

GENIUS AIR CONDITIONERS
SPECIFICATION PROCEDURES
HYBRID (DESICCANT/COMPRESSOR) SYSTEMS

OPERATION

The *GENIUS* hybrid air conditioners utilize evaporator and condenser energies of two small standard refrigerant-based compressors. The evaporator energy is employed to cool a flow of liquid desiccant. This desiccant contacts the supply air to provide its temperature reduction and dehumidification. The moisture absorbed by the desiccant is removed using heat from the condenser. This heat is transferred to the desiccant which, in turn, heats the return air stream. This heated air, now having a reduced relative humidity, allows evaporation of moisture from the desiccant before it is exhausted to the environment.

Each hybrid air conditioner is produced in two configurations. These include operation as an air conditioner and dehumidifier in climates having conventional to high humidity characteristics, and as an air conditioner operating in climates that, for most of the cooling season, do not have a significant humidity issue. The difference in the two products is the manner of initial treatment of outside air.

When servicing locations having relatively high seasonal moisture content in the outside air, the *GENIUS* hybrid air conditioners employ an energy exchange media to exchange outside air heat and humidity generally to air exiting the indoor space. The efficiency of this energy exchange ranges from 60% to 65% based upon the enthalpy difference in the outside and return air streams.

In areas having only limited periods of high humidity, The *GENIUS* hybrid air conditioners utilize a staged evaporative cooling device that is capable of reducing the outdoor air temperature to within 2 °F of its dew point. Without the compressor system operating, the absolute humidity of this air is not altered. When needed, the compressor cuts in and the desiccant hybrid air conditioner operates as described above.

BENCHMARK - CONVENTIONAL AIR CONDITIONING APPLICATIONS

The benchmark set of air energies taken is the ARI-A outside air condition of 95°F 40% RH containing 38.4 Btu's energy per pound of air and an inside condition of 80°F 50% RH containing 31.2 Btu's of energy. In order to obtain high compressor efficiencies, supply air conditions have been established at 62°F DB and 56°F WB containing energy of 24 Btu's per pound of air.

Supply air and return air are each provided at 0.4 inch water column external pressure.

AVAILABLE GENIUS PRODUCT RANGE

The hybrid 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)	Total Compressor HP	Cooling (Btu/Hr)	Cooling (Tons)
2,750	10	176,000	14.7
4,000	15	252,000	21.0

BENCHMARK VARIANCES

Outside Conditions. For design purposes, the above compressor sizing is adequate for energy levels to 38.4 Btu's per pound of air and a moisture content of 0.014 pounds per pound of air. Moving from this climatic condition to an enthalpy level of 42.7 Btu's per pound of air and/or a moisture content of 0.018 pounds per pound of air, the 11HP model should be chosen with attendant increases in the refrigerant-to-desiccant heat exchangers. For conditioning outside air energies of 47 Btu's per pound of air and/or a moisture content of 0.022 pounds per pound of air the 12 HP system should be used.

Operation - ARI-A to 43 Btu and/or 0.018 Pounds Moisture per Pound of Air

Air Flow (cfm)	Total Compressor HP	Cooling (Btu/Hr)	Cooling (Tons)
2,750	11	228,000	19.0
4,000	17	324,000	27.0

Operation - 43 Btu and/or 0.018 Pounds Moisture to 47 Btu and/or 0.022 Pounds Moisture per Pound of Air

Air Flow (cfm)	Total Compressor HP	Cooling (Btu/Hr)	Cooling (Tons)
2,750	12	281,000	23.4
4,000	18	408,000	34.0

Reduced Indoor Temperature Conditions. Return air conditions of 75°F DB and 62°F WB (48%RH) allows an increased capacity of 13% (22.1 Btu's per pound of supply air) when compared with the standard ARI-A interior conditions of 80°F DB and 67° WB (50%). Cooling capacity at standard ARI-A outdoor conditions is presented below.

Air Flow (cfm)	Total Compressor HP	Cooling (Btu/Hr)	Cooling (Tons)
2,750	10	199,200	16.6
4,000	15	294,000	24.5

Indoor Humidity Conditions. No change in specification is needed to remove higher indoor humidity loads as the supply air enters in indoor space not saturated.

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, however a 20% shortfall in return air will cause only 5% deterioration in performance. Making up a further shortfall in return air with outside air normally means an increase in energy content. This condition can be offset by increasing the compressor system by 3 horsepower such that 50% outside air (at ARI-A) may be used with no deterioration in supply air conditions.

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

Static Pressure (inch w.c.)	Air Flow Reduction	Cooling Reduction
0.6	3%	2%
0.8	6%	4%
1.0	9%	7%

Optional oversized blower motors can be specified that overcome increases in static pressure.

DEHUMIDIFICATION PERFORMANCE

The dehumidification capability of the *GENIUS* hybrid is presented in terms of outside air moisture loading (in pounds per pound of air) with the results given in pounds of water removed per hour.

Air Flow (cfm)	Moisture 0.014	Moisture 0.018	Moisture 0.022
2,750	71 lbs/hr	117 lbs/hr	164 lbs/hr
4,000	102 lbs/hr	169 lbs/hr	238 lbs/hr

PERFORMANCE IN LESS HUMID CLIMATIC CONDITIONS

Selection of the "Dry Climate" *GENIUS* hybrid with the staged indirect evaporation device for treatment of outside air depends upon the percentage of the cooling season that has acceptable moisture content in the supply air. For illustration purposes, the level is assumed to be that obtained with a conventional air conditioner delivery of 55°F saturated or 0.0092 pounds moisture per pound of air. At 2°F above the dew point, the hybrid delivery air conditions would be 57°F, 0.0092 moisture or 23.7 Btu's per pound of air. The enthalpy in outside air at this moisture content would be 30.5 Btu's per pound of air at 85°F DB, 31.7 at 90°F DB, and 32.9 at 95° F DB. The cooling obtained is presented in the following table:

Air Flow (cfm)	Outside DB 85°F	Outside DB 90°F	Outside DB 95°F
2,750	83,100 Btu/hr	97,800 Btu/hr	112,400 Btu/hr
4,000	120,500 Btu/hr	141,800 Btu/hr	163,000 Btu/hr

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.