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Appendix NA1 – Nonresidential HERS Verification, Testing, and Documentation Procedures

NA1.1 Purpose and Scope

Appendix NA1 provides direction for communication and documentation processes that must be completed for compliance with the requirements for duct sealing of HVAC systems covered by §140.4(l)1, §141.0(b)2D, and §141.0(b)2E that requires field verification and diagnostic testing of as-constructed duct systems by a certified Home Energy Rating System (HERS) Rater, using the testing procedures in Reference Nonresidential Appendix NA2. The Commission approves HERS Providers, subject to the Commission's HERS Program regulations, which appear in the California Code of Regulations, Title 20, Chapter 4, Article 8, Sections 1670-1675. Approved HERS Providers are authorized to certify HERS Raters and maintain quality control over field verification and diagnostic testing.

When the Certificate of Compliance indicates that field verification and diagnostic testing of specific energy efficiency measures are required as a condition for compliance with Title 24, Part 6, an approved HERS Provider and certified HERS Rater shall be used to conduct the field verification and diagnostic testing according to the applicable procedures in Reference Nonresidential Appendix NA2. HERS Providers and HERS Raters shall be considered special inspectors by enforcement agencies, and shall demonstrate competence to the satisfaction of the enforcement agency, for field verifications and diagnostic testing. As specified by California Code of Regulations, Title 20, Division 2, Chapter 4, Article 8, Section 1673(j)(2),HERS Providers and HERS Raters shall be independent entities from the builder or subcontractor installer of the energy efficiency improvements being field verified or diagnostically tested. An "Independent Entity means

having no financial interest in, and not advocating or recommending the use of any product or service as a means of gaining increased business with, firms or persons specified in CCR Title 20, Division 2, Chapter 4, Article 8, Sections 1671 and 1673(j).". Third Party Quality Control Programs approved by the Commission may serve some of the functions of HERS Raters for field verification and diagnostic testing purposes as specified in NA1.7.

The remainder of Reference Nonresidential Appendix NA1 describes the:

(a) Requirements for documentation and communication for HERS verification compliance processes;

(b) Responsibilities assigned to each of the parties involved in the field verification and diagnostic testing process;

(c) Requirements for procedures for installing contractors and Certificate of Installation documentation;

(d) Requirements for HERS Rater field verification and diagnostic testing and documentation procedures;

(e) Requirements for sampling procedures for HERS verification compliance;

(f) Requirements for Third Party Quality Control Programs;

(g) Requirements for HERS verification compliance for alterations to existing buildings.

NA1.2 Documentation and Communication Requirements for HERS Verification Compliance

The required building energy compliance features and the required field verification and diagnostic testing procedures shall be identified on a Certificate of Compliance completed in accordance with the requirements in Standards Sections 10-103(a)1 and 10-103(a)2. The builder or subcontractor shall complete all applicable Certificate of Installation documentation in accordance with the requirements in Standards Section 10-103(a)3 and the procedures described in NA1, and shall provide certification that the construction or installation complies with the applicable requirements on the Certificate of Compliance. The person responsible for the acceptance testing shall perform the required field verification and diagnostic testing and report the results on the Certificate of Acceptance documentation submitted in accordance with the requirements in Standards Section 10-103(a)4 and the procedures described in NA1, and shall provide certification that the construction or installation information reported on the Certificates of Installation are consistent with applicable requirements on the Certificate of Compliance. A certified HERS Rater shall perform all applicable HERS field verification and diagnostic testing and report the results on the applicable Certificate of Verification documentation submitted in accordance with the requirements of Standards Section 10-103(a)5 and the procedures in NA1, and shall provide certification that the construction or installation information reported on the Certificates of Installation, and the results of the Acceptance testing reported on the Certificate of Acceptance is consistent with applicable requirements on the Certificate of Compliance.

NA1.2.1 Compliance Document Registration and Verification

Document registration requirements are introduced in Section NA1.2.1.1 and further described in the procedures in subsequent sections of NA1. Verification of electronic documentation is introduced in Section NA1.2.1.2 and is applicable to many aspects of the documentation procedures described in subsequent sections of Nonresidential Appendix NA1.

NA1.2.1.1 Document Registration Terminology and Effective Dates for Registration Requirements

When submittal of documentation to a Data Registry is required by applicable sections of Standards Section 10-103(a), the completed documents are referred to as registered documents, and the process of completing these documents by submitting information and certification signatures to the Data Registry is called registration. Refer to Reference Joint Appendix JA1 for additional terminology for Data Registries, registered documents and registration Providers. Additional specification for the document registration process is given in Reference Joint Appendix JA7.

Data Registry is a web service with a user interface and database maintained by a Registration Provider that complies with the applicable requirements in Reference Joint Appendix JA7, with guidance from the Data

Registry Requirements Manual, and provides for registration of residential or nonresidential compliance documentation used for demonstrating compliance with Part 6.

Residential Data Registry is a Data Registry that is maintained by a HERS Provider that provides for registration, when required by Part 6, of all residential compliance documentation and the nonresidential Certificate of Verification.

Nonresidential Data Registry is a Data Registry that is maintained by a Registration Provider approved by the Commission that provides for registration, when required by Part 6, of all nonresidential compliance documentation. However, nonresidential Data Registries may not provide for registration of nonresidential Certificates of Verification.

Registration Provider is an organization that administers a Data Registry service that conforms to the requirements in Reference Joint Appendix JA7 and may conform to the guidance given in the Data Registry Requirements Manual.

NA1.2.1.1.1 Document registration requirements prior to January 1, 2015.

For all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6:

(a) All Certificate of Verification compliance documents for duct leakage testing are required to be submitted for registration and retention to an approved Residential Data Registry, and

(b) Certificate of Compliance, Certificate of Installation, and Certificate of Acceptance compliance documents are not required to be registered.

NA1.2.1.1.2 Document registration requirements effective on January 1, 2015,

Contingent upon the approval of Nonresidential Data Registry(s) by the Commission, for all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6:

(a) All Certificate of Compliance, Certificate of Installation, and Certificate of Acceptance documentation shall be submitted for registration and retention to an approved Nonresidential Data Registry.

(b) All Certificate of Verification documents for duct leakage testing are required to be submitted for registration and retention to an approved Residential Data Registry.

All submittals to the Data Registries shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

NA1.2.1.2 Verification of Registered Documents

When document registration is required, printed paper copies or electronic copies of the applicable completed, signed, registered compliance documentation shall be allowed for use for required submittals to enforcement agencies, subject to verification that the information shown on the submitted document(s) conforms to the information shown on the current revision of the registered document(s) on file in the Data Registry for the building.

The document registration Provider shall make document verification services available via phone, internet, or utilization of digital technologies, to enable enforcement agency officials, builders, installation contractors, HERS Raters, and other authorized users of the Data Registry to verify that the information shown on submitted documentation is consistent with the information shown on the current revision of the registered document on file in the Data Registry for the applicable building.

NA1.2.2 Summary of Documentation and Communication Procedures

The documentation and communication process for duct sealing field verification and diagnostic testing is summarized below. The subsequent sections of this chapter contain additional information and requirements that apply to all situations; however the section on alterations, NA1.8, applies specifically to the differences in the requirements for alterations. NA1.7 applies specifically to the differences in the requirements for Third Party Quality Control Programs.

(a) The documentation author and the principal mechanical designer shall complete the compliance documents for the building.

(b) The documentation author or the principal mechanical designer shall provide a signed Certificate of Compliance to the builder that indicates duct sealing with HERS Rater diagnostic testing and field verification is required for compliance.

(c) The builder or principal mechanical designer shall make arrangements for transmittal of a signed copy of the Certificate of Compliance, for units that require HERS verification, to a HERS Provider. The builder shall also arrange for the services of a certified HERS Rater prior to installation of the duct system, so that once the installation is complete the HERS Rater has ample time to complete the field verification and diagnostic testing without delaying final approval of occupancy by the enforcement agency. The builder or principal mechanical designer shall make available to the HERS Rater a copy of the Certificate of Compliance that was approved/signed by the principal designer/owner and submitted to the enforcement agency.

(d) The builder or subcontractor shall install the duct system(s) that requires field verification and diagnostic testing. The builder or the installing subcontractor shall perform diagnostic testing according to the procedures specified in Reference Nonresidential Appendix NA1.4 and NA2.

(e) When the installation is complete, the builder or the installing subcontractor shall complete and sign the Certificate of Installation, and Certificate of Acceptance, and post a copy of the completed signed Certificates at the building site for review by the enforcement agency in conjunction with requests for final inspection. The builder or subcontractor shall also provide a signed copy of the Certificate of Installation and Certificate of Acceptance to the HERS Rater.

(f) The HERS Rater shall confirm that the Certificate of Installation and Certificate of Acceptance has been completed as required, and that the installer's diagnostic test results and all other Certificate of Installation and Certificate of Acceptance information shows compliance consistent with the requirements given in the plans and specifications and Certificate of Compliance approved by the local enforcement agency for the building.

(g) The HERS Rater shall complete the field verification and diagnostic testing as specified in NA1.6 and shall enter the test results into the HERS Provider Data Registry.

(h) The HERS Provider shall make available copies of the Certificate of Verification to the HERS Rater, builder, and the HERS Rater shall arrange to have a copy of the completed signed Certificate of Verification posted at the building site for review by the enforcement agency in conjunction with requests for final inspection.

(i) The enforcement agency shall not approve a building with individual single zone package space conditioning equipment for occupancy until the enforcement agency has received a completed signed copy of the Certificate of Installation, Certificate of Acceptance, and the Certificate of Verification at the building site in conjunction with requests for final inspection.

(j) The Registration Providers shall make document verification services available, via phone or internet communications interface, to the enforcement agency, builders and contractors, HERS Raters, the Energy Commission, and other authorized users of the Data Registry. The HERS Provider shall ensure that the Certificate of Verification information and approval signatures are retained as specified by Title 20 Section 1673(e).

NA1.3 Summary of Responsibilities

Section NA1.3 summarizes responsibilities set forth in Appendix NA1 and organizes them by the responsible party**.** This section is not, however, a complete accounting of the responsibilities of the respective parties.

NA1.3.1 Builder

The builder shall make arrangements for submittal of a copy of the Certificate of Compliance, for buildings with duct systems requiring HERS verification, to the HERS Provider. The builder shall make arrangements for the services of a certified HERS Rater prior to installation of the duct systems, so that once the installation is complete the HERS Rater has ample time to complete the field verification and diagnostic testing without

delaying final approval of occupancy for the building permit by the enforcement agency. The builder shall make available to the HERS Rater a copy of the Certificate of Compliance that was approved/signed by the principal designer or owner and submitted to the enforcement agency.

The builder's employees or subcontractors responsible for the installation shall perform diagnostic testing, as specified in Reference Nonresidential Appendix NA1.4, NA1.5 and NA2, and shall complete and sign the Certificate of Installation and Certificate of Acceptance to certify the diagnostic testing results and that the installation work meets the requirements for compliance as shown on the Certificate of Compliance. The builder or subcontractor shall post a copy of the Certificate of Installation and Certificate of Acceptance at the construction site for review by the enforcement agency, in conjunction with requests for final inspection. The builder or subcontractor shall also make available a completed signed copy of the Certificate of Installation and Certificate of Acceptance to the HERS Rater.

If the builder chooses to utilize group sampling for HERS verification compliance, the builder, the builder's authorized representative, or the HERS Rater shall identify the units to be included in the sample group for field verification and diagnostic testing. The HERS Rater, with no direction from the installer or builder, shall randomly select one duct system from a sample group for field verification and diagnostic testing upon receiving the builder's or builder representative's request for HERS verification of that group. The builder or the HERS Rater shall arrange for registered copies of all Certificates of Verification to be posted at the building site for review by the enforcement agency in conjunction with requests for final inspection for each individual system.

The builder shall leave in the building, for the building owner at occupancy, copies of all compliance, operating, maintenance, and ventilation information specified in applicable sections of Title 24, Part 1, Section 10-103(b).

NA1.3.2 HERS Provider and Rater

The HERS Provider shall maintain a Data Registry with the capability to receive and store data information provided by authorized users of the Data Registry sufficient to facilitate administration the of HERS compliance verification procedures and documentation procedures as described in NA1, Reference Residential Appendix RA2, and Joint Appendix JA7. Data Registry capabilities include a secure web-based interface accessible by authorized users, and the ability to receive and process data transfer files as specified by Reference Joint Appendix JA7. The HERS Provider shall maintain a list of the space conditioning units in the group from which sampling is drawn, the units selected for sampling, the units sampled and the results of the sampling, the units selected for re-sampling, the units that have been tested and verified as a result of re-sampling, and the corrective action taken. The Provider shall retain records of all information content and approval signatures for completed registered Certificate of Verification forms for a period of five years as specified by Title 20 Section 1673(d).

The HERS Rater providing the diagnostic testing and verification shall transmit the test results to the Data Registry. A registered copy of the Certificate of Verification from the Provider, signed by the Rater, shall be provided for the "tested" unit and each of the remaining "not tested" units from a designated sample group for which compliance is verified based on the results of a sample. The HERS Provider's registered copy of the Certificate of Verification shall be made available to the HERS Rater, the builder, the enforcement agency, and other authorized users of the Data Registry, and a copy of the completed signed Certificate of Verification shall be posted at the building site for review by the enforcement agency in conjunction with requests for final inspection.

The HERS Rater shall produce a separate Certificate of Verification for each system that meets the diagnostic requirements for compliance. The registered Certificate of Verification shall have unique HERS Provider-designated identifiers for registration number, and sample group number, and shall include the lot location, building permit number, time and date stamp of issuance of the certificate, Provider logo or seal, and indicate if the space conditioning unit has been "tested or if it was a "not tested" unit approved as part of sample group. The HERS Rater shall not provide a Certificate of Verification for a building with a space conditioning unit that does not have a completed signed Certificate of Installation as specified in Section NA1.4 and Certificate of Acceptance as specified in Section NA1.5.

If field verification and diagnostic testing on a sampled space conditioning unit identifies a failure to meet the requirements for compliance credit, the HERS Rater shall report to the HERS Provider, the builder, and the enforcement agency that re-sampling will be required.

If re-sampling identifies another failure, the HERS Rater shall report to the HERS Provider, the builder, and the enforcement agency that corrective action, diagnostic testing, and field verification will be required for all the untested space conditioning units in the group. The report shall identify each space conditioning unit that shall be fully tested and corrected.

The HERS Provider shall also report to the builder when diagnostic testing and field verification has shown that the failures have been corrected for all of the space conditioning units.

When individual space conditioning unit testing and verification confirms that the requirements for compliance have been met, the HERS Provider shall make available to the builder and the enforcement agency a registered copy of the Certificate of Verification for each space conditioning unit in the group.

The HERS Provider shall file a report with the enforcement agency if there has been a sample group failure, explaining all actions taken (including field verification, testing, and corrective actions) to bring into compliance space conditioning units for which full testing has been required.

NA1.3.3 Third-Party Quality Control Program

Third Party Quality Control Programs (TPQCP) verify the work of participating installers, collect and evaluate more detailed data than necessary for compliance, identify in real time during the installation invalid and inaccurate installer testing and noncompliant installations, and enable corrected testing with the goal of bringing installations into compliance before the installer leaves the job site. TPQCP personnel and participating TPQCPs do not sign Certificate of Verification documentation, given that they provide assistance and quality control to HERS Raters, who remain responsible for this documentation.

An approved Third Party Quality Control Program shall:

(a) Provide training to participating program installers, installing but not limited to contractors, subcontractors, and technicians, to ensure proficiency in:

i. Quality HVAC installation procedures, common causes of failure, and corrections.

ii. Understanding of the Standards requirements for field verification and diagnostic testing of measures, which are subject to TPQCP program procedures

iii. Understanding all applicable specifications for field verification and diagnostic testing procedures specified in the Reference Residential Appendices.

iv. Any applicable specialized TPQCP-specific procedures.

(b) Collect field verification and diagnostic test data (data) from participating installers for each installation completed,

(c) Confirm the location of the system undergoing testing using an electronic tracking means such as Global Positioning Satellite (GPS) technology,

(d) Provide data checking analysis to evaluate the validity and accuracy of the collected data to independently determine whether compliance has been achieved, and to uncover invalid or erroneous information,

(e) Provide real-time direction to the installer to retest and correct problems when data checking determines that compliance has not been achieved, or erroneous information is present, so that testing can be redone and corrections can be made before the installer leaves the site,

(f) Ensure the installer resubmits updated data from new testing when retesting and correction is completed,

(g) Maintain a database of all data submitted by participating TPQCP installers, and

(h) Enable Energy Commission staff to query retained TPQCP data or documents.

TPQCPs do not impose restrictions on HERS Raters or Providers that limit their independence or ability to properly perform their functions, nor do they impose restrictions on the HERS Rater's use of equipment (beyond those required by the Energy Commission).

Refer to NA1.7 for additional detail describing the roles and responsibilities and approval procedures for TPQCP.

~~An approved third-party quality control program shall:~~

~~(a) Provide training to participating program installing contractors, installing technicians, and specialty third party quality control program subcontractors regarding compliance requirements for measures for which diagnostic testing and field verification are required,~~

~~(b) Collect data from participating installers for each installation completed for compliance credit,~~

~~(c) Complete data checking analysis to evaluate the validity and accuracy of the data to independently determine whether compliance has been achieved,~~

~~(d) Provide direction to the installer to retest and correct problems when data checking determines that compliance has not been achieved,~~

~~(e) Require resubmission of data when retesting and correction is directed, and~~

~~(f) Maintain a database of all data submitted by participating program installing contractors, installing technicians, and specialty Third Party Quality Control Program subcontractors, and shall provide functionality that allows Energy Commission staff to query retained data or documents.~~

~~The HERS Provider shall arrange for the services of an independent HERS Rater to conduct independent field verifications of the installation work performed by the participating installing contractor and the Third Party Quality Control Program, completing all of the responsibilities of a HERS Rater as specified in Appendix NA1 with the exception that sampling shall be completed for a group of up to 30 space conditioning systems.~~

NA1.3.4 Enforcement Agency

The enforcement agency, at its discretion, may require independent testing and field verification to be scheduled so that it can be completed in conjunction with the enforcement agency's required inspections. The enforcement agency may also require that it observe the diagnostic testing and field verification performed by builders or subcontractors and the certified HERS Rater in conjunction with the enforcement agency's required inspections to corroborate the results documented on the Certificate of Installation, Certificate of Acceptance, and the Certificate of Verification.

For space conditioning systems for which field verification and diagnostic testing is required for compliance, the enforcement agency shall not approve a building with individual single zone package space conditioning equipment for occupancy until the enforcement agency has received a completed Certificate of Installation and Certificate of Acceptance that has been signed by the builder/owner or installing subcontractor, and a completed registered copy of the Certificate of Verification that has been made available by the HERS Provider Data Registry. The Certificates shall be posted at the building site for review by the enforcement agency in conjunction with requests for final inspection.

NA1.4 Installer Procedures –Certificate of Installation Documentation

Certificates of Installation are required for all buildings and shall include the required compliance information for all of the installed space conditioning systems in the building that must comply. When compliance requires duct sealing, the builder's employees or subcontractors shall perform diagnostic testing according to the procedures specified in Reference Nonresidential Appendix NA2, and verify that the duct sealing work meets the requirements for compliance shown on the Certificate of Compliance. The owner or installer shall complete a Certificate of Installation and sign the certificate to certify that the installation work meets the requirements for compliance.

A signed copy of the Certificate of Installation shall be posted at the job site for review by the enforcement agency, in conjunction with requests for final inspection, and a copy shall be provided to the HERS Rater.

When the Standards do not require the Certificate of Installation to be registered, the Certificates of Installation that are posted in the field for review by the enforcement agency at final inspection are not required to be registered certificates from a Data Registry, but shall conform to all other applicable requirements of 10-103(a)3.

NA1.5 Acceptance Procedures - Certificate of Acceptance Documentation

Certificates of Acceptance for duct testing are required for all applicable single zone package space conditioning systems in the building. When compliance requires duct sealing, the acceptance test Field Technician shall perform the required field verification and diagnostic testing according to the procedures specified in Reference Nonresidential Appendix NA2, and verify that the work meets the requirements for compliance as shown on the Certificate of Compliance. The owner or installer shall complete a Certificate of Installation and sign the certificate to certify that the installation work meets the requirements for compliance credit.

A signed copy of the Certificate of Acceptance shall be posted at the job site for review by the enforcement agency, in conjunction with requests for final inspection, and a copy shall be provided to the HERS Rater.

When the Standards do not require the Certificate of Acceptance to be registered, the Certificates of Acceptance that are posted in the field for review by the enforcement agency at final inspection are not required to be registered certificates from a Data Registry, but shall conform to all other applicable requirements of 10-103(a)4.

NA1.6 HERS Rater Procedures – Verification, Testing, and Sampling

At the builder's or owner's option, HERS field verification and diagnostic testing shall be completed either for each single zone package space conditioning system in the building or for a sample from a designated group of systems. Field verification and diagnostic testing for compliance with duct sealing requirements shall use the diagnostic duct leakage from fan pressurization of ducts procedure in Reference Nonresidential Appendix NA2. If the builder or owner elects to demonstrate HERS verification compliance utilizing group sampling, the applicable procedures described in NA1.6.2, NA1.6.3 and NA1.6.4 shall be followed.

NA1.6.1 HERS Procedures - General Requirements

The general requirements in NA1.6.1 are applicable to all units that require HERS verification for compliance, and shall be incorporated into procedures specified in Sections NA1.6.2, NA1.6.3, and NA1.6.4 whenever applicable.

The builder or subcontractor shall make available to the HERS Rater a copy of the Certificate of Compliance approved/signed by the system designer/builder or owner, a copy of the Certificate of Installation as described in NA1.4, and a copy of the Certificate of Acceptance as described in NA1.5. Prior to performing field verification and diagnostic testing, the HERS Rater shall confirm that the Certificate of Installation and the Certificate of Acceptance have been completed as required, and that the installer's diagnostic test results and all other Certificate of Installation and Certificate of Acceptance information indicate compliance consistent with the Certificate of Compliance.

The HERS Rater shall perform all applicable field verification and diagnostic testing.

If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS Rater shall submit or make arrangements for submittal of the Certificate of Verification information to the HERS Provider data registry.

Authorized users of the HERS Provider data registry that are not certified HERS Raters may provide *documentation author* support to facilitate submittal of the Certificate of Verification information to the HERS Provider data registry on behalf of the HERS Rater when such facilitation has been authorized by the HERS Rater. *Documentation authors* shall provide an electronic signature to the Data Registry to certify the documentation is accurate and complete.

The Certificate of Verification shall be electronically signed by the HERS Rater who performed the field verification and diagnostic testing services to certify that the information provided on the Certificate is true and correct.

A completed signed registered copy of the Certificate of Verification shall be posted at the building site for review by the enforcement agency in conjunction with requests for final inspection.

The HERS Provider shall make document verification services available, to enforcement agencies, builders and contractors, HERS Raters, the Energy Commission, and other authorized users of the HERS Provider data registry.

NA1.6.2 HERS Procedures - Initial Field Verification and Diagnostic Testing

The HERS Rater shall diagnostically test and field verify the first single zone package space conditioning equipment unit of each building when the builder elects to demonstrate HERS verification compliance utilizing group sampling. This initial testing allows the builder to identify and correct any potential duct installation and sealing flaws or practices before other units are installed. If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS Rater shall transmit the test results to the HERS Provider registry, whereupon the Provider shall make available a copy of the registered Certificate of Verification to the HERS Rater, the builder, and the enforcement agency.

NA1.6.3 HERS Procedures -– Group Sample Field Verification and Diagnostic Testing

After the initial field verification and diagnostic testing is completed, the builder or the HERS Rater shall identify a group of up to seven individual single zone package space conditioning systems in the building from which a sample will be selected and identify the names and license numbers of the subcontractors responsible for the installations requiring field verification and diagnostic testing.

For newly constructed buildings, systems in a designated group shall all be located within the same enforcement agency jurisdiction. Refer to Section NA1.8 for requirements for sample groups applicable to alterations.

The HERS Rater shall verify that a Certificate of Compliance a Certificate of Installation, and a Certificate of Acceptance have been completed for each unit having features requiring HERS verification. The HERS Rater shall also confirm that the Certificate of Installation and Certificate of Acceptance have been completed as required, and that the field technician's diagnostic test results and all other Certificate of Acceptance information shows compliance consistent with the Certificate of Compliance. The group shall be closed prior to selection of the sample that will be field verified and diagnostically tested.

The builder or the HERS Rater may request removal of units from the group by notifying the HERS Provider prior to selection of the sample that will be tested and shall provide justification for the change. Removed units which are installed shall either be field verified and diagnostically tested individually or shall be included in a subsequent group for sampling.

At the request of the builder or the builder's authorized representative, the HERS Rater, with no direction from the installer, builder, or owner shall randomly select one unit out of the closed group for field verification and diagnostic testing. The HERS Rater shall enter the test and/or field verification results into the Data Registry regardless of whether the results indicate a pass or fail. If the test fails then the failure must be entered into the Provider's Data Registry even if the installer immediately corrects the problem. In addition, the procedures in NA1.6.4 shall be followed.

If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS Rater shall enter the test results into the Data Registry. Whereupon, the Provider shall make available to the HERS Rater, the builder, the enforcement agency and other approved users of the Data Registry, a copy of the registered Certificate of Verification for the "tested" unit and a Certificate of Verification shall also be provided for each "not tested" conditioning unit in the sample group. The Certificate of Verification shall report the successful diagnostic testing results and conclusions regarding compliance for the "tested" conditioning unit. The Certificate of Verification shall also provide:

(a) Building permit number for the unit.

(b) Registration Number – that conforms to the numbering convention specified in Reference Joint Appendix JA7.

(c) Group Number – that conforms to the numbering convention specified in Reference Joint Appendix JA7.

(d) Time and date stamp of the Provider's issuance of the registered Certificate of Verification.

(e) Provider's logo, water mark, or official seal.

(f) Indication that the conditioning unit was a "tested" unit, or was a "not tested" unit from the sample group.

The registered Certificate of Verification shall not be provided for units that have not yet been installed and sealed.

Whenever the builder changes subcontractors who are responsible for installation of the space conditioning systems, the builder shall notify the HERS Rater of the subcontractor change, and terminate sampling for any affected group. All units requiring HERS Rater field verification and diagnostic testing for compliance that were installed by previous subcontractors or were subject to field verification and diagnostic testing under the supervision of a previous HERS Provider, for which the builder does not have a completed Certificate of Verification, shall either be individually tested or included in a separate group for sampling. Individual single zone package space conditioning systems that are subject to the requirements of Section 140.4(l)1 with installations completed by new subcontractors shall either be individually tested or shall be included in a new sampling group following a new *Initial Field Verification and Testing*, as described in Section NA1.6.2.

