

Compliance Forms— Building Envelope

Instructions

The following compliance forms are provided to assist in understanding and documenting compliance with the building envelope requirements of ASHRAE/IES Standard 90.1-2019. Electronic versions of the compliance forms are available for download from ASHRAE's website.

The building envelope forms are organized into two parts on four pages.

- Part I should be used with all methods of compliance. It has header information and a mandatory provisions checklist. These pages should be filled out for all compliance methods, because the mandatory provisions apply to all compliance methods.
- Part II should be used only with the Prescriptive Building Envelope Option. Part II, page 1, has header information that must be completed for each space-conditioning category (nonresidential, residential, semiheated) and a schedule of constructions for opaque surfaces. The schedule is a simple listing of each unique construction type in the building. For each item in the list, indicate the class of construction, the source of U-factor data, the proposed U-factor or insulation R-value, and the applicable U-factor or R-value criteria that the construction must meet. An entry for the surface area of this construction type in the building is available, but this entry is optional unless area weighted averaging is being used.
- Part II, page 2, of the documentation is a schedule of fenestration construction types. This table contains an item for each unique fenestration construction type. For each item in the table, indicate the class of construction, the source of data, proposed fenestration data, and the performance criteria.

Part I: Header Information

Project Name: Enter the name of the project. This should agree with the name that is used on the plans and specifications or the common name used to refer to the project.

Project Address: Enter the street address of the project, for instance, "142 First Street."

Date: Enter the date when the compliance documentation was completed.

Design Professional Name/Telephone: Enter the name and telephone number of the design professional responsible for the project. This will generally be an architecture firm.

Contact Person/Telephone: Enter the name and telephone number of the person who should be contacted if there are questions about the compliance documentation.

City: Enter the name of the city where the project is located, including the state or province and postal code, for instance, "Riverside, CA 94105."

Climate Zone: Enter the climate zone of this project.

Prescriptive Table: Enter the number of the prescriptive table used for the project (for example, 5.5-4). See Tables 5.5-0 through Table 5.5-8 for the tables for all climate locations. If the project's county or city is listed in the Standard's Appendix B, the appropriate table number will be shown next to the county or city.

Part I: Mandatory Provisions Checklist

This section of the compliance form summarizes the mandatory requirements for the design of the building envelope. The mandatory measures are organized on this form in the same order as they are in the Standard: insulation, fenestration and doors and air leakage. Checking a box indicates that the mandatory requirement applies to the building and that the building complies with the requirement. If the requirement is not applicable, check the N/A box.

Part II: Header Information

Part II is used with the Prescriptive Building Envelope Option. A separate Part II form should be completed for each space-conditioning category in the building. The project name, contact person, and telephone number should be carried over from Part I. The following additional information is required.

Space Category: Check one of the option buttons to indicate the space-conditioning category for the opaque constructions and fenestration constructions that follow.

Section 5.5.4.4.1 Exceptions: This section has checkboxes for indicating which fenestration exceptions are being used. Five exceptions are available:

- *Opaque Permanent Projections:* When this exception is taken, the shading effect of opaque overhangs can be used to adjust the proposed building's solar heat gain coefficient (SHGC). This exception can be taken on a product-by-product basis for each fenestration product. This box should be checked if an overhang credit is taken for any vertical fenestration product.
- *Partially Opaque Permanent Projections:* This exception is similar to the previous exception but applies to louvered overhangs, overhangs constructed of translucent material, and any overhang that permits some level of light transmission.
- *Street-Level Vertical Fenestration:* When this exception is taken, street-level vertical fenestration is exempt from the SHGC criteria, provided it does not exceed 75% of the gross wall area, the street-level floor-to-floor height does not exceed 20 ft (6 m), and the street-level fenestration is shaded by an overhang that has a projection factor of at least 0.5. With this exception, the street-level wall area and vertical fenestration area that qualify for the exception are ignored in the remaining vertical fenestration to gross wall area ratio calculations.
- *North-Oriented Vertical Fenestration:* For vertical fenestration oriented within 45 degrees of north (in the northern hemisphere; trade south for north in the southern hemisphere), the SHGC is allowed to be equal to or less than the area-weighted average *SHGC* of the south-, east-, and west-oriented *vertical fenestration* before any reductions made for permanent projections in Exceptions 1 and 2 of Section 5.5.4.4.1.
- *Dynamic Glazing:* An exception is allowed for the use of glazing capable of adjusting its solar performance values such as its visible transmittance (VT) and SHGC. The National Fenestration Rating Council (NFRC) rates the higher and lower performance values of dynamic glazing, but the lower SHGC rating must be used to demonstrate compliance with this exception.

