



# CALIFORNIA STATE SCIENCE FAIR 2009 PROJECT SUMMARY

<b>Name(s)</b> Nathan G. Behrens	<b>Project Number</b> <b>J1003</b>
<b>Project Title</b> <b>Increasing Efficiency of Existing Air Conditioners by Only Changing the Timing of Operation</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The purpose of this project was to determine whether it is more efficient to run an air conditioner in the day or night and in long or short time blocks.</p> <p><b>Methods/Materials</b> More than 200 cycles of a home air conditioning system was analyzed over the period of a month. Eighteen data loggers, some with internal and some with external temperature probes, were placed outside, in the attic, before and after the evaporator and below return and outlet air vents. Relative efficiencies were calculated by comparing average temperature differences between inlet and outlet air vents (delta T) at differing times of day and lengths of air conditioner run. To ensure that the temperature measurement devices responded quicker than the air conditioner transients, a transient test was conducted by comparing the characteristic times of the data loggers against the air conditioners response. Winter data from the heater was used as a complementary data because it used the same duct system and supplemented the summer A/C data in looking at impact of run length.</p> <p><b>Results</b> The measurement device transient tests on the main data logger type showed a six minute response time to reflect 80% of a 12°C step change. After device modification, the response time was one minute. Typical A/C run lengths were five minutes.</p> <p>On long runs, the delta T dropped from 12°C to 8°C as the attic temperature rose from 25°C to 35°C. On short runs, typical delta T's were as low as 4°C when the attic temperature was ~40°C. As the attic temperature started dropping below ~35°C the temperature differences rose to 6-8°C. Winter heater delta T's were 15°C for long runs and only 5-8°C for short runs.</p> <p><b>Conclusions/Discussion</b> Daytime vs. nighttime attic temperatures reduce the air conditioner cooling capacity by approximately a third. Long runs show greater cooling capacity but also drop with higher attic temperature; the winter heating analysis is consistent showing twice the heating delta T at longer run times. Heat conduction into the ducts and leakage on the inlet side taking attic air into the ducts both reduce the delta T that cools or heats a house.</p>	
<b>Summary Statement</b> Relative efficiencies were calculated by measuring temperatures throughout a house to increase efficiency of the existing air conditioner by only changing the timing of operation.	
<b>Help Received</b> Discussions with parents. Dad showed how to run the data loggers and wrote some VBA used to catalogue and retrieve the data quickly.	