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OAK RIDGE
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MARTIN MARIETTA

Monitoring and Evaluation of Replacing Low-Efficiency Air Conditioners with High-Efficiency Air Conditioners in Single-Family Detached Houses in Austin, Texas

Richard Burns
Robert E. Hough

August 1991

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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MONITORING AND EVALUATION OF REPLACING LOW-EFFICIENCY AIR CONDITIONERS WITH HIGH-EFFICIENCY AIR CONDITIONERS IN SINGLE-FAMILY DETACHED HOUSES IN AUSTIN, TEXAS

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Robert E. Hough

The Fleming Group

August 1991

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ABSTRACT

The U.S. Department of Energy initiated this project entitled "Monitoring and Evaluation of Replacing Low-Efficiency Air Conditioners with High-Efficiency Air Conditioners in Single-Family Detached Houses in Austin, Texas" with The City of Austin and The Fleming Group (TFG) to evaluate the performance of an air conditioner retrofit program in Austin, Texas. The City of Austin's Resource Management Department pursued this project to quantify the retrofit effect of replacing low-efficiency air conditioners with high-efficiency air conditioners in single-family detached homes. If successfully implemented, this retrofit program could help defer construction of a new power plant which is a major goal of this department.

The project compares data collected from 12 houses during two cooling seasons under pre-retrofit and then post-retrofit air conditioner units. The existing low-efficiency air conditioners were monitored during the 1987 cooling season, replaced during the 1987-88 heating season with new, smaller sized, high-efficiency units, and then monitored again during the 1988 cooling season.

Results indicated that the air conditioner retrofits reduce the annual air conditioner electric consumption and peak electric demand by an average of 38%. When normalized to the nominal capacity of the air conditioner, average demand savings were 1.12 W/ft^2 and estimated annual energy savings were 1.419 kWh/ft^2.

Individual air conditioner power requirements were found to be a well defined function of outdoor temperature as expected. In the absence of detailed data, estimates of the peak demand reductions of new air conditioners can be made from the manufacturer's specifications. Air conditioner energy consumption proved to be strongly linear as a function of the outdoor temperature as expected when taken as an aggregate. No noticeable differences in the diversity factor of the air conditioner usage were found.

Analysis of the retrofit effect using PRISM yields estimates of the reduction in normalized annual consumption (NAC) and annual cooling consumption of 12% and 30%. The 30% reduction in the cooling energy estimate is less than the 38% estimated using a daily average temperature regression with directly monitored cooling consumption.

EXECUTIVE SUMMARY

BACKGROUND

The retrofitting of existing buildings is one of the greatest potential areas for saving energy in the residential sector during the next 15 years. In view of this, the U.S. Department of Energy is interested in understanding more about the performance of retrofits, and has initiated a number of cost sharing projects to contribute to a national retrofit performance database. To ensure a common data set, DOE has produced a guidance document, ORNL/CON-196, "Single-Family Building Retrofit Performance Monitoring Protocol: Data Specification Guideline." This project, undertaken with The Fleming Group (TFG) and The City of Austin, utilizes these guidelines, to evaluate an air conditioner retrofit program in Austin, Texas.

The City of Austin Resource Management Department was attempting to defer construction of a new power plant indefinitely via a number of demand side management programs. The Residential Appliance Rebate Program targets low-efficiency appliances, particularly air conditioners, for replacement with new high-efficiency units.

This project utilizes detailed data obtained in accordance with ORNL/CON-196 to determine the retrofit effect of replacing low-efficiency air conditioners with high-efficiency air conditioners in single-family detached houses in Austin, Texas and to attempt to develop a reliable analysis approach enabling weather-normalized prediction of the retrofit effect elsewhere.

The experimental design covered two cooling seasons and consisted of monitoring 14 houses. All 14 participating sites qualified for the Residential Appliance Rebate Program. During the months of September and October of the 1987 cooling season the performance of the existing low-efficiency air conditioning systems were monitored. These units were replaced over the winter with new smaller sized, high-efficiency units which were monitored from May through October of the 1988 cooling season. Two homeowners dropped out of the project; therefore, before and after data are available from 12 sites.

Data was collected at 15-minute intervals with on-site data acquisition systems. The data collected corresponds to the basic parameter set specified in the ORNL/CON-196 guidance document. Additionally, one of the sites was equipped to collect the optional weather data parameter set. All 14 houses are within one mile of each other making the weather data collected applicable to all the monitored sites. ORNL/CON-196 specified pre- and post-retrofit audits were also conducted.

RESULTS

Air conditioner power consumption at the individual sites is well defined as a function of the outdoor air temperature for both the pre- and post-retrofit periods. Table S.1 shows the peak demand requirement monitored at each site. Also shown is the predicted power consumption at 100°F based on least-square curve fits derived from the data. Reductions in the peak air conditioner demand range from 18% to 47%, with the average for the twelve sites being 38%. When normalized to the air conditioner size and the house square footage, the average reductions amount to 0.57 kW/ton and 1.12 W/ft^2, respectively.

Table S.1 Individual Site Air Conditioner Peak Demand

Site	Pre-Retrofit Data (kW)	Pre-Retrofit Regression	Post-Retrofit Data (kW)	Post-Retrofit Regression	% Demand Savings
101	5.2	5.0	2.8	2.7	46
102	4.4	3.9	2.3	2.2	44
103	3.8	3.8	2.2	2.1	45
104	4.7	4.6	2.7	2.6	44
105	5.3	5.3	3.4	3.3	38
106	5.0	4.9	2.6	2.6	47
108	4.9	3.7	2.4	2.3	38
109	4.4	4.4	3.7	3.6	18
110	3.4	3.3	2.0	1.9	42
111	3.8	3.7	2.2	2.1	43
113	3.8	3.8	3.1	2.9	24
114	3.8	3.8	3.3	3.1	18

For the utility to realize a similar reduction in its demand peak would require that all air conditioners are running full out during the peak period. Since air conditioners are often oversized and will cycle on and off even during peak conditions, it is rare that all the air conditioners being used would be cycled on. There will also be some air conditioners which are not being used at the time. The diversity factor is a measure of the actual power being consumed relative to what would be consumed if all the units were running full out. During peak 15-minute periods of peak days, the aggregate diversity factor reaches 0.9. This was true for both the pre- and post-retrofit periods and did not change due to the retrofit. When considered in aggregate, a discernable difference in air conditioner runtime as a function of outdoor temperature between the two periods was not evident.

A number of methods relating individual site air conditioner energy consumption to the weather conditions were attempted. The most effective was relating the daily energy use to the daily average outdoor temperature. However, air conditioner usage patterns on an individual basis are hard to predict as homeowners are often adjusting their thermostats or turning their units off and on, depending on whether they are in the house or not. Predicting the energy consumption of the group as a whole proved to be much more successful. A definite linear relationship exists between the daily energy consumption of the group and the daily average temperature.

Figure S.1 shows plots of this relationship for the pre- and post-periods and the best-fit regression lines through the data. The regression equations can be used to estimate the annual energy savings. When driven by Typical Meterological Year weather data for Austin, an average annual savings of 1419 Wh/ft^2 or 42% is predicted.

A common method for evaluating a retrofit effect is the PRInceton Scorekeeping Method (PRISM). PRISM has proven to be quite effective for heating season retrofits, though its effectiveness in cooling retrofits is less well documented. PRISM uses monthly utility billing data and daily average temperatures to estimate the normalized annual electric energy consumption (NAC). The NAC value accounts for deviations in the weather during the analysis period from the long term average for the region. PRISM predicts an average reduction of 12% in the total house annual electric use due to the retrofit. The annual cooling energy is also estimated, though with considerably less precision. An average 30% reduction in cooling energy is predicted.

The City of Austin, attempting to defer construction of a new power plant, is interested in the air conditioner retrofits as a means to reduce its peak capacity requirements. Comparison of the utility peak days in September of 1987 and 1988 show that air conditioner electric demand decreased by 36%, and total house electric demand decreased by 24% during the time the utility was peaking.

CONCLUSIONS

The following conclusions can be made from the data analysis.

The air conditioner retrofits being performed in Austin are effective in reducing annual air conditioner electric consumption and peak electric demand. On an average, 38% reductions in peak demand and average air conditioner energy consumption were noticed due to the retrofit. When normalized to the nominal capacity of the air conditioner, average demand savings were 1.12 W/ft^2, and estimated annual energy savings were 1.419 kWh/ft^2.

Individual air conditioner power requirements are a well defined function of outdoor temperature. In the absence of detailed data, estimates of the peak demand reduction can be made from the manufacturer's specifications.

Conclusive relationships between air conditioner electric consumption and variation in weather conditions were hard to develop for individual sites. At sites where the air conditioners were allowed to run, patterns were more evident than at sites where manual operation of the thermostat and turning the unit on and off occurred.

However, when taken as an aggregate, air conditioner energy consumption is strongly linear as a function of the outdoor temperature. The most successful relationship which emerged was daily air conditioner electric consumption as a function of the daily average temperature.

No noticeable differences in the diversity of air conditioner usage were found. During peak 15-minute periods, the diversity factor reaches 0.9.

Analysis of the retrofit effect using PRISM yields estimates of the reduction in normalized annual consumption (NAC) and annual cooling consumption of 12% and 30%. The 30% reduction in the cooling energy estimate is less than the 38% estimated using a daily average temperature regression with directly monitored cooling consumption.

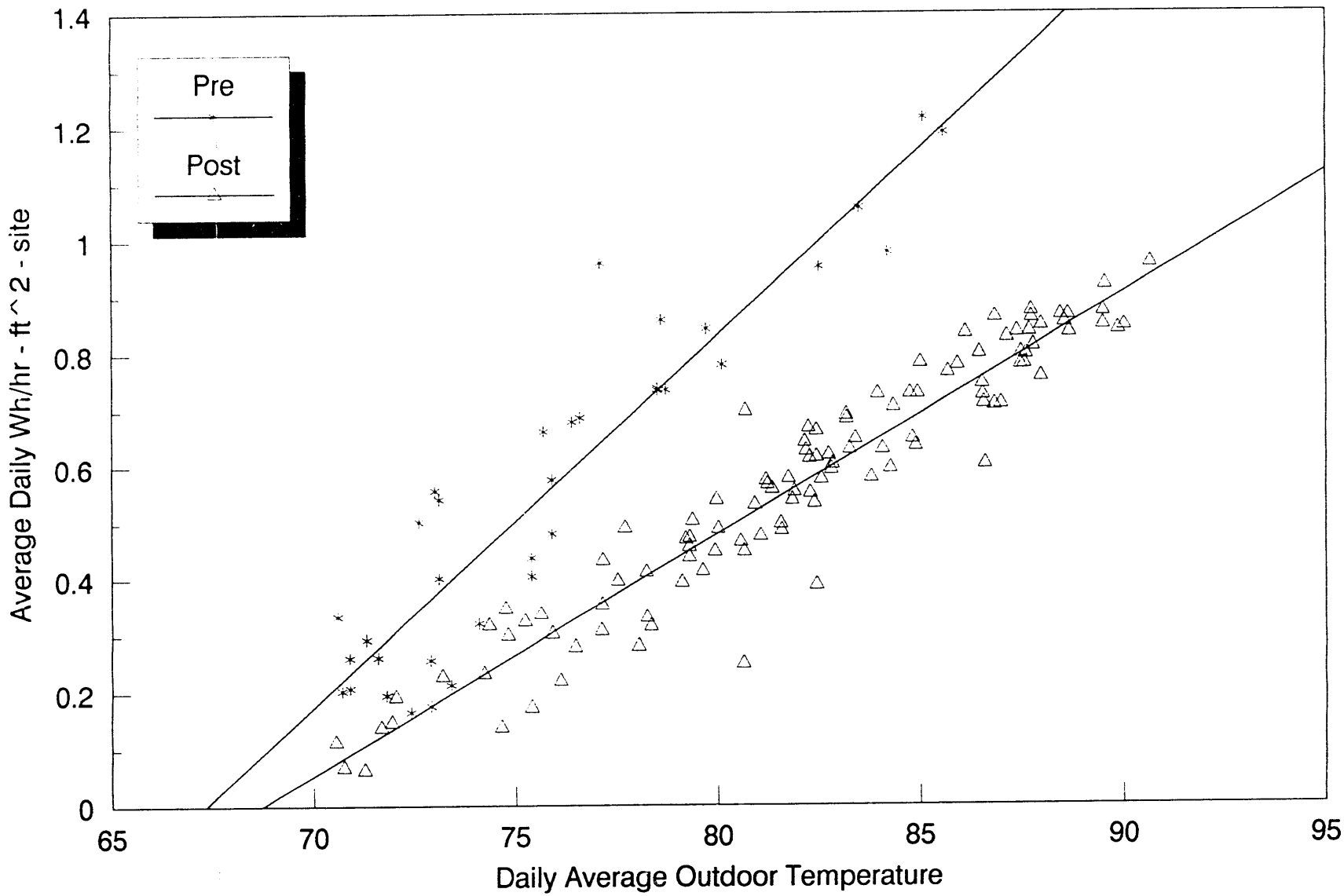


Figure S.1 - Daily Average Air Conditioner Electric Consumption
Normalized to Conditioned Area

1. INTRODUCTION

1.1 OVERVIEW

One of the greatest potential areas for saving energy in the residential sector during the next 15 years is in the retrofitting of existing buildings. While continued laboratory research and development efforts are useful, there is a need to understand how energy conservation retrofits perform in occupied residential buildings.

A great deal has been learned regarding retrofit performance through the analysis of monthly billing data collected for a large number of homes, from the analysis of more detailed data collected for a large number of homes, and from the analysis of more detailed data collected from a sample of homes. However, the data collected to date have been insufficient to assess the overall effectiveness of most conservation measures, to explain why deviations between monitored and predicted retrofit energy savings occur, to accurately predict retrofit performance in individual homes, and to allow the selection of appropriate retrofit measures in specific houses. Therefore, retrofit performance data collected from a significant sample of occupied houses and in more detail than billing data are required to address these issues.

The Existing Buildings Research Program, conducted under the Office of Buildings Energy Research of the U.S. Department of Energy (DOE), is interested in understanding retrofit performance in single-family homes. DOE has recognized the need for an improved retrofit performance database. However, DOE's resources are insufficient to conduct a comprehensive monitoring program without the assistance of the private sector. Utilizing data collected by private sector experiments and cost-sharing experiments are two feasible ways of collecting the needed data. Since the research goals of these experiments are different, a common data set would not be collected without a guidance document.

The guidance document is ORNL/CON-196, "Single-Family Building Retrofit Performance Monitoring Protocol: Data Specification Guideline".[1] DOE via ORNL initiated three cost-sharing projects to contribute to the national retrofit performance database. The current project with The Fleming Group (TFG) and the City of Austin is one of those three projects.

The City of Austin Resource Management Department was attempting to defer construction of a conventional 553 MegaWatt (MW) gas combustion turbine power plant indefinitely via a number of demand-

[1]ORNL/CON-196, "Single-Family Building Retrofit Performance Monitoring Protocol: Data Specification Guideline".

side management programs. The Residential Appliance Rebate Program was one of these programs. This Program targets low-efficiency appliances, particularly air conditioners, for replacement with new high-efficiency units. Cash rebates to both homeowners and dealers are offered as incentives to install the higher efficiency units. To qualify for rebate payments, replacement appliances must meet or exceed a minimum energy efficiency rating. Additionally, the program provides for the installation of smaller air conditioning units.

1.2 OBJECTIVES

The objectives of this project are to utilize detailed data obtained in accordance with ORNL/CON-196 to determine the retrofit effect of replacing low-efficiency air conditioners with high-efficiency air conditioners in single-family detached houses in Austin, Texas and to attempt to develop a reliable analysis approach enabling weather-normalized prediction of the retrofit effect elsewhere.

1.3 SCOPE

To meet the project objectives, the experimental design covered two cooling seasons and consists of monitoring 14 houses in Austin, Texas. All 14 sites chosen for participation in this project qualified for the Residential Appliance Rebate Program. During the months of September and October of the 1987 cooling season, the performance of the existing low-efficiency air conditioning systems were monitored. These units were replaced over the winter with new high-efficiency units which were monitored from May through October in the 1988 cooling season. Two homeowners removed themselves from the project after it was initiated. Therefore, before and after data is available from 12 houses.

Data were collected at 15-minute intervals with on-site data acquisition systems. The data collected correspond to the basic parameters specified in the ORNL/CON-196 guidance document. Additionally, one of the sites is equipped to collect the optional weather data parameter set. All 14 houses were located within one mile of each other which allows the weather data collected to be valid for all the monitored sites. ORNL/CON-196 specified energy audits with blower door, air infiltration tests conducted at each site.

Data collected during the project were analyzed using statistical treatments which normalized the data to consistent weather conditions and time periods. The effects of the retrofit on electric consumption and peak demand are determined on both an aggregate and individual site basis.

1.4 REPORT FORMAT

This report is intended to summarize the data collected and document the results of the analysis performed. The remainder of the report is laid out as follows. Chapter 2 discusses site characteristics and the expected impact of the retrofit on electric consumption and demand. Chapter 3 contains descriptions of the data points collected, the sensors used, and procedures for the transmittal, verification and storage of the data. Results and analysis are presented in Chapter 4. Conclusions drawn from this project are contained in Chapter 5. Also, a number of appendices are included which summarize the data on an individual site basis.

2. SITE DESCRIPTIONS AND ENERGY SAVINGS PREDICTIONS

2.1 SITE CHARACTERISTICS

Fourteen houses in the city of Austin, Texas were selected for this study. These homes were part of the group of houses whose owners had applied for participation in the city's air conditioner retrofit rebate program. The houses involved were all of similar age and construction characteristics and were located within a mile of each other. The houses were all owner-occupied, single story residences built on slab foundations. Nine of them were single-family detached homes.

2.1 ENERGY AUDITS

Energy auditors utilized the ORNL/CON-196 pre-retrofit audit data form to collect house and space conditioning system descriptive information and entrance interview information. These audits were performed at the time of the installation of the monitoring equipment.

Table 2.1 summarizes key data collected during the initial audits. The houses range from 16 to 22 years in age with insulation "R" values in both the ceiling and walls generally around 10 Btu/hr/ft^2/°F. The conditioned area, air conditioner unit size, and the number of occupants are useful in characterizing patterns in elect. consumption and demand peaks.

All original air conditioners were low efficiency units of the type targeted by the retrofit rebate program for replacement. Due to the age of the equipment (15-20 years) and hard to read nameplate data, manufacturer's specifications for these units were impossible to obtain. The auditors were required to use their experience and knowledge of local air conditioning practices to estimate actual unit capacities and efficiencies since documented data was not available.

Infiltration rate measurements were performed at all 14 sites using the blower door fan pressurization technique. The results are displayed in the right hand column of Table 2.1. Average infiltration rates estimated by the Lawrence Berkeley Laboratory model range from 0.61 to 1.44 air changes/hour.

Table 2.1 Site Characteristics Collected at Pre-Retrofit Audits

Site	Number of Occupants	Age of House (Years)	Number of Stories	Owner or Renter	Single Family Detached or Attached	Foundation	Conditioned Area (Sq.Ft.)	Ceiling R Value	Wall R Value	Air Changes Per Hour
101	6	16	1	Own	Detached	Slab	1747	11	11	1.61
102	3	20	1	Own	Detached	Slab	1007	[illegible]	11	[illegible]
103	2	20	1	Own	Detached	Slab	1196	[illegible]	[illegible]	[illegible]
104	1	16	1	Own	Detached	Slab	1417	11	[illegible]	1.46
105	2	17	1	Own	Detached	Slab	1851	[illegible]	11	0.94
106	2	20	1	Own	Attached	Slab	1722	11	[illegible]	[illegible]
107	5	17	1	Own	Detached	Slab	1553	[illegible]	11	0.86
108	2	20	1	Own	Detached	Slab	1295	[illegible]	11	[illegible]
109	5	17	1	Own	Detached	Slab	2120	30	11	1.44
110	1	22	1	Own	Detached	Slab	1155	[illegible]	[illegible]	[illegible]
111	3	16	1	Own	Attached	Slab	1187	14	11	[illegible]
112	3	19	1	Own	Attached	Slab	1441	12	11	[illegible]
113	2	18	1	Own	Attached	Slab	1491	11	11	1.17
114	2	18	1	Own	Attached	Slab	1470	11	11	[illegible]

The air conditioners at each site were replaced with higher efficiency units after the 1987 cooling season. Many of the units were also downsized. Table 2.2 lists the nominal size and efficiency of the original and replacement air conditioners. The efficiency of each conditioner is expressed as an Energy Efficiency Ratio (EER). The EER is the ratio of cooling provided by the air conditioner (in Btu) to the energy consumed by the air conditioner (in Watt-hours) under designated operating conditions.

