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Additional submitted attachment is included below.

CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE)

Comments on Draft Title 24 Nonresidential Compliance Manual

2016 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS

California Utilities Statewide Codes and Standards Team August 31, 2015

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1. PREFACE

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission's (CEC) efforts to update California's Building Energy Efficiency Standards (Title 24) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities (IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE) and Southern California Gas Company (SoCalGas) – and Los Angeles Department of Water and Power (LADWP) sponsored this effort. The program goal is to prepare and submit proposals that will result in cost-effective enhancements to energy efficiency in buildings.

This document presents the Statewide CASE Team's comments on the Draft Nonresidential Compliance Manual, which CEC posted for public review on July 30, 2015. Throughout this document suggested revisions to the manual are highlighted in blue; suggested additions are double underlined and suggested deletions are ~~struck with double lines~~.

2. COMMENTS ON CHAPTER 1 – INTRODUCTION

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
1-1	Paragraph 2	**Chapter 3** addresses the requirements for the ~~design of the~~ building envelope.	Covers more than just design requirements.	Sally Blair
1-1	1.1	**Chapter 13** covers the acceptance test requirements	Minor edit for clarity.	John Arent
1-6	1.5.2	1. Clarification and simplification of existing language; removing exceptions no longer relevant~~.~~ (§130.0 through -§130.5 and, §140.6 through -§140.8). 2. Significant reductions in outdoor lighting power allowances (§140.7)	Indoor lighting changes were mostly minor, but outdoor lighting changes were significant.	John Arent
1-9	1.5.3	2. Interlock controls requirements when operable windows are present, §140.4(n).	Minor edit for clarity.	John Arent
1-9	1.5.3	3. Revisions to extent of VFD fan control ~~system design~~requirements, Table 140.4-D of the Energy Standards.	Minor edit for clarity.	John Arent
1-12	1.6.1	With either the prescriptive or performance compliance paths, there are mandatory measures that must always be met. Mandatory measures include infiltration control, lighting controls, minimum insulation levels and equipment efficiency or requirements for refrigerated warehouses. The minimum mandatory levels are sometimes superseded by more stringent prescriptive or performance requirements.	Minor edit for clarity.	John Arent
1-12	1.6.2	A. **Building Envelope**. The prescriptive envelope requirements are ~~determined by the envelope component approach~~ specified as required thermal performance levels for each	Minor edit for clarity.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		building component (walls, roofs and floors). This approach is described in detail in Chapter 3 of this manual. The stringency of the envelope requirements varies according to climate zone and occupancy type.		
1-12	1.6.2	B. **Mechanical.** The prescriptive mechanical requirements are described in detail in Chapter 4. The prescriptive approach ~~does not offer any alternative approaches, but~~ specifies equipment, features and design procedures that must be followed, but does not mandate that a particular type of HVAC system be installed for a building.	Minor edit for clarity.	John Arent
1-21	1.7.7.2	1. The envelope must meet the prescriptive envelope criteria for high-rise residential buildings (Energy Standards Table 140.3-~~B~~C).	Minor correction.	John Arent
1-22	1.7.8.1	~~90 percent of the h~~Hotel/motel guest rooms must meet the applicable Residential Lighting Standards.	Can't find 90% in the 2016 Standards.	John Arent
1-37 1-38	1.8.2 Paragraph 3	~~Five basic steps are involved:~~ ~~*2013 2016 Nonresidential Compliance Manual January 2014 Date*~~ ~~Page 1-38 Introduction – About the Standards~~ ~~A. Design the building with energy efficiency measures that are expected to be sufficient to meet the energy budget. The prescriptive approach requirements provide a good starting point for the development of the design.~~ ~~B. Demonstrate that the building complies with the mandatory measures.~~ ~~C. Use an Energy Commission approved energy~~	The content of this paragraph is fine, but it is fragmented, out of place and redundant. We recommend removing the entire paragraph to improve clarity.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~compliance software.~~ ~~D. Model the energy consumption of the building using the proposed features to create the proposed energy budget. The model will also automatically calculate the allowed energy budget for the proposed building.~~ ~~E. If the proposed energy budget is no greater than the allowed energy budget, the building complies.~~		

3. COMMENTS ON CHAPTER 2 – COMPLIANCE AND ENFORCEMENT

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
2-1	Paragraph 2	After building construction is complete, if the enforcement agency's final inspection determines that the building still conforms ~~to the building plans and specifications and Certificate(s) of Compliance approved during plan check~~ to the building plans and specifications and Certificate(s) of Compliance approved during plan check~~,~~ and complies with all applicable codes and standards, the enforcement agency may approve the building and issue the Certificate of Occupancy.	We recommend keeping the deleted text (in strikethrough). It is not enough to verify that the building complies with ("applicable Codes and Standards"), it is also worth verifying that buildings are constructed according to plans.	John Arent
2-2	2.1.1 Paragraph 1	~~Beginning on January 1, 2015~~When a data registry service provider has been established, ~~new~~ requirements for a documentation procedure called *registration* will go into effect. *Registration* documentation is required for the construction and alteration of nonresidential buildings. *Registration* requirements will be described in this chapter, and elsewhere in this manual, as applicable.	Minor edit for clarity. A clear timeline for developing and deploying data registries for nonresidential buildings has not been established.	John Arent
2-3	2.2 Paragraph 3	~~Beginning on January 1, 2015, contingent upon approval of~~ When a nonresidential data registry service has been established by the Energy Commission, all nonresidential energy compliance documents will need to be registered with a nonresidential data registry prior to submittal to an enforcement agency.	Minor edit for clarity of timeline of the availability of a nonresidential data registry.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
2-4	Figure 2-1	Replace "Acceptance Commissioning" with "Acceptance Tests and Commissioning".	These are two closely related but distinct processes. Acceptance tests may be required even when commissioning is not required.	John Arent
2-5	Paragraph 1	Depending upon the size of the building, ~~T~~the Design Review Kickoff Certificate(s) of Compliance and the Construction Document Design Review Checklist Certificate(s) of Compliance must be reviewed and signed by the following person(s): ~~depending on the size of the building (see Table 2-1):~~	Minor edit for clarity.	John Arent
2-5	Paragraph 1	• For buildings ~~larger than 50,000 square feet, or for buildings with complex mechanical systems~~ with 10,000 square feet or more of conditioned space-, an independent third party engineer, architect or contractor	Update for 2016 Standards.	John Arent
2-5	Paragraph 1	~~• Buildings between 10,000 and 50,000 square feet – an in-house engineer or architect not associated with the project under review or a third party engineer.~~	Update for 2016 Standards.	John Arent
2-6	Paragraph 3	~~The discussion in this section emphasizes the need~~ It is essential to coordinate energy efficiency feature selections ~~considerations concurrently~~ with other building design considerations as part of the overall design development process	Minor edit for clarity.	John Arent
2-7	Paragraph 2	This manual provides representative details and implementation rules for individual design ~~strategies~~ components and systems. Though these individual strategies can improve building or system energy efficiency, whole-building analysis and integrated design can balance energy and cost concerns more effectively.	This statement is a little too far-reaching. The Nonresidential Compliance Manual provides examples, but it should not be considered a design guide. Moreover, it focuses mainly on energy aspects and no other aspects (material use, water, structural, etc.)	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
2-9	2.2.2.4	~~Beginning January 1, 2015~~ Once the Energy Commission has established a data registry, registration to an approved data registry will be required for all Certificate(s) of Compliance submitted to the enforcement agency ~~and must be a registered copy from an approved nonresidential data registry~~.	Data registry is not yet in place.	John Arent
2-12	2.2.3.2	The enforcement agency is responsible for verifying that all required compliance documents have been submitted for plan review and ~~that they~~ do not contain errors.	Minor edit for clarity.	John Arent
2-13	Paragraph 2	To obtain a list of Energy Commission-approved energy code compliance software applications, visit the Commission Website at: ~~http://www.energy.ca.gov/title24/2013standards/index.html;~~ http://www.energy.ca.gov/title24/2016standards/index.html, or call the Energy Standards Hotline at 1-800-772-3300.	Update for 2016 Standards. CEC should verify content on link.	John Arent
2-17	2.2.7.2 Paragraph 1	A few Providers have achieved ~~interim~~ approval as an ATTCP pending approval by the Energy Commission that they meet the requirements of §10-103-A or §10-103-B.	Verify if the approval is interim still or not.	John Arent
2-18	2.2.7.3 Paragraph 1	~~For building permit applications submitted on or after January 1, 2015~~Once the Energy Commission data registry has been established, all of the Certificate of Acceptance documents must be registered documents from an approved nonresidential data registry.	Data registry not implemented yet. CEC might consider deleting all language related to the nonresidential data registry unless there is a clear timeline for the development and deployment of the registry.	John Arent
2-27	Paragraph 4	~~Beginning January 1, 2015, contingent upon approval of a nonresidential data registry by~~	Data registry not implemented yet. This is the fifth instance of this incorrect time frame. We have tried	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		When the Energy Commission has established a data registry service, all nonresidential compliance documents will need to be registered.	to capture all instances, but we recommend that CEC search the document for "January 1, 2015" and delete all references to the timeline for the data registry.	
2-28	Paragraph 2	The HERS rater is responsible for: • conducting the field verification and diagnostic testing of the air distribution ducts when duct leakage testing is required for ducts located in unconditioned space	Minor edit for clarity.	John Arent
2-32	2.2.15	More details on field verification and diagnostic testing and the HERS provider data registry are provided in the *2013 2016 Reference Nonresidential Appendices* and *2013 2016 Reference Joint Appendices*, as described below: A. Reference Nonresidential Appendix NA1 – Nonresidential HERS Verification, Testing, and Documentation Procedures B. Reference Nonresidential Appendix NA2 – Nonresidential Field Verification and Diagnostic Test Procedures ~~C. Reference Joint Appendix JA7 – Data Registry Requirements~~	Data registry does not yet exist and the reference should be removed. The HERS Provider Registry different than the Nonresidential Data Registry referenced in JA7, right? If so, this section about the HERS providers should not reference JA7.	John Arent

4. COMMENTS ON CHAPTER 3 – BUILDING ENVELOPE

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
3-2	3.1	3.1.1 What's New for 2016 3.1.2 Compliance Options 3.1.3 Envelope Definitions and Features	Revise to include 3.1.3 Envelope Definitions and Features in Chapter Overview.	Brian Selby
3-6	Before 3.1.1.1	3.1.2 Compliance Options The Energy Standards have mandatory requirements, and prescriptive or performance methods for compliance. The Energy Standards establish a minimum level of performance which can be exceeded by advanced design and construction practices.	Revise to include these subsections under 3.1.2 Compliance Options. Rename subsections as shown in comments below.	Brian Selby
3-6	3.1.1.1	~~3.1.1.1~~3.1.2.1 Mandatory Measures	Revise to make numbering consistent with chapters.	Brian Selby
3-6	3.1.1.2	~~3.1.1.2~~3.1.2.2 Prescriptive Approach	Revise to make numbering consistent with chapters.	Brian Selby
3-7	3.1.1.3	~~3.1.1.3~~3.1.2.3 Performance Approach	Revise to make numbering consistent with chapters.	Brian Selby
3-7	3.1.1.3	The performance approach is a more sophisticated compliance method and it offers design flexibility. ~~The performance approach.~~ It may be used for: • Envelope-only compliance • Envelope and lighting compliance • Envelope and partial lighting compliance (where some tenant spaces are not yet defined) • Envelope and mechanical compliance • Envelope, lighting and mechanical compliance	Expand upon description of partial compliance options in Chapter 2. I recommend describing the core and shell permitting and other permitting combinations with greater and clarity and detail in Chapter 2.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~The performance approach allows for more energy tradeoffs between building features, such as increasing envelope efficiency insulation levels or improving window performance in order to allow more lighting power or a less efficient space conditioning system.~~ Under this method, energy use of the building is modeled by compliance software approved by the Energy Commission. See Section 3.5 and Chapter ~~9~~11 for a more complete discussion of the performance approach.		
3-7	3.1.2	~~3.1.2~~3.1.3 Envelope Definitions and Features	Revise to make numbering consistent with chapters.	Brian Selby
3-7 3-8	3.1.2	Components of the building shell include the walls, floor, the roof or ceiling, doors, and fenestration.	Revise to add "doors".	Brian Selby
3-8	3.1.2.1	~~3.1.2.1~~ 3.1.3.1 Walls and Space(s) Surrounding Occupancy Uses	Revise to make numbering consistent with chapters.	Brian Selby
3-9	3.1.2.2 Header	~~3.1.2.2~~3.1.3.2 Roofing Products (Cool Roof)	Revise to make numbering consistent with chapters.	Brian Selby
3-9	3.1.2.2 Paragraph 3	High-emitting roof surfaces reject absorbed heat quickly faster (upward and out of the building) than ~~darker~~ roof surfaces with low-emitting properties.	Lower-emitting roof surfaces are not necessarily darker.	Brian Selby
3-9	3.1.2.2 Paragraph 5	The Energy Standards specify radiative properties that represent minimum "cool roof performance" qualities of roofing products.	Revise to make consistent with other references to the Energy Standards.	Brian Selby
3-10	3.1.2.3	~~3.1.2.3~~3.1.3.3 Infiltration and Air Leakage	Revise to make numbering consistent with chapters.	Brian Selby
3-10	3.1.2.4	~~3.1.2.4~~3.1.3.4 Thermal Properties of Opaque	Revise to make numbering consistent with	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		Envelope Components	chapters.	
3-15	F. Air Barrier	~~F.~~ A. Air Barrier	Revise numbering to A at beginning of a new section under Prescriptive Requirements.	Brian Selby
3-18	Paragraph 2	3. Accelerated aged solar reflectance	Is this just another means of determining aged reflectance? Not sure why it is distinguished from aged reflectance if either value can be used interchangeably.	John Arent
3-21	3.2.2.2	~~E.~~ A. Insulation Requirements – Exterior Roofs and Ceilings	Revise numbering to A at beginning of a new section under Prescriptive Requirements.	Brian Selby
3-25	Item 3	~~3. Wood framed roofs in climate zones 3 and 5 with a U- factor of 0.034 are exempt from the low-sloped cool roof requirement.~~	This should be removed as it no longer applies with the increased stringency (lower U-factors) in climate zones 3 and 5.	John Arent
3-26	3.2.2.3	The compliance options process allows the Energy Commission to review and gather public input regarding the merits of new compliance techniques, products, materials, designs or procedures to demonstrate compliance for newly constructed buildings and additions and alterations to existing buildings. ~~For more information, see Section 1.5.16.3.1.~~	The referenced language in 3.1 has been removed. Need to correct reference or remove. This statement is good, but would be better placed in an overview chapter.	John Arent
3-26	Item G	The default reflectance and emittance values may be used below in the performance compliance approach or prescriptive tradeoff with increased insulation (Table 140.3).	These could comply either with the performance or the prescriptive tradeoff.	John Arent
3-27	Example 3-3	Answer No. Only CRRC ratings from the product directory list can be used to establish cool roof product qualification for Standards compliance.	Minor edit for clarity.	Brian Selby
3-35	6. Furred	6. Furred walls: Are a specialty wall component, commonly applied to a mass wall type. See	Revise for accuracy of definition.	Brian Selby

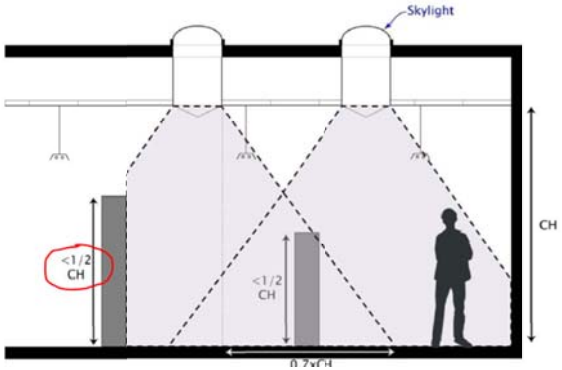
Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	walls:	Figure 3-4 below. The Reference Appendix JA4 Table 4.3.5, 4.3.6 or other masonry tables list alternative walls. ~~Additional continuous insulation layers are selected from Reference Appendix JA4 Table 4.3.13 and calculated using either Equation 4-1 or 4-4 from the JA4.~~ The effective R-value of the furred component depends upon the framing thickness, ~~and~~ type and insulation level according to the appropriate table in the JA4.3. To determine the overall U-factor for the mass wall and furred wall component assembly, use Equation 4-3 from the JA4 for double wall assemblies.		
3-36	Example 3-10	Question An 8 inch~~es~~ (20 cm) medium-weight concrete block wall with uninsulated cores has a layer of 1 inch (25 mm) thick exterior polystyrene continuous insulation with an R-value of R-5. What is the U-factor for this assembly?	Revise question for clarity.	Brian Selby
3-38	Paragraph 2	When glazing area exceeds one-half of the entire door area, it is then defined as a fenestration product in the Energy Standards, and the entire door area is modeled as a fenestration unit (see Section 3.3.2). ~~If the glazing area is less than half the door area, the glazing must be modeled as the glass area plus 2 inches in each direction of the opaque door surface (to account for a frame). However, e~~Exterior doors are part of the gross exterior wall area and must be considered when calculating the window-wall-ratio.	This is not specified in the ACM or in the CBECC-Com compliance software.	John Arent
3-65	3.3.1.1	3.3.1.1 Determining Fenestration Performance	Revise to reference the correct section in the Standards for prescriptive requirements.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		§110.6 and §~~141.0(b)3~~ 140.3(a)5		
3-69, 3-70	3.3.1.2	~~3.3.1.2 Field-Fabricated Fenestration Product or Exterior Door~~ ~~Field-fabricated fenestration is fenestration assembled on site that does not qualify as site-built fenestration. It includes windows where wood frames are constructed from raw materials at the building site, salvaged windows that do not have an NFRC label or rating, and other similar fenestration items.~~ ~~For field-fabricated fenestration, the U-factor and SHGC are default values that can be found in Table 3-124 and Table 3-6135 respectably below. Values are determined by frame type, fenestration type and glazing composition.~~ ~~Exterior doors are doors through an exterior partition. They may be opaque or have a glazed area that is less than or equal to one-half of the door area. U-factors for opaque exterior doors are listed in Reference Appendix JA4, Table 4.5.1. Doors with glazing for more than one-half of the door area are treated as fenestration products and must meet all requirements and ratings associated with fenestration.~~ ~~When a door has glazing of less than one-half the door area, the portion of the door with fenestration must be treated as part of the envelope and fenestration independent of the remainder of the door area.~~ ~~A field-fabricated product may become a site-built product if all the requirements for receiving~~	Delete this section because it is addressed elsewhere.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~a label certificate required of site-built products are met.~~		
3-72	Examples	Example 3-11 Question A designer is using a U-factor of 0.57 for compliance with a curtain wall system. The glazing system uses two lites of 1/4 in (6mm) glass with a low-e=0.1 coating on the second surface. The air gap is 1/2 in (12 mm). A standard metal frame is proposed for the curtain wall system. Is 0.57 a reasonable U-factor for compliance, and can it reasonably be achieved by the glazing contractor through the NFRC process for site-built fenestration? Answer The default U-factor for this glazing combination from Reference Nonresidential Appendix NA6 is 0.59. If no NFRC rating information is available, a U-factor of 0.59 must be used. The design U-factor of 0.57 cannot be used.	Recommend adding an example question	Brian Selby
3-73	3.3.1.3	~~3.3.1.3~~ 3.3.1.2 Certification and Labeling	Revise numbering due to deleting the previous section.	Brian Selby
3-75	B. Paragraph 2	*"Product meets the air infiltration requirements of §110.6(a)1, U-factor criteria of §110.6(a)2, SHGC criteria of §110.6(a)3 and VT criteria of §110.6(a)4 of the ~~2013~~ 2016 California Building Energy Efficiency Standards for Residential and Nonresidential Buildings."*	Revise to include 2016 reference.	Brian Selby
3-76	Figure 3-11	Product meets the air infiltration requirements of §110.6(a)1, U-factor criteria of §110.6(a)2,	Revise to include 2016 reference.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		SHGC criteria of §110.6(a)3 and VT criteria of §110.6(a)4 of the ~~2013~~ 2016Building Energy Efficiency Standards for Residential and Nonresidential Buildings.		
3-79	E.	E. Fenestration Certificate NRCC-ENV-05-E ~~(formally FC-1)~~	Delete old reference.	Brian Selby
3-81	Example 3-11	Example 3-~~11~~ 12	Revise example numbering to be sequential with previous examples.	Brian Selby
3-81	Example 3-11	Answer For site-built fenestration less than 1,000 ft2 then one of the following three methods may be used: 1. The easiest method for site-built fenestration is to rate the fenestration using the Component Modeling Approach (CMA~~ or CMAST~~) which will yield the most efficient values possible.	Revise to remove reference to CMAST.	Brian Selby
3-84	Paragraph 1	Under the ~~envelope component~~prescriptive approach, the total window area may not exceed 40 percent of the gross wall area (encompassing total conditioned space) for the building. Likewise, the west-facing window area may not exceed 40 percent of the west gross wall area (encompassing total conditioned space for the building).	Envelope component approach (total heat gain/heat loss through envelope) is no longer valid.	John Arent
3-86	Paragraph 1	~~For nonresidential buildings, the U-factor criterion is 0.36 Btu/h-°F-ft² for fixed windows, 0.46 operable windows, 0.41, for curtain wall or store front and 0.45 for glazed doors.~~	Delete sentence because there are too many variables to list and the previous sentence references Table 140.3-B and 140.3-C	Brian Selby
3-92, 3-93	3-92 last sentence and 3-93 first	The average VT requirements apply separately to ~~chromogenic~~ chromatic (dynamic or color changing) glazing and non-~~chromogenic~~ chromatic glazing. For ~~chromogenic~~ chromatic	Revise for consistency.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	sentence	glazing, higher ranges of VT can be used to meet the prescriptive requirements. However, all glazing that is not ~~chromogenic~~ chromatic glazing must separately meet the area-weighted VT prescriptive requirements.		
3-93	Example 3-3	Example 3-~~3~~13	Revise example numbering to be sequential with previous examples.	Brian Selby
3-93	Example 3-3	Answer Yes, Using the formula VT ≥ 0.11 / WWR, we determine the minimum area weighted average VT for this space, VT ≥ 0.11 / 0.3 = 0.367	Revise answer for clarity.	Brian Selby
3-98	3.3.3	When skylights are specified, the designer must also show the Skylit Daylight Zones on the building plans. ~~When the total installed general lighting power in the Skylit Daylight Zones in a room is greater than 120W, the general lighting in these Daylit Zones is controlled by automatic daylighting controls.~~ See Chapter 5 of this manual for a detailed discussion of the Daylight Zones.	Delete a sentence that is not required.	Brian Selby
3-107	3.3.3.1	There are currently no mandatory requirements measures for skylights and so the prescriptive or performance approach ~~must~~ may be used.	Minor edit for clarity.	John Arent
3-108	Paragraph 1	Electric lighting in the Skylight Daylit Zones shall meet the mandatory control requirements in §130.1(d). See Chapter 5 for more information about lighting control requirements and for more information about daylighting control requirements. ~~As described above obstructions~~	Delete sentences, requirements for obstructions are described elsewhere.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~are ignored for evaluating the architectural area served by skylights. However, for controlling lighting, one must consider the area shaded that is behind permanent obstructions that are greater than ½ the ceiling height. As a result, those luminaires behind tall obstructions are not part of the skylit daylit area and therefore not controlled by automatic daylighting controls.~~		
3-114	Paragraph 1	The Daylit Zone and controls specifications in §130.1(d) describes which luminaires are controlled and this specification must consider the daylight obstructing effects of tall racks, shelves and partitions taller than one-half the distance from the floor to the bottom of the skylight.	Revised for clarity.	Brian Selby
3-118	Example 3-4	Example 3-~~4~~14	Revise example numbering to be sequential with previous examples	Brian Selby
3-120	Figure 3-25	 Text circled in RED "~~=~~<1/2 CH"	Text circled in RED is incorrect.	Brian Selby
3-132	Example 3-15	~~Example 3-15~~ ~~Question~~ ~~The envelope and space conditioning system of~~	This example refers to a fenestration alteration and should be moved to the appropriate section.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~an office building with 120,000 ft² of conditioned floor area is being altered. The building has 24,000 ft² of vertical fenestration. Which of the following scenarios does the NFRC label certificate requirement apply to?~~ ~~1. Existing glazing remains in place during the alteration.~~ ~~2. Existing glazing is removed, stored during the alteration period and then re-installed (glazing is not altered in any way).~~ ~~3. Existing glazing is removed and replaced with new site-built glazing with the same dimensions and performance specifications.~~ ~~4. Existing glazing on the north façade (total area 800 ft²) is removed and replaced with site-built fenestration.~~ ~~Answer~~ ~~NFRC label certificate or California Energy Commission default values requirements do not apply to scenarios 1 and 2 but do apply to scenario 3.~~ ~~1. Requirement does not apply because the glazing remains unchanged and in place.~~ ~~2. Exception to §110.6(a)1 applies in this case (this exception applies to fenestration products removed and reinstalled as part of a building alteration or addition).~~ ~~3. Use either NFRC Label Certificate or use Table 110.6-A default values; applies in this case as 24,000 ft² (more than the threshold value of 1,000 ft²) of new fenestration is being installed.~~ ~~Since the site-built fenestration area is less than~~	Suggest deleting the example question here and moving to page 3-143.	

