To: California Energy Commission
Re: Docket No. 15-BSTD-01
From: Unico Incorporated
7401 Alabama Ave.
St. Louis, Mo. 63111

Docket@energy.ca.gov

Dear California Energy Commission, March 16, 2015

We are respectfully submitting this letter on behalf of the Small Duct High Velocity (SDHV) central heating and air conditioning industry, our SDHV manufacturing company and our flagship technology the Unico System. The Unico System is a product within the "Small Duct High Velocity HVAC" product class at the Department of Energy. This letter is focused on inclusion of the Small Duct High Velocity (SDHV) product class into the California Building Energy Efficiency Standards California Code of Regulations, Title 24, Docket No. 15-BSTD-01. It is our request that the California Energy Commission (CEC) include our comments, amendments, additions, alternates and tables into the 2016 guidelines.

Unico and SDHV history

SDHV technology was first used in 1917 to condition a movie theatre in upstate New York. The technology gained traction just after WW II when a high velocity heating product was developed and sold throughout the northeast United States. The product went through many iterations and manufacturers over the years, foundering for the most part. The bright spot in the promotion and sale of the SDHV technology during this time was a group of 18 HVAC contractors based in the Midwest. These contractors were the single largest purchaser of the technology at the time. The manufacturing of the SDHV system they were installing as a core product in their business, changed hands 3 times within 8 years. This caused numerous field related issues which the 18 HVAC contractors would adjust in order to supply the attributes of the technology. The price kept going up and the quality kept going down due to the frequent manufacturing changes. The tipping point came in 1985 when the contractors could not purchase equipment due to a manufacturing change. Deciding to take matters into their own hands and not be subject to the inconsistent SDHV product that the group relied upon for their collective livelihood, they decided to start a manufacturing company. That company today is Unico.

DOE and SDHV technology-

In 2000, the Department of Energy (DOE), collaborating with Unico Engineering staff and other members of the SDHV industry, created a separate product class called "Small Duct High Velocity" (SDHV) at the Department. Unfortunately, when posting to the Federal Register, the DOE posted the new product class into the traditional, large duct HVAC system product class. This clerical error was not correctable at the time due to a lawsuit filed in upstate New York, suing the federal government. The lawsuit was a result of an Executive action by President Bush in early 2001, rescinding an Executive action taken by President Clinton in late 2000 on his exit from office. President Clinton had increased the efficiency standards of central air conditioning systems. Subsequent to that, President Bush had rescinded those same actions. This froze the DOE from correcting the error and put the newly approved product class into limbo. In October of 2004 the court ruled that once an efficiency level of air conditioning is established, the only way to amend the level and move it "lower" was through federal legislation. Having been placed in the Federal Register within the traditional duct product class, the SDHV industry was forced into taking legislative action in order to correct a mistake the industry members had not made.

SDHV, the DOE and Federal Legislation

In 2012, after a nearly 8 year legislative journey the industry was able to build a coalition of legislators, environmental groups, industry, other stakeholders and with the full support of the Department of Energy, to pass HR6582, the "American Energy Manufacturing Technical Corrections Act" of 2012. The legislation was introduced onto the floor of the House by California Congressman Henry Waxman and Missouri Congressman Russ Carnahan. In the US Senate our sponsors included Missouri Senators Blunt and McCaskill, Michigan Senator Stabenow, and Louisiana Senator David Vitter. The measure passed the House 398 to 2 and the Senate 100 to 0, no opposition. President Obama signed the measure just before Christmas of 2012 and the Small Duct High Velocity (SDHV) product class was codified into federal law. This legislation established the definition of SDHV and the federally mandated minimum efficiencies for SDHV.

HR 6582 established a different test procedure at the Department of Energy (DOE) and different minimum efficiencies from traditional HVAC. SDHV is limited to a *maximum* of 350 cfm per rated ton whereas other product types have no airflow limits-maximum or minimum. In fact, it is our understanding that in the CEC guidelines there is no requirement for airflow from a mini split product class. SDHV systems have an external static pressure requirement by federal definition that is 1 inch water column (1.2" for SDHV versus .2" for traditional large duct systems) greater than conventional ducted systems. Our federal minimum efficiencies by way of federal law (HR 6582) are 12 SEER and 7.2 HSPF. SDHV also has other engineered attributes which add to the efficiency of the technology: a) leak free duct system which has less than 2% air loss by design; b) software managed airflow tied exactly to the SDHV design CFM per outlet, per room, per space and per structure; c) Even air temperature across the space so that there is no greater than 2 degree difference in temperature; d) ability to measure exactly the total CFM being delivered at each outlet and reconciling that exactly to the CFM being delivered by the motor (energy in and energy out = delivered efficiency); e) SDHV design software that engineers specific systems based on a manual N, J, D or S and creates an exact material list eliminating waste; and f) Inverter heat pump technology tied directly to the SDHV duct system and blower software which has the ability automatically to match load with outdoor and indoor conditions. The legislation provides a platform to bring the SDHV technology to local, state, and federal code authorities, specifying professionals, LEED and HERS raters, Utilities, and energy saving leaders around the country.

