AHRI Standard 430 (I-P) With Addendum 1

2014 Standard for

Performance Rating of Central Station Air-handling Unit Supply Fans

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AHRI STANDARD 430 (I-P)-2014 WITH ADDENDUM 1, PERFORMANCE RATING OF CENTRAL STATION AIR-HANDLING UNIT SUPPLY FANS

December 2015

Addendum 1 (dated December 2015) of AHRI Standard 430 (I-P)-2014, "*Changes to AHRI Standard 430 (I-P)-2014"* is provided as follows. The following changes have been incorporated (deletions are shown by ~~strikethroughs~~, additions are shown by shading) into the already published 2014 version of AHRI Standard 430 (I-P) to avoid confusion.

Note: This addendum is not ANSI approved and is currently going through the process to become so.

The changes include:

1) The scope of the standard was updated.

2.1.1 This standard applies to Supply Fan ratings ~~to~~ for Central Station Air-handling Units with ~~supply fan ratings for~~ Plenum Fans ~~in a cabinet with a Full Face Opening Axial Discharge~~, Fan Arrays, Housed Centrifugal Fans, and Axial Fans.

2) The exclusions to the scope of the standard were updated.

~~**2.2.1** This standard does not apply to forced circulation, free delivery air coolers for refrigeration, which are covered in ANSI/AHRI Standard 420.~~

~~**2.2.5** This standard does not apply to variable refrigerant flow equipment as defined in ANSI/AHRI Standard 1230.~~

3) Changed Unit Appurtenances to Appurtenances in Section 3 and renumbered accordingly.

~~**3.6** *Unit Appurtenances.* Equipment added to Central Station Air-handling Units for purposes of control, isolation, safety, static pressure regain, energy/heat recovery, wear, etc. Such appurtenances include coils, filters, dampers, air mixers, spray assemblies, energy recovery devices, acoustical silencers, eliminators, etc.~~

3.2 *Appurtenances*. Equipment added to a CSAHU for purposes including but not limited to control, isolation, safety, static pressure regain, wear, etc. Appurtenances include, but are not limited to coils, filters, energy recovery devices, dampers, air-mixers, spray assemblies, eliminators, discharge plenums, and inlet plenums.

4) Clarified the definition for Central Station Air-handling Unit.

3.3 *Central Station Air-handling Unit (CSAHU).* A factory-made encased assembly consisting of a supply fan or fans in parallel which may also include other necessary equipment to perform one or more of the

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functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying and mixing of air. It shall not contain a source of mechanical cooling. The CSAHU must have a maximum design external static pressure (ESP) greater than 1.0 in H_2O. ~~This assembly is capable of use with duct work having a total static resistance of at least 0.5 in H_2O.~~

Note: While the ESP for a specific application may be less than 1.0 in H_2O, any units generally capable of delivering greater than 1.0 in H_2O ESP shall be considered to be a CSAHU.

5) Added definitions for Fan Array, Contained Fan, Partially Contained Fan, Uncontained Fan, Identical Construction, Variable Frequency Drive, and Controller to Section 3.

3.4 *Controller*. A power electronic device that regulates the speed of a motor (typically used for direct current (DC) motors).

3.6.4 *Fan Array*. A matrix of regularly spaced direct-drive Supply Fans operating in parallel with inflow from a common inlet plenum and with outflow into a common outlet plenum. All impellers and motors must be of Identical Construction. All Operating Fans must run at the same speed. If applicable, all Variable Frequency Drives must be programmed to provide identical frequency and voltage.

3.6.4.1 *Contained Fan.* Fans in a Fan Array that are within substantially uniform enclosure(s) and do not aerodynamically interact with each other within the array.

3.6.4.2 *Partially Contained Fan.* Fans in a Fan Array that are within non-uniform enclosure(s) and some Supply Fans aerodynamically interact with each other within the array.

3.6.4.3 *Uncontained Fan.* Fans in an array that aerodynamically interact with each other.

3.6.8 *Identical Construction*. A product which has the same manufacturer, the same model number, and is intended to have the same performance under the same conditions. Exception: the model numbers may differ if the only difference between the models is something which does not affect performance (e.g. color).

3.6.9 *Operating Fan*. Any Supply Fan which is designated by the CSAHU manufacturer to be energized and rotating at the specified Rating Condition.

3.11 *Variable Frequency Drive (VFD).* A power electronic device that regulates the speed of an alternating current (AC) motor by adjusting the frequency and the voltage of the electrical power supplied to the motor.

6) Updated the angle in Figure 3 from 20° to 70°.

7) Added classifications for Fan Arrays to Section 4.

4.1.2.3.1 Single Plenum Fan

4.1.2.3.2 Plenum Fan Array

8) Added wording to Section 5.1.1.3.

5.1.1.3 *Unducted Fan Discharge Central Station Air-handling Units*. Unducted Fan Discharge Central Station Air-handling Units shall be tested in accordance with ANSI/AMCA Standard 210/ANSI/ASHRAE Standard 51, except when an outlet chamber with multiple nozzles within the chamber is used. The test chamber cross-sectional area shall be sized so that the maximum air velocity does not exceed 400 fpm. The test chamber height and width shall be at least 5% greater than the respective height and width of the duct connection at the test chamber. Discharge area cannot exceed the test chamber area. For an example, see Figure 4. Corrections for static pressure losses created by the test apparatus (e.g. the addition of ductwork) shall be made according to Appendix E and the ASHRAE Duct Fitting Database CD.