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~1,000 ft², use either the NFRC label certificate, the applicable default U-factor or SHGC set forth in Reference Nonresidential Appendix NA6, or California Energy Commission default values.~~		
3-134	Last paragraph	~~Approved compliance software programs shall automate the rotation of the building and reporting of the compliance results to insureensure it is done correctly and uniformly and to avoid unnecessary documentation.~~	This is not done automatically by compliance software.	John Arent
3-135	3.5 Paragraph 1	The compliance software ~~does an hourly simulation of~~ simulates the proposed buildings time-dependent value (TDV) energy use, which includes a detailed accounting of envelope heat transfers using the assemblies and fenestration input, and the precise geometry of any exterior overhangs or side fins. The most accurate tradeoffs between different envelope components – and between the envelope, the space-conditioning system and the installed lighting design – are therefore accounted for and compared with the standard design version of the building. The proposed design has to have ~~time-dependent value (~~TDV~~)~~ energy less than or equal to the standard design.	Revise for accuracy.	Brian Selby
3-136	3.5.2 D.	~~Surface absorptance~~ Reflectance and Emittance. ~~Surface absorptance~~ ~~absorptance~~Reflectance and Emittance is a restricted input (except for roofs).	No reference to absorptance found in any supporting documents. Revise for consistency and accuracy of terms.	Brian Selby
3-136	3.5.2 Paragraph 1	Note for roofs: ~~Surface~~ ~~absorptance~~ reflectance and emittance are variable inputs in the proposed design for roofs to provide design flexibility where a cool roof is not specified. The roof reference design is set with a cool roof surface	No reference to absorptance found in any supporting documents. Revise for consistency and accuracy of terms.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		reflectance and emittance ~~absorptance~~ for nonresidential buildings in all climate zones. ~~The difference in surface absorptance creates a credit that can be used with the whole building performance method.~~ For more information on cool roofs, see Section 3.1.4.2.		
3-140	3.6.1.2	All alterations must meet the ~~above~~ mandatory requirements stated above for additions, with the exception of the insulation requirement of §120.7 for opaque envelope components (roofs, ceilings, walls and floors).	Revise for clarity.	Brian Selby
3-141	3.6.2.1 Sentence 2	Tradeoffs between other envelope components are not ~~no longer~~ allowed in the prescriptive method.	Revise for clarity.	Brian Selby
3-143	After Table 3-20	Example 3-15 Question The envelope and space conditioning system of an office building with 120,000 ft² of conditioned floor area is being altered. The building has 24,000 ft² of vertical fenestration. Which of the following scenarios does the NFRC label certificate requirement apply to? 1. Existing glazing remains in place during the alteration. 2. Existing glazing is removed, stored during the alteration period and then re-installed (glazing is not altered in any way). 3. Existing glazing is removed and replaced with new site-built glazing with the same dimensions and performance specifications. 4. Existing glazing on the north façade (total area 800 ft²) is removed and replaced with site-built fenestration.	Insert example questions 3-15 from page 3-132.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		Answer NFRC label certificate or California Energy Commission default values requirements do not apply to scenarios 1 and 2 but do apply to scenario 3. 4. Requirement does not apply because the glazing remains unchanged and in place. 5. Exception to §110.6(a)1 applies in this case (this exception applies to fenestration products removed and reinstalled as part of a building alteration or addition). 6. Use either NFRC Label Certificate or use Table 110.6-A default values; applies in this case as 24,000 ft² (more than the threshold value of 1,000 ft²) of new fenestration is being installed. Since the site-built fenestration area is less than 1,000 ft², use either the NFRC label certificate, the applicable default U-factor or SHGC set forth in Reference Nonresidential Appendix NA6, or California Energy Commission default values.		
3-149	Paragraph 2	~~The new, s~~Simplified trade-off process:	The simplified trade-off process is no longer "new". Revise for clarity.	Brian Selby
3-149	Paragraph 4	~~To make the new trade-off process as simple as possible,~~ Table 141.0-B of the Energy Standards not only takes account of the amount of insulation necessary to compensate for using a noncompliant roofing product, it also accounts for the minimum insulation requirements that apply to roof alterations generally.	The simplified trade-off process is no longer "new". Revise for clarity.	Brian Selby
3-	Example 3-	Answer	Revise for clarity.	Brian Selby

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
152	16	Yes. Added insulation is not required when the existing roof insulation exceeds R-7 or the roof has an overall U-factor less than 0.089 Btu/h•ft²•°F.		
3-157	Example 3-22	Question What if the rooftop air conditioner from Example 3-~~25~~ 21 is lifted temporarily during re-roofing to remove and replace the roofing membrane? Is added insulation required?	Revise example numbering to be sequential with previous examples.	Brian Selby
3-161	Example 3-33	Example 3-~~33~~ 29	Revise example numbering to be sequential with previous examples.	Brian Selby
3-162	Example 3-34	Example 3-~~34~~ 30	Revise example numbering to be sequential with previous examples.	Brian Selby

5. COMMENTS ON CHAPTER 4 – MECHANICAL SYSTEMS

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
All	All	Update page numbering for this section	Page numbering for this section is not correct. The page numbering goes to 4-6 then resets back to 4-1. References to proposed revisions in this document use the page numbers as presented in the Draft document.	John Arent
4-1	Section 4.1 Overview	~~**Section 4.1** provides an overview of compliance approaches including the mandatory measure, the prescriptive approach, and the performance approach.~~ Section 4.1 provides an overview of the chapter and the scope of the mechanical systems requirements in Title 24.	Suggest revising for clarity – the overview does not quite discuss the compliance approaches, nor does it need to.	John Arent
4-2	Paragraph 2	The full acceptance requirements are in §120.5 of the Energy Efficiency Standards and in the 2016 ~~Nonresidential~~ Reference Appendix NA7.	Slight revision for clarity. With Reference Appendices, we need to ensure consistency in nomenclature across chapters.	John Arent
4-4	4.1.3.2	The performance approach creates requires creating ~~two~~ a building model~~s~~ using Energy Commission-certified compliance software. This model is compared against a base line model, which is automatically generated by the compliance software and conforms to minimum efficiency levels specified in the mandatory and applicable prescriptive requirements: 1. ~~Base-case building energy model which meets all of the mandatory and prescriptive requirements.; and~~	The base line model is automatically generated by the compliance software.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		2. Proposed building energy model that reflects the proposed building design.		
4-0	4.2 Header	Update page numbering from this page forward.	Page numbering is off starting after 4-5. Fix page numbering and Table of Contents.	John Arent
4-2	4.2.2	The following Tables, which are ~~based from §~~ duplicates of Tables 110.2A-110.2K of the Energy Standards, list the ~~different~~ minimum equipment efficiency ~~ies~~ requirements.	Recommend revisions so it is clear that the minimum efficiency requirements reside within the Standards, not the Compliance Manual. Also, CEC might consider not replicating all efficiency requirements in the Compliance Manual because they are readily available in the Standards	Heidi Hauenstein
4-1 to 4-18	Table 4-1 through 4-11	See Appendix B for proposed revisions to the efficiency tables and Appendix C for final versions of the efficiency tables with all changes accepted.	There are multiple proposed revisions to the content and formatting of the tables and how the page breaks should be made to improve readability. These recommendations have been made in Appendix B and C.	Scott Bailey
4-1	Table 4-1	Table 4-1 ~~Effiecieies for u~~Standards Table 110.2-A Unitary ~~a~~Air ~~c~~Conditioners and ~~c~~Condensing ~~u~~Units	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-1	Table 4-1	Air conditioners, air cooled, both split system and single package	Missing word “single”.	Scott Bailey
4-1	Table 4-1	Merge cells for Equipment Type column, Air Conditioners, Air cooled - see this document’s Appendix B, Table 4-1	Minor formatting edit for clarity.	Scott Bailey
4-1	Table 4-1	Merge cells for Test Procedure column, Air Conditioners, Air cooled - see this document’s Appendix B, Table 4-1	Minor formatting edit for clarity.	Scott Bailey
4-3	Table 4-1	IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI	TEST PROCEDURES should not be capitalized in table footer.	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		340/360 ~~TEST PROCEDURES~~test procedures		
4-4	Table 4-2	Table 4-2 Standards Table 110.2-B Unitary and Applied Heat Pumps	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-4	Table 4-2	Merge cells for table header Efficiency - see this document's Appendix B, Table 4-2	Minor formatting edit for clarity.	Scott Bailey
4-4	Table 4-2	Merge cells for table row Water source (cooling mode) - see this document's Appendix B, Table 4-2	Minor formatting edit for clarity.	Scott Bailey
4-4	Table 4-2	Merge cells for Test Procedure column, Air cooled (heating mode) split systems and single package - see this document's Appendix B, Table 4-2	Minor formatting edit for clarity.	Scott Bailey
4-5		Delete blank page	No purpose for blank page.	Scott Bailey
4-6	Table 4-2	Merge cells for Equipment Type column, Water source (heating mode) - see this document's Appendix B, Table 4-2	Minor formatting edit for clarity.	Scott Bailey
4-6	Table 4-2	Merge cells for Test Procedure column, Water source (heating mode) - see this document's Appendix B, Table 4-2	Minor formatting edit for clarity.	Scott Bailey
4-6	Table 4-2	[a] IEERs are only applicable to equipment with capacity control ~~as per~~as specified by ANSI/AHRI 340/360 test procedures	Duplicate "as" in table footer.	Scott Bailey
4-6	Table 4-3	Table 4-3 Standards Table 110.2-C Air-Cooled Gas Engine Heat Pumps	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-6	Table 4-3	Air-cooled gas-engine heat pump (~~H~~heating mode)	Replace uppercase H with lowercase h.	Scott Bailey
4-6	Table 4-3	47^{0}F db/43~~0~~^{0}F wb outdoor air	Replace O with degree symbol.	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
4-7	Table 4-4	Table 4-4 Standards Table 110.2-D Water Chilling Packages	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-7	Table 4-4	Merge cells for Equipment Type column, Air Cooled with Condenser Electrically Operated - see this document's Appendix B, Table 4-4	Minor formatting edit for clarity.	Scott Bailey
4-8	Table 4-4	AHRI 550/590	Add text to Test Procedure column, Air Cooled without Condenser Electrically Operated	Scott Bailey
4-8	Table 4-4	AHRI 550/590	Add text to Test Procedure column, Water Cooled, Electrically Operated, Reciprocating	Scott Bailey
4-8	Table 4-4	Merge cells for Equipment Type column, Water Cooled, Electrically Operated Positive Displacement - see this document's Appendix B, Table 4-4	Minor formatting edit for clarity.	Scott Bailey
4-8	Table 4-4	Merge cells for Test Procedure column, Water Cooled, Electrically Operated Positive Displacement - see this document's Appendix B, Table 4-4	Minor formatting edit for clarity.	Scott Bailey
4-9	Table 4-4	~~=~~≥ 600 tons	Replace greater than with greater than equals sign for Water Cooled, Electrically Operated Positive Displacement	Scott Bailey
4-9	Table 4-4	≤ 0.~~.~~560 kW/ton ≤ 0.500 IPLV	Remove double decimal symbol for Water Cooled, Electrically Operated Positive Displacement	Scott Bailey
4-9	Table 4-4	≤ 0.~~570~~560 kW/ton ≤ 0.~~539~~500 IPLV	Incorrect values for Water Cooled, Electrically Operated Centrifugal, Path A	Scott Bailey
4-9	Table 4-4	≤ 0.~~590~~585 kW/ton ≤ 0.~~400~~380 IPLV	Incorrect values for Water Cooled, Electrically Operated Centrifugal, Path B	Scott Bailey
4-9	Table 4-4	Merge cells - see this document's Appendix B, Table 4-4	Merge cells for Test Procedure column, Water Cooled, Electrically Operated Centrifugal	Scott Bailey
4-11	Table 4-5	Table 4-5 Standards Table 110.2-E Packaged Terminal Air Conditioners and Heat Pumps	Update table captions to include reference to Title	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
			24 tables	
4-11	Table 4-5	~~13.8~~14.0-(0.300 x Cap/1000)[a] ~~x~~EER	Remove 'x' before EER for PTAC (cooling mode) Newly constructed	Scott Bailey
4-11	Table 4-5	10.9-(0.213 x Cap/1000)~~a x~~[a] EER	Remove 'x' before EER and superscript footnote letter for PTAC (cooling mode) Replacements	Scott Bailey
4-11	Table 4-5	14.0-(0.300 x Cap/1000)~~a x~~[a] EER	Remove 'x' before EER and superscript footnote letter for PTHP (cooling mode) Newly constructed	Scott Bailey
4-11	Table 4-5	10.8-(0.213 x Cap/1000)~~a x~~[a] EER	Remove 'x' before EER and superscript footnote letter for PTHP (cooling mode) Replacements	Scott Bailey
4-11	Table 4-5	Merge cells for Efficiency header on continued table on page 4-15 - see this document's Appendix B, Table 4-5	Minor formatting edit for clarity.	Scott Bailey
4-11	Table 4-5	~~Equipment Type~~Efficiency	Correct table header for Efficiency column	Scott Bailey
4-11	Table 4-5	Test Procedure[c] ~~Size Category (Input)~~	Correct table header for Test Procedure column	Scott Bailey
4-11	Table 4-5	3.7-(0.052 x Cap/1000)[a] ~~x~~COP	Remove 'x' before EER for PTHP (heating mode) Newly constructed	Scott Bailey
4-11	Table 4-5	2.9-(0.026 x Cap/1000)[a] ~~x~~COP	Remove 'x' before EER for PTHP (heating mode) Replacements	Scott Bailey
4-12	Table 4-5	Merge cells for Test Procedure column, SPVAC (cooling mode) and insert ANSI/AHRI 390 - see this document's Appendix B, Table 4-5	Minor formatting edit for clarity.	Scott Bailey
4-12	Table 4-5	Merge cells for Test Procedure column, SPVHP (cooling mode) and insert ANSI/AHRI 390 - see this document's Appendix B, Table 4-5	Minor formatting edit for clarity.	Scott Bailey
4-12	Table 4-5	Merge cells for Test Procedure column, SPVAC (heating mode) and insert ANSI/AHRI 390 - see this document's Appendix B, Table	Minor formatting edit for clarity.	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		4-5		
4-12	Table 4-5	"MANUFACTURERED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS."	Correct spelling of "MANUFACTURERED" in footnotes.	Scott Bailey
4-12	Table 4-6	Table 4-6 Standards Table 110.2-F Heat Transfer Equipment	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-13	Table 4-7	Table 4-7 Standards Table 110.2-G Performance Requirements for Heat Rejection Equipment	Update table captions to include reference to Title 24 tables	Scott Bailey
4-13	Table 4-7	Propeller or axial fan evaporative condensers	Missing 's'	Scott Bailey
4-13	Table 4-7	R-507A test fluid 165^{0}F entering gas temp 105^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	Missing 'A' and extra word "entering" removed for Propeller or axial fan evaporative condensers.	Scott Bailey
4-13	Table 4-7	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	Extra word "entering" removed for Propeller or axial fan evaporative condensers.	Scott Bailey
4-13	Table 4-7	Centrifugal fan evaporative condensers	Missing 's'	Scott Bailey
4-13	Table 4-7	R-507A test fluid 165^{0}F entering gas temp 105^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	Missing 'A' and extra word "entering" removed for Centrifugal fan evaporative condensers.	Scott Bailey
4-13	Table 4-7	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	Extra word "entering" removed for Centrifugal fan evaporative condensers.	Scott Bailey
4-13	Table 4-7	≥ 176,000 Btu / h x hp	Insert missing 'x' for Air cooled condensers.	Scott Bailey
4-14	Table 4-7	For refrigerated warehouses or commercial refrigeration applications, condensers shall	Missing 's' in footnotes.	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		comply with requirements specified by Section 120.6(a) or Section 120.6(b)		
4-14	Table 4-8	Table 4-8 Standards Table 110.2-H Electrically Operated Variable Refrigerant Flow Air Conditioners	Update table captions to include reference to Title 24 tables	Scott Bailey
4-14	Table 4-8	[b] IEERs are only applicable to equipment as ~~per~~ specified by ASNI/AHRI 1230 test procedures.	Missing word "only" in footnotes	Scott Bailey
4-15	Table 4-9	Table 4-9 Standards Table 110.2-I Electrically Operated VRF Air-to-Air and Applied Heat Pumps	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-15	Table 4-9	≥ 135,000 Btu/h and < 240,000 Btu/h	Missing word "Btu/h" for VRF Air cooled, (cooling mode).	Scott Bailey
4-15	Table 4-9	≥ 240,000 Btu/h	Missing word "Btu/h" for VRF Air cooled, (cooling mode).	Scott Bailey
4-15	Table 4-9	~~≥~~ ≤ 135,000 Btu/h	Replace greater than equals sign with greater than sign for VRF Groundwater source (cooling mode).	Scott Bailey
4-15	Table 4-9	~~≥~~ ≤ 135,000 Btu/h	Replace greater than equals sign with greater than sign for VRF Ground source (cooling mode).	Scott Bailey
4-16	Table 4-9	VRF Groundwater source (heating mode)	Missing words "(heating mode)" for VRF Groundwater source.	Scott Bailey
4-16	Table 4-9	[c] IEERs are only applicable to equipment with capacity control as ~~per~~ specified by ANSI/AHRI 1230 test procedures.	Missing words "only" and "with capacity control" in footnotes.	Scott Bailey
4-17	Table 4-10	Table 4-10 Standards Table 110.2-J Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-17	Table 4-10	**Subcategory or Rating Condition**[b]	Include missing footnote reference.	Scott Bailey

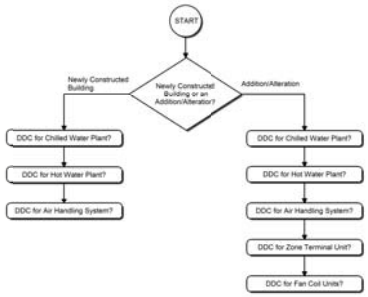
Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
4-18	Table 4-11	Table 4-11 Standards Table 110.2-K Gas and Oil Fired Boilers	Update table captions to include reference to Title 24 tables.	Scott Bailey
4-18	Table 4-11	≥ 300,000 Btu/h and ≤~~<~~ 2,500,000 Btu/h[d]	Replace less than sign with less than equals sign for Boiler, hot water, gas-fired.	Scott Bailey
4-18	Table 4-11	≥~~>~~ 2,500,000 Btu/h[e]	Replace greater than equals sign with greater than sign for Boiler, how water, gas-fired.	Scott Bailey
4-18	Table 4-11	82% ~~E_t~~ E_c	Replace thermal efficiency (Et) with combustion efficiency (Ec) for Boiler, hot water, gas-fired Before 3/2/2020 column.	Scott Bailey
4-18	Table 4-11	82% ~~E_t~~ E_c	Replace thermal efficiency (Et) with combustion efficiency (Ec) for Boiler, hot water, gas-fired After 3/2/2020 column.	Scott Bailey
4-18	Table 4-11	≥ 300,000 Btu/h and ≤~~<~~ 2,500,000 Btu/h[d]	Replace less than sign with less than equals sign for Boiler, hot water, oil-fired.	Scott Bailey
4-18	Table 4-11	≥~~>~~ 2,500,000 Btu/h[e]	Replace greater than equals sign with greater than sign for Boiler, how water, oil-fired.	Scott Bailey
4-18	Table 4-11	82% ~~E_t~~ E_c	Replace thermal efficiency (Et) with combustion efficiency (Ec) for Boiler, hot water, oil-fired After 3/2/2020 column.	Scott Bailey
4-18	Table 4-11	≥ 300,000 Btu/h and ≤~~<~~ 2,500,000 Btu/h[d]	Replace less than sign with less than equals sign for Boiler, steam, gas-fired except natural draft.	Scott Bailey
4-18	Table 4-11	≥~~>~~ 2,500,000 Btu/h[e]	Replace greater than equals sign with greater than sign for Boiler, steam, gas-fired except natural draft.	Scott Bailey
4-18	Table 4-11	≥ 300,000 Btu/h and ≤~~<~~ 2,500,000 Btu/h[d]	Replace less than sign with less than equals sign for Boiler, steam, gas-fired, natural draft.	Scott Bailey
4-18	Table 4-11	≥~~>~~ 2,500,000 Btu/h[e]	Replace greater than equals sign with greater than sign for Boiler, steam, gas-fired, natural draft.	Scott Bailey

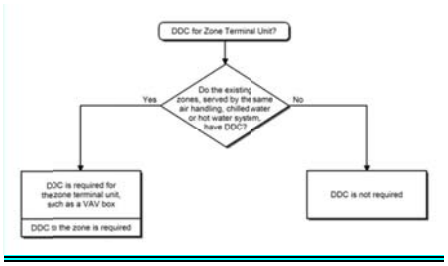
Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
4-18	Table 4-11	≥ 300,000 Btu/h and ≤~~=~~ 2,500,000 Btu/h[d]	Replace less than sign with less than equals sign for Boiler, steam, oil-fired.	Scott Bailey
4-18	Table 4-11	≥~~=~~ 2,500,000 Btu/h[e]	Replace greater than equals sign with greater than sign for Boiler, steam, oil-fired.	Scott Bailey
4-52	Item C	C. CO2 based DCV is based on two principles: 1. Several studies (Berg-Munch et al. 1986, Cain et al. 1983, Fanger 1983 and 1988, Iwashita et al. 1990, Rasmussen et al. 1985) concluded that about 15 cfm of outdoor air ventilation per person will control human body odor such that roughly 80 percent of unadapted persons (visitors) will find the odor to be at an acceptable level. As activity level increases and bioeffluents increase, the rate of outdoor air required to provide acceptable air quality increases proportionally, resulting in the same differential CO2 concentration. ~~These studies are the basis of the 15 cfm/person rate required by these Standards and most building codes. This ventilation rate can be roughly equated to CO2 concentration using the following steady-state equation:~~ ~~where V is the ventilation rate per person, is the CO2 generation rate per person, Cin,ss is the steady-state value of the indoor CO2 concentration, and Cout is the outdoor concentration. At the rate of CO2 generated by adults at typical activity levels in offices, 15 cfm/person equates to a differential CO2 concentration (indoor minus outdoor) of approximately 700 ppm.~~ ~~2. The same level of odor acceptability was~~	Recommend condense and reference study, or remove entirely. Perhaps reference ASHRAE 62.1 as well. Struck-through text is extraneous information.	John Arent

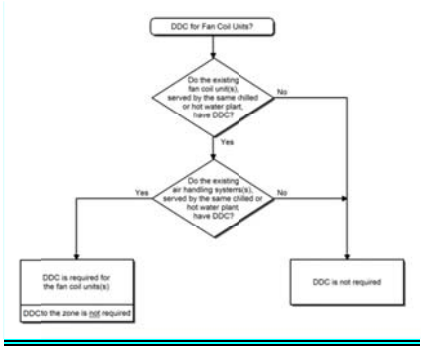
<table>
<tr><th>Page</th><th>Section/ Paragraph</th><th>Suggested Revision</th><th>Comments</th><th>Commenter</th></tr>
<tr><td></td><td></td><td>~~found to occur at 700 ppm differential CO2 concentration even for spaces that were not at equilibrium (Berg-Munch et al. 1986, Fanger 1983, Rasmussen et al. 1985), and the correlation was not strongly dependent on the level of physical activity. This suggests that while CO2 concentration may not track the number of occupants when spaces are not at steady-state, it does track the concentration of bioeffluents that determine people's perception of air quality. It also suggests that odorous bioeffluents are generated at approximately the same rate as CO2.~~
~~Hence as activity level and bioeffluent generation rate increases (in the equation above), the rate of outdoor air required to provide acceptable air quality (V) increases proportionally, resulting in the same differential CO2 concentration.~~</td><td></td><td></td></tr>
<tr><td>4-79</td><td>Table before Item D</td><td><table><tr><td>Occupied</td><td>~~73F~~75F</td><td>70F</td></tr><tr><td>Standby</td><td>~~77F~~78F</td><td>~~66F~~67F</td></tr><tr><td>Unoccupied</td><td>~~78F~~80F</td><td>~~60F~~62F</td></tr></table></td><td>The occupant sensor setback sample control conflicts with thermostat requirements in 120.2(b)3, which requires that the thermostat be capable of a 5°F deadband between cooling and heating.</td><td>John Arent</td></tr>
<tr><td>4-82</td><td>4.5.1.5 Best Practice</td><td>…or cooling.
However, to avoid instances of insufficient ventilation, or sick building syndrome, the designer should specify that the outside air dampers open and provide ventilation if:
• The unoccupied period is a 1-hour pre-occupancy purge ventilation, as per §120.1(c)2.
• The damper is enabled by an occupant sensor</td><td>This will ensure that ventilation air is being provided when the building is occupied.</td><td>Farhad Farahmand</td></tr>
</table>

