

Cooling capacity isn't always what it seems.

We all learned how to read the tonnage off of a model number within a few weeks of beginning in the trade. What you may (or may not) have learned is that just because something has an 036 in the model number does not mean it actually produces 36,000 btu/hr even during RATED conditions let alone real world conditions.

Some of you may be used to pulling up an AHRI rating to find the true capacity of a system match. This is a good start and often you will find out that the the system produces slightly less than up to 4,000 btu/hr less than the nominal rating. Here is the AHRI ratings for the system I have on my home.

Outdoor Model	Indoor Model	Furnace Model	Cooling				Heating				
			Cooling Cap.	SEER	EER	ID CFM	HSPF	High Temp		Low Temp	
								Capacity 47°F (8°C)	COP	Capacity 17°F (- 8°C)	COP
25VNA813A*030*	FE4ANF002L+UI		13,000	17.0	13.0	420	9.5	17,000	3.68	11,000	2.70
25VNA824B*030*	FE4ANF002L+UI		24,000	17.5	11.0	825	9.5	24,400	3.62	15,600	2.58
25VNA825A*030*	FE4AN(B.F)005L+UI		24,000	18.0	12.5	825	10.0	26,800	3.56	19,900	2.58
25VNA836A*030*	FE4AN(B.F)005L+UI		34,200	17.5	10.0	1,050	10.0	34,200	3.56	23,000	2.58
25VNA837A*030*	FE4ANB006L+UI		33,600	19.0	13.0	1,050	10.0	40,000	3.50	30,400	2.66
25VNA848A*030*	FE4AN(B.F)005L+UI		46,000	18.0	11.0	1,400	11.0	50,500	3.44	35,200	2.66
25VNA860A*030*	FE4ANB006L+UI		57,000	17.0	10.0	1,600	9.0	60,000	3.10	44,500	2.48

* Ratings are net values reflecting the effects of circulating fan heat. Supplemental electric heat is not included. Ratings are based on:
Cooling Standard: 80°F (27°C) db indoor entering air temperature and 95°F (35°C) db air entering outdoor unit.
High- Temp Heating Standard: 70°F (21°C) db indoor entering air temperature and 47°F (8°C) db 43°F (6°C) wb air entering outdoor unit.
Low- Temp Heating Standard: 70°F (21°C) db indoor entering air temperature and 17°F (- 8°C) db 15°F (- 9°C) wb air entering outdoor unit.
COP — Coefficient of Performance
EER — Energy Efficiency Ratio
HSPF — Heating Seasonal Performance Factor
SEER — Seasonal Energy Efficiency Ratio
UI — User Interface

You will notice that the 2-ton machine actually produces 24,000 btu/hr at the rated conditions, which are REALLY WARM temps inside and out by the way. However the 4-ton machine produces 46,000 btu/hr at the same conditions.

Cooling / heating power			
testo 605i, ...			
List		Table	
566	454		
50.4 Return air %RH	88.9 Supply air %RH		
566	454		
68.3 Return air °F	47.7 Supply air °F		
1,400 cfm	41,223 BTU/h		

Here is an example of some real world capacity readings I took on my Carrier VNA8 4-ton system with the Testo Smart Probes app and two 605i thermo-hygrometers.

This is a 4 ton unit with a proper charge (right at 11.6 subcool like the Infinity stat calls for) a 0.45 TESP, and it's been running for 30 minutes at high stage. You might be tempted to think something is wrong with the measurement or the unit, but we need to look closer.



Written by Testos
subject matter expert,
Bryan Orr

You will notice pretty quickly that my indoor temperature is low (68.3db) with a low indoor RH (54%) which equates to a 57 degree wet bulb indoor return. Also, the outdoor temperature is only 72 degrees DB. In order to tell if 41,000 btu/hr is within range or not we will need to look in detail at the manufacturers expanded performance data located in the product data.