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9) Updated the wording in Section 5.1.1.4.

5.1.1.4 *Plenum Fan Units.* The rating configuration for either Ducted Fan Discharge or Unducted Fan Discharge plenum fan units shall be Full Face Opening Axial Discharge ~~full face discharge~~ with the minimum spacing allowed per the manufacturer's specifications between the coil and the fan. If Full Face Opening Axial Discharge is not possible due to the size of the unit compared to the test chamber, the unit shall be provided with an inlet or discharge plenum and a suitably sized duct shall extend from the plenum. Corrections for static pressure losses created by the test apparatus (e.g. the addition of ductwork) shall be made according to Appendix E and the ASHRAE Duct Fitting Database CD. The discharge or inlet plenum shall be considered as an Appurtenance to the CSAHU for the purpose of testing. Figure 15 in the 2007 revision of AMCA 210 shall be used for the test set-up of belt-drive plenum fan units (see Figure 5). Figures 12 or Figure 15 in the 2007 revision of AMCA 210 shall be used for the test set-up of direct-drive plenum fan units (see Figures 5 and 6).

10) Added Section 5.1.1.7.

5.1.1.7 *Units with Fan Arrays.* The rating configuration for Units with Fan Arrays shall be Full Face Opening Axial Discharge with the minimum spacing allowed per the manufacturer's specifications between the coil and the fan. If Full Face Opening Axial Discharge is not possible due to the size of the unit, the unit shall be provided with an inlet or discharge plenum and a suitably sized duct shall extend from the plenum. Corrections for static pressure losses created by the test apparatus (e.g. the addition of ductwork) shall be made according to Appendix E and the ASHRAE Duct Fitting Database CD. The discharge or inlet plenum shall be considered as an Appurtenance to the CSAHU for the purpose of testing. The power measurement for units with Fan Arrays shall use the calibrated motor method as defined in Section 4.4.3 of AMCA 210.

5.1.1.7.1 Calibrate at least the number of motors as specified in Table 1.

5.1.1.7.1.1 Refer to NEMA MG-1 for acceptable tolerances between motor calibrations. If the requirements in NEMA MG-1 are not met, then all motors must be calibrated.

5.1.1.7.2 Motor calibrations shall be performed at the same frequency and voltage as used during the test.

5.1.1.7.3 Average the calibrated motors to get the composite motor calibration.

5.1.1.7.3.1 To get the average composite motor calibration, create a scatterplot of the data and use simple linear regression to find the equation for the line fit in the form of y=mx+b.

5.1.1.7.3.1.1 Alternatively, a polynomial regression can be computed to improve accuracy instead of a linear regression.

5.1.1.7.4 During the test, measure total power input after the VFD/Controller.

5.1.1.7.4.1 If unable to measure total power input after the VFD/Controller, measurements shall be simultaneously recorded for the power input into all individual motors to get the total power input.

5.1.1.7.4.2 Shaft power is calculated as shown below. An example is shown in Appendix D.

5.1.1.7.4.2.1 Divide the total input power by the number of operating fans.

5.1.1.7.4.2.2 Determine the shaft power per fan using the composite motor calibration data.

5.1.1.7.4.2.3 Multiply the shaft power per fan by the number of fans to get the total unit shaft power.

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Table 1. Number of Motors to be Calibrated [1]	
Number of Supply Fans in the Fan Array	Number of motors to be calibrated
2-4	2
5-8	3
9-12	4
13+	5
Notes: 1) An equal distribution of contained and uncontained fans must be measured.	

11) Updated normative references.

~~**A1.5** ANSI/AHRI Standard 420 2008, Performance Rating of Forced Circulation Free Delivery Unit Coolers for Refrigeration, 2008, American National Standards Institute and Air-Conditioning & Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.~~

A1.6 ANSI/AHRI Standard 840-~~1998~~2015, Performance Rating of ~~Standard~~ for Unit Ventilators, ~~1998~~2015, American National Standards Institute and Air-Conditioning & Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.

A1.8 ANSI/AMCA Standard 99, *Standards Handbook*, 2007, Air Movement and Control Association, Inc., 30 West University Drive, Arlington Heights, IL 60004, U.S.A.

A1.11 ASHRAE Duct Fitting Database CD Version 6.00.04, 2015, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E. Atlanta, GA 30329, U.S.A.

A1.12 ASHRAE Fundamentals, 2013, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E. Atlanta, GA 30329, U.S.A.

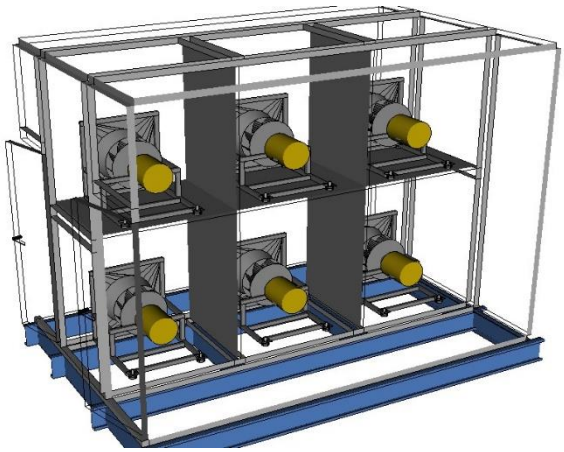
12) Added note to Figure C2.

