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Energy Code Support Program

We will be using screen shots from the Wrightsoft software program.

A complete Manual J calculation (heat gains and heat losses) must be completed prior to the appliance selection process

Heating Equipment Summary

Make	Carrier
Trade	Carrier Performance 96 Single ...
Model	59SP6A040V17--12
AHRI ref	205822110

Efficiency	96.5	AFUE
Heating input	40000	Btuh
Heating output	39000	Btuh
Temperature rise	50	°F
Actual air flow	735	cfm
Air flow factor	0.021	cfm/Btuh
Static pressure	0.70	in H2O
Space thermostat		

Cooling Equipment Summary

Make	Carrier
Trade	BASE 13 PURON AC
Cond	24ABB324(A,W)31
Coil	CAP**2414A**++TDR
AHRI ref	3250356

Efficiency	11.0 EER, 13 SEER	
Sensible cooling	15542	Btuh
Latent cooling	5748	Btuh
Total cooling	21290	Btuh
Actual air flow	990	cfm
Air flow factor	0.069	cfm/Btuh
Static pressure	0.70	in H2O
Load sensible heat ratio	0.86	

Current ACCA approved Manual S software:

At this time there are not any ACCA approved software for Manual S. This is a process that must be completed by the designer to match the appliance capacity with the calculated load.

Part of the process for manual S is not only to verify the capacity of the appliance meets the calculated load. The other is to verify that the appliance is not oversized or undersized.

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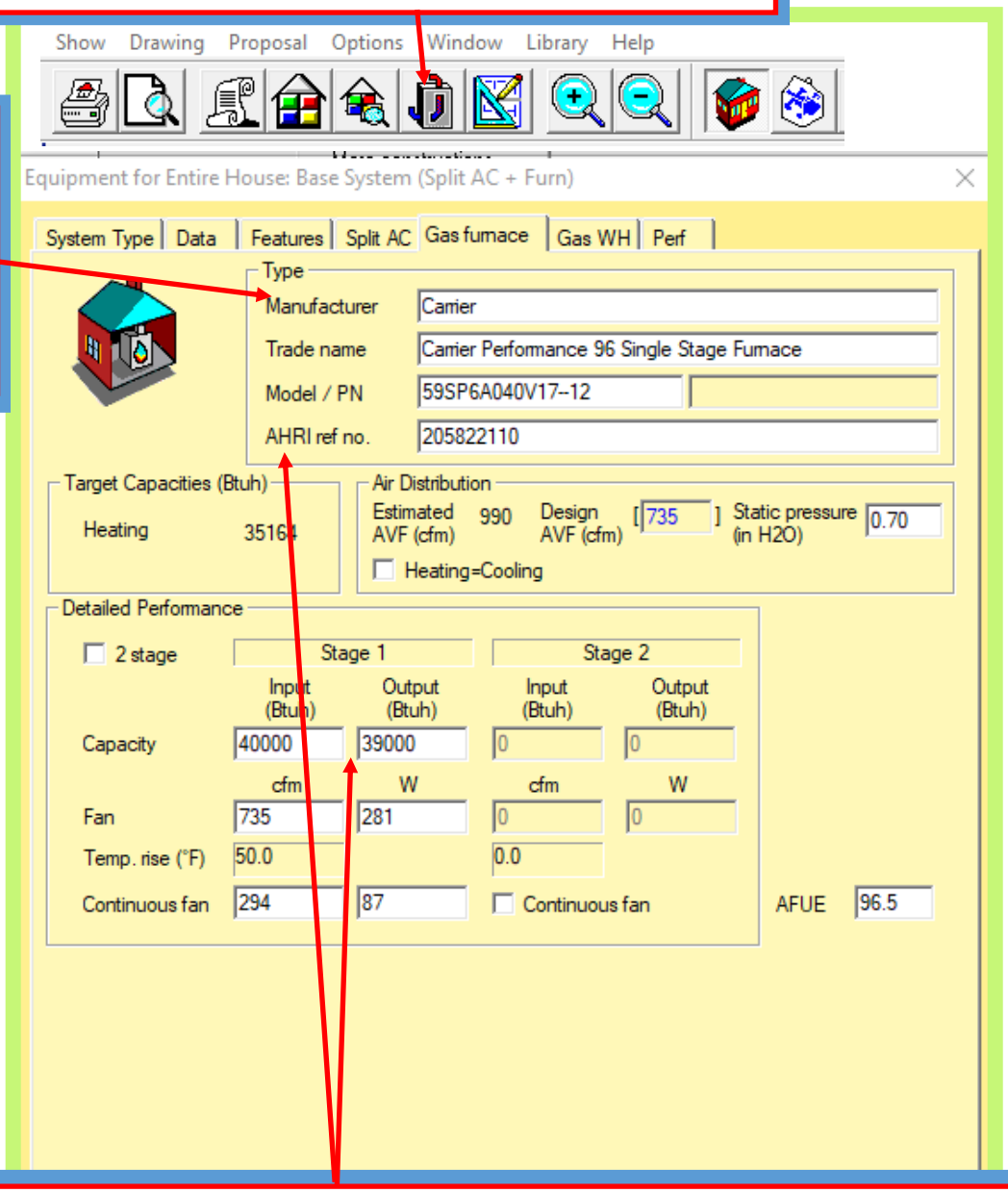
Energy Code Support Program

