

Houston Amendments to ASHRAE Standard 90.1-2013



Adopted by Ord. No. 2016-865

Passed 11/09/2016, Effective 12/09/2016

1. PURPOSE

1.1 To establish the minimum energy efficiency requirements of buildings other than low-rise residential buildings for

- a. design, construction, and a plan for operation and maintenance; and
- b. utilization of on-site, renewable energy resources.

1.2 This standard shall be known as the *City of Houston Commercial Energy Conservation Code – ASHRAE 90.1-2013*, may be cited as such, and shall be referred to herein as “this standard.” *The City of Houston Construction Code* collectively includes this volume and certain other codes, pamphlets, specifications, and documents that are adopted in or by reference to the Adopting Ordinance, City of Houston Ordinance No. 2015-1108.

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3. DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

3.1 General. Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard. Terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based upon American standard English language usage as documented in an unabridged dictionary accepted by the adopting authority. Terms that are not defined in this code but are defined in other volumes of the *City of Houston Construction Code* shall have the meanings ascribed to them in those codes.

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4. ADMINISTRATION AND ENFORCEMENT

4.1.1.4 Replacement of Portions of Existing Buildings and Maintenance. Portions of a building envelope, heating, ventilating, air conditioning, service water heating, power, lighting, and other systems and equipment that are being replaced or serviced for maintenance shall be considered as alterations of existing buildings and shall comply with the standard as described in Section 4.2.

4.1.2 Administrative Requirements. Administrative requirements relating to permit requirements, enforcement by the authority having jurisdiction, locally adopted energy standards, interpretations, claims of exemption, revocation, and rights of appeal shall be as set forth in the applicable volume of the *City of Houston Construction Code* ~~are specified by the authority having jurisdiction.~~

4.2.1.3 Alterations of Existing Buildings: Alterations of existing buildings shall comply with the provisions of Sections 5, 6, 7, 8, 9, and 10, provided, however, that nothing in this standard shall require compliance with any provision of this standard if such compliance will result in the increase of energy consumption of the building.

Exceptions:

1. A building that has been specifically designated as historically significant by the adopting authority or is listed in The National Register of Historic Places or has been determined to be eligible for listing by the U.S. Secretary of the Interior need not comply with these requirements.
2. Where one or more components of an existing building or portions thereof are being replaced, the annual energy consumption of the comprehensive design shall not be greater than the annual energy consumption of a substantially identical design, using the same energy types, in which compliance with the applicable requirements of Sections 5, 6, 7, 8, 9, and 10, as provided in Section 4.2.1.2.1, is verified by a registered design professional by the use of any calculation methods acceptable to the authority having jurisdiction.

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5. BUILDING ENVELOPE

5.1.4 Climate. ~~Determine the climate zone for the location. For U.S. locations, follow the procedure in Section 5.1.4.1. For international locations, follow the procedure in Section 5.1.4.2. Exterior design conditions shall be as set forth in Table 5.1.4.~~

TABLE 5.1.4 Exterior Design Conditions

<u>CONDITION</u>	<u>VALUE</u>
<u>Winter, design dry-bulb (E_F)</u>	<u>28° F</u>
<u>Summer, design dry-bulb</u>	<u>96° F</u>
<u>Summer, design wet-bulb</u>	<u>80.5° F</u>
<u>Degree days heating (base 65)</u>	<u>1371</u>
<u>Degree days cooling (base 50)</u>	<u>7357</u>
<u>Climate zone</u>	<u>2A</u>

~~**5.1.4.1 United States Locations.** Use Figure B1-1 or Table B1-1 in Appendix B to determine the required climate zone.~~

~~**Exception:** If there are recorded historical climatic data available for a construction site, they may be used to determine compliance if approved by the building official.~~

~~**5.1.4.2 International Locations.** For locations in Canada that are listed in Table B1-2 in Appendix B, use this table to determine the required climate zone number and, when a climate zone letter is also required, use Table B1-4 and the Major Climate Type Definitions in Appendix B to determine the letter (A, B, or C). For locations in other international countries that are listed in Table B1-3, use this table to determine the required climate zone number and, when a climate zone letter is also required, use Table B1-4 and the Major Climate Type Definitions in Appendix B to determine the letter (A, B, or C). For all international locations that are not listed either in Table B1-2 or B1-3, use Table B1-4 and the Major Climate Type Definitions in Appendix B to determine both the climate zone letter and number.~~

~~**5.4.3.3 Loading Dock Weatherseals.** In Climate zones 4 through 8, In conditioned warehouses, cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.~~

5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance. Roofs in Climate Zones 1 through 3 shall have one of the following:

- a. A minimum three-year-aged solar reflectance of 0.55 and a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with CRRC-1 Standard
- b. A minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft²·°F, based on three-year-aged solar reflectance and three-year-aged thermal emittance tested in accordance with CRRC-1 Standard
- c. Increased roof insulation levels found in Table 5.5.3.1.1

Exceptions:

