CALIFORNIA STATEWIDE
UTILITY CODES AND STANDARDS PROGRAM

2016 Title 24 Codes & Standards Enhancement (CASE) Proposal

Residential HVAC Field Verification and Diagnostics

CEC Staff Workshop, July 21st, 2014

Farhad Farahmand, TRC

Proposed Code Change Overview

Residential HVAC Verification and Diagnostics

- Four (4) measures to clarify refrigerant charge related language
  1. 150.1(c)7Ai and RA3.2 – Require liquid line filter driers
  2. 150.1(c)7Aib, 150.2(b)1Fi, and JA6.1 — Rename Charge Indicator Displays (CIDs) to Fault Indicator Displays (FIDs)
  3. RA3.2.1– Clarify that manufacturer specifications should be used as the basis for charge verification
  4. RA2.4.4, Compliance Forms, and Compliance Manual – Require installers to notify homeowners that their units have not been verified of charge

Initial Data and Findings

- Field and lab findings
  - Split systems with inside coil and outdoor compressor bearing unit are common
  - Installed on-site without the benefits of production line QC
  - 2012 study indicates testing, diagnosing, and repairing faults are not done properly

- DNV KEMA, WO32 EM&V Interim Findings Memo for Commercial Quality Maintenance – Volume 1 - Field Observations, From WO32 EM&V Team to HVAC Project Coordination Group. August 14, 2013.

Related Industry Organizations

- Western HVAC Performance Alliance
  - Advisory group composed of manufacturers, consultants, researchers, distributors, and contractors
- ASHRAE Standard Project Committee 207
  - Provides a method to test performance of fault detection and diagnostic (FDD) tools function
    - CIDs and FIDs are subcategories of FDD tools
  - For commercial air-cooled packaged equipment
  - Launch in 2012, goal is a public review draft by January 2015

1. Require Liquid Line Filter Driers

- Mitigates damage from debris and moisture in refrigerant introduced as a result of improper installation
- Standard practice
  - OEMs typically ship and require installation
  - Sometimes omitted
- Easily verified

Proposed Code Change Language

Section 150.1(c)7Ai and RA3.2: Require liquid line filter drier installation

150.1 - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR NEWLY CONSTRUCTED RESIDENTIAL BUILDINGS

(c) **Prescriptive Standards/Component Package […]**

7. Space Heating and Space Cooling […]

A. Refrigerant Charge. When refrigerant charge verification or fault indicator display is shown as required by TABLE 150.1-A,

i air-cooled air conditioners and air-source heat pumps (including but not limited to ducted split systems, ducted packaged systems, and mini-split systems) shall comply with the following requirements if the procedures are applicable to the system:

a. Be equipped with a liquid line filter drier if required per manufacturer's instructions; and,

b~~a~~. Have measurement access holes (MAH) […]; or

c~~b~~. Be equipped with a charge indicator display (CID) device …

Proposed Code Change Language

Section 150.1(c)7Ai and RA3.2: Require liquid line filter drier installation

RA3.2.2 Standard Charge Verification Procedure

- RA3.2.2.1 – Minimum Qualifications
- RA3.2.2.2 – Instrumentation Specifications
- RA3.2.2.3 – Measurement Access Hole Specification
- RA3.2.2.4 – Calibration
- RA3.2.2.5 – Liquid Line Filter Drier Installation
- RA3.2.2.~~5~~6 – Charge Verification Measurements
- RA3.2.2.~~6~~7 – Refrigerant Charge and Metering Device Calculations

RA3.2.3 Weigh-in Charging Procedure

- RA3.2.3.1.1 – Procedure Options
- RA3.2.3.1.2 – Minimum Qualifications
- RA3.2.3.1.3 – Instrumentation Specifications
- RA3.2.3.1.4 – Calibration
- RA3.2.2.1.5 – Liquid Line Filter Drier Installation
- RA3.2.3.1.~~5~~6 – Weigh-in Procedure

Proposed Code Change Language

Section 150.1(c)7Ai and RA3.2: Require liquid line filter drier installation

RA3.2 – Field Verification and Diagnostic Testing of Refrigerant Charge for Air Conditioners and Heat Pumps

RA3.2.2 Standard Charge Verification Procedure

[…]

RA3.2.2.5 Liquid Line Filter Drier Installation

Liquid line filter driers shall be installed if required per manufacturer's instructions, and installed with the proper orientation with respect to refrigerant flow, if applicable.

[…]

Proposed Code Change Language

Section 150.1(c)7Ai and RA3.2: Require liquid line filter drier installation

RA3.2 – Field Verification and Diagnostic Testing of Refrigerant Charge for Air Conditioners and Heat Pumps

RA3.2.3 Weigh-in Charging Procedure

[…]

RA3.2.3.1 HVAC Installer – Weigh-in Charging Procedure

[…]

RA3.2.3.1.5 Liquid Line Filter Drier Installation

Liquid line filter driers shall be installed if required per manufacturer's instructions, and installed with the proper orientation with respect to refrigerant flow, if applicable.