2.2 ENERGY PERFORMANCE PREDICTIONS

Predictions of the expected savings in annual energy consumption and peak demand due to the air conditioner retrofit were made using methods currently used by the City of Austin. The City used the program BETA, Building Energy Thermal Analysis, to assist the evaluation of their entire Energy Star Conservation Program. Given hourly weather data for the year, building characteristics, equipment efficiencies and appliance consumption profiles, the program calculates the house energy consumption. The program is a steady-state model which assumes the HVAC equipment will always meet the space conditioning requirement to maintain the thermostat setpoint. The results of this analysis are found in Table 2.3. The average predicted annual cooling energy savings is 2068 kWh/site. This would be the result of replacing older air conditioners with energy efficiency ratings (EER) of around 6.5 with a new group of air conditioners with EER's about 11.5.

Since BETA calculates steady state loads on an hourly basis, it does not fully predict the peak power consumption of the air conditioner. Even at peak conditions, the hourly average load will be less than the capacity of the air conditioner as these units are typically oversized for the application. However, the air conditioner may run continuously for more than the fifteen minute peak demand period at full electric consumption. The demand savings in Table 2.3 will therefore probably be less than those actually experienced. Alternatively, air conditioning demand can be estimated by dividing the capacity by the EER. Savings

estimates from this calculation are in Table 2.4. An average demand savings of 2.4 kW per site is predicted by the analysis.

Table 2.2 Air Conditioner Size and Efficiency

Site	Pre-Retrofit Nominal Size (Tons)	EER	Post-Retrofit Nominal Size (Tons)	EER
101	3.5	6.0	2.5	11.5
102	2.5	7.0	2.0	10.2
103	2.5	6.5	2.0	11.5
104	3.0	7.2	2.5	11.5
105	3.5	7.2	3.0	11.5
106	3.0	6.5	2.5	11.5
107	2.5	7.0	---	----
108	2.5	6.5	2.0	11.5
109	3.0	6.5	3.0	11.5
110	2.0	6.0	2.0	11.5
111	2.5	7.9	2.0	11.5
112	3.0	6.5	---	----
113	3.0	8.0	2.5	11.5
114	3.0	7.0	3.0	11.5

NOTE: EER = Energy Efficiency Rating

Table 2.3 Predicted Annual Electrical Energy Consumption and Demand Savings Using Building Energy Thermal Analysis (BETA) Program

	Pre-Retrofit			Post-Retrofit			Savings	
Site	Total Building kWh	Cooling kWh	Total Building Peak kW	Total Building kWh	Cooling kWh	Total Building Peak kW	Annual Consumption kWh	Peak Demand kW
Average Savings Per Site							2,068 kWh	1.48 kW

Table 2.4 Predicted Demand Savings Using Nominal Size and ERR of Air Conditioners

	Pre-Retrofit			Post-Retrofit			
Site	Nominal Size (tons)	EER	Peak kW	Nominal Size (tons)	EER	Peak kW	Demand Savings kW
101	3.5	6.0	7.0	2.5	11.5	2.6	4.4
102	2.5	7.0	4.3	2.0	10.2	2.4	1.9
103	2.5	6.5	4.6	2.0	11.5	2.1	2.5
104	3.0	7.2	5.0	2.5	11.5	2.6	2.4
105	3.5	7.7	5.5	3.0	11.5	3.1	2.3
106	3.0	6.5	5.5	2.5	11.5	2.6	2.9
107	2.5	7.0	4.3	---	----	---	---
108	2.5	6.5	4.6	2.0	11.5	2.1	2.5
109	3.0	6.5	5.5	3.0	11.5	3.1	2.4
110	2.5	6.0	5.0	2.0	11.5	2.1	2.9
111	2.5	7.9	3.8	2.0	11.5	2.1	1.7
112	3.0	6.5	5.5	---	----	---	---
113	3.0	8.0	4.5	2.5	11.5	2.6	1.9
114	3.0	7.0	5.1	3.0	11.5	3.1	2.0
				Average Savings Per Site			2.4

3. DATA ACQUISITION

3.1 DATA POINT SPECIFICATION

The data points collected at each site correspond to those defined as the basic parameter set in ORNL/CON-196. The data point list implemented on this project can be found in Table 3.1. Points 25-29 represent the optional microclimate data set which was collected only at site 101. Sensors to collect this data were selected to conform to the accuracy specifications of ORNL/CON-196. Table 3.2 lists the sensors used and the associated data points.

3.2 SITE DATA ACQUISITION OPERATION

Enerlog FDAS-10 field data acquisition systems were used at each site to collect the data. The data acquisition system initiated scans of the transducer outputs every three seconds. Data acquisition software made conversions to engineering units, computed total or average values at 15-minute intervals and stored the 15-minute data strings in internal memory. Data transmission to The Fleming Group's (TFG) central facility was conducted daily over the homeowner's existing phone line. At an early morning hour, convenient to the homeowner, the internal phone sharing module of the FDAS-10 connected the phone line to the data acquisition unit for a specific period of time or "window". A microcomputer at TFG's central facility automatically initiated calls during this open "window" to all the sites and the previous 24 hours of data were transmitted to the micro computer. Checks were included in the transmission process to ensure data were transmitted without error. If transmission errors were detected, the data were retransmitted until error-free data were received. Once data transmission was completed, the telephone link was disconnected and the normal homeowner telephone line restored. Placing the call, transmitting the data, and restoring the lines took about five minutes. Data transferred to the central microcomputer was stored on hard disks and then automatically transferred to The Fleming Group's (TFG) minicomputer for verification and uploading into the database.

3.3 DATA VERIFICATION AND UPLOAD

Once stored at the central minicomputer, every point from each data string was checked for reasonable range. For every point not within range, a message was written to an error file. Also, groups of points within each string were checked for their expected relationship to one another. If this relationship was not true, an error message was written. A data technician checked these message files daily and turned them over to an engineer analyst for investigation. Error codes were also generated for storage in the database as a permanent record and as an indication of good and bad data. After data verification, the data were stored on mass storage

disks using a database management system, ready to be accessed by the database manager for generation of reports and other analysis.

Table 3.1 Data Point List

POINT NAME	OUTPUT POINT #	DESCRIPTION	DATALOGGER INPUT CHANNEL	SENSOR TYPE	ENGIN. UNITS	FILTER /MASK
-	1	Description			Integer	
Site #	2	Site Number	-		Integer	
Year	3	Year		-	Integer	-
Day	4	JULIAN DAY	-		Integer	-
Hour/Min	5	HOUR (24)/MIN of Day	-		Integer	
TAMB	6	Ambient Air Temp.	3E1	Thermistor	Deg. F.	-
TROOM1	7	Room Air Temp. Zone 1	3E2	Thermistor	Deg. F.	
TROOM2	8	Room Air Temp. Zone 2	3E3	Thermistor	Deg. F.	
TROOM3	9	Room Air Temp. Zone 3	3E4	Thermistor	Deg. F.	
RHROOM	10	Room Relative Humidity	DE3	1 Loop	%	
KWH1C	11	Cooling System Electric Use	MUX1	Pulse	KWH	
KWH3T	12	Total House Electric Use	MUX3&4	Pulse	KWH	
CF1T	13	Total House Gas Use	P1	Pulse	CF	
CondRt	14	RunTime Condensate Pump	C4	Relay	Min.	
S1Rt	15	RunTime Air Conditioner	C5	Isolat.	Min.	
BATTIM	16	RunTime Logged on Battery	C6	Isolat.	Min.	
S2Rt	17	RunTime Gas Hot Water Heater	3E7	Optic.	Min.	
CondCy	18	Cycles Condensate Pump			#Starts	-
S1Cy	19	Cycles Air Conditioner	-		#Starts	
PFAIL	20	Cycles Power Failures	-		#Cycles	
S2Cy	21	Cycles Gas Hot Water Heater			#Cycles	
BAT	22	Data Logger Battery Voltage			Volts	
TCP1C	23	Internal CR10 Data Logger T.		PTC	Deg. F.	
TWATL	24	Data Logger Sprue Temp.	3E1	Thermistor	Deg. F.	
*** Additional Points are for Weather Station Site Only. ***						
W_TAMB	25	Ambient Air Temp.	3E	Thermistor	Deg. F.	
RHAMB	26	Rel. Humidity	DE3	1	%	
HTSK	27	Total Hor. Solar Radiation	3E7	Pyranometer	BTU/Ft.2	
WSPD	28	Wind Speed	1	Vane	MPH	
WDIR	29	Wind Direction	3E1	Shaft Enc.	Deg	

Table 3.2 Data Acquisition Sensors

Parameter	Sensor	Location
Operational Status	Low-Voltage Relays	Air Conditioner Unit Condensate Pump
Air Temperature	Precision Thermistors	Outdoor Air Temperature Indoor Room Temperature
Relative Humidity	Relative Humidity Transmitter	Indoor RH
Electric Consumption	Digital Power Monitor	Air Conditioning Electric Consumption; Total House Electric
Gas Consumption to Billing Utility	Pulse Counter Attached to Utility Billing Meter	Total House Gas Consumption
Solar Radiation	Silicon Photodiode Pyranometer	Weather Station
Windspeed and Direction	Anemometer and Vane	Weather Station
DHW Status	Optical Flame Detect Sensor	Domestic Hot Water Heater

4. PERFORMANCE RESULTS AND ANALYSIS

4.1 DIRECT DATA COMPARISON

Data were collected for the pre-retrofit period between August 27 and November 2, 1987. The entire 1988 cooling season from May through October was monitored for the post-retrofit period. The data captured during the pre-retrofit period represents the end of the cooling season in Austin. September still provides instances of peak cooling and the systems are consistently controlled to maintain the desired indoor conditions. In October, the need for air conditioning becomes more sporadic and its operation more dependent on the whims of the occupant. Therefore, direct comparison of air conditioner performance between the two periods can only be made using the month of September.

Table 4.1 summarizes the weather conditions for the months comprising the 1987 and 1988 cooling seasons. These data were compiled from the monthly summaries provided by NOAA taken at the National Weather Service Station at the Austin Municipal Airport. July and August are generally the peaks of the cooling season; however, September has a sufficient cooling requirement to obtain a realistic picture of the cooling characteristics for the set of houses studied in this project.

Table 4.1 Austin Weather Conditions for 1987 and 1988 Cooling Seasons

National Weather Service Data

Month	Long Term Average Degree Days	Degree Days	Average Monthly Temp. (°F)	Maximum Daily Average Temp. (°F)	Average High Temp. (°F)	High for Month (°F)	Days Above 90°F
May '87	[illegible]	352	76.1	81	84.9	90	1
June	419	465	80.2	86	89.3	97	17
July	521	576	83.4	94	93.5	96	28
August	503	628	83.4	89	93.4	99	27
September	420	431	78.8	85	89.3	97	16
October	190	170	69.4	76	81.5	91	2
1987	2633	2620	79.0	89	88.6	99	91
May '88	[illegible]	334	74.5	84	85.1	96	5
June	419	465	80.2	86	90.8	97	21
July	521	613	84.1	94	95.2	103	29
August	503	602	82.7	91	94.9	105	31
September	420	515	80.2	89	92.5	99	13
October	190	284	70.4	81	84.3	99	2
1988	2633	2810	80.2	91	91.1	105	117

September of 1988, with an average temperature of 82.2°F and 516 cooling degree days, was warmer than September of 1987 which had an average temperature of 78.8°F and 421 cooling degree days. Larger air conditioning loads were, therefore, experienced during the post-retrofit period. Direct comparison of the two months is further skewed by missing data. Nonetheless, Tables 4.2 and 4.3 summarize the air conditioner performance data from the twelve sites for the September months of the pre- and post-retrofit periods. Table 4.4 lists the percentage change between the two periods by site for a number of interesting performance criteria. Where necessary, when deriving these percentages, the data values where scaled proportionately to assume a complete data set for the month. Despite an 18% increase in the runtime of the air conditioners, air conditioner electric consumption decreased 24%. Total house electric consumption only decreased on average by 3%. Again, these values are somewhat clouded by differing weather conditions and incomplete data sets. Clearer indications of the effectiveness of the retrofit lie in the reductions in the average and peak air conditioner power requirements of the sites. Based on September data, the average air conditioner power requirement was reduced by 36% and the average peak demand went down 38%. It is interesting to note that the percentage of the total house electric consumption used by the air conditioners went from 52% to 40% after the retrofit.

While this comparison is informative, the conditions under which the data were collected were different and the results are not easily compared. Analysis of the data indicates, however, that air conditioner energy consumption can be characterized as a function of the outdoor air temperature. By using the collected data to determine performance characteristics, energy savings can be predicted using standardized weather data sets. The following sections explore this possibility.

4.2 PEAK DEMAND SAVINGS

Air conditioner power consumption at the individual sites is well defined as a function of the outdoor air temperature for both the pre- and post-retrofit periods. The two narrow bands of points rising slowly with the outdoor air temperature in Figure 4.1 represent the air conditioner power consumption for the pre- and post-retrofit periods at site 104. The power consumption characteristics shown in this figure are representative of all the sites.

Least-square regression curve fits through the data points accurately represent the air conditioner power consumption. A second order model was used relating air conditioner power to outdoor air temperature, (OAT)

$$kW = a + b*OAT + c*OAT\text{^}2$$

where a, b, and c are regression coefficients. Generally, the fits were quite good with the median R-squared value for the pre-retrofit period being 0.82 and for the post-retrofit period, 0.89. The use of

Table 4.2 Summary Of Monitored Air Conditioner Data September, 1987 (Pre) and September, 1988 (Post)

Site		% Data Collected	Average Indoor Temp. (°F)	a/c Cycles	a/c Runtime (Hrs)	Pounds Conden-sate	a/c kWh	Total kWh	Peak Demand kW
101	Pre	80.6	82.3	11	106.2	547.0	503	1258	5.2
	Post	71.6	83.9	15	11.6	61.5	34	536	2.8
102	Pre	84.7	80.7	614	121.1	518.3	436	811	4.4
	Post	73.7	80.4	1132	168.1	463.6	350	761	2.2
103	Pre	83.3	79.3	1431	191.5	526.1	672	1047	3.8
	Post	78.4	81.5	358	183.2	-	363	761	2.2
104	Pre	78.6	80.3	661	143.0	19.5	605	992	4.7
	Post	76.9	79.6	771	179.0	449.4	446	1128	2.7
105	Pre	71.6	82.5	519	119.4	523.1	610	1047	5.3
	Post	99.9	83.4	1050	191.1	-	586	1255	3.3
106	Pre	90.4	81.1	651	153.7	584.6	619	1067	5.0
	Post	78.4	81.1	563	188.7	523.1	462	843	2.6
108	Pre	64.9	85.2	88	101.0	1.0	319	682	3.7
	Post	78.3	81.3	580	153.5	457.0	324	906	2.3
109	Pre	83.0	80.9	405	249.1	813.0	984	1734	4.4
	Post	100.0	82.5	567	261.9	1130.0	880	2485	3.7
110	Pre	89.8	82.3	245	104.7	225.5	337	701	3.4
	Post	76.9	83.5	305	125.8	210.8	252	569	1.9
111	Pre	84.9	80.4	917	184.8	123.0	639	1194	3.8
	Post	78.2	79.0	1020	251.9	641.2	447	1082	2.1
113	Pre	89.9	80.7	1188	192.2	775.9	675	1202	3.8
	Post	70.9	83.0	490	143.0	462.4	393	1073	2.8
114	Pre	74.6	- - -	190	91.7	415.8	351	1294	3.8
	Post	74.9	- - -	432	187.5	611.0	596	1324	3.3

NOTE: a/c = Air Conditioner

Table 4.3 Air Conditioner Performance Data (Calculated Values) September, 1987(Pre) and September, 1988(Post)

Site		Nominal a/c Size (Tons)	Average Cycle Time (Minute/Cycle)	Average a/c Power (kWh/h)	a/c to Total House (%)
101	Pre	3.5	57.9	4.74	40
	Post	2.5	46.4	2.93	6
102	Pre	2.5	11.8	3.60	54
	Post	2.0	8.9	2.08	46
103	Pre	2.5	8.0	3.51	64
	Post	2.0	30.7	1.98	48
104	Pre	3.0	13.0	4.23	61
	Post	2.5	13.9	2.49	40
105	Pre	3.5	13.8	5.11	58
	Post	3.0	10.9	3.07	47
106	Pre	3.0	14.2	4.03	58
	Post	2.5	20.1	2.45	55
108	Pre	2.5	68.9	3.16	47
	Post	2.0	15.9	2.11	36
109	Pre	3.0	36.9	3.95	57
	Post	3.0	27.7	3.36	35
110	Pre	2.0	25.6	3.22	48
	Post	2.0	24.7	2.00	44
111	Pre	2.5	12.1	3.46	54
	Post	2.0	14.8	1.77	41
113	Pre	3.0	9.7	3.51	56
	Post	2.5	17.5	2.75	37
114	Pre	3.0	29.0	3.83	27
	Post	3.0	36.0	3.18	45
				Aggregate Pre	52
				Post	40

NOTE: a/c = Air Conditioner

Table 4.4 Percentage Decrease in Air Conditioner Performance Between September 1987 and September 1988

Site	Air Conditioner Runtime (%)	a/c Electric Consumption (%)	House Electric Consumption (%)	Average a/c Power (%)	Peak Demand (%)
101	87.7	92.4	52.0	38.1	46.9
102	-59.5	7.7	-7.8	42.2	50.0
103	-1.6	42.6	22.8	43.5	43.2
104	-27.9	24.7	-16.2	41.1	42.6
105	-14.7	31.1	14.1	40.0	38.1
106	-41.6	13.9	8.9	39.2	48.8
108	-26.0	15.8	-10.1	33.2	38.4
109	12.7	25.8	-18.9	14.9	15.5
110	-40.3	12.7	5.2	37.8	43.5
111	-48.0	24.1	1.6	48.7	45.3
113	5.7	26.2	-13.2	21.7	25.3
114	-103.7	-69.1	-1.9	17.0	13.2
Aggregate	**-18.1**	**24.1**	**3.0**	**35.7**	**38.0**

Note: a/c = Air Conditioner

these curve fits is quite accurate in predicting the peak demand at each site. Table 4.5 compares the predicted power consumption at 100°F outside air temperature using the curve fits and the actual measured peak demand from the data.

Table 4.5 Individual Site Air Conditioner Peak Demand (kW) @ 100°F Outside Air Temperature

Site	Pre-Retrofit Data	Pre-Retrofit Regression	Post-Retrofit Data	Post-Retrofit Regression	% Demand Savings
101	5.2	5.0	2.8	2.7	46
102	4.4	3.9	2.3	2.2	44
103	3.8	3.8	2.2	2.1	45
104	4.7	4.6	2.7	2.6	44
105	5.3	5.3	3.4	3.3	38
106	5.0	4.9	2.6	2.6	47
108	4.9	3.7	2.4	2.3	38
109	4.4	4.4	3.7	3.6	18
110	3.4	3.3	2.0	1.9	42
111	3.8	3.7	2.2	2.1	43
113	3.8	3.8	3.1	2.9	24
114	3.8	3.8	3.3	3.1	18
				Average	37

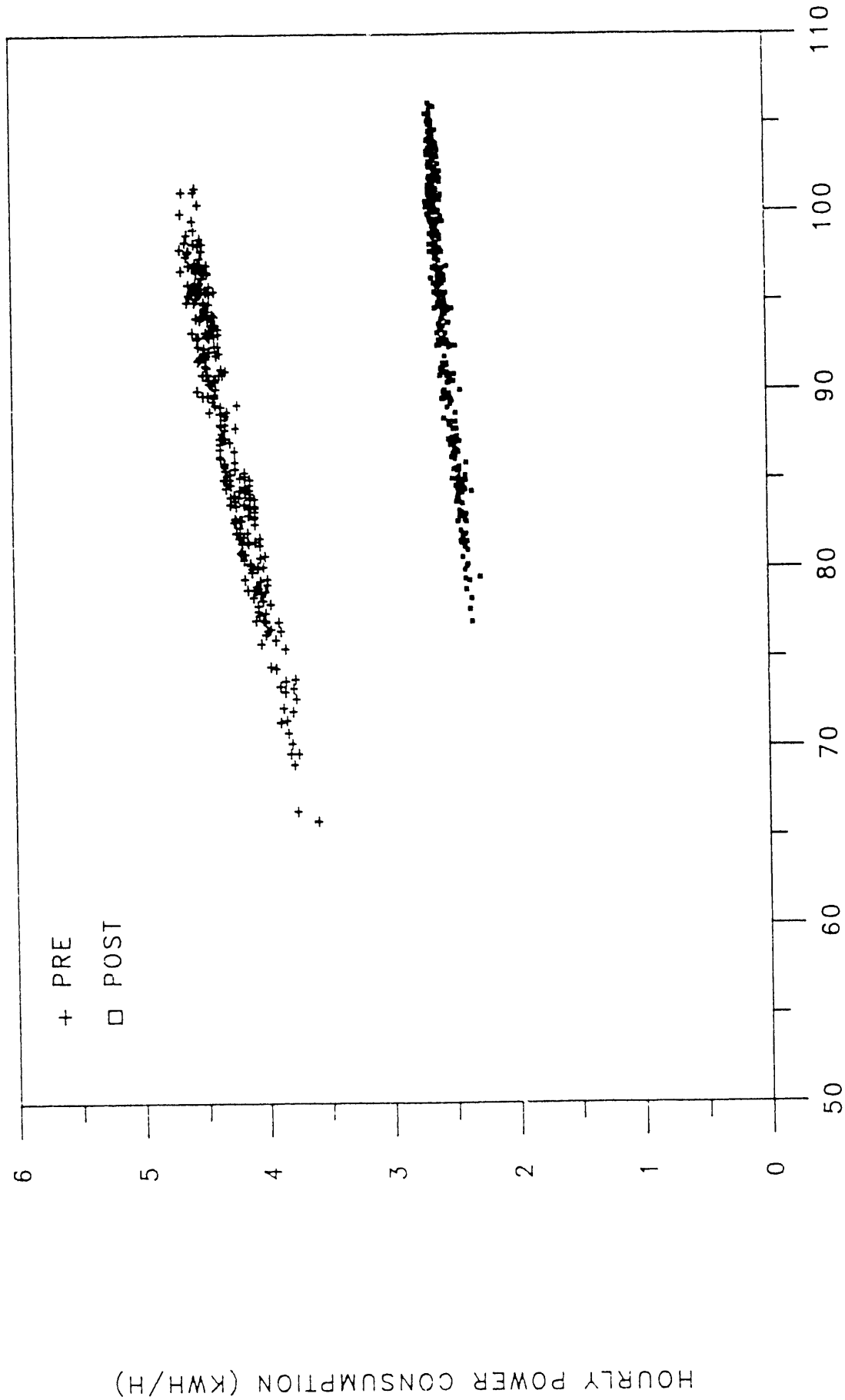


Figure 4.1 Austin Air Conditioner Retrofit Evaluation
Air Conditioner Power Consumption, Site 104

The only time the regression is not consistent with the data is at site 108 during the pre-retrofit period. The air conditioner data shows considerable scatter at 108 not consistent with the results from all the other sites (see Appendix A).