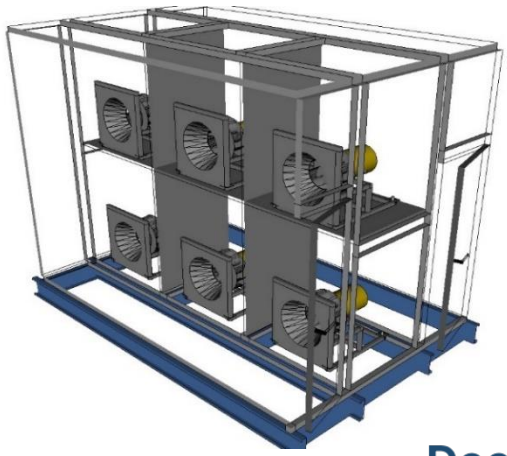
Note: Contained Fan Arrays and Partially Contained Fan Arrays (for fans which do not aerodynamically interact) will follow this figure.

13) Added note to Figure C4.

Note: Uncontained Fan Arrays and Partially Contained Fan Arrays (for fans which aerodynamically interact) will follow this figure.

14) Added Figures C5 and C6.





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Figure C5. Example Contained Fan Array

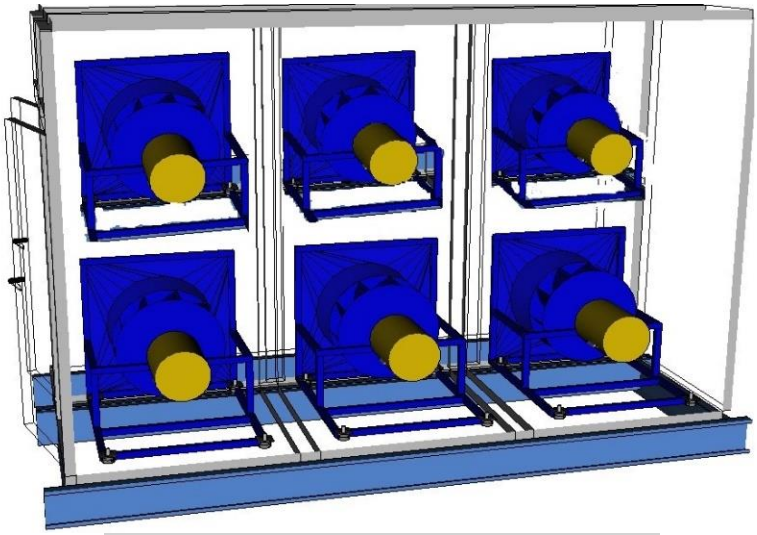


Figure C6. Example Uncontained Fan Array

15) Added Appendix D

APPENDIX D. EXAMPLE FAN ARRAY CALCULATION - INFORMATIVE

D1. The data shown in Table D1 was taken from a 2x2 Fan Array with four pole motors. The motor calibration was performed at nominal frequency of 60 Hz. The first example will use the methodology where Table 1 is followed. For 4 Operating Fans in the array, 2 were measured.

Table D1. Example Motor Calibration Data Following Table 1

Motor calibration (Motor 1)		Motor calibration (Motor 2)	
Watts	BHP	Watts	BHP
247.2	0.000	251.9	0.000
387.3	0.180	345.1	0.126
519.9	0.340	494.0	0.326
617.0	0.488	611.6	0.474
768.7	0.688	751.0	0.677
888.3	0.851	854.6	0.805
1050.0	1.062	1023.1	1.033
1143.0	1.182	1124.8	1.178
1279.4	1.358	1304.6	1.395
1380.0	1.495	1365.9	1.481

This data was plotted in Excel™ using the scatterplot function and then a trendline was added. The equation for the trendline is shown in Figure D1.