Vertical Fenestration Area/Gross Wall Area: Enter the gross wall area, the total vertical fenestration area (including all areas [including the frames] in the building envelope that let in light, including windows, plastic panels, clerestories, roof monitors, doors that are more than one-half glass, and glass block walls, except for skylights) and calculate the vertical fenestration area/gross wall area ratio. When using the Prescriptive Building Envelope Option, this value must be less than 40%. The following bullets describe the information to be entered.

- *Gross Wall Area:* Sum the gross exterior wall area for the space-conditioning category. Include only exterior walls in this summation; do not include semi-exterior walls or interior partitions. The gross wall area includes vertical fenestration and doors. If you group exterior walls together when you complete Part II: Opaque Surfaces, then this form can be a useful aid in summing the exterior wall area.
- *Vertical Fenestration Area:* Sum the vertical fenestration area for the exterior walls in the space-conditioning category. Vertical fenestration area includes the frame as well as the glazed area. Note: glass spandrel area with insulation behind it is considered opaque wall. If you group vertical fenestration together by orientation when you complete Part II: Fenestration, then this form can be a useful aid in summing the vertical fenestration area.
- *Vertical Fenestration Area/Gross Wall Area:* Divide the vertical fenestration area by the gross wall area and enter the result in this box. When using the Prescriptive Building Envelope Option, the vertical fenestration area/gross wall area ratio must be less than 0.40.

- *Vertical Fenestration Area by Orientation:* List the fenestration area by orientation. East-oriented vertical fenestration is any vertical fenestration oriented within 22.5 degrees north of due east or 45 degrees south of due east. West-oriented vertical fenestration is any vertical fenestration oriented within 22.5 degrees north of due west or 45 degrees south of due west. South-oriented vertical fenestration is any vertical fenestration oriented further south than 45 degrees south of due east or west. North-oriented vertical fenestration is any vertical fenestration oriented further north than 22.5 degrees north of due east or west. The orientations listed here are for the locations in the northern hemisphere; for locations in the southern hemisphere, invert north and south in the previous descriptions.

Skylight Area/Roof Area Ratio: This portion of the form should be completed if the space-conditioning category has skylights.

- *Gross Roof Area:* Sum the gross area of all exterior roofs for the space-conditioning category. The gross area should include openings in the roof such as skylights and roof hatches. If you group roofs together when you complete Part II: Opaque Surfaces, then this form can be a useful aid in summing the roof area.
- *Skylight Area:* Sum the skylight area for the space-conditioning category. The skylight area should include the area of the frame. If you group skylights together when you complete Part II: Fenestration, then this form can be a useful aid in summing the skylight area.
- *Skylight Area/Roof Area Ratio:* Calculate the skylight area/roof area ratio by dividing the skylight area by the gross roof area and enter the result in this box. When using the Prescriptive Building Envelope Option, the skylight area/roof area ratio must be less than 0.03, or 0.06 if the daylighting requirements of Section 5.5.4.2.2 are met.