The final column in Table 4.5 indicates the percentage reduction in peak demand at each of the individual sites. The retrofits fall into two distinct groups. Nine of the sites, or 75% of the sample, had substantial reductions in the peak demand ranging from 38% to 47%. At all of these sites, the replacement air conditioners were smaller than the original units. Sites 109 and 114, which were not downsized, had smaller reductions of about 18%. At site 113, the reduction was 24%. While the unit at site 113 was downsized, the original was only 2 years old and more efficient than the much older original units at the other sites. Taken as a whole, the twelve sites have an average peak power reduction of 38%. The average demand savings amounted to 1.59 kW per site. It is more meaningful to relate the demand savings to the size of the air conditioner or to the size of the house. The magnitude of the demand savings will depend on the size of the air conditioner, and the capacity of the air conditioner required is often related to the conditioned area of the house. When normalized to the nominal pre-retrofit size of the air conditioner and to the square footage of the conditioned area, the average peak demand reductions are 0.57 kW/ton and 1.12 W/ft^2, respectively.

While this discussion has concentrated on the overall reduction in peak demand, the reductions are similar across the whole range of outdoor air temperatures encountered during the cooling season. Figure 4.2 plots the average power requirement per square foot of the conditioned area as a function of outdoor air temperature for both the pre- and post-retrofit periods. The demand savings range from 1.04 W/ft^2 to 1.12 W/ft^2. As indicated in Table 4.6, this represents reductions of 38% to 41% throughout the temperature range of interest.

Table 4.6 Average Air Conditioner Demand Savings Normalized to Conditioned Area

Temperature (°F)	Demand Savings (W/sq.ft.)	% Savings
70	1.04	41
75	1.06	41
80	1.09	40
85	1.10	40
90	1.11	39
95	1.12	39
100	1.12	38

4.3 AIR CONDITIONER DIVERSITY

While the individual homeowner is seeing an average reduction in peak demand of 1.12 W/ft^2 at 100°F outside air temperature, the utility will only see a similar reduction in its demand peak if all air conditioners are running full out at that time. Since air conditioners are often oversized and will cycle on and off even during peak conditions, it is rare that all the air conditioners being used would be cycled on simultaneously. There will also be some air conditioners which are not being used at the time. The diversity factor is used to describe the fraction of air conditioners operating at any one time.

The diversity factor is defined as having a value of one when the air conditioner power consumption at each site equals the maximum over the entire monitoring period for the site. The diversity factor at any one time will be less than one, and is the fraction of the actual power consumption relative to the power consumption that would occur if all units were running full out for the entire time period.

Figure 4.3 shows the maximum aggregate 15-minute diversity factor for each day during the pre- and post-periods as a function of the daily average temperature. No significant change is noticeable between the retrofit periods. During peak periods of peak days, the diversity factor is around 0.9.

When the diversity factor over the whole day is plotted as a function of daily average temperature, as in Figure 4.4, an idea of what fraction of a day the air conditioner operates can be obtained. Daily diversity, particularly for the post-retrofit period, is strongly linear with average temperatures above 70°F. On peak days when the average temperature is around 90°F, the air conditioners are on for an average of half the day. Again there is no significant difference apparent between the two retrofit periods.

4.4 AIR CONDITIONER ELECTRIC ENERGY CONSUMPTION

4.4.1 Daily Average Temperature Analysis

Since the aggregate diversity factor did not change significantly between the pre- and post-retrofit periods, the reduction noted in the air conditioner power requirements should also be seen in the annual air conditioner electric consumption. Direct comparisons between the two periods cannot be made since only a small portion of the pre-retrofit period was monitored. However, the data shows that when averaged over all the sites, the daily air conditioner electric consumption is a linear function of temperature. Figure 4.5 shows the daily average air conditioner electric consumption normalized by conditioned area as a function of daily average outdoor air temperature. Linear regressions through these

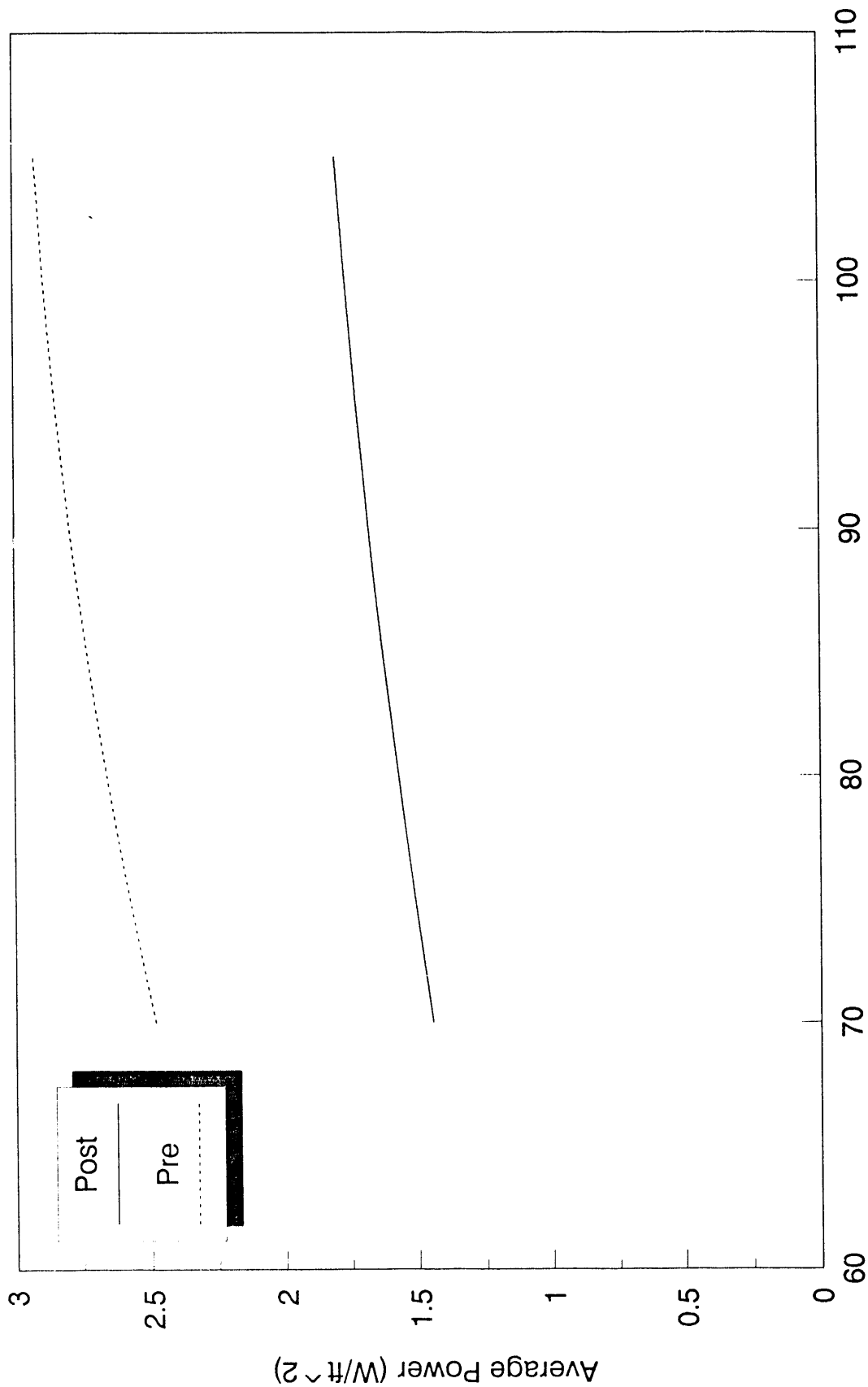


Figure 4.2 Average Air Conditioner Power Consumption
Normalized to Conditioned Area

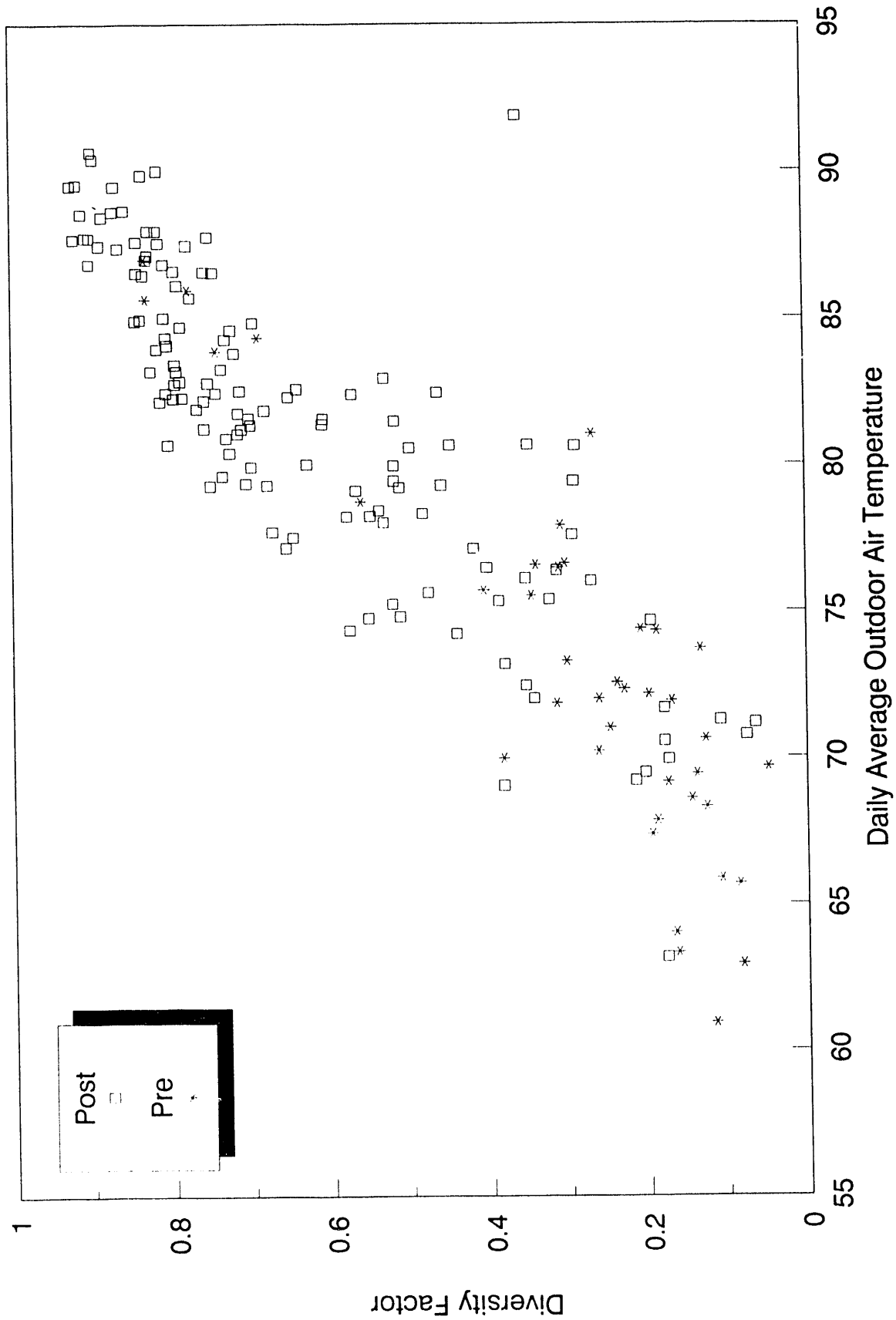


Fig. 4.3 -Daily Peak 15-Minute Diversity Factors

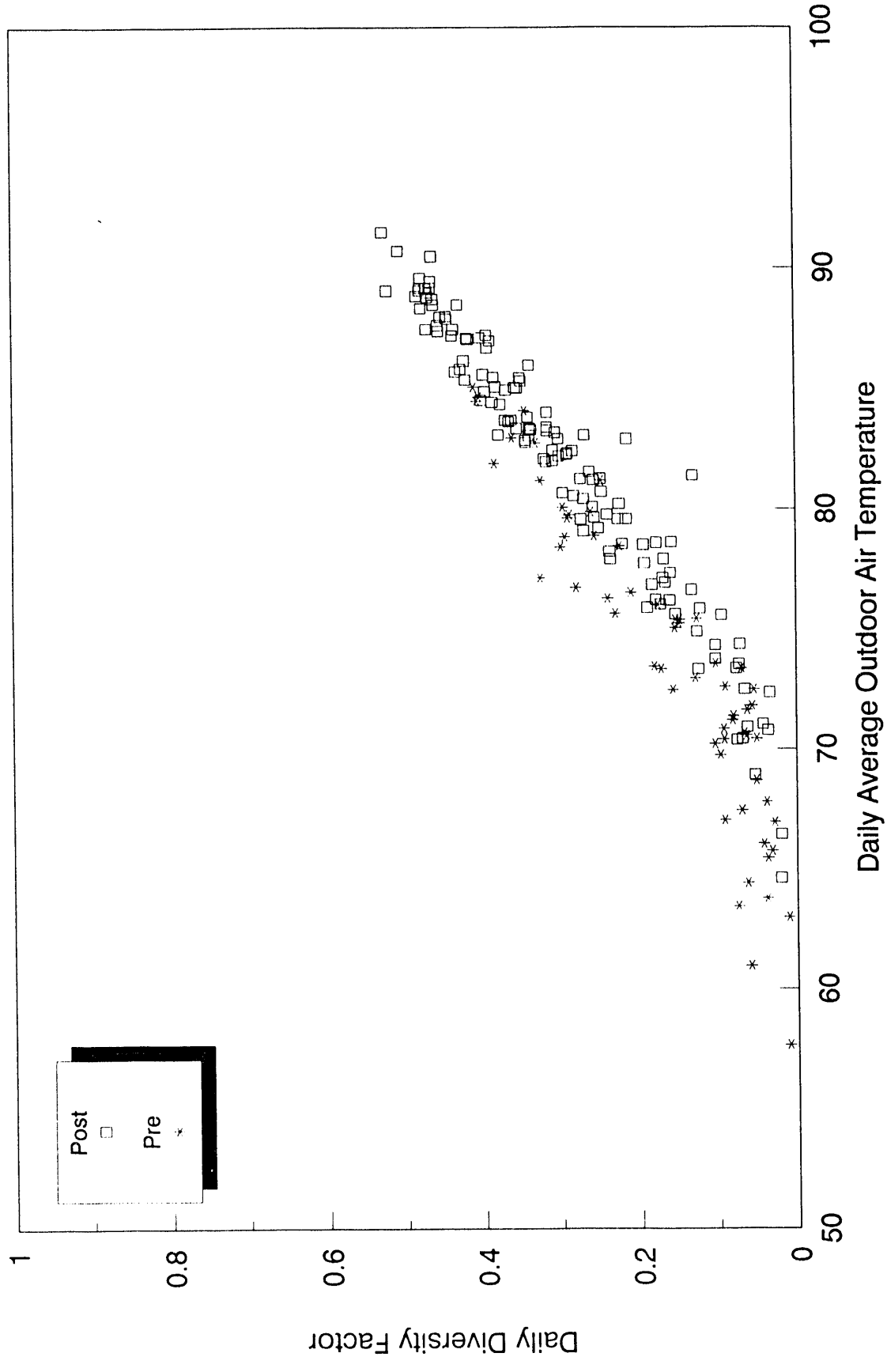


Figure 4.4 Daily Electric Demand Diversity Factors

data points are significant. Table 4.7 lists the various correlation coefficients and the corresponding R-squared values. The R-squared values range from 0.87 to 0.92.

Table 4.7 Average Daily Electric Consumption Regression Results

Model: $Wh/hr\text{-}ft^2 = a + b*Temp$	a	b	R^2
Pre-Retrofit	-4.429	0.0658	0.866
Post-Retrofit	-2.796	0.04104	0.923

Model: KWh/hr-ton = a + b*Temp	a	b	R^2
Pre-Retrofit	-2.426	0.03573	0.873
Post-Retrofit	-1.484	0.02170	0.922

These regressions can be used to estimate the average consumption over an entire cooling season. The Typical Meterological Year (TMY) weather data set for Austin was used in a simple bin analysis. The results are in Table 4.8. In the TMY data set, there are 173 days with an average temperature greater than 70°F. The average air conditioner energy consumption from the pre-retrofit period would have been 3400 Wh/ft^2 compared to 1981 Wh/ft^2 for the average post-retrofit air conditioner. This results in an annual cooling savings of 42%.

Table 4.8 Predicted Annual Energy Consumption Based on Bin Method Analysis

Daily Ave Temp. Bin (°F)	Retrofit $Wh/hr\text{-}ft^2$ Pre-	Post-	TMY Occur. (Days)	Retrofit Wh/ft^2 Pre-	Post-	Energy Savings (%)
72.5	0.3415	0.1794	40	327.8	172.2	47.5
77.5	0.6705	0.3846	39	627.6	360.0	42.6
82.5	0.9995	0.5898	72	1727.1	1019.2	41.0
87.5	1.3285	0.0795	20	637.7	381.6	40.2
92.5	1.6575	1.0002	2	79.6	48.0	39.7
			173	3399.8	1981.0	41.7

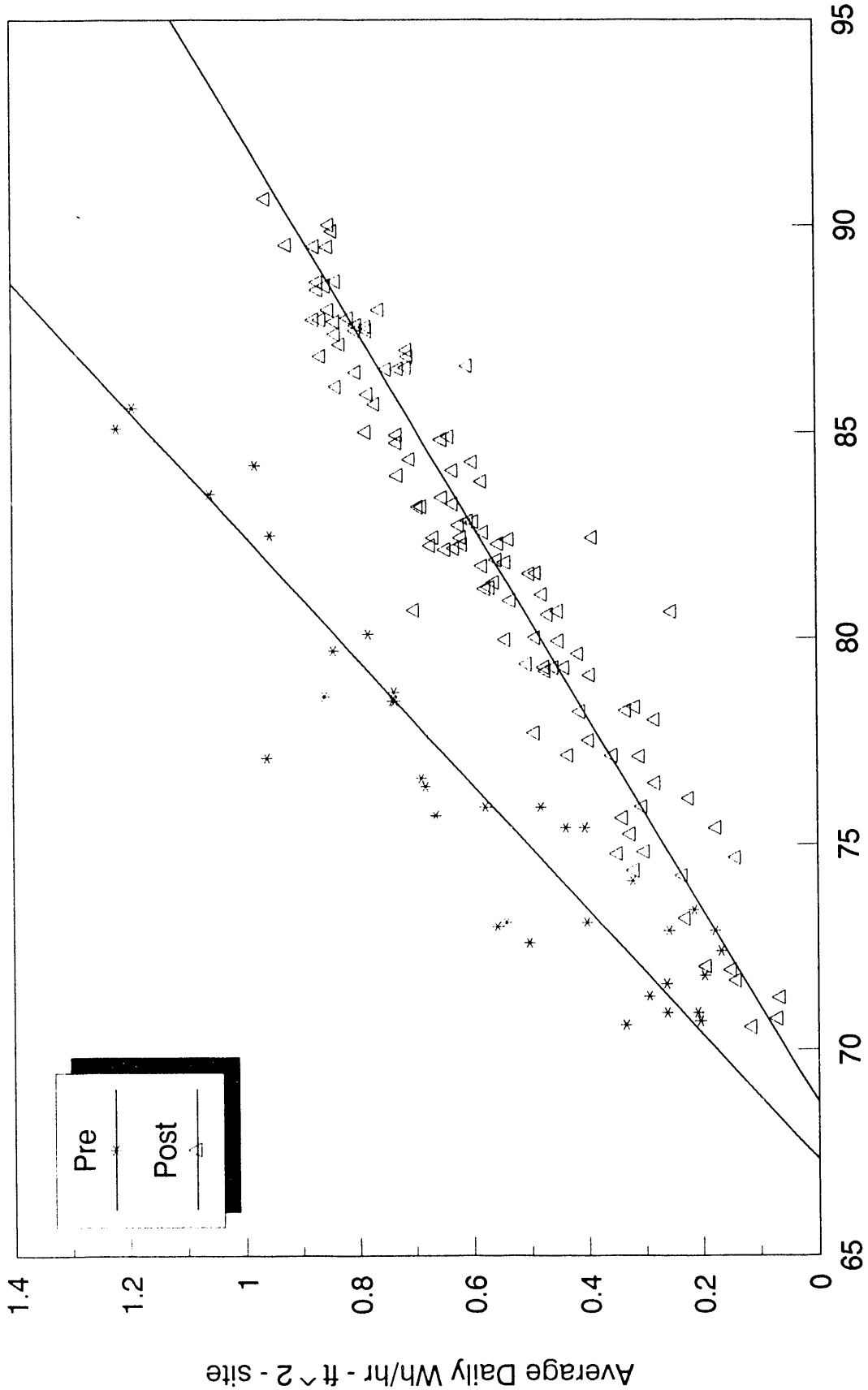


Figure 4.5 Daily Average Air Conditioner Electric Consumption
Normalized to Conditioned Area

4.4.2 PRInceton Scorekeeping Method

The PRInceton Scorekeeping Method (PRISM) is a widely used regression analysis method which determines the effectiveness of retrofit procedures using readily obtained utility billing information.[2] Briefly, PRISM utilizes monthly meter readings and daily average temperature values to correlate average energy consumption to a heating/cooling degree day with a variable base temperature. The basic regression model is

$$E = a + b*DD(t)$$

where

E	=	energy consumption during billing cycle
a	=	non-weather sensitive consumption level
b	=	energy requirement per degree day
DD(t)	=	number of degree days during the billing period based on the reference temperature t
t	=	floating reference temperature from which degree days are calculated.