This icon will open the equipment screen.

The software will have 1,000's of choices. We used a Carrier furnace for this example.



The software only has AHRI data.

The software will calculate the output based on the efficiency. In this case 96.5%rounding up to 39000.

If the location elevation is above 2000’ then the designer must calculate the output based on the manufacturers deration for altitude. The software has no clue on what the altitude deration is.

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Part of the process for manual S is to verify the capacity of the appliance meets the calculated load. The other is to verify that the appliance is not oversized. Depending on the type of heating appliance the allowed oversizing varies. This example is using a gas fired forced air furnace. Manual S allows a gas fired furnace to be 40% oversized.

Heating Summary

Structure	35164	Btuh
Ducts	0	Btuh
Central vent (0 cfm) (none)	0	Btuh
Humidification	0	Btuh
Piping	0	Btuh
Equipment load	35164	Btuh

Infiltration

Method	Simplified
Construction quality	Average
Fireplaces	0

	Heating	Cooling
Area (ft²)	3600	3600
Volume (ft³)	14464	14464
Air changes/hour	0.28	0.15
Equiv. AVF (cfm)	107	83

Heating Equipment Summary

Make	Carrier
Trade	Carrier Performance 96 Single ...
Model	59SP6A040V17--12
AHRI ref	205822110

Efficiency	96.5	AFUE
Heating input	40000	Btuh
Heating output	39000	Btuh
Temperature rise	50	°F
Actual air flow	735	cfm
Air flow factor	0.021	cfm/Btuh
Static pressure	0.70	in H2O
Space thermostat		

In our example the calculated heat loss is 35,164 Btuh.

35,164 x 1.4 = 49,229 Btuh. The proposed heating appliance can have a maximum capacity of 49,229 Btuh.

The proposed heating appliance has a capacity of 39, 000 Btuh. This is less than 49,229. This appliance is not oversized and has the capacity to heat the home.