Part II: Opaque Surfaces

This portion of Part II summarizes all opaque construction types for the space-conditioning category. An entry should be made in the table for each unique construction. Part II: Header Information requires data on the roof and exterior wall area, so at a minimum, roofs and exterior walls should be grouped together. The Opaque Surfaces portion can be used to make these calculations if you group surface types together and use the optional Surface Area column. Finally, you may also want to group constructions for each class if you want to perform area-weighted averaging. The Standard permits the proposed area-weighted average U-factor to be compared to the criteria, but only within each class of construction.

The following paragraphs describe the information to be entered on this form.

Description/Name: Enter a name for each construction or enter the code used on the drawings and specifications. When the drawings and specifications already have a schedule of constructions, the names or codes should be consistent between the compliance forms and the plans and specifications.

Class: Choose the surface type and class by marking one (and only one) column. This information is used to determine the criteria for the opaque construction.

R-Value/U-Factor Option: Mark the method used for compliance for this construction. The prescriptive tables give the criteria both as a minimum insulation R-value and, for most assemblies, a maximum U-factor. For below-grade walls, the maximum U-factor is replaced with a maximum C-factor. For slabs, the U-factor is replaced with an F-factor. The R-value method is the simplest approach; you need to document only that the insulation in the construction assembly has the required thermal resistance.

Source of U-Factor Data: If Appendix A of the Standard is the source of the U-factor or C-factor data, mark Appendix A Defaults. F-factors can only be taken from Appendix A, so this is the only possible choice for slabs. If you have calculated the U-factor or C-factor, mark Calculations. Note that the restrictions in Section A1.2 apply when you calculate your own U-factors or C-factors. Basically, your construction must be significantly different from any of those already contained in Appendix A.

High Reflectance/Emittance Roof: This column applies only to roofs that do not have attics; are located in Climate Zones 0, 1, 2, or 3; and are over cooled spaces. The roof must meet one of three requirements: 1) The exterior surface of the roof must have a reflectance greater than or equal to 0.55 and a thermal emittance greater than 0.75 when tested in accordance with the CRRC S110 Standard. 2) The roof has a Solar

Reflectance Index (SRI) of at least 64 when tested in accordance with the CRRC S100 Standard. 3) The roof insulation satisfies the insulation requirements of Table 5.5.3.1.1.

Proposed Insulation R-Value, U-Factor, C-Factor, or F-Factor: Enter the thermal performance of the construction shown on the plans and specifications. If the R-value option is used, then the R-value of the insulation should be entered in this column. For some construction types, framed walls for instance, insulation can be placed in the cavity but it can also be applied in a continuous manner on the exterior or interior of the framing. In these instances, both R-values should be entered (e.g., "R-13 + R-4 c.i."). This notation means that R-13 is installed in the cavity and R-4 is installed as exterior or interior continuous insulation. Continuous insulation (c.i.) should be identified by the "c.i." designation on the construction documents.

If the U-factor, C-factor, or F-factor method is used then the value should be taken from Appendix A of the Standard or calculated using an acceptable method, as defined in Appendix A. C-factor is used for below-grade walls; F-factor for slabs; and U-factor for other constructions.

Criteria Insulation R-Value, U-Factor, C-Factor, or F-Factor: Enter the required thermal performance of the construction. The criteria are taken from the prescriptive table for the location. The data entered should be consistent with the data entered for the proposed design. If the R-value method is used, then the criteria R-value should be entered. If the U-factor method is used, then the U-factor, C-factor, or F-factor should be entered. In either case, completing this column is simply a matter of copying information from the criteria table to the compliance form.

When a building is located in climate zones 0 through 3, and when the roof surface does not comply with the high reflectance/thermal emittance, the criteria value is taken from Table 5.5.3.1.1 instead of the climate-dependent criteria tables. See the roof prescriptive requirements section for details on what qualifies as a high reflectance/emittance roof (Section 5.5.3.1.1).

Surface Area: This column is optional, but it is useful in summing wall and roof areas, which are needed for Part II: Header Information. At a minimum, roofs and exterior walls should be grouped together so that the total area can be summed and entered in the header.