SDHV and California Consumers

The consumer in California has a myriad of choices for HVAC. Most of these, including traditional heat pumps, furnaces, central air conditioners, geothermal systems etc. are retrofitted into existing housing and connected to an existing leaky duct systems. If the most efficient HVAC system is connected to a duct system which leaks 15% to 25%, the efficient HVAC system has to run 15 to 25% more in order to satisfy the load of the structure. By comparison, the delivered CFM of air that an SDHV system delivers is a minimum of 98% of that being produced at the blower-BY DESIGN. We can quantify for the consumer the following: comfort, levels of humidity, levels of fresh air, exact BTU's both hot and cold, IAQ levels and most importantly a minimum level of delivered efficiency that exceeds 98%. SDHV has been in California since the early 90's and been installed in new homes and in retrofit applications. SDHV as part of the 2016 guidelines will give the consumer a choice that has merits that far exceed the systems in the market today. SDHV technology is not new, but is leading edge HVAC technology that can help California meet its goals of Net Zero Residential by 2020 and Net Zero Commercial by 2030.

We respectfully submit our comments and amendments to California Title 24 so that Small Duct High Velocity (SDHV) technology is included in the CEC 2016 guidelines.

Sincerely,

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***NOTE: All COMMENTS/LANGUAGE IN THIS DOCUMENT THAT IS SUGGESTED TO BE ADDED, AMENDED OR ELIMINATED IS IN RED INK AND ITALICIZED*.**

COMMENTS, AMENDMENTS AND LANGUAGE CHANGES FOR DOCKET No. 15-BSTD-01:

Section 100.1

Include the definition of "Small Duct High Velocity" (SDHV). The definition is as follows:

> **SMALL DUCT, HIGH VELOCITY (SDHV) SYSTEM** is a heating and cooling product that contains a blower and indoor coil combination that—
>
> (I) is designed for, and produces, at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220–350 CFM per rated ton of cooling; and
>
> (II) when applied in the field, uses high velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area.

JUSTIFICATION: This puts Title 24 in compliance with the Federal product class "Small Duct High Velocity" as written in the Federal Code (10 CFR 430.2) and Federal Law (42 U.S.C. 6295(d)(4)) [published in the federal register December 3, 2013, Vol. 78, No. 232, pages 72533-72534]

SUBCHAPTER 2 , Section 110-2

Add a new row for VRF SDHV in Table 110.2-H and Table 110.2-I shown below, effective January 1, 2015.

Table 110.2-H Electrically Operated Variable Refrigerant Flow (VRF) Air Conditioners – Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure
VRF Air Conditioners, Air Cooled	<45,000 Btu/h	All	VRF Multi-split System	14.0 SEER 12.2 EER	ANSI/AHRI 1230
			VRF SDHV Multi-split System	12.0 SEER	
	≥ 45,000 Btu/h and <65,000 Btu/h	All	VRF Multi-split System	14.0 SEER 11.7 EER	
			VRF SDHV Multi-split System	12.0 SEER	

Table 110.2-I Electrically Operated Variable Refrigerant Flow (VRF) Air-to-Air and Applied Heat Pumps – Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure
VRF Air Conditioners, Air Cooled	<65,000 Btu/h	All	VRF Multi-split System	14.0 SEER	ANSI/AHRI 1230
			VRF SDHV Multi-split System	12.0 SEER	

. . .

CONTINUED: Table 110.2-I Electrically Operated Variable Refrigerant Flow (VRF) Air-to-Air and Applied Heat Pumps – Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure
VRF Air Conditioners, Air Cooled	<65,000 Btu/h	All	VRF Multi-split System	8.2 HSPF	ANSI/AHRI 1230
			VRF SDHV Multi-split System	7.2 HSPF	

Furthermore, Title 20, Table C-2 should revised accordingly.

