ASHRAE 90.1 Standard Comparison

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Climate Zone **5A**		**ASHRAE 90.1-2007 (LEED V3 2009) can be compared with IECC 2009**	**ASHRAE 90.1-2010 (LEED V4) can be compared with to IECC 2012**	**ASHRAE 90.1-2013 can be compared with IECC 2015**
SYSTEM	**Component**		Section 3 includes addtional definitons: daylight area, ulti-level occupancy sensor, critical circuit, dynamic glazing, thermally effective panel surface, field-fabricated fenestration, skylight effective aperture	Section 3 includes addtional definitons: metal-coiling door, lamp efficacy, IT equipment energy , power usage effectivness (PUE), PRV
Section 5. Building Envelope	**Air barrier Mandatory Provision**	5.4.3.1. The following areas of the building shall be sealed, caulked, gasketed to minimize air leakage: joints, junctions, openings in penetration, building assemblies used as ducts or plenums, site-bilt fenestrations and doors Air leakage: Glazing swinging and revolving doors - max 1 cfm/ft2, non-swinging doors - 0.4 cfm/ft2	5.4.3.1. The entirer building envelope shall be designed and constructed with a continious air barrier with the exception for semi-heated spaces. **Air barrier materials shall have an air permeanance not exceeding 0.004 cfm/sq ft under a pressure differential of 0.3 in wg** **Sealants, tapes, other assemblies of materials - 0.04 cfm/ft2** **Curtainwall and stroefront glazing - 0.06 cfm/sf** Glazing swinging and revolving doors - 1 cfm/ft2, non-swinging doors - 0.4 cfm/ft2	Same as ASHRAE 90.1-2010
	Roof Prescriptive Option	**Non-Residential/Residential:** Insulation Entirely Above Deck *Assembly U-Value - 0.048, R-20 ci* *Attic or other roof: R-38 insulation , U-0.027* *Metal Building: R-19, U-0.065* *Reflectivity - 0.3 per Table G3.1, page 176, right column, item e.*	**Non-Residential/Residential:** Insulation Entirely Above Deck *Assembly U-Value - 0.048, R-20 ci* *Attic or other roof: R-38 insulation , U-0.027* *Metal Building: R-19, U-0.065*	**Non-Residential/Residential:** Insulation Entirely Above Deck *Assembly U-Value - 0.032, R-30 ci* *Attic or other roof: R-49 insulation, U-0.021* *Metal Building: R-10 + R11 Ls , U-0.037* *Reflectivity - 0.3 per Table G3.1. Requires roof solar reflectance and thermal emittance testing to be in accodance with CRRC-1 Standard (5.5.3.1)*
	Walls Prescriptive Option	**Non-Residential** ISteel-Framed Above Grade Wall, *Assembly U-Value - 0.064 (R-13 + R-7.5 ci)* Mass Wall Assembly U-value -0.09 (R-11.4 ci) Metal Building U-value 0.113 (R-13) Wood-Framed U-value 0.064 (R-13 +R-3.8 ci) **Residential** Mass Wall Assembly U-value -0.080 (R-13.3 ci) Air leakage requirement - N/A	**Non-Residential** ISteel-Framed Above Grade Wall, *Assembly U-Value - 0.064 (R-13 + R-7.5 ci)* Mass Wall Assembly U-value -0.09 (R-11.4 ci) Metal Building U-value 0.069 (R-13+R-5.6 ci) Wood-Framed U-value 0.064 (R-13 +R-3.8 ci) **Residential** Mass Wall Assembly U-value -0.080 (R-13.3 ci) Air leakage requirement - N/A	**Non-Residential** ISteel-Framed Above Grade Wall, *Assembly U-Value - 0.055 (R-13 + R-10 ci)* Mass Wall Assembly U-value -0.090 (R-11.4 ci) Metal Building U-value 0.050 (R-19 ci) Wood-Framed U-value 0.051 (R-13 +R-7.5 ci) **Residential** Mass Wall Assembly U-value -0.080 (R-13.3 ci) Air leakage requirement - not exceed 0.4cfm/SF of wall.