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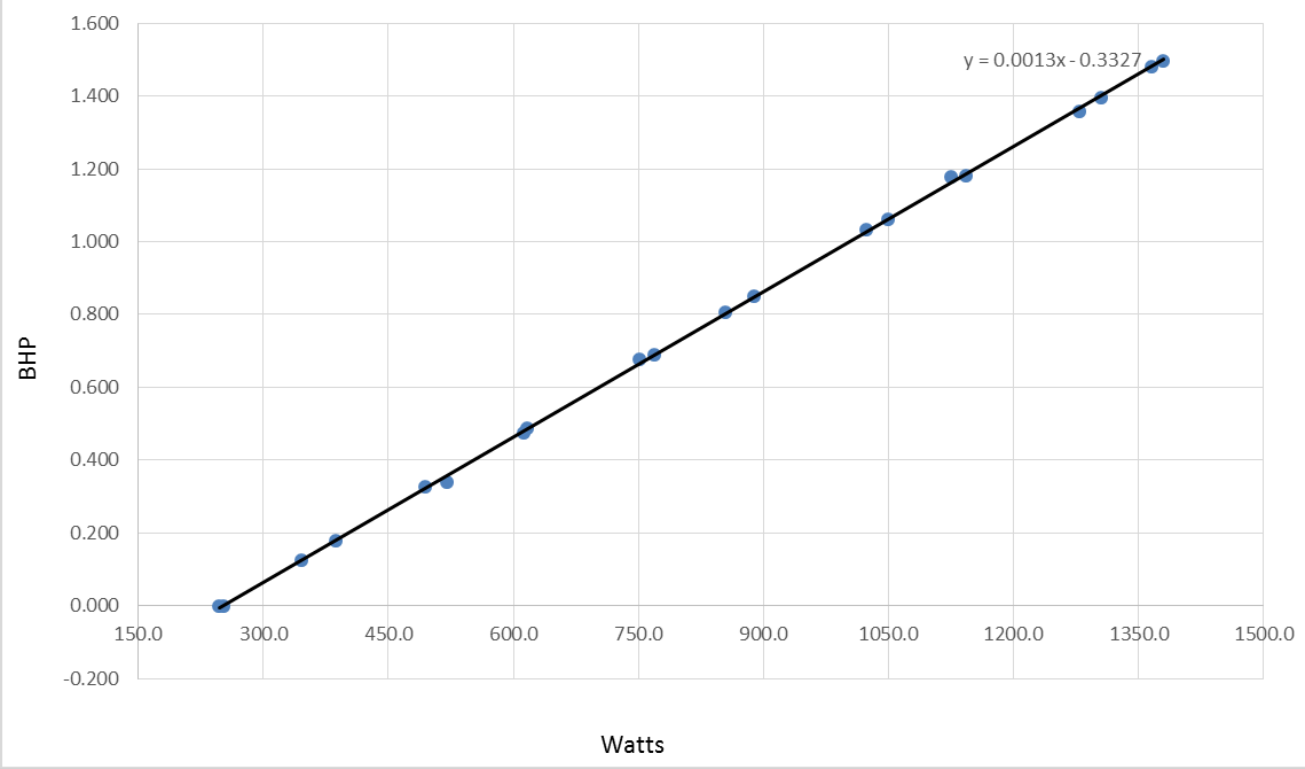


Figure D1. Example Scatterplot with Motor Calibration Data According to Table 1

The total input power measured was 3852.0 watts according to AMCA 210. With 4 Operating Fans, the input power per fan calculates to 963.0 using Equation E1. Using the formula found in the trendline (Equation E2), the BHP per fan is calculated to be 0.9192 using Equation E3. Since there are 4 fans, the total unit shaft power can be determined using Equation E4 and is calculated to 3.6768 BHP.

$$\frac{Overall\ Input\ Power}{Number\ of\ Operating\ Fans} = \frac{3852.0}{4} = 963.0 \quad \text{E1}$$

$$y = 0.0013x - .3327 \quad \text{E2}$$

$$BHP\ Per\ Fan = 0.0013 \cdot (Input\ Power\ per\ Fan) - 0.3327 = (0.0013 \cdot 963.0) - 0.3327 = 0.9192 \quad \text{E3}$$

$$Overall\ BHP\ = BHP\ Per\ Fan \cdot (Number\ of\ Operatings\ Fans) = 0.9192 \cdot 4 = 3.6768\ BHP \quad \text{E4}$$

D2. The data shown in Table D2 was taken from a 2x2 Fan Array with four pole motors. The motor calibration was performed at nominal frequency of 60 Hz. This example has all 4 fans being measured.

Table D2. Example Motor Calibration Data Not Following Table 1

Motor calibration (Motor 1)		Motor calibration (Motor 2)		Motor calibration (Motor 3)		Motor calibration (Motor 4)	
Watts	BHP	Watts	BHP	Watts	BHP	Watts	BHP
247.2	0.000	251.9	0.000	249.4	0.000	249.2	0.000
387.3	0.180	345.1	0.126	387.8	0.183	353.4	0.120
519.9	0.340	494.0	0.326	509.7	0.354	487.1	0.303
617.0	0.488	611.6	0.474	636.5	0.520	603.8	0.463
768.7	0.688	751.0	0.677	780.2	0.722	722.2	0.619

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888.3	0.851	854.6	0.805	897.0	0.871	861.4	0.808
1050.0	1.062	1023.1	1.033	1009.7	1.019	1001.4	0.990
1143.0	1.182	1124.8	1.178	1128.9	1.167	1130.5	1.159
1279.4	1.358	1304.6	1.395	1250.3	1.349	1244.9	1.315
1380.0	1.495	1365.9	1.481	1375.4	1.509	1386.9	1.506

This data was plotted in Excel™ using the scatterplot function and then a trendline was added. The equation for the trendline is shown in Figure D2.