JUSTIFICATION: This puts Title 24 in compliance with the Federal product class “Small Duct High Velocity” as written in the Federal Code (10 CFR 430.32(c)) and Federal Law (42 U.S.C. 6295(d)(4)) [published in the federal register December 3, 2013, Vol. 78, No. 232, pages 72533-72534]

SUBCHAPTER 3, Section 120.4-REQUIREMENTS FOR AIR DISTRIBUTION SYSTEM DUCTS AND PLENUMS

Add the words as shown in red and italicized as follows:

a) **CMC Compliance.** All air distribution system ducts and plenums, including, but not limited to, building cavities, mechanical closets, air-handler boxes and support platforms used as ducts or plenums, shall be installed, sealed and insulated to meet the requirements of the 2010 CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0, and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used. Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8 “***for ducts of equivalent diameter of 3” or greater and R-6 for equivalent diameters of less than 3”:***

Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8:
1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

Portions of supply-air ducts that are not in one of these spaces, including ducts buried in concrete slab, shall be insulated to a minimum installed level of R-4.2 ***“for ducts 3” or greater in equivalent diameter and R 3.3 for ducts less than 3” equivalent diameter”*** (or any higher level required by CMC Section 605.0) or be enclosed in directly conditioned space.

JUSTIFICATION: This aligns California Title 24 with the 2015 editions of the International Energy Conservation Code (IECC) and the International Residential Code (IRC). The IECC and IRC recognize that thermal losses decrease with diameter. For very small ducts (less than 3.0 inch diameter) you achieve the same thermal efficiency at lower with lower R-factors compared to large diameter ducts.

The IECC-2015 (IRC-2015) language is repeated here for convenience:

> **N1103.3.1 (R403.3.1) Insulation (Prescriptive).** Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76.2 mm) in diameter and greater and R-6 where less than 3 inches (76.2 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches

Section 120.8-NONRESIDENTIAL BUILDING COMMISSIONING

Add the language as shown in red and italicized as follows:

> (i) **Commissioning report.** A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or owner's representative. ***The installer shall complete the product manufacturer's*** ~~***recommended "best practices"***~~ ***commissioning report if provided by the manufacturer.***

JUSTIFICATION:

Some systems and equipment require special instructions from the manufacturer. Adding this language will encourage the installer to follow the proper procedure and encourage manufacturers to provide commissioning reports and procedures. As an example, Unico provides a commissioning report for its product to ensure that the correct airflow is being delivered. (See attached)

SUBCHAPTER 5

Add the language as shown in red and italicized:

Section 140.4 (c) (1)-
(c) **Power Consumption of Fans.** Each fan system used for space conditioning shall meet the requirements of Items 1, 2, 3 and 4 below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors; however, total fan system power demand need not include (i) the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than 245 pascals or one-inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or (ii) fan system power caused solely by exempt process loads.

1. **Constant volume fan systems.** The total fan power index at design conditions of each fan system with total horsepower over 25 hp ***"or a Small Duct High Velocity HVAC (SDHV) fan"*** shall not exceed 0.8 watts per cfm of supply air.

JUSTIFICATION:
As noted in the definition for small-duct high-velocity systems, the static pressure and airflow requirements are very different. For this reason the energy standards must be different. In reviewing the various manufacturer's product data, the appropriate fan energy is 50% greater than a conventional ducted system when related to air volume. However, SDHV systems are designed to use less air volume per ton than conventional ducted systems. A more appropriate metric would be to relate fan energy to system capacity. Considering that the air volume for SDHV systems is typically 75% of a of a comparable large duct system, the relative fan energy is actually less than 15% when related to capacity.

See Unico Bulletin 20-20.1 for fan power consumption at any condition for both single speed motors and variable speed EC motors.

As an example, consider a 3-ton system with single speed motors. A conventional ducted system uses 400 CFM per rated ton; an SDHV system uses 300 CFM per rated ton. A conventional ducted fan efficiency is 0.50 W/CFM at typical field conditions (0.50 inches static) so the fan power is 600 W. The same size SDHV fan efficiency is 0.80 W/CFM at typical field conditions (1.5 inches static) so the fan power is 720 W. The difference is 20%.

If EC motor is used, the analysis would be the same procedure and the power would be less but only if the static pressure in the field the same as the equipment static pressure. Interestingly, this would have a large effect on conventional systems and very negligible effect for SDHV because SDHV systems are rated at conditions closely aligned with field conditions.

SUBCHAPTER 7

Section 150.0(m) 10:

10. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall not be used.

EXCEPTION to Section 150.0(m) 10: Small Duct High Velocity (SDHV) duct systems must have a porous inner liner for at least the final 3' of each branch duct".

JUSTIFICATION:
Porous inner liners are essential for SDHV systems and must always be used near the exit of the branch ducts closest to the register. The porous inner liner attenuates the air noise of the high velocity air stream. The result is very quiet system. This is a key engineered feature of an SDHV system for the last 60 years and provides not only comfort for the occupant, but a nearly imperceptible air delivery system from an auditory aspect. For the same reason, grilles across the register opening are to be avoided whenever possible (eg. ceiling and sidewall locations).