	Floors Prescriptive Option	**Non-Residential** Slab-On-Grade: *F-Value - 0.73, No Insulation* *Exposed Mass Foor/Ceiling:* *U-0.074, R-10.4 ci* **Residential** Exposed Mass Foor/Ceiling: U-0.064, R-12.5 ci Slab-On-Grade Unheated: F-Value - 0.54, R-10 for 24"	**Non-Residential** Slab-On-Grade: *F-Value - 0.73, No Insulation* *Exposed Mass Foor/Ceiling:* *U-0.074, R-10.4 ci* **Residential** Exposed Mass Foor/Ceiling: U-0.064, R-12.5 ci Slab-On-Grade Unheated: F-Value - 0.54, R-10 for 24"	**Non-Residential** **S**lab-On-Grade: F-Value - 0.52, R-15 for 24" Exposed Mass Foor/Ceiling: U-0.057, R-14.6 ci **Residential** Exposed Mass Foor/Ceiling: U-0.041, R-16.7 ci Slab-On-Grade Unheated: F-Value - 0.51, R-20 for 24"
	Vertical Glazing Prescriptive Option	**All Areas** 0-40% of Wall Area, all exposures. Curtainwall System: *Assembly U-Value - 0.45, SHGC - 0.40;* *Window U-value -0.55, SHGC - 0.4* *Glass Door U-value - 0.8 SHGC - 0.40;* *Swining Door U-value - 0.7*	**All Areas** 0-40% of Wall Area, all exposures. Curtainwall System: *Assembly U-Value - 0.45, SHGC - 0.40;* *Window U-value -0.55, SHGC - 0.4* *Glass Door U-value - 0.8 SHGC - 0.40;* *Swining Door U-value - 0.7 Residential U-value -0.5*	**All Areas** 0-40% of Wall Area, all exposures. Curtainwall System: *Assembly U-Value - 0.42, SHGC - 0.40; VT/SHGC -1.1* *Curtainwall System Operable: Assembly U-Value - 0.50, SHGC - 0.40; VT/SHGC -1.1* *Window U-value -0.42, SHGC - 0.4, VT/SHGC -1.1* *Glass Door U-value - 0.77 SHGC - 0.40; VT/SHGC -1.1* *Swining Door U-value - 0.5* *Low-e requirements for strom window retrofits*
Electrical Systems	**Lighting Power Densitiy (using space-by-space method Prescriptive Option)** **All controls are mandatory requirements**	**Interior Lighting** Office - 1.1 W/sqft Lobby/Waiting - 1.3 W/sqft Corridors - 0.5 W/sqft Kitchen - 1.2 W/sqft Breakroom - 0.9 W/sqft Conference - 1.3 W/sqft Active Storage - 0.8 W/sqft Electrical / Mechanical - 1.5 W/sqft Restrooms - 0.9 W/sqft Data / Communication = 1.5 W/sqft Dining Area = 0.9 W/sqft Laundry = 0.6 W/sqft Apartments/Hotel Rooms = 1.1 W/sqft Exercise Area = 0.9 W/sqft Retail -1.7 W/sqft Stairway -0.69 W/SF 1. Occupancy sensor or time switch that turns lighting off within 30 minutes after the last occupant in conference/meeting and break/lunch rooms, classrooms 2. Automatic shut off of Lighting is required in buildings > 5,000 SF 3. Enlosed spaces must have manual or automatic control for general lighting ASHRAE 90.1 Standard does not apply to lighting within dwelling units or any emergency lighting	**Interior Lighting** Office - 0.98-1.11 W/sqft Lobby/Waiting - 0.64-0.90 W/sqft Corridors - 0.66 W/sqft Kitchen/Breakroom - 0.99 W/sqft Conference - 1.23 W/sqft Training - 1.24 W/sqft Storage - 0.63 W/sqft Electrical / Mechanical - 0.95 W/sqft Restrooms - 0.98 W/sqft Data / Communication = 0.95 W/sqft Dining Area = 0.9 W/sqft Laundry = 0.6 W/sqft Apartments/Hotel Rooms = 1.11 W/sqft Exercise Area = 0.72 W/sqft Retail -1.1 W/sqft Stairway -0.69 W/SF 1. Occupancy sensor or time switch that turns lighting off within 30 minutes after the last occupant in conference/meeting and break/lunch rooms, classrooms, lecture halls, training rooms, storages, restrooms, locker/dressing, fitting rooms,offices less than 250 SF 2. Automatic shut off of Lighting is required in all spaces 3. Enlosed spaces must have Manual On or Automatic On to 50% or less control for general lighting 4. Enclosed spaces muct have controls that reduce the power level by 30-70% ofull connected load in addition to turning off all lighting 5. Automatic, multi-level daylighting contols mut be installed in enclosed spaces with sidelit areas 250 SF or more and all toplit areas greater than 900 SF 6. Parking Grage Lighting must be reduced automatically by at least 30% of connected power when motion is not detected within 30 minutes. Automatic daylighting controls must be installed for perimeter lighting 7. All Installed lighting controls must be tested and documentation must be submitted certifying compliance ASHRAE 90.1 Standard does not apply to lighting within dwelling units or any emergency lighting	**Interior Lighting** Office - 0.98-1.11 W/sqft Lobby/Waiting - 0.59-1.8 