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		in the building as per §120.1(c)5, indicating that there are occupants that demand ventilation air. • The damper is enabled by an override signal as per §120.2(e)1, which includes an occupancy sensor but also an automatic time switch control device or manually operated 4-hour timer.		
4-87	Item 7	7. The FDD system shall detect the following faults:	Question: Do some FDD systems have capabilities beyond the minimum listed here? Can they detect low airflow problems, refrigerant line problems that impact efficiency or that may cause premature failure? Recommend adding a statement at the beginning of the section clarifying that these are requirements that must be included as part of the packaged unit (prime responsibility is the manufacturer, not the designer).	John Arent
4-89	Paragraph 3	1. Demand Control Ventilation (mandatory) - Title 24 §120.1(c) 2. Automatic Demand Shed Controls (mandatory) - Title 24 §120.2(h) 3. Optimum Start/Stop Controls (mandatory) - Title 24 §120.2(k) 4. Setpoint Reset Controls for Variable Air Volume Systems (prescriptive) - Title 24 §140.4(c)2C	Include references to the sections of Title 24 that are triggered so readers can easily find the relevant requirements in the Standards and in the Compliance Manual.	Scott Bailey
4-89	Paragraph 5	~~In order to ensure the cost effectiveness of DDC, t~~The Standards mandate DDC for only certain building applications with minimum qualifications or equipment capacities, as	Cost effectiveness has already been shown during the CASE process. We do not need to mention it again here.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		specified in Table 4-17.	*See next comment for additional feedback on this paragraph.*	
4-89	Paragraph 5	In order to ensure the cost effectiveness of DDC, the Standards mandate DDC for only certain building applications with minimum qualifications or equipment capacities, as specified in Table 120.2-A DDC Applications and Qualifications of the Standards, see Table 4-17 in this compliance manual which is a duplicate of Table 120.2-A of the Standards.	Include reference to the table in the Standards and clarify that Table 4-17 in the Compliance Manual is a duplicate of the table in the Standards. *See previous comment for additional feedback on this paragraph.*	Scott Bailey
4-90	Table 4-17	Individual systems supplying more than three zones and with design heating or cooling capacity of 300 kBtu/h ~~with fan systems bhp of 10 hp (7.45 kW)~~ and larger	Table entry updated to match adopted Title 24 Standards. The qualifications were modified in the 15-day language.	Scott Bailey
4-90	Table 4-17	Individual systems with design heating or cooling capacity of 300 kBtu/h ~~with fan system bhp of 10 hp (7.45 kW)~~ and larger and supplying more than three zones and more than 75 percent of zones are new	Table entry updated to match adopted Title 24 Standards. The qualifications were modified in the 15-day language.	Scott Bailey
4-90	Insert before Example 4-32	Follow the logic flowchart in Figure 4-13, Building Status Flowchart to determine if a DDC system is required for newly constructed buildings or for additions or alterations to buildings. The Building Status Flowchart will indicate which equipment flowchart (Figure 4-14 through Figure 4-18) should be used for each type of HVAC equipment that will be installed in the building. The logic of the equipment flowcharts will indicate whether DDC is required for the building, how DDC should be applied to the	Insert flow charts (Figures 4-13 through Figure 4-18) and accompanying text to help explain when DDC is required to the zone. See Appendix D for larger versions of Figure 4-13 through Figure 4-18	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		equipment and whether DDC is required to be installed to the zone level, see Figure 4-14 through Figure 4-18.  Figure 4-13 – Building Status Flowchart  Figure 4-14 – Chilled Water Plant Flowchart		

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		 Figure 4-15 – Hot Water Plant Flowchart  Figure 4-16 – Air Handling System Flowchart  		

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		Figure 4-17 – Zone Terminal Unit Flowchart  Figure 4-18 – Fan Coil Units Flowchart **Additions and Alterations Requirements** For additions or alterations to buildings, zones that are not part of the addition or alteration are not required to be retrofitted with DDC. Pre-existing DDC systems in buildings are not required to be retrofitted so DDC is to the zone.		
4-90	Example 4-32	Example 4-32 **Question** If a newly constructed building has a HVAC system ~~solely~~ comprised of an air handling system, ~~which~~ serving ~~es~~ 4 zones and a ~~total cooling capacity of 20 tons~~ chilled water plant with a design cooling capacity of 250,000 Btu/h, is DDC required? **Answer** No. Although the HVAC system is serving	Some of the qualifications in Table 120.2-A were modified at the 15-day language stage to simplify the qualifying conditions for air handling systems. The changes to the example reflect the new qualifications that were adopted.	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		more than 3 zones, the chilled water plant ~~cooling capacity~~ does not meet the minimum design cooling capacity of 300,000 Btu/h (300 kBtu/h) ~~exceed the minimum 25 ton (300kBtu/h) threshold~~. A DDC system would be required if the design cooling capacity was ~~is~~ 300,000 Btu/h ~~25 tons~~ or larger, ~~regardless that the building does not have a chilled or hot water plant.~~		
4-91	Example 4-34	Example 4-34 **Question** If a building's chilled water plant is upgraded with new chillers that have a design capacity of 500 kBtu/h and serves 3 zones, is DDC required? **Answer** Yes. The criteria that triggers the DDC requirement is that the plant upgrade is installing **new** chillers with a cooling capacity greater than 300 kBtu/h. In this case, T~~t~~he number of zones is irrelevant for determining if DDC is required ~~a plant upgrade~~.	Added missing word "cooling" and expanded the explanation for when the number of zones is irrelevant in determining if DDC is required.	Scott Bailey
4-91	First Paragraph after Example	**DDC Capabilities** The new Standards also require the mandated DDC system to have the following capabilities to ensure that the full energy saving benefits of DDC:	Add heading to help clarify that the content in the subsequent paragraph relates to the required capabilities of DDC systems.	Scott Bailey
4-91	Last paragraph	The controls shall take in to account the space temperature, outside ambient temperature, occupied temperature, ~~and~~ amount of time	Optimum start controls description was updated to match adopted Title 24; The required algorithm parameters for optimum start/stop controls were	Scott Bailey

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		prior to scheduled occupancy, and if present, the floor temperatures of a mass radiant floor slab systems~~thermal lag of each controlled zone~~.	modified for Title 24 15-day language.	
4-92	Paragraph 1	The controls shall take in to account the space temperature, outside ambient temperature, unoccupied temperature, and the amount of time prior to scheduled occupancy~~thermal lag of each controlled zone~~.	Optimum stop controls description was updated to match adopted Title 24; The required algorithm parameters for optimum start/stop controls were modified for Title 24 15-day language.	Scott Bailey
4-96	Best Practice Paragraph 1	[…] or full open position.	Add a period to the end of the last sentence.	Farhad Farahmand
4-96	Best Practice Paragraph 4	2,000 ~~cfm~~ ft/min	Velocity is expressed in ft/min.	Farhad Farahmand
4-112	Paragraph 7	Designers are encouraged to provide advice and mode indicator lights or displays or other means to communicate to occupants when it is efficient to open the windows/doors and when heating/cooling setpoints have been reset due to operable openings. An advice indicator light, for example, could be green when the zone is in cooling and the outside air temperature is less than the space temperature and would be red otherwise. Instead of a green light, a message could be displayed: "opening the window now will save cooling energy". Instead of red, a message could be displayed: "opening the window now will turn off the heating/cooling". A mode indicator light, for example, could be red when the heating	Add this paragraph after paragraph 7 at the end of section 4.5.2.7	Jeff Stein

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		setpoint has been setback in heating mode or the cooling setpoint has been setback in cooling mode and would be unlit otherwise. Instead of red, a message could be displayed: "heating/cooling is off because a window is open".		
4-139	Paragraph 5	Compliance is shown by running two models: a ~~baser-case~~base case budget building that nominally just meets the mandatory and prescriptive requirements and a proposed building that represents the actual building's proposed envelope, lighting and mechanical systems. To create a level playing field the base case and proposed designs are compared using the same assumptions of occupancy, proscribed climatic conditions and operating schedules. The results are compared using standardized time of use rates, or Time Dependent Valuations (TDV) of energy cost. The proposed building complies if ~~it's~~ its annual TDV is less than or equal to that of the budget building. Reference ~~Joint~~ Appendix JA3 describes the derivation of the TDV energy multipliers.	Minor edits for clarity.	John Arent
4-139	Paragraph 8	The ACM defines the modeling rules for developing the base-case model of the building and mechanical systems. The base-case HVAC system(s) are based on the proposed HVAC system(s) according to the following specific characteristics: ~~• Proposed space-conditioning system type~~ ~~• Heating Source~~	The proposed building space conditioning system, heating source and cooling source do not impact the baseline HVAC system used in the performance method.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~• Cooling Source~~ • Occupancy type • ~~Size~~ Floor area of building • Number of floors, and zoning		
4-140	Paragraph 1	Application of economizers where they are not required. ~~• Oversizing of heat exchangers for water-side economizers to exceed the minimum prescriptive requirement.~~ • Oversizing ducts and pipes to reduce fan and pump energy. ~~• Providing demand based controls for reset of supply temperature and pressure for air and water systems.~~ • Use of heat recovery for space or water heating. • Use of thermal energy storage systems or building mass to move cooling off peak. • Reduce reheating and recooling. • Use of thermally driven cooling equipment, such as absorption chillers~~, adbsorption chillers, or dessicant cooling~~. - Smart selection of HVAC systems, such as the use of single-zone VAV systems and VRF, where applicable	Water-size economizers are not in the baseline system, and while a compliance option, they typically will not provide additional compliance credit. Demand-based reset controls are already required. Adsorption and desiccant systems are not currently in performance approach scope.	John Arent
4-151	Paragraph 3	**5.7.1.2 Fan Power Index** is the ~~hourly~~ power consumption of the fan system per unit of air moved per minute (W/cfm) at design conditions.	This is the design fan power, not an hourly average (which could be much lower for VAV systems).	John Arent

6. COMMENTS ON CHAPTER 5 – INDOOR LIGHTING

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
5-1	Paragraph 1	This chapter covers the Title 24 California Code of Regulations, Part 6 (the Energy Standards), requirements for indoor lighting design and installation, including controls, for both conditioned and unconditioned nonresidential buildings. It is addressed primarily to lighting designers, ~~or~~ electrical engineers, and ~~to~~ enforcement agency personnel responsible for lighting ~~and electrical plan checking and inspection.~~ design, installation, plan check and inspection.	Revise for clarity.	Chitra Nambiar
5-8	Section B	…adjusted actual watts of lighting power ~~that has been installed in the~~ for the proposed building design~~building~~ Note: In the Performance approach Adjusted LPD can be calculated automatically by the compliance software based on the modelling approach. Refer to the compliance software documentation for details.	This step of the process is slightly different in the performance approach. In the performance approach the lighting credits will get double counted if the adjusted LPD is used instead of the Actual LPD. Hence, recommend including a note for clarity.	Chitra Nambiar
5-42	Section A1 Last paragraph	~~Thus general lighting does not include display lighting (which is typically directional lighting such as seen in MR, and PAR, spot or flood lamps) or "wall washers" (luminaires with an asymmetric distribution for illuminating vertical surfaces). General lighting is also not ornamental lighting as seen in drum fixtures, chandeliers or projection lighting. General lighting typically makes use of troffers (prismatic and parabolic and indirect diffusers), pendant lighting (direct,~~	Revise for clarity.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~indirect or direct/indirect), high bay fixtures, low bay fixtures and "aisle-lighter" fixtures.~~ Luminaires used for general lighting typically are troffer lights (prismatic and parabolic and indirect diffusers), pendant lighting (direct, indirect or direct/indirect), high bay fixtures, low bay fixtures and "aisle-lighter" fixtures. General lighting does not include display lighting or ornamental lighting. (Display lighting are typically directional lights using MR, PAR, spot or flood lamps or wall washers). Examples of ornamental lights include drum fixtures, chandeliers or projection lighting.)		
5-61	Paragraph 3	Thus if one prescriptively complies by installing ~~skylights or other~~ daylight openings in large enclosed spaces directly under roofs, the daylit areas ~~will have enough lighting wattage~~ could have electric lighting systems with high enough lighting power to trigger the mandatory requirements for daylighting controls. However if one complies using the performance approach it is possible to trade-off daylighting openings and daylighting controls with other building efficiency options.	Revise for clarity.	Chitra Nambiar
5-62	Section B	[remove space] In Climate Zones 2 thru 15, enclosed spaces larger than 5000 square feet shall have at least 75 percent of spaces in daylit zones and the 75 percent spaces shall be within Primary Sidelit Daylit Zone or Skylit daylit zone ~~or be within projection of skylights.~~	Revise for clarity and formatting consistency.	Chitra Nambiar
5-62	Section B-1 Paragraph 2	The daylig~~ht~~ zone and controls specification in §130.1(d) describe which luminaires are	Revise for clarity.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		controlled ~~and this specification must consider the daylight obstructing effects of tall racks, shelves, and partitions~~. The obstructing effects of tall racks, shelves and partitions must be taken into consideration while determining the specifications. There is a greater likelihood that the electrical design will occur later than the architectural design and thus greater planning for these obstructions can be built in to the lighting circuiting design. With addressable luminaires, the opportunity is available to the contractor to incorporate the latest as built modifications into the daylight control grouping of luminaires.		
5-70	Item 7	7. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multi-level, and automatic lighting controls required in §130.1, and in addition to any other ~~lighting controls~~ mandatorily required lighting controls	Revise for clarity.	Chitra Nambiar
5-91	Section C-3	The RCR is based on the entire space bounded by floor-to-ceiling partitions. If a task area within a larger space is not bounded by floor to ceiling partitions, the RCR of the entire space must be used ~~for the task area~~. When claiming additional lighting power for wall display lighting for imaginary or virtual walls (defined as "perimeter permanent full height partitions" described in §140.6(c)3Iiv) these virtual or wall display walls can be accounted for establishing in RCR calculation. ~~The exception to this rule allows for imaginary or virtual walls when the boundaries are established by "high stack" elements (close to the ceiling structure and high storage shelves) or~~	Revise for clarity.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~high partial walls defined as "perimeter permanent full height partitions" described in §140.6(c)3Iiv wall display. These permanent full height partitions are only applicable when claiming additional lighting power for wall display lighting. Note: For use in calculating the RCR of the space, the walls are not required to be display walls as is required under §140-.6(c) 3Iiv.~~		
5-92	Last paragraph	A special situation occurs when illuminating stacks of shelves in libraries, warehouses, and similar spaces. In this situation, the lighting requirements are to illuminate the vertical stack rather than the horizontal floor area (see example below). In stack areas the RCR is assumed to be greater than seven. The non-stack areas are treated normally.	This section points to an example but the example is not included in the chapter. Please include the example in the manual or rephrase to remove this reference. The language that needs clarification has been highlighted in the cell to the left, but no revisions have been suggested.	Chitra Nambiar
5-99	Section j	j. Use the appropriate compliance forms to document the additional allowed power for wall display lighting.	Please provide Compliance Form name as reference. The language that needs clarification has been highlighted in the cell to the left, but no revisions have been suggested.	Chitra Nambiar
5-100	Section e-ii	e. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for: i. Floors having floor displays; or ii. Floors not having floor displays but having tasks with illuminance recommendations (in the Tenth Edition of the IES Lighting Handbook) higher than the general lighting level in column 2 of Table 5-7Table 140.6-D.	Example for point two will be helpful.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
5-100	Section h	h. Lighting ~~internal to~~ display case~~s~~ interiors shall be counted either as floor display lighting in accordance with §140.6(c)3J; or as very valuable display case lighting in accordance with §140.6(c)3Liii and iv.	Revise for clarity.	Chitra Nambiar
5-100	Section i	~~i. To qualify for the additional power for floor display and task lighting, the lighting system shall be a type that is appropriate for creating a higher level of illuminance on the floor display or task. Floor display and task lighting shall be of a type different from the general lighting system.~~ ~~Lighting systems appropriate for floor display and task lighting consist of only directional lighting types, such as PAR, R, MR, AR; or of lighting employing optics providing directional display light from non-directional lamps. ii. If track lighting is used, only track heads that are classified as directional lighting types qualify~~ Additional lighting power for floor display and task lighting is allowed if: i. Lighting system used is capable of creating higher level of illuminance for the task or floor display and is of a type different from general lighting system used in the space. ii. Lighting systems appropriate for floor display and task lighting consist of only directional lighting types, such as PAR, R, MR, AR; or of lighting employing optics providing directional display light from non-directional lamps. iii. If track lighting is used, only track heads that are classified as directional lighting types qualify	Revise for clarity.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		for additional power.		
5-102	Section n	n. Use the appropriate compliance form to document the additional allowed power for Floor Display/Task Lighting Power lighting.	Please provide Compliance Form name as reference. The language that needs clarification has been highlighted in the cell to the left, but no revisions have been suggested.	Chitra Nambiar
5-103	Section a	a. Indoor ornamental lighting is defined in §~~100.1(b)~~100.1 and §140.6(c)3K(ii) as decorative luminaires that are chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights, and light-color panels ~~Additionally, §140.6(c)3K(ii) further defines qualifying ornamental lighting to include luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights, and light color panels~~ when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.	Revise for clarity.	Chitra Nambiar
5-104	Section j	j. Use the appropriate compliance form to document the additional allowed power for Ornamental/Special Effects Lighting.	Please provide Compliance Form name as reference. The language that needs clarification has been highlighted in the cell to the left, but no revisions have been suggested.	Chitra Nambiar
5-105	Section b	b. To qualify for additional allowed power for very valuable display case lighting, a case shall contain jewelry, coins, fine china, fine crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections ~~the display of which involves customer inspection of very fine detail from outside of a locked case~~ in a locked case that will be inspected by a customer in fine detail from outside.	Revise for clarity.	Chitra Nambiar

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
5-105	Last paragraph	Use the appropriate compliance form to document the additional allowed power for valuable display case lighting.	Please provide Compliance Form name as reference. The language that needs clarification has been highlighted in the cell to the left, but no revisions have been suggested.	Chitra Nambiar
5-122	Paragraph 3	When a lighting permit is sought under the performance approach, the applicant ~~uses a proposed lighting power density to determine whether or not the building meets the energy budget. If it does, this proposed lighting power density is automatically translated into the allowed lighting power for the building (by multiplying by the area of the building)~~ models the proposed lighting in the compliance software. The energy budget of the proposed building is determined by the software based on the modelled inouts	Revise for clarity.	Chitra Nambiar
5-122	Paragraph 4	Trade-offs in general lighting power ~~is~~ are allowed between all spaces all using the Area Category Method~~, between all spaces all using the Tailored Method, and between all spaces that use using the Area Category and~~ or Tailored Methods.	Revise for clarity.	Chitra Nambiar

7. COMMENTS ON CHAPTER 6 – OUTDOOR LIGHTING

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
6-5	After Paragraph 2	[Add example graphic for layered lighting approach]	The "layered" approach becomes clear later on in the chapter, however on first read layering was a little hard to grasp. Unclear if we simply add the LPD for each allowance and use the sum as the allowed LPD for all outdoor lighting or map the layers in plan view, add LPD for overlapping layers and our allowed LPD is different for each different area. As opposed to rewording this, an example graphic showing a site in plan view with the various lighting layers applied would make this immediately clear.	Sam Currie
6-14	Example 6-3	…found within the Uplight and Glare components only, the energy code does not have backlight requirements.	Though it is mentioned earlier in the chapter, the example question is asking specifically about backlight requirements so it may be helpful for users who do not read the entire chapter.	Sam Currie
6-16	Example 6-5	Define the function of the luminaire ~~be~~ by determining…	Fix typo.	Sam Currie
6-17	Item A	A. Automatic Shutoff Controls §130.2(c) 1 and §130.2(c) 2	The automatic scheduling control requirement is in §130.2(c) 2. This paragraph should retain mention of that requirement, because automatic scheduling controls are a type of automatic shutoff control that all outdoor lighting covered by §130.2(c) must employ.	Eric Rubin
6-17	Item A Paragraph 1	All installed outdoor lighting must be controlled by a photocontrol or outdoor astronomical time-switch controls that automatically turns off the outdoor lighting when daylight is available.	The 2013 Compliance Manual was right to call out the need for automatic scheduling controls in addition to a control that turns off outdoor lighting during the day.	Eric Rubin

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~Additionally, outdoor lighting must be controlled by an automatic scheduling control.~~ Additionally, outdoor lighting must be controlled by an automatic scheduling control—a time-based control capable of turning off power for a portion of the night.	Added an abbreviated definition of automatic scheduling control (defined in §100.1) to remove ambiguity.	
6-18	Paragraph 3	The lighting must also still have a time switch or other automatic scheduling ~~device~~ control so that the lighting will be extinguished ~~during the~~ for a portion of the after-hours period. ~~These~~ The occupancy-based control and the automatic scheduling control may be combined into a single intelligent device, ~~but it may also be accomplished through the use of~~ or they can be two separate control mechanisms.	Replaced "scheduling device" with "automatic scheduling control" so readers understand this refers to the same requirement listed in 6.3.3A. Used language that parallels the description of an automatic scheduling control in 6.3.3A and the definition in §100.1 ("for a portion of") to be consistent. Revised the second sentence for clarity.	Eric Rubin
6-31	6.4.5 Paragraph 4	…which is expressed in W/ft^2, W/ft, or W, ~~respectively~~ depending upon the application	Respective to what? The preceding list ("area or length") could also be modified to account for W and then "respectively" would be more appropriate.	Sam Currie
6-34	Paragraph 2	…for specific applications determined in accordance with Error! Reference source not found	This seems to be an issue with the citation manager being used.	Sam Currie
6-35	Table 140.7-A	No allowance[1] ~~1~~	Minor edit, the "1" should be a superscript.	Sam Currie
6-36	B. Area Wattage Allowances	…included in the project times the AWA listed in ~~Table 6-8~~ Table 140.7-A. Multiply the illuminated hardscape area by the AWA from ~~Table 6-8~~ Table 140.7-A for the appropriate lighting zone.	The previous table name has been struck from the text but not replaced by the updated table number.	Sam Currie
6-45	Item 6	Allowance for the total area within the drip line of the canopy or inside the tunnel. Luminaires qualifying for this allowance shall be located	Tunnels has been added to this item's title however the description of the qualified area hasn't been edited to include tunnels.	Sam Currie

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		under the canopy or tunnel. See Section 6.4.9D for additional information about lighting under canopies and tunnels.		
6-55	Example 6-32	Answer Assuming there are two lanes and each lane is 1000 ~~feet long~~ ft^2, the allowance for Lighting Zone 2 is 2,000 times 0.355 W/ft^2 which allows for ~~is~~ 710 W	The area is mistakenly described as a length; edit for clarity.	Sam Currie