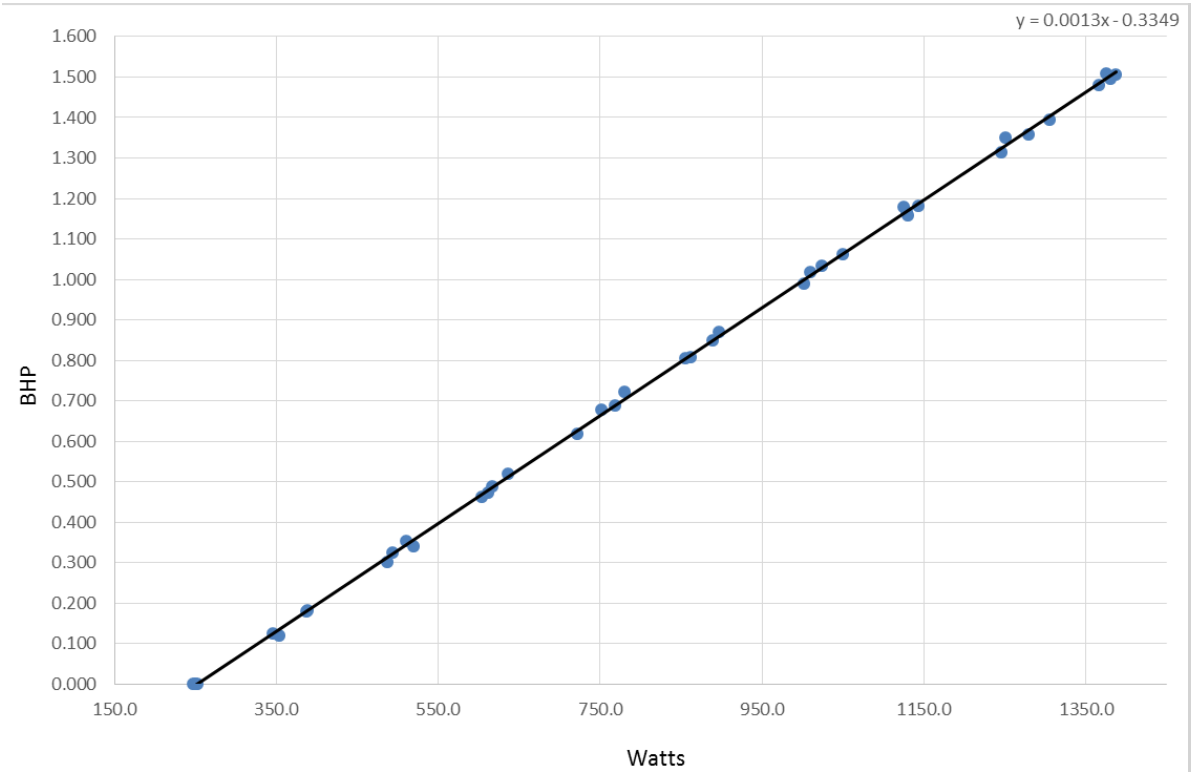


Figure D2. Example Scatterplot with Motor Calibration Data Not According to Table 1

The total input power measured was 3852.0 watts according to AMCA 210. With 4 Operating Fans, the input power per fan can be calculated using Equation E5 to be 963. Using the formula found in the trendline (Equation E6) in Figure D2, the BHP per fan can be calculated using Equation E7 to be 0.917. Since there are 4 Operating Fans, the total unit shaft power is calculated by Equation E8 to be 3.668 BHP.

$$\frac{Overall\ Input\ Power}{Number\ of\ Operating\ Fans} = \frac{3852.0}{4} = 963.0 \quad \text{E5}$$

$$y = 0.0013x - 0.3349 \quad \text{E6}$$

$$BHP\ Per\ Fan = 0.0013 \cdot (Input\ Power\ per\ Fan) - 0.3349 = (0.0013 \cdot 963.0) - 0.3349 = 0.917 \quad \text{E7}$$

$$Overall\ BHP\ = BHP\ Per\ Fan \cdot (Number\ of\ Operatings\ Fans) = 0.917 \cdot 4 = 3.668\ BHP \quad \text{E8}$$

16) Added Appendix E.

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APPENDIX E. CORRECTING FOR PRESSURE DROP THROUGH THE TEST EQUIPMENT FOR UNDUCTED DISCHARGE TESTS-NORMATIVE

E1 This appendix shows which air pressure losses created by the laboratory test equipment must be accounted for when testing units with inlet or discharge plenums either supplied by the manufacturer or constructed by the laboratory.

E2 *Definitions*.

E2.1 *Constructed by the Laboratory*. Any portion of the test set up that was not supplied by the manufacturer and was built solely to connect the unit to the test chamber for the purpose of the test. Any plenum extension shall have the same internal height and width as the test Unit Height and Unit Width.

E2.2 *Duct Dimensions*.

E2.2.1 *Duct Height (H_D)*. The internal vertical dimension of the duct.

E2.2.2 *Duct Length (L_D)*. The length of the duct between the test chamber and either the inlet plenum or discharge plenum, depending on the test configuration.

E2.2.3 *Duct Width (W_D)*. The internal horizontal dimension of the duct.

E2.3 *Duct Total Pressure Loss (P_{TD})*. The total pressure loss in the duct. This loss is often negligible.

E2.4 *Plenum Length (L_P)*. The distance from the internal wall of the plenum Constructed by the Laboratory to either the nearest fan or appurtenance. The manufacturer may designate this value as either fixed or a minimum.

E2.5 *Total Pressure Loss Entering Test Chamber (P_{TEC})*. The reduction in total air pressure caused by the expansion of the air flow as the air leaves the duct and enters the test chamber. This is used only when testing using the setup in Figure 12.

E2.6 *Total Pressure Loss Entering Unit (P_{TEU})*. The reduction in total air pressure caused by the contraction of the air when it leaves the duct and enters the unit. This is used only when testing using the setup in Figure 15. If the manufacturer provided the inlet plenum, this loss shall not be included.