Part II: Fenestration

This portion of the form is a schedule of each fenestration product in the building. Vertical fenestration and skylights should be grouped separately in the list because the area of each of these types of products must be summed and entered in Part II: Header Information. If you are taking the overhang exception (calculating an adjusted SHGC to account for the shading effect of overhangs), then you must make separate entries in the table for each vertical fenestration product with different overhang dimensions.

Description/Name: Enter a name for each fenestration product or enter the code used on the drawings and specifications. When the drawings and specifications already have a schedule of fenestration products (including windows, clerestories, roof monitors, doors, and/or skylights), the names or codes should be consistent between the compliance forms and the plans and specifications.

Class: Choose the vertical fenestration frame type or the skylight class by marking one (and only one) column. This information is used to determine the fenestration criteria.

Source of Data: Indicate the source of the performance data for the proposed fenestration. For fenestration, the performance data must be taken either from NFRC ratings or from Appendix A of the Standard. The Standard permits you to take U-factor data from Appendix A but take center-of-glass SHGC data from manufacturers' literature. When this is the case, mark Appendix A as the source of the data.

Area: Enter the area of the proposed fenestration. The area should include the area of the frame as well as the glazing, because the NFRC performance ratings apply to the whole assembly area. Do not include glass spandrel area with insulation behind it, as this is considered opaque wall. Separately group vertical fenestration and skylights and leave a few blank rows at the end of each grouping so that the area of that group can be summed.

U-Factor: Enter the U-factor of the fenestration. This value should be taken either from NFRC ratings or from Table A8.2 of the Standard. However, Table A8.1-1 can be used for unlabeled skylights.

SHGC: Enter the solar heat gain coefficient for the fenestration. If you are using an NFRC-rated fenestration product, the SHGC is included as part of the rating, and this value should be entered on the compliance form. For dynamic glazing, enter the lower SHGC rating from the NFRC label or certificate. For skylights only, if you are using Table A8.1-1 for U-factor data, then Table A8.1-2 can be used as the source of the SHGC. However, the data in Table A8.1-2 is limited to only a few glazing types. As an alternative, you can take the center-of-glass SHGC from the manufacturer's literature and use this for compliance purposes (see Section A8 of the Standard for more information and limitations on this approach).

Overhang: If an overhang shades the vertical fenestration product, make a check in this box. Otherwise, leave the box unchecked. The box should remain unchecked for all skylights, since overhangs cannot shade skylights. In order to qualify for this credit, overhangs must be constructed so that they last as long as the building.

Projection Factor: If an overhang shades a vertical fenestration product having a south, east, or west orientation, enter the overhang projection factor for the vertical fenestration product. The projection factor is the ratio of the horizontal distance that the overhang projects from the surface of the vertical fenestration product to the vertical distance from the sill to the bottom of the overhang. This column is not applicable to vertical fenestration having a north orientation or to skylights.

Overhang Multiplier: If an overhang shades a vertical fenestration product having a south, east, or west orientation, enter the overhang multiplier. This is taken from Table 5.5.4.4.1 of the Standard. This table is not applicable to vertical fenestration having a north orientation and skylights.

Adjusted SHGC: Calculate and enter the adjusted SHGC by multiplying the SHGC of the unshaded vertical fenestration product by the overhang multiplier. This column is not applicable to vertical fenestration having a north orientation and skylights.

Criteria U-Factor: Enter the criteria U-factor for the fenestration product by selecting the appropriate criterion from the criteria table. The U-factor criterion depends on the frame type class of construction for vertical fenestration products. The proposed U-factor must be less than or equal to the criterion.

Criteria SHGC: Enter the SHGC criterion for the fenestration by selecting the appropriate criterion from the criteria table. The proposed SHGC (or adjusted SHGC) must be less than or equal to the criterion.