The HERS Rater shall not notify the builder when sample testing will occur prior to the completion of the work that is to be tested, or prior to entry of the data from the Certificate of Installation.

The HERS Provider shall close a group within 6 months after the signature date shown on any Certificate of Installation in the group. When such group closure occurs, the HERS Provider shall notify the builder or contractor and HERS Rater that the group has been closed, and a sample shall be selected for field verification and diagnostic testing.

NA1.6.4 HERS Procedures - Re-sampling, Full Testing and Corrective Action

"Re-sampling" refers to the procedure that requires testing of additional dwellings within a group when the selected sample dwelling from a group fails to comply with the HERS verification requirements.

When a failure is encountered during sample testing, the failure shall be entered into the Provider's Data Registry. Corrective action shall be taken on the failed system and then retested to verify that corrective action was successful. Corrective action and retesting on the system shall be repeated until the testing indicates compliance and the results have been entered into the Data Registry, whereupon, a registered Certificate of Verification for the system shall made available to the HERS Rater, the builder, the enforcement agency, and other authorized users of the Data Registry.

In addition, the HERS Rater shall conduct re-sampling to assess whether the first failure in the group is unique or if the rest of the units in the group are likely to have similar failings. The HERS Rater shall randomly select for re-sampling one of the remaining untested units in the group for testing.

If testing in the re-sample confirms that the requirements for compliance credit are met, then the unit with the failure shall not be considered an indication of failure in the other units in the group. The HERS Rater shall transmit the re-sample test results to the Data Registry, whereupon the Provider shall make available to the HERS Rater, the builder, the enforcement agency, and other authorized users of the Data Registry, a copy of the registered Certificate of Verification for each of the remaining units in the group including the dwelling unit in the re-sample.

If field verification and diagnostic testing of the second sample results in a failure, the HERS Rater shall report the second failure to the HERS Provider, the builder, and the enforcement agency. All space conditioning systems in the group must thereafter be individually field verified and diagnostically tested. The builder shall take corrective action on any space conditioning systems in the group that failed to comply when tested. In cases where corrective action would require destruction of building components, and the performance compliance method is used, the builder may choose to reanalyze compliance and choose different measures

that will achieve compliance. In this case a new Certificate of Compliance shall be completed and submitted to the HERS Provider, the HERS Rater and the enforcement agency. The HERS Rater shall conduct field verification and diagnostic testing for each of these space conditioning units to verify that problems have been corrected and that the requirements for compliance have been met. Upon verification of compliance, the HERS Rater shall enter the test results into the Data Registry. Whereupon the Provider shall make available to the HERS Rater, the builder, the enforcement agency, and other authorized users of the Data Registry a copy of the registered Certificate of Verification for each individual unit in the group.

The HERS Provider shall file a report with the enforcement agency explaining all action taken (including field verification, diagnostic testing, and corrective action,) to bring into compliance units for which full testing has been required. If corrective action requires work not specifically exempted by the CMC or the CBC, the builder shall obtain a permit from the enforcement agency prior to commencement of any of the work.

Corrections to avoid reporting a failure to the Data Registry shall not be made to a sampled or re-sampled unit after the HERS Rater selects the sample unit, or during the course of HERS testing of the unit. If it becomes evident that such corrections have been made to a sampled or re-sampled unit to avoid reporting a failure, field verification and diagnostic testing shall be required to be performed on 100 percent of the individual single zone package space conditioning equipment units in the group.

NA1.7 Third Party Quality Control Programs

The Energy Commission may approve Third Party Quality Control Programs (TPQCP) to verify the work of participating installers, collect and evaluate more detailed data than necessary for compliance, identify in real time during the installation invalid and inaccurate installer testing and noncompliant installations, and enable corrected testing with the goal of bringing installations into compliance before the installer leaves the job site. TPQCP personnel and participating TPQCP installation contractors do not have the authority to sign Certificate of Verification documentation as a HERS Rater.

NA1.7.1 Third Party Quality Control Program Responsibilities

An approved Third Party Quality Control Program shall:

(a) Provide training to participating program installers (including contractors, subcontractors, and technicians) to ensure proficiency in:

i. Quality HVAC installation procedures, common causes of failure, and corrections.
ii. Understanding of the Standards requirements for field verification and diagnostic testing of measures, which are subject to TPQCP program procedures
iii. Understanding all applicable specifications for field verification and diagnostic testing procedures specified in the Reference Residential Appendices.
iv. Any applicable specialized TPQCP-specific procedures.

(b) Collect field verification and diagnostic test data (data) from participating installers for each installation completed.

(c) Automatically confirm the location of the system undergoing testing using an electronic tracking means such as Global Positioning Satellite (GPS) technology if available.

(d) Provide data checking analysis to evaluate the validity and accuracy of the collected data to independently determine whether compliance has been achieved. Data checking based on more detailed data than is required for showing compliance must be able to uncover invalid or erroneous information supplied by installers.

(e) Provide direction to the installer to retest and correct problems when data checking determines that compliance has not been achieved. The direction to the installer shall occur in real time so that testing can be redone and corrections can be made before the installer leaves the site.

(f) Ensure the installer resubmits updated data from new testing when retesting and correction is completed.

(g) Maintain a database of all data submitted by all participating TPQCP installers.

(h) Provide functionality that enables Energy Commission staff to query retained TPQCP data or documents.

(i) TPQCP shall not impose restrictions on the HERS Rater or the HERS Provider that limit their independence, or the ability of the HERS Rater or the HERS Provider to properly perform their functions.

(j) TPQCP shall not impose restrictions on the HERS Rater's use of equipment beyond those required by the Energy Commission.

NA1.7.2 Requirements for Data Collected by a Third Party Quality Control Program

TPQCP data collection shall conform to the following requirements:

(a) Data shall be more detailed than the data required for showing compliance with the Standards.

(b) Data shall enable the TPQCP to conduct an independent check on the validity and accuracy of the installer's claim that compliance has been achieved.

(c) Data shall not be alterable by the installer to indicate that compliance has been achieved when in fact compliance has not been achieved.

NA1.7.3 HERS Provider Responsibilities

HERS Providers shall conform to the following requirements:

(a) HERS Providers shall assign a HERS Rater to conduct independent field verification and diagnostic testing of the installation work performed by the participating Third Party Quality Control Program installing contractors, and to submit Certificates of Verification at the close of the sampling group.

(b) HERS Providers shall notify enforcement agencies when groups close or exceed six months without closing.

(c) HERS Providers shall explain, in their applications for approval by the Energy Commission, the way in which their program will work with TPQCPs.

NA1.7.4 HERS Rater Responsibilities

HERS Raters shall conform to the following requirements:

(a) Complete all of the responsibilities of a HERS Rater as specified in Appendix NA1, with the exception that sampling procedures utilized for TPQCP installations shall be limited to sampling of a "closed" group as described in Section NA1.6. However, the sample tested shall be selected and field verified from within a group of up to thirty dwelling units.

(b) HERS Raters shall be independent entities from the Third Party Quality Control Program.

(c) If re-sampling is required, the HERS Rater shall perform full testing and corrective action as specified in Section NA1.6 with the exception that re-sampling shall be completed for a minimum of one out of every thirty dwelling units from the group.

NA1.7.5 Conflict of Interest Guidelines

The TPQCP shall meet the requirements imposed on a HERS Rater specified in the Energy Commission's HERS Program regulations (California Code of Regulations, Title 20, Division 2, Chapter 4, Article 8, Sections 1670 -1675), including the requirement to be an independent entity from the builder, the HERS Provider, the HERS Rater that provides independent field verifications, and the subcontractor installer as specified by Section 1673(j). However, a Third Party Quality Control Program may have business relationships with installers participating in the program to advocate or promote the program and an installer's participation in the program, and to advocate or promote products that the Third Party Quality Control Program sells to installers as part of the Program.

NA1.7.6 Conditions of TPQCP Approval

Prior to approval by the Commission, the Third Party Quality Control Program shall provide a detailed explanation to the Commission of the following:

(a) The data that is to be collected from the installers.

(b) The data checking process that will be used to evaluate the validity and accuracy of the data submitted by the TPQCP installation contractors.

(c) The justification for why this data checking process will provide strong assurance that the installation actually complies.

(d) The a detailed description of the database that will be maintained by the TPQCP, and the functionality that will allow Energy Commission staff to query retained data or documents.

(e) A detailed explanation of how their data input complies with Reference Joint Appendix JA7.9.

(f) A detailed description of the training that will be provided to TPQCP installers.

(g) The procedures the TPQCP will follow to ensure the installer makes appropriate on-site data submittals, installation corrections.

The Third Party Quality Control Program may apply for a confidential designation for information submitted to the Energy Commission as specified in the Commission's Administrative Regulations (California Code of Regulations, Title 20, Division 2, Chapter 7, Article 2, Section 2505).

NA1.7.7 Training for TPQCP Installation Contractors

As a condition to participation in the TPQCP program, all approved TPQCP installing contractors and the TPQCP installing contractor's responsible installation technicians shall be trained and confirmed to be proficient in the following:

(a) Quality installation procedures.

(b) The requirements of this Appendix.

(c) Any applicable specialized TPQCP-specific procedures

The training requirements also apply to the installing contractor's specialty subcontractors who provide Third Party Quality Control Program services. All installation verification and diagnostic work performed in the program shall be subject to the same quality assurance procedures as required by the Energy Commission's HERS program regulations.

~~The Commission may approve third-party quality control programs that serve some of the function of HERS Raters for diagnostic testing and field verification purposes but do not have the authority to sign compliance documentation as a HERS Rater. The third-party quality control program shall provide training to installers regarding compliance requirements for duct sealing. The third-party quality control program shall collect data from participating installers for each installation completed for compliance credit, provide data checking analysis to evaluate the validity and accuracy of the data to independently determine whether compliance has been achieved, provide direction to the installer to retest and correct problems when data checking determines that compliance has not been achieved, require resubmission of data when retesting and correction is directed, and maintain a database of all data submitted by installers and shall provide functionality that allows Energy Commission staff to query retained data or documents. The data that is collected by the third-party quality control program shall be more detailed than the data required for showing compliance with the Standards, shall provide an independent check on the validity and accuracy of the installer's claim that compliance has been achieved, and shall not be alterable by the installer to indicate that compliance has been achieved when in fact compliance has not been achieved.~~

~~The HERS Provider shall arrange for the services of a HERS Rater to conduct independent field verifications of the installation work performed by the participating Third Party Quality Control Program installing contractor. The HERS rater shall complete all of the responsibilities of a HERS Rater as specified in Appendix NA1, with the exception that sampling shall be completed for a group of up to thirty space conditioning systems with a minimum sample of one out of every thirty sequentially completed units from the group. The HERS Rater shall be an independent entity from the third-party quality control program. Re-sampling, full testing and corrective~~

~~action shall be completed as specified in NA1.6.4 with the exception that the group size can be up to thirty systems.~~

~~The third-party quality control program shall not impose restrictions on the HERS Rater or the HERS Provider that limit their independence, or the ability of the HERS Rater or the HERS Provider to properly perform their functions. For example, the third party quality control program shall not impose restrictions on a HERS Rater's use of equipment beyond that required by the Energy Commission.~~

~~The third-party quality control program shall meet all of the requirements imposed on of a HERS Rater specified in the Commission's HERS Program regulations (California Code of Regulations, Title 20, Division 2, Chapter 4, Article 8, Sections 1670 -1675), including the requirement that they be an independent entity from the builder the HERS Rater for the units, and the subcontractor installer as specified by Section 1673(j). However, a third-party quality control program may have business relationships with installers participating in the program to advocate or promote the program and an installer's participation in the program and to advocate or promote products that the third-party quality control program sells to installers as part of the program.~~

~~Prior to approval by the Commission, the third party quality control program shall provide a detailed explanation to the Commission of 1) the data that is to be collected from the installers, 2) the data checking process that will be used to evaluate the validity and accuracy of the data, 3) the justification for why this data checking process will provide strong assurance that the installation actually complies, and 4) the format for the database that will be maintained and the functionality that will allow Energy Commission staff to query retained data or documents. The third-party quality control program may apply for a confidential designation of this information as specified in the Commission's Administrative Regulations (California Code of Regulations, Title 20, Division 2, Chapter 7, Article 2, Section 2505). The third-party quality control program shall also provide a detailed explanation of the training that will be provided to installers and the procedures that it will follow to complete independent field verifications.~~

~~The third party quality control program licensed/certified installing contractor and the installing contractor's responsible installing technicians shall be required to be trained in quality installation procedures, the requirements of Appendix NA1, and any other applicable specialized third party quality control program-specific procedures as a condition for participation in the program. The training requirements also apply to the installing contractor's specialty subcontractors who provide Third Party Quality Control Program services. All installation verification and diagnostic work performed in the program shall be subject to the same quality assurance procedures as required by the Energy Commission's HERS program regulations.~~

~~The third-party quality control program shall be considered for approval as part of the rating system of a HERS Provider, which is certified as specified in the Commission's HERS Program regulations, Title 20,Division 2, Chapter 4, Article 8, Section 1674. A third-party quality control program can be added to the rating system through the re-certification of a certified HERS Provider as specified by Title 20, Division 2, Chapter 4, Article 8, Section 1674(e).~~

NA1.8 Installer Requirements and HERS Procedures for Alterations

This section on alterations describes the differences that apply to alterations. Otherwise the procedures and requirements detailed in previous sections of NA1 shall also apply to alterations. For alterations, building owners or their agents may carry out the actions that are assigned to builders in previous sections of Appendix NA1.

Applicable procedures for registration of compliance documents described in Appendix NA1 shall also apply to alterations.

When compliance for an alteration requires diagnostic testing and field verification, the building permit applicant may choose for the testing and field verification to be completed for the permitted space conditioning system alone, or alternatively as part of a designated sample group of space conditioning systems for which the same installing company has completed work that requires field verification and diagnostic testing for compliance.

When sampling is utilized for HERS verification compliance for alterations, the buildings in a designated sample group are not required to be located within the same enforcement agency jurisdiction. However, to enable the enforcement agency to schedule testing to accomplish the corroboration of field verification and

diagnostic testing procedures performed by builders, subcontractors, or certified HERS Rater as described in Section NA1.3.4, the enforcement agency may require that a separate system from the sample group that is located within its jurisdiction be tested.

The building permit applicant shall submit or make arrangements for submittal of the required Certificate of Compliance information to the HERS Provider and complete the applicable Certificate of Compliance documentation in accordance with the requirements in Standards Section 10-103(a)1 and 10-103(a)2.

When the enforcement agency does not require building design plans to be submitted with the application for a building permit for an alteration, the applicable registered Certificate of Compliance documentation specified in 10-103(a)1 is not required to be approved by the enforcement agency prior to issuance of a building permit, but shall be approved by the enforcement agency prior to final inspection of the dwelling unit, and shall be made available to the enforcement agency for all applicable inspections as specified in Standards Section 10-103(a)2A.

HERS Raters or other authorized users of the Data Registry may provide *documentation author* support to facilitate the submittal of any required Certificate of Compliance information to a Data Registry on behalf of the building owner or agent of the building owner, when such facilitation has been authorized by the building owner or agent of the building owner. *Documentation authors* shall provide an electronic signature to certify the documentation is accurate and complete. The building owner or agent of the building owner who is eligible under Division 3 of the Business and Professions Code to take responsibility for the design specification for the alteration shall provide an electronic signature to register the Certificate of Compliance, to certify the information provided on the Certificate is true and correct, to certify conformance with Part 6, and shall submit the registered Certificate of Compliance to the enforcement agency for approval.

The building permit applicant or building owner or agent shall make available to the HERS Rater a copy of the registered Certificate of Compliance approved by the enforcement agency.

The installer or field technician shall perform diagnostic testing and the procedures specified in Reference nonresidential Appendix NA1.4 and NA2.

When the installation is complete, the person responsible for the installation shall complete and sign the Certificate of Installation, and post a copy at the building site for review by the enforcement agency in conjunction with requests for final inspection. The owner or subcontractor shall also provide a completed signed copy of the Certificate of Installation to the HERS Rater.

The field technician responsible for performing the acceptance test on the system shall complete the Certificate of Acceptance. The Certificate of Acceptance shall be signed by the system designer or installing contractor who is responsible for the system performance. A copy of the completed signed Certificate shall be posted at the building site for review by the enforcement agency in conjunction with requests for final inspection. The owner or subcontractor shall also provide a completed signed copy of the Certificate of Installation to the HERS Rater.

The HERS Rater shall verify that the Certificate of Compliance, Certificate of Installation, and Certificate of Acceptance have been completed for each unit having features requiring HERS verification, and that the field technician's diagnostic test results and all other Certificate of Acceptance information shows compliance consistent with the Certificate of Compliance for the system.

If group sampling is utilized for compliance, the HERS Rater shall define a group of up to seven units for sampling purposes, requiring that all units within the group have been serviced by the same installing company. The installing company may request a group for sampling that is smaller than seven units. Whenever the HERS Rater for an installing company is changed, a new group shall be established.

Re-sampling, full testing and corrective action shall be completed if necessary as specified in NA1.6.4. For alterations, the installing company shall offer to complete field verification and diagnostic testing and any necessary corrective action at no charge to building owners in the group.

The enforcement agency shall not approve the alteration until the enforcement agency has received a completed Certificate of Installation as specified in NA1.4, Certificate of Acceptance as specified in Section NA1.5, and a copy of the registered Certificate of Verification as specified in NA1.6.

Third Party Quality Control Programs, as specified in NA1.7, may also be used with alterations. When a Third Party Quality Control Program is used, the enforcement agency may approve compliance based on the

Certificate of Installation, where data checking has indicated that the unit complies, on the condition that if HERS compliance verification procedures indicate that re-sampling, full testing or corrective action is necessary, such work shall be completed.

Nonresidential Appendix NA2

Appendix NA2 – Nonresidential Field Verification and Diagnostic Test Procedures

NA2.1 Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems

NA2.1.1 Purpose and Scope

1. NA2.1 contains procedures for field verification and diagnostic testing for air leakage in single zone, constant volume, nonresidential air distribution systems serving zones with 5000 ft² of conditioned floor area or less as required by Standards section 140.4(l)1.
2. NA2.1 procedures are applicable to new space conditioning systems in newly constructed buildings and to new or altered space conditioning systems in existing buildings.
3. NA2.1 procedures shall be used by installers, HERS Raters, and others who perform field verification of air distribution systems as required by Standards Section ~~140.4(l)~~140.4(l)1.
4. Table NA2.1-1 provides a summary of the duct leakage verification and diagnostic test protocols included in Section NA2.1, and the compliance criteria.

NA2.1.2 Instrumentation Specifications

The instrumentation for the air distribution diagnostic measurements shall conform to the following specifications:

NA2.1.2.1 Pressure Measurements

All pressure measurements shall be measured with measurement systems (i.e. sensor plus data acquisition system) having an accuracy of plus or minus 0.2 Pa. All pressure measurements within the duct system shall be made with static pressure probes, Dwyer A303 or equivalent.

NA2.1.2.2 Duct Leakage Measurements

All measurements of duct leakage airflow shall have an accuracy of plus or minus 3 percent of measured airflow or better using digital gauges.

NA2.1.2.3 Calibration

All instrumentation used for duct leakage diagnostic measurements shall be calibrated according to the manufacturer's calibration procedure to conform to the accuracy requirement specified in Section NA2.1.2.

NA2.1.3 Diagnostic Apparatus

NA2.1.3.1 Apparatus for Duct Pressurization and Leakage Flow Measurement

The apparatus for duct system pressurization and duct system leakage measurements shall consist of a duct system pressurization and leakage airflow measurement device meeting the specifications in Section NA2.1.2.

NA2.1.3.2 Apparatus for Smoke-Test of Accessible-Duct Sealing (Existing Duct Systems)

The apparatus for determining leakage in and verifying sealing of all accessible leaks in existing duct systems provide means for introducing controllable amounts of non-toxic visual or theatrical smoke into the duct pressurization apparatus for identifying leaks in accessible portions of the duct system. The means for generating smoke shall have sufficient capacity to ensure that any accessible leaks will emit visibly identifiable smoke.

NA2.1.4 Verification and Diagnostic Procedures

NA2.1.4.1 Nominal Air Handler Airflow

The nominal air handler airflow used to determine the target leakage rate for compliance for an air conditioner or heat pump shall be 400 cfm per rated ton of cooling capacity. Nominal air handler airflow for heating-only system furnaces shall be based on 21.7 cfm per kBtu/hr of rated heating output capacity.

NA2.1.4.2 Diagnostic Duct Leakage

Diagnostic duct leakage measurement shall be used by installers and HERS Raters to verify that duct leakage meets the compliance criteria for sealed duct systems for which field verification and diagnostic testing is required. Table NA2.1-1 summarizes the leakage criteria and the diagnostic test procedures that shall be used to demonstrate compliance.

Table NA2.1-1 – Duct Leakage Verification and Diagnostic Test Protocols and Compliance Criteria

Case	User and Application	Leakage Compliance Criteria, (% of Nominal Air Handler Airflow)	Procedure(s)
Sealed and tested new duct systems	Installer Testing HERS Rater Testing	6%	NA2.1.4.2.1
Sealed and tested altered existing duct systems	Installer Testing HERS Rater Testing	15%	NA2.1.4.2.1
Sealed and tested altered existing duct systems	Installer Testing and Inspection HERS Rater Testing and Verification	Fails Leakage Test but All Accessible Ducts are Sealed Inspection and Smoke Test with 100% Verification	NA2.1.4.2.2 NA2.1.4.2.3 NA2.1.4.2.4

NA2.1.4.2.1 Diagnostic Duct Leakage from Fan Pressurization of Ducts

The objective of this procedure is for an installer to determine and a HERS Rater to verify the leakage of a new or altered duct system. The duct leakage shall be determined by pressurizing the entire duct system ducts to 25 Pa (0.1 inches water) with respect to outside. The following procedure shall be used for the fan pressurization tests:

(a) Verify that the air handler, supply and return plenums and all the connectors, transition pieces, duct boots, and registers are installed, and ensure the following locations have been sealed:

1. Connections to plenums and other connections to the air-handling unit.

2. Refrigerant line and other penetrations into the air-handling unit.
3. Air handler access door or panel (do not use permanent sealing material, metal tape is acceptable).

The entire duct system including the air- handler shall be included in the test.

(b) For newly installed or altered ducts, verify that cloth backed rubber adhesive duct tape has not been used.

(c) Temporarily seal all the supply registers and return grilles, except for one large centrally located return grille or the air handler cabinet access door or panel. Verify that all outside air dampers and/or economizers are sealed prior to pressurizing the system.

(d) Attach the fan flowmeter device to the duct system at the unsealed return grille or the air handler cabinet access door or panel.

(e) Install a static pressure probe at a supply register located close to the air handler, or at the supply plenum.

(f) Adjust the fan flowmeter to produce a positive 25 Pa (0.1 inches water) pressure at the supply register or the supply plenum with respect to the outside or with respect to the building space with the entry door open to the outside.

(g) Record the flow through the flowmeter, this is the duct leakage flow at 25 Pa (0.1 inches water).

(h) Divide the duct leakage flow by the nominal air handler airflow determined by the procedure in Section NA2.1.4.1 and convert to a percentage. If the duct leakage flow percentage is equal to or less than the target compliance criterion from Table NA2.1-1, the system passes.

NA2.1.4.2.2 Sealing of All Accessible Leaks

For altered existing duct systems that are unable to pass the leakage test in Section NA2.1.4.2.1, the objective of this test is to verify that all accessible leaks are sealed. The following procedure shall be used:

(a) Complete the leakage test specified in Section NA2.1.4.2.1.

(b) Seal all accessible ducts.

(c) After sealing is complete, again use the procedure in NA2.1.4.2.1 to measure the leakage after duct sealing.

(d) Complete the Smoke Test as specified in NA2.1.4.2.3.

(e) Complete the Visual Inspection as specified in NA2.1.4.2.4.

All duct systems that fail to pass the leakage test specified in Section NA2.1.4.2.1 shall be tested and inspected by a HERS Rater to verify that all accessible ducts have been sealed and damaged ducts have been replaced. Compliance with HERS verification requirements shall not utilize group sampling procedures when the installer used the Sealing of All Accessible Leaks procedure in Section NA2.1.4.2.2.

NA2.1.4.2.3 Smoke-Test of Accessible-Duct Sealing

For altered existing ducts that fail the leakage tests, the objective of the smoke test is to confirm that all accessible leaks have been sealed. The following procedure shall be used:

(a) Inject either theatrical or other non-toxic smoke into a fan pressurization device that is maintaining a duct pressure difference of 25 Pa (0.1 inches water) relative to the duct surroundings, with all grilles and registers in the duct system sealed.

(b) Visually inspect all accessible portions of the duct system during smoke injection.

(c) The system shall pass the test if one of the following conditions is met:

1. No visible smoke exits the accessible portions of the duct system.
2. Smoke only emanates from the furnace cabinet which is gasketed and sealed by the manufacturer and no visible smoke exits from the accessible portions of the duct system.

NA2.1.4.2.4 Visual Inspection of Accessible Duct Sealing

For altered existing duct systems that are unable to pass the leakage test in Section NA2.1.4.2.1, the objective of this inspection in conjunction with the smoke test (Section NA2.1.4.2.3) is to confirm that all accessible leaks have been sealed. Visually inspect to verify that the following locations have been sealed:

(a) Connections to plenums and other connections to the air-handling unit.

(b) Refrigerant line and other penetrations into the air-handling unit.

(c) Air handler access door or panel (do not use permanent sealing material, metal tape is acceptable).

(d) Register boots sealed to surrounding material.

(e) Connections between lengths of duct, as well as connections to takeoffs, wyes, tees, and splitter boxes.

NA2.2 Field Verification and Diagnostic Testing of Mechanical Ventilation Systems

NA2.2.1 Purpose and Scope

NA2.2. contains procedures for measuring the airflow in mechanical ventilation systems to confirm compliance with the requirements of ASHRAE 62.2.

NA2.2. is applicable to mechanical ventilation systems in low-rise residential buildings.

NA2.2. provides required procedures for installers, HERS raters and others who are required to perform field verification of mechanical ventilation systems for compliance with Part 6.

Table NA2.2--1 – Summary of Verification and Diagnostic procedures

Diagnostic	Description	Procedure
Dwelling-Unit Mechanical Ventilation Airflow – Continuous Operation	Verify that whole-building ventilation system complies with the airflow rate required by ASHRAE Standard 62.2.	NA2.2.4.1 Continuous Operation
Dwelling-Unit Mechanical Ventilation Airflow – Intermittent Operation	Verify that whole-building ventilation system complies with the airflow rate required by ASHRAE Standard 62.2.	NA2.2.4.2.Intermittent Operation

NA2.2.2 Instrumentation Specifications

The instrumentation for the air distribution diagnostic measurements shall conform to the following specifications:

NA2.2.2.1 Pressure Measurements

All pressure measurements shall be measured with measurement systems (i.e., sensor plus data acquisition system) having an accuracy equal to or better than ± 1% of pressure reading or ± 0.2 Pa (0.0008 inches water) (whichever is greater). All pressure measurements within the duct system shall be made with static pressure probes such as Dwyer A303 or equivalent.