E2.7 *Total Pressure Loss Leaving Test Chamber (P_{TLC})*. The reduction in total air pressure caused by the contraction of the air flow between the test chamber and the duct. This is used only when testing using the setup in Figure 15.

E2.8 *Total Pressure Loss Leaving Unit (P_{TLU})*. The reduction in total air pressure caused by the contraction of the air when it leaves the unit and enters the duct. This is used only when testing using the setup in Figure 12. If the manufacturer provided the discharge plenum, this loss shall not be included.

E2.9 *Total Pressure Loss of Test Equipment*. The sum of the total pressure losses created by the portion of the test setup Constructed by the Laboratory.

E2.10 *Unit Dimensions*.

E2.10.1 *Unit Height (H_U)*. The internal vertical dimension of the unit under test.

E2.10.2 *Unit Width (W_U)*. The internal horizontal dimension of the unit under test.

E3 *Procedure*.

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E3.1 Determine which components of pressure loss must be calculated.

E3.1.1 Testing using Figure 6 and manufacturer provides the discharge plenum (Figure E1): P_{TD} and P_{TEC}.

E3.1.2 Testing using Figure 6 and laboratory constructs the discharge plenum (Figure E2): P_{TEC}, P_{TD} and P_{TLU}.

E3.1.3 1 Testing using Figure 5 and manufacturer provides the inlet plenum (Figure E3): P_{TLC} and P_{TD}.

E3.1.4 Testing using Figure 5 and laboratory constructs the inlet plenum (Figure E4): P_{TLC}, P_{TD} and P_{TEU}.

E3.2 Calculate each of the pressure losses using the values for H_D, W_D, L_D, H_U, W_U, the air flow, and air density based on the procedures in ASHRAE Fundamentals 2013 Chapter 21 and the values in the ASHRAE Duct Fitting Database CD.

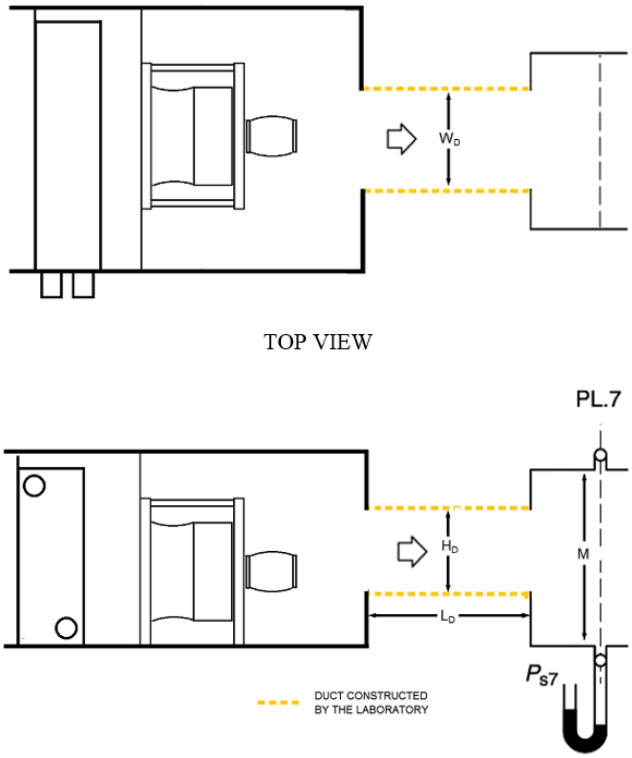


Figure E1. Unit Tested Per Figure 12 of AMCA 210 with Discharge Plenum Supplied By the Manufacturer