1. Ballasted roofs with a minimum stone ballast of ~~17 lb/ft² or 23 lb/ft² pavers~~1½ inches nominal diameter
2. Vegetated roof systems that contain a minimum thickness of 2.5 in. of growing medium and covering a minimum of 75% of the roof area with durable plantings
3. Roofs where a minimum of 75% of the roof area
 - a. is shaded during the peak sun angle on June 21 by permanent components or features of the building;
 - b. is covered by offset photovoltaic arrays, building-integrated photovoltaic arrays, or solar air or water collectors; or
 - c. is permitted to be interpolated using a combination of 1 and 2 above
4. Steep-sloped roofs
5. Low-sloped metal building roofs in Climate Zones 2 and 3.
6. Roofs over ventilated attics, roofs over semi- heated spaces, or roofs over conditioned spaces that are not cooled spaces
7. Asphaltic membranes in Climate Zones 2 and 3

The values for three-year-aged solar reflectance and three-year-aged thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization and shall be labeled and certified by the manufacturer.

5.9 Building Envelope Commissioning. For projects larger than 50,000 ft² conditioned area, except heated only warehouses and semiheated spaces, detailed instructions for commissioning building envelope systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.

6. HEATING, VENTILATING, AND AIR CONDITIONING

6.3.2 Criteria: The HVAC system must meet ALL of the following criteria:

- a. The system serves a single HVAC zone.
- b. The equipment must meet the variable flow requirements of Section 6.5.3.2.1.
- c. Cooling (if any) shall be provided by a unitary packaged or split-system air conditioner that is either air cooled or evaporatively cooled, with efficiency meeting the requirements shown in Table 6.8.1-1 (air conditioners), Table 6.8.1-2 (heat pumps), or Table 6.8.1-4 (packaged terminal and room air conditioners and heat pumps) for the applicable equipment category.
- d. The system shall have an air economizer meeting the requirements of Section 6.5.1.
- e. Heating (if any) shall be provided by a unitary packaged or split-system heat pump that meets the applicable efficiency requirements shown in Table 6.8.1-2 (heat pumps) or Table 6.8.1-4 (packaged terminal and room air conditioners and heat pumps), a fuel-fired furnace that meets the applicable efficiency requirements shown in Table 6.8.1-5 (furnaces, duct furnaces, and unit heaters), an electric resistance heater, or a baseboard system connected to a boiler that meets the applicable efficiency requirements shown in Table 6.8.1-6 (boilers).
- f. The system shall meet the exhaust air energy recovery requirements of Section 6.5.6.1.
- g. The system shall be controlled by a manual changeover or dual setpoint thermostat.
- h. If a heat pump equipped with auxiliary internal electric resistance heaters is installed, controls shall be provided that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation is permitted during outdoor coil defrost cycles. The heat pump must be controlled by either (1) a digital or electronic thermostat designed for heat-pump use that energizes auxiliary heat only when the heat pump has insufficient capacity to maintain setpoint or to warm up the space at a sufficient rate or (2) a multistage space thermostat and an outdoor air thermostat wired to energize auxiliary heat only on the last stage of the space thermostat and when outdoor air temperature is less than 40°F.

Exception: Heat pumps that comply with the following:

1. Have a minimum efficiency regulated by NAECA
 2. Meet the requirements in Table 6.8.1-2
 3. Include all usage of internal electric resistance heating
- i. ~~**DELETE AND RESERVE.** The system controls shall not permit reheat or any other form of simultaneous heating and cooling for humidity control.~~
 - j. Systems serving spaces other than hotel/motel guest rooms, and other than those requiring continuous operation, which have both a cooling or heating capacity greater than 15,000 Btu/h and a supply fan motor power greater than 0.75 hp, shall be provided with a time clock that (1) can start and stop the system under different schedules for seven different day types per week, (2) is capable of retaining programming and time setting during a loss of power for a period of at least ten hours, (3) includes an accessible manual override that allows temporary operation of the system for up to two hours, (4) is capable of temperature setback down to 55°F during off hours, and (5) is capable of temperature setup to 90°F during off hours.

- k. Except for piping within manufacturers' units, HVAC piping shall be insulated in accordance with Tables 6.8.3-1 and 6.8.3-2. Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation.
- l. Ductwork and plenums shall be insulated in accordance with Tables 6.8.2-1 and 6.8.2-2 and shall be sealed in accordance with Section 6.4.4.2.1.
- m. Construction documents shall require a ducted system to be air balanced in accordance with industry accepted procedures.
- n. Outdoor air intake and exhaust systems shall meet the requirements of Section 6.4.3.4.
- o. Where separate heating and cooling equipment serves the same temperature zone, thermostats shall be interlocked to prevent simultaneous heating and cooling.
- p. Systems with a design supply air capacity greater than 10,000 cfm shall have optimum start controls.
- q. The system shall comply with the demand control ventilation requirements in Section 6.4.3.8.
- r. The system complies with the door switch requirements in Section 6.5.10.