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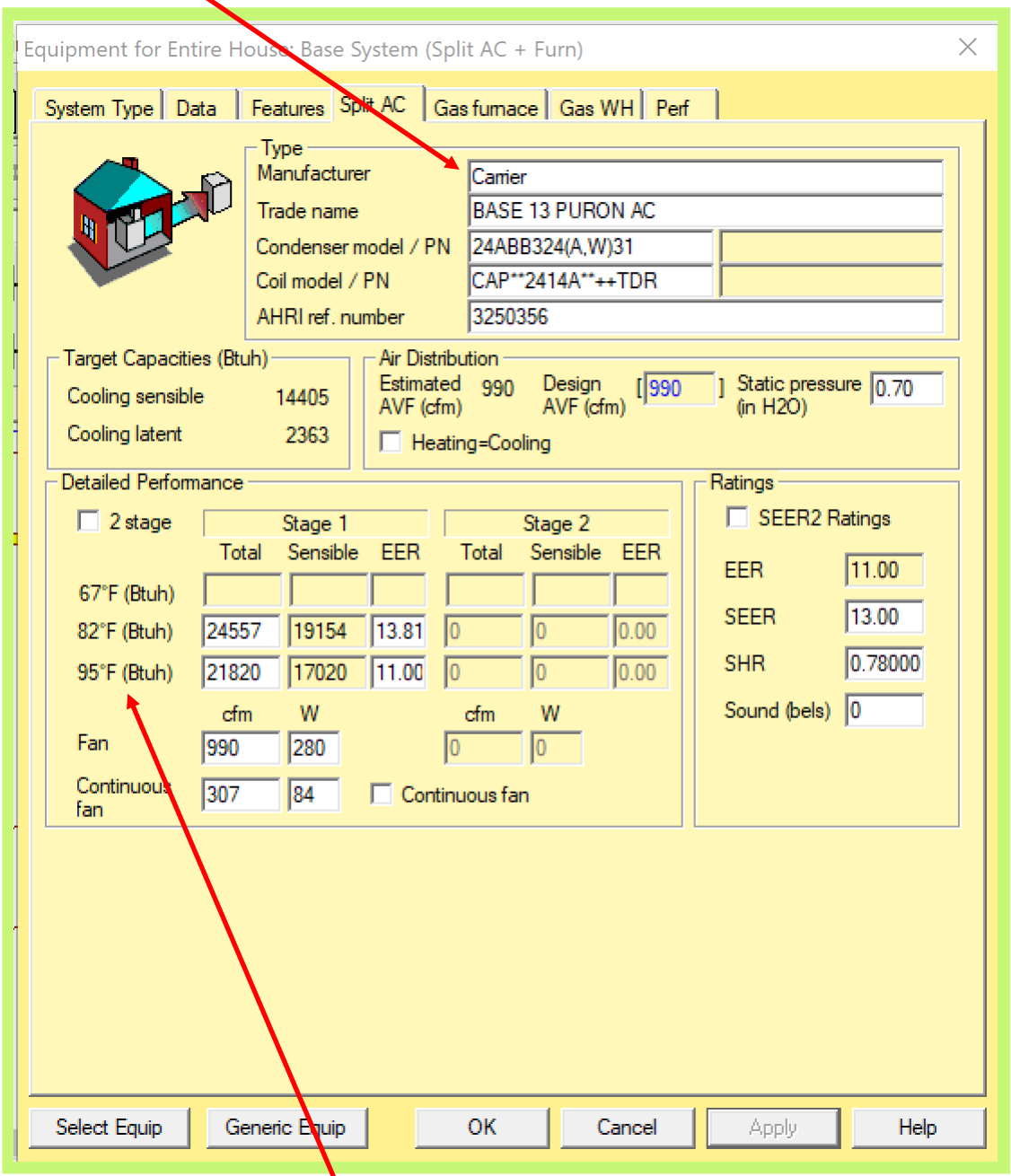
Energy Code Support Program

The software will have 1,000's of choices. We used a Carrier air conditioner for this example.



The software only has AHRI data. The designer must enter the capacities at the design temperatures.

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Energy Code Support Program

Our Calculated Air Conditioning Loads

Sensible Cooling Equipment Load Sizing

Structure	14405	Btuh
Ducts	0	Btuh
Central vent (0 cfm) (none)	0	Btuh
Blower	0	Btuh
Use manufacturer's data	y	
Rate/swing multiplier	1.00	
Equipment sensible load	14405	Btuh

Latent Cooling Equipment Load Sizing

Structure	2363	Btuh
Ducts	0	Btuh
Central vent (0 cfm) (none)	0	Btuh
Equipment latent load	2363	Btuh
Equipment Total Load (Sen+Lat)	16768	Btuh
Req. total capacity at 0.85 SHR	1.4	ton

Cooling Equipment Summary

Make	Carrier		
Trade	BASE 13 PURON AC		
Cond	24ABB324(A,W)31		
Coil	CAP**2414A**++TDR		
AHRI ref	3250356		
Efficiency	11.0 EER, 13 SEER		
Sensible cooling		17020	Btuh
Latent cooling		4800	Btuh
Total cooling		21820	Btuh
Actual air flow		990	cfm
Air flow factor		0.069	cfm/Btuh
Static pressure		0.70	in H2O
Load sensible heat ratio		0.86	

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Energy Code Support Program

AHRI capacities cannot be used for your design. AHR has standards by which all conditioning appliances are tested.

This is a good thing all appliances are tested at the same design parameters. The issue is that the design parameters are not those used in our designs.

The test standard has the indoor temperature at 80° (at a 67° wet bulb) and the outdoor temperature at 95°. We are designing a 75° indoor and 87° outdoor design temperature.

This is why it is important to use detailed or expanded performance data from the manufacturer. Below is a partial table.