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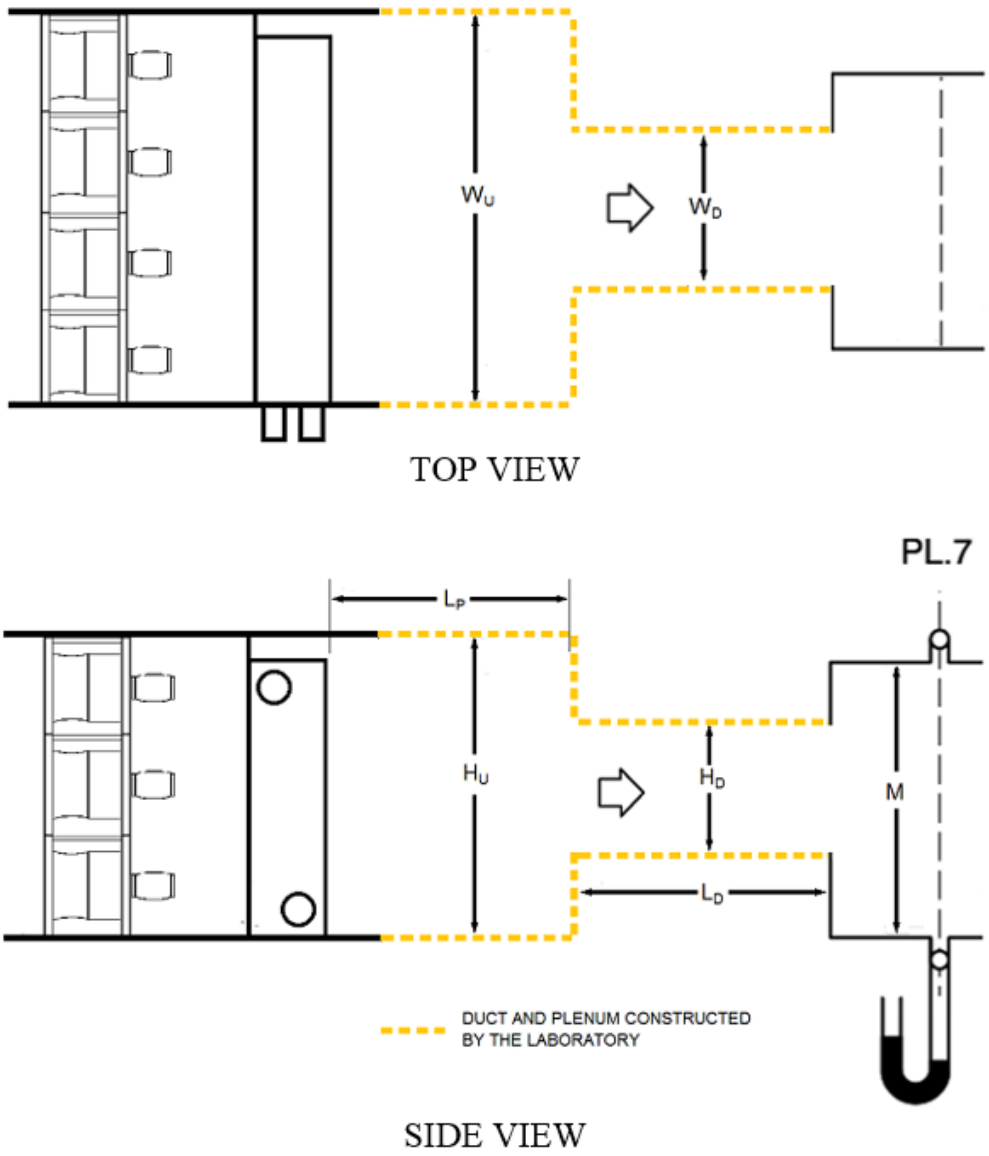


Figure E2. Unit Tested Per Figure 12 of AMCA 210 with Discharge Plenum Constructed By the Laboratory

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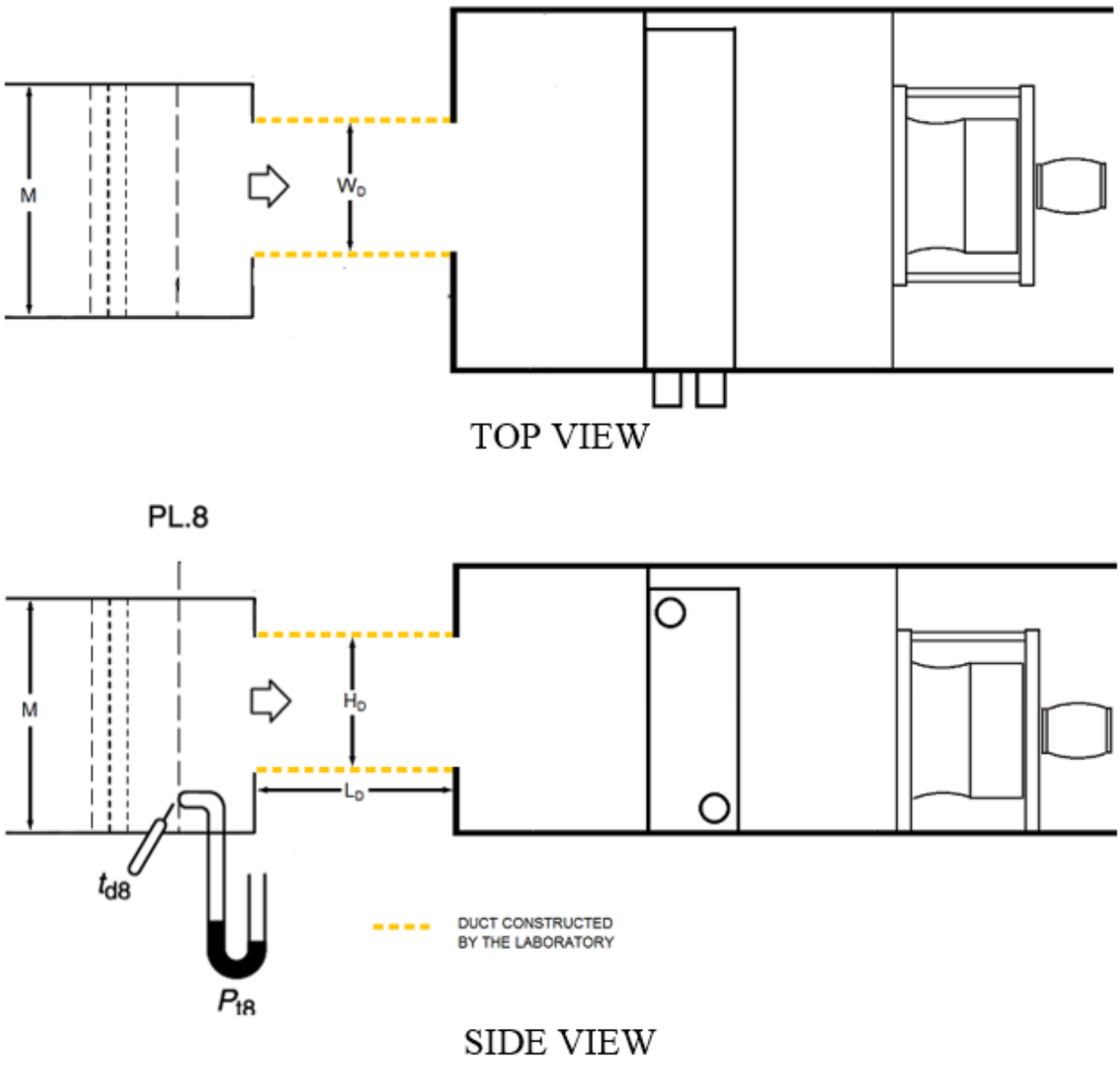