8. COMMENTS ON CHAPTER 7 – SIGN LIGHTING

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
i	Table of Contents	7.4.2 ~~Applications Excluded from Sign Lighting Energy Requirements~~ Lighting Energy Compliance Options	Revise title for sections. Unusual practice to state exceptions before rules.	Misti Bruceri
i	Table of Contents	7.4.3 ~~Lighting Energy Compliance Options~~ Applications Excluded from Sign Lighting Energy Requirements	Revise title for sections. Unusual practice to state exceptions before rules.	Misti Bruceri
i	Table of Contents	~~7-20~~	Remove page reference to deleted section 7.6.6.	Misti Bruceri
7-1	7.1.2 Paragraph 1	…for all illuminated signs (§130.3),	Retain parentheses when not explicitly referring to applicable section.	Misti Bruceri
7-1	7.1.2 Paragraph 2	…are the same throughout all of the state's building climate zones and are independent…	Revise for clarity.	Misti Bruceri
7-2	7.1.3 Paragraph 2	…must be certified by the manufacturer to the Energy Commission and are required to be listed…	Grammatical fix.	Misti Bruceri
7-3	7.2.1 B	~~a~~All the information provided	Capitalize.	Misti Bruceri
7-3	7.2.1 B	~~t~~The equipment, product, or device	Capitalize.	Misti Bruceri
7-4	Paragraph 1	…the Title 20 Appliance Efficiency Regulations. The ~~F~~following are types of lighting controls…	Grammatical fix.	Misti Bruceri
7-4	7.2.2 A.	• Astronomical Time-Switch Controls Multi-Level Astronomical Time-Switch Controls	Delete line-space between bullet points.	Misti Bruceri
7-4	7.2.2.1A. (definition)	• Participation in programs or services	Change bullet list (and capitalization) so that last bullet-points are sub-bullets, as per section 100.1	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		designed to modify electricity use o ~~I~~in response to wholesale market prices, or ~~W~~when system reliability is jeopardized.	definition.	
7-5	Paragraph 1	…and automatically responding to at least one standards~~'~~-based messaging protocol…	Fix typo—replace apostrophe with hyphen.	Misti Bruceri
7-5	7.2.3 Paragraph 1	~~Lighting control systems may be installed for compliance with lighting control requirements in the Standards providing they~~ Compliant lighting control systems are those that meet all of the applicable requirements.	Revise for clarity.	Misti Bruceri
7-5	7.2.3A.	A lighting control system shall comply with all requirements listed below~~:~~, and all components of the system…	Replace semicolon with comma.	Misti Bruceri
7-5	7.2.3A. Bullet 1	Before a ~~L~~lighting ~~C~~control ~~S~~system ~~(~~including an energy management control system (EMCS), can be recognized…	Revise to fix capitalization and present acronym term.	Misti Bruceri
7-5	7.2.3A. Bullet 3	…consume no more than one watt of power per indicator light (§110.9(a)5).	Include reference to applicable section.	Misti Bruceri
7-6	7.2.3B.5. Bullet 1	Be capable of reducing power consumption by a minimum of 65 percent ~~when the dimmer is at its lowest level~~;	Eliminate unnecessary wording.	Misti Bruceri
7-7	Paragraph 1	Note that the installed wattage of sign lighting is not considered ~~for compliance~~ when using the Alternate Lighting Source compliance option…	Eliminate unnecessary wording.	Misti Bruceri
7-7	7.2.4A.	~~A~~**A.**	Formatting: Bold "A"	Misti Bruceri
7-7	7.2.4C.	C. The wattage of luminaires with permanently	Reflects same addition made to the Standards	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		installed or remotely installed ballasts or drivers…	§130.0(c)6.	
7-7	7.2.4C.	…as specified by UL 1598. The maximum input wattage of the rated driver published in driver manufacturer's catalogs based on independent testing lab reports as specified by UL 8750 or LM-79.	Reflects same addition made to the Standards §130.0(c)6.B.	Misti Bruceri
7-9	7.4.1	The Sign Lighting Energy Requirements apply to all internally illuminated ~~(cabinet)~~ signs, …	Internally illuminated signs are not just cabinet signs. Use cabinet signs later as one example of I.I. signs.	Misti Bruceri
7-9	7.4.1	Examples include ~~internally illuminated and externally illuminated signs, including billboards, and off-premise and on-premise signs.~~cabinet signs, channel letters, lightboxes, backlit signs, illuminated billboards, and electronic message centers.	Provide examples rather than restating sign types, e.g. "internally illuminated."	Misti Bruceri
7-9, 7-10	7.4.2 7.4.3	"Switch entire text for sections 7.4.2. and 7.4.3 with one another"	As per the suggested change in order of presentation highlighted above for the Table of Contents. It is unusual to state exclusions before the actual compliance options/requirements.	Misti Bruceri
7-9	7.4.2	The following sign lighting applications are ~~not required to comply~~ excepted from compliance with the sign lighting energy requirements only. ~~However, these exceptions do not apply to other applicable requirements of the Energy Standards, unless also specifically excluded in that section of the Standards.~~	Simplified for clarification.	Misti Bruceri
7-10	7.4.3 Option 2	~~Menu~~ List of Compliant Alternate Lighting Sources	Make Option 2 title consistent with 7.4.3.2.	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
7-10	7.4.3.1	**Option 1: Maximum Allowed Lighting Power ~~Compliance~~**	Unnecessary wording and does not match that used immediately above in the NR manual.	Misti Bruceri
7-10	7.4.3.1	This option for complying with the sign lighting energy requirements is ~~the Maximum Allowed Lighting Power option,~~ also known as the watts per square foot approach.	Remove redundant wording.	Misti Bruceri
7-10	7.4.3.1A.	…12 watts per square foot of the illuminated sign area. See Figure 7-1 and Figure 7-2. For double-faced signs, only the area of a single face shall be used to determine the allowed power. See Figure 7-3.	Direct readers to the appropriate figures that help illustrate the requirements.	Misti Bruceri
7-11	Figure 7-1	Include ~~A~~area from ~~E~~each ~~F~~face ~~W~~when ~~S~~separated by an ~~O~~opaque ~~D~~divider	Correct capitalization, missing "an," and font size needs to be enlarged.	Misti Bruceri
7-11	Figure 7-2	…with Fluorescent Lamps and Translucent Face	Pluralization.	Misti Bruceri
7-12	Figure 7-3	…with Fluorescent Lamps and Translucent Faces	Pluralization.	Misti Bruceri
7-12	7.4.3.2	**Option 2 – List of Compliant Alternate Lighting Sources**	Match wording to7.4.3 Page 7-10	Misti Bruceri
7-12	7.4.3.2	~~Option 2~~ This option for complying with the sign lighting energy requirements is to use only lighting technologies ~~listed included~~ on the list of compliant sources. When using this option for compliance~~, the rules for determining sign lighting power do not apply because~~ there is no requirement to calculate ~~the maximum allowed~~ lighting power ~~with this compliance option~~.	Revise for clarity and to be consistent with suggested changes to 7.4.3.1.	Misti Bruceri
7-12	7.4.3.2	~~A. List of Compliant Lighting Sources~~	Remove redundant heading.	Misti Bruceri
7-12	7.4.3.2	Pulse start that ~~that~~ are 320 watts or smaller, are not 250 watt~~s~~ or 175 watt~~s~~ lamps, and are served by a ballast that has a minimum efficiency of 80	Eliminate typo and maintain consistency with section 140.8(b).	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	Bullet 2	percent		
7-13	7.4.3.2	3. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to the following:	Grammatical fix.	Misti Bruceri
7-14	7.4.4	Remove all text/figures under "Hybrid Signs" on page 7-14 following : "…incandescent "chaser" lamps forming an illuminated arrow."	Figure 7-4, Figure 7-5 and related text is confusing as presented. Neither are specific examples of **Hybrid Signs**. The content for Figure 7-4 would serve better if included within the current section 7.4.2, subsection 1. To illustrate this particular excluded application. The content for Figure 7-5 would serve better if included within the current section 7.4.3.1.B. "For externally illuminated signs."	Misti Bruceri
7-14	Paragraph 1	…is not part of an electronic message center (EMC) using unfiltered incandescent lamps.	Revise for completeness.	Misti Bruceri
7-14	Figure 7-4 heading	Unfiltered Incandescent Sign	Revise for completeness	Misti Bruceri
7-15	Example 7-2 Question	…with the Standards under ~~Alternative~~Option 2 (~~Specific Technology Approach~~ Compliant Alternate Lighting Sources)?	Revise to maintain consistency.	Misti Bruceri
7-15	Example 7-4 Answer	Your other option is to replace the incandescent sources with an energy efficient option that is permitted under the ~~specific technology approach~~Alternate Lighting Sources option, such as hard-wired LED (with the appropriate power supply efficiency), pulse start or ceramic metal halide (with the appropriate minimum efficiency	Revise to maintain consistency. Revise to quote all relevant requirements of the Standards. Additionally, section 140.8(b)5. does not specify "hard-wired" LEDs.	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		ballast), or hard-wired CFL sources.		
7-15	Example 7-5 Question	…panel sign displaying an illuminated arrow and lettering ~~equipped with~~having power supplies with an efficiency of 76 percent. Does this sign comply with the ~~specific technology~~Alternate Lighting Sources approach?	Revise for clarity and consistency. Additionally, this question and answer is not specific enough—no lighting source is specified for the internally illuminated panel, other than saying it has an electronic ballast— which may or may not have the required minimum efficiency or output frequency, dependent upon the actual lighting source.	Misti Bruceri
7-16	Example 7-5 Answer	…that complies with the ~~specific technology approach~~Alternate Lighting Sources option and two unfiltered neon signs, with efficient power supplies, ~~also~~ that also comply with the ~~specific technology approach~~Alternate Lighting Sources option.	Revise for clarity and consistency. Additionally, see comments above re. missing specificity.	Misti Bruceri
7-16	7.5 Section reference box	…§141.0(b)~~1~~2H	Incorrect section reference.	Misti Bruceri
7-16	7-5	…an indoor or outdoor addition, or alteration to a building…	Punctuation	Misti Bruceri
7-16	7.5.1	…signs that are altered as specified by §141.0(b)~~1K~~2M are required to…	Incorrect section reference.	Misti Bruceri
7-17	Paragraph 1	The ~~lighting power~~ requirements for signs (either ~~specific technology or watts per square foot~~theMaximum Allowed Lighting Power or the Alternate Lighting Sources option) are triggered…	Revise for clarity and consistency.	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		…result of the alteration, as specified in §141.0(b)2M:		
7-17	Paragraph 2	The ~~lighting power~~ requirements for signs are not triggered when just…	Revise for consistency.	Misti Bruceri
7-17	Example 7-7 Answer	…the replacement involves rewiring the ballasts, then the ~~alteration~~ requirements of §140.8 apply to the whole sign.	Revise for clarity.	Misti Bruceri
7-19	Paragraph 4	The sign lighting compliance document~~ation~~s are designated as "NRCC-LTS".	Revise word choice.	Misti Bruceri
7-19	Paragraph 5	Sign lighting compliance documents for ~~compliance with~~ the 2016 Standards…	Revise unnecessary wording.	Misti Bruceri
7-19	7.6.1 A. and B.	~~A. For the period of January 1 through December 31, 2015~~ ~~Sign lighting compliance documents are similar to the 2013 compliance documents, except they have been updated to reflect changes in the 2016 Standards~~ ~~B.~~ Starting on January 1, 2016…	Remove content that will be irrelevant given the commencement date of the 2016 Standards.	Misti Bruceri
7-19	7.6.3	**Two Combined SLTG Document~~ation~~s** There are two compliance document~~ation~~s required…	Revise word choice.	Misti Bruceri
7-20	7.6.4	E Developed primarily for the Enforcement ~~(E) AHJ~~ Agency	Revise for clarity.	Misti Bruceri
7-20	7.6.5	There is another installation certificate required	Revise for grammar.	Misti Bruceri

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		when a lighting control system~~s~~ or an energy management control system~~s~~ is…		

9. COMMENTS ON CHAPTER 8 – ELECTRICAL POWER DISTRIBUTION

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
8-1	Paragraph 1	This chapter describes the Title-24 requirements in Section 130.5 for energy efficiency measures used for the electrical power distribution systems of nonresidential, high-rise residential, and hotel/motel occupancy buildings	Revise for clarity/additional detail and make "system" plural.	Mark Hinrichs
8-2	8.1.2	The following requirements for electrical power distribution systems….	Insert the word "following" for clarity.	Mark Hinrichs
8-3	8.1.2 A	The requirements of §130.5 ~~applies~~ apply	Apply, not applies.	Mark Hinrichs
8-4	8.2 Paragraph 2	…the meter must measure and record…	Meter needs to keep that information.	Mark Hinrichs
8-4	8.2 Paragraph 4	Service is defined in §100.1 as "the conductors and equipment for delivering…"	Edit for clarity.	Mark Hinrichs
8-5	Table 130.5, Column 1 Row 3	"tracking kWh for a user-defined period"	This conflicts with Example 8.3, which refers to a "utility defined period".	Mark Hinrichs
8-15	8.3.1.1 Last line	"..specified in Table 130.5-B of the….	Space needed after "-B"	Mark Hinrichs
8-13 to 8-17	Most paragraphs		Disaggregation needs to be defined properly (and not just used without definition) after using the word "Separation"	Mark Hinrichs
8-16	8.3.1.3, Bullet 2	Method 2 allows ~~a~~ distribution equipment to serve more than one load type ~~by the equipment~~ .	Removed for clarity and simplification.	Mark Hinrichs
8-16	8.3.1.3	Method 3 allows a complete~~r~~ metering system	Typo	Mark Hinrichs

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	Bullet 3	~~provided~~ that at a minimum measures….		
8-17	Example 8-6	Move diagram label "Lighting Panel" so doesn't overlap with shapes.	Could just be pagination error.	Mark Hinrichs
8-19	Example 8-9, Paragraph 1	Each circuit is to ~~be~~ serve~~d with~~ no more than one load type.	Edited for clarity.	Mark Hinrichs
Many	Most Examples	There are issues with almost every Example that would be too difficult to address in this format.	These issues may be mostly due to pagination and may resolve themselves, but the examples should be reviewed after deletions are effected.	Mark Hinrichs
8-25	8.4 Paragraph 2	The maximum ~~combined~~ voltage drop ~~on both installed feeder conductors and circuit conductors~~ from utility service entrance to the farthest connected load….	Minor edit for clarity.	Mark Hinrichs
8-37	8.5 Title	Circuit Controls for Controlled and Uncontrolled 120-Volt Receptacles ~~and Controlled Receptacles~~ -§130.5(d)	Minor edit for clarity.	Mark Hinrichs
8-39	Paragraph 1	…or by controls integrated into the office modular furniture systems	Minor edit for clarity.	Mark Hinrichs
8-40	Paragraph 1	..in any building or ~~sign~~ electronic message center ….	Minor edit for clarity.	Mark Hinrichs
8-41	8.6 Paragraph 1	Low-voltage dry-type distribution transformers are required to be certified by the manufacturer ~~to the Energy Commission.~~ as follows:	Minor edit for clarity.	Mark Hinrichs
8-47	8.8.2 Paragraph 5	The following is the ~~numbering scheme~~ method used to identify ~~of~~ the compliance documentation forms	Minor edit for clarity.	Mark Hinrichs

10. COMMENTS ON CHAPTER 9 – SOLAR READY

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
9-1	Paragraph 1	This chapter of the nonresidential compliance manual addresses nonresidential solar ready buildings requirements. These requirements ~~are new for the 20163 Standards~~ (§110.10 and §141.0) ~~and they~~ are mandatory for newly constructed nonresidential buildings, hotels/motels, high-rise multi-family buildings.	Remove reference to "new" requirements.	Brian Selby
9-6	Example 9-2~~223~~	Example 9-~~2223~~ 3	Revise example numbering to be sequential with previous examples.	Brian Selby
9-7	Example 9-~~4445~~	Example 9-~~4445~~ 5	Revise example numbering to be sequential with previous examples.	Brian Selby
9-9	9.4.2	All buildings that must include a solar zone must also include a plan for connecting a PV ~~and~~ or SWH system to the building's electrical or plumbing system. The construction documents must indicate:	Revise for consistency.	Brian Selby

11. COMMENTS ON CHAPTER 10 – PROCESS ENERGY

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
10-119	10.10.1	§120.6(f) applies to all nonresidential new construction elevators, as well as existing elevators undergoing major alterations involving mechanical equipment, lighting systems, and/or controls. … Both the lighting system and ventilation fans are to be controlled….	Grammatical fix for the first sentence and adding the word system after lighting. It's important to stress that lighting systems need to be changed for the code to apply, not just replacing lights that have burnt out.	John Baffa
10-119	10.10.1	…density of the elevator cab~~in~~ lighting and , requiring a minimum wattage per cfm for ventilation fans in ~~cabins~~ cabs without air conditioning.	Note mixed us of term elevator cab and elevator cabin in this section. The Standards use the term cab.	Martyn Dodd
10-120	10.10.2 B,C	Elevator Ventilation CFM Fan Performance Elevator Lighting and Fan Shutoff Control	Capitalize words that appear on the section title.	Robert Fragoso
10-120	10.10.2 C	When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall automatically switch off until elevator cab operation resumes. This can be accomplished with an occupancy sensor, or more elaborate built in elevator controls.	Emphasis on automation.	Robert Fragoso
10-120	10.10.4	Add the definition of a repair back in. "A repair is the reconstruction or renewal of any part of an existing elevator system for the purpose of its maintenance. For example, a repair could include the replacement of lights or cosmetic features."	The original version submitted had an additional definition explaining what is to be considered a repair (as opposed to alteration). We have this same type of definition in the escalator section, which was not removed.	John Baffa
10-120	10.11.1 Overview	…as well as existing escalators and moving walkways undergoing major alterations involving mechanical equipment or controls in the same	Typo	Martyn Dodd

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		locations. The goal behind this measure is to save energy by reducing the full speed run time of the escalator by slowing it down when unoccupied.		
10-121	10.11.2	§120.6(g) is a mandatory measure that…	Section 10.11.2 deals with the measures under §12.6(g) not §120.6(f).	Robert Fragoso
10-122	10.11.2	Get permission to use escalator picture. Diagram already approved	We do not have approval to use one of the photos yet (the actual picture).	John Baffa
10-122	10.11.2	Escalator speed control is required only in airports…	Missing a "d"	Robert Fragoso
10-122	Paragraph 1	…in an airport terminal, bus or ~~tail~~ rail terminal or station, subway or transit station, or a marine terminal. The reason behind…	Typo	Martyn Dodd

12. COMMENTS ON CHAPTER 11 – PERFORMANCE APPROACH

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
All pages	throughout	Update page numbering so the page numbers in the Table of Contents use Romen numerals (e.g., 11-i).	Update page numbers so formatting is consistent with other chapters.	Heidi Hauenstein
All pages	throughout	…indoor conditioned lighting..	Making clear that only conditioned indoor lighting can be included consistently throughout this chapter is recommended.	Gina Rodda
11-2	Last paragraph	The Nonresidential Alternative Calculation Method (ACM) ~~Reference~~ Approval Manual describes the application and approval process for submitted compliance software. This document is adopted as part of the Energy Efficiency Standards rule making process. The Nonresidential ACM Reference Manual is approved by the California Energy Commission (Energy Commission).	The Approval Manual contains the Administrative and process-related rules that is adopted. The Reference Manual is the technical manual containing the modeling rules and test requirements, which is approved.	John Arent
11-3	11.2.1	The public domain computer program and the Energy Commission-approved privately developed programs ~~are officially called alternative calculation methods (ACMs)~~. It's easiest to refer to ~~talk about~~ these programs as "compliance software," which will be the term used ~~and we will use that term~~ throughout this manual.	The ACM Reference Manual contains the modeling rules and software test requirements. When we refer to the ACM, we are talking about the ACM Reference Manual or the rulesets within the Reference Manual. Software packages that comply with these requirements are referred to as "Compliance Software" or "Title 24 Nonresidential Compliance Software".	John Arent
11-3	11.2.2	Covered process mechanical equipment (i.e. kitchens, laboratories, parking garages)	Adding some reference to the covered process equipment that is now included in the performance method.	Gina Rodda
11-3	11.2.3.1	~~Alternative calculation methods~~Compliance	ACM refers to the rule set and reference tests that	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		software tools must be approved by the California Energy Commission.	candidate compliance software must conform to in order to be certified by the CEC.	
11-3	11.2.3.1	Print the appropriate standardized compliance ~~ds~~ forms with the required information and format if a proposed building complies.	Fixing typo for clarity.	John Arent
11-5	11.2.4.1	...exercise ~~proper~~ appropriate judgement.. ..whether ~~good~~ appropriate judgment... ..should conform to ~~standard~~ appropriate engineering practice.	The words "proper" and "good" sounds judgmental to me, so would suggest a different word that can be used consistently such as "appropriate".	Gina Rodda
11-6	11.3.1	including fenestration areas and energy properties, wall, door, roof/ceiling, and floor areas, construction assemblies, ~~solar heat gain coefficients~~, mass characteristics, equipment specifications, lighting, and service water heating information from the drawings and specifications.	Already covered as "energy properties".	Gina Rodda
11-7	11.3.2.1	Fenestrations in Walls and Shading: Each vertical glass area, orientation, tilt, U-factor, visual transmittance (VT) and Ssolar Hheat Ggain Ccoefficient (SHGC). Horizontal (Skylight) Glass and Shading: Each horizontal or skylight glass area, orientation, tilt, U-factor, VT and solar heat gain coefficientSHGC.	Visual transmittance should also be included.	John Arent
11-8	11.3.2.1	…specified, the TDV energy use ~~will~~ should be based on a standard design heating or cooling system (§140.1(b)).	Software does not auto-size, and user will need to input realistic sizing of equipment.	Gina Rodda
11-8	End of		Suggest including information on water heating	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	11.3.2.1		systems, opaque demising partitions and other interior surfaces, mechanical controls (i.e. DCV, fans, pumps), economizers, room occupancy for lighting and ventilation.	
11-8	11.3.3	The compliance software calculates TDV energy for three main components: the space conditioning energy use, the indoor lighting energy use, and the service water heating energy use. It does not allow energy credits or penalties for plug loads (even though a default value for the internal gains from plug loads is are modeled in the hourly computer simulation), vertical transportation (elevators), ~~garage ventilation,~~ outdoor lighting or other miscellaneous energy uses.	Garage ventilation is a covered process, and is modeled.	John Arent
11-8	11.3.3	The compliance software calculates TDV energy for three main components: the space conditioning energy use, the conditioned indoor lighting energy use,… The proposed building energy budget is defined by §140.1(b) and includes the envelope, space conditioning and ventilation, conditioned indoor lighting and water heating systems assigned to the building.	Lighting within conditioned spaces only.	Gina Rodda
11-8	End of 11.3.3	~~and the lighting and mechanical values associated with the building occupancy and design defined in the Nonresidential ACMAlternative Calculation Reference Manual~~. Lighting and mechanical values are not based on the prescriptive requirements, but with values	Suggest making it very clear that, while the envelope is based on prescriptive standards, the lighting and mechanical systems are from NR ACM Reference Manual.	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		defined in the NR ACM		
11-8	11.3.3.1		Suggest providing information on HVAC and envelope budget just like lighting (with the 1, 2, 3 outline). Further background on what is going on per the NR ACM needs to be briefly outlined and made consistent with how the lighting and water heating is laid out (which is easy to understand).	Gina Rodda
11-9	11.3.3.2	~~For "merchandise sales" areas, where the proposed lighting power is lower than the Prescriptive prescriptive allowed lighting power, the ACM program compliance software calculates the proposed lighting power at the Prescriptive prescriptive allowed lighting power.~~	Not true so should be removed.	John Arent
11-9	Paragraph 3	For all occupancies except hotel guest rooms and high-rise residential living quarters, the proposed lighting power density is input into the software ~~expressed in in units of W/ft²~~.	Lighting power is Watts, not W/ft2. No need to specify this clearly here.	John Arent
11-9	11.3.3.2	For example: "merchandise sales" areas, when ~~where~~ the proposed lighting power is lower	A little unsure the intent behind this sentence. Could also just be deleted.	Gina Rodda
11-9	11.3.3.2	4. For residential occupancies (hotel guest rooms or high-rise residential buildings), the approved computer programcompliance software will automatically set the proposed lighting power density and the standard design lighting power LPD at the same the value as specified in the Nonresidential ACM Reference Manual. For all occupancies except hotel guest rooms and high-rise residential living quarters, the proposed lighting power density is input into the software expressed in in units of W/ft². ~~For residential~~	Looks like this should be indented and in line with 1, 2, 3 above.	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~occupancies (hotel guest rooms or high-rise residential buildings), the approved computer programcompliance software will automatically set the proposed lighting power density and the standard design lighting power LPD at the same the value as specified in the Nonresidential ACM Reference Manual.~~		
11-9	11.3.3.3	This method sets the standard design based on gas fired equipment using either individual water heaters in each unit or a central system to define the standard design. Solar hot water heating may also be required per Residential ACM. The installed system must be consistent with plans and specifications submitted in the building permit application.	Suggest adding language regarding solar hot water.	Gina Rodda
11-9	11.3.3.3 Paragraph 3	1. For nonresidential occupancies, a method described in the Nonresidential ACM Reference Manual uses the proposed design with minimal efficiency gas fired equipment as the standard design. 2.~~1.~~ For hotels, motels and high-rise residential buildings…	Renumber so two methods are clearly identified. Make it clear it is a gas based unit, not electric that is the baseline per NR ACM.	Gina Rodda
11-10	11.4	The performance approach may be used for whole building permit applications; or for permit applications that involve any combination of ~~either building envelope, and indoor lighting, or the mechanical system or for lighting and mechanical together. The performance method may be used to demonstrate compliance with the~~ envelope and ~~alone or the~~ mechanical and indoor conditioned lighting ~~system alone~~, but lighting	Could be simplified to just make clear the combinations of performance options.	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		cannot be used ~~to show lighting compliance~~ alone.		
11-10	11.4.2.1	When a feature of a building is not included in the permit application, it is required to default to a feature ~~automatically~~ determined ~~in~~ by the ~~compliance software~~ NR ACM Reference Manual	The NR ACM Reference Manual establishes the default, but the software does not always "automatically" select the default values (i.e. HVAC is not automatic, but lighting and envelope features are).	Gina Rodda
11-11	11.4.2.1	~~The default space conditioning system features are fixed if no space conditioning system exists in the building. A standard package gas/electric unit is assumed for each thermal zone in the proposed design. The package system is sized based on the envelope design and whether it meets the prescriptive requirements. If a space conditioning system is included in the permit application, the default space conditioning system is based on the standard design as determined in the Nonresidential ACM Reference Manual.~~	Compliance software does not do this automatically, the user must put in equipment that meets the Standards.	Gina Rodda
11-11	Paragraph 4 Sentence 2	Default service water heating systems are specified for each occupancy type. For nonresidential occupancies other than hotels, motels and high-rise residential buildings the default ~~can~~ will be gas-fired ~~or electric~~.	NR ACM Reference Manual establishes the water heater as gas fired.	Gina Rodda
11-11	11.4.2.2 Paragraph 3	Default space conditioning system features are fixed based on the building's existing space conditioning system. The program user inputs the existing space conditioning system, including actual sizes and types of equipment. The compliance software then applies the proposed building's space conditioning features to create a standard design mechanical system used to	I am not sure this is correct, since I know I have to model the existing equipment currently. Suggest that further guidance be pursued on how this works.	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		calculate the energy budget. This means that if an application is not being sought for a mechanical permit, the compliance software computer program will automatically default the features of the standard design to be the same as the features of the proposed design. No mechanical forms will be printed		
11-12	11.4.3.1	…newly installed space conditioning, ~~electrical power distribution system~~, or service water heating system ~~serving the addition,~~ must meet mandatory measures and the applicable energy budget: …	This is the first time the electric power distribution system mandatory requirement has been included, making it seem that it is only required for additions. Since it is a mandatory feature, I would suggest not including (because then every mandatory measures would have to be listed) and including a reference in the very beginning of the chapter to list all mandatory measures that may be triggered.	Gina Rodda
11-14	11.4.4.2 Paragraph 4	In order to obtain this credit, a third party inspector must: …	The third party inspection process was not implemented for the 2013 Standards, and I am unaware of it being a process for 2016. Would suggest verifying the intent of this portion of the Standards and, if known, indicate the timeframe and procedure for the third party review in the NR Compliance Manual so not to confuse people.	Gina Rodda
11-15	Example 11-3	Alterations to an existing office building in Climate Zone 12 includes replacing all single clear metal frame operable windows with new NFRC-rated windows (U-factor =0.45, SHGC=0.31.) What standard design values will the compliance software use for the replacement fenestration area?	Include VT. May need to change answer based on direction taken for third party verification.	Gina Rodda
11-18	11.5 Paragraph 2	In the types of permit applications where some building components are unknown, the unknown components cannot be entered by the user and	In some cases, unknown HVAC equipment has to be modeled per the NR ACM Reference Manaul. Either note this or alter the sentence to not be	Gina Rodda

