110.6 110.8 All Mandatory Envelopes

SECTION 110.6 – MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

(a) **Certification of Fenestration Products and Exterior Doors other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the Commission, or if an independent certifying organization approved by the Commission has certified, that the product complies with all of the applicable requirements of this subsection.

1. **Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft² of window area, 0.3 cfm/ft² of door area for residential doors, 0.3 cfm/ft² of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft² for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E 283 at a pressure differential of 75 pascals (or 1.57 pounds/ft²), incorporated herein by reference.

2. **U-factor.** A fenestration product's U-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A~~TABLE 110.6-A~~.

   ~~**EXCEPTION to Section 116(a)2:** If the fenestration product is a skylight or is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.~~

3. **SHGC.** A fenestration product's SHGC shall be rated in accordance with NFRC 200 for site-built fenestration, or use the applicable default SHGC set forth in TABLE 110.6-B~~TABLE 110.6-B~~.

   ~~**EXCEPTION to Section 116(a)3:** If the fenestration product is a skylight or is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.~~

4. **Labeling.** Fenestration products shall:

   A. Have a temporary label for manufactured ~~(~~or separate label certificate for site-built fenestration~~)~~ meeting the requirements of Section 10-111(a)1, labels not to be removed before inspection by the enforcement agency, listing the certified U-factor and SHGC, and certifying that the air leakage requirements of Section 110.6(a)1 are met for each product line; and

   B. Have a permanent label (or label certificate for site-built fenestration) meeting the requirements of Section 10-111(a)2 if the product is rated using NFRC procedures.

5. **Fenestration Acceptance Requirements.** Before an occupancy permit is granted, site-built fenestration products in other then low-rise residential buildings shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for each product installed and be readily accessible at the project location. A Certificate of Acceptance shall be completed, signed and submitted to the enforcement agency that certifies that the fenestration product meets the acceptance requirements.

   EXCEPTION to Section 110.6(a)1: Fenestration products removed and reinstalled as part of a building alteration or addition.

(b) **Installation of Field-fabricated Fenestration and Exterior Doors.** Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using U-factors from TABLE 110.6-A~~TABLE 110.6-A~~ and SHGC values from TABLE 110.6-B~~TABLE 110.6-B~~. Field-fabricated fenestration and field-fabricated exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped.

EXCEPTION to Section 110.6(a)1: Field-fabricated fenestration and field-fabricated exterior doors.

EXCEPTION to Section 110.6(b): Unframed glass doors and fire doors need not be weatherstripped or caulked.

TABLE 110.6-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME	PRODUCT TYPE	SINGLE PANE U-FACTOR	DOUBLE PANE [1] U-FACTOR	GLASS BLOCK [2] U-FACTOR
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/garden window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/garden window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Doors	0.99	0.53	N.A.
	Greenhouse/garden windows	1.94	1.06	N.A.
	Skylight	1.47	0.84	N.A.

1. For all dual-glazed fenestration products, adjust the listed U-factors as follows:
   a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.
   b. Add 0.05 to any product with true divided lite (dividers through the panes).
2. Nonrated t~~T~~ranslucent or transparent panels shall use glass block values.

TABLE 110.6-B DEFAULT SOLAR HEAT GAIN COEFFICIENT (SHGC)

FRAME TYPE	PRODUCT	GLAZING	~~TOTAL WINDOW~~FENESTRATION PRODUCT SHGC		
			Single Pane	Double Pane	Glass Block [1]
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.

1. ~~Translucent~~Nonrated translucent or transparent panels shall use glass block values.

SECTION 110.7 – MANDATORY REQUIREMENTS ~~FOR~~TO LIMIT AIR LEAKAGE ~~JOINTS AND OTHER OPENINGS~~

(a) All potential sources of air leakage such as ~~Joints~~ joints~~and~~ , ~~other~~ all openings in the building envelope, supply and exhaust ~~-~~fans ~~that are potential sources of air leakage~~ shall be caulked, gasketed, weatherstripped, or otherwise sealed to limit infiltration and exfiltration.