NA2.2.2.2 Airflow Rate Measurements

All measurements of ventilation fan airflow rate shall be made with an airflow rate measurement apparatus (i.e., sensor plus data acquisition system) having an accuracy equal to or better than ± 10% of reading. The

apparatus shall have an accuracy specification that is applicable to the airflow rates that must be verified utilizing the procedures in Section NA2.2.4.

NA2.2.2.3 Calibration

All instrumentation used for mechanical ventilation system airflow rate diagnostic measurements shall be calibrated according to the manufacturer's calibration procedure to ensure the airflow measurement apparatus conforms to the accuracy requirement specified in Section NA2.2.2.2.

NA2.2.3 Diagnostic Apparatus for Measurement of Ventilation System Airflow

Ventilation system airflow rate shall be measured using one of the apparatuses listed in Section NA2.2.3. The apparatus shall produce airflow rate measurements that conform to the accuracy requirements specified in Section NA2.2.2 for measurements of high-rise residential mechanical ventilation system airflow at system grilles or registers for single or multiple branch ventilation duct systems.

The airflow rate measurement apparatus manufacturers shall publish in their product documentation, specifications for how their airflow measurement apparatuses are to be used for accurately measuring residential mechanical ventilation system airflow at system grilles or registers of single or multiple branch ventilation systems.

The airflow measurement apparatus manufacturers shall certify to the Energy Commission that use of the apparatus in accordance with the specifications given in the manufacturer's product documentation will produce measurement results that are within the accuracy required by Section NA2.2.2.2.

For the airflow measurement apparatuses that are certified to the Commission as meeting the accuracy required by Section NA2.2.2.2, the following information will be posted on the Energy Commission website, making the information available to all people involved in the airflow verification compliance process:

(a) The product manufacturers' model numbers for the airflow measurement apparatuses.

(b) The product manufacturers' product documentation that gives the specifications for use of the airflow measurement apparatuses to accurately measure high-rise residential mechanical ventilation system airflow at system grilles or registers of single or multiple branch ventilation systems.

A manufacturer's certification to the Commission of the accuracy of the airflow measurement apparatus, and submittal to the Commission of the product documentation that specifies the proper use of the airflow measurement apparatus to produce accurate airflow rate measurements shall be prerequisites for allowing the manufacturer's airflow measurement apparatus to be used for conducting the system airflow verification procedures in Section NA2.2 for demonstrating compliance with Part 6.

NA2.2.3.1 High-Rise Residential Mechanical Exhaust Airflow Measurement Device

A flowmeter that meets the applicable instrument accuracy specifications in NA2.2.2.2 shall be used to measure the mechanical exhaust airflow.

NA2.2.3.2 Powered Flow Capture Hood Airflow Measurement Device

A powered and pressure balanced flow capture hood (subsequently referred to as a Powered Flow Hood[1]) that has the capability to balance the flow capture static pressure difference between the room and the flow capture hood enclosure to 0.0 ± 0.2 Pa (0.0008 inches water) and meets the applicable instrumentation specifications in Section NA2.2.2.2 may be used to verify the ventilation airflow rate if the powered flow hood has a flow capture area at least as large as the ventilation system register/grille in all dimensions. The fan adjustment needed to balance the flow capture static pressure difference between the room and the

[1] Also known as "active" flow hood, or "fan assisted" flow hood.

flow capture hood enclosure to 0.0 ± 0.2 Pa (0.0008 inches water) shall be provided by either an automatic control or a manual control operated in accordance with the apparatus manufacturer's instructions specified in the manufacturer's product documentation.

NA2.2.3.3 Traditional Flow Capture Hood

A traditional flow capture hood[2] meeting the applicable instrumentation specifications in Section NA2.2.2.2 may be used to verify the ventilation system airflow rate if the non-powered flow hood has a capture area at least as large as the ventilation system register/grille in all dimensions.

NA2.2.4 Procedures

This section describes the procedures used to verify Mechanical ventilation system airflow.

NA2.2.4.1 Dwelling Unit Mechanical Ventilation Airflow Rate Measurement - Continuous Operation

NA2.2.4.1.1 Exhaust Ventilation Systems

A flow measuring device that meets the applicable instrumentation requirements of Section NA2.2.2.2 shall be used. If the measured airflow is equal to or greater than the value for the dwelling unit ventilation airflow rate required by Section 4 of ASHRAE Standard 62.2, the mechanical ventilation system complies with the requirement for dwelling unit mechanical ventilation airflow. If the measured airflow is less than the required dwelling unit ventilation airflow rate, the mechanical ventilation system does not comply, and corrective action shall be taken.

NA2.2.4.1.2 Supply Ventilation Systems

The Executive Director may approve supply mechanical ventilation systems, devices, or controls for use for compliance with the HERS Rater field verification and diagnostic testing requirement for dwelling unit mechanical ventilation airflow, subject to a manufacturer providing sufficient evidence to the Executive Director that the installed mechanical ventilation systems, devices, or controls will provide at least the minimum dwelling unit ventilation airflow required by ASHRAE Standard 62.2, and subject to consideration of the manufacturer's proposed field verification and diagnostic test protocol for these ventilation system(s).

Approved systems, devices, or controls, and field verification and diagnostic test protocols for Supply Ventilation Systems shall be listed in directories published by the Energy Commission.

NA2.2.4.2 Dwelling Unit Mechanical Ventilation Airflow Rate Measurement - Intermittent Operation

The Executive Director may approve intermittent mechanical ventilation systems, devices, or controls for use for compliance with the HERS Rater field verification and diagnostic testing requirement dwelling unit mechanical ventilation airflow, subject to a manufacturer providing sufficient evidence to the Executive Director that the installed mechanical ventilation systems, devices, or controls will provide at least the minimum dwelling unit ventilation airflow required by ASHRAE Standard 62.2, and subject to consideration of the manufacturer's proposed field verification and diagnostic test protocol for the ventilation system(s).

Approved systems, devices, or controls, and field verification and diagnostic test protocols for intermittent mechanical ventilation systems shall be listed in directories published by the Energy Commission.

NA2.2.4.3 Kitchen Range Hood Verification

The verification shall utilize certified rating data from the Home Ventilating Institute (HVI) Certified Home Ventilating Products Directory at https://hvi.org/proddirectory/index.cfm or another directory of certified

[2] Also known as “non-powered flow hood, "standard" flow hood, "commercially available" flow hood, or "passive" flow hood

product performance ratings approved by the Energy Commission for determining compliance. The verification procedure shall consist of visual inspection of the installed kitchen range hood to verify and record the following information:

(a) The manufacturer name and model number.

(b) The model is listed in the HVI Directory.

(c) The rated airflow value listed in the HVI directory complies with the airflow requirements specified in Standards Section 120.1(b)2Bii

(d) The sound rating listed in the HVI directory complies with the sound rating requirements specified in Standards Section 120.1(b)2Bii

NA2.3 Field Verification and Diagnostic Testing of Dwelling Unit Air Leakage

NA2.3.1 Purpose and Scope

The purpose of this test procedure is to measure the air leakage rate through a high-rise residential dwelling unit enclosures measured in cubic feet per minute at a 50 Pa pressure difference (CFM50). The measurement procedure described in this section is derived from Residential Energy Services Network's (RESNET) Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems (ANSI/RESNET/ICC 380-2016). This procedure requires the use of software consistent with ASTM E779-10. This test method is intended to produce a measure of the air tightness of a dwelling unit envelope for determining the envelope leakage for conformance with the maximum leakage specified in Section 120.1(b)2AvbI.

The procedure shall be used to verify the dwelling unit air leakage rate before the building construction permit is finalized.

(a) The Home Energy Rating System (HERS) rater shall measure the dwelling unit air leakage rate to ensure measured air leakage is less than or equal to the dwelling unit air leakage rate specified in Section 12.1(b)2AvbI. HERS verified dwelling unit air leakage shall be documented on compliance forms.

(b) For purposes of this procedure *Conditioned Space Boundary* is defined as: dwelling unit envelope

NA2.3.2 On-Site Inspection Protocol

The on-site inspection protocol shall be ANSI/RESNET/ICC 380-2016 with the following modifications:

NA2.3.2.1 One-Point Test:

The one-point air tightness test specified in Section 3.4.1 of the protocol shall be used. The multi-point test specified in Section 3.4.2 of the protocol shall not be used.

NA2.3.2.2 Resulting Values:

The adjustment specified in Section 3.5.1 shall not be performed. Equations 5a, 5b, and 6 shall not be used. Corrected CFM50 and CMS50 shall be used in place of Adjusted CFM50 and CMS50. ELA shall be used in place of Adjusted ELA.

NA2.3.3 Other Leakage Metrics:

Other metrics such as ACH50, SLA, and NLA may be calculated as specified in Section 3.5.2 of the protocol, using Corrected CFM50 and CMS50 in place of Adjusted CFM50 and CMS50.

NA2.3.4 Equipment Accuracy and Requirements

Equipment shall meet the specifications in Section 3.1 of the protocol.

Blower door and associated pressure testing instruments shall be tested annually for calibration by the HERS Provider or HERS rater. The HERS Provider or HERS rater shall use a standard for field testing of calibration provided by the equipment manufacturer. Magnehelic Gauges cannot be field tested and shall be recalibrated by the Blower Door manufacturer annually. Fan and flow measuring systems for shall be regularly field checked for defects and maintained according to manufacturers' recommendations. The HERS Provider or HERS rater shall maintain a written log of the annual calibration check to verify all equipment accuracy for a period of three (3) years. These records shall be made available to the Commission.

NA2.3.5 Air Leakage Reporting

The HERS rater shall compare the measured air leakage rate determined by Section RA 3.8.2 to the dwelling unit air leakage rate specified in Section 120.1(b)2AvbI. HERS verified building air leakage shall be documented on compliance forms.

Where: *Measured air leakage rate = Adjusted CFM50*

Table RA3.8-2- Temperature Correction Factors for Pressurization Testing- Calculated according to ASTM E779-10

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-20**	1.062	1.072	1.081	1.090	1.099	1.108	1.117	1.127	1.136
	-15	1.056	1.066	1.075	1.084	1.093	1.102	1.111	1.120	1.129
	-10	1.051	1.060	1.069	1.078	1.087	1.096	1.105	1.114	1.123
	-5	1.045	1.054	1.063	1.072	1.081	1.090	1.099	1.108	1.117
	0	1.039	1.048	1.057	1.066	1.075	1.084	1.093	1.102	1.111
	5	1.033	1.042	1.051	1.060	1.069	1.078	1.087	1.096	1.105
	10	1.028	1.037	1.046	1.055	1.064	1.072	1.081	1.090	1.099
	15	1.023	1.031	1.040	1.049	1.058	1.067	1.076	1.084	1.093
	20	1.017	1.026	1.035	1.044	1.052	1.061	1.070	1.079	1.087
	25	1.012	1.021	1.029	1.038	1.047	1.056	1.064	1.073	1.082
	30	1.007	1.015	1.024	1.033	1.041	1.050	1.059	1.067	1.076
	35	1.002	1.010	1.019	1.028	1.036	1.045	1.054	1.062	1.071
	40	0.997	1.005	1.014	1.023	1.031	1.040	1.048	1.057	1.065
	45	0.992	1.000	1.009	1.017	1.026	1.035	1.043	1.051	1.060
	50	0.987	0.995	1.004	1.012	1.021	1.029	1.038	1.046	1.055
	55	0.982	0.990	0.999	1.008	1.016	1.024	1.033	1.041	1.050
	60	0.997	0.986	0.994	1.003	1.011	1.019	1.028	1.036	1.045
	65	0.973	0.981	0.989	0.998	1.006	1.015	1.023	1.031	1.040
	70	0.968	0.976	0.985	0.993	1.001	1.010	1.018	1.026	1.035
	75	0.963	0.972	0.980	0.988	0.997	1.005	1.013	1.022	1.030
	80	0.959	0.967	0.976	0.984	0.992	1.000	1.009	1.017	1.025
	85	0.955	0.963	0.971	0.979	0.988	0.996	1.004	1.012	1.020
	90	0.950	0.958	0.967	0.975	0.983	0.991	0.999	1.008	1.016
	95	0.946	0.954	0.962	0.970	0.979	0.987	0.995	1.003	1.011
	100	0.942	0.950	0.958	0.966	0.970	0.982	0.990	0.998	1.007
	105	0.938	0.946	0.954	0.962	0.970	0.978	0.986	0.994	1.002
	110	0.933	0.942	0.950	0.952	0.966	0.974	0.982	0.990	0.998

CONTINUED: Table RA3.8-3 Temperature Correction Factors for Depressurization Testing- Calculated according to ASTM E779-10

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-20**	0.865	0.861	0.857	0.853	0.849	0.845	0.841	0.837	0.833
	-15	0.874	0.870	0.866	0.862	0.858	0.854	0.850	0.846	0.842
	-10	0.883	0.879	0.874	0.870	0.866	0.862	0.858	0.854	0.850
	-5	0.892	0.887	0.883	0.879	0.875	0.871	0.867	0.863	0.859
	0	0.900	0.896	0.892	0.887	0.883	0.879	0.875	0.871	0.867
	5	0.909	0.905	0.900	0.896	0.892	0.888	0.883	0.879	0.875
	10	0.918	0.913	0.909	0.905	0.900	0.896	0.892	0.888	0.884
	15	0.927	0.922	0.918	0.913	0.909	0.905	0.900	0.896	0.892
	20	0.935	0.931	0.926	0.922	09.17	0.913	0.909	0.905	0.900
	25	0.944	0.939	0.935	0.930	0.926	0.922	0.917	0.913	0.909
	30	0.952	0.948	0.943	0.939	0.934	0.930	0.926	0.921	0.917
	35	0.961	0.956	0.952	0.947	0.943	0.938	0.934	0.930	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	0.964	0.960	0.955	0.951	0.946	0.942
	50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955	0.950
	55	0.995	0.990	0.986	0.981	0.976	0.972	0.967	0.963	0.958
	60	1.004	0.999	0.994	0.998	0.985	0.980	0.976	0.971	0.967
	65	1.012	1.008	1.003	0.998	0.993	0.988	0.984	0.979	0.975
	70	1.021	1.016	1.011	1.006	1.001	0.997	0.992	0.988	0.983
	75	1.029	1.024	1.019	1.015	1.010	1.005	1.000	0.996	0.991
	80	1.038	1.033	1.028	1.023	1.018	1.013	1.009	1.004	0.999
	85	1.046	1.041	1.036	1.031	1.026	1.022	1.017	1.012	1.008
	90	1.055	1.050	1.045	1.040	1.035	1.030	1.025	1.020	1.016
	95	1.063	1.058	1.053	1.048	1.043	1.038	1.033	1.028	1.024
	100	1.072	1.066	1.061	1.056	1.051	1.046	1.041	1.037	1.032
	105	1.080	1.075	1.070	1.064	1.059	1.054	1.050	1.045	1.040
	110	1.088	1.083	1.078	1.073	1.068	1.063	1.058	1.053	1.048

Nonresidential Appendix NA3

Appendix NA3 – Fan Motor Efficiencies

Table NA3-1 – Fan Motor Efficiencies (< 1 HP)

Nameplate or Brake Horsepower	Standard Fan Motor Efficiency	NEMA* High Efficiency	Premium Efficiency
1/20	40%	...	...
1/12	49%	...	...
1/8	55%	...	...
1/6	60%	...	...
1/4	64%	...	...
1/3	66%	...	...
1/2	70%	76.0%	80.0%
3/4	72%	77.0%	84.0%
NOTE: For default drive efficiencies, see Nonresidential ACM Reference Manual			
*NEMA - Proposed standard using test procedures.			
Minimum NEMA efficiency as specified by test IEEE 112b Rating Method.			

Table NA3-2 – Fan Motor Efficiencies (1 HP and over)

	Open Motors				Enclosed Motors			
Motor Horsepower	2 pole 3600 rpm	4 pole 1800 rpm	6 pole 1200 rpm	8 pole 900 rpm	2 pole 3600 rpm	4 pole 1800 rpm	6 pole 1200 rpm	8 pole 900 rpm
1	77.0	85.5	82.5	74.0	77.0	85.5	82.5	74.0
1.5	84.0	86.5	86.5	75.5	84.0	86.5	87.5	77.0
2	85.5	86.5	87.5	85.5	85.5	86.5	88.5	82.5
3	85.5	89.5	88.5	86.5	86.5	89.5	89.5	84.0
5	86.5	89.5	89.5	87.5	88.5	89.5	89.5	85.5
7.5	88.5	91.0	90.2	88.5	89.5	91.7	91.0	85.5
10	89.5	91.7	91.7	89.5	90.2	91.7	91.0	88.5
15	90.2	93.0	91.7	89.5	91.0	92.4	91.7	88.5
20	91.0	93.0	92.4	90.2	91.0	93.0	91.7	89.5
25	91.7	93.6	93.0	90.2	91.7	93.6	93.0	89.5
30	91.7	94.1	93.6	91.0	91.7	93.6	93.0	91.0
40	92.4	94.1	94.1	91.0	92.4	94.1	94.1	91.0
50	93.0	94.5	94.1	91.7	93.0	94.5	94.1	91.7
60	93.6	95.0	94.5	92.4	93.6	95.0	94.5	91.7
75	93.6	95.0	94.5	93.6	93.6	95.4	94.5	93.0
100	93.6	95.4	95.0	93.6	94.1	95.4	95.0	93.0
125	94.1	95.4	95.0	93.6	95.0	95.4	95.0	93.6
150	94.1	95.8	95.4	93.6	95.0	95.8	95.8	93.6
200	95.0	95.8	95.4	93.6	95.4	96.2	95.8	94.1
250	95.0	95.8	95.4	94.5	95.8	96.2	95.8	94.5
300	95.4	95.8	95.4		95.8	96.2	95.8	
350	95.4	95.8	95.4		95.8	96.2	95.8	—
400	95.8	95.8	95.8		95.8	96.2	95.8	
450	95.8	96.2	96.2		95.8	96.2	95.8	
500	95.8	96.2	96.2		95.8	96.2	95.8	

Nonresidential Appendix NA4

Appendix NA4 – Compliance Procedures for Relocatable Public School Buildings

NA4.1 Purpose and Scope

This document describes the compliance procedures that shall be followed when the whole building performance approach is used for relocatable public school buildings. Relocatable public school buildings are constructed (manufactured) at a central location and could be shipped and installed in any California climate zone. Furthermore, once they arrive at the school site, they could be positioned so that the windows face in any direction. The portable nature of relocatable classrooms requires that a special procedure be followed for showing compliance when the whole building performance method is used. Compliance documentation for relocatable public school buildings will be reviewed by the Division of the State Architect (DSA).

NA4.2 The Plan Check Process

The Division of the State Architect is the enforcement agency for relocatable public school buildings. Since relocatables are manufactured in batches, like cars or other manufactured products, the plan check and approval process occurs in two phases. The first phase is when the relocatable manufacturer completes design of a model or modifies a model. At this point, complete plans and specifications are submitted to the DSA; DSA reviews the plans for compliance with the energy standards and other California Building Code (CBC) requirements; and a “pre-check” (PC) design approval is granted. Once the PC design is approved, a school district or the manufacturer may file an “over-the-counter” application with DSA to construct one or more relocatables. The over-the-counter application is intended to be reviewed quickly, since the PC design has already been pre-checked. The over-the-counter application is the building permit application for construction and installation of a relocatable at a specific site, and includes the approved PC design drawings as well as site development plans for the proposed site where the relocatable will be installed. An over-the-counter application also is required for the construction of a stockpile of one or more relocatables based on the approved PC design drawings. Stockpiled relocatables are stored typically at the manufacturer’s yard until the actual school site is determined where the relocatable will be installed. Another over-the-counter application is required to install a previously stockpiled relocatable at which time site development plans for the proposed site are checked.

The effective date for all buildings subject to the energy standards is the date of permit application. If a building permit application is submitted on or after the effective date, then the new energy standards apply. For relocatable classrooms, the date of the permit application is the date of the over-the-counter

application, not the date of the application for PC design approval. The PC design is only valid until the code changes.

NA4.3 The Compliance Process

Like other nonresidential buildings, the standard design for relocatable public school buildings is defined by the prescriptive requirements. In the case of relocatables, there are two choices of prescriptive criteria:

(a) Table 140.3-D in the Standards may be used for relocatable school buildings that can be installed in any climate zone in the state. In this case, the compliance is demonstrated in climates 14, 15, and 16 and this is accepted as evidence that the classroom will comply in all climate zones. These relocatables will have a permanent label that allows it to be used anywhere in the state as specified in Section 140.3(a)8 of the Standards.

(b) Table 140.3-B in the Standards may be used for relocatable school buildings that are to be installed in only specific climate zones. In this case, compliance is demonstrated in each climate zone for which the relocatable has been designed to comply. These relocatables will have a permanent label that identifies in which climate zones it may be installed as specified in Section 140.3(a)8 in the Standards. It is not lawful to install the relocatable in other climate zones.

The building envelope of the standard design has the same geometry as the proposed design, including window area and position of windows on the exterior walls, and meets the prescriptive requirements specified in Section 140.3. Lighting power for the standard design meets the prescriptive requirements specified in Section 140.6. The HVAC system for the standard design meets the prescriptive requirements specified in Section 140.4. The system typically installed in relocatables is a single-zone packaged heat pump or furnace. Most relocatable school buildings do not have water heating systems, so this component is neutral in the analysis. Other modeling assumptions such as equipment loads are the same for both the proposed design and the standard design and are specified in the Nonresidential ACM Reference Manual.

Manufacturers shall certify compliance with the standards and all compliance documentation shall be provided. If the manufacturer chooses to comply using Table 140.3-B in the Standards for compliance in only specific climate zones, then the manufacturers shall indicate the climates zones for which the classroom will be allowed to be located as specified in Section 140.3(a)8 of the Standards.

Since relocatable public school buildings could be positioned in any orientation, it is necessary to perform compliance calculations for multiple orientations. Each model with the same proposed design energy features shall be rotated through 8 different orientations either in climate zones 14, 15 and 16 for relocatables showing statewide compliance or in the specific climate zones that the manufacturer proposes for the relocatable to be allowed to be installed, i.e., the building with the same proposed design energy features is rotated in 45 degree increments and shall comply in each case. Approved compliance programs shall automate the rotation of the building and reporting of the compliance results to insure it is done correctly and uniformly and to avoid unnecessary documentation.

NA4.4 Documentation

The program shall present the results of the compliance calculations in a format similar to Table NA4-3. For each of the cases (8orientations times number of climates), the Time Dependent Valuation (TDV) energy for the *Standard Design* and the *Proposed Design* are shown (the energy features of the *Proposed Design* shall be the same for all orientations). The final column shows the compliance margin, which is the difference between the TDV energy for the *Proposed Design* and the *Standard Design*. Approved compliance programs shall scan the data presented in the Table NA4-3 format and prominently highlight the case that has the smallest compliance margin. Complete compliance documentation shall be submitted for the building and energy features that achieve compliance in all of the climate zones and orientations as represented by the case with the smallest margin. DSA may require that compliance documentation for other cases also be submitted; showing that the *Proposed Design* building and energy features are identical to the case submitted, in each orientation and climate zone. Table NA4-3 shows rows for climate zones 14, 15, and 16, which are the ones used when the criteria of Table 140.3-D in the Standards is used to show compliance throughout the state. If the criteria of Table 140.3-B in the Standards is used, then rows shall be

added to the table for each climate zone for which the manufacturer wants the relocatable to be allowed to be installed.

Table NA4-3 – Summary of Compliance Calculations Needed for Relocatable Classrooms

			TDV Energy	
Climate Zone	Azimuth	Proposed Design	Standard Design	Compliance Margin
14	30			
	75			
	120			
	165			
	210			
	255			
	300			
	345			
15	30			
	75			
	120			
	165			
	210			
	255			
	300			
	345			
16	30			
	75			
	120			
	165			
	210			
	255			
	300			
	345			

NA4.5 Optional Features

Relocatable classrooms may come with a variety of optional features, like cars. A school district can buy the "basic model" or it can pay for options. Many of the optional features do not affect energy efficiency and are not significant from the perspective of energy code compliance. Examples include floor finishes (various grades of carpet or tiles), casework, and ceiling and wall finishes. Other optional features do affect energy performance such as window construction, insulation, lighting systems, lighting controls, HVAC ductwork, HVAC equipment, and HVAC controls.

When a manufacturer offers a relocatable classroom model with a variety of options, it is necessary to identify those options that affect energy performance and to show that the model complies with any combination of the optional features. Most of the time, optional energy features are upgrades that clearly improve performance. If the basic model complies with the Standards, then adding any or all of the optional features would improve performance. The following are examples of optional features that are clear upgrades in terms of energy performance:

(a) HVAC equipment that has both a higher SEER and higher EER than the equipment in the basic model.

(b) Lighting systems that result in less power than the basic model.

(c) Lighting controls, such as occupancy sensors, that are recognized by the standards and for which power adjustment factors in Table 140.6-A are published in Section 140.6.

(d) Windows that have both a lower SHGC and lower U-factor (limited to relocatables that do not take credit for daylighting).

(e) Wall, roof or floor construction options that result in a lower U-factor than the basic model.

For energy code compliance purposes, it is necessary to show that every variation of the relocatable classroom that is offered to customers will comply with the Standards. There are two approaches for achieving this, as defined below:

1. **Basic Model Plus Energy Upgrades Approach.** The simplest approach is to show that the basic model complies with the Standards and that all of the options that are offered to customers are clear energy upgrades that would only improve performance. As long as each and every measure in the basic model is met or exceeded by the energy upgrades, the relocatable classroom will comply with the Standards.

   While clear upgrades are obvious in most cases, the following are some examples of options that are not energy upgrades, for which additional analysis would be needed to show compliance that every combination of options comply.

   (a) HVAC equipment that has a higher SEER, but a lower EER.

   (b) Windows that lower SHGC but increase U-factor, or vice versa.

   (c) Insulation options that reduce the U-factor for say walls, but increase it for the roof.

   (d) Any other combination of measures that results in the performance of anyone measure being reduced in comparison to a complying basic model.

2. **Modeling of Every Combination Approach.** A more complex whole building performance approach is required when a model is available with options which in combination may or may not comply. In this case every combination of options shall be modeled, and the specific combinations that comply shall be determined and only those combinations shall be allowed. This approach, while possible, requires considerably more effort on the part of the relocatable manufacturer and its energy consultant. It also places a greater burden on DSA when they issue the over-the-counter building permit for the PC design that only allows specific combinations of energy options. DSA would have to examine the specific optional features that are proposed with the over-the-counter application and make sure that the proposed combination of measures achieves compliance.