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		cannot be reported on output documents	absolute.	
11-18	11.5 Paragraph 3	Most compliance documents associated with the performance approach are generated automatically. ~~These reports are similar in informational content and layout to their prescriptive method counterparts.~~	These forms do not look anything like the prescriptive forms anymore.	Gina Rodda
11-18	11.5 Paragraph 4	Unless minimal efficiency and default capacities are used in the performance analysis, either equipment cut sheets showing rated capacities, fan bhp, and airflow at ARI conditions, or the installation certificate must be provided.	These need to be verified against the design documents (such as the equipment schedule and specifications), not cutsheets or installation certificates (which is an in the field form, so not applicable at the permit stage).	Gina Rodda
11-18	11.5 Item 1	~~Construction Assemblies Worksheet for adjusting and combining assemblies from Reference Joint Appendix JA4~~	The assemblies are listed within the NRCC-PRF form, and are not a JA4 reference anymore (that is only applicable to prescriptive compliance).	Gina Rodda
11-18	11.5 Item 2	Formatted Copy of Input	Not sure if there was going to be more after this? Not sure what it means without further explanation.	Gina Rodda
11-22	11.5.1	When tailored lighting is used to justify an increase in the allowed lighting watts, a lower lighting load in the proposed design cannot be modeled for credit. The standard design building uses the lesser of allowed Watts per ft² or actual lighting power to be installed in the building. The proposed design building uses the actual lighting power to be installed as detailed on the lighting plans. This value must be equal to or greater than the allowed Watts per ft².	This seems out of place here. Would suggest moving it or making sure the language is already there, in previous sections of this chapter.	Gina Rodda
11-22	11.5.1	Using NRCC-PRF as an inspection checklist	This form has been designed for the building inspector to use as an in-the-field checklist. May want to reconsider how this form is described.	Gina Rodda

13. COMMENTS ON CHAPTER 12 – BUILDING COMMISSIONING

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
i	Table of Contents		Update table of contents once headings get fixed (see below for headings comments)	Sally Blair
12-1	Paragraph 1	For all newly constructed nonresidential buildings, commissioning shall be included in the design and construction process of the building project to verify that the building energy systems and components meet the owner's or owner representative's project requirements. ~~For buildings less than 10,000 square feet, only the Design Phase Design Review requirements (Design Reviewer Requirements, Design Review Kickoff and Construction Documents Design Review) and Commissioning Measures Shown in the Construction Documents shall be completed.~~ For hotel/motel or high-rise residential occupancies that are considered mixed-use and one of the uses is a nonresidential occupancy (such as retail), requirements in Section 120.8 apply depending upon the conditioned floor area of the nonresidential occupancy.	Standards language does a pretty good job of explaining which requirements apply based on > or < 10,000 sf, except for whether or not the requirements only apply to newly constructed nonres buildings. However, the language written about hotel/motel and high-rise residential buildings could use clarification.	Sally Blair
12-1	Paragraph 2	~~Summary of Commissioning Requirements. The following items shall be completed:~~ ~~12-1 Introduction;~~ ~~12-2 Owner's or owner representative's project requirements;~~ ~~12-3 Basis of design;~~ ~~12-4 Design phase design review;~~	Repetitive with Chapter 12 table of contents so recommend removing this.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~12-5 Commissioning measures shown in the construction documents;~~ ~~12-6 Commissioning plan;~~ ~~12-7 Functional performance testing;~~ ~~12-8 Documentation and training; and~~ ~~12-9 Commissioning report.; and~~ ~~12-10 Commissioning Compliance Documents.~~		
12-1	Paragraph 3	~~The purpose of this code is to improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of concepts that reduce negative and increase positive environmental impacts. Commissioning is a vital element in this effort:~~ The following acronyms will be used throughout this Chapter:	Some of this seems left from Part 11. Recommend revising to introduce acronyms that follow.	Sally Blair
12-2	Glossary Last bullet	Scope of the Commissioning Requirements • All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements, excluding those related solely to covered processes. • Applicability of requirements in Section 120.8 primarily depend upon whether the nonresidential conditioned floor area is less than, or equal to/ greater than 10,000sf. For nonresidential buildings, this is straightforward. However, for high-rise residential and hotel/motel occupancies, further detail is offered for clarity: - High-rise residential and hotel/motel occupancies that are considered mixed-	Revise to match Standards language exactly & add language about nonresidential conditioned floor area for clarity.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		use, and where the other use is a nonresidential occupancy (such as retail), the applicability of requirements is based on whether the conditioned floor area of the mixed-use nonresidential occupancy is less than or equal to/greater than 10,000sf. The intent of this section is not to apply all requirements to high-rise residential or hotel/motel occupancies which are not considered mixed use, but do have > 10,000sf of nonresidential conditioned floor area in the form of support spaces such as corridors.		
12-3	Heading 12.2	12.2 ~~Introduction~~ Owners Project Requirements	Typo	Sally Blair
12-3	Paragraph 3	~~The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following: 1. Energy efficiency goals; 2. Ventilation requirements; 3. Project program, including facility functions and hours of operation, and need for after-hours operation; and 4. Equipment and systems expectations~~ Nonresidential buildings having less than 10,000 sf of conditioned space (a.k.a. conditioned floor area) are exempt from the OPR requirements in Section 120.8(b). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the	The current language repeats the Standards and may not be necessary. I do think it would be useful to say up front that buildings with less than 10,000 sf of conditioned space are exempt from OPR.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		OPR requirements in Section 120.8(b).		
12-3	Paragraph 5	Compliance is demonstrated by the owner or owner's representative developing and/or approving the OPR document before the design phase begins. ~~and can be defined as follows~~: The following components must be included in the OPR at a minimum:	Clarify bullets following this paragraph are what should be included in an OPR.	Sally Blair
12-4	Item 5	5. ~~Enforcement~~ Building Envelope Performance Expectations ~~At their discretion, the building official confirms demonstrated compliance at Plan Review by: a. a) Receipt of a copy of the OPR document (optional), and b. b) Receipt of a form compliance document signed by the owner or owner representative attesting that the OPR has been completed and approved by the owner.~~	Missing item 5: Building Envelope Performance Expectations from the 2016 Standards. I'm not really sure what this means so couldn't suggest language to describe requirements. Suggest explaining what is meant to be addressed in the OPR.	Sally Blair
12-4	Add 12.2.3	12.2.3 Enforcement At their discretion, the building official confirms demonstrated compliance at Plan Review by: a. Receipt of a copy of the OPR document (optional), and b. Receipt of the NRCC-CXR-01-E indicating the OPR was reviewed at the Design Review Kickoff. ~~a compliance document signed by the owner or owner representative attesting that the OPR has been completed and approved by the owner.~~	Recommend specifying the OPR can be verified on the NRCC-CXR-01-E form.	Sally Blair
12-4	Add 12.2.4	12.2.4 Example Documents Organizations such as the California Commissioning Collaborative publish online resources regarding the OPR, including example	Include a link to where folks can find examples.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		documents.		
12-4	Last paragraph	§120.8(c) -. Basis of Design (BOD). ~~A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The BOD document shall cover the following systems and components: 1. Heating, ventilation, air conditioning (HVAC) systems and controls; 2. Indoor lighting system and controls; 3. Water heating systems and controls; and 4. Any building envelope component considered in the OPR.~~ Nonresidential buildings having less than 10,000 sf of conditioned space (a.k.a. conditioned floor area) are exempt from the BOD requirements in Section 120.8(c). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the BOD requirements in Section 120.8(c).	Repeats exactly what's in the Standards. Recommend listing exemptions up front.	Sally Blair
12-6	Item 4	4. Building Envelope Components a. Provide narrative description of system – type, performance, control type, energy savings, payback period b. Describe reason for system selection – why chosen system is better than alternatives, considering issues such as performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility	Remove sequence of operation from envelope component bullet.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		company incentives, owner preference ~~e. Sequence of Operation – operating schedules, setpoints, storage capacity~~ ~~d.~~ c. Describe how system meets the OPR		
12-6	Add 12.3.3	12.3.3 Enforcement At their discretion, the building official confirms demonstrated compliance at Plan Review by: a. Receipt of a copy of the BOD document (optional), or b. Receipt of the NRCC-CXR-01-E indicating the BOD was reviewed at the Design Review Kickoff. ~~a compliance document signed by the owner, owner's representative, architect, engineer or designer of record, attesting that the BOD has been completed and meets the requirements of the OPR.~~	Recommend specifying CXR-01 form as the one to check for compliance.	Sally Blair
12-6	Add 12.3.4	12.3.4 Example Documents Organizations such as the California Commissioning Collaborative publish online resources regarding the BOD, including example documents.	Include a link to where readers can find examples.	Sally Blair
12-7	Paragraph 1	§120.8(d). - Design Phase Design Review All newly constructed nonresidential buildings must comply with requirements in Section 120.8(d).	Confirm this only applies to newly constructed NR buildings.	Sally Blair
12-7	Paragraph 1	~~1. Design Reviewer Requirements:~~ ~~For buildings less than 10,000 square feet, design phase design review may be completed by the design engineer. Buildings between 10,000 and 50,000 square feet require completion of the~~	Recommend removing, was not updated for 2016 Standards per 10-103.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~Design Review Checklist by either an engineer in-house to the design firm but not associated with the building project, or a third-party design engineer. For buildings larger than 50,000 square feet or for buildings with complex mechanical systems, an independent review of these documents by a third-party design engineer is required.~~		
12-7	Paragraph 2	~~2. Design Review. During the schematic design phase of the building project, the owner or owner's representative, design team and design reviewer must meet to discuss the project scope, schedule and how the design reviewer will coordinate with the project team. The building owner or owner's representative shall include the Design Review Checklist compliance documentform in the Certificate of Compliance documentation (see Section 10-103).~~	Recommend removing, this repeats what's in the Standards.	Sally Blair
12-7	Paragraph 3	~~3. Construction Documents Design Review: The construction documents design review compliance forms documents list the items that shall be checked by the design reviewer during the construction document review. The completed forms compliance documents shall be returned to the owner and design team for review and sign-off. The building owner or owner's representative shall include the construction documents design review compliance forms documents in the Certificate of Compliance Documentation documentation (see Section 10-103).~~	Recommend removing, this repeats what's in the Standards.	Sally Blair
12-8	Add 1c &	c. There are two compliance documents used to	Recommend talking about forms and who can sign	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	1d.	document the Design Review Kickoff: • NRCC-CXR-01-E- This compliance document is used to prepare the project team to meet the commissioning requirements in Section 120.8(d). It would be beneficial to complete this form at the kickoff meeting. • NRCC-CXR-05-E- This compliance document is used to document that the design review kickoff and design review were conducted for the project. d. For all Nonresidential buildings, the Design Review Kickoff Certificate(s) of Compliance, and the Construction Document Design Review Checklist Certificate(s) of Compliance shall be reviewed and signed by a licensed professional engineer or licensed architect, or a licensed contractor representing services performed by or under the direct supervision of a licensed engineer or architect, as specified in the provisions of Division 3 of the Business and Professions Code. • **For buildings less than 10,000 square feet**, this signer may be the engineer or architect of record. • **For buildings greater than 10,000 square feet but less than 50,000 square feet**, this signer shall be a qualified in-house engineer or architect with no other project involvement or a third party engineer, architect, or contractor. **For buildings greater than 50,000 square feet and all buildings with complex mechanical**	them here.	

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		systems serving more than 10,000 square feet, this signer shall be a third party engineer, architect, or contractor		
12-8	Item 2b	b. ~~The Design reviewer provides a review of the construction documents:~~ ~~i. Prescriptive Path Compliance. Projects following the Prescriptive Path will use compliance forms documents provided in the Design Review Kickoff meeting (Certificate of Compliance – Cx Construction Documents-General, – Simple HVAC Systems, and – Complex Mechanical Systems forms compliance documents, NRCC-CXR-02-E through NRCC-CXR-04-E)~~ ~~ii. Performance Path Compliance. Projects following the Performance Path for compliance will use compliance forms documents provided in the Design Review Kickoff meeting (Certificate of Compliance – Cx Construction Documents-General, -Simple HVAC Systems, and –Complex Mechanical Systems forms compliance documents NRCC-CXR-02-E through NRCCCXR-04-E)~~ There are three compliance documents used to document the Construction Documents Design Review: • NRCC-CXR-02-E- This compliance document is used as a checklist for all projects that require a Construction Documents Design Review. • NRCC-CXR-03-E- This compliance document is used as a supplement to the	Revise for clarity.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		NRCC-CXR-02-E for simple mechanical systems. NRCC-CXR-04-E- This compliance document is used as a supplement to the NRCC-CXR-02-E for complex mechanical systems.		
12-8	Last paragraph	~~Qualifications for the design reviewer are based on the project size and complexity of mechanical systems. The design reviewer must be a licensed professional engineer that meets the following:~~ ~~1. Buildings<10,000sf- engineer of record- (self review) or contractor if engineer of record not required.~~ ~~2. Buildings > 10,000sf and <50,000sf- qualified, in house engineer with no there project involvement or third party engineer.~~ ~~3. Buildings > 50,000sf OR buildings < 50,000 sf with complex mechanical systems: third party engineer.~~ ~~The commissioning coordinator who meets the above requirements may also complete the construction documents design review.~~ 12.4.3 Qualifications to Act as Design Reviewer The design reviewer needs to be the documentation author for the NRCC-CXR-01-E through NRCC-CXR-04-E. See qualification requirements in 12.4.2-1d above or Section 10-103 of the Standards.	Add heading to allow quick navigation & update language per 10-103.	Sally Blair
12-9	Paragraph 1	12.4.4 Enforcement Compliance is demonstrated by completion of the compliance forms documents NRCC-CXR-01-E through NRCC-CXR-04-E, as applicable,	Add heading for easy navigation and remove reference to Section 12-10 since it is being deleted.	Sally Blair

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		and signature form page, NRCC-CXR-05-E. ~~See section Section 12-10 Commissioning Compliance Documents for additional information on completing these compliance documents.~~		
12-9	Paragraph 3	§120.8(e): - Commissioning measures shown in the construction documents. ~~This includes commissioning measures or requirements in the construction documents (plans and specifications). Commissioning measures or requirements should be clear, detailed and complete to clarify the commissioning process. These requirements should include the list of systems and assemblies commissioned, testing scope, roles and responsibilities of contractors, requirements for meetings, management of issues, the commissioning schedule, O&M manual development and training, and checklist and functional test form compliance document development, execution and documentation. Include, for information only, roles of non-contractor parties.~~ All newly constructed nonresidential buildings must comply with requirements in Section 120.8(e). Nonresidential or mixed-use high-rise residential or mixed-use hotel/motel occupancies with nonresidential conditioned floor area ≥ 10,000 sf must include all information necessary to complete the design review and implement commissioning activities in the field. These occupancies with nonresidential conditioned floor area < 10,000 sf need only	Suggest removing repetitive language from Standards and clarifying requirements for buildings with < 10,000sf of cfa. Confirm only applies to newly constructed NR buildings.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		include information necessary to complete the design review requirements in Section 120.8(d). More detailed information about these requirements is discussed below.		
12-9	Last paragraph	12.5.3 Compliance Method Compliance is achieved by including commissioning requirements in the project plans and specifications, and differs depending on whether the project has < 10,000sf of nonresidential conditioned floor area or > 10,000 sf of nonresidential conditioned floor area. **Projects with < 10,000 sf of nonresidential conditioned floor area** should utilize the Design Review compliance documents (NRCC-CXR-02-E, NRCC-CXR-03-E and NRCC-CXR-04-E) as a checklist of what should be shown on plans or specifications in order to meet requirements in Section 120.8(e). The plans and specifications should be detailed and complete enough for the design reviewer to utilize these compliance documents to complete the design review. **Projects with > 10,000 sf of nonresidential conditioned floor area** will need to include more information to facilitate the commissioning process throughout the construction and building turnover phases of the project. The following items are suggested to be included in the plans and specifications: 1. Primary (and optionally all) commissioning requirements are included in the general specification division (typically Division 1) and clear cross references of all commissioning	Suggest clarifying how compliance will differ for projects with cfa < 10,000sf vs. those with ≥ 10,000sf.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		requirements to and from the general division are included to ensure all subcontractors are held to them		
12-10	Add 12.5.4	12.5.4 Enforcement At their discretion, the building official confirms demonstrated compliance at Plan Review by: a) Receipt of a copy of the commissioning specifications (optional)~~, or~~ ~~b) Receipt of a form compliance document signed by the owner or owner representative or designer of record attesting that the owner-approved commissioning specifications are included in the construction documents.~~	Add heading for easy navigation. Remove option (b) to demonstrate compliance – I am not aware of any compliance form that includes the described documentation.	Sally Blair
12-11	Paragraph 1	§120.8(f). - Commissioning Plan. ~~Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following: 1. General project information 2. Commissioning goals 3. Systems to be commissioned. 4. Plans to test systems and components, which shall include: a. An explanation of the original design intent b. Equipment and systems to be tested, including the extent of tests c. Functions to be tested d. Conditions under which the test shall be performed e. Measureable criteria for acceptable performance f. Commissioning team information including roles g. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through~~	Remove language duplicating standards, suggest clarifying exemptions from Cx Plan requirements.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~120.8(i) shall be included.~~ Nonresidential buildings having less than 10,000 sf of conditioned space (a.k.a. conditioned floor area) are exempt from the Commissioning Plan requirements in Section 120.8(f). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the Commissioning Plan requirements in Section 120.8(f).		
12-12	Add 12.6.4	12.6.4 Enforcement At their discretion, the building official confirms demonstrated compliance at Plan Review by: a) Receipt of a copy of the commissioning plan (optional)~~, or~~ ~~b) Receipt of a form compliance document signed by the owner or owner representative or designer of record attesting that the Cx Plan has been completed.~~	Add heading for easy navigation. Remove option (b) to demonstrate compliance, I am not aware of any compliance form that includes the described documentation.	Sally Blair
12-13	Paragraph 1	§120.8(g): - Functional Performance Testing. ~~Functional performance tests shall demonstrate the correct installation and operation of each component, system, and system-tosystem interface in accordance with the acceptance test requirements. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.~~ Nonresidential buildings having less than 10,000	Suggest removing language that is replicated from Standards. Suggest adding when FPT is not required.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		sf of conditioned space (a.k.a. conditioned floor area) are exempt from the functional performance testing requirements in Section 120.8(g). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the functional performance testing requirements in Section 120.8(g). Neither of these exemptions excludes the project from needing to meet Acceptance testing requirements described in other sections of the Standards.		
12-13	Paragraph 3	The following systems to be functionally tested are listed in the BOD: 1. HVAC systems and controls 2. Indoor lighting system and controls 3. Water heating system and controls 4. ~~Covered processes~~ Building Envelope Components	Remove covered process and include building envelope per 2016 updates.	Sally Blair
12-13	Paragraph 4	12.7.2 Existing Law or Regulation Title 24 Acceptance Testing requirements call for functional testing of some systems and equipment. Refer to Chapter 13: Acceptance Requirements, located in this Nonresidential Compliance Manual for further guidance. Although functional performance testing for commissioning under Section 120.8 is related to Acceptance Testing, the systems to be functionally tested under Section 120.8 are based	Provide more clarity on how Acceptance Testing requirements and Cx FPT requirements interact.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		upon systems described in the BOD. These systems may not have Acceptance Testing requirements per the Standards. There may be systems listed in the BOD which also have acceptance testing requirements, such as lighting controls. To meet Acceptance Testing requirements, acceptance tests must be performed by certified Acceptance Test Technicians as described in Chapter 13.		
12-14	Paragraph 2	12.7.4 Enforcement 1. Receipt of a copy of completed and signed Functional Performance Tests that indicate any deficiencies have been corrected (optional), or 2. ~~Receipt of a compliance document signed by the owner, owner representative or commissioning coordinator~~ review of acceptance certificates (NRCAs) attesting that the Functional Performance Tests have been completed and any deficiencies corrected. Although there are no field forms for commissioning requirements, authorities having jurisdiction can review issues logs or acceptance certificates to verify field testing was completed and resolved.	Add heading for easy navigation. Clarify that there are no Cx field forms but inspectors can review NRCAs documenting Acceptance Testing.	Sally Blair
12-14	Last paragraph	§120.8(h). Documentation and training. ~~A Systems Manual and Systems Operations Training are required.~~ ~~§120.8(h)1. Systems manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following: 1. Site information,~~	Recommend removing language that repeats from Standards. Provide detail on projects exempt from 120.8(h).	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		~~including facility description, history and current requirements. 2. Site contact information 3. Instructions for basic O&M, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log 4. Description of major systems 5. Site equipment inventory and maintenance notes 6. A copy of all special inspection verifications required by the enforcing agency or the Standards.~~ Nonresidential buildings having less than 10,000 sf of conditioned space (a.k.a. conditioned floor area) are exempt from the documentation and training requirements in Section 120.8(h). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the documentation and training requirements in Section 120.8(h).		
12-17	Paragraph 2	12.8.3 Enforcement At their discretion, the building official confirms demonstrated compliance during Field Inspection by: a. Receipt of a copy of the Systems Manual (optional)~~, or~~ ~~b. Receipt of a compliance document signed by the owner or owner representative attesting that the System's Manual has been completed.~~	Add heading to help with navigation and remove (b) as there is no compliance form documenting the information described.	Sally Blair
12-18	Add 12.8.5	12.8.5 Enforcement 1. In the event appropriate maintenance staff is	Add heading to help with navigation and remove (b) as there is no compliance form documenting the	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		made available to receive training for each equipment type and/or system installed in the building. a. Receipt of a copy of the written training program and completed attendance forms, or ~~b. Receipt of a compliance document signed by the owner or owner representative attesting that the training program and delivery of training has been completed~~ 2. In the event appropriate maintenance staff are unavailable to receive training for each equipment type and/or system installed in the building. a. Receipt of a copy of the training program provided to the owner or owner's representative (optional), or ~~b. Receipt of a compliance document signed by the owner or owner representative attesting that the written training program has been provided.~~	information described.	
12-19	Page header	Selecting Trained Personnel for Commissioning ~~Commissioning~~ report	Typo	Sally Blair
12-19	Paragraph 1	§120.8(i) -: Commissioning report. ~~A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or representative.~~ Nonresidential buildings having less than 10,000 sf of conditioned space (a.k.a. conditioned floor area) are exempt from the commissioning report	Remove repetitive language & add exemptions.	Sally Blair