[…]

RA3.2.3.2 HERS Rater – Observation of Weigh-in Charging Procedure

[…]

(b) The lineset correction is calculated based on the length and diameter of the lineset, including the liquid line filter drier if required per manufacturer instructions.

[…]

2. Rename CIDs to FIDs

- Change name to Fault Indicator Display (FID)
- CEC approval process allows devices that meet a generic set of criteria
  - Signal that broad range of devices may comply
  - Primarily commercial fault detection devices on the market
    - Compressor operation
    - Surface temperature
    - Vibrations
    - Performance degradation
  - Must still detect charge and airflow performance

Proposed Code Change Language

Section 150.1(c), 150.2(b), and JA6.1: CIDs to FIDs

150.1 - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR NEWLY CONSTRUCTED RESIDENTIAL BUILDINGS

(c) **Prescriptive Standards/Component Package […]**

7. Space Heating and Space Cooling […]

A. Refrigerant Charge. When refrigerant charge verification or ~~charge~~ fault indicator display is shown as required by TABLE 150.1-A,

i air-cooled air conditioners and air-source heat pumps (including but not limited to ducted split systems, ducted packaged systems, and mini-split systems) shall comply with the following requirements if the procedures are applicable to the system:

a. Have measurement access holes (MAH) […]; or,

b. Be equipped with a ~~charge~~ fault indicator display (~~C~~FID) device that provides a clearly visible indication to the occupant when the air conditioner fails to meet the required system operating parameters specified in the applicable section of Reference Joint Appendix JA6 for the installed ~~C~~FID technology. The ~~C~~FID indication shall be constantly visible and within one foot of the air conditioner's thermostat. ~~C~~FID installations shall be confirmed by field verification and diagnostic testing utilizing the procedures specified in Reference Residential Appendix RA3.4.2.

Proposed Code Change Language

Section 150.1(c), 150.2(b), and JA6.1: CIDs to FIDs

150.1 - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR NEWLY CONSTRUCTED RESIDENTIAL BUILDINGS

(c) **Prescriptive Standards/Component Package […]**

CONTINUED: TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design

			Climate Zone								
			1	2	3	4	5	6	7	8	9
HVAC SYSTEM	Space Heating[8]	Electric-Resistance Allowed	No	No	No	No	No	No	No	No	No
		If gas, AFUE	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		If Heat Pump, HSPF[6]	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	Space cooling	SEER	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		Refrigerant Charge Verification or ~~Charge~~ Fault Indicator Display	NR	REQ	NR	NR	NR	NR	NR	REQ	REQ
		Whole House Fan[7]	NR	NR	NR	NR	NR	NR	NR	REQ	REQ
	al n ers										

Proposed Code Change Language

Section 150.1(c), 150.2(b), and JA6.1: CIDs to FIDs

150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS

(b) **Alterations […]**

1. Prescriptive approach. […]

F. Altered Space-Conditioning System - Mechanical Cooling: […]

Additionally, these systems shall comply with the following requirements as applicable:

i. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners and air-source heat pumps (including but not limited to ducted split systems, ducted package systems, and minisplit systems) shall have proper refrigerant charge field verified in accordance with all applicable procedures specified in Reference Residential Appendix Section RA3.2.2, or Reference Residential Appendix RA1 if the procedures in Section RA3.2.2, or RA1 are applicable to the system, or be equipped with a ~~C~~FID that meets the requirements in Section 150.1(c)7Aib if the ~~C~~FID is applicable to the system.

a. Systems that do not comply with the minimum 300 cfm per ton airflow requirement as specified in Reference Residential Appendix Section RA3.2.2.7.2 shall comply with the procedures in Section RA3.2.2.7.3;

[…]

Proposed Code Change Language

Section 150.1(c), 150.2(b), and JA6.1: CIDs to FIDs

JA6.1 – HVAC System Fault Detection and Diagnostic Technology - Fault ~~*Charge*~~ *Indicator Display (F~~C~~ID)*

JA6.1.1 Purpose and Scope
[…]

Fault~~Charge~~ indicator display technologies other than what is described in Section JA6.1 are possible, and when vapor compression air conditioner and heat pump system refrigerant charge, metering device and airflow operating performance can be reliably determined by methods and instrumentation other than those specifically defined in section JA6.1 such alternative ~~charge~~ fault indicator display technologies may be allowed for ~~Charge~~ Fault Indicator Display compliance credit if the manufacturer of the product requests approval from the Energy Commission. The Commission may grant such approval after reviewing submittals from the applicant.