   The manufacturer or its energy consultant would need to prepare a table or chart that shows all of the acceptable combinations that achieve compliance. This chart could be quite complex, depending on the number of optional features that are offered.

   Table NA4-4 is intended to illustrate the complexity that could be involved in modeling of every combination of energy features. It shows a list of typical optional features that would affect energy performance. In this example, there are two possible for each of the eight options, e.g. the feature is either there or not (in an actual case there could be a different number of options and a different number of states for any option). In the example any one of the features could be combined with any of the others. The number of possible combinations in this example is two (the number of states) to the eighth power (the number of measures that have two states). The number of possible options is then 2^8 or 256. This is the number of combinations that would need to be modeled in order to determine which combination of optional features achieves compliance.

Table NA4-4 – Examples of Optional Features for Relocatable Classrooms

	Options Offered	States
1	Efficient lighting option	Yes/No
2	High efficiency heat pump	Yes/No
3	Improved wall insulation	Yes/No
4	Improved roof insulation	Yes/No
5	Occupancy sensor for lighting	Yes/No
6	Low-e windows	Yes/No
7	Skylights	Yes/No
8	Daylighting Controls	Yes/No

Nonresidential Appendix NA5

RESERVED

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Nonresidential Appendix NA6

Appendix NA6 – Alternate Default Fenestration Procedure to Calculate Thermal Performance

NA6.1 Scope

This procedure provides for non-rated site-built fenestration up to 1,000 ft^2 (other than a repair or replacement glass) an option to comply with the Energy Standards. The Center of Glass (COG) values are required to be used in Equation NA6-1, NA6-2 and NA6-3 and shall be determined by the manufacturers in accordance with NFRC procedures. A copy of the manufacturer cut sheets or data sheet shall be provided identifying the COG values as an attachment with the Fenestration Certificate (FC-1).

(a) NONRESIDENTIAL

For Nonresidential site-built fenestration up to1,000 ft² in area, other than existing, repair or replacement glass, the Alternate Default Fenestration Procedure shall be used when no NFRC Label Certificate is available. The manufacturer cut sheet or data sheet shall be used to identify the COG values for the U-factor, Solar Heat Gain Coefficient ($SHGC_C$) and Visible Transmittance (VT_C). If unable to determine center of glass information, the alternative Energy Commissions Default Tables in Section 110.6 of the Energy Standards must be used to determine the appropriate fenestration default values. The values listed in Table 110.6-A for U-factors and Table 110.6-B for SHGC values are whole fenestration product values. Since there is no default Visible Transmittance value available, the alternative is VT_C =1.0; this will be used to determine the total fenestration product, VT_T, which includes the glass and frame of the fenestration.

For Nonresidential, the altered fenestration (other than a repair) shall meet the values listed in Table 141.0-A unless the altered glass area meets the Exception to Section 140.1(b)2A in the Energy Standards. If the altered fenestration or glass alone is not rated by NFRC then the Alternate Default Fenestration Procedure can be used similar to Nonresidential up to 1,000 ft² as described above.

(b) RESIDENTIAL

For Residential cases, the Alternate Default Fenestration Procedure option is available only when nonrated site-built fenestration is being installed in a residential dwelling. For Residential site-built fenestration up to 250 ft² in area or 5% times the conditioned floor area (CFA), whichever is greater shall meet Sections §110.6(a)2 and §110.6(a)3.

The Alternate Default Fenestration calculated values are typically less efficient than those listed in the Prescriptive Approach in Table 150.1-A and Table 150.1-B of the Energy Standards. The Visible Transmittance (VT) value is not required to meet residential energy compliance. If unable to acquire center of glass (COG) thermal performance values from the manufacturer, then the Energy Commissions Default Tables shall be used; Table 110.6-A for U-factors and Table 110.6-B for SHGC values and documented on the on a self-produced manufactured default label. The default label shall be attached to the unrated fenestration product. An example of the label can be found in the Residential Compliance Manual.

(c) DOCUMENTATION

1. The Energy Commission's FC-1 Label Certificate Form for nonresidential application shall be used to document the Alternate Default Fenestration calculated values for each non-rated site-built fenestration unit; or
2. For residential, a manufactured Default Label attached to each non-rated site-built fenestration unit.

The equations listed below are to be used for only for unrated site-built fenestration that meets the requirements in either item 1 or 2 above.

NA6.2 Default U-factor

Equation NA6-1

$$U_T = C_1 + (C_2 \times U_c)$$

Where:

U_T = U-factor Is the Total Performance of the fenestration including glass and frame

C_1 = Coefficient selected from Table NA6-5~~Table NA6-5~~

C_2 = Coefficient selected from Table NA6-5~~Table NA6-5~~

U_C = Center of glass U-factor calculated in accordance with NFRC 100 Section 4.5.3.1 http://www.nfrc.org/software.aspx

Table NA6-5 – U-factor Coefficients

Product Type	Frame Type	C_1	C_2
Site-Built Vertical Fenestration	Metal	0.311	0.872
	Metal Thermal Break	0.202	0.867
	Non-Metal	0.202	0.867
Skylights with a Curb	Metal	0.711	1.065
	Metal Thermal Break	0.437	1.229
	Non-Metal	0.437	1.229
Skylights with no Curb (Deck Mounted)	Metal	0.~~195~~310	0.~~882~~878
	Metal Thermal Break	0.~~310~~195	0.~~878~~882
	Non-Metal	0.310	0.878

NA6.3 Default Solar Heat Gain Coefficient, SHGC

The SHGC of the fenestration product shall be calculated using the following equation:

Equation NA6-2

$$SHGC_T = 0.08 + (0.86 \times SHGC_c)$$

Where:

$SHGC_T$ = SHGC Is the Total Performance of the fenestration including glass and frame

$SHGC_C$ = Center of glass SHGC calculated in accordance with NFRC 200 Section 4.5.1.1 http://www.nfrc.org/software.aspx

NA6.4 Default Visible Transmittance, VT

(a) Equation NA6-3 - VT of Center of Glass (COG) calculation

$$VT_T = VT_F \times VT_C$$

Where:

VT_T = Is the Total Performance of the fenestration including glass and frame

VT_F = 0.53 for projecting windows, such as casement and awning windows

VT_F = 0.67 for operable or sliding windows

VT_F = 0.77 for fixed or non operable windows

VT_F= 0.88 for curtain wall/storefront, Site-built and manufactured non-curb mounted skylights

VT_F = 1.0 for Curb Mounted manufactured Skylights

VT_C = Center of glass VT is calculated in accordance with NFRC 200 Section 4.5.1.1 or NFRC 202 for Translucent Products or NFRC 203 for Tubular Daylighting Devices and Hybrid Tubular Daylighting Devices or ASTM E972 http://www.nfrc.org/software.aspx

NA6.5 Responsibilities for Compliance

This section describes the responsibilities of energy consultants, designers, architects, builders, installers, and enforcement agencies when using the procedures of this appendix.

NA6.5.1 Energy Consultants, Designers, Architects

The person with responsibility for preparing the compliance documentation shall establish the inputs from the following:

(a) The center of glass U-factor, SHGC and VT shall be taken from manufacturers' literature and determined using methods consistent with NFRC 100, NFRC 200, NFRC 202 and NFRC 203 procedures.

(b) The frame type (Metal, Metal Thermal Break, Non-metal) shall be verified from manufacturers' literature and through observations of frame sections provided by the manufacturer.

For the Prescriptive Overall Compliance Method, the calculated values shall be entered on the prescriptive ENV-1-C form. In addition the FC-1 Label Certificate must be also filled and located at the project site location in according to Reference Nonresidential Appendix NA7.

For the Performance Compliance Approach, the calculated values shall be entered and documented on the Performance PERF-1 and Performance ENV-1-C forms. In addition the FC-1 Label Certificate must be filled and located at the project site location in according to Reference Nonresidential Appendix NA7.

For both the prescriptive and performance compliance method, the building plans shall contain a window schedule that lists the calculated values in which matches the FC-1 Form or improved thermal performance values than listed on the FC-1 Form. The specifications of the windows shall be consistent with the values used in this procedure, e.g. frame type glazing product, etc.

Permit applications must include fenestration U-factor, SHGC and VT values documentation for the building plan checker. This documentation must include a copy of the manufacturer's documentation showing the Glazing Type information (center of glass U-factor, center of glass SHGC, center of glass VT, number of panes, coatings and the frame type (frame material type, presence of thermal breaks, and identification of structural glazing (glazing with no frame)) that is used to determine U_T, $SHGC_T$, and VT_T. If the proposed design uses multiple fenestration products, manufacturer's documentation for each fenestration product shall be attached to the plans. Manufacturer's documentation must be provided for each unique combination of glazing and frame used for compliance and shall be located at the project's location.

If mixed fenestration is included in the compliance analysis, then the compliance submittal must clearly identify which are certified fenestration products, and which are non-certified fenestration products. Non-certified fenestration products are limited to less than 1,000 ft² for commercial buildings or up to 250 ft² in area or 0.5% of the CFA, whichever is greater, for residential buildings. The manufacturer's documentation and calculations for each product must be included in the submittal, and either the ENV-1C or PERF-1 form must be included on the building plans. All non-certified fenestration products, including skylights,require a completed FC-1.

NA6.5.2 Builder and Installer Responsibilities

The builder must ensure that the fenestration (glass and frame) documentation showing the U factor, SHGC, and VT used for determining compliance is provided to the installer. The builder is responsible for ensuring that the persons preparing compliance documentation are specifying products the builder intends to install. The builder is responsible for ensuring that the installer installs glass with thermal performance equal to or better than the thermal performance used for energy compliance and that the frame type installed is the same as that used for compliance. The builder also must ensure that the field inspector for the enforcement agency is provided with manufacturer's documentation attached to each Energy Commission's FC-1 Label Certificate showing the thermal performance and method of determining thermal performance for the actual fenestration products installed. The builder should verify that these fenestration products are clearly shown on the building plans before fenestration products are purchased and installed. A copy of the manufacturer's documentation and FC-1 shall be located at the project location.

NA6.5.3 Enforcement Agency Responsibilities

NA6.5.3.1 Plan Checker

The enforcement agency plan checker or reviewer is responsible for ensuring that the plans identify all site-built fenestration and skylights occasionally residential site-built fenestration will be used and also identified on the FC-1 Form. The plan checker shall ensure that site-built fenestration and skylights using the alternate default procedure shall meet the following:

(a) Confirm that U-factors, SHGC and VT (for Commercial use only) values are clearly shown on the window schedules on the plans and documented on the energy compliance forms, and

(b) Confirm that manufacturer documentation of the Glazing Type and Frame Type has been provided for the each of the fenestration products using the procedure of this appendix and documents the Center of Glass values; and

(c) Verify the building meets the non-certified fenestration requirement (less than 1,000 ft² for commercial, or up to 250 ft² in area or 0.5% of the CFA whichever is greater for Residential); and

(d) For Nonresidential, confirm that an FC-1 Label Certificate has been completed for each non-rated site-built fenestration product, or for Residential, verify that the non-rated site-built fenestration efficiencies match the building plans and energy compliance forms.

NA6.5.3.2 Enforcement Agency Inspector

(a) For Residential up to 250 ft² in area or 0.5% of the CFA, whichever is greater, of non-rated site-built fenestration is allowed. The inspector should verify the manufacturer's label attached to each residential site-built fenestration product to ensure that it matches with residential energy compliance forms.

(b) For Nonresidential no greater than 1,000 ft² of site-built fenestration is allowed for this alternative procedure. The field inspector is responsible for ensuring that the U-factor, SHGC and VT for the installed fenestration match the building plans and energy compliance forms. Inspection of the Commission's FC-1 Label Certificate shall match each of the Prescriptive ENV form or the Performance PERF and ENV forms for the installed site-built fenestration product.

Nonresidential Appendix NA7

Appendix NA7 – Installation and Acceptance Requirements for Nonresidential Buildings and Covered Processes

NA7.1 Purpose and Scope

This appendix defines acceptance procedures that must be completed on certain controls and equipment before the installation is deemed to be in compliance with the Standards. These requirements apply to all newly installed equipment for which there are acceptance requirements in new and existing buildings. The procedures apply to nonresidential, high-rise residential, hotel/motel buildings and covered processes as defined by the California Energy Commission's Energy Efficiency Standards for Nonresidential Buildings (Standards). The purpose of the acceptance tests is to assure:

(a) The presence of equipment or building components according to the specifications in the compliance documents.

(b) Installation quality and proper functioning of the controls and equipment to meet the intent of the design and the Standards.

Modifications and additions to these acceptance requirements needed to improve clarity or to better ensure proper installation and functionality may be approved by the Energy Commission.

NA7.2 Introduction

Acceptance requirements are defined as implementation of targeted inspection checks and functional and performance testing to determine whether specific building components, equipment, systems, and interfaces between systems conform to the criteria set forth in the Standards and to related construction documents (plans or specifications). Acceptance requirements improve code compliance effectiveness and help meet the expected level of performance.

Acceptance testing is not intended to take the place of commissioning or test and balance procedures that a building owner might incorporate into a building project. It is an adjunct process focusing only on demonstrating compliance with the Standards.

Third-party review of the information provided on Certificate of Acceptance documentation is not required, with one exception: duct leakage diagnostic test results for some constant volume space conditioning systems serving less than 5,000 square feet of conditioned floor area are required to be verified by a certified HERS Rater as specified in Standards Section 140.4(l)1.

NA7.3 Roles and Responsibilities

Individuals who perform the field testing and verification work, and provide the information required for completion of the Certificate of Acceptance documentation are not required to be licensed professionals. The person who signs the Certificate of Acceptance document to certify compliance with the acceptance requirements shall be licensed as specified in Standards Section 10-103(a)4.

NA7.3.1 Responsible Person

The Certificate of Acceptance shall be signed by the person who is in charge of the acceptance testing for the scope of work identified on the Certificate of Acceptance. The *Responsible Person* shall be a licensed professional who is eligible under Division 3 of the Business and Professions code in the applicable classification, to take responsibility for the aspects of the system design, construction, or installation applicable to the scope of work identified on the Certificate of Acceptance. The *Responsible Person* shall review the information on the Certificate of Acceptance document and sign the document to certify compliance with the acceptance requirements. The *Responsible Person* shall assume responsibility for the acceptance testing work performed by the *Field Technician* agent(s) or employee(s), and if necessary shall interview the person who performed the acceptance test work in order to ascertain whether the testing work reported on the Certificate of Acceptance was completed as reported and is consistent with the *Responsible Person's* expectation. The *Responsible Person* may also perform the required acceptance testing work, and in that case shall also sign as the *Field Technician* on the Certificate of Acceptance document.

NA7.3.2 Field Technician

The *Field Technician* is responsible for performing the acceptance test procedures and documenting the results on the Certificate of Acceptance document. The *Field Technician* shall sign the Certificate of Acceptance to certify that the information provided on the Certificate of Acceptance is true and correct.

NA7.3.3 Documentation Author

Documentation Authors who provide administrative support for document preparation for Certificate of Acceptance documentation shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete.

NA7.3.4 Enforcement Agency

The Certificate of Acceptance shall be submitted to the enforcement agency in order to receive the final Certificate of Occupancy. The enforcement agency shall have the authority to require the *Responsible Person* and *Field Technician* to demonstrate competence, to its satisfaction.

NA7.4 Building Envelope Acceptance Tests

NA7.4.1 Fenestration

(a) Each fenestration product shall provide an NFRC Label Certificate or the Commission's Fenestration Certificate, FC-1, to identify the thermal performance (e.g. U-factor, SHGC, and VT) of each fenestration product being installed. The labels shall be located at the job site for verification by the enforcement agency. In addition, the responsible party shall fill out the Fenestration Acceptance Certificate. The responsible party shall verify the thermal performance of each specified fenestration product being installed matches the label certificate, energy compliance documentation and building plans. A copy of the certificate shall be given to the building owner and the enforcement agency for their records.

NA7.4.1.1 Elements Requiring Verification:

The responsible party shall verify the following:

(a) The thermal performance for each fenestration product matches the building plans, energy compliance documentation, and the label certificate; and

(b) The delivery receipt or purchase order matches the delivered fenestration product(s); and

(c) Verify the NFRC Label Certificate is filled out and includes an NFRC's Certified Product Directory (CPD) number and a Certificate Number (when the Component Modeling Approach Label is submitted).

(d) For non-rated fenestration verify FC-1 is completely filled.

(e) The Certificate of Acceptance form is completed and signed.

NA7.4.1.2 Required Documentation

(a) NFRC Product Label Certificate:

1. The Component Modeling Approach (CMA) Label Certificate can list a single or multiple fenestration products, each with its own CPD number on the left column and verified for authenticity by contacting NFRC or
2. The Certificate Number for each CMA Label Certificate can be verified for authenticity by contacting NFRC or
3. Commission's Fenestration Label Certificate:
4. The FC-1 are used to document Fenestration products not certified or rated by NFRC by using the Commission's Default Table values in §110.6- A and Table 110.6-B or the calculated values as indicated Nonresidential Appendix NA6.

(b) Purchase Order or Receipt:

1. A copy of the purchase order or a detailed payment receipt shall be used to cross reference with the NFRC Product Label Certificate CPD number or the FC-1 values; and
2. The purchase order or a detailed payment receipt should match the energy compliance documentation and the building plans.

(c) Fenestration Building Plans:

1. The building plans shall list in a schedule for each fenestration product to be installed in the building.

(d) Certificate of Acceptance Form:

1. The acceptance form shall be filled out by the responsible party and signed; and
2. The signed Certificate of Acceptance shall be submitted to enforcement agency or field inspector; and
3. A copy of the Certificate of Acceptance shall be given to the building owner.

NA7.4.2 Window Films

NA7.4.2.1 Procedures

These procedures detail the installation and verification protocols necessary to meet acceptance requirements of window films. Each window film product shall be provided with a temporary NFRC Label on the box to identify the thermal performance (e.g. U-factor, Solar Heat Gain Coefficient(SHGC), and Visible Transmittance (VT)) of each window film product being installed. The labels, an Energy Commission Default FC-1 form or an NFRC label, shall be located at the job site for verification by the enforcement agency. In addition, the responsible person shall fill out the Installation Certificate (ENV-INST) and the Certificate of Acceptance (ENV-2A), Fenestration Acceptance Certificate. The responsible person shall verify the thermal performance of each window film to be installed matches the energy Certificate of Compliance (ENV-1C) documentation and building plans. A copy of the Installation and Acceptance certificate shall be given to the building owner and the enforcement agency for their records.

NA7.4.2.2 The Responsible Person or Installer Shall Meet the Following Protocols before Installation:

(a) Verify the name of the manufacture or brand name matches with building plans;

(b) From the building plans or energy compliance forms, identify the azimuth orientation in degrees or in cardinal orientation for each of the window film to be installed to ensure the correct window film specifications are installed in the appropriate orientation;

(c) Verify the temporary NFRC label on the box for each window film's U-factor, Solar Heat Gain (SHGC) and Visible Transmittance (VT) matches the energy compliance ENV-1C documentation and building plans, if the U-factor and SHGC values do not match refer back to the Responsible Person of the building construction or enforcement agency. Energy recompliance may have to be done and building plans updated;

(d) Verify the NFRC Window Film Label Certificate is filled out and includes an NFRC's Certified Product Directory (CPD) number;

(e) List the NFRC Certified Product Directory (CPD) identification (ID) number provided on the label on the ENV-INST form;

(f) If no NFRC Label is included on the box or identification of the window film then verify with the Responsible Person of the building construction or enforcement agency to ensure the window film is actually meets or exceeds the energy specifications before installation;

(g) Installation of window films shall follow the **International Window Film Association** (IWFA) Visual Quality Standards for Applied Window Film (dated May 15, 1999); and

(h) After the installation the installer completes and signs the Declaration Statement on the Installation Certificate ENV-INST. A signed copy of the ENV-INST Certificate(s) shall remain at the job site for verification by the building inspector.

NA7.4.2.3 Field Technician or Responsible Person Shall Meet the Following Protocols After Installation:

(a) Verify the Installation Certificate ENV-INST and the Declaration Statement is signed before inspection; and

(b) The window film(s) label on the box matches the ENV-INST and building plan's schedule, U-factor, SHGC, and VT for each of the installed window films; and

(c) If any of the acceptance procedures (ENV-2A) fails, refer back to the Responsible Person, Installer, or the enforcement agency for correction; and, after correction verify failed procedures have been corrected and re-inspect again; and

(d) After window film inspection, complete all parts of the ENV-2A, including the signature of the Declaration Statements; and

(e) Provide certificates and additional copies to the builder, enforcement agency and building owner at occupancy.

NA7.4.2.4 Documentation at Occupancy:

The following documentation shall be made available to the responsible party of construction or building owner at occupancy;

(a) A completed and signed ENV-INST and ENV-2A, form(s);

(b) The IWFA Visual Quality Standards for Applied Window Film (dated May 15, 1999), a copy can be obtained through www.iwfa.com;

(c) A sample (8" by 10") of the film installed with a copy of its Performance Specification Sheet attached; and

1. A 10 or more year Warranty Certificate(s).

NA7.4.3 Dynamic Glazing

NA7.4.3.1 Procedures

These procedures detail the installation and verification protocols necessary to meet acceptance requirements of dynamic glazing. Each dynamic glazing product shall be provided with a temporary NFRC Label on the glazing or an NFRC Label Certificate to identify the thermal performance (e.g. U-factor, Solar Heat Gain Coefficient(SHGC), and Visible Transmittance (VT)) of each product being installed. The NFRC label certificate shall be located at the job site for verification by the enforcement agency. In addition, the responsible person shall fill out the Installation Certificate (ENV-INST) and the Certificate of Acceptance (ENV-2A), Fenestration Acceptance Certificate. The responsible person shall verify 1) the dynamic glazing to be installed matches the energy Certificate of Compliance (ENV-1C) documentation and building plans. A copy of the Installation and Acceptance certificate shall be given to the building owner and the enforcement agency for their records.

NA7.4.3.2 The Responsible Person or Installer Shall Meet the Following Protocols before Installation:

(a) Verify the dynamic glazing matches with building plans and Energy Compliance forms;

(b) From the building plans or energy compliance forms, identify the azimuth orientation in degrees or in cardinal orientation for each of the dynamic glazing to be installed to ensure the correct dynamic glazing specifications or model are installed in the appropriate orientation;

(c) Verify dynamic glazing controls if applicable matches the building plans schedule;

(d) Verify NFRC's Certified Product Directory (CPD) number if applicable;

(e) If no NFRC Label Form is included, then the default values of Table 110.6-A and 110.6-B in Section 110.6 of the Standards are being specified;

(f) Installation of dynamic glazing shall meet the manufactures installation instructions;

(g) After the installation the installer completes and signs the Declaration Statement on the Installation Certificate ENV-INST. A signed copy of the ENV-INST Certificate(s) shall remain at the job site for verification by the building inspector.

NA7.4.3.3 Field Technician or Responsible Person Shall Meet the Following Protocols After Installation:

(a) Verify the Installation Certificate ENV-INST and the Declaration Statement is signed before inspection of the installation; and

(b) When controls are installed with the dynamic glazing, it should be verified that it meets the exact operation specifications of the dynamic glazing installation, functional and testing instructions.

(c) After dynamic glazing inspection is complete ensure the ENV-2A certificate form is completed and including the signature of the Declaration Statements; and

(d) Provide certificates and additional copies to the builder, enforcement agency and building owner at occupancy.

NA7.4.3.4 Documentation at Occupancy:

The following documentation shall be made available to the responsible party of construction or building owner at occupancy;

(a) A completed and signed ENV-INST and ENV-2A, form(s);

1. If supplied by the manufacturer, a copy of the manufacturer's warranty and user manual.

NA7.4.4 Clerestories for PAF

NA7.4.4.1 Procedures

These procedures detail the installation and verification protocols necessary to meet acceptance requirements of clerestories for PAF. In addition, the responsible person shall fill out Certificate of Acceptance. The responsible person shall verify the clerestories to be installed matches the energy compliance documentation (Certificate of Compliance) and building plans. A copy of the Installation and Acceptance certificate shall be given to the building owner and the enforcement agency for their records.

NA7.4.4.2 The Responsible Person or Installer Shall Meet the Following Protocols before Installation:

(a) Verify the height of the clerestory's head height and glazing height match the building plans;

(b) Installation of clerestories shall meet the manufactures installation instructions;

(c) After the installation the installer completes and signs the Declaration Statement on the Installation Certificate NRCI-ENV-01-E. A signed copy of the NRCI-ENV-01-E Certificate(s) shall remain at the job site for verification by the building inspector.

NA7.4.4.3 Field Technician or Responsible Person Shall Meet the Following Protocols After Installation:

(a) Verify the Installation Certificate NRCI-ENV-01-E and the Declaration Statement is signed before inspection of the installation; and

(b) If operable shading is installed on the clerestory, verify that the clerestory shading is controlled separately from other fenestration shading control.

(c) After clerestories inspection is completed, complete the NRCA-ENV-02-F certificate form and sign the Declaration Statements of the form; and

(d) Provide certificates and additional copies to the builder, enforcement agency and building owner at occupancy.

NA7.4.4.4 Documentation at Occupancy:

The following documentation shall be made available to the responsible party of construction or building owner at occupancy;

(a) A completed and signed NRCI-ENV-01-E and NRCA-ENV-02-F, form(s);

If supplied by the manufacturer, a copy of the manufacturer's warranty and user manual

NA7.5 Mechanical Systems Acceptance Tests

NA7.5.1 Outdoor Air

NA7.5.1.1 Variable Air Volume Systems Outdoor Air Acceptance

NA7.5.1.1.1 Construction Inspection

Prior to functional testing, verify and document the following:

(a) Sensor used to control outdoor air flow is either factory calibrated or field calibrated.

(b) Attach calibration certification or results.

(c) Dynamic damper control is being used to control outside air.

(d) Specify the type of dynamic control being utilized to control outside air.

(e) Specify the method of delivering outside air to the unit.

(f) Pre-occupancy purge has been programmed for the 1-hour period immediately before the building is normally occupied.

NA7.5.1.1.2 Functional Testing

Step 1: If the system has an outdoor air economizer, force the economizer high limit to disable economizer control (e.g. for a fixed drybulb high limit, lower the setpoint below the current outdoor air temperature).

Step 2: Adjust supply airflow to achieve design airflow or maximum airflow at full cooling. Verify and document the following:

(a) Measured outside airflow reading is within 10 percent of the total ventilation air called for in the Certificate of Compliance.

(b) Outside air damper position stabilizes within 5 minutes.

Step 3: Adjust supply airflow to either the sum of the minimum zone airflows, full heating, or 30 percent of the total design airflow. Verify and document the following:

(a) Measured outside airflow reading is within 10 percent of the total ventilation air called for in the Certificate of Compliance.

