | 0.57   | 0.50 | 1.32     |
| Tinted Uncoated Insulated Glass (Blue)                                       | 49% | 0.48           | 0.57   | 0.46 | 1.07     |
| High Performance Tinted Uncoated Insulated Glass (Blue-green)                | 67% | 0.48           | 0.57   | 0.50 | 1.34     |
| High Performance Tinted Uncoated Insulated Glass (Azurlite)                  | 63% | 0.48           | 0.57   | 0.40 | 1.58     |
| High Performance Tinted Uncoated Insulated Glass (EverGreen)                 | 59% | 0.48           | 0.57   | 0.39 | 1.51     |
| Clear Low-e Coated Insulating Glass (High VT)                                | 70% | 0.31           | 0.37   | 0.53 | 1.32     |
| Clear Low-e Coated Insulating Glass (Medium VT)                              | 50% | 0.31           | 0.35   | 0.39 | 1.28     |
| Clear Low-e Coated Insulating Glass (Low VT)                                 | 30% | 0.31           | 0.34   | 0.27 | 1.11     |
| Tinted Coated Low-e Insulating Glass (Gray - High VT)                        | 40% | 0.31           | 0.32   | 0.33 | 1.21     |
| Tinted Coated Low-e Insulating Glass (Gray - Medium VT)                      | 25% | 0.31           | 0.34   | 0.24 | 1.04     |
| Tinted Coated Low-e Insulating Glass (Gray - Low VT)                         | 20% | 0.31           | 0.34   | 0.21 | 0.95     |
| Tinted Coated Low-e Insulating Glass (Bronze - High VT)                      | 45% | 0.31           | 0.32   | 0.37 | 1.22     |
| Tinted Coated Low-e Insulating Glass (Bronze - Medium VT)                    | 28% | 0.31           | 0.34   | 0.27 | 1.04     |
| Tinted Coated Low-e Insulating Glass (Bronze - Low VT)                       | 20% | 0.31           | 0.34   | 0.20 | 1.00     |
| Tinted Coated Low-e Insulating Glass (Green - High VT)                       | 60% | 0.31           | 0.32   | 0.38 | 1.58     |
| Tinted Coated Low-e Insulating Glass (Green - Medium VT)                     | 43% | 0.31           | 0.35   | 0.28 | 1.54     |
| Tinted Coated Low-e Insulating Glass (Green - Low VT)                        | 30% | 0.31           | 0.34   | 0.22 | 1.36     |
| Tinted Coated Low-e Insulating Glass (Blue - High VT)                        | 38% | 0.31           | 0.32   | 0.35 | 1.09     |
| Tinted Coated Low-e Insulating Glass (Blue - Medium VT)                      | 28% | 0.31           | 0.35   | 0.24 | 1.17     |
| Tinted Coated Low-e Insulating Glass (Blue - Low VT)                         | 18% | 0.31           | 0.34   | 0.19 | 0.95     |
| High Performance Tinted Coated Low-e Insulating Glass (Blue-green - High VT) | 60% | 0.31           | 0.32   | 0.39 | 1.54     |
| High Performance Tinted Coated Low-e Insulating Glass (Blue-green - Med. VT) | 40% | 0.31           | 0.33   | 0.29 | 1.38     |
| High Performance Tinted Coated Low-e Insulating Glass (Blue-green - Low VT)  | 30% | 0.31           | 0.34   | 0.24 | 1.25     |
| High Performance Tinted Coated Low-e Insulating Glass (Azurlite - High VT)   | 55% | 0.31           | 0.34   | 0.32 | 1.72     |
| High Performance Tinted Coated Low-e Insulating Glass (Azurlite - Medium VT) | 37% | 0.31           | 0.34   | 0.25 | 1.48     |
| High Performance Tinted Coated Low-e Insulating Glass (Azurlite - Low VT)    | 29% | 0.31           | 0.34   | 0.19 | 1.53     |
| High Performance Tinted Coated Low-e Insulating Glass (EverGreen - High VT)  | 53% | 0.31           | 0.33   | 0.31 | 1.71     |
| High Performance Tinted Coated Low-e Insulating Glass (EverGreen - Med. VT)  | 35% | 0.31           | 0.34   | 0.24 | 1.46     |
| High Performance Tinted Coated Low-e Insulating Glass (EverGreen - Low VT)   | 24% | 0.31           | 0.34   | 0.18 | 1.33     |

- 1.5 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system.