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		requirements in Section 120.8(i). Hotel/ motel and high-rise residential buildings that are mixed use and the nonresidential occupancies have less than 10,000 sf of conditioned floor area are also exempt from the commissioning report requirements in Section 120.8(i).		
12-19	Add 12.9.3	12.9.3 Enforcement At their discretion, the building official confirms demonstrated compliance during Field Inspection by: a. Receipt of a copy of the Commissioning Report (optional)~~, or~~ ~~b. Receipt of a form compliance document signed by the owner or owner representative attesting that the Cx Report has been completed.~~	Add heading for easy navigation and remove (b) as there is no form that documents this requirement.	Sally Blair

14. COMMENTS ON CHAPTER 13 – ACCEPTANCE TESTING

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
13-1	Header	Acceptance Test Requirements ~~– Acceptance requirements ensure that equipment, controls and systems operate as required by the Standards. The activities specified in these requirements have three aspects:~~ Page 13-1	The introductory text to Section 13 should be deleted from the header.	Russ King
13-1	Section 13	Acceptance requirements ensure that equipment, controls and systems operate as required by the Standards. The activities specified in these requirements have three aspects: ~~– Visual inspection of the equipment and installation~~ ~~– Review of the certification requirements~~ ~~– Functional tests of the systems and controls~~	The "three aspects" should be not be deleted.	Russ King
13-3	13.2 Paragraph 1	From simple thermostats and manual light switches to complex building automation systems, controls are an integral part of a building's health, safety . . .	Clarify wording.	Russ King
13-3	13.2 Paragraph 1	However, the building owners disable many building control and equipment components after occupancy due to lack of functionality from improper installation.	Provide supporting evidence for this statement (e.g., "Studies show that . . .").	Russ King
13-3	13.2 Before Paragraph 2	[Add introductory language]	I recommend some introductory language that ties acceptance testing to the commissioning requirements and explains how they relate.	Russ King
13-3	Items A-E	A. Poor Economizer Operation B. Fans Cycling Off During Occupied	Rename sections to be more consistent and better describe "issues" found in the field.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		Periods C. Fans Operating During Unoccupied Periods D. Spaces Heated and Cooled Simultaneously No Outdoor Air Provided		
13-4	Paragraph 4	Ultimately, a licensed contractor or design professional must take responsibility for the acceptance testing (Responsible Person), however, to make the process more cost effective, the actual testing and data collection can be done by an unlicensed, but qualified person (Field Technician).	I recommend adding this sentence to clarify the roles a little better.	Russ King
13-4	Paragraph 5	Typically, the individuals who supervise ~~participate in~~ the acceptance testing/verification procedures are contractors, engineers, . .	Clarify roles better.	Russ King
13-4	Paragraph 5	(*Field Technicians*) are ~~do~~ not required to be licensed professionals, but some acceptance testing requires special certification.	Fix typo, relate licensing to certification.	Russ King
13-4	Paragraph 6	A certified Acceptance Test Technician (ATT) is required to perform testing and be the signatory for: • Lighting Controls (NRCA-LTI-02-A), • Automatic Daylighting (NRCA-LTI-03-A), • Demand Responsive Lighting Controls (NRCA-LTI-03-A) and	Format into bullets for clarity.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		• Outdoor Motion Sensor and Lighting Shut-off Controls (NRCA-LTO-02-A) ~~acceptance tests and to be the signatory on the Certificate of Acceptance.~~ However, an Acceptance Test Technician Acceptance is not required to be a third party that is independent from the designer or the contractor.		
13-4	Paragraph 7	…the Industry Certification Threshold has not been surpassed as of the publish date of this Manual.	Edit for clarification.	Russ King
13-5	Bullet 1	Review the ~~bid~~ construction documents and specifications to make sure that the building component (i.e., equipment, . . .	"bid documents" are usually not binding nor accurate. The contract and the plans are.	Russ King
13-5	Paragraph 2	If more than one person has responsibility for the acceptance testing required on a single Certificate of Acceptance, each person shall sign . .	Edit for clarification.	Russ King
13-5	13.1.2 A Paragraph 1	Note that being a ~~the~~ *Field Technician* does not require . . .	Edit for clarification.	Russ King
13-5	13.1.2 A Bullet 2	…by §120.5 and to be the signatory	Edit for clarification.	Russ King
13-6	13.1.2 B	…by the ~~his~~ Field Technician . . .	Edit for clarification.	Russ King
13-10	13.1.3 Sentence 1	The acceptance requirements include five important steps ~~require four major check-points to be conducted~~.	Updated to match number of steps.	Russ King
13-11	13.1.3 A Paragraph 1	~~typically~~ should be done prior to signing a Certificate of Compliance.	It's very optimistic to think this is typically done at all. Say "should be done" is more appropriate.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
13-11	13.1.3 A Paragraph 2	In reviewing the plans, the designer indicates ~~notes~~ the appropriate certificate …	Edit for clarification.	Russ King
13-11	13.1.3 B Paragraph 1	(*Responsible Person*) must perform a construction inspection prior to acceptance testing. Reviewing the acceptance requirements with the installing contractor prior to installation is very useful for ~~on~~ several reasons ~~counts~~.	Edit for clarification.	Russ King
13-11	13.1.3 B Paragraph 2	~~In some cases, performing tests immediately after installation is most economical, requiring the complete installation of any associated systems and equipment necessary for proper system.~~	This sentence does not relate to the section (Construction Inspection). Move to next section or delete.	Russ King
13-11	13.1.3 B Paragraph 4	~~Purchasing sensors and equipment with calibration certificates reduces the amount of time required for site calibration thus lowering overall costs.~~	This sentence does not relate to the section (Construction Inspection).	Russ King
13-12	13.1.3 C Sentence 1	A *Field Technician* assumes responsibility for properly performing the required acceptance requirements procedures and for the accuracy of the data collected.	Edit for clarification.	Russ King
13-12	13.1.3 C Paragraph 2	The *Responsible Person* can act as the ~~may also perform the~~ *Field Technician*~~'s responsibilities~~, and . . .	Edit for clarification.	Russ King
13-13	Table 13-1	Add a column to indicate when the acceptance tests are required.	The Standards are not clear on which tests are required, since in some cases the systems themselves aren't required, but the tests are required when the systems are present.	John Arent
13-14	13.1.3 E	The completed and signed Certificate of Acceptance must be submitted to the local	Edit for clarification.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	Sentence 1	building department in a manner consistent ~~is accordance~~ with the local laws, ordinances, regulations or customs.		
13-14	Section 13.1.3 E		Recommend moving entire section to before Table 13-1 so it's not lost.	Russ King
13-15	13.1.4 Sentence 1	The administrative requirements contained in the Standards (§ 10-103(b)) require the envelope and mechanical plans and specifications to contain:	It's not correct to say that the plans and specifications need contain these items. See rewrite below.	Russ King
13-15	13.1.4 Sentence 1	The administrative requirements contained in the Standards (§ 10-103(b)) require that the following information be provided to the building owner as part of the compliance, operating, maintenance, and ventilation information: • Completed acceptance testing documents for mechanical systems and equipment shown in Table 13-1; ~~submission of record drawings are provided to the building owners within 90 days of receiving a final occupancy permit,~~ ~~□ Submission of oOperating and maintenance information are provided to the building owner, and~~ • Installation certificates for mechanical equipment (e.g., factory installed economizers)	Rewrite, I couldn't find the reference to the 90 requirement in this code section.	Russ King
13-16	13.1.4.1, A. General		The first three bulleted items are not really "issues", they are basic compliance with the	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
	Issues - Envelope		requirements: The fenestration performance factors must be equal to or better than those listed on the NRCC. What is "re-compliance"? Note: This is repeated later in NA7.4.1 At a Glance. See below. Recommend deleting one.	
13-17	13.1.4.1, A. General Issues - Envelope	When using the Performance Approach, the weighted average thermal performance per orientation is applicable if it is ~~it's~~ equal or better than the specified values as noted above; otherwise, re-compliance is required.	This needs a lot more explanation and a code reference.	Russ King
13-20	13.1.4.1 E.	***Air ~~and Water~~ Measurements***	Is air balancing a requirement or a recommendation? Code reference? Why is "water" in the title?	Russ King
13-27	Section 13.1.5 Bullets	13.1.5 Lighting Acceptance Testing Overview	Same comments as Section 13.1.4, above.	Russ King
13-33	Header	Acceptance Test Requirements – The numbers preceding each test are keyed to the section of the Reference Nonresidential Appendix NA, where the required tests are fully documented.	Delete text from header. Move to body of page.	Russ King
At A Glance	All		I recommend that each one of these be formatted as a standalone document and attached to the appropriate NRCA certificate in Appendix A as instructions and not be part of the NRCM body text.	Russ King
13-33	NA7.4.1 Purpose of Test	Envelope components require NFRC or Energy Commissions Label Certificate including site-built fenestration. Label Certificate matches building plans and energy compliance documentation. This Certificate of Acceptance summarizes the	The way this is written does not really explain the "Purpose of Test". Either change the title or edit the text so that it can begin, "The purpose of this test is to . . ." for example: The purpose of this test is to:	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		results of the Acceptance test as specified in the Reference Nonresidential Appendix, NA7.4. Additional related references are in §10-103(a)4, §10-111, §116(a)5 of the Energy Efficiency Standards.	1. Verify that all fenestration, including site built, has an NFRC or Energy Commission Label certification. 2. Performance values on label certificate meets or exceeds required values from Certificate of Compliance and plans. Summarize the results of the acceptance tests as specified in . . .	
13-33	NA7.4.1 Test Conditions	~~Not applicable~~ No special conditions are required to perform this acceptance testing.	Edit for clarification.	Russ King
13-33	NA7.4.1 Estimated Time to Complete	~~Not applicable~~ Depends on number of fenestration products to verify.	Edit for clarification.	Russ King
13-33	NA7.4.1 Acceptance Criteria	~~Products will be either NFRC Rated or not rated. For NFRC Rated Products, record and cross reference the rating. For unrated products, record and attach the NRCC-ENV-05-E document and cross reference against the building plans.~~ Performance values of installed fenestration must meet or exceed require values on plans and compliance documentation.	Edit for clarification.	Russ King
13-33	NA7.4.1 Potential Issues and Cautions		This is repeated word for word from section 13.1.4.1. Recommend deleting one or the other.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
13-34	NA7.5.1 Instrumentation	An airflow measurement probe (e.g. hot-wire anemometer or velocity pressure probe), or	This is not consistent with the instrumentation requirements for residential air flow measurements.	Russ King
13-63	Item 2	2. Integrated DDC Controls	The Standards make references to standalone or integrated FDD systems. This will ensure that similar language is used.	Farhad Farahmand
13-68	Before the last bullet point.	Check that the system is designed to provide up to 100 percent outside air. Outdoor air flow can be measured directly, or indirectly, in a variety of ways. Acceptable methods for measuring outdoor airflow include, but are not limited to the following techniques: • Read the outdoor airflow value measured by an air flow monitoring station if one is installed. • Traverse across the outdoor air duct to measure duct air velocity, measure duct size, and calculate flow. • Measure face velocity at various points across outdoor air intake, measure intake damper size, and calculate flow. **Best Practice:** The face velocity at the outside air damper can be used as an approximation for ensuring that the economizer system is designed to provide up to 100 percent outside air. The face velocity can be calculated using the design airflow and the minimum area of the economizer damper/duct opening. The design airflow (ft^3/min) should be	These bullet points are pulled from the Test Procedure: NA7.5.1.1 Outdoor Air: Variable Air Volume section, which checks for minimum outdoor air flow. This is a test that allows the tester to adhere to the Standards more closely, and matches the language in Chapter 4 regarding the 2,000 ft/min face velocity.	Farhad Farahmand

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		available from the mechanical drawings or air handler cut sheet. The minimum area (ft^2) through which air is flowing from the outside to the fan can be measured in the field, or it can be found on the economizer damper cut sheet if the economizer damper is the smallest area. Dividing the design airflow by the smallest area will give the velocity of the air in ft/min. Economizers that can supply 100 percent of the supply airflow without large pressure drops typically have face velocities of less than **2,000 ft/min**.		
13-97	Item A	***A. Test Comments*** Newly Constructed and Additions/Alterations: This acceptance test is required for each ~~Applies to any FDD system installed on a~~ packaged direct expansion (DX) unit with cooling capacity of 54 kBtu/h or greater at AHRI rated conditions.	This test is only required if an FDD system is installed. An FDD system is not required for this application. This is not clear in the Standards and should be made clear in the NRCM.	John Arent
13-101	Item A	***A. Test Comments*** Newly Constructed and Additions/Alterations: Applies to any FDD system installed on an air handling unit or a zone terminal unit. A minimum of 5 percent of the terminal boxes (VAV box) shall be tested. This test is only required in a FDD system is installed on a VAV system (air handler unit and/or terminal units). An FDD system is not required for this application, but if one is installed, the acceptance test is required.	This test is only required if an FDD system is installed. An FDD system is not required for this application. This is not clear in the Standards and should be made clear in the NR CM.	John Arent

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
13-210	NA7.14.1	Acceptance Criteria Turn off when the cabin doors have been closed and the elevator has been unoccupied for more than 15 minutes. Remain on after more than 15 minutes with the doors closed when occupied.	The occupancy is vital to the behavior desired from the controls.	Robert Fragoso
13-212	NA7.15.1	Functional Testing Step 3: Measure the travel time of the conveyance	This step measures the escalator's travel time and not speed. The speed is calculated in the following step, step 4.	Robert Fragoso
13-246	13.36 Paragraph 1	~~This section goes over the requirements for:~~ • ~~Industry certification thresholds before acceptance test technician and employer certification requirements go into effect;~~ • ~~Acceptance Test Technician Certification Provider (ATTCP) qualifications and approval;~~ • ~~Training and Certification procedures for Acceptance Test Technicians and Employers;~~ • ~~Provider Accountability; and Interim Approval.~~ ~~An Acceptance Test Employer is…~~	Undelete the introductory statement and modify as suggested. Add an explanation of what and Acceptance Test Employer (ATE) is and what their purpose is.	Russ King
13-247	Paragraph 1	The ~~perspective~~ prospective ATTCP must submit . . .	Typo	Russ King
13-247	Section 1 Paragraph 1	ATTCPs shall explain ~~in their application to the Energy Commission~~ their organizational	Eliminate redundant phrase.	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		structure		
13-247	Compliance subsection	Compliance Guidelines: ~~The Energy Commission has approved several ATTCP applicants and all applications included . . .~~ The following items are acceptable methods for meeting this requirement . . .	This is a statement of fact that implies a precedent, without really saying so. Also, the title "Compliance" is a little vague.	Russ King
13-251	Compliance subsection Bullet 2	Several ATTCPs require extensive classroom training to accomplish this educational requirement~~. However,~~ and one ATTCP requires that each applicant hold a third party certificate of training that the Energy Commission found to be equivalent to the curricula required.	This is a statement of fact that implies a precedent, without really saying so. Modify to directly state what the acceptable options are without referring to other ATTCPs.	Russ King
13-252	Bullets 1-4	The following are some relevant questions that the ATTCP might consider when establishing an ATT applicant's prequalified experience: o It is recommended that relevant experience be documented and include designing, installing or commissioning activities and not be limited to installation and repair work. o It is recommended that evidence of relevant experience include letters from employers. o It is recommended that applicants are certified professionals in one of the following:	Instead of suggesting that they consider these questions, shouldn't the CEC be giving the answer? The CEC is who approves the application and would therefore be who ultimately decides whether they are correct or not. In the applications that the Energy Commission has approved, classroom instructor to student ratios were between 1:25 and 1:35; for laboratory training, the ratios were between 1:6 and 1:12. Most importantly, each ATTCP application included a discussion of the basis for each ratio.	Russ King
13-252	2nd to last bullet	Applications will be considered individually, however, i~~I~~n the applications that the Energy Commission has approved, classroom	This is a statement of fact that implies a precedent, without really saying so. Modify to directly state what the acceptable options are without referring to	Russ King

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
		instructor to student ratios were between 1:25 and 1:35; for laboratory training, the ratios were between 1:6 and 1:12. Most importantly, each ATTCP application included a discussion of the basis for each ratio.	other ATTCPs.	
13-255	Bullet 2	Applications will be considered individually. ~~H~~however, the applications that the Energy Commission has approved all include the implementation of an on-line presence to contend with the ATT/ATE application processing, complaints process, certification status and ATT/ATE contact information.	This is a statement of fact that implies a precedent, without really saying so. Modify to directly state what the acceptable options are without referring to other ATTCPs.	Russ King
13-260	*Intent* section	Third, to ensure that the ~~market~~ construction industry is not impacted significantly by a scarcity of certified ATTs.	Minor edit for clarification.	Russ King
13-260	*Compliance* section	~~As the ATTCP program exists now, there is a division between unionized and non-unionized technicians.~~ Unionized ATTCP generally only accept unionized ATT applicants. To ensure broader access to all applicants the threshold requirement dictates that there be an ATTCP that will accept non-union applicants. Therefore, in order to satisfy the Threshold requirements it is necessary for there to be a Nonresidential Mechanical ATTCP that will accept non-union applicants.	Further explanation is warranted here. "Division" sounds hostile.	Russ King

In addition to the edits listed above, Jeff Stein recommends adding the following test procedure to Chapter 13:

Test Procedure: NA7.X Operable Opening Mechanical System Shut-off Controls

Construction Inspection

The Field Technician should verify the following:

- Interlock switches are physically installed at each operable opening
- Interlock controls and mechanical heating and/or cooling are fully functional before testing

Step 1: Shut all openings and override space temperature or setpoint to drive zone into full heating. Space temperature and heating setpoint should be above 55F.

1. ***Verify and Document:***

- Zone operates in full heating

Step 2: One by one, open and close each of the operable openings, while zone is in full heating. If zone has more than two operable openings then only 2 need to be tested, but if either of those 2 fails then all openings must be successfully tested. If the controls include a delay for resetting the setpoints (e.g. 5 minute delay) then the delay may be temporarily reduced to expedite testing.

2. ***Verify and Document for each opening:***

- Heating setpoint is reset to 55F within 5 minutes and/or zone is disabled within 5 minutes after each opening is opened.
- Heating setpoint is restored and zone is enabled within 5 minutes of when each opening is shut.
- VAV systems: zone airflow rate drops from heating maximum flow to minimum ventilation flow within 5 minutes after opening is open and is restored to heating maximum flow within 5 minutes when opening is shut.
- If zone has a mode indicator then it indicates that heating setpoint is reset when opening is open and not reset when opening is shut.
- If zone has an advice indicator then it advises not to open the openings (since zone is in heating mode).

Step 3: Override space temperature and/or cooling setpoint as necessary to drive zone into full cooling. Space temperature and cooling setpoint should be below

90F. If the system is configured to allow openings to serve as economizer free cooling (i.e. cooling setpoint not to be reset when outside temperature is less than space temperature even if window is open) then override outside or space temperature as necessary so that outside temperature is greater than space temperature. One by one, open and close each of the operable openings, while zone is in full cooling. If zone has more than two operable openings then only 2 need to be tested, but if either of those 2 fails then all openings must be successfully tested.

3. ***Verify and Document for each opening:***

- Cooling setpoint is reset to 90F and/or zone is disabled within 5 minutes of when each opening is opened.
- Cooling setpoint is restored and zone is enabled within 5 minutes of when each opening is shut.
- VAV systems: zone airflow rate drops from cooling maximum flow to minimum ventilation flow within 5 minutes of when opening is open and is restored to cooling maximum within 5 minutes of when opening is shut.
- If zone has a mode indicator then it indicates that cooling setpoint is reset when opening is open and not reset when opening is shut.
- If zone has an advice indicator then it advises not to open the openings.

Step 4: This step is OPTIONAL. If zone is configured to allow openings to serve as economizer free cooling (i.e. cooling setpoint not to be reset when outside temperature is less than space temperature even if window is open) then override cooling setpoint and/or outside or space temperature as necessary such that zone is in full cooling and outside air temperature is less than space temperature. Open all openings.

4. ***Verify and Document:***

- Zone operates in full cooling.
- If zone has a mode indicator then it does not indicate that cooling setpoint has been reset due to open opening(s).
- If zone has an advice indicator then it advises to open the openings.

Step 5: Restore all overrides.

15. COMMENTS ON APPENDIX A – COMPLIANCE DOCUMENTS

Page	Section/ Paragraph	Suggested Revision	Comments	Commenter
2	NRCA-LTI-02-A	Lights controlled by occupancy sensors turn off within a maximum of ~~30~~ 20 minutes from the start of an unoccupied condition per Standard Section 110.9(b).	02 Occupancy Sensors Step 1: The maximum programmable delay time was reduced to 20 minutes in Section 110.9(b). Reduce the value to 20 minutes.	Michael Mutmansky
3	NRCA-LTI-02-A	Lights go to partial off state within a maximum of ~~30~~ 20 minutes from start of an unoccupied condition per Standard Section 110.9(a)	03 Partial-OFF Occupancy Sensors Step 1: The maximum programmable delay time was reduced to 20 minutes in Section 110.9(b). Reduce the value to 20 minutes.	Michael Mutmansky
3	NRCA-LTI-02-A	Both stages (automatic on and manual on) lights turn off within a maximum of ~~30~~ 20 minutes from start of an unoccupied condition per Standard Section 110.9(a)	04 Partial-ON Occupancy Sensors Step 2: The maximum programmable delay time was reduced to 20 minutes in Section 110.9(b). Reduce the value to 20 minutes.	Michael Mutmansky
1	NCRA-LTO-02-A	Lights controlled by the sensor reduce light output within a maximum of ~~30~~ 20 minutes from the start of an unoccupied condition.	B Functional Testing: The maximum programmable delay time was reduced to 20 minutes in Section 110.9(b). Reduce the value to 20 minutes.	Michael Mutmansky
3	NCRA-LTO-02-A	Lights controlled by the sensor are off or reduces light output within a maximum of ~~30~~ 20 minutes from the start of an unoccupied condition.	B Functional Testing, 042. Partial On Occupancy Sensor: The maximum programmable delay time was reduced to 20 minutes in Section 110.9(b). Reduce the value to 20 minutes.	Michael Mutmansky

16. COMMENTS ON APPENDIX B – EXCERPTS FROM APPLIANCE STANDARDS

The California Utilities Statewide Codes and Standards Team does not have any suggested changes to Appendix B of the Draft Nonresidential Compliance Manual.