(b) Outside air damper position stabilizes within 5 minutes.

Step 4: Restore system to “as-found” operating conditions

NA7.5.1.2 Constant Volume System Outdoor Air Acceptance

NA7.5.1.2.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) System is designed to provide a fixed minimum OSA when the unit is on.

(b) Specify the method of delivering outside air to the unit.

(c) Pre-occupancy purge has been programmed for the 1-hour period immediately before the building is normally occupied.

(d) Minimum position is marked on the outside air damper.

(e) The system has means of maintaining the minimum outdoor air damper position.

NA7.5.1.2.2 Functional Testing

Step 1: If the system has an outdoor air economizer, force the economizer to the minimum position and stop outside air damper modulation (e.g. for a fixed drybulb high limit, lower the setpoint below the current outdoor air temperature)

(a) Measured outside airflow reading is within 10 percent of the total ventilation air called for in the Certificate of Compliance.

NA7.5.2 Constant-Volume, Single-Zone, Air Conditioners and Heat Pumps

NA7.5.2.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Thermostat is located within the space-conditioning zone that is served by the HVAC system.

(b) Thermostat meets the temperature adjustment and dead band requirements of Standards §120.2(b).

(c) Occupied, unoccupied, and holiday schedules have been programmed as specified by the facility's schedule.

(d) Pre-occupancy purge has been programmed to meet the requirements of Standards §120.1(dc)2.

NA7.5.2.2 Functional Testing

Step 1: Disable economizer and demand control ventilation systems (if applicable).

Step 2: Simulate a heating demand during the occupied condition. Verify and document the following:

(a) Supply fan operates continually.

(b) The unit provides heating.

(c) No cooling is provided by the unit.

(d) Outside air damper is at minimum position.

Step 3: Simulate operation in the dead band during occupied condition. Verify and document the following:

(e) Supply fan operates continually.

(f) Neither heating nor cooling is provided by the unit.

(g) Outside air damper is at minimum position.

Step 4: Simulate cooling demand during occupied condition. Lock out economizer (if applicable). Verify and document the following:

(h) Supply fan operates continually.

(i) The unit provides cooling.

(j) No heating is provided by the unit.

(k) Outside air damper is at minimum position.

Step 5: Simulate operation in the dead band during unoccupied mode. Verify and document the following:

(l) Supply fan is off.

(m) Outside air damper is fully closed.

(n) Neither heating nor cooling is provided by the unit.

Step 6: Simulate heating demand during unoccupied conditions. Verify and document the following:

(o) Supply fan is on (either continuously or cycling).

(p) Heating is provided by the unit.

(q) No cooling is provided by the unit.

(r) Outside air damper is either closed or at minimum position.

Step 7: Simulate cooling demand during unoccupied condition. Lock out economizer (if applicable). Verify and document the following:

(s) Supply fan is on (either continuously or cycling).

(t) Cooling is provided by the unit.

(u) No heating is provided by the unit.

(v) Outside air damper is either closed or at minimum position.

Step 8: Simulate manual override during unoccupied condition. Verify and document the following:

(w) System operates in "occupied" mode.

(x) System reverts to "unoccupied" mode when manual override time period expires.

Step 9: Restore economizer and demand control ventilation systems (if applicable), and remove all system overrides initiated during the test.

NA7.5.3 Air Distribution Systems

NA7.5.3.1 Construction Inspection

Prior to Functional Testing on new duct systems, verify and document the following:

(a) Duct connections meet the requirements of Standards §120.4.

(b) Specify choice of drawbands.

(c) Flexible ducts are not constricted in any way.

(d) Duct leakage tests shall be performed before access to ductwork and connections are blocked.

(e) Joints and seams are properly sealed according to the requirements of Standards §120.4.

(f) Joints and seams are not sealed with cloth back rubber adhesive tape unless used in combination with Mastic and drawbands. Cloth backed tape may be used if tape has been approved by the CEC. Ducts are fully accessible for testing.

(g) Insulation R-Values meet the minimum requirements of §120.4(a).Insulation is protected from damage and suitable for outdoor service if applicable as specified by Standards §120.4(f).

Prior to Functional Testing on all new and existing duct systems, visually inspect to verify that the following locations have been sealed:

(h) Connections to plenums and other connections to the forced air unit

(i) Refrigerant line and other penetrations into the forced air unit

(j) Air handler door panel (do not use permanent sealing material, metal tape is acceptable)

(k) Register boots sealed to surrounding material

(l) Connections between lengths of duct, as well as connections to takeoffs, wyes, tees, and splitter boxes

NA7.5.3.2 Functional Testing

Step 1: Perform duct leakage test as specified by Reference Nonresidential Appendix NA2 to verify the duct leakage conforms to the requirements of Standards §~~140.4(l)~~140.4(l)1 and §141.0(b)2D.

Step 2: Obtain HERS Rater field verification as specified in Reference Nonresidential Appendix NA1.

NA7.5.4.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Economizer high limit shutoff control complies with Table 140.4-EB of Section140.4(e)32.

(b) If the high-limit control is fixed dry-bulb or fixed enthalpy + fixed dry-bulb, it shall have an adjustable setpoint.

(c) Economizer lockout control sensor is located to prevent false readings.

(d) Sensor performance curve is provided by factory with economizer instruction material.

(e) Sensor output value measured during sensor calibration is plotted on the performance curve.

(f) Economizer damper moves freely without binding.

(g) Economizer has control systems, including two-stage or electronic thermostats, that cycle compressors off when economizers can provide partial cooling

(h) Economizer reliability features are present as specified by Standards Section 140.4(e)2D4.

(i) Economizer inlet damper is designed to modulate up to 100 percent open, and return air damper to 100 percent closed, without over-pressurizing the building.

(j) For systems with DDC controls lockout sensor(s) are either factory calibrated or field calibrated.

(k) For systems with non-DDC controls, manufacturer's startup and testing procedures have been applied.

(l) The economizer has been certified to the Energy Commission as specified by Section 140.4(e)2Diii4C.

NA7.5.4.2 Functional Testing

Step 1: Disable demand control ventilation systems (if applicable).

Step 2: Enable the economizer and simulate a cooling demand large enough to drive the economizer fully open. Verify and document the following:

(a) Economizer damper is 100 percent open and return air damper is 100 percent closed.

(b) All applicable fans and dampers operate as intended to maintain building pressure.

(c) The unit heating is disabled (if unit has heating capability).

Step 3: Disable the economizer and simulate a cooling demand. Verify and document the following:

(d) Economizer damper closes to its minimum position.

(e) All applicable fans and dampers operate as intended to maintain building pressure.

(f) The unit heating is disabled (if unit has heating capability).

Step 4: If unit has heating capability, simulate a heating demand and set the economizer so that it is capable of operating (i.e. actual outdoor air conditions are below lockout setpoint). Verify the following:

(g) The economizer is at minimum position

(h) Return air damper opens

Step 5: Turn off the unit. Verify and document the following:

(i) Economizer damper closes completely.

Step 6: Restore demand control ventilation systems (if applicable) and remove all system overrides initiated during the test.

NA7.5.5 Demand Control Ventilation (DCV) Systems

NA7.5.5.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Carbon dioxide control sensor is factory calibrated as specified by §120.1(~~c~~d)4.

(b) The sensor is located in the high density space between 3 ft and 6 ft above the floor or at the anticipated level of the occupants' heads.

(c) DCV control setpoint is at or below the CO_2 concentration permitted by §120.1(~~c~~d)4.C.

NA7.5.5.2 Functional Testing

Step 1: Disable economizer controls

Step 2: Simulate a signal at or slightly above the CO_2 concentration setpoint required by §120.1(~~c~~d)4.C. Verify and document the following:

(a) For single zone units, outdoor air damper modulates open to satisfy the total ventilation air called for in the Certificate of Compliance.

(b) For multiple zone units, either outdoor air damper or zone damper modulate open to satisfy the zone ventilation requirements.

Step 3: Simulate signal well below the CO_2 setpoint. Verify and document the following:

(c) For single zone units, outdoor air damper modulates to the design minimum value.

(d) For multiple zone units, either outdoor air damper or zone damper modulate to satisfy the reduced zone ventilation requirements.

Step 4: Restore economizer controls and remove all system overrides initiated during the test.

Step 5: With all controls restored, apply CO_2 calibration gas at a concentration slightly above the setpoint to the sensor. Verify that the outdoor air damper modulates open to satisfy the total ventilation air called for in the Certificate of Compliance.

NA7.5.6 Supply Fan Variable Flow Controls

NA7.5.6.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Supply fan includes device(s) for modulating airflow, such as variable speed drive or electrically commutated motor.

(b) For multiple zone systems:

1. Discharge static pressure sensors are either factory calibrated or field-calibrated.
2. The static pressure location, setpoint, and reset control meets the requirements of §140.4(c)2.~~B~~A and §140.4(c)2.B~~C~~.

NA7.5.6.2 Functional Testing

Step 1: Simulate demand for full design airflow. Verify and document the following:

(a) Supply fan controls modulate to increase capacity.

(b) For multiple zone systems, supply fan maintains discharge static pressure within +/-10 percent of the current operating setpoint.

(c) Supply fan controls stabilize within a 5 minute period.

Step 2: Simulate demand for reduced or minimum airflow. Verify and document the following:

(d) Supply fan controls modulate to decrease capacity.

(e) Current operating setpoint has decreased (for systems with DDC to the zone level).

(f) For multiple zone systems, supply fan maintains discharge static pressure within +/-10 percent of the current operating setpoint.

(g) Supply fan controls stabilize within a 5 minute period.

Step 3: Restore system to correct operating conditions

NA7.5.7 Valve Leakage Test

NA7.5.7.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Valve and piping arrangements were installed as specified by the design drawings.

NA7.5.7.2 Functional Testing

Step 1: For each of the pumps serving the distribution system, dead head the pumps using the discharge isolation valves at the pumps. Document the following:

(a) Record the differential pressure across the pumps.

(b) Verify that this is within 5 percent of the submittal data for the pump.

Step 2: Reopen the pump discharge isolation valves. Automatically close all valves on the systems being tested. If 3-way valves are present, close off the bypass line. Verify and document the following:

(c) The valves automatically close.

(d) Record the pressure differential across the pump.

(e) Verify that the pressure differential is within 5 percent of the reading from Step 1 for the pump that is operating during the valve test.

Step 3: Restore system to correct operating conditions.

NA7.5.8 Supply Water Temperature Reset Controls

NA7.5.8.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Supply water temperature sensors have been either factory or field calibrated.

NA7.5.8.2 Functional Testing

Step 1: Change reset control variable to its maximum value. Verify and document the following:

(a) Chilled or hot water temperature setpoint is reset to appropriate value.

(b) Verify that actual supply temperature changes to within 2 percent of the new setpoint.

Step 2: Change reset control variable to its minimum value. Verify and document the following:

(c) Chilled or hot water temperature setpoint is reset to appropriate value.

(d) Verify that actual supply temperature changes to within 2 percent of the new setpoint.

Step 3: Restore reset control variable to automatic control. Verify and document the following:

(e) Chilled or hot water temperature set-point is reset to appropriate value.

(f) Verify that actual supply temperature changes to within 2 percent of the newl setpoint.

NA7.5.9 Hydronic System Variable Flow Controls

NA7.5.9.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) The static pressure location, setpoint, and reset control meets the requirements of the Standards Section 140.4(k)6B.

(b) Pressure sensors are either factory or field calibrated.

NA7.5.9.2 Functional Testing

Step 1: Modulate control valves to reduce water flow to 50 percent of the design flow or less, but not lower than the pump minimum flow. Verify and document the following:

(a) Pump operating speed decreases (for systems with DDC to the zone level).

(b) Current operating setpoint has not increased (for all other systems that are not DDC).

(c) System pressure is within 5 percent of current operating setpoint.

(d) System operation stabilizes within 5 minutes after test procedures are initiated.

Step 2: Open control valves to increase water flow to a minimum of 90 percent design flow. Verify and document the following:

(e) Pump speed increases

(f) Pumps are operating at 100 percent speed.

(g) System pressure is greater than the setpoint in Step 1.

(h) System pressure is either within ±5 percent of current operating setpoint. System operation stabilizes within 5 minutes after test procedures are initiated.

Step 3: Restore system to correct operating conditions.

NA7.5.10 Automatic Demand Shed Control Acceptance

NA7.5.10.1 Construction Inspection

Prior to Acceptance Testing, verify and document the following:

(a) That the EMCS interface enables activation of the central demand shed controls.

NA7.5.10.2 Functional Testing

Step 1: Engage the global demand shed system. Verify and document the following:

(a) That the cooling setpoint in non-critical spaces increases by the proper amount.

(b) That the cooling setpoint in critical spaces do not change.

Step 2: Disengage the global demand shed system. Verify and document the following:

(c) That the cooling setpoint in non-critical spaces return to their original values.

(d) That the cooling setpoint in critical spaces do not change.

NA7.5.11 Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units

NA7.5.11.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Verify fault detection and diagnostics (FDD) hardware is installed on HVAC unit.

(b) Verify the FDD system matches the make and model reported on the design drawings.

(c) Verify the following air temperature sensors are permanently installed:

1. outside air
2. supply air
3. return air

(d) Verify the controller has the capability of displaying the value of the following parameters:

1. Air temperatures: outside air, supply air, return air.

(e) Verify the controller provides system status by indicating the following conditions:

1. Free cooling available
2. Economizer enabled
3. Compressor enabled
4. Heating enabled
5. Mixed air low limit cycle active

NA7.5.11.2 Functional Testing

For each HVAC unit to be tested, complete the following:

NA7.5.11.2.1 Functional Testing for Air Temperature Sensor Failure/Fault

Step 1: Verify the FDD system indicates normal operation.

Step 2: Disconnect outside air temperature sensor from unit controller. Verify and document the following:

(a) FDD system reports a fault.

Step 3: Connect outside air temperature sensor to unit controller. Verify and document the following:

(b) FDD system indicates normal operation.

NA7.5.11.2.2 Functional Testing for Excess Outside Air

Step 1: Coordinate this test with NA7.5.1 Outdoor Air

(a) If NA7.5.1 Outdoor Air passes, verify FDD system indicates normal operation.

NA7.5.11.2.3 Functional Testing for Economizer Operation

Step 1: Interfere with normal unit operation so test NA7.5.4 Air Economizer Controls fails by immobilizing the outdoor air economizer damper according to manufacturer's instructions

(a) After NA7.5.4 Air Economizer Controls fails, verify FDD system reports a fault.

Step 2: Successfully complete and pass NA7.5.4 Air Economizer Controls

(b) After NA7.5.4 Air Economizer Controls passes, verify FDD system reports normal operation.

NA7.5.12 Automatic Fault Detection and Diagnostics (FDD) for Air Handling Units and Zone Terminal Units.

NA7.5.12.1 Construction Inspection for Air Handling Units

Prior to Functional Testing, verify and document the following:

(a) Verify on the submittal documents or sensor specifications that locally installed supply air, outside air, and return air (if applicable) temperature sensors have an accuracy of ±2ºF over the range of 40ºF to 80ºF.

~~*NA7.5.12.1*~~*NA7.5.12.2 Functional Testing for Air Handling Unit~~s~~ Economizers*

Testing of each AHU with FDD controls shall include the following tests.

(a) Bypass alarm delays

Step 1: If applicable, bypass alarm delays to ensure that faults generate alarms immediately.

~~(a)~~(b) Sensor ~~drift/~~failure:

Step 1: Disconnect ~~outside~~local supply air temperature sensor from unit controller.

Step 2: Verify that the FDD system reports a fault.

Step 3: Connect ~~O~~SAT sensor to the unit controller.

Step 4: Verify that FDD indicates normal system operation and clear all faults and alarms.

Step 5: If the outside air temperature sensor is local, disconnect the local OAT from the unit controller.

Step 6: Verify that the FDD system reports a fault.

Step 7: Connect the local OAT sensor to the unit controller.

Step 8: Verify that FDD indicates normal system operation and clear all faults an dalarms.

~~(b)~~(c) ~~Damper/actuator fault~~Inappropriate economizing:

Step 1: Override the operating state to occupied heating mode by overriding zone thermostat(s) to create a heating demand and overriding the OAT sensor below the low limit lockout.

Step 2~~1~~: From the control system workstation, override~~command~~ the ~~mixing box~~economizer dampers to ~~full open (~~100 percent outdoor air~~)~~.

Step 3~~2~~: ~~Disconnect power to the actuator and v~~Verify that a fault is reported at the control workstation.

Step 4~~3~~: Remove the economizer damper override and verify that the control system indicates normal system operation.~~Reconnect power to the actuator and command the mixing box dampers to full open.~~

Step 5~~4~~: Remove all overrides and clear all faults and alarms.~~Verify that the control system does not report a fault.~~

Step 6: Override the operating stat to economizer-only cooling mode by overriding zone thermostat(s) to create a cooling demand and overriding the OAT sensor so that free cooling is available.

Step ~~5~~7: From the control system workstation, override~~command~~ the ~~mixing box~~economizer dampers to ~~a full-closed position (~~0 percent outdoor air~~),~~.

Step ~~6~~8: ~~Disconnect power to the actuator and v~~Verify that a fault is reported at the control workstation.

Step 9~~7~~: Remove the economizer damper override and verify that the control system indicates normal system operation.~~Reconnect power to the actuator and command the dampers closed.~~

Step 10~~8~~: Remove all overrides and clear all faults and alarms.~~Verify that the control system does not report a fault during normal operation.~~

~~(c) Valve/actuator fault:~~

~~Step 1: From the control system workstation, command the heating and cooling coil valves to full open or closed, then disconnect power to the actuator and verify that a fault is reported at the control workstation.~~

(d) Reinstate alarm delay

Step 1: Reinstate alarm delays to ensure that faults generate alarms as before step (a), if applicable

~~(d) Inappropriate simultaneous heating, mechanical cooling, and/or economizing:~~

~~Step 1: From the control system workstation, override the heating coil valve and verify that a fault is reported at the control workstation.~~

~~Step 2: From the control system workstation, override the cooling coil valve and verify that a fault is reported at the control workstation.~~

~~Step 3: From the control system workstation, override the mixing box dampers and verify that a fault is reported at the control workstation.~~

NA7.5.12.3 Functional Testing for Air Handling Unit Valves

(a) Bypass alarm delays

Step 1: If applicable, bypass alarm delays to ensure that faults generate alarms immediately

(b) Valve/actuator fault:

Step 1: Override the operating state to occupied cooling mode by overriding zone thermostat(s) to create a cooling demand and overriding the OAT sensor to 90ºF.

Step 2: From the control system workstation, override the heating coil valves to the full open position (100% heating mode).

Step 3: Verify flow through the valve by differential temperature or differential pressure method.

Step 4: Verify that a fault is reported at the control workstation.

Step 5: Remove the heating coil valve override and verify that the control system indicates normal system operation.

Step 6: Remove all overrides and clear all faults and alarms.

Step 7: Override the operating state to occupied heating mode by overriding zone thermostat(s) to create a heating demand and overriding the OAT sensor to 40ºF.

Step 8: From the control system workstation, override the cooling coil valve to the full open position (100% cooling mode).

Step 9: Verify flow through the valve by differential temperature or differential pressure method.

Step 10: Verify that a fault is reported at the control workstation.

Step 11: Remove the cooling coil valve override and verify that the control system indicates normal system operation.

Step 12: Remove all overrides and clear all faults and alarms.

(c) Reinstate alarm delay

Step 1: Reinstate alarm delays to ensure that faults generate alarms as before Step (a), if applicable.

~~NA7.5.12.2~~NA7.5.12.4 Functional Testing for Zone Terminal Units

Testing shall be performed on one of each type of terminal unit (VAV box) in the project. A minimum of 5 percent of the terminal boxes shall be tested.

(a) Sensor drift/failure:

Step 1: Disconnect the tubing to the differential pressure sensor of the VAV box.

Step 2: Verify that control system detects and reports the fault.

Step 3: Reconnect the sensor and verify proper sensor operation.

Step 4: Verify that the control system does not report a fault.

(b) Damper/actuator fault:

1. Damper stuck open.

Step 1: Command the damper to be fully open (room temperature above setpoint).

Step 2: Disconnect the actuator to the damper.

Step 3: Adjust the cooling setpoint so that the room temperature is below the cooling setpoint to command the damper to the minimum position. Verify that the control system reports a fault.

Step 4: Reconnect the actuator and restore to normal operation.

2. Damper stuck closed.

Step 1: Set the damper to the minimum position.

Step 2: Disconnect the actuator to the damper.

Step 3: Set the cooling setpoint below the room temperature to simulate a call for cooling. Verify that the control system reports a fault.

Step 4: Reconnect the actuator and restore to normal operation.

(c) Valve/actuator fault (For systems with hydronic reheat):

Step 1: Command the reheat coil valve to (full) open.

Step 2: Disconnect power to the actuator. Set the heating setpoint temperature to be lower than the current space temperature, to command the valve closed. Verify that the fault is reported at the control workstation.

Step 3: Reconnect the actuator and restore normal operation.

(d) Feedback loop tuning fault (unstable airflow):

Step 1: Set the integral coefficient of the box controller to a value 50 times the current value.

Step 2: The damper cycles continuously and airflow is unstable. Verify that the control system detects and reports the fault.

Step 3: Reset the integral coefficient of the controller to the original value to restore normal operation.

(e) Disconnected inlet duct:

Step 1: From the control system workstation, commands the damper to full closed, then disconnect power to the actuator and verify that a fault is reported at the control workstation.

(f) Discharge air temperature sensor:

Step 1: Adjust zone setpoints to drive the box from dead band to full heating.

Step 2: Verify that in heating, the supply air temperature resets up to the maximum setpoint while the airflow is maintained at the dead band flow rate.

Step 3: Verify that after the supply air temperature is reset up to the maximum setpoint, the airflow rate then increases up to the heating maximum flow rate in order to meet the heating load.

NA7.5.13 Distributed Energy Storage DX AC Systems Acceptance Tests[3]

These acceptance requirements apply only to constant or variable volume, direct expansion (DX) systems with distributed energy storage (DES/DXAC). These acceptance requirements are in addition to those for other systems or equipment such as economizers, packaged equipment, etc.

NA7.5.13.1 Construction Inspection

Prior to Performance Testing, verify and document the following:

(a) The water tank is filled to the proper level.

(b) The water tank is sitting on a foundation with adequate structural strength.

(c) The water tank is insulated and the top cover is in place.

(d) The DES/DXAC is installed correctly (refrigerant piping, etc.).

(e) Verify that the correct model number is installed and configured.

NA7.5.13.2 Equipment Testing

Step 1: Simulate cooling load during daytime period (e.g. by setting time schedule to include actual time and placing thermostat cooling set-point below actual temperature). Verify and document the following:

(a) Supply fan operates continually.

(b) If the DES/DXAC has cooling capacity, DES/DXAC runs to meet the cooling demand (in ice melt mode).

(c) If the DES/DXAC has no ice and there is a call for cooling, the DES/DXAC runs in direct cooling mode.

Step 2: Simulate no cooling load during daytime condition. Verify and document the following:

(d) Supply fan operates as as specified by the facility thermostat or control system.

(e) The DES/DXAC and the condensing unit do not run.

Step 3: Simulate no cooling load during morning shoulder time period. Verify and document the following:

(f) The DES/DXAC is idle.

Step 4: Simulate a cooling load during morning shoulder time period. Verify and document the following:

(g) The DES/DXAC runs in direct cooling mode.

NA7.5.13.3 Calibrating Controls

Set the proper time and date, as ~~as~~ specified by manufacturer's installation manual for approved installers.

NA7.5.14 Thermal Energy Storage (TES) Systems

The following acceptance tests apply to thermal energy storage systems that are used in conjunction with chilled water air conditioning systems.

[3] From AEC, Distributed Energy Storage for Direct-Expansion Air Conditioners, January 27, 2005

NA7.5.14.1 Eligibility Criteria

The following types of TES systems are eligible for compliance credit:

(a) Chilled Water Storage

(b) Ice-on-Coil Internal Melt

(c) Ice-on-Coil External Melt

(d) Ice Harvester

(e) Brine

(f) Ice-Slurry

(g) Eutectic Salt

(h) Clathrate Hydrate Slurry (CHS)

(i) Cryogenic

(j) Encapsulated (e.g. Ice Balls)

The following Certificate of Compliance information for both the chiller and the storage tank shall be provided on the plans to document the key TES System parameters and allow plan check comparison to the inputs used in the ~~the~~ compliance software.

Chiller:

(k) Brand and Model

(l) Type (Centrifugal, Reciprocating, Other)

(m) Heat Rejection Type (Air, Water, Other)

(n) Charge Mode Capacity (Tons)

(o) Discharge Mode Capacity (Tons)

(p) Discharge Mode Efficiency (kW/Ton or EER)

(q) Charge Mode Efficiency (kW/Ton or EER)

(r) Fluid Type and Percentage

Storage Tank:

(s) Brand and Model

(t) Number of Tanks

(u) Storage Capacity per Tank (ton-hours)

(v) Storage Rate (tons)

(w) Minimum Charging Temperature

(x) Discharge Rate (tons)

NA7.5.14.2 Functional Testing

Acceptance testing also shall be conducted and documented on the Certificate of Acceptance in two parts:

In the TES System Design Verification part, the installing contractor shall certify the following information, which verifies proper installation of the TES System consistent with system design expectations:

(a) Chiller(s) start-up procedure has been completed

(b) System fluid test and balance has been completed

(c) Air separation and purge has been completed

(d) Fluid (e.g. glycol) has been verified at the concentration and type indicated on the design documents

(e) The TES system has been fully charged at least once and charge duration noted

(f) The system has been partially discharged at least once and discharge duration noted

(g) The system is in a partial charge state in preparation for step 2 tests

(h) Schedule of operation has been activated as designed

(i) Mode documentation describes the state of system components in each mode of operation

In the TES System Controls and Operation Verification part, the installing contractor also shall complete the following acceptance testing to ensure the TES System is controlled and operates consistent with the compliance simulation. The installing contractor shall convey the results of the testing to the enforcement agency using the Certificate of Acceptance.

(a) Verify that the TES system and the chilled water plant is controlled and monitored by an energy management system (EMS).

(b) Indicate the method of simulation that will be used during the test. Either manual selection of each operating mode or the use of an EMS by inputting the schedule as indicated by the designer.

(c) Storage/charge mode. Manually select storage mode. Verify that the TES system stores energy. If scheduled, input the time interval that would result in storage/charge mode. Verify that the TES system stores energy.

(d) End of charge signal. Simulate a full storage charge by changing the (manufacturer recommended) thermal storage end of charge output sensor to the EMS. Verify that the storage charging has stopped.