Figure E3. Unit Tested Per Figure 15 of AMCA 210 with Inlet Plenum Provided By the Manufacturer

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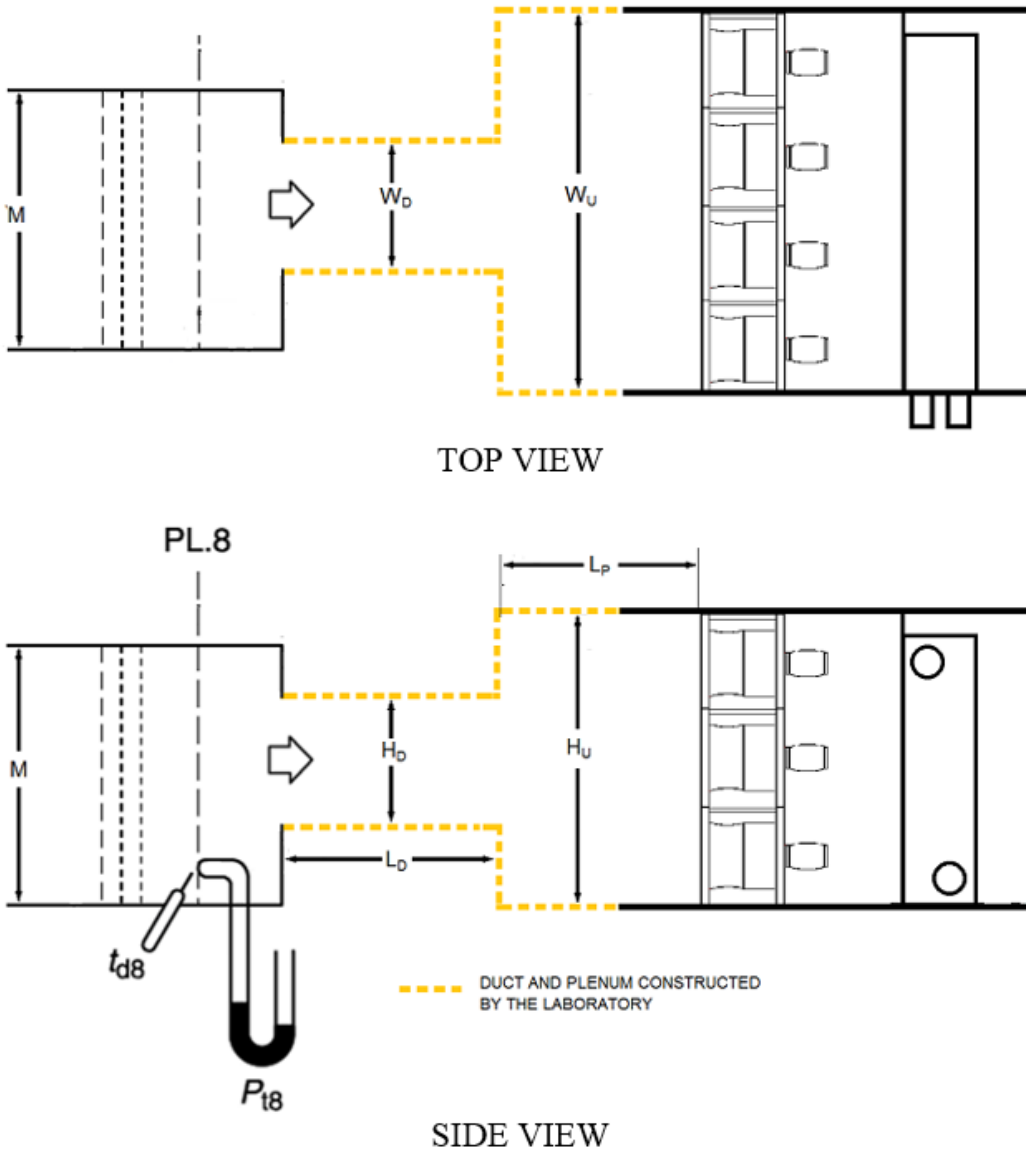


Figure E4. Unit Tested Per Figure 15 Of AMCA 210 With Inlet Plenum Constructed By The Laboratory.

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AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk .

Note:

This standard supersedes AHRI Standard 430-2009.
See AHRI Standard 431 for SI ratings.

Scope of Certification Program and Certified Ratings

Please refer to the most current version of the Central Station Air-handling Unit's Supply Fans Certification Program Operations Manual (OM) for the Scope of the Certification Program and Certified Ratings.

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