RESNET
RESIDENTIAL ENERGY SERVICES NETWORK

Setting the **Standards** for
Home Energy Efficiency

Interpretation: Permit use of brake horsepower to model VFD ventilation fan power

Designation: IR 301-2019-037

Approved: March 3, 2025 by RESNET SDC 300

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Reference:

Standard	ANSI / RESNET / ICC 301-2019 and 301-2022
Page Number(s):	
Sections(s):	4.2 Energy Rating Reference Home and Rated Home Configuration, and Normative Appendix B
Table(s):	Inspection Procedure for Minimum Rated Features
Relating to:	Building Element: Dwelling Unit Mechanical Ventilation System(s)

Request from:

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Background Statement: *Provided by person requesting the interpretation.*

VFD fan motors may be rated in both brake horsepower and horsepower. Horsepower will represent the sizing of the motor and brake horsepower will represent the power at a set speed and/or design condition. Some ventilation fan manufacturers use brake horsepower to present fan power at set specific CFMs for their VFD controlled units. This applies to singular fans, such as a central rooftop exhaust fan, and combo units, such as an ERV with a supply and exhaust fan. For example, below, Figure 1 shows a Greenheck rooftop exhaust fan with brake horsepower listed at specific static pressure conditions and CFM settings, and Figure 2 shows a Renewaire central ERV with brake horsepower listed at specific static pressure conditions and CFM settings.

All dimensions in inches *(millimeters)*. *May be greater depending on motor.
^Weight shown is largest cataloged Open Drip-Proof motor.

Direct Drive RPM

E-1050 RPM	G-1300 RPM	D-1550 RPM	VG-1725 RPM

Direct Drive	Motor HP	Fan RPM		Static Pressure in Inches wg									
				0	0.1	0.125	0.15	0.2	0.25	0.3	0.375	0.5	0.625
090													
VG-1/10	E-1/40	1050	CFM	520	441	420	398	351	293				
			BHP	0.01	0.02	0.02	0.02	0.02	0.02				
			Sones	4	3.9	3.9	4	4.1	4.2				
VARI-GREEN	G-1/25	1300	CFM	644	580	565	549	515	478	440	373		
			BHP	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05		
			Sones	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.6		
	D-1/15	1550	CFM	768	714	701	688	662	633	605	557	473	338
			BHP	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.07
			Sones	7.6	7.5	7.5	7.5	7.5	7.4	7.4	7.4	7.4	7.8
		1725	CFM	855	806	794	782	759	735	709	671	600	522
			BHP	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.11
			Sones	9.7	9.5	9.5	9.5	9.5	9.4	9.4	9.2	9.1	9.1
095													
VG-1/6	E-1/30	1050	CFM	717	606	570	534	468	389	290			
			BHP	0.03	0.03	0.04	0.04	0.04	0.04	0.03			
			Sones	5.4	4.5	4.5	4.5	4.4	4.5	4.6			
VARI-GREEN	G-1/12	1300	CFM	888	802	780	754	695	640	586	493	184	
			BHP	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.05	
			Sones	7.6	6.8	6.7	6.6	6.5	6.4	6.4	6.4	6.8	
	D-1/8	1550	CFM	1059	987	969	950	912	863	814	745	623	474
			BHP	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.11
			Sones	9.6	9.4	9.3	9.2	9	8.8	8.7	8.7	8.7	8.7
		1725	CFM	1179	1114	1098	1081	1048	1013	969	903	800	688
			BHP	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.16
			Sones	11.4	11.4	11.4	11.5	11.4	11.2	11	10.9	11.3	11.3

Figure 1 – Greenheck G-090-VG (exhaust fan) air flow performance chart

AIRFLOW PERFORMANCE

Blower RPM	External Static Pressure (Inches Water Column)															
	0.25		0.50		0.75		1.00		1.25		1.50		1.75		2.00	
	SCFM	BHP	SCFM	BHP	SCFM	BHP	SCFM	BHP	SCFM	BHP	SCFM	BHP	SCFM	BHP	SCFM	BHP
800																
900	642	0.4														
1000	829	0.4	558	0.4												
1100	1016	0.5	776	0.5												
1200	1200	0.7	986	0.6	739	0.5										
1300	1381	0.9	1191	0.8	973	0.7	721	0.6								
1400	1562	1.1	1392	1.0	1199	0.9	977	0.7	725	0.6						
1500	1743	1.3	1590	1.2	1419	1.1	1223	1.0	1000	0.8	750	0.7				
1600	1923	1.7	1785	1.5	1632	1.4	1459	1.3	1263	1.1	1041	1.0	795	0.8	534	0.7
1700			1975	1.9	1836	1.7	1683	1.6	1511	1.4	1317	1.3	1099	1.1	859	0.9

Figure 2 – Renewaire HE2XRT (ERV) air flow performance chart

Currently, section 4.2.2 of ANSI/RESNET/ICC 301 permits fan motor power to be calculated using only horsepower. This presents an issue when modeling VFD ventilation fans whom' s design conditions, static pressure and set RPM, result in an operational brake horsepower lower than the motor horsepower. As currently written, ANSI/RESNET/ICC 301 would force that fan power be calculated using the motor size or horsepower. This results in overestimating the power consumption of VFD controlled ventilation equipment, since the horsepower rating of the motor may be significantly higher than installed power, depending on design conditions. Below, Figures 3 and 4 illustrate a 47.6% difference between system Watts/CFM when using horsepower or brake horsepower to calculate fan power.