The parameters a, b and t are determined from the regression analysis. PRISM chooses the base reference temperature, t, such that the correlation coefficient, R^2, for the model is maximized. Having determined the parameter estimates, PRISM calculates an estimate for the annual energy consumption of a typical year by using the average number of degree days occurring over at least a ten-year historical period.

PRISM methodology has proven to be effective when used to evaluate the effect of retrofit procedures on heating energy consumption. PRISM effectiveness with cooling energy retrofits is less well documented.

For this analysis, electric billing information from the years 1987 and 1988 was used. The air conditioner replacements were all performed by April 1988. It is assumed that the air conditioners contributed only marginally to the house electric consumption in 1988 before the replacement. Therefore, the entire year of 1988 is considered the post-retrofit period. This allows the comparison of two 12-month periods. The daily average temperatures used are those recorded by the National Weather Service at the Austin, Texas municipal airport. Daily average temperatures for the years 1977 through 1986 made up the normalization period.

Table 4.9 is the summarized PRISM output for the original 14 homes in the study. The values in parentheses are the standard errors of the associated estimates. Generally, the R-square values show

[2] M.F. Fels, Ed., Energy and Buildings, 9, (1-2), 1986

Table 4.9 Prism Summary Output

********** PRISM--Cooling Only (CO) **********

UNIT ID	PRE OR POST	TIME PERIOD	RAW CONS (kWh)	R^2	TREF (F)	BASE LEVEL (kWh/Day)	COOL SLOPE (kWh/CDD)	COOLING PART (kWh/Year)	NAC (kWh/Year)
H101	PRE	12/08/86-12/07/87	12820	0.944	83.5(0.6)	25.23(2.09)	28.526(5.994)	4727.(436.)	13944.(648.)
H101	POST	12/07/87-12/05/88	11518	0.373	70.4(13.7)	24.72(5.81)	1.258(1.177)	2345.(1557.)	11374.(1196.)
H102	PRE	12/10/86-12/09/87	8300	0.980	70.6(1.2)	13.00(0.83)	2.080(0.204)	3785.(216.)	8534.(195.)
H102	POST	12/09/87-12/07/88	8194	0.967	66.8(2.2)	13.46(1.09)	1.182(0.143)	3035.(315.)	7952.(189.)
H103	PRE	12/10/86-12/09/87	10469	0.915	63.6(4.1)	12.38(2.91)	1.880(0.401)	6172.(911.)	10692.(553.)
H103	POST	12/09/87-12/06/88	8207	0.936	72.4(2.3)	12.10(1.70)	2.348(0.449)	3558.(438.)	7977.(383.)
H104	PRE	12/08/86-12/07/87	12413	0.947	73.3(2.0)	20.57(2.04)	3.981(0.788)	5413.(526.)	12924.(503.)
H104	POST	12/07/87-12/05/88	11405	0.883	69.0(4.0)	22.70(2.11)	1.352(0.325)	2871.(554.)	11161.(403.)
H105	PRE	12/08/86-12/07/87	11679	0.981	70.8(1.1)	14.23(1.49)	3.878(0.365)	6917.(391.)	12116.(349.)
H105	POST	12/07/87-12/05/88	10568	0.985	70.7(1.2)	16.29(1.02)	2.382(0.206)	4316.(272.)	10264.(209.)
H106	PRE	12/08/86-12/07/87	7143	0.916	79.7(1.4)	10.65(1.84)	7.764(2.170)	3878.(430.)	7767.(541.)
H106	POST	12/07/87-12/05/88	7889	0.977	72.5(1.4)	11.04(1.04)	2.403(0.269)	3601.(271.)	7635.(236.)
H107	PRE	12/09/86-12/08/87	12703	0.705	83.3(1.7)	30.07(2.53)	13.009(7.437)	2241.(526.)	13224.(790.)
H107	POST	12/08/87-12/06/88	12395	0.874	82.0(1.4)	28.51(1.44)	6.698(2.499)	1840.(252.)	12253.(436.)
H108	PRE	12/10/86-12/09/87	11395	0.962	81.9(0.5)	24.38(0.91)	11.031(1.700)	3128.(214.)	12033.(281.)
H108	POST	12/09/87-12/07/88	11013	0.860	78.0(3.2)	25.83(1.14)	2.137(1.007)	1494.(279.)	10927.(305.)
H109	PRE	12/08/86-12/07/87	20462	0.983	76.0(1.1)	36.51(1.74)	8.538(1.230)	8183.(403.)	21519.(464.)
H109	POST	12/07/87-12/05/88	17582	0.959	73.3(2.0)	30.89(2.36)	4.327(0.720)	5904.(609.)	17189.(532.)
H110	PRE	12/10/86-12/09/87	6813	0.928	80.5(1.3)	11.44(1.28)	7.574(2.373)	3188.(298.)	7369.(397.)
H110	POST	12/09/87-12/07/88	6656	0.965	76.8(1.6)	13.16(0.64)	2.049(0.415)	1752.(162.)	6560.(160.)
H111	PRE	12/08/86-12/07/87	12381	0.991	67.6(1.0)	17.42(0.93)	2.611(0.177)	6254.(267.)	12615.(202.)
H111	POST	12/07/87-12/05/88	11970	0.975	60.1(2.8)	17.66(1.62)	1.242(0.125)	5152.(526.)	11604.(222.)
H112	PRE	12/09/86-12/08/87	15565	0.917	74.7(2.7)	23.37(3.95)	6.872(2.001)	7896.(1018.)	16433.(971.)
H112	POST	12/08/87-12/06/88	12700	0.884	71.8(3.5)	25.05(2.26)	2.050(0.553)	3322.(604.)	12472.(486.)
H113	PRE	12/09/86-12/08/87	11262	0.964	70.3(1.7)	17.36(1.55)	2.783(0.379)	5207.(407.)	11548.(362.)
H113	POST	12/08/87-12/06/88	11110	0.904	67.0(3.8)	16.66(2.91)	1.826(0.381)	4611.(799.)	10695.(526.)
H114	PRE	12/08/86-12/07/87	16228	0.959	79.8(0.9)	30.41(1.97)	12.329(2.324)	6090.(461.)	17196.(579.)
H114	POST	12/07/87-12/05/88	18327	0.775	73.1(5.2)	37.10(4.68)	3.246(1.430)	4509.(1208.)	18059.(1057.)

* Values in parenthesis represent standard error of the estimate.

strong correlations, with most being above 0.9. Considerable variation in the reference temperatures between the pre- and post-retrofit periods exists. While the normalized annual consumption estimate (NAC) is relatively insensitive to the choice of reference temperature, the base level and cooling slope parameters vary significantly with changes in the reference temperature. Often changes in the base reference temperature have been attributed to a change in the thermostatic set point. However, the indoor temperature data collected from the monitoring does not indicate substantial changes between the two periods in the temperatures maintained. It is more likely that uncertainty in the reference temperature is due to inconsistency in the homeowners use of their air conditioners. Meaningful relationships predicting air conditioner energy use on a site by site basis were difficult to develop directly from the monitored data.

Estimates of the total house energy use appear to be more reliable than the estimates of the cooling use. Table 4.10 shows the energy savings for the 10 houses with pre- and post-retrofit R-square values above 0.85. Taken as a group, there was only a 5% decrease in total electrical energy consumption between 1987 and 1988. However, 1988 was substantially warmer than 1987, and PRISM suggests that the normalized annual consumption decreased by an average of 12% due to the air conditioner replacements. The average decrease in predicted cooling energy consumption was 31%. This compares to the 40% reduction in air conditioner energy estimated in the previous section. The standard errors of the NAC and the cooling component for these 10 houses averaged 3.3% and 10.1% of the estimates, respectively.

Table 4.10 Percentage Decreases in Electrical Energy Use Between 1987 and 1988 Using PRISM Analysis

Site	Actual Annual Electric Consumption	PRISM Annual Air Conditioner Consumption	PRISM Normalized Annual Consumption
102	1.3%	19.8%	6.8%
103	21.6	42.4	25.4
104	8.1	47.0	13.6
105	9.5	37.6	15.3
106	-10.4	7.1	1.7
108	3.4	52.2	9.2
109	14.1	27.9	20.1
110	2.3	45.0	11.0
111	3.3	17.6	8.0
113	1.3	11.4	7.4
Average	5.4%	30.8%	11.8%

Peak Day

The City of Austin was primarily interested in the Appliance Retrofit Rebate Program as a means to reduce its system wide peak generation requirement. A comparison of peak days between the two seasons illustrates the effectiveness of the retrofits in reducing the electrical energy requirement. During the summer, the utility peaks predominantly between 4 p.m. and 5 p.m. In 1987, the system peak occurred on August 11th and was 1391 MW. The 1988 peak occurred on August 23rd and was 1395 MW. Since pre-retrofit monitoring did not begin until late August, a direct comparison of the peak days cannot be made. However, the September peaks were collected and are presented here.

The September 1987 peak occurred between 4 and 5 p.m. on the 16th and was 1291 MW. The September 1988 peak occurred at the same hour on the 15th with a magnitude of 1272 MW. A series of plots is presented which compares the weather conditions and electrical energy consumption as monitored over the 24 hours of these peak days. Superimposed on some of these plots are similar data for August 23, 1988, the 1988 system peak. This provides a comparison of how the September peak compares with the system peak. The values shown on these plots represent averages over all of the monitored sites.

Figure 4.6 depicts the measured outdoor air temperature conditions on the peak days. The September days had similar temperature profiles. Both days also had intermittent cloud cover. As would be expected, the August peak day was warmer. Indoor conditions, shown in Figure 4.7, were kept at similar levels on all the days. Indoor temperatures were maintained around 80°F throughout the project.

Aggregate air conditioner electrical energy consumption normalized by house square footage is presented in Figure 4.8. Substantial reductions are noted between the pre- and post-retrofit periods. During the system peak hour, pre-retrofit air conditioner electric energy averaged 1.08 Wh/hr - ft^2. For the post-retrofit period, this was reduced to 0.70 Wh/hr - ft^2. This is a 36% decrease in air conditioner electric consumption during the period the system is peaking. The September peak is about 90% of the August peak of 0.78 Wh/hr - ft^2.

Reductions in the total house electrical energy requirement are also achieved. Figure 4.9 shows average total electrical usages during the peak hour of 3.04 Wh/hr - ft^2 during the pre-retrofit period and 2.30 Wh/hr - ft^2 for the post-retrofit period. This is a 24% decrease in the total house electrical energy requirement. Again, the August peak is higher at 2.58 Wh/hr - ft^2.

No significant difference in air conditioner runtimes is noticeable between the two periods. The diversity factor profiles in Figure 4.10 are similar for the September days. During the peak hours the maximum diversity factor is 0.79 for both days. The air conditioners will operate longer on the warmer August days as indicated by the higher diversity factor of 0.85.

Figure 4.6 Peak Day Outdoor Air Temperatures

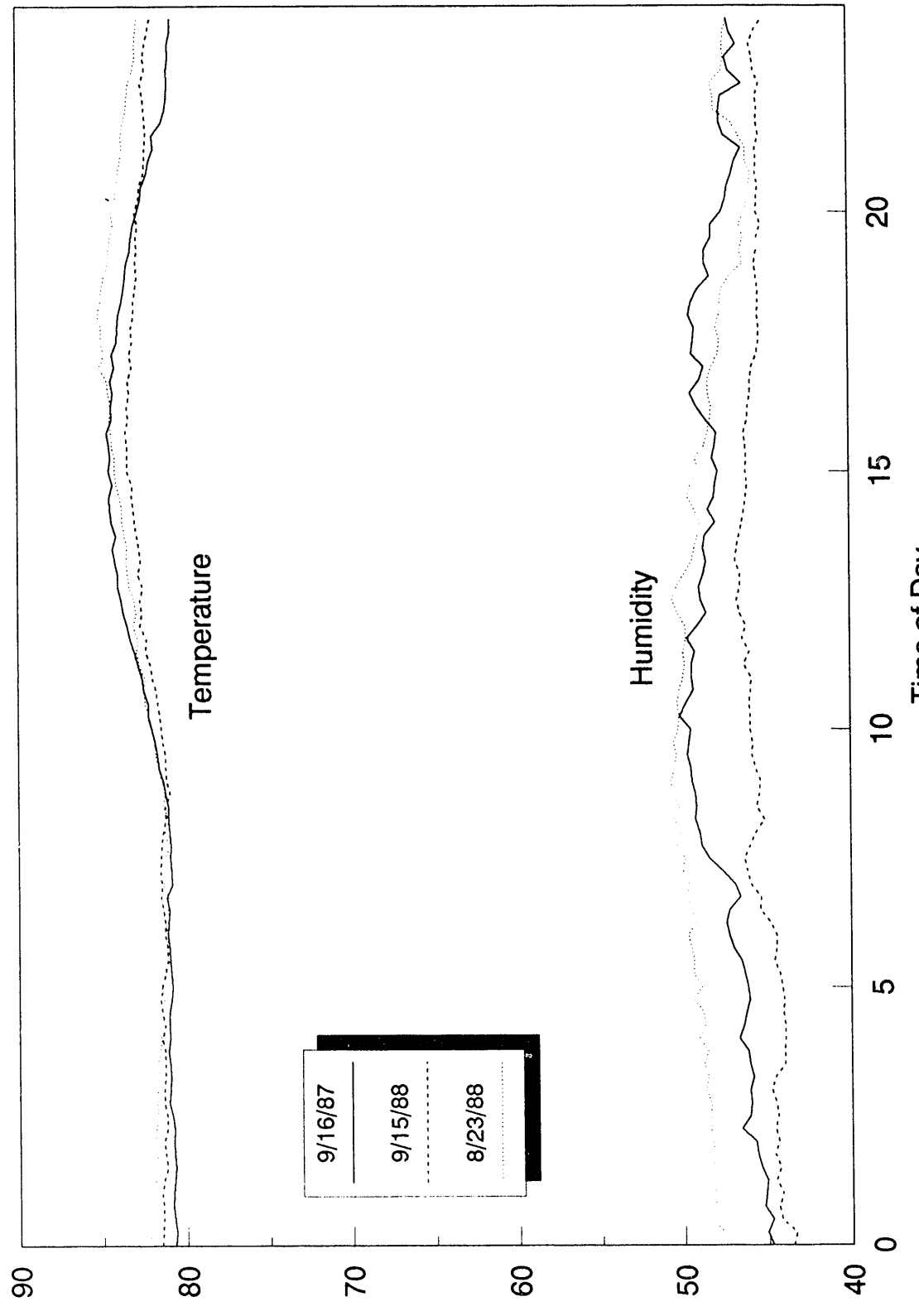


Figure 4.7 Peak Day Indoor Air Conditions

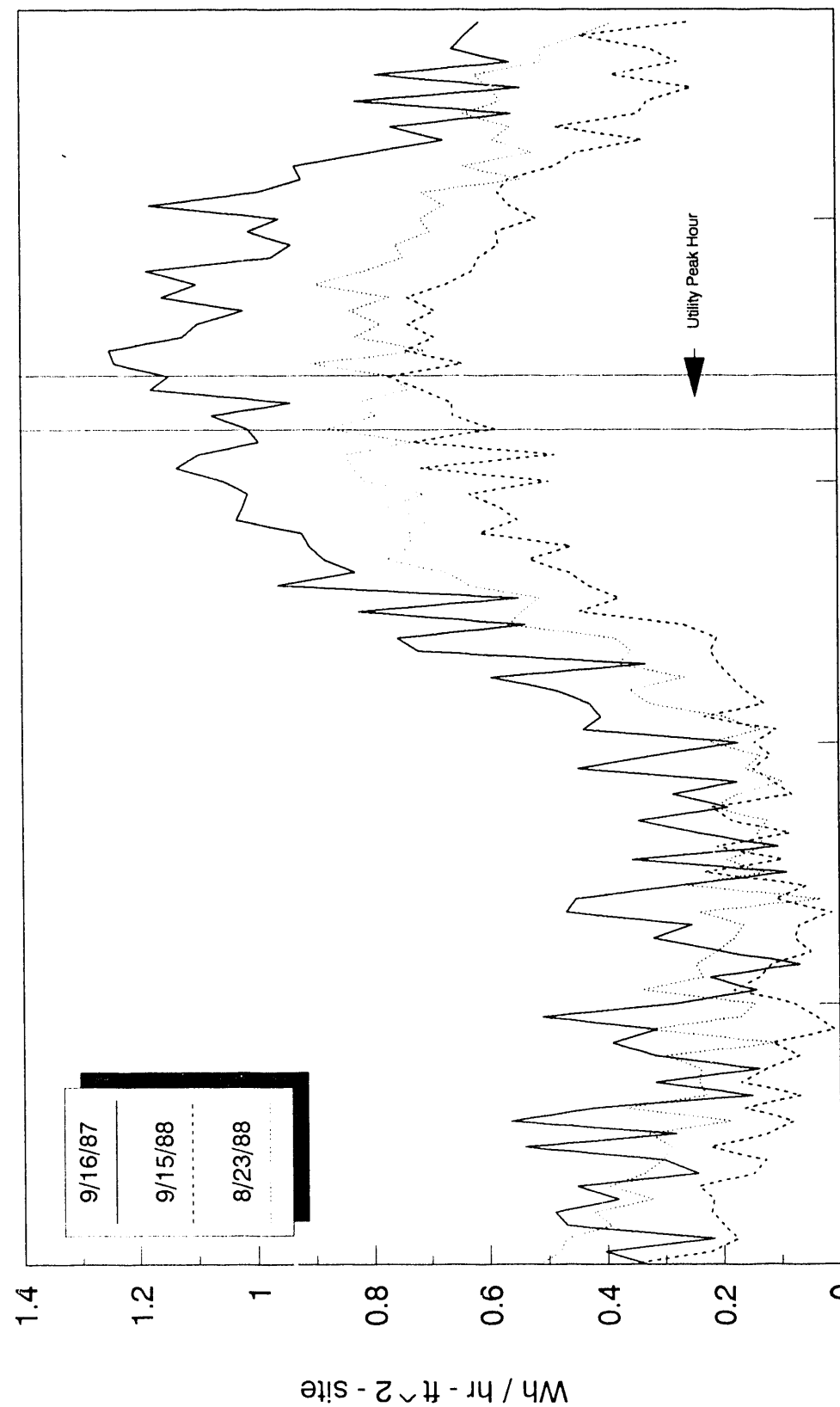


Figure 4.8 Peak Day Aggregate Air Conditioner Electric Usage Normalized to House Square Footage