**APPLICABILITY**

- 2.1 Commercial application of glazing with high thermal and optical performance.

**COST IMPACT**

- 3.1 Costs vary, but high performance low-e coatings add about \$2.00 to \$3.00 per square foot to the cost of a double-pane glazing. A spectrally selective blue or green tint may add about \$1.00 to \$2.00 per square foot.

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY****EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Viracon. <http://www.viracon.com/>
- 4.2 PPG Industries Corporate. <http://www.ppg.com/>
- 4.3 Pilkington. <http://www.pilkington.com/>

**REFERENCES FOR MORE INFORMATION**

- 5.1 <http://www.nfrc.org/> (Fenestration rating standard)

**RELATED SPECIFICATION SECTIONS**

- 6.1 08410 – Metal-framed storefronts
- 6.2 08520 – Aluminum windows
- 6.3 08550 – Wood-framed windows
- 6.4 08620 – Unit skylights
- 6.5 08630 – Metal-framed skylights
- 6.6 08910 – Metal-framed curtain wall

# REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

## SECTION 08910 – METAL-FRAMED CURTAIN WALL

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. U-Factor (Thermal Transmittance): Heat transmission in unit time through unit area of a material or construction and the boundary of air films, induced by unit temperature difference between the environments on each side. It is measured in Btu/ hr. sq. ft. °F.
- B. SHGC (Solar Heat Gain Coefficient): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted or convected into the space.

#### 1.2 SYSTEM DESCRIPTION

- A. Provide metal framed curtain walls with [insulated] glazing installed to maintain specified thermal criteria.

#### 1.3 SUBMITTALS

##### A. SPECIAL ENVIRONMENTAL REQUIREMENTS

Submit the following in accordance with the requirements of Section 01350:

- 1. Resource efficient product data: Submit required information concerning project recyclability (packaging), product recycled content, and product recyclability.
- 2. Environmental issues certification: Submit written certification stating that the products installed are essentially the same as those defined by the Project requirements (specifications, submittals, and/or test data) in terms of recycled content, recyclability and indoor air quality.

#### 1.4 QUALITY ASSURANCE

- A. Environmental issues: Refer to Section 01350 – Special Environmental Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01350 – Special Environmental Requirements.
- B. Refer to Section 01565 – Site Waste Management Program.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Description: Metal-framed curtain wall with [insulated] glass. (*Note 1.2*)
- B. Performance Requirement:
  - 1. Curtain wall shall be Energy Star compliant.
  - 2. Metal-framed curtain wall: U-factor of the transparent portion of the metal framed curtain wall assembly (including glass and frame) shall be rated in accordance with NFRC 100.

## REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY

- a. U-factor of curtain wall assembly shall not be greater than \_\_\_\_\_. Btu/hr. sq. ft. °F. *(Note 1.2)*
3. Metal-framed curtain wall: SHGC of the visible portion of the metal framed curtain wall assembly (including glass and frame) shall be rated in accordance with NFRC 200.
  - a. Solar Heat Gain Factor (SHGC) of curtain wall assembly shall not be greater than \_\_\_\_\_. *(Note 1.3)*
4. Glass: Visible light transmittance shall be rated in accordance with NFRC 300.
  - a. Visible light transmittance shall not be less than \_\_\_\_\_. *(Note 1.4)*
5. Metal framed curtain wall assembly (including glass, sash and frame): Air leakage shall be rated in accordance with NFRC 400, and shall not exceed 0.4 cfm/sq. ft. *(Note 1.5)*
- C. Recycled Content: *(Note 1.6)*
  1. Aluminum frames: Minimum 75% post-consumer recycled content.
  2. Steel frames: 17% post-consumer recycled content, total 35% total recycled content.
- D. Glazing Panel: [Insulated glass] *(Note 1.2)*
  1. Glass type: [Clear] [Tinted] Refer to Section 8810 – Glass
  2. Color of tint: [Specify only if applicable] Refer to Section 8810 – Glass
  3. Center of Glass U-factor: Refer to Section 8810 – Glass
  4. Solar Heat Gain Coefficient: Refer to Section 8810 – Glass
  5. Visible Transmittance: Refer to Section 8810 – Glass
  6. Glazing panel shall have a double weather seal. *(Note 1.5)*
  7. Glazed curtain wall shall include waterproof spacer and sealant at the structural joint. *(Note 1.5)*
- E. Mullions: Shall be thermally broken. *(Note 1.7)*
- F. Frame: [Steel] [Aluminum]
  1. All points of contact between the operable and non-operable components of the door shall be weatherstripped. If weatherstripping is not used, the edge shall be welded using laser technology. *(Note 1.5)*
  2. A continuous thermal break shall be present between any two metal [or any other highly conductive material] surfaces when one faces the external environment and the other faces the interior. *(Note 1.7)*
  3. Thermally broken sections shall not be assembled by means of screws, gammets or other fasteners. *(Note 1.8)*
  4. Where thermally broken welded frame product is specified, welds shall not cause thermal transfers between exterior and interior surfaces. *(Note 1.8)*
- G. Glazing Panel: *(Note 1.4)*
  1. Glass type: [Clear] [Tinted] [high performance tint] Refer to Section 8810 – Glass *(Note 1.4)*
  2. Color of tint: [Specify only if applicable] Refer to Section 8810 – Glass
  3. Center of Glass U-factor: Refer to Section 8810 – Glass
  4. Solar Heat Gain Coefficient: Refer to Section 8810 – Glass

## **REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

5. Visible Transmittance: Refer to Section 8810 – Glass
  6. Glazing panel shall have a double weather seal. *(Note 1.5)*
- H. Finish and primer:
1. Refer to Section 01350 – Special Environmental Requirements.
  2. Refer to Section 9910 – Paints.
- I. System shall have adequate drainage channels to drain the water entering the joints and condensation occurring within the system through drain holes and gutters of adequate size to the exterior surface of the wall. There shall be no moisture or air penetration through the curtain wall.
- J. Recyclability: Project goal is to provide products that are 100 percent recyclable or reusable.
- 2.2 SOURCE QUALITY CONTROL
- A. Indoor Air Quality Issues:
1. Window shall be shop-primed and painted. *(Note 1.9)*
  2. For touch-up in field refer to Section 01350- Special Environmental Requirement.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Metal framed curtain wall components shall be examined for damage, signs of warping, denting or splitting and replaced immediately. Products with signs of any damage, mildew, and other contamination before installation shall be rejected. *(Note 1.10)*
- B. Gaskets with gaps or other visible installation irregularities on framing delivered to site shall be corrected by manufacturer. *(Note 1.10)*
- C. Examine all wall openings before product is installed to verify that they are installed plumb, true and level. *(Note 1.11)*
- D. Wall space around the frame shall be filled with insulation. *(Note 1.12)*

#### 3.2 INSTALLATION

- A. Frame product shall be set plumb, square, aligned and without twist at correct elevation. Product shall be tightly fitted to the opening, rigidly secured in place and properly braced. *(Note 1.10)*
- B. Sill members shall be set with joint fillers or gaskets to provide weather tight construction. *(Note 1.5)*

#### 3.3 CLEANING

- A. Final cleaning shall be as described in section 01350.
- B. Remove and recycle excess material as required by the site waste management program, section 01565.