Building Envelope Compliance Documentation

Project Name:		
Project Address:		Date:
Design Professional Name:	Email:	Telephone:
Contact Person:	Email:	Telephone:
City:	Climate Zone:	Prescriptive Table:

Mandatory Provisions Checklist

Insulation (Section 5.4.1 and 5.8.1)

- Insulation materials are installed in accordance with manufacturer's recommendations and in such a manner as to achieve rated R-value of insulation.
 - Exception: compressed cavity insulation per Exception 1 to Section 5.8.1.2.
 - Exception: metal building roofs or metal building walls per Exception 2 to Section 5.8.1.2.
- Loose-fill insulation is not used in attic roof spaces when the slope of the ceiling is more than three in twelve.
- Attic eave vents have baffling to deflect the incoming air above the surface of the insulation.
- Insulation is installed in a permanent manner in substantial contact with the inside surface.
- Batt insulation installed in floor cavities is supported in a permanent manner by supports no greater than 24 in. (600 mm) on center.
- Lighting fixtures, HVAC, and other equipment are not recessed into the building envelope in such a manner to affect the insulation thickness.

Exceptions:

 - The recessed area is less than 1% of the total opaque area of the assembly.
 - The entire roof, wall, or floor is covered with insulation to the full depth required.
 - The effects of reduced insulation are included in calculations using an area-weighted average.
- Roof insulation is not installed over a suspended ceiling with removable ceiling panels.
- Exterior insulation is covered with a protective material to prevent damage from sunlight, moisture, wind, landscaping operations, and equipment maintenance.
- Insulation is protected in attics and mechanical rooms where access is needed.
- Foundation vents do not interfere with the insulation.
- Insulation materials in ground contact have a water absorption rate no greater than 0.3%.
- Where two or more layers of rigid insulation board are used in a construction assembly, the edge joints between each layer of boards is staggered.

Fenestration and Doors (Section 5.4.2 and 5.8.2)

- U-factors are determined in accordance with NFRC 100. U-factors for skylights shall be determined for a slope of 20° above the horizontal.

Exceptions:

 - U-factors are taken from Section A.8.1 for skylights.
 - U-factors are taken from Section A.8.2 for vertical fenestration.
 - U-factors are taken from Section A.7 for opaque doors.
 - U-factors are derived from DASMA 105 for sectional garage doors and metal coiling doors.
- Solar heat gain coefficient (SHGC) is determined in accordance with NFRC 200.

Exceptions:

 - SHGC is determined by multiplying the shading coefficient (SC) of the center of the glass by 0.86. Shading coefficient is determined using a spectral data file determined in accordance with NFRC 300.
 - SHGC for the center of glass is used. SHGC is determined using a spectral data file determined in accordance with NFRC 300.
 - SHGC is taken from Section A8.1 for skylights.
 - SHGC is taken from Section A8.2 for vertical fenestration.
- Visible transmittance (VT) is determined in accordance with NFRC 200.

Exception:

 - VTannual determined in accordance with NFRC 203 for tubular daylight devices.
 - For skylights whose transmittances are not within the scope of NFRC 200, their transmittance is the solar photometric transmittance of the skylight glazing materials determined in accordance with ASTM E972.

Building Envelope Compliance Documentation**Air Leakage (Section 5.4.3)**

The building envelope has a continuous air barrier meeting the requirements of Section 5.4.3.1.

Air leakage through fenestration and doors meets the requirements of Section 5.8.3.2.

Exceptions:

- Field-fabricated fenestration and doors.
- Metal coiling doors in semiheated spaces in Climate Zones 0 through 6.
- Products that comply with the maximum whole-building leakage rate per Exception 3 to Section 5.8.3.2.

Cargo doors and loading dock doors are equipped with weatherseals in Climate Zone 0 and Climate Zones 4 through 8.

Building entrances have vestibules or revolving doors.