APPENDIX A: COMMENTER CONTACT INFORMATION

Brian Selby
Selby Energy Inc.
brian@selbyenergyinc.com

Chitra Nambiar
NORESCO
cnambiar@noresco.com

Farhad Farahmand
TRC
ffarahmand@trcsolutions.com

Eric Rubin
Energy Solutions
erubin@energy-solution.com

Gina Rodda
Gabel Associates, LLC
gina@gabelenergy.com

Heidi Hauenstein
Energy Solutions
hhauenstein@energy-solution.com

Jeff Stein
Taylor Engineering
jstein@taylor-engineering.com

John Arent
NORESCO
jarent@noresco.com

John Baffa
ASWB Engineering
jbaffa@aswb-engineering.com

Mark Hinrichs
ASWB Engineering
mhinrichs@aswb-engineering.com

Martyn Dodd
Energy Soft
mart@energysoft.com

Michael Mutmansky
TRC
mmutmansky@trcsolutions.com

Misti Bruceri
Misti Bruceri & Associates, LLC
mistib@comcast.net

Noah Czech
NORESCO
nczech@noresco.com

Robert Fragoso
ASWB Engineering
rfragoso@aswb-engineering.com

Rosemary Howley
Gabel & Associates
rosemary@gabelenergyinc.com

Russ King
Benningfield Group
russ.king@benningfieldgroup.com

Sally Blair
NORESCO
sblair@noresco.com

Sam Currie
NORESCO
scurrie@noresco.com

Scott Bailey
ASWB Engineering
sebailey@aswb-engineering.com

APPENDIX B: HVAC EQUIPMENT EFFICIENCY TABLES WITH CHANGES TRACKED

This appendix lists the HVAC Equipment Efficiency Tables in Chapter 4 of the Compliance Manual, Tables 4-1 through Tables 4-11. These tables have been completely regenerated to be "clean," meaning that the table rows should display correctly regardless of pagination. Ideally, these tables should be easily copied and pasted (**paste with keep source formatting**) into a document with minimal tweaking. It is highly recommended to use these tables in order to provide readable tables in the final document.

These tables are marked up as follows:

- Additions from the 2013 Compliance Manual to the First Public Draft are single underlined and deletions are ~~single strikethrough~~.
- Suggested revisions to the First Public Draft are highlighted in blue; suggested additions are double underlined and suggested deletions are ~~struck with double lines~~.
- Suggested modifications to the table/cell structures are highlighted in magenta.

See Appendix C for the HVAC Equipment Efficiency Tables with all the additions, deletions and structure changes incorporated; the final form of the tables.

Please note if the pasted tables become larger than the tables in this appendix, it is most likely because the tables were not pasted with keep source formatting.

Table 4-1 ~~Efficiencies for u~~Standards Table 110.2-A Unitary ~~a~~Air ~~c~~Conditioners and ~~c~~Condensing ~~u~~Units

Equipment Type	Size Category	Efficiency[a]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air conditioners, air cooled, both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.2 EER[b] 11.4 IEER[b]	11.2 EER[b] 12.9 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	11.0 EER[b] 11.2 IEER[b]	11.0 EER[b] 12.4 IEER[b]	
	≥ 240,000 Btu/h and < 760,000 Btu/h	10.0 EER[b] 10.1 IEER[b]	10.0 EER[b] 11.6 IEER[b]	
	≥ 760,000 Btu/h	9.7 EER[b] 9.8 IEER[b]	9.7 EER[b] 11.2 IEER[b]	
Air conditioners, water cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]	12.1 EER[b] 13.9 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.5 EER[b] 12.5 IEER[b]	12.5 EER[b] 13.9 IEER[b]	ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	12.4 EER[b] 12.6 IEER[b]	12.4 EER[b] 13.6 IEER[b]	ANSI/AHRI 340/360
	≥ 760,000 Btu/h	12.2 EER[b] 12.4 IEER[b]	12.2 EER[b] 13.5 IEER[b]	ANSI/AHRI 340/360
Air conditioners, evaporatively cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]		ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.0 EER[b] 12.2 IEER[b]		ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	11.9 EER[b] 12.1 IEER[b]		ANSI/AHRI 340/360
	≥ 760,000 Btu/h	11.7 EER[b] 11.9 IEER[b]		ANSI/AHRI 340/360
Condensing units, air cooled	≥ 135,000 Btu/h	10.5 EER 11.8 IEER		ANSI/AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		

[a] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 340/360 ~~TEST PROCEDURES~~test procedures

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-2 Standards Table 110.2-B Unitary and Applied Heat Pumps

Equipment Type	Size Category	Efficiency[a]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air cooled, (cooling mode), both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.0 EER[b] 11.2 IEER[b]	11.0 EER[b] 12.2 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	10.6 EER[b] 10.7 IEER[b]	10.6 EER[b] 11.6 IEER[b]	
	≥ 240,000 Btu/h and < 760,000 Btu/h	9.5 EER[b] 9.6 IEER[b]	9.5 EER[b] 10.6 IEER[b]	
Water source (cooling mode)	≥ 65,000 Btu/h and < 240,000 Btu/h	86^{0}F entering water	~~12.0~~13.0 EER	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59^{0}F entering water	18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77^{0}F entering water	14.1 EER	ISO-13256-1
Water source water-to-water (cooling mode)	< 135,000 Btu/h	86^{0}F entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water (cooling mode)	< 135,000 Btu/h	59^{0}F entering water	16.3 EER	ISO-13256-1
Groundwater source brine-to-water (cooling mode)	< 135,000 Btu/h	77^{0}F entering water	12.1 EER	ISO-13256-2
Air cooled (heating mode) split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	47^{0}F db/43^{0}F wb outdoor air	3.3 COP	ANSI/AHRI 340/360
		17^{0}F db/15^{0}F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	47^{0}F db/43^{0}F wb outdoor air	3.2 COP	
		17^{0}F db/15^{0}F wb outdoor air	2.05 COP	
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68^{0}F entering water	4.3 COP	ISO-13256-1
	≥ 135,000 Btu/h and < 240,000 Btu/h	68^{0}F entering water	2.90 COP	
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50^{0}F entering water	3.7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32^{0}F entering water	3.2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68^{0}F entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50^{0}F entering water	3.1 COP	ISO-13256-2
Ground source bring-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32^{0}F entering water	2.5 COP	ISO-13256-2

[a] IEERs are only applicable to equipment with capacity control ~~as per~~as specified by ANSI/AHRI 340/360 test procedures

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-3 Standards Table 110.2-C Air-Cooled Gas Engine Heat Pumps

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency	Test Procedure[a]
Air-cooled gas-engine heat pump (cooling mode)	All Capacities	95^0F db outdoor air	0.60 COP	ANSI Z21.40.4A
Air-cooled gas-engine heat pump (~~H~~heating mode)	All Capacities	47^0F db/43~~0~~^{0}F wb outdoor air	0.72 COP	ANSI Z21.40.4A

[a] Applicable test procedure and reference year are provided under the definitions

Table 4-4 Standards Table 110.2-D Water Chilling Packages

Equipment Type	Size Category	Path A Efficiency[a,b]	Path B Efficiency[a,b]	Test Procedure[c]
Air Cooled, with Condenser Electrically Operated	< 150 tons	≥ ~~9.562~~10.100 EER ≥ ~~12.500~~13.700 IPLV	≥ 9.700 EER ≥ 15.800 IPLV~~NA~~	AHRI 550/590
	≥ 150 tons	≥ ~~9.562~~10.100 EER ≥ ~~12.750~~14.000 IPLV	≥ 9.700 EER ≥ 16.100 IPLV~~NA~~	
Air Cooled, without Condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated Positive Displacement	< 75 tons	≤ 0.~~780~~750 kW/ton ≤ 0.~~630~~600 IPLV	≤ 0.~~800~~780 kW/ton ≤ 0.~~600~~500 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.~~775~~720 kW/ton ≤ 0.~~615~~560 IPLV	≤ 0.~~790~~750 kW/ton ≤ 0.~~586~~490 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.~~680~~660 kW/ton ≤ 0.~~580~~540 IPLV	≤ 0.~~718~~680 kW/ton ≤ 0.~~540~~440 IPLV	
	≥ 300 tons and < 600 tons	≤ 0.~~620~~610 kW/ton ≤ 0.~~540~~520 IPLV	≤ 0.~~639~~625 kW/ton ≤ 0.~~490~~410 IPLV	
	~~>~~≥ 600 tons	≤ 0.~~5~~560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Water Cooled, Electrically Operated Centrifugal	< 150 tons	≤ 0.~~634~~610 kW/ton ≤ 0.~~596~~550 IPLV	≤ 0.~~639~~695 kW/ton ≤ 0.~~450~~440 IPLV	AHRI 550/590
	≥ 150 tons and < 300 tons	≤ 0.~~634~~610 kW/ton ≤ 0.~~596~~550 IPLV	≤ 0.~~639~~635 kW/ton ≤ 0.~~450~~400 IPLV	
	≥ 300 tons and < ~~600~~400 tons	≤ 0.~~576~~560 kW/ton ≤ 0.~~549~~520 IPLV	≤ 0.~~600~~595 kW/ton ≤ 0.~~400~~390 IPLV	
	≥ 400 tons and < 600 tons	≤ 0.~~570~~560 kW/ton ≤ 0.~~539~~500 IPLV	≤ 0.~~590~~585 kW/ton ≤ 0.~~400~~380 IPLV	
	≥ 600 tons	≤ 0.~~570~~560 kW/ton ≤ 0.~~539~~500 IPLV	≤ 0.~~590~~585 kW/ton ≤ 0.~~400~~380 IPLV	
Air Cooled Absorption, Single Effect	All Capacities	≥ 0.600 COP	NA[d]	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	≥ 0.700 COP	NA[d]	
Absorption Double Effect, Indirect-Fired	All Capacities	≥ 1.000 COP ≥ 1.050 IPLV	NA[d]	
Absorption Double Effect, Direct-Fired	All Capacities	≥ 1.000 COP ≥ 1.000 IPLV	NA[d]	
Water Cooled Gas Engine Driven Chiller	All Capacities	≥ 1.20 COP ≥ 2.00 IPLV	NA[d]	ANSI Z21.40.4A

[a] No requirements for:
- Centrifugal chillers with design leaving evaporator temperature < 360F; or
- Positive displacement chillers with designed leaving fluid temperatures ≤ 320F; or
- Absorption chillers with design leaving fluid temperature < 400F

[b] Must meet the minimum requirements of Path A or Path B. However, both the full load (COP) and IPLV must be met to fulfill the requirements of the applicable Path.

[c] See Section 100.1 for definitions

[d] NA means not applicable

Table 4-5 Standards Table 110.2-E Packaged Terminal Air Conditioners and Heat Pumps

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	~~Equipment Type~~Efficiency		Test Procedure[c] ~~Size Category (Input)~~
			~~Before 10/08/2012~~	After 10/08/2012	
PTAC (cooling mode) Newly constructed or newly conditioned or additions	All Capacities	95^{0}F db outdoor air	~~12.5 (0.213 x Cap/1000)[a] x EER~~	~~13.8~~14.0-(0.300 x Cap/1000)[a] ~~x~~-EER	ANSI/AHRI/CSA 310/380
PTAC (cooling mode) Replacements[b]	All Capacities	95^{0}F db outdoor air	~~10.9-(0.213 x Cap/1000)a x EER~~	10.9-(0.213 x Cap/1000)~~a x~~[a] EER	
PTHP (cooling mode) Newly constructed or newly conditioned or additions	All Capacities	95^{0}F db outdoor air	~~12.3 (0.213 x Cap/1000)a x EER~~	14.0-(0.300 x Cap/1000)~~a x~~[a] EER	
PTHP (cooling mode) Replacements[b]	All Capacities	95^{0}F db outdoor air	~~10.8 (0.213 x Cap/1000)a x EER~~	10.8-(0.213 x Cap/1000)~~a x~~[a] EER	
PTHP (heating mode) Newly constructed or newly conditioned or additions	All Capacities	-	~~3.2-(0.026 x Cap/1000)a x COP~~	3.7-(0.052 x Cap/1000)[a] ~~x~~-COP	
PTHP (heating mode) Replacements[b]	All Capacities	-	~~2.9 (0.026 x Cap/1000)[a] x COP~~	2.9-(0.026 x Cap/1000)[a] ~~x~~COP	
SPVAC (cooling mode)	< 65,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~9.0 EER~~	~~9.0~~10.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~8.9 EER~~	~~8.9~~10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~8.6 EER~~	~~8.6~~10.0 EER	
SPVAC (cooling mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air		9.2 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air		9.0 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~9.0 EER~~	~~9.0~~10.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~8.9 EER~~	~~8.9~~10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air	~~8.6 EER~~	~~8.6~~10.0 EER	
SPVHP (cooling mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air		9.2 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95^{0}F db/75^{0}F wb outdoor air		9.0 EER	

SPVHP (heating mode)	< 65,000 Btu/h	47°F db/43°F wb outdoor air	~~3.0 COP~~	3.0 COP	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/	47°F db/43°F wb outdoor air	~~3.0 COP~~	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/43°F wb outdoor air	~~2.9 COP~~	~~2.9~~3.0 COP	
SPVHP (heating mode) nonweatherized space constrained	≤ 30,000 Btu/h	47°F db/43°F wb outdoor air		3.00 COP	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	47°F db/43°F wb outdoor air		3.00 COP	

[a] Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

[b] Replacement units must be factory labeled as follows: "MANUFACTUR~~E~~RED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high or less than 42 inch wide and having a cross-sectional area less than 670 square~~-~~ inches.

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-6 Standards Table 110.2-F Heat Transfer Equipment

Equipment Type	Subcategory	Minimum Efficiency[a]	Test Procedure[c]
Liquid-to-liquid heat exchangers	Plate type	NR	ANSI/AHRI 400

[a] NR = no requirement

[b] Applicable test procedure and reference year are provided under the definitions

Table 4-7 Standards Table 110.2-G Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required [a,b,c,d]	Test Procedure[e]
Propeller or axial fan ~~O~~open-circuit cooling towers	All	95^{0}F entering water 85^{0}F leaving water 75^{0}F entering air wb	≧ 42.1 gpm/hp	CTI ATC-105 and CTI STD-201 ~~CTI ATC-105 and CTI STD-201~~ ~~CTI ATC-105 and CTI STD-201~~ ~~CTI ATC-105 and CTI STD-201~~
Centrifugal fan open-circuit cooling towers	All	95^{0}F entering water 85^{0}F leaving water 75^{0}F entering air wb	≧ 20.0 gpm/hp	
Propeller or axial fan closed-circuit cooling towers	All	102^{0}F entering water 90^{0}F leaving water 75^{0}F entering air wb	≧ 14.0 gpm/hp	
Centrifugal fan closed-circuit cooling towers	All	102^{0}F entering water 90^{0}F leaving water 75^{0}F entering air wb	≧ 7.0 gpm/hp	
Propeller or axial fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	≥ 157,000 Btu / h x hp	CTI ATC-106
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	≥ 134,000 Btu / h x hp	
Centrifugal fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	≥ 135,000 Btu / h x hp	
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F ~~entering~~ condensing temp 75^{0}F entering air wb	≥ 110,000 Btu / h x hp	
Air cooled condensers	All	R22 test fluid 125^{0}F condensing temp 190^{0}F entering gas temp 15^{0}F subcooling 95^{0}F entering db	≧ 176,000 Btu / h x hp	ANSI/AHRI 460

[a] Open-circuit cooling tower performance is defined as the water flow rating of the tower at the given rated conditions divided by the fan motor nameplate power.

[b] Closed-circuit cooling tower performance is defined as th e process water flow rating of the tower at the given rated conditions divided by the sum of the fan motor nameplate rated power and the integral spray pump motor nameplate power.

[c] Air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

[d] Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90 percent of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

[e] Applicable test procedure and reference year are provided under the definitions.

For refrigerated warehouses or commercial refrigeration applications, condensers shall comply with requirements specified by Section 120.6(a) or Section 120.6(b)

Table 4-8 Standards Table 110.2-H Electrically Operated Variable Refrigerant Flow Air Conditioners

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Variable Refrigerant Flow (VRF) Air Conditioners, Air Cooled	< 65,000 Btu/h	All	VRF Multi-Split System	13.0 SEER	ANSI/AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.2 EER 13.1 IEER[b]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.0 EER 12.9 IEER[b]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	10.0 EER 11.6 IEER[b]	

[a] Applicable test procedure and reference year are provided under the definitions.

[b] IEERs are only applicable to equipment as ~~per~~ specified by ASNI/AHRI 1230 test procedures.

Table 4-9 Standards Table 110.2-I Electrically Operated VRF Air-to-Air and Applied Heat Pumps

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[b]
VRF Air cooled, (cooling mode)	< 65,000 Btu/h	All	VRF Multi-Split System[a]	13.0 SEER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	11.2 EER 13.1 IEER[b]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	11.0 EER 12.9 IEER[b]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	10.0 EER 11.6 IEER[b]	
VRF Water source (cooling mode)	< 65,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	12.0 EER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	12.0 EER	
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	10.EER	
VRF Groundwater source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System[a] 59^{0}F entering water	16.2 EER	AHRI 1230
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 59^{0}F entering water	13.8 EER	
VRF Ground source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System[a] 77^{0}F entering water	13.4 EER	AHRI 1230
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 77^{0}F entering water	11.0 EER	
VRF Air cooled (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF Multi-Split System	7.7 HSPF	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47^{0}F db / 43^{0}F wb outdoor air	3.3 COP	
			VRF Multi-Split System 17^{0}F db / 15^{0}F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47^{0}F db / 43^{0}F wb outdoor air	3.2 COP	
			VRF Multi-Split System 17^{0}F db / 15^{0}F wb outdoor air	2.05 COP	
VRF Water source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 68^{0}F entering water	4.2 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 68^{0}F entering water	3.9 COP	

VRF Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50^0F entering water	3.6 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50^0F entering water	3.3 COP	
VRF Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32^0F entering water	3.1 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32^0F entering water	2.8 COP	

[a] Deduct 0.2 from the required EERs and IEERs for Variable Refrigerant Flow (VRF) Multi-split system units with a heating recovery section.

[b] Applicable test procedure and reference year are provided under the definitions.

[c] IEERs are only applicable to equipment with capacity control as ~~per~~ specified by ANSI/AHRI 1230 test procedures.

Table 4-10 Standards Table 110.2-J Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters

Equipment Type	Size Category (Input)	Subcategory or Rating Condition[b]	Minimum Efficiency	Test Procedure[a]
Warm-Air Furnace, Gas-Fired	< 225,000 Btu/h	Maximum Capacitiy[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,00 Btu/h	Maximum Capacitiy[b]	80% E_t	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, Oil-Fired	< 225,000 Btu/h	Maximum Capacitiy[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,00 Btu/h	Maximum Capacitiy[b]	~~80~~81% E_t	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacitiy[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heater, Gas-Fired	All Capacities	Maximum Capacitiy[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacitiy[b]	~~80~~81% E_c	Section 40, Combustion, UL 731

[a] Applicable test procedure and reference year are provided under the definitions.

[b] Compliance of multiple firing rate units shall be at maximum firing rate.

E_t = thermal efficiency, units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

1. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
2. Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

Table 4-11 Standards Table 110.2-K Gas and Oil Fired Boilers

Equipment Type	Subcategory	Size Category (Input)	Minimum Efficiency[b,c]		Test Procedure[a]
			Before 3/2/2020	After 3/2/2020	
Boiler, hot water	Gas-Fired	< 300,000 Btu/h	~~80~~82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	80% E_t	80% E_t	DOE 10 CFR Part 431
		≥ 2,500,000 Btu/h[e]	82% ~~E_t~~E_c	82% ~~E_t~~E_c	
	Oil-Fired	< 300,000 Btu/h	~~80~~84% AFUE	84% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	82% E_t	82% E_t	DOE 10 CFR Part 431
		≥ 2,500,000 Btu/h[e]	~~82~~84% ~~E_t~~E_c	84% ~~E_t~~E_c	
Boiler, steam	Gas-Fired	< 300,000 Btu/h	~~75~~80% AFUE	80% AFUE	DOE 10 CFR Part 430
	Gas-Fired All, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	79% E_t	79% E_t	DOE 10 CFR Part 431
		≥ 2,500,000 Btu/h[e]	79% E_t	79% E_t	DOE 10 CFR Part 431
	Gas-Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	77% E_t	79% E_t	DOE 10 CFR Part 431
		≥ 2,500,000 Btu/h[e]	77% E_t	79% E_t	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	~~80~~82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	81% E_t	81% E_t	DOE 10 CFR Part 431
		≥ 2,500,000 Btu/h[e]	81% E_t	81% E_t	DOE 10 CFR Part 431

[a] Applicable test procedure and reference year are provided under the definitions.
[b] E_c = combustion efficiency (100% less flue losses). See reference document for detail information
[c] E_t = thermal efficiency. See test procedure for detailed information.
[d] Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.
[e] Included oil-fired (residual).

APPENDIX C: HVAC EQUIPMENT EFFICIENCY TABLES

This appendix lists the HVAC Equipment Efficiency Tables in Chapter 4 of the Compliance Manual, Tables 4-1 through Tables 4-11. These tables have been completely regenerated to be "clean", meaning that the table rows should display correctly regardless of pagination. Ideally, these tables should be easily copied and pasted (**paste with keep source formatting**) into a document with minimal tweaking. It is highly recommended to use these tables in order to provide readable tables in the final document.

These tables represent the final form after all recommended insertions and deletions have been incorporated.

Please note if the pasted tables become larger than the tables in this appendix, it is most likely because the tables were not pasted with keep source formatting.

Table 4-1 Standards Table 110.2-A Unitary Air Conditioners and Condensing Units

Equipment Type	Size Category	Efficiency[a]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air conditioners, air cooled, both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.2 EER[b] 11.4 IEER[b]	11.2 EER[b] 12.9 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	11.0 EER[b] 11.2 IEER[b]	11.0 EER[b] 12.4 IEER[b]	
	≥ 240,000 Btu/h and < 760,000 Btu/h	10.0 EER[b] 10.1 IEER[b]	10.0 EER[b] 11.6 IEER[b]	
	≥ 760,000 Btu/h	9.7 EER[b] 9.8 IEER[b]	9.7 EER[b] 11.2 IEER[b]	
Air conditioners, water cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]	12.1 EER[b] 13.9 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.5 EER[b] 12.5 IEER[b]	12.5 EER[b] 13.9 IEER[b]	ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	12.4 EER[b] 12.6 IEER[b]	12.4 EER[b] 13.6 IEER[b]	ANSI/AHRI 340/360
	≥ 760,000 Btu/h	12.2 EER[b] 12.4 IEER[b]	12.2 EER[b] 13.5 IEER[b]	ANSI/AHRI 340/360
Air conditioners, evaporatively cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]		ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.0 EER[b] 12.2 IEER[b]		ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	11.9 EER[b] 12.1 IEER[b]		ANSI/AHRI 340/360
	≥ 760,000 Btu/h	11.7 EER[b] 11.9 IEER[b]		ANSI/AHRI 340/360
Condensing units, air cooled	≥ 135,000 Btu/h	10.5 EER 11.8 IEER		ANSI/AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		

[a] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 340/360 test procedures

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-2 Standards Table 110.2-B Unitary and Applied Heat Pumps

Equipment Type	Size Category	Efficiency[a]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air cooled, (cooling mode), both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.0 EER[b] 11.2 IEER[b]	11.0 EER[b] 12.2 IEER[b]	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	10.6 EER[b] 10.7 IEER[b]	10.6 EER[b] 11.6 IEER[b]	
	≥ 240,000 Btu/h and < 760,000 Btu/h	9.5 EER[b] 9.6 IEER[b]	9.5 EER[b] 10.6 IEER[b]	
Water source (cooling mode)	≥ 65,000 Btu/h and < 240,000 Btu/h	86^{0}F entering water	13.0 EER	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59^{0}F entering water	18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77^{0}F entering water	14.1 EER	ISO-13256-1
Water source water-to-water (cooling mode)	< 135,000 Btu/h	86^{0}F entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water (cooling mode)	< 135,000 Btu/h	59^{0}F entering water	16.3 EER	ISO-13256-1
Groundwater source brine-to-water (cooling mode)	< 135,000 Btu/h	77^{0}F entering water	12.1 EER	ISO-13256-2
Air cooled (heating mode) split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	47^{0}F db/43^{0}F wb outdoor air	3.3 COP	ANSI/AHRI 340/360
		17^{0}F db/15^{0}F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	47^{0}F db/43^{0}F wb outdoor air	3.2 COP	
		17^{0}F db/15^{0}F wb outdoor air	2.05 COP	
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68^{0}F entering water	4.3 COP	ISO-13256-1
	≥ 135,000 Btu/h and < 240,000 Btu/h	68^{0}F entering water	2.90 COP	
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50^{0}F entering water	3.7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32^{0}F entering water	3.2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68^{0}F entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50^{0}F entering water	3.1 COP	ISO-13256-2
Ground source bring-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32^{0}F entering water	2.5 COP	ISO-13256-2

[a] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 340/360 test procedures

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-3 Standards Table 110.2-C Air-Cooled Gas Engine Heat Pumps

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency	Test Procedure[a]
Air-cooled gas-engine heat pump (cooling mode)	All Capacities	95^0F db outdoor air	0.60 COP	ANSI Z21.40.4A
Air-cooled gas-engine heat pump (heating mode)	All Capacities	47^0F db/43^0F wb outdoor air	0.72 COP	ANSI Z21.40.4A

[a] Applicable test procedure and reference year are provided under the definitions

Table 4-4 Standards Table 110.2-D Water Chilling Packages

Equipment Type	Size Category	Path A Efficiency[a.b]	Path B Efficiency[a.b]	Test Procedure[c]
Air Cooled, with Condenser Electrically Operated	< 150 tons	≥ 10.100 EER ≥ 13.700 IPLV	≥ 9.700 EER ≥ 15.800 IPLV	AHRI 550/590
	≥ 150 tons	≥ 10.100 EER ≥ 14.000 IPLV	≥ 9.700 EER ≥ 16.100 IPLV	
Air Cooled, without Condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated Positive Displacement	< 75 tons	≤ 0.750 kW/ton ≤ 0.600 IPLV	≤ 0.780 kW/ton ≤ 0.500 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.720 kW/ton ≤ 0.560 IPLV	≤ 0.750 kW/ton ≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV	
	≥ 300 tons and < 600 tons	≤ 0.610 kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Water Cooled, Electrically Operated Centrifugal	< 150 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV	AHRI 550/590
	≥ 150 tons and < 300 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons	≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 IPLV	
	≥ 400 tons and < 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Air Cooled Absorption, Single Effect	All Capacities	≥ 0.600 COP	NA[d]	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	≥ 0.700 COP	NA[d]	
Absorption Double Effect, Indirect-Fired	All Capacities	≥ 1.000 COP ≥ 1.050 IPLV	NA[d]	
Absorption Double Effect, Direct-Fired	All Capacities	≥ 1.000 COP ≥ 1.000 IPLV	NA[d]	
Water Cooled Gas Engine Driven Chiller	All Capacities	≥ 1.20 COP ≥ 2.00 IPLV	NA[d]	ANSI Z21.40.4A

[a] No requirements for:
- Centrifugal chillers with design leaving evaporator temperature < 360F; or
- Positive displacement chillers with designed leaving fluid temperatures ≤ 320F; or
- Absorption chillers with design leaving fluid temperature < 400F

[b] Must meet the minimum requirements of Path A or Path B. However, both the full load (COP) and IPLV must be met to fulfill the requirements of the applicable Path.