The 324 indicates a two ton unit and a two ton coil

DETAILED COOLING CAPACITIES# CONTINUED

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)											
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)		
CFM	EWB °F (°C)	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		S
		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡	
24ABB324(A,W)31 Outdoor Section With CAP**2414A** Indoor Section													
700	72 (22.2)	27.09	13.27	1.65	25.82	12.82	1.85	24.63	12.41	2.06	23.42	12.00	
	67 (19.4)	24.89	16.41	1.65	23.83	15.99	1.84	22.71	15.56	2.05	21.55	15.13	
	63 (17.2)††	23.39	15.98	1.64	22.38	15.55	1.84	21.29	15.11	2.05	20.18	14.66	
	62 (16.7)	23.01	19.56	1.64	22.03	19.14	1.84	20.99	18.67	2.05	19.94	18.19	
	57 (13.9)	22.46	22.46	1.64	21.66	21.66	1.83	20.79	20.79	2.05	19.89	19.89	
800	72 (22.2)	27.52	13.92	1.69	26.15	13.46	1.88	24.91	13.04	2.10	23.67	12.62	
	67 (19.4)	25.25	17.44	1.68	24.16	17.03	1.88	23.00	16.60	2.09	21.82	16.16	
	63 (17.2)††	23.76	16.95	1.68	22.72	16.53	1.87	21.60	16.08	2.09	20.46	15.63	
	62 (16.7)	23.47	20.99	1.68	22.49	20.52	1.87	21.52	21.52	2.09	20.58	20.58	
	57 (13.9)	23.30	23.30	1.68	22.44	22.44	1.87	21.53	21.53	2.09	20.58	20.58	
900	72 (22.2)	27.79	14.53	1.73	26.41	14.07	1.92	25.10	13.63	2.13	23.83	13.21	
	67 (19.4)	25.51	18.45	1.72	24.38	18.03	1.91	23.21	17.59	2.13	22.00	17.15	
	63 (17.2)††	24.03	17.89	1.72	22.96	17.47	1.91	21.82	17.01	2.12	20.66	16.55	
	62 (16.7)	23.97	23.97	1.72	23.07	23.07	1.91	22.11	22.11	2.12	21.12	21.12	
	57 (13.9)	23.96	23.96	1.72	23.07	23.07	1.91	22.11	22.11	2.12	21.12	21.12	

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Energy Code Support Program

DETAILED COOLING CAPACITIES# CONTINUED

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)											
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)		
CFM	EWB °F (°C)	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		S
		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡	
24ABB324(A,W)31 Outdoor Section With CAP**2414A** Indoor Section													
700	72 (22.2)	27.09	13.27	1.65	25.82	12.82	1.85	24.63	12.41	2.06	23.42	12.00	
	67 (19.4)	24.89	16.41	1.65	23.83	15.99	1.84	22.71	15.56	2.05	21.55	15.13	
	63 (17.2)††	23.39	15.98	1.64	22.38	15.55	1.84	21.29	15.11	2.05	20.18	14.66	
	62 (16.7)	23.01	19.56	1.64	22.03	19.14	1.84	20.99	18.67	2.05	19.94	18.19	
	57 (13.9)	22.46	22.46	1.64	21.66	21.66	1.83	20.79	20.79	2.05	19.89	19.89	
800	72 (22.2)	27.52	13.92	1.69	26.15	13.46	1.88	24.91	13.04	2.10	23.67	12.62	
	67 (19.4)	25.25	17.44	1.68	24.16	17.03	1.88	23.00	16.60	2.09	21.82	16.16	
	63 (17.2)††	23.76	16.95	1.68	22.72	16.53	1.87	21.60	16.08	2.09	20.46	15.63	
	62 (16.7)	23.47	20.99	1.68	22.49	20.52	1.87	21.52	21.52	2.09	20.58	20.58	
	57 (13.9)	23.30	23.30	1.68	22.44	22.44	1.87	21.53	21.53	2.09	20.58	20.58	
900	72 (22.2)	27.79	14.53	1.73	26.41	14.07	1.92	25.10	13.63	2.13	23.83	13.21	
	67 (19.4)	25.51	18.45	1.72	24.38	18.03	1.91	23.21	17.59	2.13	22.00	17.15	
	63 (17.2)††	24.03	17.89	1.72	22.96	17.47	1.91	21.82	17.01	2.12	20.66	16.55	
	62 (16.7)	23.97	23.97	1.72	23.07	23.07	1.91	22.11	22.11	2.12	21.12	21.12	
	57 (13.9)	23.96	23.96	1.72	23.07	23.07	1.91	22.11	22.11	2.12	21.12	21.12	

Manual S allows us to be within 5° of our outdoor design temperature.