W/sqft (varies based on facility type) Corridors - 0.41-0.92 W/sqft Kitchen- 1.21 W/sqft Breakroom - 0.73-0.92 W/sqft Conference - 0.72-1.23 W/sqft Active Storage - 0.63-1.24 W/sqft Electrical / Mechanical - 0.42 W/sqft Restrooms - 0.98-1.21 W/sqft Data / Communication = 1.71 W/sqft Dining Area = 0.89 W/sqft Laundry = 0.6 W/sqft Apartments/Hotel Rooms = 0.91 W/sqft Exercise Area = 0.72 W/sqft Retail -1.1 W/sqft Stairway -0.69 W/SF 1. Occupancy sensor or time switch that turns lighting off within 30 minutes after the last occupant in conference/meeting and break/lunch rooms, classrooms, lecture halls, training rooms, storages, restrooms, locker/dressing, fitting rooms,offices less than 250 SF 2. Automatic shut off of Lighting is required in all spaces 3. Enlosed spaces must have Manual On or Automatic On to 50% or less control for general lighting 4. Enclosed spaces muct have controls that reduce the power level by 30-70% ofull connected load in addition to turning off all lighting 5. Automatic, multi-level daylighting contols mut be installed in enclosed spaces with sidelit areas 250 SF or more and all toplit areas greater than 900 SF 6. Parking Grage Lighting must be reduced automatically by at least 30% of connected power when motion is not detected within 30 minutes. Automatic daylighting controls must be installed for perimeter lighting 7. All Installed lighting controls must be tested and documentation must be submitted certifying compliance 8. Automatic lighting controls for guestroom type spaces. Section 9.4.1.3 9. Continious Dimming controls in secondary sidelighted areas, which is based on an installed wattage rather than area of the space 10. Submittal requirements ASHRAE 90.1 Standard does not apply to lighting within dwelling units or any emergency lighting
	Power Section 8 Mandatory Provisions	1. Feeder Conductors shall be sized for a max. voltage drop of 2% at design load 2. Branch Circuits shall be sized for a max. voltage drop of 3% at design load	1. Feeder Conductors shall be sized for a max. voltage drop of 2% at design load 2. Branch Circuits shall be sized for a max. voltage drop of 3% at design load 3. Automatice receptacle control for at least 50% of all 125-volt, 15- and 20 amp receptacles in orivate offices, open offices, computer classrooms except equipment for 24/7 operation. Controls shall function in compliance with section 8.4.2	1. Feeder Conductors shall be sized for a max. voltage drop of 2% at design load 2. Branch Circuits shall be sized for a max. voltage drop of 3% at design load 3. Automatice receptacle control for at least 50% of all 125-volt, 15- and 20 amp receptacles in all private offices =, conference rooms, printing/copy rooms, breakrooms, classrooms, and individual workstations except equipment for 24/7 operation. Controls shall function in compliance with section 8.4.2 4. Automatice receptacle control for at least 25% of branch circuits feeders installed for modular furniture not shown in construction document. 5. Electrical Energy Monitoring for total electricsal use, HVAC Systems, Interior lighting, exterior lighting, receptacle circuits. All data shall be recorded for every 15 minutes with the data storage for 36 months and shall be available for a tenant. Exception: Building less than 25,000 ft2, dwelling units 6. Low-Voltage Dry-type Transformers shall comply with EPAct 2005 and efficicnecies by Table 8.4.4. Exceptions based on EPAct 2005 and 10CFR 431 7. Section 10.4.5 Whole-Building Energy Monitoring: Gas, Chilled Water, Hot Water, Steam for every 60 minutes with the data storage for 36 months
	Site Exterior Lighting **All controls are mandatory requirements**	Parking Lots and Drives - 0.15 W/SF Walkways <10 ft -1W/lin ft Walkways ≥ 10 ft - 0.2 W/SF Maiin Entry - 30W/lin ft Other Doors - 20W/lin ft Canopies/Overhangs -1.25 W/ft2 Building façade -0.2 W/ft2 1. Lighting must be OFF during the day (when daylight available)	Requirements based on the lighting zone 0,1,2,3 or 4. more stingent and detailed than ASHRAE 90.1-2007 Parking Lots and Drives - 0.04-13 W/SF Walkways <10 ft -0.7-1 W/lin ft Walkways ≥ 10 ft - 0.14-0.2 W/SF Maiin Entry - 20-30 W/lin ft Other Doors - 20 W/lin ft Canopies/Overhangs -0.6-1.0 W/ft2 Building façade -0.1-0.2 W/ft2 1. Lighting must be OFF during the day by photosensor 2. Lightign is regulated during the night so it is either OFF or operating at a reduced level depending on the purpose of the lighting	Requirements based on the lighting zone 0,1,2,3 or 4. more stingent and detailed than ASHRAE 90.1-2007 1. Lighting must be OFF during the day by photosensor 2. Lightign is regulated during the night so it is either OFF or operating at a reduced level depending on the purpose of the lighting
