

**GENIUS AIR CONDITIONERS**  
**SPECIFICATION PROCEDURES**  
**THERMAL (HEAT DRIVEN) SYSTEMS**

**BACKGROUND**

The *GENIUS* thermal based air conditioners utilize a separate regenerator for removing moisture from the liquid desiccant. Heat to the regenerators may be supplied by gas, propane, steam, hot water, or other CHP sources such as engine coolant. The air conditioners operate by exchanging air energies between the outside air stream and building exhaust (return) air flow. The performance of *GENIUS* air conditioners is measured by the energy transferred from the outside air to the exhaust air, which will vary at different indoor or outdoor temperature and humidity. This transfer of sensible and latent energy (together - enthalpy) is expressed as Btu's per pound of air.

**BENCHMARK**

The benchmark set of air energies taken in this paper is the ARI-A standard condition of 95°F 40% RH containing 38.4 Btu's energy per pound of air, and the inside condition of 80°F 50% RH holding 31.2 Btu's of energy. The supply air condition would be 55°F saturated containing 22.3 Btu's per pound. Supply air is provided at 0.4 inch water column external static pressure and return air at 0.2 inch water column external static pressure.

**AVAILABLE GENIUS PRODUCT RANGE**

The thermal-based product is available in two platforms, each with a designated supply air flow. The air flows are 2,750 cubic feet per minute and 4,000 cubic feet per minute.

*Cooling Capacity at ARI-A Benchmark*

Air Flow (cfm)	Cooling (Btu/Hr)	Cooling (Tons)
2,750	193,000	16.1
4,000	280,000	23.3

**VARIANCES FROM THE BENCHMARK**

**Outside Conditions.** No changes in equipment are necessary until outside energy design levels above 42.5 Btu's per pound of air are specified. With optional larger liquid-to-liquid heat exchangers, the Btu threshold rises to 45 Btu's per pound of air. This is equal to 90°F DB, 81.5°F WB and a RH of 70%. Changes in cooling performance without altering the liquid-to-liquid heat exchangers are presented in footnote 1.

*Cooling Capacity at 45 Btu's per Pound of Air with larger heat exchangers*

Air Flow (cfm)	Cooling (Btu/Hr)	Cooling (Tons)
2,750	269,700	22.5
4,000	392,200	32.7

**Indoor Humidity Conditions.** No change in specification is needed as supply air will automatically adjust from 74% RH to 95% RH in order to maintain indoor conditions at a set point (normally 50% RH).

**Reduced Indoor Temperature Conditions.** Owing to reduced energy in the return air, the system compensates automatically (to indoor conditions of 72° F).

**Partial Load Considerations.** Given the same absolute moisture loading in the outside air, an outside air temperature decrease of 3 degrees, for example, results in only 1 degree decrease in supply air temperature as the temperature spread “driving force” within the system is reduced. Thus, the cooling capacity of the *GENIUS* air conditioner significantly compensates for daily temperature variances without need for intermittent interruption of the air supply.

**Return Air.** Performance of the *GENIUS* air conditioners has been computed on supply air volume equal return air volume. Making up a shortfall in return air with outside air normally means an increase in energy content. With the optional larger heat exchangers, up to 50% outside air (at ARI-A) may be used with no deterioration in air delivery conditions. Changes without the option are presented in footnote 2.

**Static Pressure (Supply Air).** The design point is 0.4 inches water column external static pressure. Reductions in cooling capacity relating to reduced air flows are partially offset because of improved operating efficiencies. The relationship between static pressure and reduction in both air flow and cooling capacity is shown below.

Static Pressure Inch W.C.	Air Flow Reduction	Cooling Reduction
0.6	3%	2%
0.8	6%	4%
1.0	9%	7%

## REGENERATORS

Gas-fired regenerators are available to support two *GENIUS* air conditioners operating at ARI-A or less stringent outside air conditions and one *GENIUS* air conditioner at moisture loading above this level (0.014 pounds of moisture per pound of air). Regenerators supplied by hot water or other liquids service one *GENIUS* air conditioner. Regenerator specifications are available separately.

## HIGH ENERGY OUTSIDE AIR

When outside design point air energy is above 42.5 Btu's per pound, the optional larger liquid-to-liquid heat exchangers should be specified. If design conditions are above 45 Btu's per pound, supply temperatures will increase according to the following table.

Outside Air Energy Btu (lb air)	Supply Air Temperature (degree F WB)
46	56
47	57
48	58

## HIGH ENERGY INDOOR AIR

Energy in the return air will alter performance if substantially different from the ARI-A return air condition of 80°F 50% RH (31.23 Btu's per pound). For example, one-half 80°F 50% RH and one-half 95°F 40% RH air would give a loading of 34.9 Btu's per pound of air (31.23 plus 38.5 divided by 2). No adjustments are necessary to maintain a supply temperature of 55°F WB until the return energy level exceeds 33 Btu's per pound of air. From 33 to 35 Btu's per pound of air the optional higher capacity liquid-to-liquid heat exchangers allow maintenance of supply air at 55°F WB. As seen in the following chart, above 35 Btu's the supply temperature will increase at the rate of approximately 0.8 degree F WB for each additional Btu per pound of air.

Return Air Energy (Btu/lb air)	Heat Exchanger Pack	Supply Air Temperature (°F WB)
31.2	No	54.2
33	No	55.1
34	Yes	54.6
35	Yes	55.2
36	Yes	56.0
37	Yes	56.9
38	Yes	57.7

## **INCREASES IN CAPACITY OF LIQUID-TO-LIQUID HEAT EXCHANGERS**

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The maximum number of increases in the liquid-to-liquid heat exchanger capacities in order to maintain air delivery temperatures is two; or for example, one increase for high outside air loading and one increase for reduced percentage of return air.

## **SUPPLY AIR STATIC PRESSURE**

Maintenance of supply air flows at the 0.4 inch water column static pressure levels should be met by supplying external duct blowers.

### **Footnotes**

(1) Without the alteration to the heat exchanger, at design levels above 42.5 Btu's supply temperatures will increase by 0.45 °F WB per each one Btu increase in outside air energy. For examples, 90°F DB, 79°F WB, 62% RH would fall within the 55° delivery while 90°F DB, 81.5°F WB, 70% RH would deliver supply air at 56.3°F WB. Increases above 45 Btu's per pound of air will result in 1.0 °F increase in supply air (WB) for each Btu per pound increase in the outside air.

(2) Without the optional larger heat exchangers, an increase of one Btu per pound of air (above the ARI-A indoor standard of 31.2 Btu's) will result in a cooling loss of 0.37 Btu's.

General note: Please reference attached paper "Energy Utilization Comparisons" for additional information.

Specifications and operational data pertaining to the *GENIUS* air conditioners are constantly being refined and may be altered at any time without notice.

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