**END OF SECTION**

## SECTION 08910 – METAL-FRAMED CURTAIN WALL – NOTES

## JUSTIFICATION

- 1.1 Windows are a source of daylighting, and can reduce lighting loads in a commercial application. Daylighting has also been associated with health and productivity benefits.
- 1.2 Metal framed curtain walls typically have very high conductivity and can increase energy consumption in a building. Windows with low thermal transmittance (u-factor) reduce energy consumption in a building. Insulated glass has lower thermal conductance than monolithic glass. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method. Most climate zones in California require double-glazed windows. Insulated glass and thermal breaks lower thermal transmission from the exterior to the interior.
- 1.3 A lower SHGC contributes to energy efficiency in a cooling dominated climate and a higher SHGC for a heating dominated climate. A low SHGC is recommended for California climates. See Table 1-H or Table 1-I of 2001 Energy Efficiency Standards For Residential And Nonresidential Buildings (adopted pursuant to Assembly Bill 970, Statutes of 2000), by the California Energy Commission. These tables contain the minimum thermal performance required for a building to comply with the California energy code using the prescriptive method.
- 1.4 High visible transmittance is preferred for daylighting purposes. Typically, high visible light transmittance is associated with a higher SHGC, which is not desirable in most California climate zones. Select glazing that has a high visible light transmittance and low SHGC for most California climate zones. High performance glazing has a low SHGC and high visible light transmittance, which is ideal for daylighting and cooling benefits. High performance glass lowers radiant heat transfer from the exterior to the interior, without greatly compromising the visible light transmittance.
- 1.5 Reducing air infiltration reduces heating and cooling energy. Weatherstripping or using sealants ensures a weather tight system. The laser weld does not use filler material and is more uniform. This ensures that there is minimal energy loss through infiltration. The laser edge does not use any grinding and stays stronger for a longer period of time, which maximizes the usability of the product.
- 1.6 Manufacturing process for metal products is energy intensive. Recycled content in each of the components saves resources, lowers energy consumed during the manufacturing process.
- 1.7 Thermal breaks reduce energy loss from the interior surface to the exterior.
- 1.8 Fastening screws or using other conductive fasteners form thermal bridges and increase thermal conduction between the indoor and outdoor.
- 1.9 Field painting is not desirable due to indoor air quality issues.

**REFERENCE SPECIFICATIONS FOR ENERGY AND RESOURCE EFFICIENCY**

- 1.10 Any irregularity or damage to the edges will prevent a tight fit, and increase infiltration. This will contribute to increase in heating and cooling energy.
- 1.11 If the openings or frame are not plumb and level, or the corners do not meet at right angles, the product and the opening will not fit tightly, making it susceptible to energy loss through air infiltration.
- 1.12 Filling the wall space around the frame with insulation ensures thermal integrity of the walls and the storefront.

**APPLICABILITY**

- 2.1 Commercial application of metal-framed curtain walls.

**COST IMPACT**

- 3.1 Refer to Section 08810 – Glass
- 3.2 Adding a thermally broken frame adds about \$ 2.55 per square foot.

**EXAMPLE PRODUCTS AND MANUFACTURERS**

- 4.1 Amarlite™ Entrance Framing System, Amarlite™ Glazed Aluminum Curtain Wall Systems by Arch Aluminum & Glass <http://www.arch.amarlite.com>

**REFERENCES FOR MORE INFORMATION**

- 5.1 <http://www.nfrc.org/> (Fenestration rating standard)

**RELATED SPECIFICATION SECTIONS**

- 6.1 08410 – Metal-framed storefronts
- 6.2 08520 – Aluminum windows
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- 6.3 08620 – Unit skylights
- 6.4 08630 – Metal-framed skylights
- 6.5 08810 – Glass