Exceptions:

- Doors not intended as building entrance.
- Doors opening directly from a dwelling unit.
- Building entrances in buildings located in Climate Zone 1 or 2.
- Semiheated spaces.
- Building entrances in buildings located in Climate Zone 3 that are both (1) less than four stories and (2) smaller than 10,000 ft² (1,000 m²) in gross conditioned floor area.
- Building entrances in buildings located in Climate Zones 0, 4, 5, 6, 7, and 8 less than 1,000 ft² (100 m²) in gross floor area.
- Doors separate from the building entrance that open into spaces smaller than 3,000 ft² (300 m²) in gross conditioned floor area.
- Building entrances in building located in Climate Zones 0, 3, and 4 that have self-closing doors with an air curtain that complies with 10.4.5.
- Building entrances in building located in Climate Zones 5 through 8 that are 15 stories or less and have self-closing doors with an air curtain that complies with 10.4.5.

Building Envelope Compliance Documentation

Project Name:					
Contact Person:		Email:			
Telephone:					
Space Category	Section 5.5.4.4.1 Exceptions	Allowable Vertical Fenestration Area		Allowable Skylight Area	
<input type="checkbox"/> Nonresidential Conditioned Space <input type="checkbox"/> Residential Conditioned Space <input type="checkbox"/> Semiheated Space (complete separate Part II form for each space conditioning category)	<input type="checkbox"/> Opaque Permanent Projections	<input type="text"/>	Gross Wall Area (ft ² or m ²)	<input type="text"/>	
	<input type="checkbox"/> Partially Opaque Permanent Projections	<input type="text"/>	Vertical Fenestration Area (ft ² or m ²)	<input type="text"/>	
	<input type="checkbox"/> Street-Side Street-Level Vertical Fenestration	<input type="text"/>	North-Oriented Vertical Fenestration Area (ft ² or m ²)	Section 5.5.4.5 Orientation <input type="radio"/> Option a: Area Only (fill in % area for east and west fenestration area) <input type="radio"/> Option b: Area and SHGC	<input type="text"/>
	<input type="checkbox"/> Dynamic Glazing	<input type="text"/>	South-Oriented Vertical Fenestration Area (ft ² or m ²)		<input type="text"/>
	<input type="checkbox"/> North-Oriented Fenestration	<input type="text"/>	East-Oriented Vertical Fenestration Area (ft ² or m ²)	<input type="text"/>	<input type="text"/>
			West-Oriented Vertical Fenestration Area (ft ² or m ²)	<input type="text"/>	<input type="text"/>
			% of Total Vertical Fenestration Area (must be ≤25%)	<input type="text"/>	
			% of Total Vertical Fenestration Area (must be ≤25%)	<input type="text"/>	
				Gross Roof Area (ft ² or m ²) Skylight Area (ft ² or m ²) Skylight Area/Roof Area Ratio Section 5.5.4.2.3: Space requires minimum skylight area?	

Opaque Surfaces

Description/Name	Class (Pick one)										Pick one	Pick one	High Reflectance/Emissance Roof	Proposed U-Factor, Insulation R-Value, C-Factor, or F-Factor	Criteria U-Factor, Insulation R-Value, C-Factor, or F-Factor	Surface Area (ft ² or m ²) (Optional, except for Area Weighted Averaging)	
	Roof		Wall			Floor		Slab		Door							
	Insulation Above Deck	Metal Building Attic and Other	Mass	Metal Building Steel-Framed	Wood-Framed / Other	Below-Grade Wall	Mass	Steel Joist	Wood-Framed / Other	Unheated Heated							Swinging
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Building Envelope Compliance Documentation

Project Name:		
Contact Person:	Email:	Telephone:

Fenestration

Description/Name	Fenestration (Pick one)				NFRC Rating	Appendix A Defaults	Proposed Fenestration						Criteria	
	Skylight	Fixed vertical	Operable vertical	Entrance door			Area	U-Factor	Solar Heat Gain Coefficient (SHGC)	Overhang	Projection Factor	Overhang Multiplier	Adjusted Solar Heat Gain Coefficient (SHGC)	U-Factor
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