DETAILED COOLING CAPACITIES# - EFFICIENCY MODE CONTINUED

EDB °F (°C)	EVAR AIR	25VNA48 / FE4ANF005 Efficiency Mode Condenser Entering Air Temperature * F (°C)																																					
		115 (48.1)						105 (40.5)						95 (35)						85 (29.4)						75 (23.9)						65 (18.3)							
		ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**	ID SCFM	Capacity MBtuh		Total Sys. KW**										
STAGE 5																																							
75 (23.9)	72 (22.2)	1400	44.46	17.96	5.30	1400	47.55	19.13	4.76	1400	50.59	20.28	4.26	1400	53.58	21.41	3.78	1400	56.49	22.53	3.33	1400	59.36	23.64	2.90	1400	62.23	24.75	2.47	1400	65.10	25.86	2.04						
	67 (19.4)		40.53	24.37	5.19		43.36	25.62	4.67		46.12	26.85	4.18		48.81	28.07	3.72		51.44	29.27	3.28		54.03	30.47	2.88		56.62	31.67	2.47		59.21	32.87	1.67	61.80	34.07	0.86			
	63 (17.2)		37.62	29.42	5.09		40.24	30.72	4.59		42.79	32.02	4.12		45.28	33.30	3.67		47.70	34.55	3.25		49.87	35.83	2.83		51.84	37.11	2.42		53.91	38.68	1.61	56.04	40.12	0.81	58.33	41.63	0.01
	57 (13.9)		34.79	34.79	4.99		36.84	36.84	4.50		38.82	38.82	4.04		40.75	40.75	3.61		42.87	42.14	3.21		44.94	43.50	2.83		47.06	44.21	2.06		49.24	44.95	0.84	51.53	45.95	0.01	53.84	46.95	0.01
80 (26.7)	72 (22.2)	1400	44.36	24.28	5.30	1400	47.46	25.53	4.77	1400	50.50	26.76	4.26	1400	53.48	27.99	3.78	1400	56.39	29.19	3.33	1400	59.24	30.40	2.90	1400	62.09	31.61	2.47	1400	64.94	32.82	2.04						
	67 (19.4)		40.43	30.64	5.19		43.26	31.96	4.67		46.02	33.28	4.18		48.71	34.57	3.72		51.35	35.85	3.28		53.94	37.15	2.88		56.52	38.71	2.06		59.10	39.87	0.84	61.76	41.03	0.01			
	63 (17.2)		37.66	35.55	5.10		40.25	36.99	4.59		42.77	38.38	4.12		45.25	39.75	3.67		47.66	41.00	3.25		49.65	42.41	2.86		51.64	43.81	1.61		53.82	45.21	0.40	56.01	46.95	0.01	58.32	48.15	0.01
	57 (13.9)		36.88	36.88	5.07		39.04	39.04	4.56		41.10	41.10	4.09		43.11	43.11	3.64		45.06	45.06	3.23		47.06	45.06	3.23		49.06	45.06	3.23		51.06	45.06	3.23	53.06	45.06	3.23	55.06	45.06	3.23
STAGE 3																																							
75 (23.9)	72 (22.2)	1200	29.36	12.30	3.08	1200	31.57	13.11	2.74	1200	33.60	13.87	2.38	1200	35.72	14.66	2.08	1200	37.85	15.46	1.79	1200	39.94	16.25	1.53	1200	42.03	17.04	1.28	1200	44.12	17.83	0.98						
	67 (19.4)		26.65	17.55	3.05		28.66	18.45	2.73		30.51	19.30	2.38		32.44	20.17	2.09		34.35	21.06	1.82		36.25	21.92	1.56		38.16	22.79	1.28		40.07	23.61	0.67	41.88	24.38	0.01			
	63 (17.2)		24.64	21.63	3.04		26.47	22.60	2.72		28.19	23.52	2.38		29.95	24.47	2.10		31.72	25.42	1.83		33.46	26.36	1.58		35.19	27.21	1.28		36.96	28.00	0.74	38.76	28.79	0.01	40.56	29.57	0.01
	57 (13.9)		23.69	23.69	3.03		25.21	25.21	2.71		26.63	26.63	2.37		28.09	28.09	2.10		29.52	29.52	1.84		30.92	30.92	1.60		32.35	32.35	1.28		34.25	34.25	0.74	36.15	36.15	0.01	38.98	38.98	0.01
80 (26.7)	72 (22.2)	1200	29.26	17.54	3.08	1200	31.47	18.44	2.74	1200	33.50	19.28	2.38	1200	35.64	20.16	2.08	1200	37.75	21.04	1.79	1200	39.84	21.91	1.53	1200	41.93	22.79	1.28	1200	44.02	23.64	0.98						
	67 (19.4)		26.58	22.70	3.06		28.58	23.70	2.73		30.43	24.64	2.38		32.35	25.61	2.09		34.25	26.57	1.82		36.15	27.54	1.56		38.06	28.37	1.28		39.87	29.14	0.67	41.68	30.00	0.01			
	63 (17.2)		25.33	25.33	3.04		26.94	26.94	2.72		28.40	28.38	2.38		30.14	29.65	2.10		31.85	30.76	1.83		33.56	31.83	1.58		35.27	32.61	1.28		37.02	33.46	0.74	38.93	34.31	0.01	40.64	35.06	0.01
	57 (13.9)		25.29	25.29	3.04		26.90	26.90	2.72		28.39	28.39	2.38		29.92	29.92	2.10		31.42	31.42	1.83		32.90	32.90	1.58		34.25	34.25	1.28		35.68	35.68	0.74	37.51	37.51	0.01	39.02	39.02	0.01
STAGE 1																																							
75 (23.9)	72 (22.2)	1100	25.37	10.73	2.67	1100	27.27	11.42	2.37	875	19.54	8.42	1.06	875	20.95	8.94	0.89	875	22.36	9.47	0.72	875	23.78	10.00	0.56	875	25.19	10.53	0.25	875	26.60	11.00	0.01						
	67 (19.4)		22.95	15.36	2.66		24.75	16.20	2.37		17.66	12.16	1.09		18.94	12.78	0.92		20.22	13.39	0.76		21.49	14.00	0.61		22.76	14.57	0.36		24.03	15.04	0.01	25.30	15.51	0.01			
	63 (17.2)		21.20	18.93	2.65		22.84	19.87	2.38		16.38	15.07	1.11		17.54	15.80	0.95		18.70	16.45	0.79		19.87	17.13	0.65		21.04	17.75	0.45		22.31	18.18	0.15	23.54	18.63	0.01	24.78	19.08	0.01
	57 (13.9)		20.51	20.51	2.65		21.90	21.90	2.38		18.01	18.01	1.11		19.02	17.02	0.96		20.03	18.02	0.81		21.04	19.01	0.67		22.05	19.91	0.40		23.06	20.80	0.19	24.07	21.70	0.01	25.08	22.59	0.01
80 (26.7)	72 (22.2)	1100	25.29	15.39	2.67	1100	27.28	16.22	2.37	875	19.46	12.19	1.06	875	20.87	12.80	0.89	875	22.28	13.41	0.72	875	23.69	14.03	0.56	875	25.10	14.59	0.25	875	26.51	15.16	0.01						
	67 (19.4)		22.91	19.93	2.66		24.69	20.87	2.37		17.66	15.85	1.09		18.93	16.56	0.92		20.19	17.27	0.76		21.46	17.97	0.61		22.73	18.54	0.40		24.00	19.01	0.01	25.25	19.56	0.01			
	63 (17.2)		21.96	21.96	2.66		23.43	23.43	2.38		17.13	17.13	1.10		18.21	18.21	0.93		19.27	19.27	0.78		20.33	20.33	0.64		21.40	21.40	0.45		22.47	22.47	0.19	23.61	23.61	0.01	24.75	24.75	0.01
	57 (13.9)		21.92	21.92	2.66		23.39	23.39	2.38		17.10	17.10	1.10		18.18	18.18	0.93		19.24	19.24	0.78		20.29	20.29	0.64		21.34	21.34	0.45		22.42	22.42	0.19	23.56	23.56	0.01	24.64	24.64	0.01