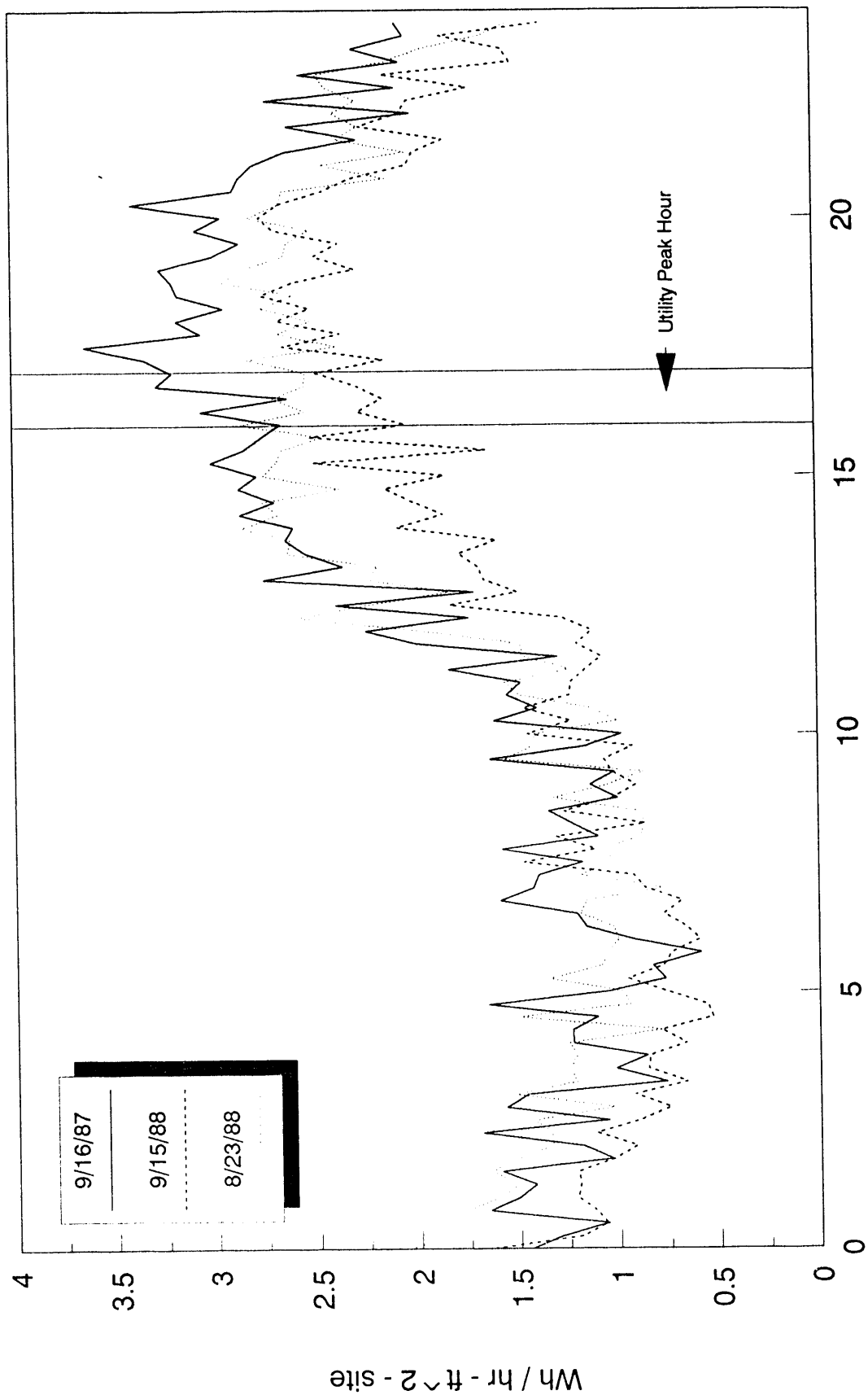


Figure 4.9 Peak Day Total House Electric Usage
Normalized to House Square Footage

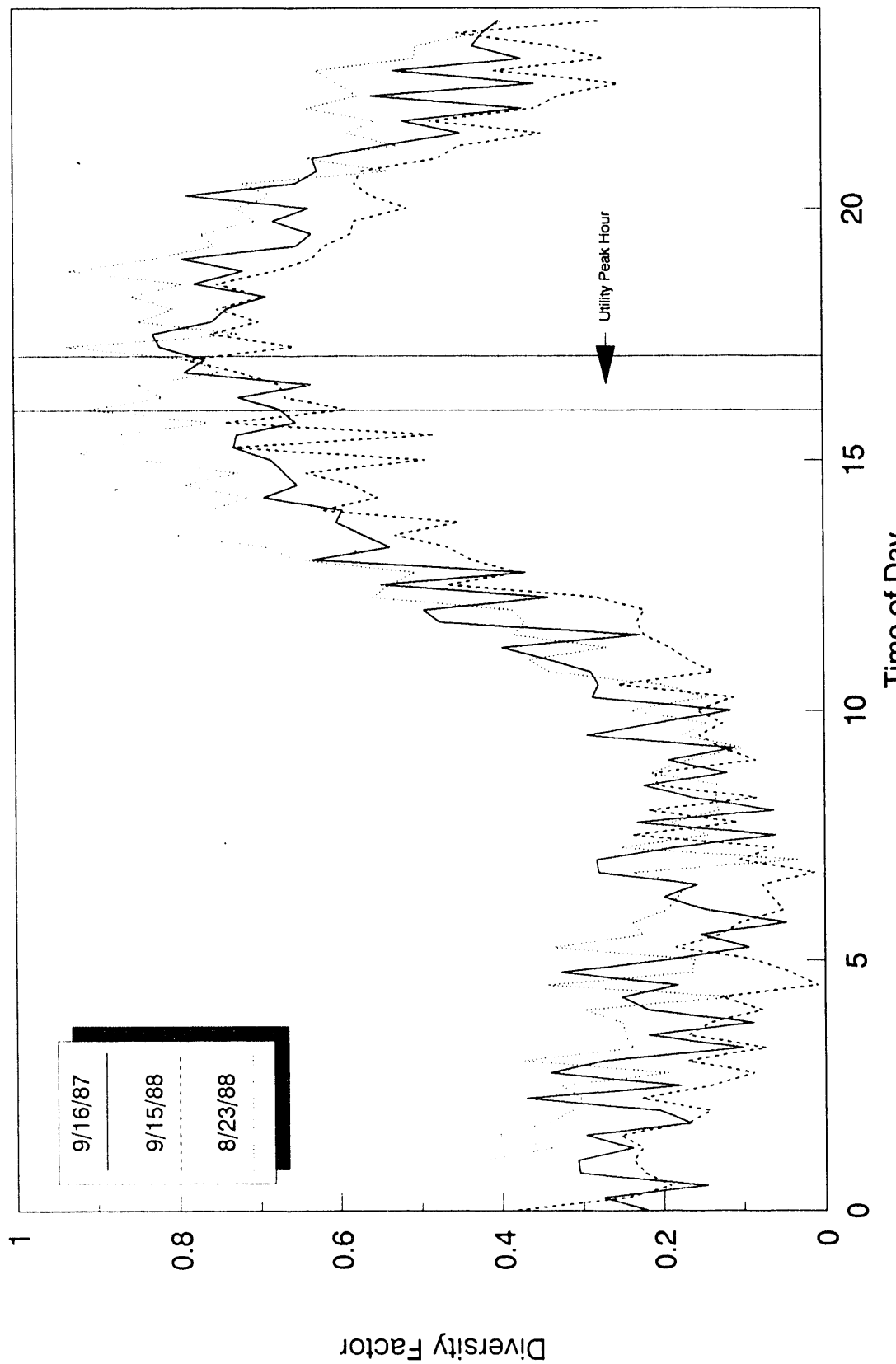


Figure 4.10 Peak Day Diversity Factor Profiles

5.0 CONCLUSIONS

The following conclusions can be made from the data analysis.

The air conditioner retrofits performed in Austin were effective in reducing annual air conditioner electric consumption and peak electric demand. On an average, 38% reductions in peak demand and average air conditioner energy consumption were found due to the retrofit. When normalized to the house conditioned area, average demand savings were 1.12W/ft^2, and estimated annual energy savings were 1.419 kWh/ft^2.

Individual air conditioner power requirements are a well defined function of outdoor temperature. In the absence of detailed data, estimates of the peak demand reduction can be made from the manufacturer's specifications.

Conclusive relationships between air conditioner electric consumption and variation in weather conditions were hard to develop for individual sites. At sites where the air conditioners were allowed to run, patterns were more evident than at sites where manual operation of the thermostat and turning the unit on and off occurred.

However, when taken as an aggregate, air conditioner energy consumption is strongly linear as a function of the outdoor temperature. The most successful relationship which emerged was daily air conditioner electric consumption as a function of the daily average temperature.

No noticeable differences in the diversity of air conditioner usage were found. During peak 15- minute periods, the diversity factor reaches 0.9.

Analysis of the retrofit effect using PRISM yields estimates of the reduction in normalized annual consumption (NAC) and annual cooling consumption of 12% and 30%. The 30% reduction in the cooling energy estimate is less than the 38% estimated using a daily average temperature regression with directly monitored cooling consumption.

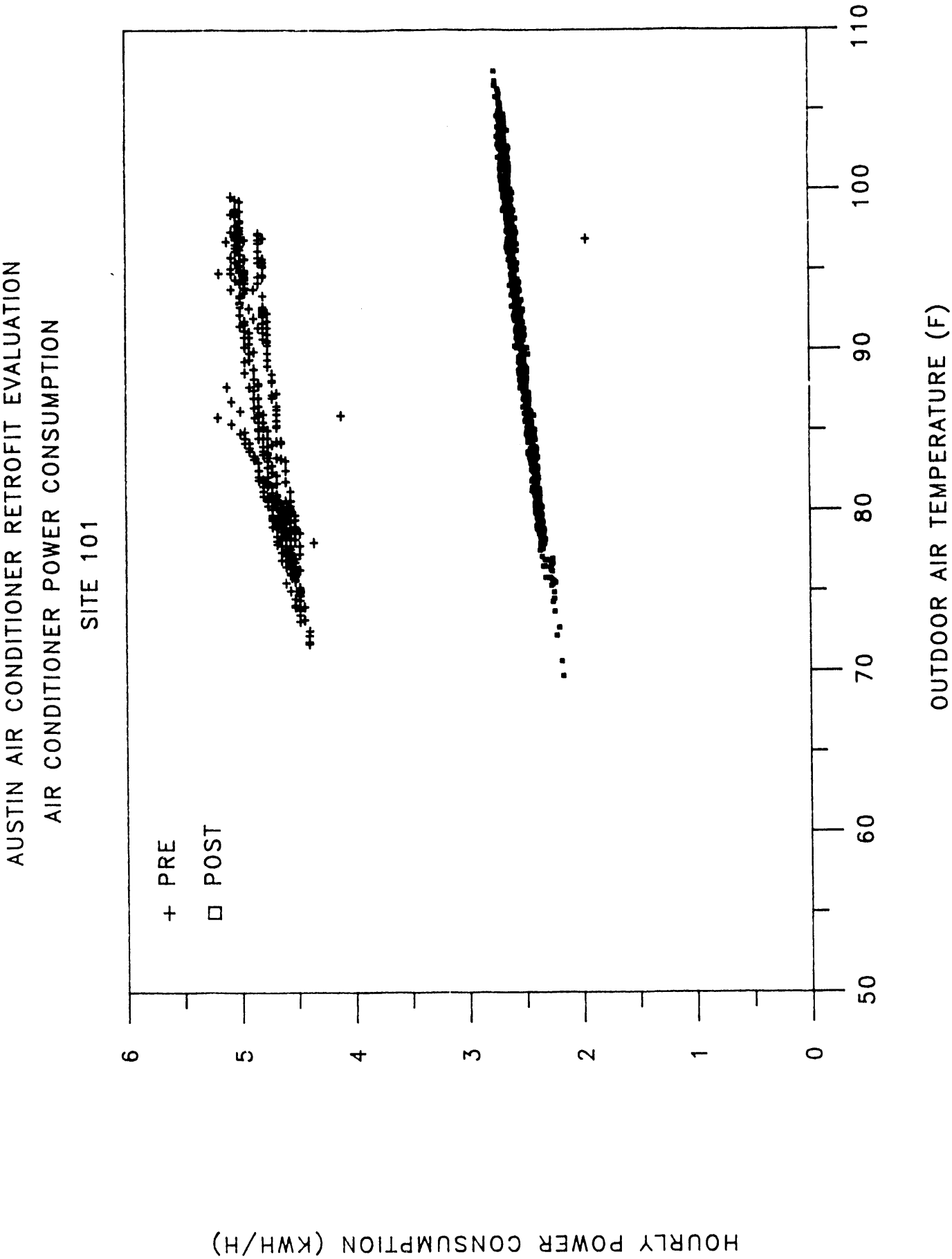
6.0 REFERENCES

1. Ternes, M.P. (1986), "Single-Family Building Retrofit Performance Monitoring Protocol: Data Specification Guideline," ORNL/CON-196, Oak Ridge National Laboratory, Oak Ridge, TN.

2. M.F. Fels, ed. (1986), "Measuring Energy Savings: The Scorekeeping Approach," A special issue of Energy and Buildings, 9, (1-2), Elsevier, Lausanne, Switzerland.