Section 150.0(m) Air-Distribution and Ventilation System Ducts, Plenums, and Fans.

Add the text as shown in red and italicized:

13. **Duct System Sizing and Air Filter Grille Sizing.**

. . .

B. Demonstrate, in every control mode, airflow greater than or equal to 350 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

ALTERNATIVE to Section 150.0(m)13B: Standard ducted systems (systems without zoning dampers) may comply by meeting the applicable requirements in TABLE 150.0-C or 150.0-D as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Sections RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-C and 150.0-D.

EXCEPTION to Section 150.0(m)13B: Multispeed compressor systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

EXCEPTION to section 150.0(m)13B: Small Duct High Velocity (SDHV) systems shall have airflow between 250 and 350 CFM per rated ton with air handling unit fan efficacy less than or equal to 0.8 watts per CFM as confirmed by filed verification and testing in accordance with the procedures given in Reference Residential appendix RA3.3 or using the manufacturer's commissioning instructions."

15. **Zonally Controlled Central Forced Air Systems.** Zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than or equal to 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

EXCEPTION to Section 150.0(m)15: Multispeed compressor systems or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach set forth in Section 150.1(b) shall demonstrate compliance for airflow (cfm/ton) and fan efficacy (Watt/cfm) by operating the system at maximum compressor capacity and maximum system fan speed and with all zones calling for conditioning.

EXCEPTION to Section 150.0(m)15: Small Duct High Velocity (SDHV) systems are designed to operate at lower air volumes and slightly higher watts per CFM (up to .80) with a maximum air volume of 350 CFM per rated ton. These systems can be zoned when designed according to manufacturer's design specifications for zoning an SDHV system.

JUSTIFICATION:
The airflow for SDHV must comply with the definition as prescribed by the Federal Code. This necessitates that the language state the *maximum* airflow. However, it appears that the intent of Title 24 is to prescribe a *minimum.* Therefore, knowing our product and the range of operation for most SDHV systems, specifying a range is most appropriate. Most SDHV products are rated with airflow between 280 and 320 CFM per rated ton. Allowing for some tolerance, the appropriate range should be 250 to 350 CFM per rated ton. [Note: some manufacturers relate air flow to the *nominal* ton. This is related to the outdoor unit nameplate and is typically greater than the *rated* or *actual* capacity. Using *rated* provides clarity.]

As noted in the definition for small-duct high-velocity systems, the static pressure and airflow requirements are very different. For this reason the energy standards must be different. In reviewing the various manufacturer's product data, the appropriate fan energy is 50% greater than a conventional ducted system when related to air volume. However, SDHV systems are designed to use less air volume per ton than conventional ducted systems. A more appropriate metric would be to relate fan energy to system capacity. Considering that the air volume for SDHV systems is typically 75% of a of a comparable large duct system, the relative fan energy is actually less than 15% when related to capacity.

See Unico Bulletin 20-20.1 for fan power consumption at any condition for both single speed motors and variable speed EC motors.

As an example, consider a 3-ton system with single speed motors. A conventional ducted system uses 400 CFM per rated ton; an SDHV system uses 300 CFM per rated ton. A conventional ducted fan efficiency is 0.50 W/CFM at typical field conditions (0.50 inches static) so the fan power is 600 W. The same size SDHV fan efficiency is 0.80 W/CFM at typical field conditions (1.5 inches static) so the fan power is 720 W. The difference is 20%.

If EC motor is used, the analysis would be the same procedure and the power would be less but only if the static pressure in the field the same as the equipment static pressure. Interestingly, this would have a large effect on conventional systems and very negligible effect for SDHV because SDHV systems are rated at conditions closely aligned with field conditions.

Add the following table.

TABLE 150.0-E: Return Duct Sizing for SDHV systems

Return duct length shall be of any length sized for a maximum pressure drop of 0.10 inches of static pressure and shall contain at least two 90 degrees of bend for proper sound attenuation. Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 25 Pa (0.10 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille. For systems with multiple returns, the minimum return diameter is 2 inches less than shown.		
System Nominal Cooling Capacity (Ton)*	**Minimum Return Duct Diameter (inch)**	**Minimum Total Return Filter Grille Gross Area ($inch^2$)**
1.5	**12**	**280 180 fpm**
2.0	**14**	**350**
2.5	**14**	**350**
3.0	**16**	**420**
3.5	**18**	**420**
4.0	**18**	**720**
5.0	**20**	**600**

JUSTIFICATION

SDHV systems are designed to minimize the space needed for installation. As such they are designed for less air and higher static pressure. The typical system is designed for 0.15 inches of static pressure for the return duct system of which the duct accounts for 0.05 inches of water column and the filter 0.10 inches w.c.. Conventional duct grilles are sized for 200 ft/min. SDHV grilles are 300 ft/min. This is in keeping with the general goal of maintaining a small footprint which is the recognized utility of the SDHV product class. The SDHV system is designed for the higher static pressure through the filter. This is part of the higher static pressure requirement and is built into the SEER and HSPF.