HVAC Systems	**Baseline HVAC System Type(s)**	Gas/Hybrid: **ASHRAE 90.1 System 1** Packaged PTAC with HW Fossil Boilers (Residential) **ASHRAE 90.1 System 3** Packaged DX AC with gas-fired heat exchangers (Non-Residential and 3 floors or less and <25,000 ft2) **ASHRAE 90.1 System 5** Packaged VAV with Reheat with HW Fossil Boilers (Nonresidential and 4 or 5 floors and < 25,000 ft2 or 5 floors or less and 25,000 to 150,000 ft2) **ASHRAE 90.1 System 7 P**ackaged VAV with Reheat with HW Fossil Boilers (Nonresidential and more than 5 floors or > 150,000 ft2)	Gas/Hybrid: **ASHRAE 90.1 System 1** Packaged PTAC with HW Fossil Boilers (Residential) **ASHRAE 90.1 System 3** Packaged DX AC with gas-fired heat exchangers (Non-Residential and 3 floors or less and <25,000 ft2) **ASHRAE 90.1 System 5** Packaged VAV with Reheat with HW Fossil Boilers (Nonresidential and 4 or 5 floors and < 25,000 ft2 or 5 floors or less and 25,000 to 150,000 ft2) **ASHRAE 90.1 System 7 P**ackaged VAV with Reheat with HW Fossil Boilers (Nonresidential and more than 5 floors or > 150,000 ft2) **ASHRAE 90.1 System 9** Heating & Ventilation with fossil fuel (Heated Only Storage)	Climate Zone 4-8: **ASHRAE 90.1 System 1** Packaged PTAC with HW Fossil Boilers (Residential) **ASHRAE 90.1 System 3** Packaged DX AC with gas-fired heat exchangers (Public Assembly <120,000 ft2 , Retail and 2 floors or less, Non-Residential and 3 floors or less and <25,000 ft2) **ASHRAE 90.1 System 5** Packaged VAV with Reheat with HW Fossil Boilers (Nonresidential and 4 or 5 floors and < 25,000 ft2 or 5 floors or less and 25,000 to 150,000 ft2) **ASHRAE 90.1 System 7 P**ackaged VAV with Reheat with HW Fossil Boilers (Nonresidential and more than 5 floors or > 150,000 ft2) **ASHRAE 90.1 System 9** Heating & Ventilation with fossil fuel (Heated Only Storage) **ASHRAE 90.1 System 12** - Single Zone Constant Volume, Hot Water (Public assembly)
	Energy Recovery Section 6.5.6 Prescriptive Option	Required if system has more than 5,000 cfm and minimum OA of 70% or greater. 50% efficiency. Exception: systems that are not cooled and are heated to less than 60F Lab systems, cooling systems in zones 3c, 4c,5b,5c,6b,7,8. etc	Required for systems that exceeds values of Table 6.5.6.1 50% efficiency. Exception: systems that are not cooled and are heated to less than 60F; Lab systems meeting 6.5.7.2; Cooling systems in zones 3c, 4c,5b,5c,6b,7,8. etc	Required for systems that exceeds values of Table 6.5.6.1-1 or 6.5.6.1-2 (more stringent that 90.1-2010) 50% efficiency. Exception: systems that are not cooled and are heated to less than 60F; Lab systems meeting 6.5.7.2; Cooling systems in zones 3c, 4c,5b,5c,6b,7,8. etc
	FAN POWER Prescriptive Option	CV SYSTEM: HP ≤ CFM * 0.0011 BHP ≤ CFM*0.00094+ A VAV SYSTEM: HP ≤ CFM * 0.0015 BHP ≤ CFM*0.0013+ A A = SUM (PD*CFM/4131) , PD from Table 6.5.3.1.1B 1. Fan with motors 10 hp or larger shall have variable speed drive. 2. Motors efficicnecy must comply with EPAct 1992 as shown in Table 10.8	CV SYSTEM: HP ≤ CFM * 0.0011 BHP ≤ CFM*0.00094+ A VAV SYSTEM: HP ≤ CFM * 0.0015 BHP ≤ CFM*0.0013+ A A = SUM (PD*CFM/4131) , PD from Table 6.5.3.1.1B 1. Fan with motors 10 hp or larger shall have variable speed drive. 