(b) The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space using the following:

1. **Air Barrier Joints and Seams** shall be sealed including sealing transitions in places and changes in materials. Air barrier penetrations shall be sealed. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation; and

2. Continuous Air B~~b~~arrier Shall be installed to the building envelope meeting one of the following:

A. Using individual materials that have an air permeance not exceeding 0.004cfm/ft2 under a pressure differential of 0.3in. w.g. (1.57psf) (0.02 L/s.m2 at 75 pa) when tested in accordance with ASTM E2178; or

B. Using assemblies of materials and components that have an average air leakage not to exceed 0.04 cfm/ft2 under a pressure differential of 0.3 in. w.g (1.57psf) (0.2 L/s.m2 at 75 pa) when tested in accordance with ASTM E1677**;** or

EXCEPTION to Section 110.7(d)2B: Materials in TABLE 110.7-A below shall be deemed to comply with this section provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

TABLE 110.7-A MATERIALS DEEMED TO COMPLY AS AIR BARRIER

	MATERIALS AND THICKNESS		MATERIALS AND THICKNESS
1	Plywood – min. 3/8 in thickness	9	Built up roofing membrane

2	Oriented strand board – min. 3/8 in	10	Modified bituminous roof membrane
3	Extruded polystyrene insulation board – min. ½ in	11	Fully adhered single-ply roof membrane
4	Foil-back polyisocyanurate insulation board – min. ½ in	12	A Portland cement/sand parge, or gypsum plaster minimum 5/8 in
5	Closed cell spray foam with a minimum density of 2.0 pcf no less than 1½ in	13	Cast-in-place and precast concrete.
6	Open cell spray foam with a minimum density of 0.4 to1.5 pcf no less than 5½ in	14	Fully grouted concrete block masonry
7	Exterior or interior gypsum board - minimum 1/2 in	15	Sheet steel or aluminum
8	Cement board - minimum 1/2 in thickness		

C. Testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 0.40- cfm/ft2 at a pressure differential of 0.3 in w.g. (1.57 psf) (2.0 L/s.m2 at 75 pa) in accordance with ASTM E779 or an equivalent approved method.

EXCEPTIONS to Section 110.7(d)2C:

1. Concrete masonry walls which have two coatings of paint or sealer coating.

2. Concrete masonry walls with integral rigid board insulation.

3. Structurally Insulated Panels.

4. Portland cement/sand parge, stucco, or plaster minimum 1/2 inch.

~~An exhaust fan shall~~ (c)~~be3~~ Recessed lighting fixtures installed that penetrate the air barrier shall be sealed to maintain the integrity of the air barrier.

~~sealed with a gasket or caulk between the exhaust fan housing and ceiling.~~

SECTION 110.8 – MANDATORY REQUIREMENTS FOR INSULATION, ~~AND~~ ROOFING PRODUCTS AND RADIANT BARRIER

(a) Insulation **Certification by Manufacturers.** Any insulation shall be certified by Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Material."

(b) **Installation of Urea Formaldehyde Foam Insulation.** Urea formaldehyde foam insulation may be applied or installed only if:

1. It is installed in exterior side walls; and

2. A four-mil-thick plastic polyethylene vapor ~~barrier~~ retarder or equivalent plastic sheathing vapor ~~barrier~~ retarder is installed between the urea formaldehyde foam insulation and the interior space in all applications.

(c) **Flame spread Rating of Insulation.** All insulating material shall be installed in compliance with the flame spread rating and smoke density requirements of the CBC.

(d) **Installation of Insulation in Existing Buildings.** Insulation installed in an existing attic, or on an existing duct or water heater, shall comply with the applicable requirements of subsections 1, 2, and 3 below. If a contractor installs the insulation, the contractor shall certify to the customer, in writing, that the insulation meets the applicable requirements of subsections 1, 2, and 3 below.