SUBCHAPTER 8

Section 150.1(c)10-

10. **Central Fan Integrated Ventilation Systems.** Central forced air system fans used in central fan integrated ventilation systems shall demonstrate, in Air Distribution Mode, an air-handling unit fan efficacy less than or equal to 0.58 W/CFM ***"(0.80 watts per CFM for Small Duct High Velocity (SDHV) systems)"*** as confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix RA3.3

JUSTIFICATION:

As noted in the definition for small-duct high-velocity systems, the static pressure and airflow requirements are very different. For this reason the energy standards must be different. In reviewing the various manufacturer's product data, the appropriate fan energy is 50% greater than a conventional ducted system when related to air volume. However, SDHV systems are designed to use less air volume per ton than conventional ducted systems. A more appropriate metric would be to relate fan energy to system capacity. Considering that the air volume for SDHV systems is typically 75% of a of a comparable large duct system, the relative fan energy is actually less than 15% when related to capacity.

See Unico Bulletin 20-20.1 for fan power consumption at any condition for both single speed motors and variable speed EC motors.

As an example, consider a 3-ton system with single speed motors. A conventional ducted system uses 400 CFM per rated ton; an SDHV system uses 300 CFM per rated ton. A conventional ducted fan efficiency is 0.50 W/CFM at typical field conditions (0.50 inches static) so the fan power is 600 W. The same size SDHV fan efficiency is 0.80 W/CFM at typical field conditions (1.5 inches static) so the fan power is 720 W. The difference is 20%.

If EC motor is used, the analysis would be the same procedure and the power would be less but only if the static pressure in the field the same as the equipment static pressure. Interestingly, this would have a large effect on conventional systems and very negligible effect for SDHV because SDHV systems are rated at conditions closely aligned with field conditions.

SUBCHAPTER 9

E. **Altered Space-Conditioning System - Duct Sealing:** In all Climate Zones, when a space-conditioning system is altered by the installation or replacement of space-conditioning system equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil) the duct system that is connected to the altered space-conditioning system equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix RA3.1 and the leakage compliance criteria specified in Reference Residential Appendix Table RA3.1-2, conforming to one of the following requirements:
i. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or
ii. The measured duct leakage to outside shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section
150.0 (ii) a. "ALTERNATE Method Of airflow verification: "If the fan manufacturer provides an accurate reporting of CFM using software or a manual procedure, then that value can be used to determine leakage by comparing it to the total airflow measured at the register."
RA3.1.4.3.4; or
iii. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Ei or Section 150.2(b)1Eii, then, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

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SECTION 150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS IN TO EXISTING LOW-RISE RESIDENTIAL BUILDINGS THAT WILL BE LOW-RISE RESIDENTIAL OCCUPANCIES

F. **Altered Space-Conditioning System - Mechanical Cooling:** When a space-conditioning system is an air conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:
then nonsetback i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c). ***(NOTE: Small Duct High Velocity (SDHV) diagnostic testing standard is to be added to Residential Appendix Section RA3.2)***
Additionally, these systems shall comply with the following requirements as applicable:
ii. 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 comply with the airflow rate requirements of a or b and the refrigerant charge requirement of c:
a. Demonstrate minimum system airflow rate greater than or equal to 300 cfm per ton ***"(or between 250 and 350 CFM per rated ton for Small Duct High Velocity (SDHV) systems)"*** as verified by field verification and diagnostic testing in accordance with procedures specified in Reference Residential Appendix Section RA3.2.4; or
b. If unable to comply with the minimum 300 cfm per ton airflow requirement ***"(or between 250 and 35-CFM per rated ton for SDHV systems)"*** perform the procedures in Section RA3.2.4.3; and the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5; and
c. Confirm correct refrigerant charge through field verification and diagnostic testing in

accordance with the procedures specified in Reference Residential Appendix Section RA3.2, or RA1have 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.

JUSTIFICATION: Small Duct High Velocity (SDHV) systems by federal definition are designed to operate at between 250 and 350 CFM per rated ton.