ENERGY RECOVERY VENTILATOR SCHEDULE

TAG	MODEL	OUTDOOR AIR PERFORMANCE				EXHAUST AIR PERFORMANCE				ELECTRICAL					WEIGHT LBS	W / CFM	SUMMER PERFORMANCE			WINTER PERFORMANCE			ACCESSORIES
		CFM	E.S.P.	HP	BHP	CFM	E.S.P.	HP	BHP	VOLTS	PHASE	HZ	MCA	MOCP			E.A.T. °F	L.A.T. °F	EFFECTIVENESS SENS / TOTAL	E.A.T. °F	L.A.T. °F	EFFECTIVENESS SENS / TOTAL	
ERV-1	HE-2XJRTV-S35VV	1,460	1.0	2.0	1.25	2,000	1.0	2.0	1.3	208	3	60	14.9	20	516	1.3	91	80	70.4% / 51.2%	4	51	70.4% / 68.5%	ALL

Figure 3 - ERV Schedule showing HP vs. BHP

Unit	Total Watts using HP	Total W/CFM using HP	Total Watts using BHP	Total W/CFM using BHP
Renewaire HE-2XJRTV-S35W	4590.8	1.3	2926.6	0.8

Figure 4 – Calculated Watt/CFM of Figure 3 ERV

Section G3.2.2.8 of ASHRAE 90.1-2022 provides equations for converting brake horsepower to watts. See Figure 5 for reference. Functionally, it is the same equation that ANSI/RESNET/ICC 301 lists in Section 4.2.2 Normative Note 4, "Fan motors rating in horsepower shall be converted to Watts by multiplying by 746 and dividing by fan motor efficiency", but with brake horsepower substituted for horsepower.

G3.2.2.8 System Fan Power. *System* fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered *VAV* boxes) shall be calculated using the following formulas:

For *Systems* 1 and 2,

$$P_{fan} = CFM_s \times 0.3$$

For *Systems* 3 through 8, and 11, 12, and 13,

$$P_{fan} = bhp \times 746 / \text{fan motor } efficiency$$

For *Systems* 9 and 10 (supply fan),

$$P_{fan} = CFM_s \times 0.3$$

For *Systems* 9 and 10 (non-*mechanical cooling* fan if required by Section G3.2.2.7.2),

$$P_{fan} = CFM_{nmc} \times 0.054$$

where

P_{fan}	=	electric power to fan motor, W
bhp	=	brake horsepower of baseline fan motor fromTable G3.2.2.8
fan motor *efficiency*	=	the *efficiency* for the next motor size greater than the bhp from Table G3.2.2.8
CFM_s	=	the baseline *system* maximum design supply fan airflow rate, cfm
CFM_{nmc}	=	the baseline non-*mechanical cooling* fan airflow, cfm

Figure 5 – ASHRAE 90.1-2022 System fan power calculation equations

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Proposed Interpretation: *Provided by person requesting the interpretation.*

For fans with manufacturer published brake horsepower at predefined fan speeds, the brake horsepower that most closely matches the total system ventilation rate can be permitted to be used to calculate equipment power. It can be converted to Watts by multiplying brake horsepower by 746 and dividing by fan motor efficiency.

SDC Response:

Is the proposed interpretation correct? _____ Yes __X___ No

SDC Comments:

Within Table 4.2.2(1) of ANSI/RESNET/ICC 301-2022, table note 'm' and 'n' elaborate on the available options to determine "Dwelling Unit Mechanical Ventilation System fan power" for the Rated Home.

Where the DUMV system serves multiple dwelling units, note 'n' offers a default of 1 Watt/cfm where fan power cannot be determined and Normative Note 4 offers the following alternative calculation for fan power:

"4. (Normative Note) Fan motors rating in horsepower shall be converted to Watts by multiplying by 746 and dividing by fan motor efficiency. Where fan motor efficiency is unknown, use 0.65 for single-phase and 0.75 for 3-phase motors."

While it is understood that other modeling protocols like ASHRAE 90.1 Appendix G use this same equation with "brake" horsepower rather than "horsepower", a proposed change to Standard 301 via an Addendum would be required to specifically accommodate the use of "brake" horsepower.

The current intent of the Standard is to use horsepower (HP) to convert to Watts, or use the other available W/cfm defaults, or determine fan power by "observation" via direct measurement of Watts, as allowed by Section 4.5.1.