APPENDIX A

AIR CONDITIONER POWER CONSUMPTION PLOTS


AUSTIN AIR CONDITIONER RETROFIT EVALUATION
AIR CONDITIONER POWER CONSUMPTION
SITE 101
+ PRE
□ POST
HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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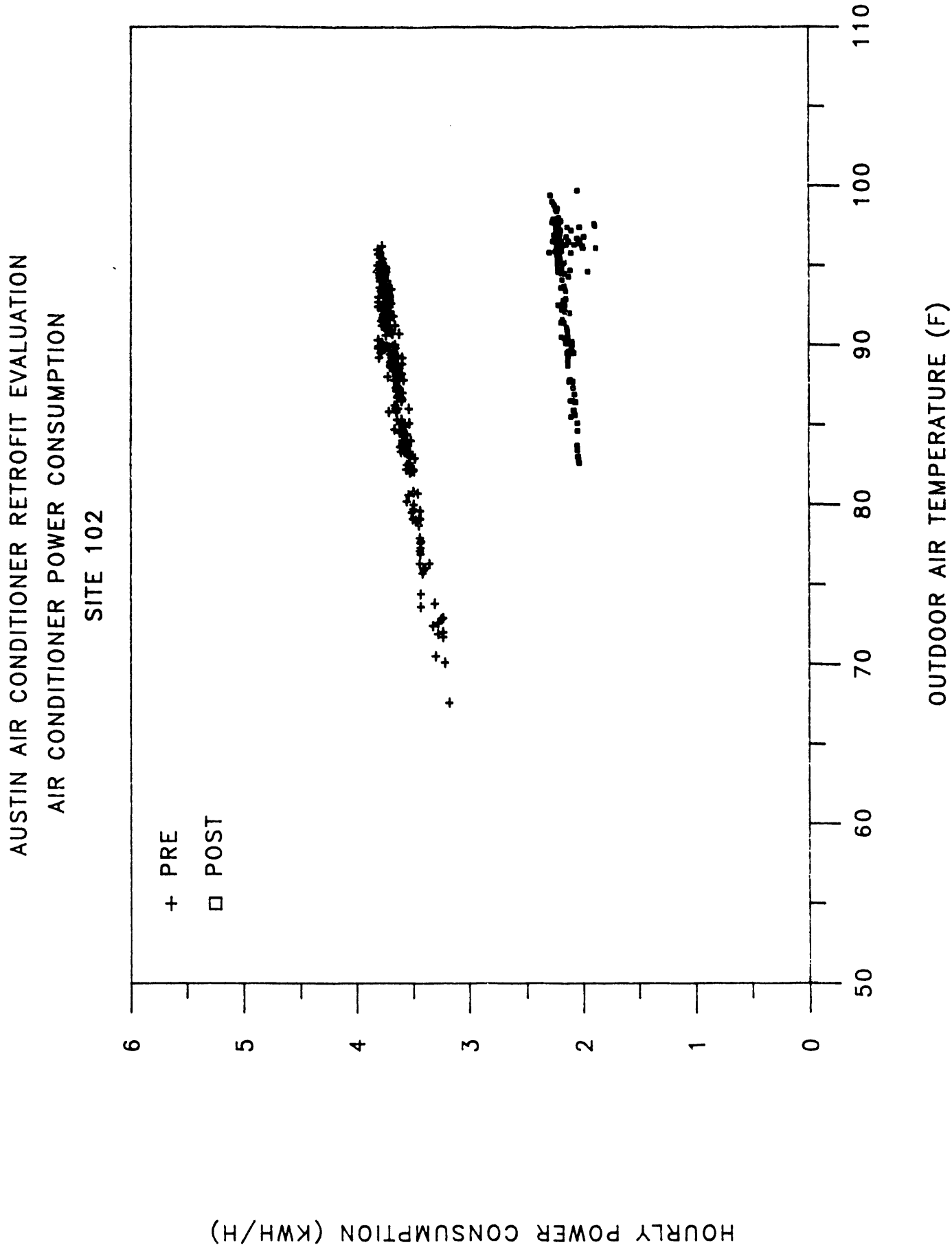
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SITE 102
+ PRE
□ POST
HOURLY POWER CONSUMPTION (KWH/H)
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OUTDOOR AIR TEMPERATURE (F)
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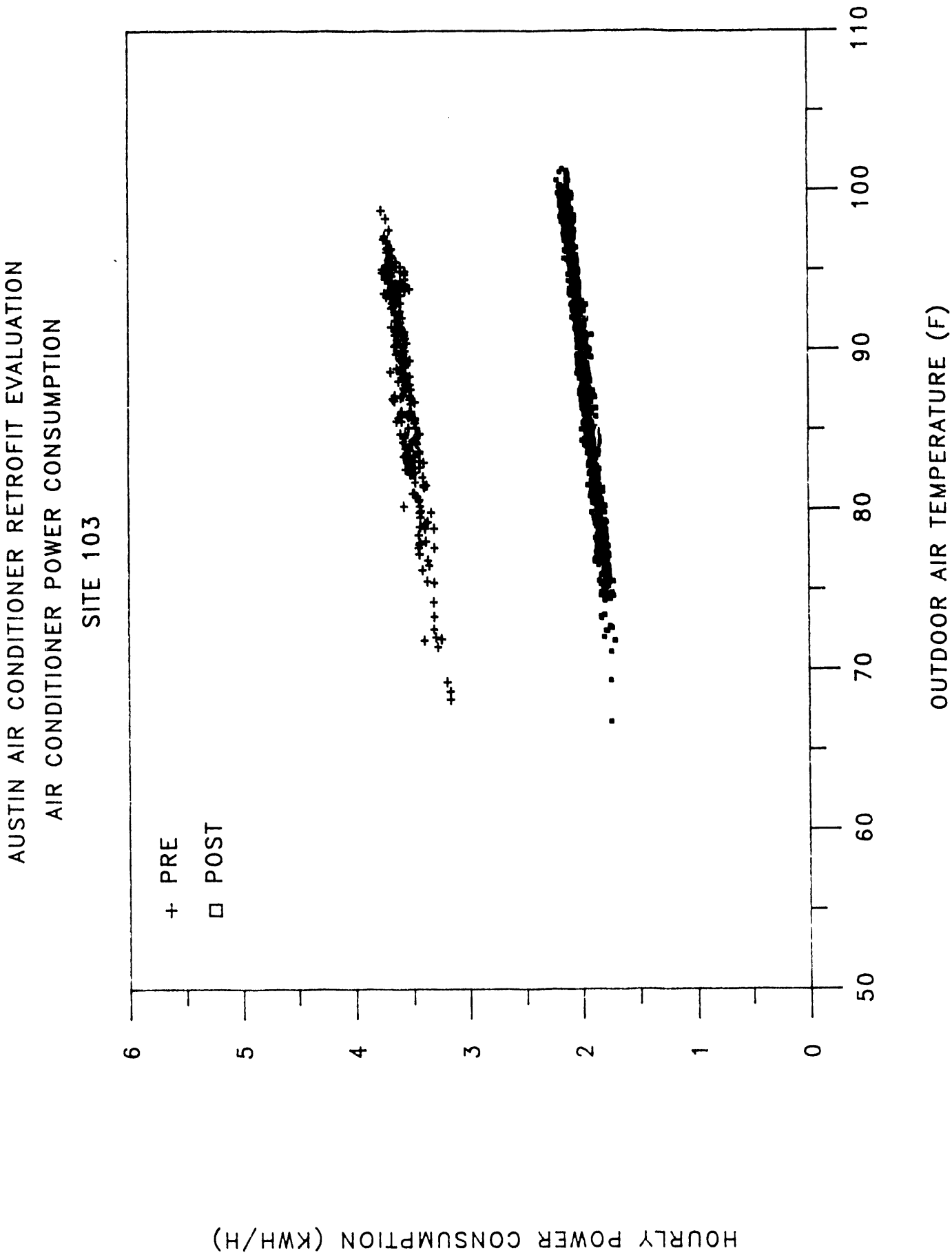
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SITE 103
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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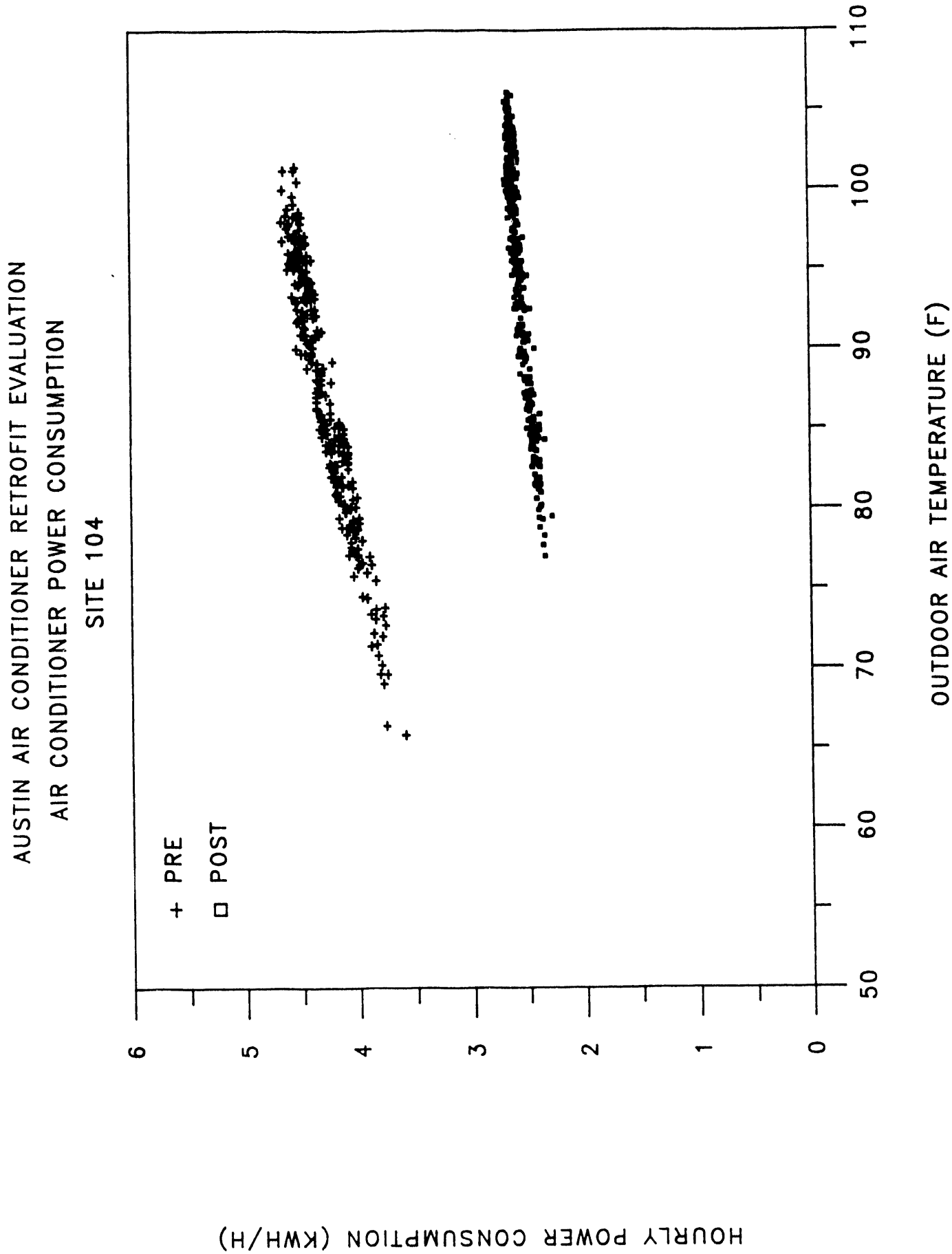
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SITE 104
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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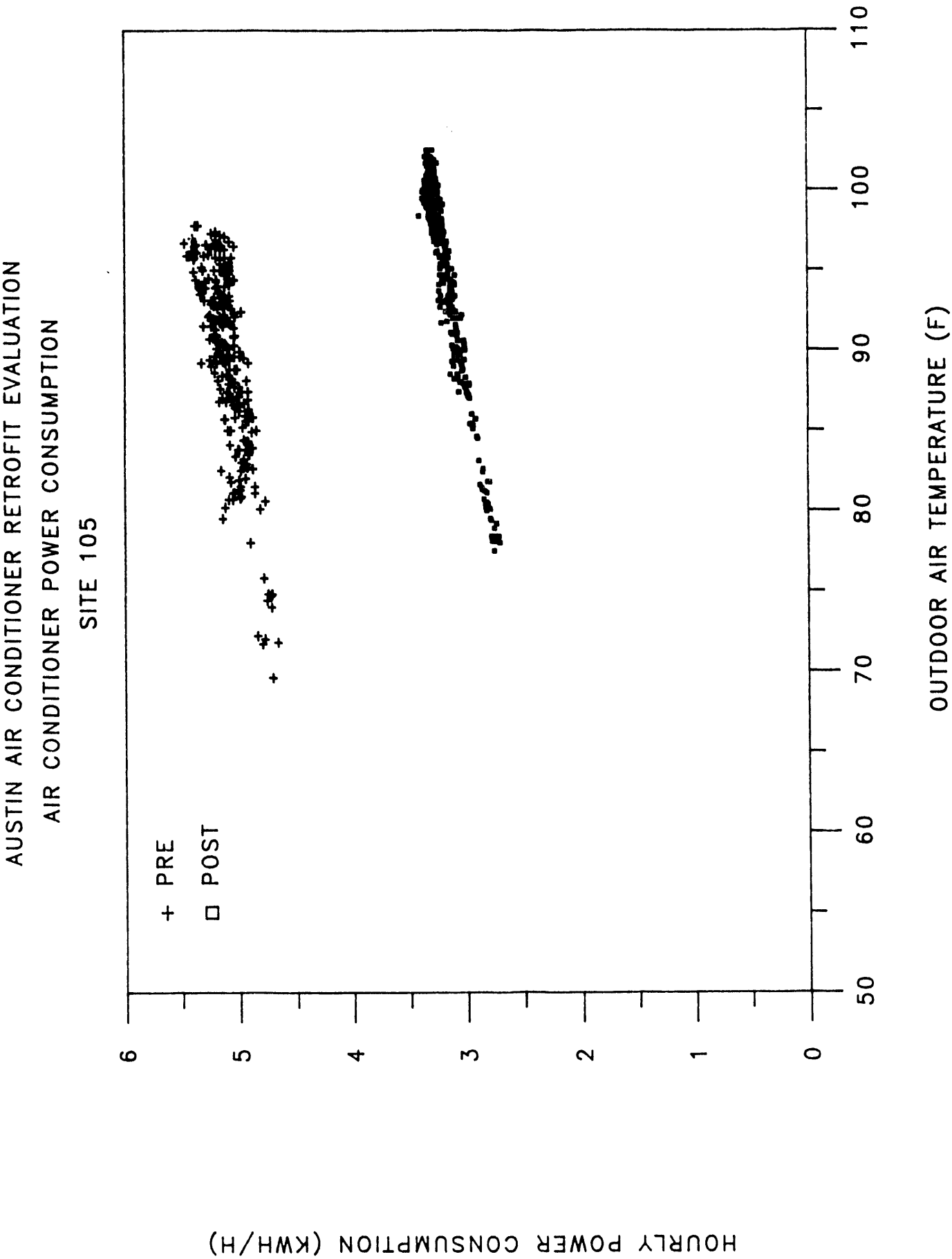
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AIR CONDITIONER POWER CONSUMPTION
SITE 105
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HOURLY POWER CONSUMPTION (KWH/H)
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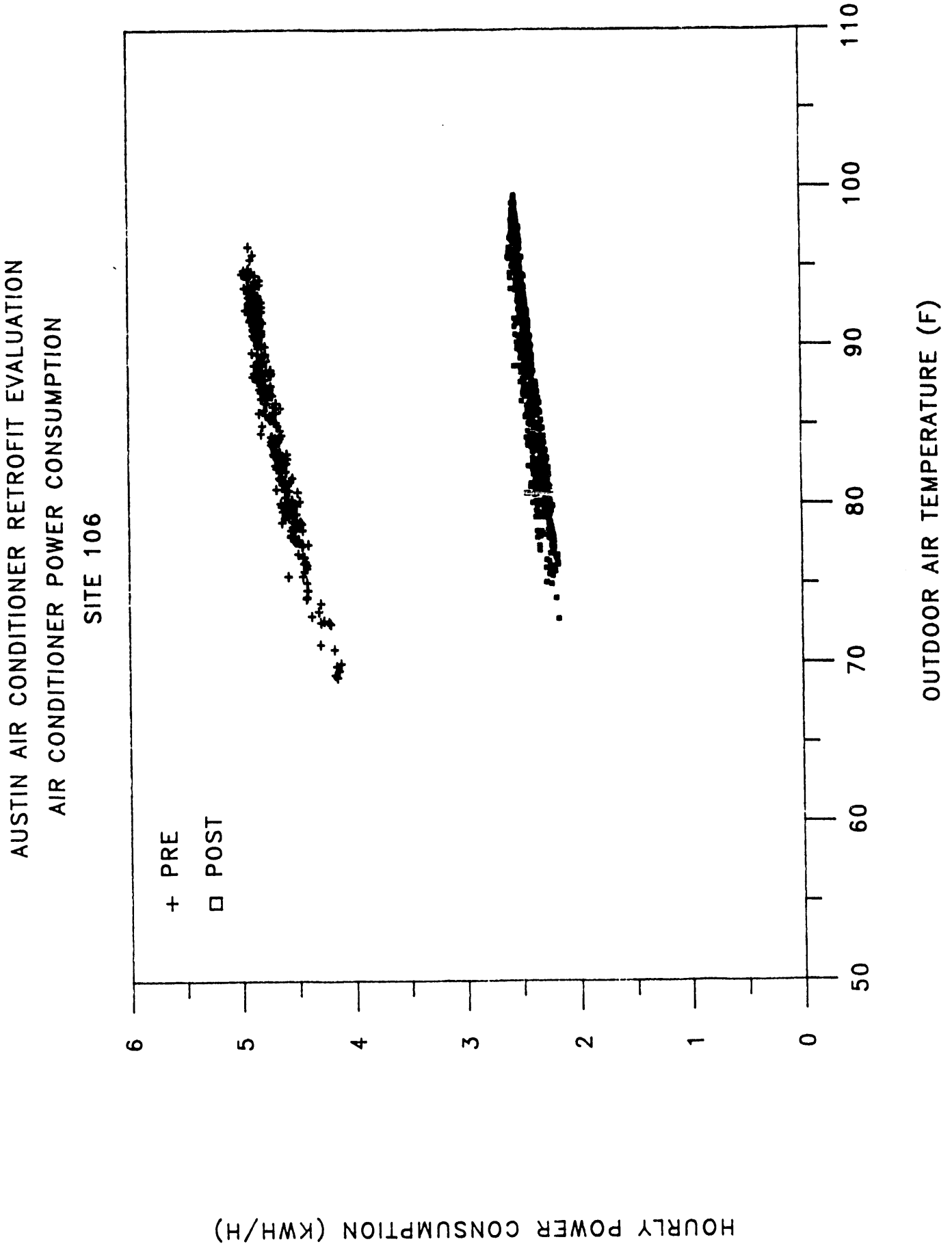
OUTDOOR AIR TEMPERATURE (F)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AIR CONDITIONER POWER CONSUMPTION
SITE 106
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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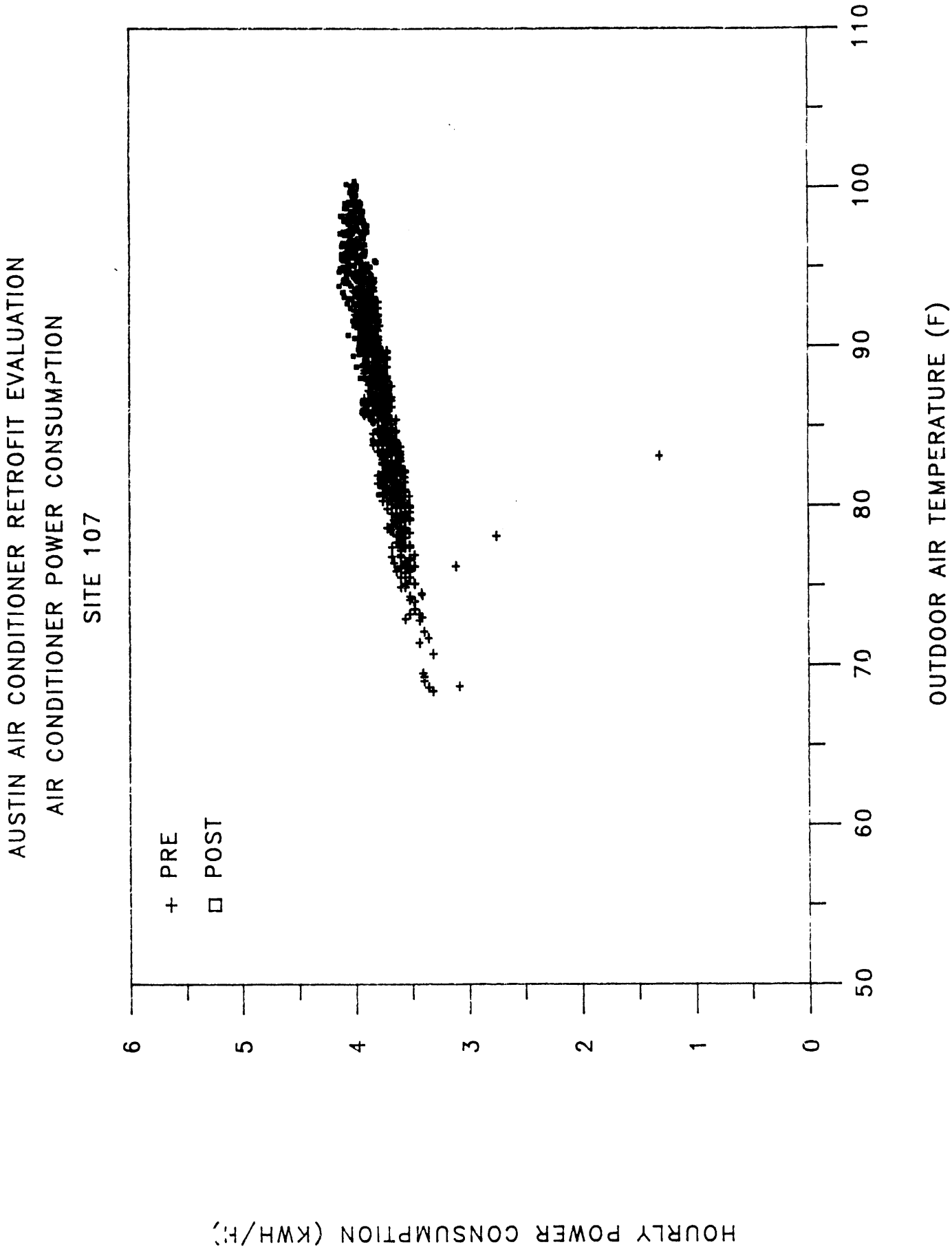
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AIR CONDITIONER POWER CONSUMPTION
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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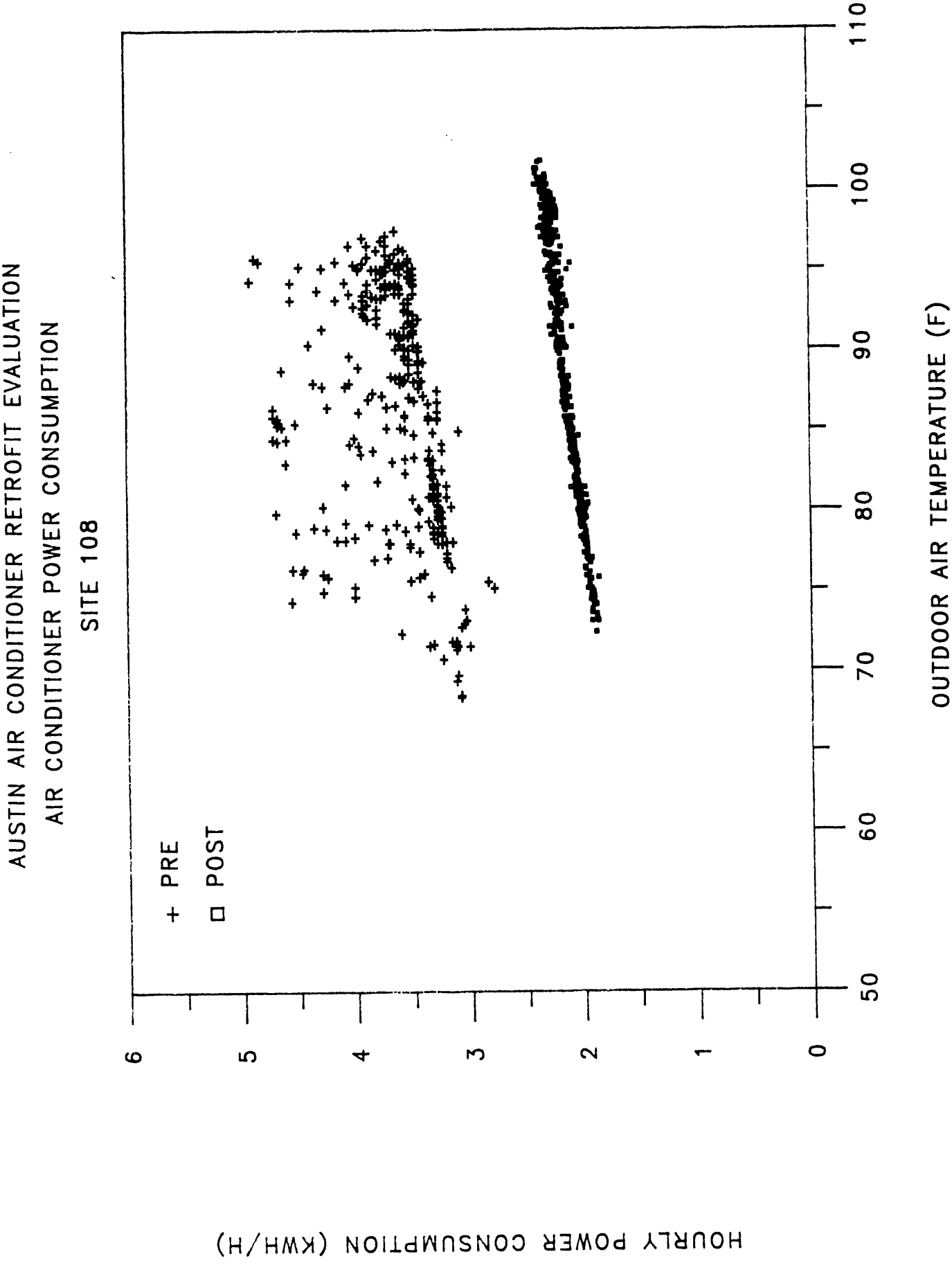
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AIR CONDITIONER POWER CONSUMPTION
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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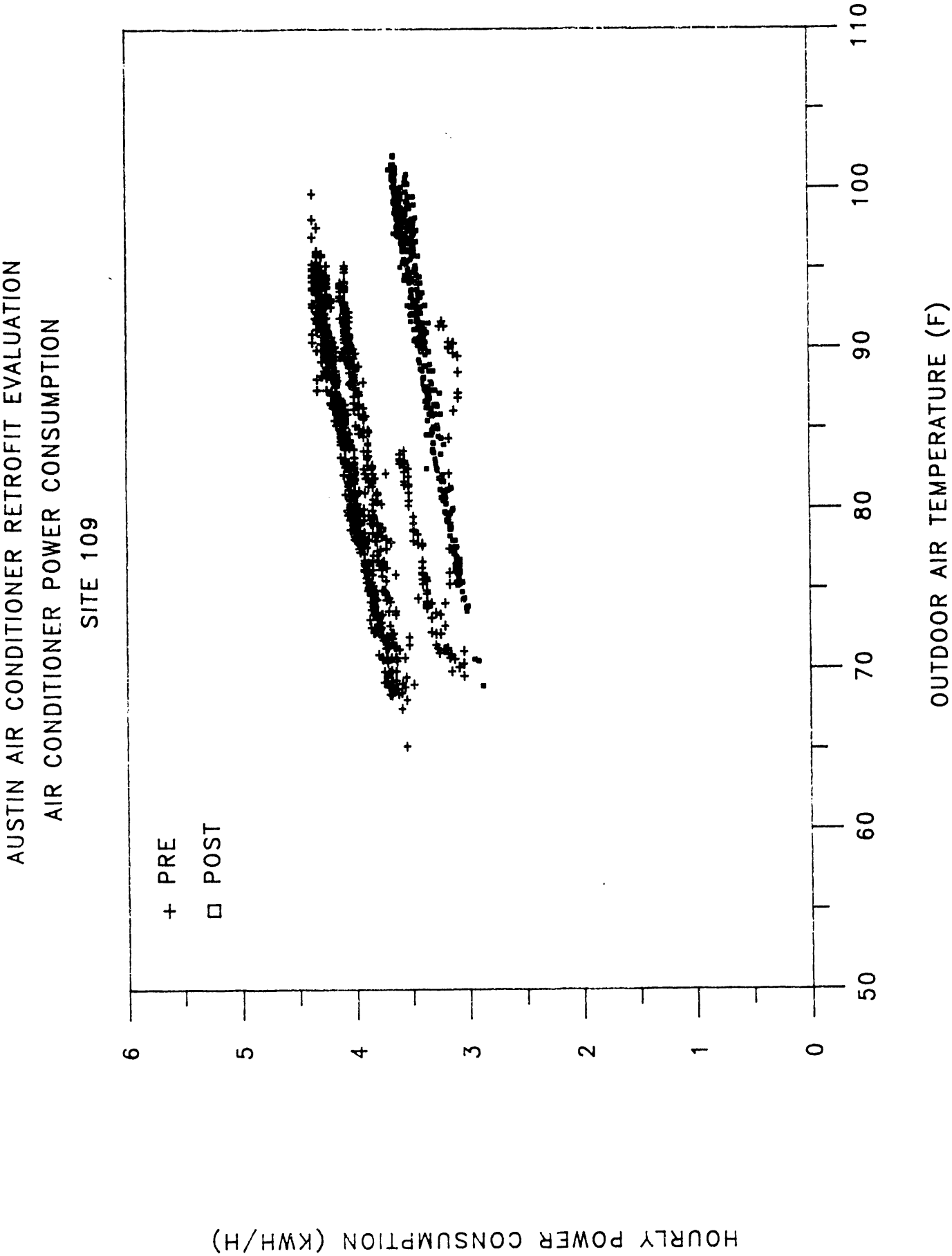
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AIR CONDITIONER POWER CONSUMPTION
SITE 109
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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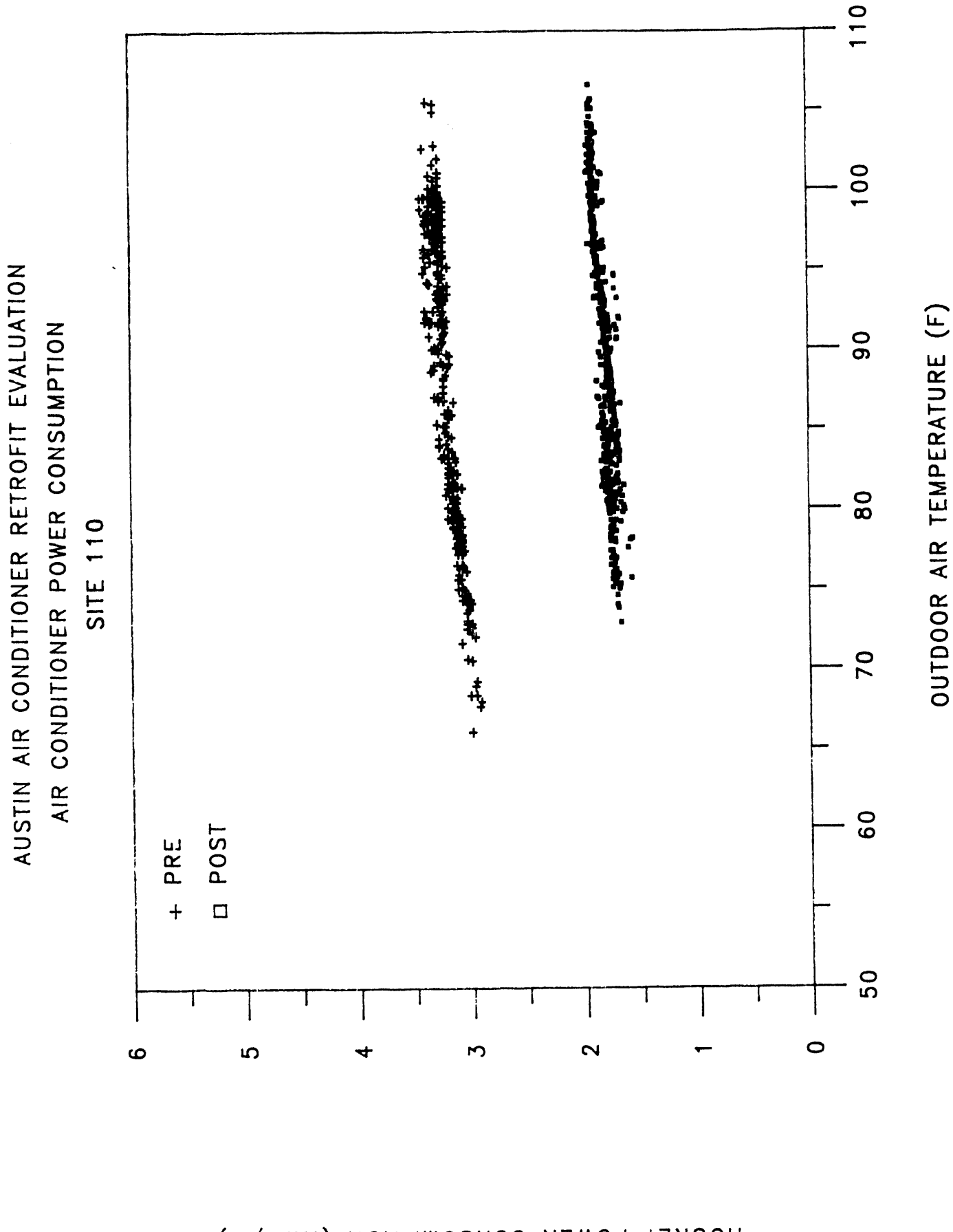
AUSTIN AIR CONDITIONER RETROFIT EVALUATION
AIR CONDITIONER POWER CONSUMPTION
SITE 110
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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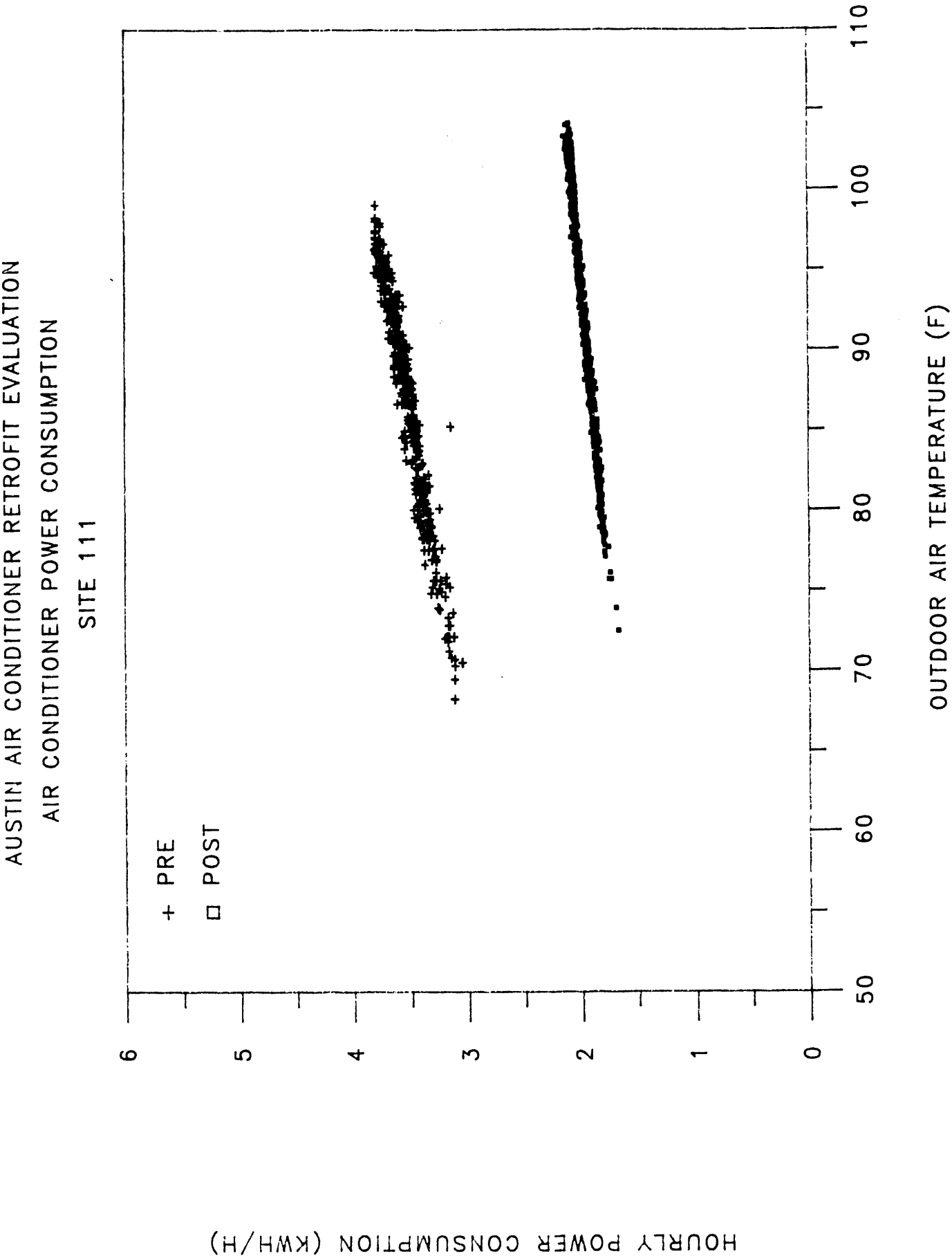
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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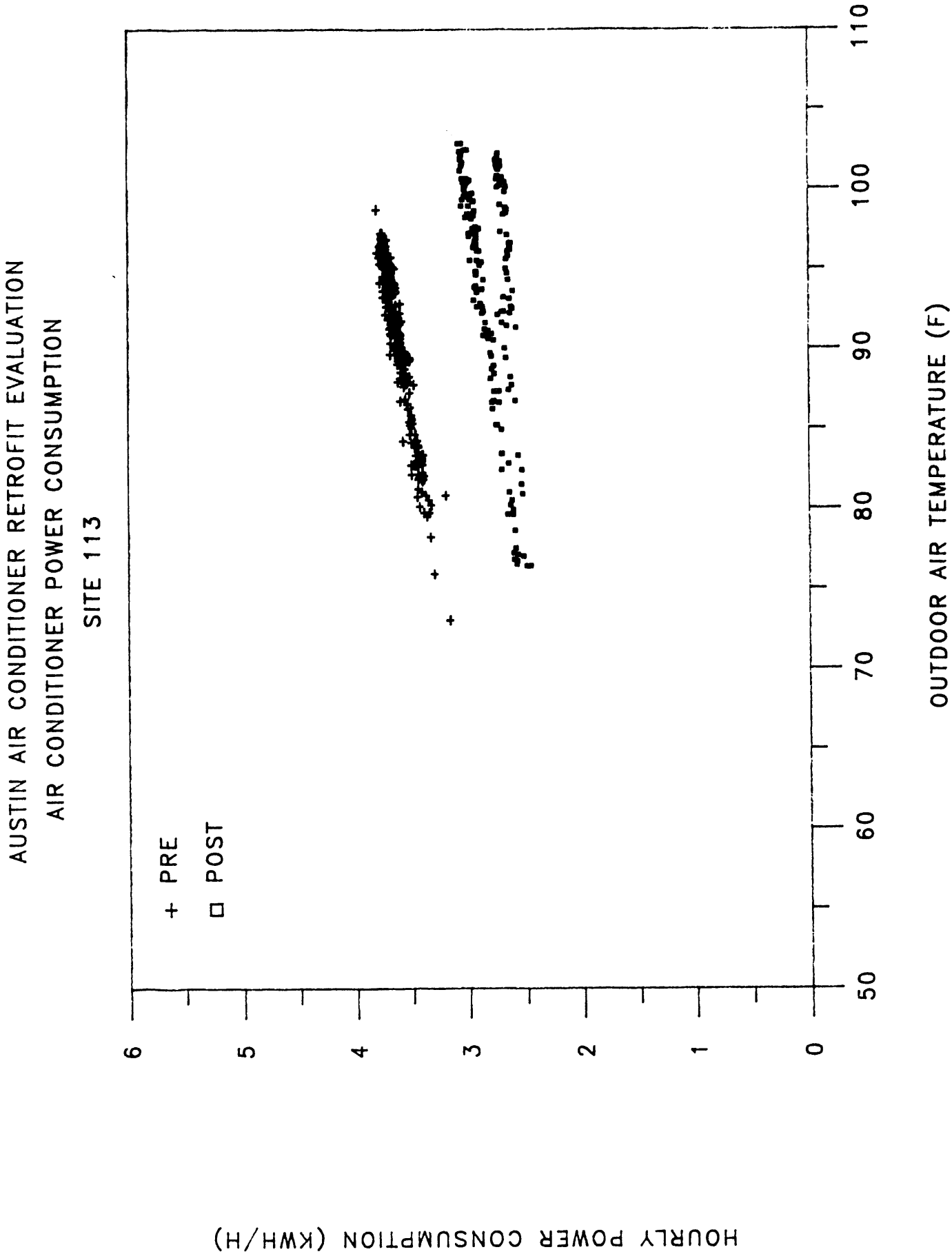
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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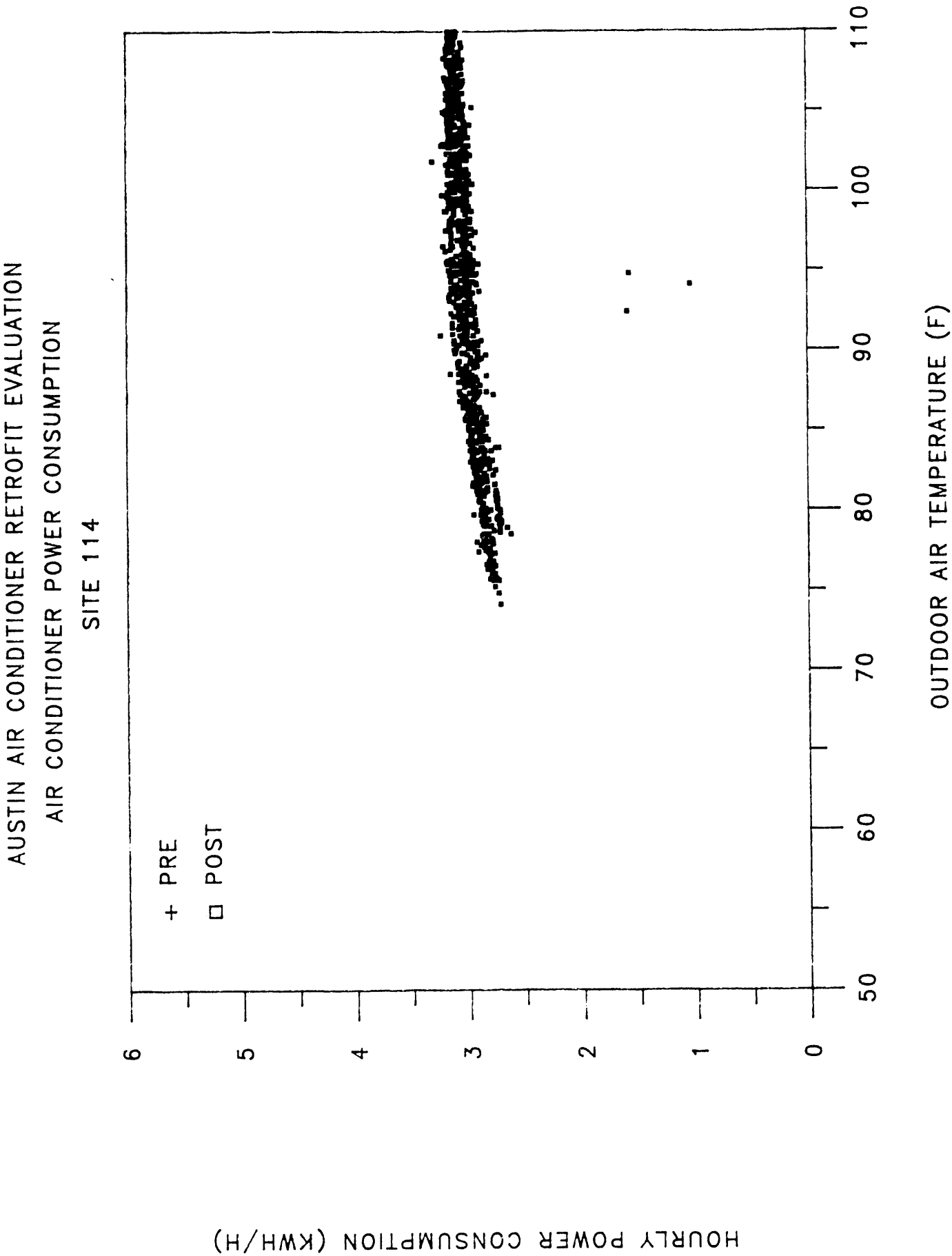
AUSTIN AIR CONDITIONER RETROFIT EVALUATION
AIR CONDITIONER POWER CONSUMPTION
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HOURLY POWER CONSUMPTION (KWH/H)
OUTDOOR AIR TEMPERATURE (F)
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APPENDIX B