Operation in this area is restricted to maintain reliable system operation and customer comfort. The system will default to the next available stage
 Stage 1 - Compressor speed limited to stage two at 105 and 115 outdoor.

Here is the expanded data for this particular match and we lucked out. My air handler, condenser and suction line size are the match that the rating is based on. In some cases you will need to use a multiplier based on an alternate match or smaller copper sizes which can further reduce the rated capacity and possibly the efficiency as well, like in the case of the FE4ANF003 or 002 below.

COOLING INDOOR MODEL	CAPACITY	POWER	FURNACE MODEL
*FE4AN(B,F)005	1.00	1.00	
FE4AN(B,F)003	0.96	1.06	
FE4ANF002	0.95	1.05	
CAP**3614AL*	0.95	1.05	58CV(A,X)070- 12

Now let's zoom in on the performance data that applies to our actual conditions and see how we did. The highlighted figure is the closest this chart comes to our actual conditions, though our indoor dry bulb is actually

ID SCFM	75 (23.9)		
	Capacity MBtuh	Total Sys. KW**	Total Sys. KW**
1400	56.49	22.53	3.33
	51.44	29.27	3.28
	47.70	34.55	3.25
	42.87	42.14	3.21

significantly lower than the 75 degree DB on the chart. So now the real world 41,223 btu/hr actually stacks up pretty well with the 42,870 btu/hr on the chart. All of this to say that when sizing equipment and when testing capacity there is a LOT more to it than just the nominal tonnage in the model number. The only real way to know is to dig into the manufacturer product data and really understand that piece of equipment.