2. Motors efficicnecy must comply with EPAct 1992 as shown in Table 10.8A before December 19, 2010 Motors efficicnecy must comply with EIA 2007 as shown in Table 10.8-1b afterDecember 19, 2010 3. Multiple-zone VAV System Ventilation Optimization Control	CV SYSTEM: HP ≤ CFM * 0.0011 BHP ≤ CFM*0.00094+ A VAV SYSTEM: HP ≤ CFM * 0.0015 BHP ≤ CFM*0.0013+ A A = SUM (PD*CFM/4131) , PD from Table 6.5.3.1-2 (More stringent) 1. The fan BHP must be indicated with HP on the design documents 2. Fan efficicnecy shall have 67 FEG grade of higher. Total efficiency at the design point of operatrion shall be within 15 percentage points of the max total efficiency. Exception: fans with motor 5 hp or less. 3. All Units based on space temperature shall have 2-stage fan control with the minimum speed not exceed 66% of full load and 40% of fan power 4. All other units that control temperature by modulating the airflow to the space, shall have modulating fan controls. 5. Fractional HP motors ≥ 1/12 hp needs to be electronically-commutated motors or have a min. 70% efficiency in accordance with 10 CFR 4321 5. Motors efficicnecy must comply with EIA 2007 as shown in Table 10.8-1 6. Multiple-zone VAV System Ventilation Optimization Control
	Cooling Efficiency Mandatory Provisions	Air Conditioners, Air cooled: < 65 Mbh -13 SEER ≥ 65 Mbh - <135 Mbh - 11 EER ≥ 135 Mbh - < 240 Mbh - 10.8 EER ≥ 240 Mbh - < 760 Mbh - 9.8 EER ≥ 760 Mbh - 9.5 EER	Air Conditioners, Air cooled: < 65 Mbh -13 SEER ≥ 65 Mbh - <135 Mbh -11 EER/ 11.2 IEER ≥ 135 Mbh - < 240 Mbh - 10.8 EER/11.0 IEER ≥ 240 Mbh - < 760 Mbh -9.8 EER/9.9 IEER ≥ 760 Mbh - 9.5 EER/ 9.6 IEER Computer and VRF Air-to-Air unit efficiencies based on equipment size	Air Conditioners, Air cooled: < 65 Mbh -14 SEER ≥ 65 Mbh - <135 Mbh - 12.7 IEER ≥ 135 Mbh - < 240 Mbh - 11.6 IEER ≥ 240 Mbh - < 760 Mbh -11.4 IEER ≥ 760 Mbh - 11 IEER Computer and VRF Air-to-Air unit efficiencies based on equipment size Efficiency Requirements for evaporative condensers with ammonia refrigerants
	Controls Prescriptive Option	1. Economizer is required for units ≥ 135,000 Btuh Not required for residential spaces with system capacity ≤ 27,000 Btuh Intergrated economizer is required for systems ≥65,000 Btuh and 2 two stages of cooling in climate zone 3b, 4b 2. CV Systems ≥ 15,000 btuh shall have a temperature setback to 55F and 90F during unoccupied hours except spaces with contineuous operation (Mandatory) 3. Optimum start controls for systems with greater than 10,000 cfm (Mandatory) 4. Exhaust fan with greater than 300 cfm, not for continious exhuast shall have gravity or motorized damper (Mandatory) 5. Motorized damper air leakage 10 cfm/ft2 (Mandatory) 6. DCV for spaces with > 500ft2, ≤ 25 ft2/person and sustems with OA > 3000 cfm or an air-side aconomizer (Exception: Section 6.4.3.9) 7. MERV 13 Filter for ventilation systems (LEED 2009)	1. Economizer is required for units ≥ 54,000 Btuh, for computer rooms: ≥ 135,000 Btuh Not required for residential spaces with system capacity ≤ 10,800 Btuh 2. CV Systems ≥ 15,000 btuh shall have a temperature setback to 55F and 90F during unoccupied hours except spaces with contineuous operation (Mandatory) 3. Optimum start controls for systems with greater than 10,000 cfm or Indivudual heating and cooling systems with setback controls and DDC (Mandatory) 4. All outdoor air intake and exhaust systems shall be equipped with Motorized Damper (Mandatory) 5. Motorized damper air leakage 4 cfm/ft2 (Mandatory) 6. Enclosed Parking Garage Ventilation systems shall detect contaminant level and to reduce air to 50% or less of design capacity. Exception: garage less 30,000 ft2 without cooling or heating (Mandatory) 7. DCV for spaces with > 500ft2, < 25 ft2/person and sustems with OA > 3000 cfm or an air-side aconomizer.(Exception: Section 6.4.3.9) 8. Single Zone VAV Controls in compliance with section 6.4.3.10 (Mandatory) 9. Sensible Heating panel & Radiant bottom floor Heating Insulation - R-3.5 (Mandatory) 10. Where reheatring is permitted, zones that have both supply and return/exhaust opening shall not supply heating air more than 20F above the space temperature setpoint 11. VAV systems with DDC shall include means to reduce OA below design rates to change system ventilation efficiency as defined by App A of ASHRAE 62.1. Exception: system with ERW 12. Multiple zone HVAC Systems must include controls to reset the SA temperature at least 25% of the difference between the SA temperature and the design room air temperature. 