OPERATIONAL SUMMARIES

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/28/87 - 11/02/87
DATABASE PERIODS RECORDED: 5102 (79.3% OF TIME INTERVAL)

SITE: 1

HOUSE SQUARE FEET: 1742.00
A/C NOMINAL TONS: 3.50
NUMBER OF OCCUPANTS: 6

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.42	1.97	0.12	KWH	2131.67
CENTRAL A/C	KWH/15 MIN	0.13	1.30	0.00	KWH	674.57

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2398	1.1309	0.0689	WH/FT2	1223.696
TOTAL HOUSE	KWH/TON	0.1194	0.5629	0.0000	KWH/TON	609.050
CENTRAL A/C	WH/FT2	0.0759	0.7463	0.0000	WH/FT2	387.239
CENTRAL A/C	KWH/TON	0.0378	0.3714	0.0000	KWH/TON	192.734

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	14.65	15.00	0.15	HR	146.06
CENTRAL A/C CYCLES	CYC/15 MIN	0.00	2.00	0.00	CYCLES	17.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.14	2.93	0.00	LBS	710.53
TOTAL HOUSE GAS	CF/15 MIN	0.95	14.00	0.00	CF	4844.00
OUTDOOR TEMP.	DEG. F	73.97	99.70	47.34	--	--
INDOOR TEMP.	DEG. F	80.96	90.70	73.10	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.99	16.70	-29.84	--	--
INDOOR RH	%	47.08	77.00	25.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	5/01/88 - 10/31/88
DATABASE PERIODS RECORDED:	13656 (77.3% OF TIME INTERVAL)
SITE:	1
HOUSE SQUARE FEET:	1742.00
A/C NOMINAL TONS:	2.50
NUMBER OF OCCUPANTS:	6

SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.42	1.54	0.04	KWH	5736.46
CENTRAL A/C	KWH/15 MIN	0.15	0.72	0.00	KWH	1981.44

NORMALIZED SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2411	0.8858	0.0212	WH/FT2	3293.029
TOTAL HOUSE	KWH/TON	0.1680	0.6172	0.0000	KWH/TON	2294.580
CENTRAL A/C	WH/FT2	0.0833	0.4133	0.0000	WH/FT2	1137.462
CENTRAL A/C	KWH/TON	0.0580	0.2880	0.0000	KWH/TON	792.592

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	8.00	15.00	0.00	HR	778.41
CENTRAL A/C CYCLES	CYC/15 MIN	0.11	2.00	0.00	CYCLES	1527.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.23	2.93	0.00	LBS	3092.00
TOTAL HOUSE GAS	CF/15 MIN	0.77	14.00	0.00	CF	10509.00
OUTDOOR TEMP.	DEG. F	81.07	111.90	52.93	--	--
INDOOR TEMP.	DEG. F	80.83	94.10	69.00	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	0.25	26.30	-25.61	--	--
INDOOR RH	%	50.74	80.80	17.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 3878 (66.2% OF TIME INTERVAL)

SITE: 1

HOUSE SQUARE FEET: 1742.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 6

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.23	1.12	0.06	KWH	909.42
CENTRAL A/C	KWH/15 MIN	0.01	0.69	0.00	KWH	47.69

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1346	0.6435	0.0344	WH/FT2	522.053
TOTAL HOUSE	KWH/TON	0.0938	0.4484	0.0000	KWH/TON	363.767
CENTRAL A/C	WH/FT2	0.0071	0.3944	0.0000	WH/FT2	27.376
CENTRAL A/C	KWH/TON	0.0049	0.2748	0.0000	KWH/TON	19.076