3. Manufacturer Charging Specifications

- Refrigerant charging protocols using generic tables have uncertainty of 40%
  - Manufacturer instructions and specifications should be used when available
- Installation manuals available for new equipment
  - Hard copies left with condenser
  - Online
- If manufacturers certified a Special Case Protocol to the CEC, installers must adhere to it

Proposed Code Change Language

RA3.2 Field Verification and Diagnostic Testing of Refrigerant Charge for Air Conditioners and Heat Pumps

RA3.2.1 Purpose and Scope

[…]

(d) Failure to follow the manufacturer's installation and charging instructions may result in significant refrigeration system faults that may invalidate refrigerant charge and metering device verification results. The installer shall certify that he/she has conformed to the manufacturer's instructions and specifications for charging the system prior to proceeding with the verification procedures in this appendix. In the case where the manufacturer has certified to the Commission a "Special Case Refrigerant Charge Verification Protocol" meeting the requirements of RA1.1.1, HERS Rater refrigerant charge verification procedures shall adhere to approved special case protocol.

[…]

(f) The applicable procedures in Section RA3.2.2 shall always be used by the HERS Rater for verification of the system's refrigerant charge when HERS verification is required for compliance unless ~~an applicable alternate procedure a~~ Special Case Protocol is available in Reference Residential Appendix RA1, or the Standards specify the Section RA3.2.3.2 procedure (observation of weigh-in) as mandatory for compliance, or as an available option for compliance and the HVAC installer elects to use the RA3.2.3.2 procedure for HERS verification.

[…]

RA3.2.1.2 Scope of the Weigh-In Charging Procedure

(a) The procedures in Section RA3.2.3 are applicable to air-cooled air conditioners or air-source heat pumps.

[…]

(e) The procedures in Section RA3.2.3.1 may be used by the HVAC installer as an alternative to the Standard Charge Verification Procedure in RA3.2.2, ~~or as an alternative to any applicable Special Case Refrigerant Charge Verification Protocol in Reference Residential Appendix RA1.~~

4. Homeowner Notification of Delayed Charge Verification

- Installer may delay charge verification until warmer weather
  - Signs agreement to return if correction is needed
- HERS Provider Data Registry can support tracking of delayed refrigerant charge verification
  - CASE Team recommends gathering further data to understand prevalence for 2019

Proposed Code Language

RA2.4.4, Compliance Manual, and Compliance Form: Require homeowner notification.

Appendix RA2 – Residential HERS Verification, Testing, and Documentation Procedures

RA2.4 Summary of Responsibilities

RA2.4.4 Enforcement Agency

[…]

If necessary to avoid delay of approval of dwelling units completed when outside temperatures are below 55°F, the enforcement agency may approve compliance with the refrigerant charge verification requirements when installers have used the Weigh-in Charging Method described in Reference Residential Appendix RA3, Section RA3.2.3.1 and have not used the Section RA3.2.3.2 option for HERS verification compliance. This approval will be on the condition that installers submit to the enforcement agency a registered Certificate of Installation that includes a signed declaration indicating agreement to return to correct refrigerant charge if a HERS Rater determines at a later time when the outside temperature is 55°F or above, that correction is necessary. The installer must also notify homeowners that their system has not been verified of charge. The HERS Provider shall track these projects to ensure a HERS Rater conducts the required refrigerant charge verification for all such systems.

[…]

Proposed Code Change Language

RA2.4.4, Compliance Manual, and Compliance Form: Require homeowner notification.

Compliance Form CF2R-MCH-25c – Weigh In Charging Procedure:

F. WEIGH IN CHARGE PROCEDURE – ADDITIONAL REQUIREMENTS	
01	All brazing of refrigerant lines done with dry nitrogen in lines and evaporator coil
02	Prior to introducing refrigerant, system is evacuated to 500 microns or less and, when isolated, has risen no more than 300 microns after 5 minutes.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

03 ---- If HERS Rater charge verification is being delayed until after dwelling is occupied, notice is provided to homeowners that charge has not yet been verified.

Proposed Code Change Language

RA2.4.4, Compliance Manual, and Compliance Form: Require homeowner notification.

Compliance Manual Chapter 4

Note to Homeowner: We're not done yet!

Congratulations on your new Air-Conditioning system! Your new system is much more efficient than older systems, and it has been installed to industry guidelines, ensuring many years of comfort and efficient service.

One thing you need to know, however, is that the installation process is not complete! Because your unit was installed when the outside air temperature was too low to fine tune the air conditioner, the unit must be serviced and verified when the weather is warmer.

This requires your cooperation. You need to allow access to the unit for your Installer and/or HERS Rater (verifier) to verify that the refrigerant charge and airflow are set correctly. Your project is not considered finished until this verification takes place. If it is not done, **your unit may cost more to operate, may not heat and cool as effectively, and may not last as long**.

You will be contacted within the next few months to schedule this service. If you do not hear something after a few months of warmer weather, please contact your Installer. Enjoy your new system!

Feedback From Statewide CASE Team Stakeholder Meeting

- Stakeholder meeting held May 21, 2014
  - Notes and presentations from stakeholder meeting available at Title24Stakeholders.com
- Liquid line filter driers installed outside of the unit to enable easy access for replacement
- FID products available for submittal to CEC
- Delaying charge verification may increase chance of failure, costs

Questions?

Farhad Farahmand
FFarahmand@TRCSolutions.com
916-962-7001