Which in our case is 87°. We used the 95° column although slightly out of the five degree range we could interpolate between the 85° and 95° columns. That is really getting down to the nitty gritty. You know this unit will have a slightly greater capacity at 87°. Not enough to worry about.

We use the 900 CFM row although using any of the three airspeeds would be acceptable. Notice that the higher the airspeed the higher the total capacity and the higher the sensible capacity. Will you use the row at the 63° wet bulb with the double cross symbol.

Why the 63° wet bulb you ask? A 75° temperature with a 63° wet bulb is 50% relative humidity. Just to let you know that is comfort.

Total Capacity = 21,820 Btuh With 17, 010 Btuh Sensible and 4,810 Btuh latent capacity. This is called the Sensible Latent split.

The table footnote explains why we're using this row.

tt = rating indoor condition (75° F edb/63° F ewb). All other indoor air temperatures are at 80° F

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Sensible Cooling Equipment Load Sizing

Structure	14405	Btuh
Ducts	0	Btuh
Central vent (0 cfm)	0	Btuh
(none)		
Blower	0	Btuh
Use manufacturer's data	y	
Rate/swing multiplier	1.00	
Equipment sensible load	14405	Btuh

Latent Cooling Equipment Load Sizing

Structure	2363	Btuh
Ducts	0	Btuh
Central vent (0 cfm)	0	Btuh
(none)		
Equipment latent load	2363	Btuh
Equipment Total Load (Sen+Lat)	16768	Btuh
Req. total capacity at 0.85 SHR	1.4	ton

Cooling Equipment Summary

Make	Carrier		
Trade	BASE 13 PURON AC		
Cond	24ABB324(A,W)31		
Coil	CAP**2414A**++TDR		
AHRI ref	3250356		
Efficiency	11.0 EER, 13 SEER		
Sensible cooling		17020	Btuh
Latent cooling		4800	Btuh
Total cooling		21820	Btuh
Actual air flow		990	cfm
Air flow factor		0.069	cfm/Btuh
Static pressure		0.70	in H2O
Load sensible heat ratio		0.86	

We try to pick the appliance with the same Sensible Heat Ratio (SHR) as close as we can to the calculation.

Sensible load/total load 14405/16768 = 0.86 Calculated SHR

Current selection Total Capacity = 21,820 Btuh With 17, 010 Btuh Sensible and 4,810 Btuh latent capacity.

17,010/21,820 = 0.78 We will look at this later.

We also must meet the calculated Sensible and Latent loads, regardless of the SHR.

Manual S allows the total capacity of a split system air conditioner can be up to 15% oversized .

The calculated total heat gain is 16,768 Btuh.

16,768 x 1.15 = 19,283 Capacity of the proposed system is 21,820 Btuh. System is oversized. Or is it?

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AHRI capacities cannot be used for your design. AHR has standards by which all conditioning appliances are tested. This is a good thing all appliances are tested at the same design parameters. The issue is that the design parameters are not those used in our designs. The test standard has the indoor temperature at 80° (at a 67° wet bulb) and the outdoor temperature at 95°. We are designing a 75° indoor and 87° outdoor design temperature. This is why it is important to use detailed or expanded performance data from the manufacturer. Below is a partial table.