[c] See Section 100.1 for definitions

[d] NA means not applicable

Table 4-5 Standards Table 110.2-E Packaged Terminal Air Conditioners and Heat Pumps

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Efficiency	Test Procedure[c]
PTAC (cooling mode) Newly constructed or newly conditioned or additions	All Capacities	95^0F db outdoor air	14.0-(0.300 x Cap/1000)[a] EER	ANSI/AHRI/CSA 310/380
PTAC (cooling mode) Replacements[b]	All Capacities	95^0F db outdoor air	10.9-(0.213 x Cap/1000)[a] EER	
PTHP (cooling mode) Newly constructed or newly conditioned or additions	All Capacities	95^0F db outdoor air	14.0-(0.300 x Cap/1000)[a] EER	
PTHP (cooling mode) Replacements[b]	All Capacities	95^0F db outdoor air	10.8-(0.213 x Cap/1000)[a] EER	
PTHP (heating mode) Newly constructed or newly conditioned or additions	All Capacities	-	3.7-(0.052 x Cap/1000)[a] COP	
PTHP (heating mode) Replacements[b]	All Capacities	-	2.9-(0.026 x Cap/1000)[a] COP	
SPVAC (cooling mode)	< 65,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	
SPVAC (cooling mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^0F db/75^0F wb outdoor air	9.2 EER	ANSI/AHRI 390
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95^0F db/75^0F wb outdoor air	9.0 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^0F db/75^0F wb outdoor air	10.0 EER	
SPVHP (cooling mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^0F db/75^0F wb outdoor air	9.2 EER	ANSI/AHRI 390
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95^0F db/75^0F wb outdoor air	9.0 EER	

SPVHP (heating mode)	< 65,000 Btu/h	47^0F db/43^0F wb outdoor air	3.0 COP	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	47^0F db/43^0F wb outdoor air	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47^0F db/43^0F wb outdoor air	3.0 COP	
SPVHP (heating mode) nonweatherized space constrained	≤ 30,000 Btu/h	47^0F db/43^0F wb outdoor air	3.0 COP	ANSI/AHRI 390
	> 30,000 Btu/h and ≤ 36,000 Btu/h	47^0F db/43^0F wb outdoor air	3.0 COP	

[a] Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

[b] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high or less than 42 inch wide and having a cross-sectional area less than 670 square inches.

[c] Applicable test procedure and reference year are provided under the definitions

Table 4-6 Standards Table 110.2-F Heat Transfer Equipment

Equipment Type	Subcategory	Minimum Efficiency[a]	Test Procedure[c]
Liquid-to-liquid heat exchangers	Plate type	NR	ANSI/AHRI 400

[a] NR = no requirement

[b] Applicable test procedure and reference year are provided under the definitions

Table 4-7 Standards Table 110.2-G Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required [a,b,c,d]	Test Procedure[e]
Propeller or axial fan open-circuit cooling towers	All	95^{0}F entering water 85^{0}F leaving water 75^{0}F entering air wb	≧ 42.1 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95^{0}F entering water 85^{0}F leaving water 75^{0}F entering air wb	≧ 20.0 gpm/hp	
Propeller or axial fan closed-circuit cooling towers	All	102^{0}F entering water 90^{0}F leaving water 75^{0}F entering air wb	≧ 14.0 gpm/hp	
Centrifugal fan closed-circuit cooling towers	All	102^{0}F entering water 90^{0}F leaving water 75^{0}F entering air wb	≧ 7.0 gpm/hp	
Propeller or axial fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb	≥ 157,000 Btu / h x hp	CTI ATC-106
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb	≥ 134,000 Btu / h x hp	
Centrifugal fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb	≥ 135,000 Btu / h x hp	
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb	≥ 110,000 Btu / h x hp	
Air cooled condensers	All	R22 test fluid 125^{0}F condensing temp 190^{0}F entering gas temp 15^{0}F subcooling 95^{0}F entering db	≧ 176,000 Btu / h x hp	ANSI/AHRI 460

[a] Open-circuit cooling tower performance is defined as the water flow rating of the tower at the given rated conditions divided by the fan motor nameplate power.

[b] Closed-circuit cooling tower performance is defined as th e process water flow rating of the tower at the given rated conditions divided by the sum of the fan motor nameplate rated power and the integral spray pump motor nameplate power.

[c] Air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

[d] Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90 percent of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

[e] Applicable test procedure and reference year are provided under the definitions.

For refrigerated warehouses or commercial refrigeration applications, condensers shall comply with requirements specified by Section 120.6(a) or Section 120.6(b)

Table 4-8 Standards Table 110.2-H Electrically Operated Variable Refrigerant Flow Air Conditioners

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Variable Refrigerant Flow (VRF) Air Conditioners, Air Cooled	< 65,000 Btu/h	All	VRF Multi-Split System	13.0 SEER	ANSI/AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.2 EER 13.1 IEER[b]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.0 EER 12.9 IEER[b]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	10.0 EER 11.6 IEER[b]	

[a] Applicable test procedure and reference year are provided under the definitions.

[b] IEERs are only applicable to equipment as specified by ASNI/AHRI 1230 test procedures.

Table 4-9 Standards Table 110.2-I Electrically Operated VRF Air-to-Air and Applied Heat Pumps

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[b]
VRF Air cooled, (cooling mode)	< 65,000 Btu/h	All	VRF Multi-Split System[a]	13.0 SEER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	11.2 EER 13.1 IEER[b]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	11.0 EER 12.9 IEER[b]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System[a]	10.0 EER 11.6 IEER[b]	
VRF Water source (cooling mode)	< 65,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	12.0 EER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	12.0 EER	
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 86^{0}F entering water	10.EER	
VRF Groundwater source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System[a] 59^{0}F entering water	16.2 EER	AHRI 1230
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 59^{0}F entering water	13.8 EER	
VRF Ground source (cooling mode)	< 135,000 Btu/h	All	VRF Multi-Split System[a] 77^{0}F entering water	13.4 EER	AHRI 1230
	≥ 135,000 Btu/h	All	VRF Multi-Split System[a] 77^{0}F entering water	11.0 EER	
VRF Air cooled (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF Multi-Split System	7.7 HSPF	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47^{0}F db / 43^{0}F wb outdoor air	3.3 COP	
			VRF Multi-Split System 17^{0}F db / 15^{0}F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 47^{0}F db / 43^{0}F wb outdoor air	3.2 COP	
			VRF Multi-Split System 17^{0}F db / 15^{0}F wb outdoor air	2.05 COP	
VRF Water source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 68^{0}F entering water	4.2 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 68^{0}F entering water	3.9 COP	

VRF Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50^0F entering water	3.6 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 50^0F entering water	3.3 COP	
VRF Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32^0F entering water	3.1 COP	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF Multi-Split System 32^0F entering water	2.8 COP	

[a] Deduct 0.2 from the required EERs and IEERs for Variable Refrigerant Flow (VRF) Multi-split system units with a heating recovery section.

[b] Applicable test procedure and reference year are provided under the definitions.

[c] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 1230 test procedures.

Table 4-10 Standards Table 110.2-J Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters

Equipment Type	Size Category (Input)	Subcategory or Rating Condition[b]	Minimum Efficiency	Test Procedure[a]
Warm-Air Furnace, Gas-Fired	< 225,000 Btu/h	Maximum Capacitiy[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,00 Btu/h	Maximum Capacitiy[b]	80% E_t	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, Oil-Fired	< 225,000 Btu/h	Maximum Capacitiy[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,00 Btu/h	Maximum Capacitiy[b]	~~80~~81% E_t	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacitiy[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heater, Gas-Fired	All Capacities	Maximum Capacitiy[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacitiy[b]	~~80~~81% E_c	Section 40, Combustion, UL 731

[a] Applicable test procedure and reference year are provided under the definitions.

[b] Compliance of multiple firing rate units shall be at maximum firing rate.

E_t = thermal efficiency, units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

1. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
2. Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

Table 4-11 Standards Table 110.2-K Gas and Oil Fired Boilers

Equipment Type	Subcategory	Size Category (Input)	Minimum Efficiency[b,c]		Test Procedure[a]
			Before 3/2/2020	After 3/2/2020	
Boiler, hot water	Gas-Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	80% E_t	80% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	82% E_c	82% E_c	
	Oil-Fired	< 300,000 Btu/h	84% AFUE	84% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	82% E_t	82% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	84% E_c	84% E_c	
Boiler, steam	Gas-Fired	< 300,000 Btu/h	80% AFUE	80% AFUE	DOE 10 CFR Part 430
	Gas-Fired All, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	79% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	79% E_t	79% E_t	DOE 10 CFR Part 431
	Gas-Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	77% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	77% E_t	79% E_t	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	81% E_t	81% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	81% E_t	81% E_t	DOE 10 CFR Part 431

[a] Applicable test procedure and reference year are provided under the definitions.
[b] E_c = combustion efficiency (100% less flue losses). See reference document for detail information
[c] E_t = thermal efficiency. See test procedure for detailed information.
[d] Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.
[e] Included oil-fired (residual).

APPENDIX D: DDC FLOW CHARTS (FIGURE 14-13 THROUGH FIGURE 14-18)

The Statewide Utility Team recommends adding the following flow charts to Chapter 4 of the Compliance Manual to help explain when DDC is required to the zone level.

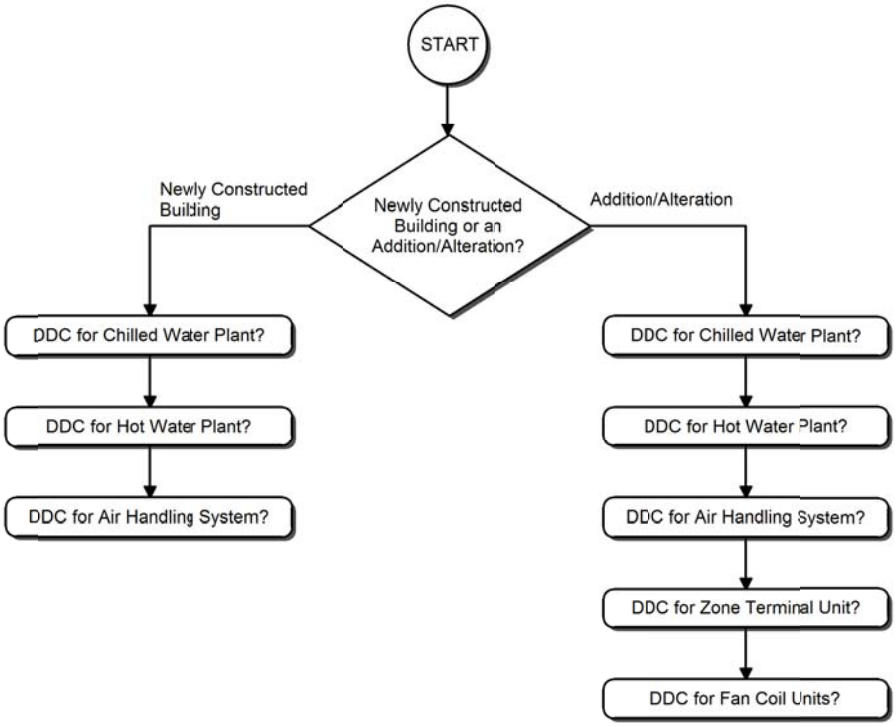

Figure 4-13 – Building Status Flowchart

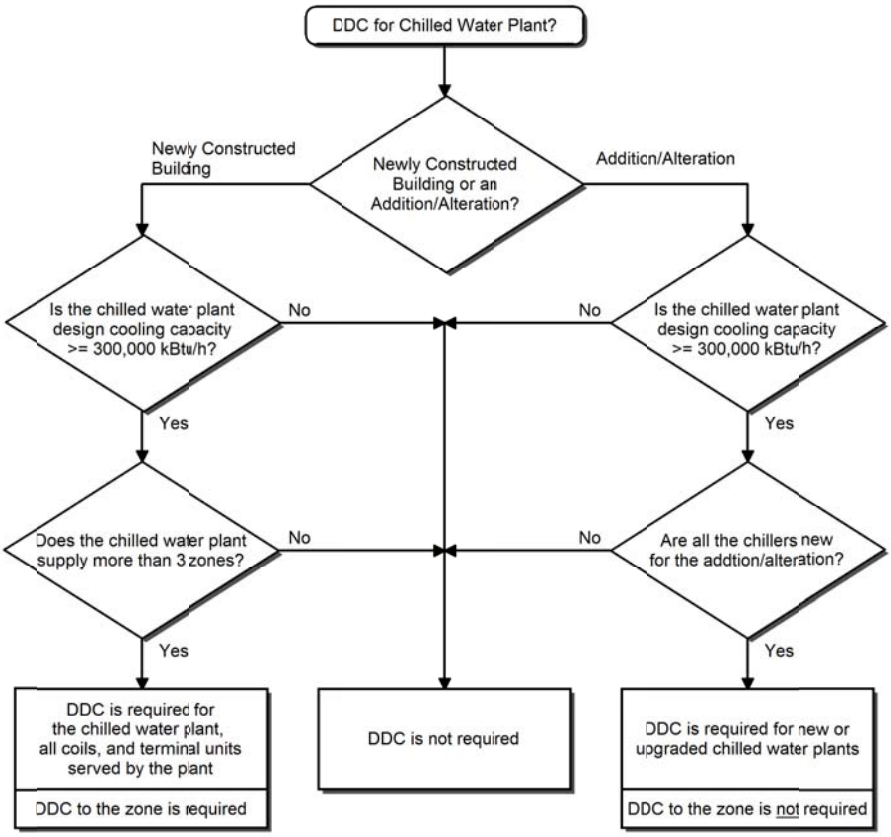

Figure 4-14 – Chilled Water Plant Flowchart

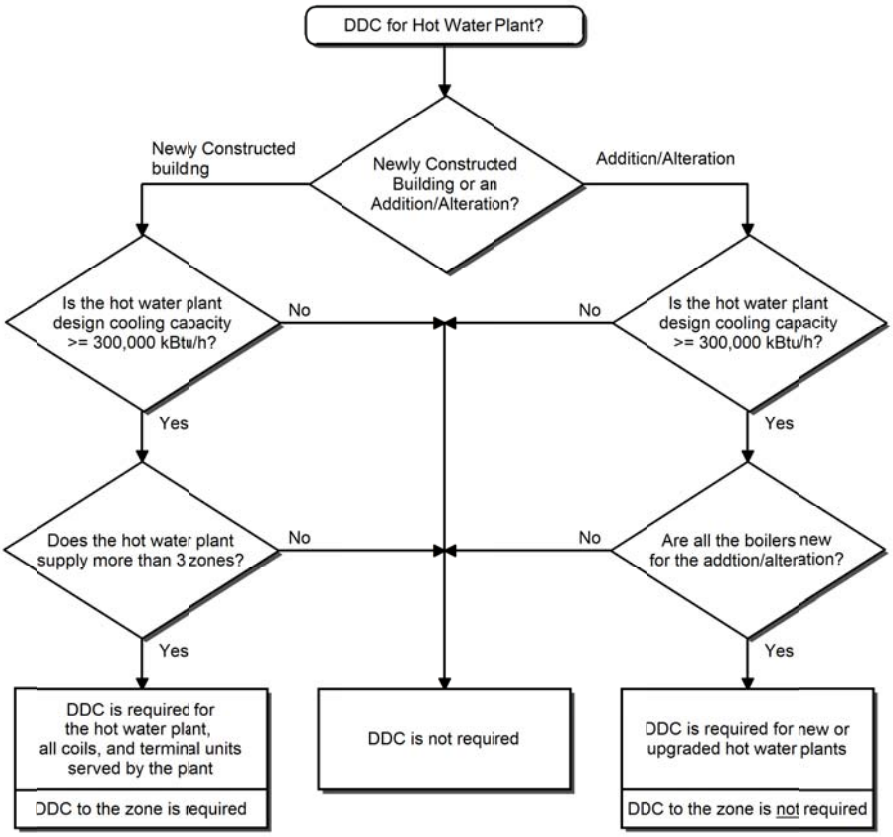

Figure 4-15 – Hot Water Plant Flowchart

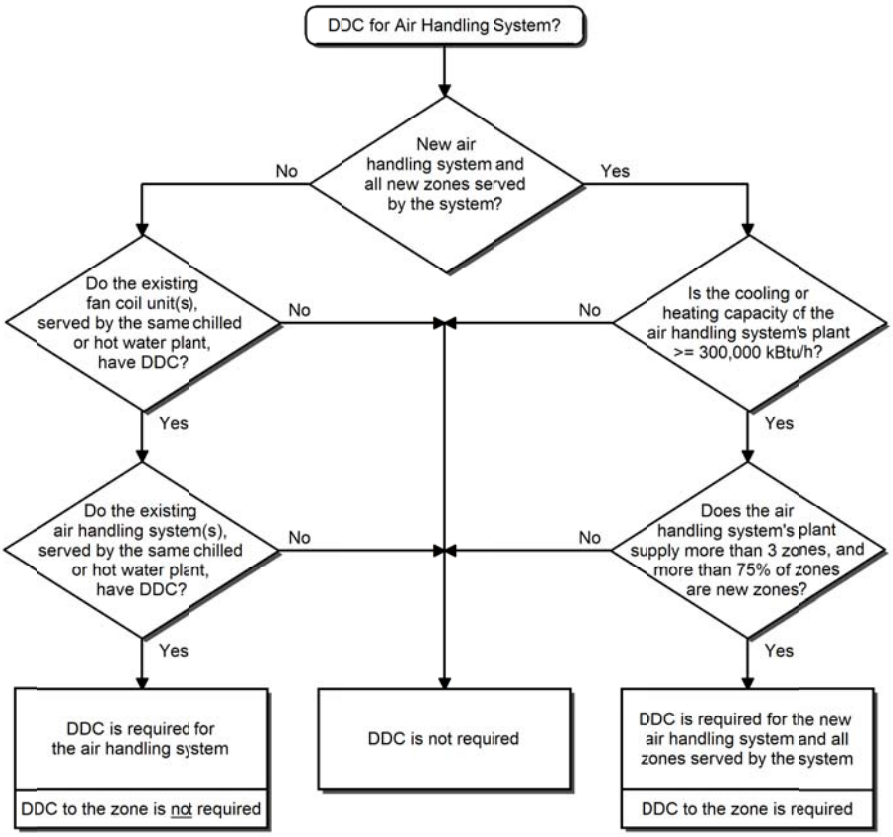

Figure 4-16 – Air Handling System Flowchart

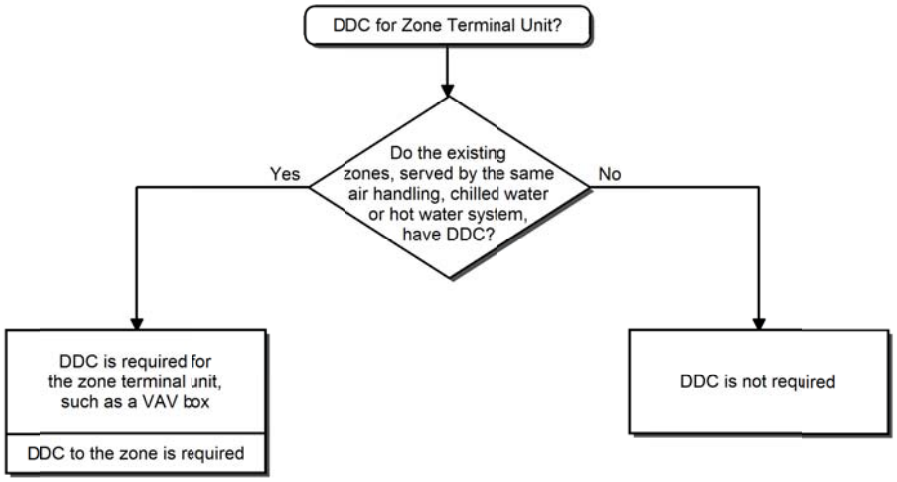

Figure 4-17 – Zone Terminal Unit Flowchart

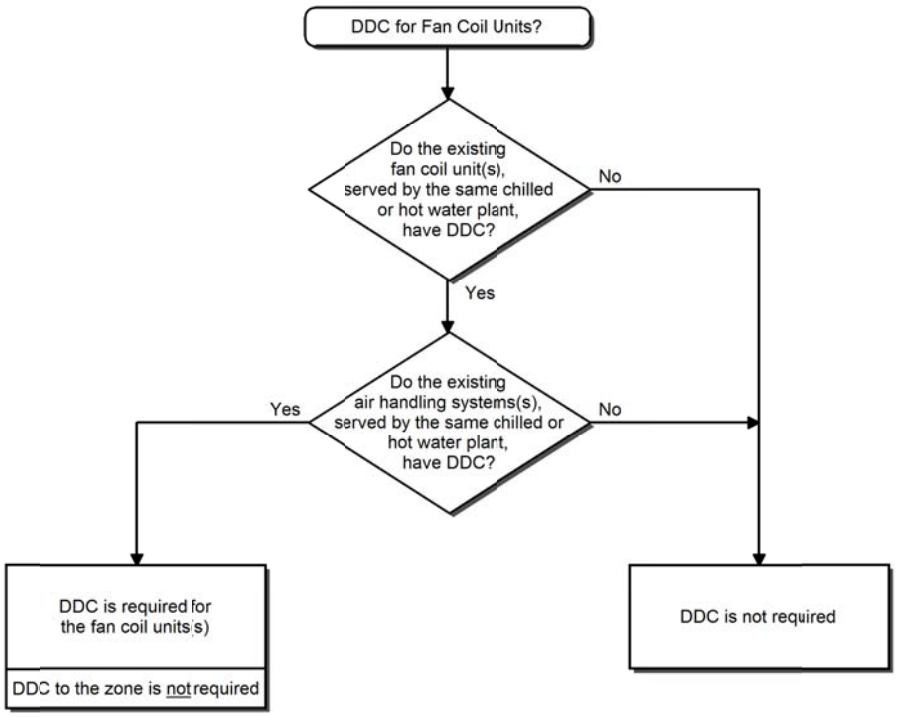

Figure 4-18 – Fan Coil Units Flowchart