(e) Discharge mode. Generate a call for cooling. Manually select storage only discharge mode. Verify that the TES system starts discharging with the compressors off. Return to the off/secured mode. If scheduled, input the time interval that would result in discharge mode and verify that the storage starts discharging with the compressors off. .

(f) Mechanical cooling only mode. Generate a call for cooling. Manually select mechanical cooling only mode and verify that the storage does not discharge and the cooling load is met by the compressor only. Return to the off/secure mode. If scheduled, input the time interval that would result in mechanical cooling only mode and verify that the storage does not discharge and the cooling load is met by the compressor only.

(g) Discharge and mechanical cooling mode. Generate a call for cooling. Manually select discharge and mechanical cooling mode and verify that the TES system discharges with the compressor sharing the load. If scheduled, input the time interval that would result in discharge and mechanical cooling mode and verify that the storage starts discharging with the compressor sharing the load.

(h) Off/storage-secured mode. Manually select the off/storage-secured mode and verify that the storage does not discharge and all compressors are off, regardless of the presence of calls for cooling. If scheduled, input the time interval that would result in off/storage-secured mode and verify that the storage does not discharge and all compressors are off, regardless of the presence of calls for cooling.

(i) Charge plus cool mode. If provisions for this mode have been made by the system designer, verify that the tank(s) can be charged while serving an active cooling load, simulated by generating a call for cooling and entering the charge mode either manually or by time schedule. If the system disallows this mode of operation, verify that the energy storage is disallowed or discontinued while an active cooling load is present.

NA7.5.15 Supply Air Temperature Reset Controls

The following acceptance tests apply to supply air temperature reset controls.

NA7.5.15.1 Construction Inspection

Prior to functional testing, verify and document the following:

(a) Supply air temperature reset controls are installed as specified by the requirements of the ~~2016 Building Energy Efficiency Standards~~ Section 140.4(f).

(b) All system air temperature sensors are factory or field calibrated within 2% of a calibrated reference temperature sensor. Attach a copy of the calibration certificate or field verification results.

(c) Document current supply air temperature.

NA7.5.15.2 Functional Testing

(a) Check to make sure that chilled and hot water coils, if used, are not already fully open and calling for maximum cooling/heating. If this is the case, reverse Steps 1 and 2 and/or change the setpoint range as necessary to conduct this test.

(b) Identify the reset controller parameter.

Step 1: During occupied mode, adjust the reset control parameter to decrease the supply air temperature (to the lower supply temperature limit). Verify and document the following:

(a) Supply air temperature controls modulate as intended~~.~~.

(b) Actual supply air temperature ~~.~~decreases to meet the new setpoint within ±2ºF.

(c) Supply air temperature stabilizes within 15 minutes.

Step 2: During occupied mode, adjust the reset control parameter to increase the supply air temperature (to the upper supply temperature limit). Verify and document the following:

(a) Supply air temperature controls modulate as intended.

(b) Actual supply air temperature increases to meet the new setpoint within ±2ºF.

(c) Supply air temperature stabilizes within 15 minutes.

Step 3: Restore reset control parameter to automatic control. Verify and document the following:

(a) Supply air temperature controls modulate as intended.

(b) Actual supply air temperature changes to meet the new setpoint within ±2ºF.

(c) Supply air temperature stabilizes within 15 minutes.

NA7.5.16 Condenser Water Supply Temperature Reset Controls

The following acceptance tests apply to condenser water temperature reset controls.

NA7.5.16.1 Construction Inspection

Prior to functional testing, verify and document the following:

(a) Condenser water supply system, control system, and temperature control sequence, including condenser water supply high and low limits, are available and documented in the building documents.

(b) Cooling tower fan motors are operational, and cooling tower fan speed controls (e.g. VSDs) are installed, operational, and connected to cooling tower fan motors as specified by Original Equipment Manufacturer (OEM) start-up manuals and sequence of operation.

(c) Cooling tower fan control sequence, including tower design wetbulb temperature and approach, is available and documented in the building documents.

(d) The following temperature sensors are installed as specified by the plans: outdoor air dry-bulb, outdoor air wet-bulb, entering condenser water, and leaving chilled water. Note any discrepancies.

(e) All ambient dry bulb temperature, relative humidity, and pressure sensors used by controller are factory calibrated within 2% of a calibrated reference sensor. Attach a copy of calibration certificate or field verification results.

(f) Document the current outdoor air dry bulb and wet bulb temperatures, entering condenser water temperature, and leaving chilled water temperature readings from the control system.

NA7.5.16.2 Functional Testing

(a) The system cooling load must be sufficiently high to run the test. If necessary, artificially increase the evaporator load to perform the functional tests, or wait until a time of stable chiller operation. If necessary, reverse Steps 1 and 2 in the test based on atmospheric conditions and buildings loads.

(b) If testing in cold ambient conditions, ensure that freeze protection controls are installed and functional to prevent equipment damage.

(c) If the actual control sequence differs significantly from that implied by the tests and/or has already been tested during the building commissioning process, attach a description of the control sequence, a description of the tests that were done to verify the system operates according to the sequence, the test results, and a plot of associated trend data.

(d) Identify the reset control parameter.

Step 1: Adjust the reset control parameter to decrease the condenser water supply temperature toward the lower supply temperature limit. Allow time for the system to stabilize. Verify and document the following:

(a) Condenser water supply temperature controls modulate as intended.

(b) Actual condenser water supply temperature decreases to meet the new setpoint within ±2ºF.

(c) Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet higher setpoint.

(d) Chiller load amperage decrease.

Step 2: Adjust the reset control parameter to increase the condenser water supply temperature toward the upper supply temperature limit.

Verify and document the following:

(e) Condenser water supply temperature controls modulate as intended.

(f) Actual condenser water supply temperature increases to meet the new setpoint within ±2ºF.

(g) Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet the lower setpoint.

(h) Chiller load amperage increase.

Step 3: Restore reset control parameter to automatic control. Verify and document the following:

(i) Condenser water supply temperature controls modulate as intended.

(j) Actual condenser water supply temperature changes to meet the new setpoint.

(k) Cooling tower fan(s) and chiller(s) stage properly and/or adjust speed accordingly to return to normal operation and meet the setpoint.

NA7.6 Lighting Control Acceptance Requirements

Lighting control acceptance testing shall be performed on:

(a) Automatic Daylighting Controls complying with Section 130.1(d)

(b) Shut-off Controls complying with Section 130.1(c)

(c) Demand Responsive Controls in accordance with Section 130.1(e).

NA7.6.1 Automatic Daylighting Controls Acceptance Tests

NA 7.6.1.1 Construction Inspection

Verify that automatic daylighting controls qualify as one of the required control types, are installed, and fully functional in accordance with each applicable requirement in Section 130.1(d), and list each specific exception claimed, from Section 130.1(d).

NA 7.6.1.2 Functional testing

All photocontrols serving more than 5,000 ft² of daylit area shall undergo functional testing. Photocontrols that are serving smaller spaces may be sampled as follows:

For buildings with up to five (5) photocontrols, all photocontrols shall be tested. For buildings with more than five (5) photocontrols, sampling may be done on spaces with similar sensors and cardinal orientations of glazing; sampling shall include a minimum of 1 photocontrol for each group of up to 5 additional photocontrols. If the first photocontrol in the sample group passes the functional test, the remaining building spaces in the sample group also pass. If the first photocontrol in the sample group fails the functional test, the rest of the photocontrols in the group shall be tested. If any tested photocontrol fails the functional test, it shall be repaired, replaced or adjusted until it passes the test.

For each photocontrol to be tested do the following:

(a) Test each group of lights controlled separately by the photocontrol according to the following protocol. In all interior spaces other than parking garages, a separate test shall be conducted for daylighting control of the primary sidelit zone separate from the secondary sidelit zone.

NA 7.6.1.2.1 Continuous Dimming Control Systems

This requirement is for systems that have more than 10 levels of controlled light output in a given zone.

(a) Identify the minimum daylighting location in the controlled zone (Reference Location). This can be identified using either the illuminance method or the distance method.

Illuminance Method

(b) Turn OFF controlled lighting and measure daylight illuminance within zones illuminated by controlled luminaires.

(c) Identify the Reference Location; this is the task location with lowest daylight illuminance in the zone illuminated by controlled luminaires. This location will be used for illuminance measurements in subsequent tests.

Distance Method

Identify the task location within the zone illuminated by controlled luminaires that is farthest away from daylight sources. This is the Reference Location and will be used for illuminance measurements in subsequent tests.

(d) No daylight test. Simulate or provide conditions without daylight. Verify and document the following:

1. Automatic daylight control system provides appropriate control so that electric lighting system is providing full light output unless otherwise specified by design documents.
2. Document the reference illuminance, which is the electric lighting illuminance level at the reference location identified in Step 1.
3. Light output is stable with no discernable flicker.

(e) Full daylight test. Simulate or provide bright conditions. Verify and document the following:

1. Lighting power reduction is at least 65 percent under fully dimmed conditions and light output is stable with no discernable flicker.

2. Only luminaires in daylit zones are affected by daylight control. . If the daylighting controls control lighting outside of the daylight zones including those behind obstructions as described in Section 130.1(d)1, the control system is not compliant.

3. If a Power Adjustment Factor is claimed for Daylight Dimming plus OFF controls in accordance with Section 140.6(a)2H, compliant systems shall automatically turn OFF the luminaires that are receiving this credit. This portion of the full daylight test does not apply to lighting systems that are not claiming a Power Adjustment Factor for Daylight Dimming plus OFF controls.

(f) Partial daylight test. Simulate or provide daylight conditions where illuminance (fc) from daylight only at the Reference Location is between 60 and 95 percent of Reference Illuminance (fc) documented in Step 2. Verify and document the following:

1. Measure that the combined illuminance of daylight and controlled electric lighting (fc) at the reference location is no less than the electric lighting illuminance (fc) at this location during the no daylight test documented in Step (d)2.

2. Measure that the combined illuminance of daylight and controlled electric lighting (fc) at the Reference Location is no greater than 150 percent of the reference illuminance (fc) documented in Step (d)2.

3. Light output is stable with no discernable flicker.

NA 7.6.1.2.2 Stepped Switching or Stepped Dimming Control Systems

This requirement is for systems that have no more than 10 discrete steps of control of light output.

If the control has 3 steps of control or less, conduct the following tests for all steps of control. If the control has more than 3 steps of control, testing 3 steps of control is sufficient for showing compliance.

(a) Identify the minimum daylighting location(s) in the controlled zone. (Reference Location). This can be identified using either the illuminance method or the distance method.

Illuminance Method

1. Turn OFF controlled lighting and measure daylight illuminances within a zone illuminated by controlled luminaires.

2. Identify the reference location; this is the task location with lowest daylight illuminance in the zone illuminated by controlled luminaires. This location will be used for illuminance measurements in subsequent tests.

3. Turn controlled lights back ON.

Distance Method

1. Identify the task location within the zone illuminated by controlled luminaires that is farthest away from daylight sources. This is the reference location and will be used for illuminance measurements in subsequent tests.

(b) No daylight test. Simulate or provide conditions without daylight for a stepped switching or stepped dimming control system. Verify and document the following:

1. If the control is manually adjusted (not self commissioning), make note of the time delay and override time delay or set time delay to minimum setting. This condition shall be in effect through step 4.

2. Automatic daylight control system turns ON all stages of controlled lights unless it is documented that multi-level luminaires have been "tuned" to less than full output and providing design illuminance (fc) levels

3. Stepped dimming control system provides reduced flicker over the entire operating range as specified by §110.9.

4. Document the reference illuminance which is the electric lighting illuminance level measured at the reference location identified in Step 1.

(c) Full daylight test. Simulate or provide bright conditions. Verify and document the following:

1. Lighting power reduction of controlled luminaires is at least 65 percent
2. Only luminaires in daylit zones (toplit zone, primary sidelit zone and secondary sidelit zone) are affected by daylight control. If the daylighting controls control lighting outside of the daylight zones including those behind obstructions as described in Section 130.1(d)1, the control system is not compliant.

(d) Partial daylight test. For each control stage that is tested in this step, the control stages with lower setpoints than the stage tested are left ON and those stages of control with higher setpoints are dimmed or controlled off. Simulate or provide conditions so that each control stage turns on and off or dims. Verify and document the following for each control stage:

1. Document the total daylight and electric lighting illuminance level measured at its reference location just after the stage of control dims or shuts off a stage of lighting:
   A. The total measured illumination shall be no less than the reference illuminance measured at this location during the no daylight test documented in Step 2.
   B. The total measured illumination shall be no greater than 150 percent of the reference illuminance.
2. The control stage shall not cycle on and off or cycle between dim and undimmed while daylight illuminance remains constant.
3. Only luminaires in daylit zones (toplit zone, primary sidelit zone, and secondary sidelit zone) are affected by daylight control.

(e) Verify time delay.

1. Verify that time delay automatically resets to normal mode within 60 minutes.
2. Set normal mode time delay to at least three minutes.
3. Confirm that there is a time delay of at least 3 minutes between the time when illuminance exceeds the setpoint for a given dimming stage and when the control dims or switches off the controlled lights.

NA7.6.2 Shut-off Controls Acceptance Tests

NA7.6.2.1 General Requirements

Verify that the shut-off control qualifies as one of the required control types, is installed, and is fully functional in accordance with each applicable requirement in Section 130.1(c), or that the application meets one of the exceptions. List each specific exception claimed, from Section 130.1(c).

NA7.6.2.2 Occupancy Sensing Lighting Control Construction Inspection

Prior to Functional testing, verify and document the following:

(a) Occupancy sensor has been located to minimize false signals:

(b) No closer than four (4) feet from a HVAC diffuser.

(c) Passive infrared sensor pattern does not enter into adjacent zones.

(d) Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.

(e) Ultrasonic occupancy sensors do not emit audible sound.

NA7.6.2.3 Occupancy Sensing Lighting Control Functional testing

For buildings with up to seven (7) occupancy sensors, all occupancy sensors shall be tested. For buildings with more than seven (7) occupancy sensors, sampling may be done on spaces with similar sensors and space geometries; sampling shall include a minimum of 1 occupancy sensor for each group of up to 7 additional photocontrols. If the first occupancy sensor in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first occupancy sensor in the sample group fails the acceptance test the rest of the occupancy sensors in that group must be tested. If any tested occupancy sensor fails it shall be repaired, replaced or adjusted until it passes the test.

For each sensor to be tested do the following:

(a) For a representative sample of building spaces, simulate an unoccupied condition. Verify and document the following:

1. Lights controlled by occupancy sensors turn off within a maximum of 20 minutes from the start of an unoccupied condition.
2. The occupant sensor does not trigger a false “on” from movement in an area adjacent to the space containing the controlled luminaires or from HVAC operation.
3. Signal sensitivity is adequate to achieve desired control.

(b) For a representative sample of building spaces, simulate an occupied condition. Verify and document the following:

1. Status indicator or annunciator operates correctly.
2. Lights controlled by occupancy sensors turn on immediately upon an occupied condition, OR sensor indicates space is “occupied” and lights are turned on manually (automatic OFF and manual ON control strategy).

NA7.6.2.4 Automatic Time Switch Lighting Control Construction Inspection

Prior to Functional testing, verify and document the following:

(a) Automatic time switch control is programmed with acceptable weekday, weekend, and holiday (if applicable) schedules.

(b) Document for the owner automatic time switch programming including weekday, weekend, holiday schedules as well as all set-up and preference program settings.

(c) Verify the correct time and date is properly set in the time switch.

(d) Verify the battery back-up (if applicable) is installed and energized.

(e) Override time limit is set to no more than 2 hours.

(f) Override switches remote from area with controlled luminaires have annunciator lights.

NA7.6.2.5 Automatic Time Switch Lighting Control Functional testing

(a) Simulate occupied condition. Verify and document the following:

1. All lights can be turned on and off by their respective area control switch.
2. Verify the switch only operates lighting in the enclosed space (ceiling-height partitioned area) in which the switch is located.

(b) Simulate unoccupied condition. Verify and document the following:

1. All non-exempt lighting turn off in accordance with the programmed time switch schedules.
2. Manual override switch allows only the lights in the enclosed space (ceiling height partitioned) where the override switch is located to turn on or remain on until the next scheduled shut off occurs.

NA7.6.3.1 Construction Inspection

Prior to Functional testing, verify and document the following:

(a) That the demand responsive control is capable of receiving a demand response signal directly or indirectly through another device and that it complies with the requirements in Section 130.1(e).

(b) If the demand response signal is received from another device (such as an EMCS), that system must itself be capable of receiving a demand response signal from a utility meter or other external source.

NA7.6.3.2 Functional testing

For buildings with up to seven (7) enclosed spaces requiring demand responsive lighting controls, all spaces shall be tested. For buildings with more than seven (7) enclosed spaces requiring demand responsive lighting controls, sampling may be done on additional spaces with similar lighting systems; sampling shall include a minimum of 1 enclosed space for each group of up to 7 additional enclosed spaces. If the first enclosed space with a demand responsive lighting control in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first enclosed space with a demand responsive lighting control in the sample group fails the acceptance test the rest of the enclosed spaces in that group must be tested. If any tested demand responsive lighting control system fails it shall be repaired, replaced or adjusted until it passes the test.

Test the reduction in lighting power due to the demand responsive lighting control using one of the following two methods.

Method 1: Illuminance Measurement. Measure the reduction in illuminance in enclosed spaces required to meet Section 130.1(b), as follows:

(a) In each space, select one location for illuminance measurement. The chosen location must not be in a skylit or primary sidelit area. When placed at the location, the illuminance meter must not have a direct view of a window or skylight. If this is not possible, perform the test at a time and location at which daylight illuminance provides less than half of the design illuminance. Mark each location to ensure that the illuminance meter can be accurately located.

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Calculate the area-weighted average reduction in illuminance in the demand response condition, compared with the full output condition. The area-weighted reduction must be at least 15% but must not reduce the combined illuminance from electric light and daylight to less than 50% of the design illuminance in any individual space.

(c) Minimum output test

1. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at more than minimum output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.

4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.

5. In each space, the illuminance in the demand response condition must not be less than the illuminance in the minimum output condition or 50% of the design illuminance, whichever is less.

   EXCEPTION: In daylit spaces, the illuminance in the demand response condition may reduce below the minimum output condition, but in the demand response condition the combined illuminance from daylight and electric light must be at least 50% of the design illuminance.

Method 2: Current measurement. Measure the reduction in electrical current in spaces required to meet Section 130.1(b), as follows:

(a) At the lighting circuit panel, select at least one lighting circuit that serves spaces required to meet Section 130.1(e).

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.

2. Take one electric current measurement for each selected circuit.

3. Simulate a demand response condition using the demand responsive control.

4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.

5. Add together all the circuit currents, and calculate the reduction in current in the demand response condition, compared with the full output condition. The combined reduction must be at least 15% but must not reduce the output of any individual circuit by more than 50%.

(c) Minimum output test

1. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at more than minimum output, or may be off.

2. Take one electric current measurement for each selected circuit.

3. Simulate a demand response condition using the demand responsive control.

4. Take one electric current measurement for each selected circuit with the electric lighting system in the demand response condition.

5. In each space, the electric current in the demand response condition must not be less than 50% or the electric current in the minimum output condition, whichever is less.

   EXCEPTION: Circuits that supply power to the daylit portion of enclosed spaces as long as lighting in non-daylit portions of the enclosed space.

NA7.7 Lighting Control Installation Requirements

Lighting control installation inspection shall be performed on:

Lighting control systems installed to comply with Section 110.9(b).

(a) Energy Management Control System installed to comply with Section 130.0(e).

(b) All line-voltage track lighting integral current limiters in accordance with Section 110.9 and Section 130.0.

(c) All dedicated line-voltage track lighting supplementary overcurrent protection panels in accordance with Section 110.9 and Section 130.0.

(d) Interlocked lighting systems serving an area in accordance with Section 140.6(a)1.

(e) Lighting controls installed to earn a Power Adjustment Factor (PAF) in accordance with Section 140.6(a)2.

(f) Lighting for a Videoconferencing Studio in Accordance with Exception to Section 140.6(c)2Gvii.

NA7.7.1 Lighting Control Systems Installed to Comply with Section 110.9(b)

NA7.7.1.1 Installation Inspection

If a lighting control required by Title 24, Part 6 is a field assembled system consisting of two or more components, verify the system components meet all of the requirements for each lighting control type, in accordance with Section 110.9, On the approved installation compliance form, identify, list, and verify each type of lighting control system as follows:

(a) Separately identify and list each type of lighting control system. When there are identical lighting control systems in a single building, identical lighting control system may be listed together.

(b) Identify and list all requirements for the type of self-contained lighting control device for which the lighting control system is installed to function as, in accordance with Section 110.9 and in accordance with the Title 20 Appliance Efficiency Regulations.

(c) Verify the lighting control system complies with all of the applicable requirement as listed.

(d) If the lighting control system does not meet all applicable requirements, the installation fails.

NA7.7.2 Energy Management Control System (EMCS) Installed in Accordance with Section 130.1(f)

NA7.7.2.1 Installation Requirements

(a) The EMCS shall be separately tested for each respective lighting control system for which it is installed to function as.

(b) List and verify functional compliance with all applicable requirements in accordance with Sections 130.1 through 130.5.

(c) If applicable, list and verify functional compliance with all applicable requirements for all applications for which the EMCS is installed to function as, in accordance with Section 140.6.

(d) If applicable, list and verify functional compliance with all applicable requirements for all applications for which the EMCS is installed to function as, in accordance with Section 140.7.

(e) If applicable, list and verify functional compliance with all applicable requirements for all applications for which the EMCS is installed to function as, in accordance with Section 150(k).

~~NA7.7.3 Track Lighting Integral Current Limiter~~

~~***NA7.7.3.1 Certification requirements***~~

~~(a) Verify that the track lighting integral current limiter is certified to the Energy Commission in accordance with Section 110.9 by checking the Energy Commission database. If the track current limiter has not been certified to the Energy Commission, this method for determining installed lighting power shall not be used for compliance with Title 24, Part 6, and the installation test shall be terminated.~~

~~***NA7.7.3.2 Installation Inspection***~~

~~Verify and document the following on the approved installation compliance form:~~

~~(a) The track current limiter is used exclusively on the same manufacturer's track for which it is designed.~~

(b) The track current limiter is designed and installed so that the track current limiter housing is permanently attached to the track so that the system will be irreparably damaged if the integral track current limiter housing were to be removed after installation into the track. Methods of attachment may include but are not limited to one-way barbs, rivets, and one-way screws.

(c) The track current limiter has identical volt-ampere (VA) rating of the track current limiter, as installed and rated for compliance with Title 24, Part 6, clearly marked as follows:

1. So that it is visible for the building officials' field inspection without opening cover-plates, fixtures, or panels.

2. Permanently marked on the circuit breaker.

3. On a factory-printed label that is permanently affixed to a non-removable base-plate inside the wiring compartment.

(d) The track current limiter employs tamper resistant fasteners for the cover to the wiring compartment.

(e) The track current limiter has a conspicuous factory installed label permanently affixed to the inside of the wiring compartment warning against removing, tampering with, rewiring, or bypassing the device.

(f) Each electrical panel from which track lighting integral current limiters are connected has a factory printed label permanently affixed and prominently located, with the following information: "NOTICE: Current limiting devices installed in track lighting integral current limiters connected to this panel shall only be replaced with the same or lower amperage. Adding track or replacement of existing current limiters with higher continuous ampere rating will void the track lighting integral current limiter certification, and will require re-submittal and re-certification of California Title 24, Part 6 compliance documentation."

(g) For installations where a total of five or less track current limiters are installed in a single building, all integral track current limiters shall be inspected. For installations where a total of more than five track current limiters are installed in a single building, no less than five track current limiters shall be inspected, up to five inspections for each 20 installed track current limiters.

~~(h)~~(a) If any of the above requirements fail, the track current limiter fails the installation test, and this method for determining installed lighting power shall not be used for compliance with Title 24.

NA7.7.4 Line-Voltage Track Lighting Supplementary Overcurrent Protection Panel

NA7.7.4.1 Installation Inspection

Verify and document the following on the approved compliance form:

(a) The supplementary overcurrent protection panel is Listed, as defined in Section 100.1.

(b) The supplementary overcurrent protection panel is used only for line voltage track lighting. No other lighting or building power is connected to a track-lighting supplementary overcurrent protection panel.

(c) No overcurrent protection panel has been used to determine installed wattage for any lighting system other than line-voltage track lighting.

(d) The supplementary overcurrent protection panel is installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing supplementary overcurrent protection for the track lighting circuits served by the supplementary over current protection pane.

(e) There is a prominently labeled permanently attached to the panel by the manufacturer with the following information: "NOTICE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will

~~void the panel listing and require re-submittal and re-certification of California Title 24, Part 6 compliance documentation."~~

~~(f) If any of the above requirements fail, the supplementary overcurrent protection panel fails the Installation test, and this method for determining installed lighting power shall not be used for compliance with Title 24.~~

~~NA7.7.5~~NA7.7.3 Interlocked Lighting Systems Serving an Area in Accordance with Section 140.6(a)1

~~*NA7.7.5.1*~~*NA7.7.3.1* *Installation Inspection*

Verify and document the following:

(a) The space qualifies only as one or more the following types: Auditorium, convention center, conference room, multipurpose room, or theater, in accordance with the definitions of those space types in Section 100.1,

(b) There are no more than two interlocked lighting systems serving the space.

(c) The two lighting systems are interlocked with a non-programmable double throw switch to prevent simultaneous operation, in accordance with Section 140.6(a).

(d) If all of the above in not true, the installation fails, and all connected lighting in the space shall be counted as part of the total installed lighting power.

~~NA7.7.6~~NA7.7.4 Lighting Controls Installed to Earn a Power Adjustment Factor (PAF) in Accordance with Section 140.6(a)2

~~*NA7.7.6.1*~~*NA7.7.4.1* *Construction Inspection for all PAFs except Institutional Tuning*

Verify and document the following:

(a) Separately list all requirements for each PAF that is claimed in accordance with Sections 110.9, and 140.6(a)2, and Table 140.6-A.

(b) Verify the installation complies with all applicable requirements in accordance with Sections 110.9, and 140.6(a)2, and Table 140.6-A.

(c) If all of the above in not true for a specific PAF, the installation fails, and that specific PAF cannot be used.

(d) For lighting systems that are claiming a PAF for daylight dimming plus OFF control in accordance with Section 140.6(a)2H, the system must successfully complete the functional performance test in Section NA 7.6.1.2.1, and in addition during the Full Daylight Test the controls shall automatically turn OFF the luminaires that are receiving the daylight dimming plus OFF PAF credit.

~~*NA7.7.6.2*~~*NA7.7.4.2* *Acceptance Test for Institutional Tuning*

For buildings with up to seven (7) enclosed areas claiming the Institutional Tuning PAF (power adjustment factor), all areas shall be tested. For buildings with more than seven (7) areas claiming this PAF, random sampling may be done on seven of the larger enclosed areas with tuned dimming systems. If any of the areas in the sample group of seven areas fails the acceptance test, another group of seven areas must be tested. If any tested system fails, it shall be tuned until it passes the test.