13 Pipe sizing limitations based on gpm. Table 6.5.4.5 14. Limitation on Centrifugal Fan Open Circuit cooling towers listed in Table 6.8.1G 15. MERV 13 Filter for ventilation systems, in accordance with ASHRAE 52.2-2007 (LEED V4)	1. Economizer is required for units ≥ 54,000 Btuh, for computer rooms: ≥ 135,000 Btuh Not required for residential spaces with system capacity ≤ 10,800 Btuh Intergrated economizer is required for systems ≥65,000 Btuh and 2 two stages of cooling Sensor Accuracy requirements Section 6.5.1.1.6 2. CV Systems ≥ 15,000 btuh shall have a temperature setback to 55F and 90F during unoccupied hours except spaces with contineuous operation(Mandatory) 3. Optimum start controls for systems with any DDC system Section 6.4.3.3.3 (Mandatory) 4. All outdoor air intake and exhaust systems shall be equipped with Motorized Damper (Mandatory) 5. Motorized damper air leakage 4 cfm/ft2 (Mandatory) 6. Enclosed Parking Garage Ventilation systems shall detect contaminant level and to reduce air to 50% or less of design capacity. Exception: garage less 30,000 ft2 without cooling or heating (Mandatory) 7. Humidification Controls shall prevent the use of fossil fuel or electricity to produce 30RH in the warmest zone or to reduce RH to 60% in the coldest zone (Mandatory) 8. DCV for spaces with > 500ft2, ≤ 25 ft2/person and sustems with OA > 3000 cfm or an air-side aconomizer.(Exception: Section 6.4.3.9) 9. Heating in Vestibules shall incluse automatic controls to shut off the heating when OAT ≥45F and thermostat setpoint limited to 60F (Mandatory) 10. DDC Control are required for systems with fan power > than 10 hp or cooling & Heating plants with > 300 Mbh except systems that comply with Section 6.4.3.10 (Mandatory) 11. Sensible Heating panel & Radiant bottom floor Heating Insulation - R-3.5 (Mandatory) 12. Walk-in Coolers/Freezers: Coolers door insulation R-25, freezers -R-32, freezer's floor insulation R-28, etc (Section 6.4.5)(Mandatory) 13. Refriferated Display case: Lighting controls to reduce 50% lighting power, temperature control (Section 6.4.6)(Mandatory) 14. Where reheatring is permitted, zones that have both supply and return/exhaust opening shall not supply heating air more than 20F above the space temperature setpoint 15. VAV systems with DDC shall include means to reduce OA below design rates to change system ventilation efficiency as defined by App A of ASHRAE 62.1. Exception: system with ERW 16. Multiple zone HVAC Systems must include controls to reset the SA temperature at least 25% of the difference between the SA temperature and the design room air temperature. 17. Boilers ≥ 1000-5,000 MBH shall have thw turndown ratio 3:1 , ≥ 5,000-10,000 MBH -4:1, ≥ 10,000 -5:1 18. Pipe sizing limitations based on gpm. Table 6.5.4.6 19. Limitation on Centrifugal Fan Open Circuit cooling towers listed in Table 6.8.1-7 20. Door switches to control heating/ cooling when door is open (Section 6.5.10) 21. Computer Room System shall meet requirements of section 6.6.1 22. Revised night setback requirements with elemination of exceptions 23. MERV 13 Filter for ventilation systems, in accordance with ASHRAE 52.2-2007 (LEED V4)
	Thermal Comfort Mandatory Provisions	Office, Lobbies, Residential spaces : 75F/50% , Winter- 70F/35% Kitchen: 70F/50%, and Winter -68F Fitness Room: 68-75F/50%, and Winter -68F Stairwells - summer ambient, winter -55F Utility Rooms - summer 89F, winter -55F Vestibule - 60F	Office, Lobbies, Residential spaces : 75F/50% , Winter- 70F/35% Kitchen: 70F/50%, and Winter -68F Fitness Room: 68-75F/50%, and Winter -68F Stairwells - summer ambient, winter -55F Utility Rooms - summer 89F, winter -55F Vestibule - 60F	Office, Lobbies, Residential spaces : 75F/50% , Winter- 70F/35% Kitchen: 70F/50%, and Winter -68F Fitness Room: 68-75F/50%, and Winter -68F Stairwells - summer ambient, winter -55F Utility Rooms - summer 89F, winter -55F Vestibule - 60F
	Heating Efficiency Mandatory Provisions	Gas Fired Furnace -80% Efficiency Gas-Fired Boilers: < 300 Mbh -80% Efficiency ≥ 300 Mbh - < 2,500 Mbh - 80% Efficiency >2,500 Mbh 82% Efficiency Electric Furnace with ≥ 225 mbh - 0.75% losses	Gas Fired Furnace -80% Efficiency Gas-Fired Boilers: < 300 Mbh -80% Efficiency ≥ 300 Mbh - < 2,500 Mbh - 80% Efficiency >2,500 Mbh 82% Efficiency Electric Furnace with ≥ 225 mbh - 0.75% losses	Gas Fired Furnace -80% Efficiency Gas-Fired Boilers: < 300 Mbh -82% Efficiency ≥ 300 Mbh - < 2,500 Mbh - 80% Efficiency >2,500 Mbh 82% Efficiency Electric Furnace with ≥ 225 mbh - 0.75% losses