1. **Attics.** If insulation is installed in the existing attic of a low-rise residential building, the R-value of the total amount of insulation (after addition of insulation to the amount, if any, already in the attic) shall ~~be at least R-38 in climate zones 1 and 16; and R-30 in all other climate zones~~meet the requirements of Section 150.0(a).

   EXCEPTION to Section 110.8(d)1: Where the accessible space in the attic is not large enough to accommodate the required R-value, the entire accessible space shall be filled with insulation provided such installation does not violate Section 1203.2 of Title 24, Part 2.

2. **Water heaters.** If external insulation is installed on an existing unfired water storage tank or on an existing back-up tank for a solar water-heating system, it shall have an R-value of at least R-12, or the heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.

3. **Ducts.** If insulation is installed on an existing space-conditioning duct, it shall comply with Section 605 of the CMC.

(e) Insulation **Placement ~~on~~of ~~r~~Roof/Ceeilings ~~insulation~~.** Insulation installed to limit heat loss and gain through the top of conditioned spaces shall comply with the following:

1. Insulation shall be installed in direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling; and

2. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed and the space between the ceiling and the roof is either directly or indirectly conditioned space and shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements; and

3. Insulation shall not be placed on top of a suspended ceiling with removable ceiling panels ~~shall be deemed to have no affect on envelope heat loss~~; and

   EXCEPTION to Section 110.8(e) 3: When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

4. Insulation shall be installed below the roofing membrane or layer used to seal the roof from water penetration unless the insulation has a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C 272.

NOTE: Vents, which do not penetrate the roof deck, that are designed for wind resistance for roof membranes are not within the scope of Section 110.8(e)2.

(f) Insulation for **Demising Walls in Nonresidential Buildings.** The opaque portions of framed demising walls in nonresidential buildings shall be insulated with an installed R-value of no less than R-13 between framing members.

(g) **Insulation Requirements for Heated Slab Floors.** Heated slab-on-grade floors shall be insulated according to the requirements in TABLE 110.8 ~~TABLE 118-A~~B.

1. Insulation materials in ground contact must:

   A. Comply with the certification requirements of Section 110.8(a); and

   B. Have a water absorption rate for the insulation material alone without facings that are no greater than 0.3 percent when tested in accordance with Test Method A – 24 Hour-Immersion of ASTM C272.

2. Insulation installation must:

   A. Cover the insulation with a solid guard that protects against damage from ultraviolet radiation, moisture, landscaping operation, equipment maintenance, and wind; and

   B. Include a rigid plate, which penetrates the slab and blocks the insulation from acting as a conduit for insects from the ground to the structure above the foundation.

(h) **Wet Insulation Systems.** When insulation is installed on roofs above the roofing membrane or layer used to seal the roof from water penetration, the effective R-value of the insulation shall be as specified in Reference Joint Appendix JA4.

(i) **Roofing Products Solar Reflectance and Thermal Emittance.**

1. In order to meet the requirements of Sections 140.1, 140.2, 140.3(a)1, 1410.90(b)1B, 150.1(cf)12, 150.2(b)1H or 152(b)2, a roofing product's thermal emittance and an 3 year aged solar reflectance shall be certified and labeled according to the requirements of Section 10-113.

   EXCEPTION to Section 110.8(i)1: Roofing products that are not certified according to Section 10-113 shall assume the following default aged reflectance/emittance values:

   A. For asphalt shingles, 0.08/0.75

   B. For all other roofing products, 0.10/0.75

2. If CRRC testing for an 3 year aged solar reflectance is not available for any roofing products, the 3 year aged value shall be derived from the CRRC initial value using the equation $\rho_{aged}=[0.2+\beta[\rho_{initial}-0.2]$ ~~$R_{aged} = [0.2+0.7[\rho_{initial} 0.2]$~~, wWhere $\rho_{initial}$ = the initial sSolar rReflectance and soiling resistance β is listed by product type in Table 110.8-A.