~~NA7.7.6.2.1~~NA7.7.4.2.1 Construction Inspection of Institutional Tuning

Prior to Functional testing, verify and document the following:

(a) The controls or the methods of controlling the maximum output of luminaires is such that the maximum light output of the controlled lighting system can be limited and that normal operation of the controlled lighting does not override the maximum light output.

(b) The controls are not readily accessible to unauthorized personnel.

~~NA7.7.6.2.2~~NA7.7.4.2.2 Functional testing of Institutional Tuning

For each area to be tested, do the following:

(a) The acceptance test technician shall either observe the first seven (7) systems being successfully tuned or shall verify systems that have already been tuned using the sampling protocol described in NA7.7.6.2.

(b) If the acceptance test technician is observing the tuning of the system, the party responsible for the tuning shall certify that the remainder of the system is tuned in a similar manner.

Observation of the systems during Institutional Tuning

Step 1: Determination of maximum power or output prior to Institutional Tuning

(a) Set all lighting controls to provide maximum output of the tested system without applying the limits specified for institutional tuning.

(b) Measure the full light output at a location where the illuminance is due to the controlled lighting, or measure the power draw of the controlled lighting.

Step 2: Institutional Tuning and Post-tuning Measurement

(a) Apply the limits specified for instutional tuning to the lighting system. Do not alter any other control settings.

(b) Verify the light or power reduction after institutional tuning by measuring the light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1.

(c) If the light output or power draw measured in Step 2(b) is 85% or less of the light output or power draw measured in Step 1(b), the system passes this test; otherwise the system fails this test.

Verification of systems already tuned

Step 1: Measurement of tuned lighting system

(a) Set all lighting controls except Institutional Tuning controls to provide maximum output of tested system. Controls set to maximum light output include but not limited to: manual dimmers, multilevel occupancy sensing, and automatic daylighting controls.

(b) Measure full light output at location where most of the illuminance is due to the controlled lighting or measure power draw of the controlled lighting.

Step 2: Measurement of lighting system with Institutional Tuning overriden

(a) Reset Institutional Tuning controls to allow full light output. Set all lighting controls to provide maximum output of tested system including but not limited to: Institution Tuning control, manual dimmers, multilevel occupancy sensing, and automatic daylighting controls.

(b) Measure full light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1.

(c) If the light output or power draw measured in Step 1(b) is 85% or less of the light output or power draw measured in Step 2(b), the system passes this test; otherwise the system fails this test.

Step 3: Restore Institutional Tuning settings

(a) If tested system passed the test in Step 2, restore Institutional Tuning settings.

~~NA7.7.7~~NA7.7.5 Lighting for a Videoconferencing Studio in Accordance with Exception to Section 140.6(a)3T

~~NA7.7.7.1~~NA7.7.5.1 Installation Inspection

Verify and document the following:

(a) The videoconferencing studio is using only the Area Category Method for compliance. The extra lighting allowance shall not be taken when using the Complete Building Method or Tailored Method of compliance.

(b) The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites.

(c) General lighting is switched in accordance with Table 130.1-A.

(d) Wall wash lighting is separately switched from the general lighting system.

(e) All of the lighting is controlled by a multiscene programmable control system (scene preset control system).

(f) If all of the above is not true, the installation fails, and the extra wattage for videoconferencing studio lighting cannot be used.

NA7.8 Outdoor Lighting Controls Acceptance Test

Verify that outdoor lighting controls qualify as one of the required control types, are installed, and are fully functional in accordance with each applicable requirement in Section 130.2(c), or that the application meets one of the exceptions. List each specific exception claimed, from Section 130.2(c).

NA7.8.1 Motion Sensor Construction Inspection

Prior to Functional testing, verify and document the following:

(a) Sensor has been located to minimize false signals.

(b) Sensor is not triggered by motion outside of adjacent area.

(c) Desired sensor coverage is not blocked by obstructions that could adversely affect performance.

NA7.8.2 Motion Sensor Functional testing

For buildings with up to seven (7) outdoor motion sensors, all outdoor motion sensors shall be tested. For buildings with more than seven (7) outdoor motion sensors for outdoor lighting system, sampling may be done on outdoor areas with similar sensors that cover similar unobstructed areas; sampling shall include a minimum of 1 outdoor motion sensor for each group of up to 7 additional outdoor motion sensors. If the first sensor in the sample group passes the acceptance test, the remaining outdoor areas in the sample group also pass. If the first sensor in the sample group fails the acceptance test, the rest of the sensors in that group shall be tested and any failed sensor in the sample group shall be repaired or replaced and retested until the sensor passes the test.

Step 1: Simulate motion in area under lights controlled by the sensor. Verify and document the following:

(a) Status indicator operates correctly.

(b) Lights controlled by sensors turn on immediately upon entry into the area lit by the controlled lights near the motion sensor.

(c) Signal sensitivity is adequate to achieve desired control.

Step 2: Simulate no motion in area with lighting controlled by the sensor.

Verify and document the following:

(a) Lights controlled by the sensor reduces light output within a maximum of 30 minutes from the start of an unoccupied condition.

(b) The sensor does not trigger a false “on” from movement outside of the controlled area.

(c) Signal sensitivity is adequate to achieve desired control.

NA7.8.3 Photocontrol Construction Inspection

Verify and document the following:

The photocontrol is installed.

NA7.8.4 Photocontrol Functional Testing

Verify and document the following:

(a) During daytime simulation, all controlled outdoor lights are turned off.

(b) During nighttime simulation, all controlled outdoor lights are turned on.

NA7.8.5 Astronomical Time-Switch Control Construction Inspection

Prior to Functional Testing, confirm and document the following:

(a) Verify the astronomical time-switch control is installed.

(b) Verify the astronomical time switch control is programmed with ~~acceptable~~ ON schedule and OFF schedule that matches the schedules in the construction documents. If the schedule is unknown, verify that the programmed schedule matches the default schedule where the OFF schedule is from midnight to 6am and the ON schedule is all other night time hours, seven days per week.

(c) Demonstrate and document for the ~~time switch~~lighting control programming including ON schedule and OFF schedule, for weekday, weekend, and holidays (if applicable).

(d) Verify the correct time and date is properly set in the control.

NA7.8.6 Astronomical Time-Switch Control Functional Testing

Verify and document the following:

(a) During daytime simulation, all controlled outdoor ~~lights~~ lighting ~~are~~is turned ~~off~~OFF.

(b) During nighttime simulation, all controlled outdoor ~~lights~~ lighting ~~are~~is turned ~~on~~ ON in accordance with the astronomical schedule.

(c) During nighttime simulation, ~~all~~ power of controlled outdoor lights ~~are~~ is turned ~~off~~OFF or reduced by at least 50 percent ~~in~~ in accordance with the programmed schedule.

NA7.8.7 Part-Night Outdoor Lighting Control Construction Inspection

Prior to Functional Testing ~~for time based control type~~, confirm and document the following:

(a) Verify the part-night outdoor lighting control is installed.

(b) Verify the control is programmed with ~~acceptable~~ ON schedules and OFF schedule that matches the schedules in the construction documents. If the schedule is unknown, verify that the programmed schedule matches the default schedule where the OFF schedule is from midnight to 6am and the ON schedule is all other night time hours, seven days per week.

(c) Demonstrate and document for the lighting control programming including both ON schedule and OFF schedule, for weekday, weekend, and holidays (if applicable).

(d) Verify the correct time and date is properly set in the control.

Prior to Functional Testing for occupancy-based control type, verify and document the following:

(a) Sensor has been located to minimize false signals.

(b) Sensor is not triggered by motion outside of adjacent area.

(c) Desired sensor coverage is not blocked by obstructions that could adversely affect performance.

NA7.8.8 Part-Night Outdoor Lighting Control Functional Testing

~~For time-based control type, verify~~ Verify and document the following:

(a) During daytime simulation, all controlled outdoor ~~lights~~ lighting ~~are~~is turned ~~off~~OFF.

(b) During nighttime simulation, all controlled outdoor ~~lights~~ lighting ~~are~~is turned ~~on~~ ON in accordance with the ~~ON~~ programmed schedule.

(c) During nighttime simulation, ~~all~~ power of controlled ~~outdoor~~ lighting ~~lights are~~ is turned ~~off~~ OFF or reduced ~~in light level~~by at least 50 percent in accordance with the ~~OFF~~ programmed schedule.

For part-night control used in conjunction with motion sensor control, verify and document the following:

(a) During daytime simulation, all controlled outdoor lighting is turned off.

(b) Simulate motion in area under the luminaire controlled by the motion sensor. Verify and document the following:

i. Status indicator operates correctly.

ii. Luminaires controlled by the sensor turn on immediately upon entry into the area lit be the controlled luminaires near the motion sensor.

iii. Signal sensitivity is adequate to achieve desired control.

(c) During simulation of normally occupied schedule, simulate no occupancy in area with lighting controlled by the motion sensor. Verify and document the following:

i. The outdoor lighting power controlled by the motion sensor is reduced by at least 50 percent within a maximum of 15 minutes from the start of an unoccupied condition. Fraction of light output reduction is an acceptable proxy for reduction in lighting power.

ii. Signal sensitivity is adequate to achieve desired control.

(d) During simulation of normally unoccupied schedule, simulate no occupancy in area with lighting controlled by the motion sensor. Verify and document the following:

i. The outdoor lighting power controlled by the motion sensor is reduced by at least 50 percent within a maximum of 15 minutes from the start of an unoccupied condition. Fraction of light output reduction is an acceptable proxy for reduction in lighting power.

ii. Signal sensitivity is adequate to achieve desired control.

~~For occupancy-based control type, verify and document the following:~~

~~Step 1: Simulate motion in area under lights controlled by the sensor. Verify and document the following:~~

~~(a) Status indicator operates correctly.~~

~~(b) Lights controlled by sensors turn on immediately upon entry into the area lit by the controlled lights near the motion sensor.~~

~~(c) Signal sensitivity is adequate to achieve desired control.~~

~~Step 2: Simulate no occupancy in area with lighting controlled by the sensor. Verify and document the following:~~

~~(a) Lights controlled by the sensor are off or reduces light output within a maximum of 30 minutes from the start of an unoccupied condition.~~

~~(b) The sensor does not trigger a false "on" from movement outside of the controlled area.~~

~~(c) Signal sensitivity is adequate to achieve desired control.~~

~~NA7.8.9 Automatic Scheduling Control Construction Inspection~~

~~Prior to functional testing, confirm and document the following:~~

~~(a) Verify the automatic scheduling control is installed.~~

~~(b) Verify the control is programmed with acceptable schedules.~~

~~(c) Demonstrate and document for the lighting control programming including both ON schedule and OFF schedule, for weekday, weekend, and holidays (if applicable).~~

~~(d) Verify the correct time and date is properly set in the control.~~

~~NA7.8.10 Automatic Scheduling Control Functional Testing~~

~~Verify and document the following:~~

~~(a) During daytime simulation, all controlled outdoor lights are turned off.~~

~~(b) During nighttime simulation, all controlled outdoor lights are turned on in accordance with the ON schedule.~~

~~(c) During nighttime simulation, all controlled outdoor lights are turned off in accordance with the OFF schedule.~~

NA7.9 Sign Lighting Acceptance Tests

Reserved For Future Use

NA7.10 Refrigerated Warehouse Refrigeration System Acceptance Tests

The measurement devices used to verify the refrigerated warehouse controls shall be calibrated once every two years using a NIST traceable reference. The calibrated measurement devices to be used in these acceptance tests are called the "standard" and shall have the following measurement tolerances: The temperature measurement devices shall be calibrated to +/- 0.7°F between -30°F and 200°F. The pressure measurement devices shall be calibrated to +/- 2.5 psi between 0 and 500 psig. The relative humidity (RH) measurement devices shall be calibrated to +/- 1% between 5% and 90% RH.

NA7.10.1 Electric Resistance Underslab Heating System

NA7.10.1.1 Construction Inspection

Prior to functional testing, verify and document the following for all electric resistance underslab heating systems:

(a) Verify that summer on-peak period is programmed into all underslab heater controls to meet the requirements of Section 120.6(a)2.

NA7.10.1.2 Functional Testing

Step 1: Using the control system, lower slab temperature setpoint. Verify and document the following using an electrical test meter:

(a) The underslab electric resistance heater is off.

Step 2: Using the control system, raise the slab temperature setpoint. Verify and document the following using an electrical test meter:

(b) The underslab electric resistance heater is on.

Step 3: Using the control system, change the control system's time and date corresponding to the local utility's summer on-peak period. If control system only accounts for time, set system time corresponding to the local utility's summer on-peak period. Verify and document the following using an electrical test meter:

(c) The underslab electric resistance heater is off.

Step 4: Restore system to correct schedule and control setpoints.

NA7.10.2 Evaporators and Evaporator Fan Motor Variable Speed Control

NA7.10.2.1 Construction Inspection

Prior to functional testing, document the following on all evaporators:

(a) All refrigerated space temperature sensors used for control are verified to read accurately (or provide an appropriate offset) using a temperature standard.

(b) All refrigerated space humidity sensors used for control are verified to read accurately (or provide an appropriate offset) using a humidity standard.

(c) All refrigerated space temperature and humidity sensors are verified to be mounted in a location away from direct evaporator discharge air draft.

(d) Verify that all fans motors are operational and rotating in the correct direction.

(e) Verify that fan speed control is operational and connected to evaporator fan motors.

(f) Verify that all speed controls are in "auto" mode.

NA7.10.2.2 Functional Testing

Conduct and document the following functional tests on all evaporators.

Step 1: Measure current space temperature or humidity. Program this temperature or humidity as the test temperature or humidity setpoint into the control system for the functional test steps. Allow 5 minutes for system to normalize.

Step 2: Using the control system, lower test temperature or humidity setpoint in 1 degree or 1% RH increments below any control dead band range until:

(a) Evaporator fan controls modulate to increase fan motor speed.

(b) Evaporator fan motor speed increases in response to controls.

(c) Verify and document the above.

Step 3: Using the control system, raise the test temperature or humidity setpoint in 1 degree or 1% RH increments above any control dead band range until fans go to minimum speed. Verify and document the following:

(d) Evaporator fan controls modulate to decrease fan motor speed.

(e) Evaporator fan motor speed decreases in response to controls.

(f) Minimum fan motor control speed (rpm or percent of full speed).

Step 4: Restore control system to correct control setpoints.

NA7.10.3.1 Evaporative Condensers and Condenser Fan Motor Variable Speed Control

NA7.10.3.1.1 Construction Inspection

Prior to functional testing, document the following:

(a) Verify the minimum condensing temperature control setpoint is at or below 70°F.

(b) Verify the master system controller saturated condensing temperature input is the temperature equivalent reading of the condenser pressure sensor.

(c) Verify all drain leg pressure regulator valves are set below the minimum condensing temperature/pressure setpoint.

(d) Verify all receiver pressurization valves, such as the outlet pressure regulator (OPR), are set lower than the drain leg pressure regulator valve setting.

(e) Verify all condenser inlet and outlet pressure sensors read accurately (or provide an appropriate offset) using a pressure standard.

(f) Verify all ambient dry bulb temperature sensors used by controller read accurately (or provide an appropriate offset) using a temperature standard.

(g) Verify all relative humidity sensor used by controller read accurately (or provide an appropriate offset) using RH standard.

(h) Verify all temperature sensors used by the controller are mounted in a location that is not exposed to direct sunlight.

(i) Verify that all sensor readings used by the condenser controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature; dry bulb and relative humidity sensor readings are correctly converted to wet bulb temperature, etc.)

(j) Verify that all fan motors are operational and rotating in the correct direction.

(k) Verify that all condenser fan speed controls are operational and connected to condenser fan motors to operate in unison the fans serving a common condenser loop.

(l) Verify that all speed controls are in “auto” mode.

NA7.10.3.1.2 Functional Testing

Note: The system cooling load must be sufficiently high to run the test. Artificially increase evaporator loads or decrease compressor capacity (manually turn off compressors, etc.) as may be required to perform the Functional Testing.

Step 1: Override any heat reclaim, floating suction pressure, floating head pressure and defrost functionality before performing functional tests.

Step 2:

(a) Document current outdoor ambient air dry bulb and wet bulb temperatures, relative humidity and refrigeration system condensing temperature/condensing pressure readings from the control system.

(b) Calculate and document the temperature difference (TD), defined as the difference between the wet bulb temperature and the refrigeration system saturated condensing temperature (SCT).

(c) Document current head pressure control setpoint.

Step 3: Using the desired condenser fan motor cycling or head pressure control strategy, program into the control system a setpoint equal to the reading or calculation obtained in Step 2. This will be referred to as the “test setpoint.” Allow 5 minutes for condenser fan speed to normalize.

Step 4: Using the control system, raise the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to minimum fan motor speed. Verify and document the following:

(d) Fan motor speed decreases.

(e) All condenser fan motors serving common condenser loop decrease speed in unison in response to controller output.

(f) Minimum fan motor control speed (rpm or percent of full speed).

(g) If the refrigeration system is already operating at minimum saturated condensing temperature/head pressure, reverse Steps 4 and 5.

Step 5: Using the control system, lower the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to increase fan motor speed. Verify and document the following:

(h) Fan motor speed increases.

(i) All condenser fan motors serving common condenser loop increase speed in unison in response to controller output.

Step 6: Document the current minimum condensing temperature setpoint. Using the control system, change the minimum condensing temperature setpoint to a value greater than the current operating condensing temperature. Verify and document the following:

(j) Condenser fan controls modulate to decrease capacity.

(k) All condenser fans serving common condenser loop modulate in unison.

(l) Condenser fan controls stabilize within a 5 minute period.

Step 7: Using the control system, reset the system head pressure controls, fan motor controls and minimum condensing temperature control setpoint to original settings documented in Steps 3 and 6.

Step 8: Restore any heat reclaim, floating suction pressure, floating head pressure and defrost functionality. Reset the minimum condensing temperature setpoint to the value documented in Step #6.

NA7.10.3.2 Air-Cooled Condensers and Condenser Fan Motor Variable Speed Control

Conduct and document the following functional tests on all air-cooled condensers.

NA7.10.3.2.1 Construction Inspection

Prior to functional testing, document the following:

(a) Verify that the minimum condensing temperature control setpoint is at or below 70°F.

(b) Verify that the master system controller saturated condensing temperature input is the temperature equivalent reading of the condenser pressure sensor.

(c) Verify all drain leg pressure regulator valves are set below the minimum condensing temperature/pressure setpoint.

(d) Verify all receiver pressurization valves, such as the outlet pressure regulator (OPR), are set lower than the drain leg pressure regulator valve setting.

(e) Verify all condenser inlet and outlet pressure sensors read accurately (or provide an appropriate offset) using a pressure standard.

(f) Verify all ambient dry bulb temperature sensors used by controller read accurately (or provide an appropriate offset) using temperature standard.

(g) Verify all temperature sensors used by the controller are mounted in a location that is not exposed to direct sunlight.

(h) Verify that all sensor readings used by the condenser controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature, etc.)

(i) Verify that all fan motors are operational and rotating in the correct direction.

(j) Verify that all condenser fan speed controls are operational and connected to condenser fan motors to operate in unison the fans serving a common condenser loop.

(k) Verify that all speed controls are in “auto” mode.

NA7.10.3.2.2 Functional Testing

Note: The system cooling load must be sufficiently high to run the test. Artificially increase evaporator loads or decrease compressor capacity (manually turn off compressors, etc.) as may be required to perform the Functional Testing.

Step 1: Override any heat reclaim, floating suction pressure, floating head pressure and defrost functionality before performing functional tests.

~~Papachristou Papachristou~~ Document current outdoor ambient air dry bulb temperature and refrigeration system condensing temperature/condensing pressure readings from the control system.

Step 2: Calculate and document the temperature difference (TD), defined as the difference between the dry bulb temperature and the refrigeration system saturated condensing temperature (SCT).

Document current head pressure control setpoint.

Step 3: Using the desired condenser fan motor cycling or head pressure control strategy, program into the control system a setpoint equal to the reading or calculation obtained in Step 2.

This will be referred to as the “test setpoint.” Allow 5 minutes for condenser fan speed to normalize.

Step 4: Using the control system, raise the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to minimum fan motor speed. Verify and document the following:

(a) Fan motor speed decreases.

(b) All condenser fan motors serving common condenser loop decrease speed in unison in response to controller output.

(c) Minimum fan motor control speed (rpm or percent of full speed).

(d) If the refrigeration system is already operating at minimum saturated condensing temperature/head pressure, reverse Steps 4 and 5.

Step 5: Using the control system, lower the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to increase fan motor speed. Verify and document the following:

(a) Fan motor speed increases.

(b) All condenser fan motors serving common condenser loop increase speed in unison in response to controller output.

Step 6: Document current minimum condensing temperature setpoint. Using the control system change the minimum condensing temperature setpoint to a value greater than the current operating condensing temperature. Verify and document the following:

(a) Condenser fan controls modulate to decrease capacity.

(b) All condenser fans serving common condenser loop modulate in unison.

(c) Condenser fan controls stabilize within a 5 minute period.

Step 7: Using the control system, reset the system head pressure controls, fan motor controls and minimum condensing temperature control setpoint to original settings documented in Steps 3 and 6.

Step 8: Restore any heat reclaim, floating suction pressure, floating head pressure and defrost functionality. Reset the minimum condensing temperature setpoint to the value documented in Step 6.

NA7.10.3.3 Adiabatic Condensers and Condenser Fan Motor Variable Speed Control

Conduct and document the following functional tests on all air-cooled condensers.

NA7.10.3.3.1 Construction Inspection

Prior to functional testing, document the following:

(a) Verify that the minimum condensing temperature control setpoint is at or below 70°F.

(b) Verify that the master system controller saturated condensing temperature input is the temperature equivalent reading of the condenser pressure sensor.

(c) Verify all drain leg pressure regulator valves are set below the minimum condensing temperature/pressure setpoint.

(d) Verify all receiver pressurization valves, such as the outlet pressure regulator (OPR), are set lower than the drain leg pressure regulator valve setting.

(e) Verify all condenser inlet and outlet pressure sensors read accurately (or provide an appropriate offset) using a pressure standard.

(f) Verify all ambient dry bulb temperature sensors used by controller read accurately (or provide an appropriate offset) using temperature standard.

(g) Verify all temperature sensors used by the controller are mounted in a location that is not exposed to direct sunlight.

(h) Verify that all sensor readings used by the condenser controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature, etc.)

(i) Verify that all fan motors are operational and rotating in the correct direction.

(j) Verify that all condenser fan speed controls are operational and connected to condenser fan motors to operate in unison the fans serving a common condenser loop.

(k) Verify that all speed controls are in “auto” mode.

NA7.10.3.3.2 Functional Testing

Note: The system cooling load must be sufficiently high to run the test. Artificially increase evaporator loads or decrease compressor capacity (manually turn off compressors, etc.) as may be required to perform the Functional Testing. The functional test shall be performed in dry mode.

Step 1: Override any heat reclaim, floating suction pressure, floating head pressure and defrost functionality before performing functional tests.

Document current outdoor ambient air dry bulb temperature and refrigeration system condensing temperature/condensing pressure readings from the control system.

Step 2: Calculate and document the temperature difference (TD), defined as the difference between the dry bulb temperature and the refrigeration system saturated condensing temperature (SCT).

Document current head pressure control setpoint.

Step 3: Using the desired condenser fan motor cycling or head pressure control strategy, program into the control system a setpoint equal to the reading or calculation obtained in Step 2.

This will be referred to as the “test setpoint.” Allow 5 minutes for condenser fan speed to normalize.

Step 4: Using the control system, raise the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to minimum fan motor speed. Verify and document the following:

(a) Fan motor speed decreases.

(b) All condenser fan motors serving common condenser loop decrease speed in unison in response to controller output.

(c) Minimum fan motor control speed (rpm or percent of full speed).

(d) If the refrigeration system is already operating at minimum saturated condensing temperature/head pressure, reverse Steps 4 and 5.

Step 5: Using the control system, lower the test setpoint in 1 degree (or 3 psi) increments until the condenser fan control modulates to increase fan motor speed. Verify and document the following:

(a) Fan motor speed increases.

(b) All condenser fan motors serving common condenser loop increase speed in unison in response to controller output.

Step 6: Document current minimum condensing temperature setpoint. Using the control system change the minimum condensing temperature setpoint to a value greater than the current operating condensing temperature. Verify and document the following:

(a) Condenser fan controls modulate to decrease capacity.

(b) All condenser fans serving common condenser loop modulate in unison.

(c) Condenser fan controls stabilize within a 5 minute period.

Step 7: Using the control system, reset the system head pressure controls, fan motor controls and minimum condensing temperature control setpoint to original settings documented in Steps 3 and 6.

Step 8: Restore any heat reclaim, floating suction pressure, floating head pressure and defrost functionality. Reset the minimum condensing temperature setpoint to the value documented in Step 6.

NA7.10.4 Variable Speed Screw Compressors

Conduct and document the following functional tests on all variable-speed screw compressors.

NA7.10.4.1 Construction Inspection

Prior to functional testing, document the following:

(a) Verify all single open-drive screw compressors dedicated to a suction group have variable speed control.

(b) Verify all compressor suction and discharge pressure sensors read accurately (or provide an appropriate offset) using a standard.

(c) Verify all input or control temperature sensors used by controller read accurately (or provide an appropriate offset) using temperature standard.

(d) Verify that all sensor readings used by the compressor controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature, etc.).

(e) Verify that all compressor speed controls are operational and connected to compressor motors.

(f) Verify that all speed controls are in “auto” mode.

(g) Verify that compressor panel control readings for “RPMs,” “% speed,” “kW”, and “amps” match the readings from the PLC or other control systems.

(h) Verify that compressor nameplate data is correctly entered into the PLC or other control system.

NA7.10.4.2 Functional Testing

Note: The system cooling load must be sufficiently high to run the test. Artificially increase or decrease evaporator loads (add or shut off zone loads, change setpoints, etc.) as may be required to perform the Functional Testing.

Step 1: Override any heat reclaim, floating suction pressure, floating head pressure and defrost functionality before performing functional tests.

Step 2: Measure and document the current compressor operating suction pressure and saturated suction temperature.

Step 3: Document the suction pressure/saturated suction temperature setpoint. Program into the control system a target setpoint equal to the current operating condition measured in Step #2. Allow 5 minutes for system to normalize. This will be referred to as the "test suction pressure/saturated suction temperature setpoint."

Step 4: Using the control system, raise the test suction setpoint in 1 psi increments until the compressor controller modulates to decrease compressor speed. Verify and document the following:

(a) Compressor speed decreases.