6.4.4.2.2 Duct Leakage Tests. Ductwork that is designed to operate at static pressures in excess of 3 in. wc and all ductwork located outdoors shall be leak-tested according to industry-accepted test procedures (see Informative Appendix E). Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. All sections shall be selected by the building owner or the designated representative of the building owner. Positive pressure leakage testing is acceptable for negative pressure ductwork. The maximum permitted duct leakage shall be

$$L_{max} = C_L P^{0.65}$$

where

L_{max} = maximum permitted leakage, cfm/100 ft² duct surface area

C_L = 6, duct leakage class, cfm/100 ft² duct surface area at 1 in. wc

P = test pressure, which shall be equal to the design duct pressure class rating, in. wc

Documentation shall be furnished by the installer and given to the authority having jurisdiction demonstrating that representative sections totaling at least 25% of the duct area have been tested and that all tested sections meet the requirements of this section.

6.7.2.3.2 Air System Balancing. Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 1 hp, fan speed shall be adjusted to meet design flow conditions. Each supply outlet and zone terminal device shall be equipped with means for air balancing. Each of such systems shall be tested and calibrated to ensure they are functioning according to design.

6.7.2.3.3 Hydronic System Balancing. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Individual hydronic heating and

cooling coils shall be equipped with means for balancing and pressure test connections. Each of such systems shall be tested and calibrated to ensure they are functioning according to design.

Exceptions: Impellers need not be trimmed nor pump speed adjusted

1. for pumps with pump motors of 10 hp or less or
2. when throttling results in no greater than 5% of the nameplate horsepower draw, or 3 hp, whichever is greater, above that required if the impeller was trimmed.

6.7.2.4 System Commissioning. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft² conditioned area, except heated-only warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.

**TABLE 6.8.2-1 Minimum Duct Insulation R-Value,^a
Cooling- and Heating-Only Supply Ducts and Return Ducts**

Duct Location							
Climate Zone	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation ^a	Unconditioned Space ^b	Indirectly Conditioned Space ^c	Buried
Heating-Only Ducts							
1,2	<u>R-8</u> None	<u>R-6</u> None	<u>R-6</u> None	<u>R-6</u> None	<u>R-6</u> None	None	<u>R-6</u> None
3	R-3.5	None	None	None	None	None	None
4	R-3.5	None	None	None	None	None	None
5	R-6	R-3.5	None	None	None	None	R-3.5
6	R-6	R-6	R-3.5	None	None	None	R-3.5
7	R-8	R-6	R-6	None	R-3.5	None	R-3.5
8	R-8	R-8	R-6	None	R-6	None	R-6
Cooling-Only Ducts							
1	R-6	R-6	R-8	R-3.5	R-3.5	None	R-3.5
2	<u>R-8</u> R-6	R-6	R-6	<u>R-6</u> R-3.5	<u>R-6</u> R-3.5	None	<u>R-6</u> R-3.5
3	R-6	R-6	R-6	R-3.5	R-1.9	None	None
4	R-3.5	R-3.5	R-6	R-1.9	R-1.9	None	None
5,6	R-3.5	R-1.9	R-3.5	R-1.9	R-1.9	None	None
7,8	R-1.9	R-1.9	R-1.9	R-1.9	R-1.9	None	None
Return Ducts							
<u>2</u> 1 to 8	<u>R-8</u> R-3.5	<u>R-6</u> R-3.5	<u>R-6</u> R-3.5	<u>R-6</u> None	<u>R-6</u> None	None	R-6 None

a. Insulation R-values, measured in (h²·°F)/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of Section 6.4.4.2 or Section 5. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.

- b. Includes crawlspaces, both ventilated and non-ventilated.
- c. Includes return air plenums with or without exposed roofs above.

**TABLE 6.8.2-2 Minimum Duct Insulation R-Value,^a
Combined Heating and Cooling Supply Ducts and Return Ducts**

Duct Location							
Climate Zone	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation ^a	Unconditioned Space ^b	Indirectly Conditioned Space ^c	Buried
Supply Ducts							
1	R-6	R-6	R-8	R-3.5	R-3.5	None	R-3.5
2	R-6 R-8	R-6	R-6	R-3.5 R-6	R-3.5 R-6	None	R-3.5 R-6
3	R-6	R-6	R-6	R-3.5	R-3.5	None	R-3.5
4	R-6	R-6	R-6	R-3.5	R-3.5	None	R-3.5
5	R-6	R-6	R-6	R-1.9	R-3.5	None	R-3.5
6	R-8	R-6	R-6	R-1.9	R-3.5	None	R-3.5
7	R-8	R-6	R-6	R-1.9	R-3.5	None	R-3.5
8	R-8	R-8	R-8	R-1.9	R-6	None	R-6
Return Ducts							
1 to 8	R-3.5	R-3.5	R-3.5	None	None		None
2	R-3.5 R-8	R-3.5 R-6	R-3.5 R-6	None R-6	None R-6	None	None R-6

- a. Insulation R-values, measured in (h-ft²·°F)/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of Section 6.4.4.2 or Section 5. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.
- b. Includes crawlspaces, both ventilated and nonventilated.
- c. Includes return air plenums with or without exposed roofs above.