	Pipe Insulation Table 6.8.3	Insulation for 141-200F Temperature Range: <1" pipe/tube size -1" insulation 1 to <1 1/2" pipe/tube size -1" insulation 1 1/2" to <4" pipe/tube size - 1" insulation 4" to <8" pipe/tube size - 1.5" insulation	Insulation for 141-200F Temperature Range: <1" pipe/tube size -1.5" insulation 1 to <1 1/2" pipe/tube size -1.5" insulation 1 1/2" to <4" pipe/tube size - 2" insulation 4" to <8" pipe/tube size - 2" insulation	Insulation for 141-200F Temperature Range: <1" pipe/tube size -1.5" insulation 1 to <1 1/2" pipe/tube size -1.5" insulation 1 1/2" to <4" pipe/tube size - 2" insulation 4" to <8" pipe/tube size - 2" insulation
Domestic Water	**Hot Water**	**Plumbing fixtures:** Lavatory - 0.5 gpm Residential Lavatory -2.2 gpm Water Closets - 1.6 gpf Urinal -1.0 gpf Bath tub - 2.5 gpm Kitchen Sink - 2.2 gpm Pre-rinse valve -1.6 gpm Dishwasher undercounter -1.6 gal/rack, single tank conveyor - 1 gal/rack 1. Heat Recovery systems shall be installed for heating/preheating of hot water if the facility operates 24 hrs/day, th total installed heat rejection capacity of the water cooled systems exceeds 6,000 MBH of heat rejection and design service water heatingbload exceeds 1,000 MBH. Table 7.8 in 90.1-2007 on page 57: Electric water heaters ≤ 12 kW Perfomance: 0.93-0.00132V EF >12 KW Perfomance: 20+35 √V SL, Btuh Gas instant. water heaters: < 200 Mbh Perfomance: 0.62-0.0019V EF > 200 Mbh Perfomance: 80% or 80%(Q/800+110√V SL, Btuh)	**Plumbing fixtures:** Lavatory - 0.5 gpm (0.4 gpm -Prescriptive Compliance) Residential Lavatory -2.2 gpm (1.5 gpm-Prescriptive Compliance) Water Closets - 1.6 gpf (1.28 gpf -Prescriptive Compliance) Urinal -1.0 gpf (0.5 gpf -Prescriptive Compliance) Showerhead - 2.5 gpm (2.0 gpm-Prescriptive Compliance) Kitchen Sink - 2.2 gpm (1.75 gpm-Prescriptive Compliance) Pre-rinse valve -1.3 gpm Dishwasher undercounter -1.6 gal/rack, single tank conveyor - 1 gal/rack 1. WH-1,2 Standby Loss: 20+35 √50 = 267.5 Btuh, SL Heat Recovery systems shall be installed for heating/preheating of hot water if the facility operates 24 hrs/day, th total installed heat rejection capacity of the water cooled systems exceeds 6,000 MBH of heat rejection and design service water heatingbload exceeds 1,000 MBH. 2. New Buildings with gas service HW Systems of 1,000 MBh or greater shall have min thermal efficiency of 90% except water heaters installed in individual dwelling units. 3. Fire pump motors and NEMA Design B, general purpose electric motors with a power rating of more than 200 hp, but not more than 500 hp must have minimum full load efficiency that is not less than as shown in Table 10.8C 4. Service Water Pressure Booster System must be designed with the section 10.4.2 Table 7.8 in 90.1-2007 on page 57: Electric water heaters ≤ 12 kW Perfomance: 0.97-0.00132V EF >12 KW Perfomance: 20+35 √V SL, Btuh Gas instant. water heaters: < 200 Mbh Perfomance: 0.62-0.0019V EF > 200 Mbh Perfomance: 80% or 80% (Q/800+110√V) SL, Btuh	**Plumbing fixtures:** Lavatory - 0.5 gpm (0.4 gpm -Prescriptive Compliance) Residential Lavatory -2.2 gpm (1.5 gpm-Prescriptive Compliance) Water Closets - 1.6 gpf (1.28 gpf -Prescriptive Compliance) Urinal -1.0 gpf (0.5 gpf -Prescriptive Compliance) Showerhead - 2.5 gpm (2.0 gpm-Prescriptive Compliance) Kitchen Sink - 2.2 gpm (1.75 gpm-Prescriptive Compliance) Pre-rinse valve -1.3 gpm Dishwasher undercounter -1.6 gal/rack, single tank conveyor - 1 gal/rack 1. WH-1,2 Standby Loss: 20+35 √50 = 267.5 Btuh, SL Heat Recovery systems shall be installed for heating/preheating of hot water if the facility operates 24 hrs/day, th total installed heat rejection capacity of the water cooled systems exceeds 6,000 MBH of heat rejection and design service water heatingbload exceeds 1,000 MBH. 2. New Buildings with gas service HW Systems of 1,000 MBh or greater shall have min thermal efficiency of 90% except water heaters installed in individual dwelling units. 3. Fire pump motors must have minimum full load efficiency that is not less than as shown in Table 10.8-6 4. General purpose electric motors with a power rating of more than 200 hp, but not more than 500 hp must have minimum full load efficiency that is not less than as shown in Table 10.8-3 5. Service Water Pressure Booster System must be designed with the section 10.4.2 Table 7.8 in 90.1-2007 on page 57: Electric water heaters ≤ 12 kW Perfomance: 0.97-0.00035V EF >12 KW Perfomance:5.9+5.3/Vm %h Gas instant. water heaters: < 200 Mbh Perfomance: 0.62-0.0005V EF > 200 Mbh Perfomance: 80% or 80% (Q/800+110√V) SL, Btuh