(b) Compressor speed continues to decrease to minimum speed.

(c) Any slide valve or other unloading means does not unload until after the compressor has reached its minimum speed (RPM).

Step 5: Using the control system, lower the test suction setpoint in 1 psi increments until the compressor controller modulates to increase compressor speed. Verify and document the following:

(d) Any slide valve or other unloading means first goes to 100 percent before compressor speed increases from minimum.

(e) Compressor begins to increase speed.

(f) Compressor speed continues to increase to 100 percent.

Step 6: Using the control system, program the suction target setpoints back to original settings as documented in Step 3.

Step 7: Restore any heat reclaim, floating suction pressure, floating head pressure and defrost functionality.

NA7.11 Commercial Kitchen Exhaust System Acceptance Tests

NA7.11.1 Kitchen Exhaust Systems with Type I Hood Systems

The following acceptance tests apply to commercial kitchen exhaust systems with Type I exhaust hoods. All Type I exhaust hoods used in commercial kitchens shall be tested.

NA7.11.1.1 Construction Inspection

Step 1: Verify exhaust and replacement air systems are installed, power is installed and control systems such as demand control ventilation are calibrated.

Step 2: For kitchen/dining facilities having total Type 1 and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, calculate the maximum allowable exhaust rate for each Type 1 hood as specified by Table 140.9-A.

NA7.11.1.2 Functional Testing at Full Load Conditions

The following acceptance test applies to systems with and without demand control ventilation exhaust systems. These tests shall be conducted at full load conditions.

Step 1: Operate all sources of outdoor air providing replacement air for the hoods.

Step 2: Operate all sources of recirculated air providing conditioning for the space in which the hoods are located.

Step 3: Operate all appliances under the hoods at operating temperatures.

Step 4: Verify that the thermal plume and smoke is completely captured and contained within each hood at full load conditions by observing smoke or steam produced by actual cooking operation and/or by visually seeding the thermal plume using devices such as smoke candles or smoke puffers. Smoke bombs shall not be used (note: smoke bombs typically create a large volume of effluent from a point source and do not necessarily confirm whether the cooking effluent is being captured). For some appliances (e.g., broilers, griddles, fryers), actual cooking at the normal production rate is a reliable method of generating smoke). Other appliances that typically generate hot moist air without smoke (e.g., ovens, steamers) need seeding of the thermal plume with artificial smoke to verify capture and containment.

Step 5: Verify that space pressurization is appropriate (e.g. kitchen is slightly negative relative to adjacent spaces and all doors open/close properly).

Step 6: Verify that each Type 1 hood has an exhaust rate that is below the maximum allowed.

Step 7: Make adjustments as necessary until full capture and containment and adequate space pressurization are achieved and maximum allowable exhaust rates are not exceeded. Adjustments may include:

(a) Adjust exhaust hood airflow rates

(b) Add hood side panels

(c) Add rear seal (back plate)

(d) Increase hood overhang by pushing equipment back

(e) Relocate supply outlets to improve the capture and containment performance

Step 8: Measure and record final exhaust airflow rate per Type 1 hood.

NA7.11.1.3 Functional Testing for Exhaust Systems with Demand Control Ventilation

The following additional acceptance test shall be performed on all exhaust hoods with demand control ventilation exhaust systems.

Step 1: Turn off all kitchen hoods, makeup air and transfer systems.

Step 2: Turn on one of the appliances on the line and bring to operating temperature. Confirm that:

(a) DCV system automatically switches from off to the minimum flow setpoint.

(b) The minimum flow setpoint does not exceed the larger of:

1. 50% of the design flow, or
2. The ventilation rate required as specified by Section 120.1.

(c) The makeup air and transfer air system flow rates modulate as appropriate to match the exhaust rate.

(d) Appropriate space pressurization is maintained.

Step 3: Press the timed override button. Confirm that system ramps to full speed and back to minimum speed after override times out.

Step 4: Operate all appliances at typical conditions. Apply sample cooking products and/or utilize smoke puffers as appropriate to simulate full load conditions. Confirm that:

(e) DCV system automatically ramps to full speed.

(f) Hood maintains full capture and containment during ramping to and at full-speed.

(g) Appropriate space pressurization is maintained.

NA7.12 Parking Garage Ventilation System Acceptance Tests

NA7.12.1 Construction Inspection

Verify and document the following tests prior to the functional testing:

(a) Carbon monoxide control sensor is factory-calibrated as specified by Section 120.6(c).

(b) The sensor is located in the highest expected concentration location in its zone as specified by Section 120.6(c).

(c) Control setpoint is at or below the CO concentration permitted by Section 120.6(c).

NA7.12.2 Functional Testing

Conduct the following tests with garage ventilation system operating in occupied mode and with actual garage CO concentration well below setpoint.

Step 1: With all sensors active and all sensors reading below 25 ppm, observe that fans are at minimum speed and fan motor demand is no more than 30 percent of design wattage.

Step 2: Apply CO span gas with a concentration of 30 ppm, and a concentration accuracy of +/- 2%, one by one to 50% of the sensors but no more than 10 sensors per garage and to at least one sensor per proximity zone. For each sensor tested observe:

(a) CO reading is between 25 and 35 ppm.

(b) Ventilation system ramps to full speed when span gas is applied.

(c) Ventilation system ramps to minimum speed when span gas is removed.

Step 3: Temporarily override the programmed sensor calibration/replacement period to 5 minutes.

(d) Wait 5 minutes and observe that fans ramp to full speed and an alarm is received by the facility operators. Restore calibration/replacement period.

Step 4: Temporarily place the system in unoccupied mode and override the programmed unoccupied sensor alarm differential from 30% for 4 hours to 1% for 5 minutes. Wait 5 minutes and observe that fans ramp to full speed and an alarm is received by the facility operators. Restore programming.

Step 5: Temporarily override the programmed occupied sensor proximity zone alarm differential from 30% for 4 hours to 1% for 5 minutes. Wait 5 minutes and observe that fans ramp to full speed and an alarm is received by the facility operators. Restore programming.

NA7.13 Compressed Air System Acceptance Tests

NA7.13.1 Construction Inspection

Prior to functional testing, a compressed air system must verify and document the following:

(a) Size (hp), rated capacity (acfm), and control type of each air compressor

(b) Total online system capacity (the sum of the individual capacities)

(c) System operating pressure

(d) Compressor(s) designated as trim compressors

(e) Method for observing and recording the states of each compressor in the system, which shall include at least the following states:

Off

Unloaded

Partially loaded

Fully loaded

Short cycling (loading and unloading more often than once per minute)

Blow off (venting compressed air at the compressor itself)

NA7.13.2 Functional Testing

Step 1: As specified by the test methods outlined in the Construction Inspection, verify that these methods have been employed, so that the states of the compressors and the current air demand (as measured by a flow sensor or otherwise inferred by system measurements) can be observed and recorded during testing.

Step 2: Run the compressed air supply system steadily at as close to the expected operational load range as can be practically implemented, for a duration of at least 10 minutes.

Step 3: Observe and record the states of each compressor and the current air demand during the test.

Step 4: Confirm that the combinations of compressors states meet the following criteria:

(a) No compressor exhibits short-cycling (loading and unloading more often than once per minute).

(b) No compressor exhibits blowoff (venting compressed air at the compressor itself).

(c) For new systems, the trim compressors shall be the only compressors partially loaded, while the base compressors will either be fully loaded or off by the end of the test.

NA7.14 Elevator Lighting and Ventilation Controls

NA7.14.1 Construction Inspection

Verify and document the following prior to functional testing:

(a) The ~~O~~occupancy sensor has been located to minimize false signals, and the elevator cab does not have any obstructions that could adversely affect the sensor's performance.

(b) For PIR sensors, the sensor pattern does not enter into the elevator lobby.

~~(c) Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.~~

(~~d~~c) For ~~U~~ultrasonic ~~occupancy~~ sensors, the sensor does not emit audible sound.

Note that some elevators are able to use weight sensors to provide occupancy sensing. In this case, document that the elevator uses weight sensing to provide occupant sensing and proceed to the functional test.

NA7.14.2 Functional Testing

For each elevator cab being tested, confirm the following:

(a) Verify that the lighting and ventilation controlled inside the elevator cab turn off after 15 minutes from the start of an unoccupied condition.

(b) Verify that the signal sensitivity is adequate to achieve desired control. The sensor should not detect motion in the elevator lobby.

(c) Verify that lighting and ventilation immediately turn "on" when an unoccupied condition becomes occupied.

(d) Verify that the lighting and ventilation will not shut off when occupied. Stand in the elevator with the door closed and wait 15 minutes to confirm that the lighting and ventilation remain on.

NA7.15 Escalator and Moving Walkway Speed Control

NA7.15.1 Construction Inspection

Verify and document the following prior to functional testing:

(a) Variable speed drive is installed on the escalator.

(b) Occupancy sensor has been located to minimize false signals.

(c) Occupancy sensors do not trigger from pedestrians on adjacent escalators.

(d) Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.

(e) Ultrasonic occupancy sensors do not emit audible sound

NA7.15.2 Functional Testing

For each escalator or moving walkway being tested, confirm the following:

(a) Verify the amount of time necessary to ride the entire length of the escalator while standing still.

(b) Stand away from the escalator. After being in an unoccupied condition for more than three times the length of time for a full ride, the escalator should slow down.

(c) Approach the escalator entrance while in an unoccupied condition from multiple angles to ensure passenger detection cannot be bypassed.

(d) Verify the slow speed setting is 10 ft/min.

(e) Verify the full speed setting is below 100 ft/min.

(f) Verify the acceleration and deceleration of speed changes. The acceleration shall not exceed 1 ft/sec sq.

(g) Approach the escalator in an unoccupied condition at an average walking pace. The escalator should reach full speed before boarding.

(h) Approach the escalator in an unoccupied condition at an average walking pace. The escalator should reach full speed before boarding. An alarm should signal to alert that the pedestrian is approaching in the wrong direction.

NA7.16 Lab Ventilation System Acceptance Test

NA7.16.1 Construction Inspection for Wind Speed/Direction Control

Verify and document the following prior to functional testing:

(a) Wind speed and direction sensor is factory-calibrated (with calibration certificate) or field calibrated, as specified by Section 140.9(c)3C.

(b) The sensor is located in a location and at a height that is outside the wake region of nearby structures and experiences similar wind conditions to the free stream environment above the exhaust stacks as specified by Section 140.9(c)3C.

(c) The sensor is installed in close proximity to the fan that it will control so that it captures a representative wind speed/direction reading.

(d) The sensor is wired correctly to the controls to ensure proper control of volume flow rate.

(e) Wind speed/direction look-up table has been established and matches dispersion analysis results.

(f) Verify the methodology to measure volume flow rate:

1. Airflow sensor.
2. Static pressure as proxy.
3. Fan speed to volume flow rate curve.
4. Other.

NA7.16.2 Functional Testing for Wind Speed/Direction Control

Step 1: Simulate the minimum look-up table wind speed by either covering the sensor or overriding the curve points so the current wind speed is below the speed correlating to minimum volume flow rate at the stack.

(a) With all sensors active and all sensors reading below the minimum wind speed, observe minimum volume flow rate at the stack.

(b) Restore all curve points.

Step 2: Simulate a mid-range wind speed from the look-up table by either inducing a wind current, with an air speed accuracy of +/- 2%, or overriding the curve points so the current wind speed correlates to a mid-range volume flow rate at the stack.

(a) With all sensors active and all sensors reading a mid-range wind speed, observe corresponding mid-range volume flow rate at the stack.

(b) Restore all curve points.

Step 3: Simulate the maximum look-up table wind speed by either inducing a wind current, with an air speed accuracy of +/- 2%, or overriding the curve points so the current wind speed correlates to the maximum volume flow rate at the stack.

(a) With all sensors active and all sensors reading above the maximum wind speed, observe maximum volume flow rate at the stack.

(b) Restore all curve points.

Step 4: Temporarily override the programmed sensor calibration/replacement period to 5 minutes. Wait 5 minutes and observe that minimum volume flow rate at the stack is that at worst-case wind conditions and an alarm is received by the facility operators. Restore calibration/replacement period.

Step 5: Simulate sensor failure by disconnecting the sensor. Observe that minimum volume flow rate at the stack is that at worst-case wind conditions and an alarm is received by the facility operators. Reconnect sensor.

NA7.16.3 Construction Inspection for Containment Control

Verify and document the following tests prior to functional testing:

(a) Contaminant sensor is factory-calibrated (with calibration certificate) or field calibrated, as specified by Section 140.9(c)3D.

(b) The sensor is located within each exhaust plenum as specified by Section 140.9(c)3D.

(c) The sensor is wired correctly to the controls to ensure proper control of volume flow rate.

(d) Contaminant concentration threshold has been established and matches dispersion analysis results.

(e) Verify the methodology to measure volume flow rate:

1. Airflow sensor
2. Static pressure as proxy
3. Fan speed to volume flow rate curve
4. Other

~~(a)~~(f) If multiple sensors are present, ensure fan is controlled based on the highest concentration reading.

NA7.16.4 Functional Testing For Contaminant Control

Step 1: Ensure no contaminant event is present. Simulate minimum exhaust air demand in all lab spaces.

Verify that the volume flow rate at the stack is at or above the minimum non-event value.

Step 2: Increase exhaust air demand at the lab spaces.

Verify that the volume flow rate at the stack is at or above the minimum non-event value.

Step 3: Simulate minimum exhaust air demand in all lab spaces. Simulate a contaminant event.

Verify that the volume flow rate at the stack is at or above the minimum event value.

Step 4: Increase exhaust air demand at the lab spaces.

Verify that the volume flow rate at the stack is at or above the minimum event value.

Step 5: Temporarily override the programmed sensor calibration/replacement period to 5 minutes. Wait 5 minutes and observe that minimum volume flow rate at the stack is that of a contaminant event and an alarm is received by the facility operators. Restore calibration/replacement period.

Step 6: Simulate sensor failure by disconnecting the sensor. Observe that minimum volume flow rate at the stack is that of a contaminant event and an alarm is received by the facility operators. Reconnect sensor.

Nonresidential Appendix NA8

Appendix NA8 –Luminaire Power

NA8.1 Luminaire Power

The following tables contain a limited list of lamp and ballast combinations. These tables provide an alternate voluntary option to the provision in Section 130(c) for determining luminaire power for any lamp and ballast combination specifically listed in Appendix NA8. This appendix is not intended to list all possible lamp and ballast combinations, and shall not to be used to determine luminaire power for any lighting system not specifically listed in this appendix.

Table NA8-1 – Fluorescent U-Tubes

Type	Lamps		Ballasts			System Watts
	Number	Designation	Number	Designation	Description	
2 ft. Fluorescent U-Tube T8	1	FB31T8/F32T8U	1	ELECT NO	Electronic Normal Output	39
	2	FB31T8/F32T8U	1	ELECT NO	Electronic Normal Output	62
	3	FB31T8/F32T8U	1	ELECT NO	Electronic Normal Output	92
	1	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	33
	2	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	64
	3	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	93
	4	FB31T8/F32T8U	1	ELECT DIM	Electronic Dimming	116

NO = ballast factor 85 to 100%

Table NA8-2 – Fluorescent Linear Lamps T5

Type	Lamps		Ballasts			System Watts
	Number	Designation	Number	Designation	Description	
~23" Fluorescent Program Start T5 (14W)	1	F14T5	1	ELECT	Elect. Program Start BF=1	18
	2	F14T5	1	ELECT	Elect. Program Start BF=1	34
~34.5" Fluorescent Program Start T5 (21W)	1	F21T5	1	ELECT	Elect. Program Start BF=1	27
	2	F21T5	1	ELECT	Elect. Program Start BF=1	50
~46" Fluorescent Program Start T5 (28W)	1	F28T5	1	ELECT	Elect. Program Start BF=1	30
	2	F28T5	1	ELECT	Elect. Program Start BF=1	60
~58.5" Fluorescent Program Start T5 (35W)	1	F35T5	1	ELECT	Elect. Program Start BF=1	40
	2	F35T5	1	ELECT	Elect. Program Start BF=1	78
~23" Fluorescent Program Start T5 High Output (24W)	1	F24T5HO	1	ELECT	Elect. Program Start BF=1	29
	2	F24T5HO	1	ELECT	Elect. Program Start BF=1	55
~34.5" Fluorescent Program Start T5 High Output(39W)	1	F39T5	1	ELECT	Elect. Program Start BF=1	43
	2	F39T5	1	ELECT	Elect. Program Start BF=1	85
~46" Fluorescent Program Start T5 High Output (54W)	1	F54T5	1	ELECT	Elect. Program Start BF=1	62
	2	F54T5	1	ELECT	Elect. Program Start BF=1	121
	1	F54T5	1	ELECT DIM	Elect. Dimming	63
	2	F54T5	1	ELECT DIM	Elect. Dimming	125
~57.5" Fluorescent Program Start T5 High Output (80W)	1	ºF80T5	1	ELECT	Elect. Program Start BF=1	90

Table NA8-3 – Fluorescent Rapid Start T-8

Type	Lamps		Ballasts			System Watts
	Number	Designation	Number	Designation	Description	
2 foot Fluorescent Rapid Start T8 (17W) Electronic Ballasts	1	F17T8	1	ELECT NO	Electronic Normal Output	22
	2	F17T8	1	ELECT NO	Electronic Normal Output	33
	3	F17T8	1	ELECT NO	Electronic Normal Output	53
	3	F17T8	2	ELECT NO	Electronic Normal Output	55
	4	F17T8	1	ELECT NO	Electronic Normal Output	63
2 foot Fluorescent Rapid Start T8 (17W)	1	F17T8	1	ELECT DIM	Electronic Dimming	20
	2	F17T8	1	ELECT DIM	Electronic Dimming	37
	3	F17T8	1	ELECT DIM	Electronic Dimming	56
	4	F17T8	1	ELECT DIM	Electronic Dimming	69
3 foot Fluorescent Rapid Start T8 (25W) Electronic Ballasts	1	F25T8	1	ELECT NO	Electronic Normal Output	27
	2	F25T8	1	ELECT NO	Electronic Normal Output	48
	3	F25T8	1	ELECT NO	Electronic Normal Output	68
	4	F25T8	1	ELECT NO	Electronic Normal Output	89
	1	F25T8	1	ELECT RO	Electronic Reduced Output	24
	2	F25T8	1	ELECT RO	Electronic Reduced Output	41
	3	F25T8	1	ELECT RO	Electronic Reduced Output	59
	4	F25T8	1	ELECT RO	Electronic Reduced Output	76
	1	F25T8	1	ELECT HO	Electronic High Output	29
	2	F25T8	1	ELECT HO	Electronic High Output	51
	3	F25T8	1	ELECT HO	Electronic High Output	74
	1	F25T8	1	ELECT DIM	Electronic Dimming	25
	2	F25T8	1	ELECT DIM	Electronic Dimming	49
	3	F25T8	1	ELECT DIM	Electronic Dimming	76
	4	F25T8	1	ELECT DIM	Electronic Dimming	96

Table NA8-3 (continued) – Fluorescent Rapid Start T-8

4 foot Fluorescent Instant Start T8 (“Energy Saving” 30W)	1	F32T8/30ES	1	ELECT NO	Electronic Normal Output	29
	2	F32T8/30ES	1	ELECT NO	Electronic Normal Output	54
	3	F32T8/30ES	1	ELECT NO	Electronic Normal Output	79
	4	F32T8/30ES	1	ELECT NO	Electronic Normal Output	104
	1	F32T8/30ES	1	ELECT RO	Electronic Reduced Output	27
	2	F32T8/30ES	1	ELECT RO	Electronic Reduced Output	48
	3	F32T8/30ES	1	ELECT RO	Electronic Reduced Output	70
	4	F32T8/30ES	1	ELECT RO	Electronic Reduced Output	91
	1	F32T8/30ES	1	ELECT NO EE	EE Normal Output	33
	2	F32T8/30ES	1	ELECT NO EE	Energy efficiency Normal Output	52
	3	F32T8/30ES	1	ELECT NO EE	Energy efficiency Normal Output	77
	4	F32T8/30ES	1	ELECT NO EE	Energy efficiency Normal Output	101
	1	F32T8/30ES	1	ELECT RO EE	EE Reduced Output	28
	2	F32T8/30ES	1	ELECT RO EE	EE Reduced Output	45
	3	F32T8/30ES	1	ELECT RO EE	EE Reduced Output	66
	4	F32T8/30ES	1	ELECT RO EE	EE Reduced Output	88

Table NA8-3 (continued) – Fluorescent Rapid Start T-8

4 foot Fluorescent Rapid Start T8 (32W)	1	F32T8	1	ELECT NO	Electronic Normal Output	32
	2	F32T8	1	ELECT NO	Electronic Normal Output	62
	3	F32T8	1	ELECT NO	Electronic Normal Output	93
	4	F32T8	1	ELECT NO	Electronic Normal Output	114
	1	F32T8	1	EE NO	EE Normal Output	35
	2	F32T8	1	EE NO	EE Normal Output	55
	3	F32T8	1	EE NO	EE Normal Output	82
	4	F32T8	1	EE NO	EE Normal Output	107
	1	F32T8	1	ELECT RO	Electronic Reduced Output	29
	2	F32T8	1	ELECT RO	Electronic Reduced Output	51
	3	F32T8	1	ELECT RO	Electronic Reduced Output	76
	4	F32T8	1	ELECT RO	Electronic Reduced Output	98
	2	F32T8	1	ELECT HO	Electronic High Output	77
	3	F32T8	1	ELECT HO	Electronic High Output	112
	1	F32T8	1	EE RO	EE Reduced Output	30
	2	F32T8	1	EE RO	EE Reduced Output	48
	3	F32T8	1	EE RO	EE Reduced Output	73
	4	F32T8	1	EE RO	EE Reduced Output	96
	2	F32T8	1	ELECT TL	Electronic Two Level (50 & 100%)	65
	1	F32T8	1	ELECT DIM1	Electronic Dimming	35
	2	F32T8	1	ELECT DIM1	Electronic Dimming	68
	3	F32T8	1	ELECT DIM1	Electronic Dimming	102
	1	F32T8	1	ELECT DIM2	Electronic Dimming	33
	2	F32T8	1	ELECT DIM2	Electronic Dimming	64
	3	F32T8	1	ELECT DIM2	Electronic Dimming	93
	4	F32T8	1	ELECT DIM2	Electronic Dimming	116
5 foot Fluorescent Rapid Start T8 (40W)	1	F40T8	1	ELECT	Electronic	46
	2	F40T8	1	ELECT	Electronic	79
	3	F40T8	1	ELECT	Electronic	112

RO = ballast factor 70 to 85% NO = ballast factor 85 to 100% HO = ballast factor >100%

Table NA8-4 – Fluorescent Rapid Start High Output (HO) T8, 8 ft

Type	Lamps		Ballasts			System Watts	Comment
	Number	Designation	Number	Designation	Description		
8 foot Fluorescent Rapid Start T8 High Output (86W)	1	F96T8/HO	1	ELECT	Electronic	88	
	2	F96T8/HO	1	ELECT	Electronic	160	

HO = ballast factor >100%

Table NA8-5 – High Intensity Discharge

Type	Lamps		Ballasts			System Watts	Comment
	Number	Designation	Number	Designation	Description		
Metal Halide	1	M35/39	1	MAG STD	Mag. Stand.	58	
	1	M35/39	1	ELECT	Electronic	44	
	1	M50	1	MAG STD	Mag. Stand.	67	
	1	M50	1	ELECT	Electronic	58	
	1	M70	1	MAG STD	Mag. Stand.	95	
	1	M70	1	ELECT	Electronic	86	
	1	M100	1	MAG STD	Mag. Stand.	130	
	1	M100	1	ELECT	Electronic	110	
	1	M150	1	MAG STD	Mag. Stand.	185	
	1	M150	1	ELECT	Electronic	168	
	1	M175	1	MAG STD	Mag. Stand.	208	
	1	M175	1	ELECT	Electronic	194	
	1	M200	1	MAG STD	Mag. Stand.	232	
	1	M250	1	MAG STD	Mag. Stand.	295	
	1	M250	1	ELECT	Electronic	269	
	1	M320	1	MAG STD	Mag. Stand.	368	
	1	M320	1	ELECT	Electronic	343	
	1	M360	1	MAG STD	Mag. Stand.	422	
	1	M400	1	MAG STD	Mag. Stand.	452	
	1	M400	1	ELECT	Electronic	430	
	1	M450	1	MAG STD	Mag. Stand.	508	
	1	M750	1	MAG STD	Mag. Stand.	818	
	1	M1000	1	MAG STD	Mag. Stand.	1080	
	1	M1500	1	MAG STD	Mag. Stand.	1605	
High Pressure Sodium	1	S35	1	MAG STD	Mag. Stand.	47	
	1	S50	1	MAG STD	Mag. Stand.	66	
	1	S70	1	MAG STD	Mag. Stand.	91	
	1	S100	1	MAG STD	Mag. Stand.	128	
	1	S150	1	MAG STD	Mag. Stand.	188	
	1	S200	1	MAG STD	Mag. Stand.	230	
	1	S250	1	MAG STD	Mag. Stand.	295	
	1	S400	1	MAG STD	Mag. Stand.	464	
	1	S1000	1	MAG STD	Mag. Stand.	1100	

Table NA8-6 –12 Volt Tungsten Halogen Lamps Including MR16, Bi-pin, AR70, AR111, PAR36

(Shall NOT apply to track lighting systems)

Type	Lamps		Ballasts			System Watts	Comment
	Number	Designation	Number	Designation	Description		
	1	20 watt lamp	1	ELECT	Electronic Power Supply	23	
	1	25 watt lamp	1	ELECT	Electronic Power Supply	28	
	1	35 watt lamp	1	ELECT	Electronic Power Supply	38	
	1	37 watt lamp	1	ELECT	Electronic Power Supply	41	
	1	42 watt lamp	1	ELECT	Electronic Power Supply	45	
	1	50 watt lamp	1	ELECT	Electronic Power Supply	54	
	1	65 watt lamp	1	ELECT	Electronic Power Supply	69	
	1	71 watt lamp	1	ELECT	Electronic Power Supply	75	
	1	75 watt lamp	1	ELECT	Electronic Power Supply	80	
	1	20 watt lamp	1	MAG	Mag. Transformer	24	
	1	25 watt lamp	1	MAG	Mag. Transformer	29	
	1	35 watt lamp	1	MAG	Mag. Transformer	39	
	1	37 watt lamp	1	MAG	Mag. Transformer	42	
	1	42 watt lamp	1	MAG	Mag. Transformer	46	
	1	50 watt lamp	1	MAG	Mag. Transformer	55	
	1	65 watt lamp	1	MAG	Mag. Transformer	70	
	1	71 watt lamp	1	MAG	Mag. Transformer	76	
	1	75 watt lamp	1	MAG	Mag. Transformer	81	