TABLE 110.8-A VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

Product Type	CRRC Product Category	β
Field-Applied Coating	Field-Applied Coating	0.65
Other	Not A Field-Applied Coating	0.70

3. Solar Reflectance Index (SRI), calculated as specified by ASTM E 1980-01, may be used as an alternative to thermal emittance and an 3 year aged solar reflectance when complying with the requirements of Sections 140.1, 140.2, 140.3(a)1, 140.9141.0(b)1B, 150.1(cf)12, 150.2(b)1H.,or 150.2(b)2. SRI calculations shall be based on moderate wind velocity of 2-6 meters per second. The SRI shall be calculated based on the 3 year aged reflectance value of the roofing products.

4. Liquid applied roof coatings applied to low-sloped roofs in the field as the top surface of a roof covering shall:

   A. Be applied across the entire roof surface to meet the dry mil thickness or coverage recommended by the coating manufacturer, taking into consideration the substrate on which the coating is applied, and

   B. Meet the minimum performance requirements listed in TABLE 110.8-CTABLE 118-BC or the minimum performance requirements of ASTM C836, D3468, D6083, or D6694, whichever are appropriate to the coating material.

      EXCEPTION 1 to Section 110.8(i)4B:

      Aluminum-pigmented asphalt roof coatings shall meet the requirements of ASTM D2824 or ASTM D6848 and be installed as specified by ASTM D3805.

      EXCEPTION 2 to Section 110.8(i)4B:

      Cement-based roof coatings shall contain a minimum of 20 percent cement and shall meet the requirements of ASTM C1583, ASTM D822, and ASTM D5870.

TABLE 110.8-~~A~~B SLAB INSULATION REQUIREMENTS FOR HEATED SLAB-ON-GRADE

Insulation Location	Insulation Orientation	Installation Requirements	Climate Zone	Insulation R-Factor
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where this is less than the required depth. For below grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or to the frost line, whichever is greater.	1 – 15	5
			16	10
Between heated slab and outside foundation wall	Vertical and Horizontal	Vertical insulation from top of slab at inside edge of outside wall down to the top of the horizontal insulation. Horizontal insulation from the outside edge of the vertical insulation extending 4 feet toward the center of the slab in a direction normal to the outside of the building in plan view.	1 – 15	5
			16	10 vertical and 7 horizontal

TABLE 110.8-~~C~~B MINIMUM PERFORMANCE REQUIREMENTS FOR LIQUID APPLIED ROOF COATINGS

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 200% 73° F (23° C)
Initial percent elongation (break) OR Initial Flexibility	D 2370 D522, Test B	Minimum 60% 0° F (-18° C) Minimum pass 1” mandrel 0° F (-18° C)
Initial tensile strength (maximum stress)	D 2370	Minimum 100 psi (1.38 Mpa) 73° F (23° C)
Initial tensile strength (maximum stress) OR Initial Flexibility	D 2370 D522, Test B	Minimum 200 psi (2.76 Mpa) 0° F (-18° C) Minimum pass 1” mandrel 0° F (-18° C)
Final percent elongation (break) after accelerated weathering 1000 h	D2370	Minimum 100% 73° F (23° C)
Final percent elongation (break) after accelerated weathering 1000 h OR Flexibility after accelerated weathering 1000h	D2370	Minimum 40% 0° F (-18° C) Minimum pass 1” mandrel 0° F (-18° C)
Permeance	D 1653	Maximum 50 perms
Accelerated weathering 1000 h	D 4798	No cracking or checking[1]
1. Any cracking or checking visible to the eye fails the test procedure.		

(j) **Radiant Barrier.** A radiant barrier shall have an emittance of 0.05 or less, tested in accordance with ASTM C1371 or ASTM E408, shall be certified to the Department of Consumer Affairs as required by Title 24, Part12, Chapter12-13, Standards for Insulating Material.