Process Load	**Elevators Kitchen Equipment Miscelleneous Load**	Section 6.5.7 : Kitchen exhuast hoods ≥ 5,000 cfm shall be provided with makeup air sized at least for 50% of EA that is unheated or heated to 60F Fume hood with ≥ 15,000 cfm shall include VAV exhaust to reduce air vilume by 50% , etc	1. Section 6.5.7 : Make-up air introduced into hood cavity of Kitchen exhaust hoods shall not exceeed 10% of the EA airflow rate. Condtioned SA delivered to any space with a kitchen hood shall not exceed the supply flow required to meet the space heating/cooling or the available transfer air from adjacent spaces. If kitchen exhuast hoods ≥ 5,000 cfm , each hood shall have an exhaust rate that complies with Table 6.5.7.1.3 and it shall have one of the following: a) at least 50% of all replacement air is transfer air that would otherwise be exhausted b) DCV on at least 75% of EA c) ERW on at least 50% of the EA. Lab exhaust systems ≥ 5,000 cfm shall include VAV exhaust or direct MA supply equal to 75% of the EA rate heated no warmer than 2F below room setpoint, cooled to no coller than 3F above room setpoint. 2. Elevator systems shall comply with section 10.4.3.(Lighting efficacy not less than 35 lumens/watt, cab ventilators - max 0.33 W/cfm at max speed) 3. Pool Heaters (Mandatory): heaters must be equipped with a readily accessible ON/OFF switch. Time switches must be installed on pool heaters/pumps except those that require 24/7 operation	1. Section 6.5.7 : Make-u air ontroduced intro hood cavity of Kitchen exhuast hoods shall not exceeed 10% of the EA rate. Condtioned SA delivered to any space with a kitchen hood shall not exceed the supply flow required to meet the space heating/cooling or the available transfer air from adjacent spaces. If kitchen exhuast hoods ≥ 5,000 cfm , each hood shall have an exhaust rate that complies with Table 6.5.7.1.3 and it shall have one of the following: a) at least 50% of all replacement air is transfer air that would otherwise be exhausted b) DCV on at least 75% of EA c) ERW on at least 50% of the EA. Lab exhaust systems ≥ 5,000 cfm shall include VAV exhaust or direct MA supply equal to 75% of the EA rate heated no warmer than 2F below room setpoint, cooled to no coller than 3F above room setpoint. 2. Refrigeration display cases, walk-in coolers or walk-in freezers connectedd to remote compressors shall meet section 6.5.11 3. Freezers/Refrigerators efficiency in compliance with Table 6.8.1-12, 6.8.1-13 4. Elevator systems shall comply with section 10.4.3 (Lighting efficacy not less than 35 lumens/watt, cab ventilators - max 0.33 W/cfm at max speed) 5. Pool Heaters (Mandatory): heaters must be equipped with a readily accessible ON/OFF switch. Time switches must be installed on pool heaters/pumps except those that require 24/7 operation

Conditioned Space - a cooled space, heated spaces, or indirectly conditioned space.
Cooled Space is an enclosed space within a building that is cooled by a cooling system whouse sensible output capacity exceeds 5 Btuh/ft2 of floor area
Heated Space is an enclosed space within a building that is heated by a heating system whouse output capacity exceeds 5 Buth/Sf for zone 1 and 2, 10 Btuh/sf for zone 3, 15 Btuh/sf for Zone 4 and 5, 20 Btuh/SF for zone 6 and 7, and 25 Btuh/SF for zone 8
Semiheated Space is an enclosed space within a building that is heatedby a heating system whose output capacity is greater than or equal to 3.4 Btuh/ft2 but not a conditioned space

Useful Links:
http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23269.pdf
https://www.energycodes.gov/development/commercial/prototype_models
https://www.energycodes.gov/adoption/states
http://www.dli.pa.gov/ucc/Pages/default.aspx