DETAILED COOLING CAPACITIES#

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°										
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)	
CFM	EWB °F (°C)	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh	
		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡
24ABB318(A,W)31 Outdoor Section With CAP**1814A** Indoor Section												
525	72 (22.2)	20.79	10.51	1.27	19.89	10.18	1.42	18.93	9.83	1.58	17.94	9.47
	67 (19.4)	19.09	12.93	1.27	18.24	12.58	1.42	17.33	12.21	1.59	16.39	11.84
	63 (17.2)††	17.84	12.55	1.27	17.02	12.19	1.42	16.15	11.82	1.59	15.24	11.43
	62 (16.7)	17.53	15.32	1.27	16.74	14.95	1.42	15.91	14.57	1.59	15.04	14.16
	57 (13.9)	17.00	17.00	1.27	16.36	16.36	1.42	15.67	15.67	1.59	14.95	14.95
600	72 (22.2)	21.12	11.01	1.29	20.19	10.67	1.44	19.19	10.32	1.61	18.18	9.96
	67 (19.4)	19.42	13.74	1.29	18.54	13.39	1.45	17.60	13.02	1.61	16.63	12.65
	63 (17.2)††	18.17	13.32	1.30	17.32	12.96	1.45	16.43	12.58	1.62	15.49	12.19
	62 (16.7)	17.93	16.44	1.30	17.12	16.06	1.45	16.30	16.21	1.62	15.53	15.53
	57 (13.9)	17.70	17.70	1.30	17.02	17.02	1.45	16.29	16.29	1.62	15.53	15.53
675	72 (22.2)	21.35	11.48	1.32	20.39	11.14	1.47	19.37	10.79	1.64	18.34	10.43
	67 (19.4)	19.66	14.52	1.32	18.76	14.17	1.47	17.79	13.80	1.64	16.81	13.42
	63 (17.2)††	18.41	14.06	1.32	17.55	13.70	1.48	16.63	13.31	1.64	15.67	12.92
	62 (16.7)	18.28	18.11	1.32	17.55	17.55	1.48	16.79	16.79	1.64	15.99	15.99
	57 (13.9)	18.26	18.26	1.32	17.55	17.55	1.48	16.79	16.79	1.64	15.99	15.99

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Capacities for the next smaller unit.

The 318 indicates a 1.5 ton unit and a 1.5 ton

DETAILED COOLING CAPACITIES#

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°										
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)	
CFM	EWB °F (°C)	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh		Total System KW**	Capacity MBtuh	
		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡
24ABB318(A,W)31 Outdoor Section With CAP**1814A** Indoor Section												
525	72 (22.2)	20.79	10.51	1.27	19.89	10.18	1.42	18.93	9.83	1.58	17.94	9.47
	67 (19.4)	19.09	12.93	1.27	18.24	12.58	1.42	17.33	12.21	1.59	16.39	11.84
	63 (17.2)††	17.84	12.55	1.27	17.02	12.19	1.42	16.15	11.82	1.59	15.24	11.43
	62 (16.7)	17.53	15.32	1.27	16.74	14.95	1.42	15.91	14.57	1.59	15.04	14.16
	57 (13.9)	17.00	17.00	1.27	16.36	16.36	1.42	15.67	15.67	1.59	14.95	14.95
600	72 (22.2)	21.12	11.01	1.29	20.19	10.67	1.44	19.19	10.32	1.61	18.18	9.96
	67 (19.4)	19.42	13.74	1.29	18.54	13.39	1.45	17.60	13.02	1.61	16.63	12.65
	63 (17.2)††	18.17	13.32	1.30	17.32	12.96	1.45	16.43	12.58	1.62	15.49	12.19
	62 (16.7)	17.93	16.44	1.30	17.12	16.06	1.45	16.30	16.21	1.62	15.53	15.53
	57 (13.9)	17.70	17.70	1.30	17.02	17.02	1.45	16.29	16.29	1.62	15.53	15.53
675	72 (22.2)	21.35	11.48	1.32	20.39	11.14	1.47	19.37	10.79	1.64	18.34	10.43
	67 (19.4)	19.66	14.52	1.32	18.76	14.17	1.47	17.79	13.80	1.64	16.81	13.42
	63 (17.2)††	18.41	14.06	1.32	17.55	13.70	1.48	16.63	13.31	1.64	15.67	12.92
	62 (16.7)	18.28	18.11	1.32	17.55	17.55	1.48	16.79	16.79	1.64	15.99	15.99
	57 (13.9)	18.26	18.26	1.32	17.55	17.55	1.48	16.79	16.79	1.64	15.99	15.99

The next smaller unit (at 675 cfm) has a total capacity of 16,630 Btuh.

13,310 Btuh Sensible and 3,320 Btuh Latent

Per manual S we can take the 1/2 the excess latent capacity and add that to the sensible capacity as this is self correcting. This is why when the cfm increases so does the sensible capacity. The more air that passes through the coil the warmer the coil becomes and reduces the latent capacity. You can see this in the chart.

Calculated loads. 14,405 Sensible and 2,363 Latent

3,320 - 2,363 = 957 excess latent capacity. 975/2 = 478 Btuh

13,310 + 478 = 13,478 Btuh.

Does not meet the needed Sensible capacity this unit is too small.

As this unit is too small the next larger unit can be used, even though it is more that 15% oversized.