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	0.68	15.00	0.00	HR	11.58
CENTRAL A/C CYCLES	CYC/15 MIN	0.00	1.00	0.00	CYCLES	15.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.02	1.95	0.00	LBS	61.49
TOTAL HOUSE GAS	CF/15 MIN	0.57	14.00	0.00	CF	2211.00
OUTDOOR TEMP.	DEG. F	76.84	101.50	52.93	--	--
INDOOR TEMP.	DEG. F	82.32	90.70	69.00	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.48	17.50	-25.61	--	--
INDOOR RH	%	50.92	80.80	17.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/26/87 - 11/02/87
DATABASE PERIODS RECORDED: 4751 (71.7% OF TIME INTERVAL)

SITE: 2

HOUSE SQUARE FEET: 1007.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.27	2.43	0.00	KWH	1295.28
CENTRAL A/C	KWH/15 MIN	0.12	1.09	0.00	KWH	587.11

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2708	2.4131	0.0000	WH/FT2	1286.277
TOTAL HOUSE	KWH/TON	0.1091	0.9720	0.0000	KWH/TON	518.113
CENTRAL A/C	WH/FT2	0.1227	1.0824	0.0000	WH/FT2	583.029
CENTRAL A/C	KWH/TON	0.0494	0.4360	0.0000	KWH/TON	234.844

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.06	15.00	0.00	HR	163.09
CENTRAL A/C CYCLES	CYC/15 MIN	0.17	2.00	0.00	CYCLES	830.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.15	1.95	0.00	LBS	703.70
TOTAL HOUSE GAS	CF/15 MIN	0.61	8.00	0.00	CF	2890.00
OUTDOOR TEMP.	DEG. F	74.62	97.70	48.12	--	--
INDOOR TEMP.	DEG. F	79.26	84.40	68.25	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 4.64	16.80	-22.84	--	--
INDOOR RH	%	42.99	73.00	12.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 15891 (90.0% OF TIME INTERVAL)

SITE: 2

HOUSE SQUARE FEET: 1007.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.33	2.17	0.00	KWH	5217.71
CENTRAL A/C	KWH/15 MIN	0.14	0.58	0.00	KWH	2222.03

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3261	2.1519	0.0000	WH/FT2	5181.455
TOTAL HOUSE	KWH/TON	0.1642	1.0835	0.0000	KWH/TON	2608.856
CENTRAL A/C	WH/FT2	0.1389	0.5750	0.0000	WH/FT2	2206.584
CENTRAL A/C	KWH/TON	0.0699	0.2895	0.0000	KWH/TON	1111.015

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.15	15.00	0.00	HR	1098.25
CENTRAL A/C CYCLES	CYC/15 MIN	0.49	4.00	0.00	CYCLES	7782.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.19	2.93	0.00	LBS	3039.35
TOTAL HOUSE GAS	CF/15 MIN	0.49	10.00	0.00	CF	7720.61
OUTDOOR TEMP.	DEG. F	80.84	104.90	52.86	--	--
INDOOR TEMP.	DEG. F	79.70	85.20	71.10	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	1.14	24.00	-21.38	--	--
INDOOR RH	%	42.92	71.70	29.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 4179 (71.4% OF TIME INTERVAL)

SITE: 2

HOUSE SQUARE FEET: 1007.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.30	2.17	0.00	KWH	1245.43
CENTRAL A/C	KWH/15 MIN	0.12	0.55	0.00	KWH	480.81

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2959	2.1519	0.0000	WH/FT2	1236.772
TOTAL HOUSE	KWH/TON	0.1490	1.0835	0.0000	KWH/TON	622.715
CENTRAL A/C	WH/FT2	0.1143	0.5492	0.0000	WH/FT2	477.468
CENTRAL A/C	KWH/TON	0.0575	0.2765	0.0000	KWH/TON	240.405

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.32	15.00	0.00	HR	231.57
CENTRAL A/C CYCLES	CYC/15 MIN	0.39	2.00	0.00	CYCLES	1623.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.16	1.95	0.00	LBS	666.66
TOTAL HOUSE GAS	CF/15 MIN	0.53	8.00	0.00	CF	2229.28
OUTDOOR TEMP.	DEG. F	77.76	98.70	52.86	--	--
INDOOR TEMP.	DEG. F	79.60	85.20	71.50	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 1.84	18.10	-21.35	--	--
INDOOR RH	%	41.03	60.80	29.70	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	8/26/87 - 11/02/87
DATABASE PERIODS RECORDED:	5253 (79.3% OF TIME INTERVAL)
SITE:	3
HOUSE SQUARE FEET:	1106.00
A/C NOMINAL TONS:	2.50
NUMBER OF OCCUPANTS:	2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.38	1.53	0.03	KWH	2008.72
CENTRAL A/C	KWH/15 MIN	0.22	0.95	0.00	KWH	1171.07

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3458	1.3834	0.0271	WH/FT2	1816.215
TOTAL HOUSE	KWH/TON	0.1530	0.6120	0.0000	KWH/TON	803.495
CENTRAL A/C	WH/FT2	0.2016	0.8590	0.0000	WH/FT2	1058.819
CENTRAL A/C	KWH/TON	0.0892	0.3300	0.0000	KWH/TON	468.422

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.84	15.00	0.00	HR	336.11
CENTRAL A/C CYCLES	CYC/15 MIN	0.48	2.00	0.00	CYCLES	2525.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.16	0.98	0.00	LBS	866.70
TOTAL HOUSE GAS	CF/15 MIN	1.02	13.00	0.00	CF	5340.00
OUTDOOR TEMP.	DEG. F	73.46	99.00	46.12	--	--
INDOOR TEMP.	DEG. F	78.62	88.50	72.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.16	20.10	-26.52	--	--
INDOOR RH	%	46.72	72.00	25.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	5/01/88 - 10/31/88
DATABASE PERIODS RECORDED:	14582 (82.6% OF TIME INTERVAL)
SITE:	3
HOUSE SQUARE FEET:	1106.00
A/C NOMINAL TONS:	2.00
NUMBER OF OCCUPANTS:	2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.34	1.35	0.03	KWH	4960.75
CENTRAL A/C	KWH/15 MIN	0.17	0.56	0.00	KWH	2414.72

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3077	1.2179	0.0253	WH/FT2	4485.279
TOTAL HOUSE	KWH/TON	0.1702	0.6735	0.0000	KWH/TON	2480.375
CENTRAL A/C	WH/FT2	0.1497	0.5108	0.0000	WH/FT2	2183.293
CENTRAL A/C	KWH/TON	0.0828	0.2825	0.0000	KWH/TON	1207.358

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.98	15.00	0.00	HR	1209.23
CENTRAL A/C CYCLES	CYC/15 MIN	0.16	2.00	0.00	CYCLES	2338.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.07	1.95	0.00	LBS	1081.42
TOTAL HOUSE GAS	CF/15 MIN	0.68	11.00	0.00	CF	9853.00
OUTDOOR TEMP.	DEG. F	79.05	106.30	50.30	--	--
INDOOR TEMP.	DEG. F	80.51	88.30	73.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 1.47	25.60	-25.15	--	--
INDOOR RH	%	48.13	73.90	31.70	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 4765 (81.4% OF TIME INTERVAL)

SITE: 3

HOUSE SQUARE FEET: 1106.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.26	1.35	0.03	KWH	1240.59
CENTRAL A/C	KWH/15 MIN	0.11	0.54	0.00	KWH	535.02

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2355	1.2179	0.0253	WH/FT2	1121.699
TOTAL HOUSE	KWH/TON	0.1302	0.6735	0.0000	KWH/TON	620.297
CENTRAL A/C	WH/FT2	0.1015	0.4846	0.0000	WH/FT2	483.772
CENTRAL A/C	KWH/TON	0.0561	0.2680	0.0000	KWH/TON	267.511

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.29	15.00	0.00	HR	261.63
CENTRAL A/C CYCLES	CYC/15 MIN	0.11	1.00	0.00	CYCLES	532.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.00	0.00	0.00	LBS	0.00
TOTAL HOUSE GAS	CF/15 MIN	0.55	11.00	0.00	CF	2634.00
OUTDOOR TEMP.	DEG. F	75.56	99.00	50.30	--	--
INDOOR TEMP.	DEG. F	80.90	88.30	73.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.33	19.40	-25.15	--	--
INDOOR RH	%	44.25	61.80	31.70	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	8/26/87 - 11/02/87
DATABASE PERIODS RECORDED:	5356 (80.9% OF TIME INTERVAL)
SITE:	4
HOUSE SQUARE FEET:	1417.00
A/C NOMINAL TONS:	3.00
NUMBER OF OCCUPANTS:	1

SITE POWER QUANTITIES

		15-MINUTE DEMAND			USAGE OVER	INTERVAL
	UNITS	AVE	MAX	MIN	UNITS	USAGE
TOTAL HOUSE	KWH/15 MIN	0.39	1.38	0.00	KWH	2064.14
CENTRAL A/C	KWH/15 MIN	0.20	1.18	0.00	KWH	1092.24

NORMALIZED SITE POWER QUANTITIES

		15-MINUTE DEMAND			USAGE OVER	INTERVAL
	UNITS	AVE	MAX	MIN	UNITS	USAGE
TOTAL HOUSE	WH/FT2	0.2721	0.9760	0.0000	WH/FT2	1456.706
TOTAL HOUSE	KWH/TON	0.1285	0.4610	0.0000	KWH/TON	688.049
CENTRAL A/C	WH/FT2	0.1439	0.8327	0.0000	WH/FT2	770.808
CENTRAL A/C	KWH/TON	0.0680	0.3933	0.0000	KWH/TON	364.080

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.93	15.00	0.00	HR	261.64
CENTRAL A/C CYCLES	CYC/15 MIN	0.24	2.00	0.00	CYCLES	1266.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.03	0.98	0.00	LBS	134.69
TOTAL HOUSE GAS	CF/15 MIN	0.51	11.00	0.00	CF	2728.00
OUTDOOR TEMP.	DEG. F	74.33	101.40	48.16	--	--
INDOOR TEMP.	DEG. F	79.22	86.10	73.10	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 4.88	22.30	-26.54	--	--
INDOOR RH	%	42.46	78.00	29.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 13886 (78.6% OF TIME INTERVAL)

SITE: 4

HOUSE SQUARE FEET: 1417.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 1

SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.41	2.87	0.01	KWH	5743.04
CENTRAL A/C	KWH/15 MIN	0.19	0.69	0.00	KWH	2642.99

NORMALIZED SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2919	2.0254	0.0083	WH/FT2	4052.953
TOTAL HOUSE	KWH/TON	0.1655	1.1480	0.0000	KWH/TON	2297.216
CENTRAL A/C	WH/FT2	0.1343	0.4869	0.0000	WH/FT2	1865.197
CENTRAL A/C	KWH/TON	0.0761	0.2790	0.0000	KWH/TON	1057.194

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.54	15.00	0.00	HR	1050.29
CENTRAL A/C CYCLES	CYC/15 MIN	0.33	2.00	0.00	CYCLES	4526.44
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.18	3.90	0.00	LBS	2525.34
TOTAL HOUSE GAS	CF/15 MIN	0.51	14.00	0.00	CF	7081.35
OUTDOOR TEMP.	DEG. F	81.30	109.80	52.41	--	--
INDOOR TEMP.	DEG. F	79.65	84.10	73.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	1.65	28.00	-22.92	--	--
INDOOR RH	%	48.09	71.30	39.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 3885 (66.3% OF TIME INTERVAL)

SITE: 4

HOUSE SQUARE FEET: 1417.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 1

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.45	2.87	0.01	KWH	1752.90
CENTRAL A/C	KWH/15 MIN	0.16	0.69	0.00	KWH	603.22

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3186	2.0254	0.0083	WH/FT2	1237.052
TOTAL HOUSE	KWH/TON	0.1806	1.1480	0.0000	KWH/TON	701.159
CENTRAL A/C	WH/FT2	0.1096	0.4864	0.0000	WH/FT2	425.693
CENTRAL A/C	KWH/TON	0.0621	0.2790	0.0000	KWH/TON	241.288

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.71	15.00	0.00	HR	240.28
CENTRAL A/C CYCLES	CYC/15 MIN	0.28	1.00	0.00	CYCLES	1095.44
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.15	0.98	0.00	LBS	591.90
TOTAL HOUSE GAS	CF/15 MIN	0.41	10.00	0.00	CF	1578.35
OUTDOOR TEMP.	DEG. F	76.98	99.70	52.41	--	--
INDOOR TEMP.	DEG. F	79.51	84.10	73.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 2.53	22.00	-22.92	--	--
INDOOR RH	%	47.09	68.50	39.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/26/87 - 11/01/87
DATABASE PERIODS RECORDED: 5245 (80.3% OF TIME INTERVAL)

SITE: 5

HOUSE SQUARE FEET: 1851.00
A/C NOMINAL TONS: 3.50
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.38	2.61	0.03	KWH	1978.45
CENTRAL A/C	KWH/15 MIN	0.18	1.32	0.00	KWH	945.17

NORMALIZED SITE POWER QUANTITIES

		15-MINUTE DEMAND				
	UNITS	AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2038	1.4100	0.0162	WH/FT2	1068.858
TOTAL HOUSE	KWH/TON	0.1078	0.7457	0.0000	KWH/TON	565.269
CENTRAL A/C	WH/FT2	0.0974	0.7131	0.0000	WH/FT2	510.627
CENTRAL A/C	KWH/TON	0.0515	0.3771	0.0000	KWH/TON	270.048

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.13	15.00	0.00	HR	186.32
CENTRAL A/C CYCLES	CYC/15 MIN	0.15	2.00	0.00	CYCLES	796.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.15	1.95	0.00	LBS	768.11
TOTAL HOUSE GAS	CF/15 MIN	0.76	23.00	0.00	CF	3978.00
OUTDOOR TEMP.	DEG. F	73.45	101.20	48.53	--	--
INDOOR TEMP.	DEG. F	81.15	88.10	75.40	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 7.70	19.70	-29.83	--	--
INDOOR RH	%	42.82	67.00	32.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 16758 (94.9% OF TIME INTERVAL)

SITE: 5

HOUSE SQUARE FEET: 1851.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.45	2.01	0.03	KWH	7463.15
CENTRAL A/C	KWH/15 MIN	0.21	0.87	0.00	KWH	3441.24

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2406	1.0854	0.0146	WH/FT2	4031.949
TOTAL HOUSE	KWH/TON	0.1484	0.6697	0.0000	KWH/TON	2487.719
CENTRAL A/C	WH/FT2	0.1109	0.4673	0.0000	WH/FT2	1859.125
CENTRAL A/C	KWH/TON	0.0684	0.2883	0.0000	KWH/TON	1147.036

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.79	15.00	0.00	HR	1057.76
CENTRAL A/C CYCLES	CYC/15 MIN	0.36	2.00	0.00	CYCLES	6017.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.12	1.95	0.00	LBS	2087.64
TOTAL HOUSE GAS	CF/15 MIN	0.58	10.00	0.00	CF	9781.00
OUTDOOR TEMP.	DEG. F	80.78	106.10	51.84	--	--
INDOOR TEMP.	DEG. F	83.09	87.70	75.60	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 2.32	22.10	-24.88	--	--
INDOOR RH	%	47.46	67.00	17.20	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 5142 (87.8% OF TIME INTERVAL)

SITE: 5

HOUSE SQUARE FEET: 1851.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.37	1.89	0.03	KWH	1888.18
CENTRAL A/C	KWH/15 MIN	0.14	0.82	0.00	KWH	740.09

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1984	1.0200	0.0146	WH/FT2	1020.088
TOTAL HOUSE	KWH/TON	0.1224	0.6293	0.0000	KWH/TON	629.393
CENTRAL A/C	WH/FT2	0.0778	0.4430	0.0000	WH/FT2	399.840
CENTRAL A/C	KWH/TON	0.0480	0.2733	0.0000	KWH/TON	246.693

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.79	15.00	0.00	HR	238.88
CENTRAL A/C CYCLES	CYC/15 MIN	0.27	2.00	0.00	CYCLES	1390.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.00	0.00	0.00	LBS	0.00
TOTAL HOUSE GAS	CF/15 MIN	0.59	10.00	0.00	CF	3022.00
OUTDOOR TEMP.	DEG. F	76.72	100.10	51.84	--	--
INDOOR TEMP.	DEG. F	82.50	87.00	75.60	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.78	16.80	-24.88	--	--
INDOOR RH	%	45.73	64.70	17.20	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/87 - 11/02/87
DATABASE PERIODS RECORDED: 5773 (88.4% OF TIME INTERVAL)

SITE: 6

HOUSE SQUARE FEET: 1722.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.25	1.70	0.01	KWH	1446.25
CENTRAL A/C	KWH/15 MIN	0.12	1.24	0.00	KWH	667.52

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1455	0.9857	0.0060	WH/FT2	839.860
TOTAL HOUSE	KWH/TON	0.0835	0.5658	0.0000	KWH/TON	482.087
CENTRAL A/C	WH/FT2	0.0671	0.7201	0.0000	WH/FT2	387.642
CENTRAL A/C	KWH/TON	0.0385	0.4133	0.0000	KWH/TON	222.507

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.71	15.00	0.00	HR	164.36
CENTRAL A/C CYCLES	CYC/15 MIN	0.12	1.00	0.00	CYCLES	717.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.11	1.95	0.00	LBS	631.47
TOTAL HOUSE GAS	CF/15 MIN	0.28	8.00	0.00	CF	1644.00
OUTDOOR TEMP.	DEG. F	73.29	97.20	49.85	--	--
INDOOR TEMP.	DEG. F	80.35	86.10	71.60	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 7.06	15.30	-23.49	--	--
INDOOR RH	%	44.78	78.00	20.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 14960 (84.7% OF TIME INTERVAL)

SITE: 6

HOUSE SQUARE FEET: 1722.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.33	2.48	0.01	KWH	4975.30
CENTRAL A/C	KWH/15 MIN	0.17	0.68	0.00	KWH	2568.06

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1932	1.4420	0.0054	WH/FT2	2889.244
TOTAL HOUSE	KWH/TON	0.1330	0.9932	0.0000	KWH/TON	1990.114
CENTRAL A/C	WH/FT2	0.0997	0.3920	0.0012	WH/FT2	1491.382
CENTRAL A/C	KWH/TON	0.0687	0.2700	0.0000	KWH/TON	1027.312

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.16	15.00	0.00	HR	1037.89
CENTRAL A/C CYCLES	CYC/15 MIN	0.10	6.00	0.00	CYCLES	1546.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.22	3.90	0.00	LBS	3223.78
TOTAL HOUSE GAS	CF/15 MIN	0.21	6.00	0.00	CF	3145.00
OUTDOOR TEMP.	DEG. F	78.87	103.80	53.76	--	--
INDOOR TEMP.	DEG. F	81.65	89.90	74.20	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 2.78	21.70	-23.95	--	--
INDOOR RH	%	51.79	84.50	18.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 4887 (83.5% OF TIME INTERVAL)

SITE: 6

HOUSE SQUARE FEET: 1722.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.28	1.28	0.01	KWH	1384.14
CENTRAL A/C	KWH/15 MIN	0.13	0.64	0.00	KWH	654.67

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1645	0.7439	0.0069	WH/FT2	803.799
TOTAL HOUSE	KWH/TON	0.1133	0.5124	0.0000	KWH/TON	553.657
CENTRAL A/C	WH/FT2	0.0778	0.3722	0.0012	WH/FT2	380.191
CENTRAL A/C	KWH/TON	0.0536	0.2564	0.0000	KWH/TON	261.880

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.25	15.00	0.00	HR	264.77
CENTRAL A/C CYCLES	CYC/15 MIN	0.16	2.00	0.00	CYCLES	802.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.15	1.95	0.00	LBS	734.93
TOTAL HOUSE GAS	CF/15 MIN	0.21	6.00	0.00	CF	1043.00
OUTDOOR TEMP.	DEG. F	75.07	98.70	53.76	--	--
INDOOR TEMP.	DEG. F	80.63	87.30	75.10	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.56	18.00	-23.95	--	--
INDOOR RH	%	49.47	76.50	33.60	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/88 - 11/02/87
DATABASE PERIODS RECORDED: 5786 (88.6 % OF TIME INTERVAL)

SITE: 7

HOUSE SQUARE FEET: 1535.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 5

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.46	2.43	0.08	KWH	2633.13
CENTRAL A/C	KWH/15 MIN	0.13	1.01	0.00	KWH	733.71

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2976	1.5831	0.0521	WH/FT2	1715.437
TOTAL HOUSE	KWH/TON	0.1827	0.9720	0.0000	KWH/TON	1053.279
CENTRAL A/C	WH/FT2	0.0826	0.6580	0.0000	WH/FT2	477.948
CENTRAL A/C	KWH/TON	0.0507	0.4040	0.0000	KWH/TON	293.472

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.30	15.00	0.00	HR	414.46
CENTRAL A/C CYCLES	CYC/15 MIN	0.10	10.00	0.00	CYCLES	571.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.15	1.95	0.00	LBS	853.02
TOTAL HOUSE GAS	CF/15 MIN	0.59	12.00	0.00	CF	3412.00
OUTDOOR TEMP.	DEG. F	73.11	97.50	47.35	--	--
INDOOR TEMP.	DEG. F	82.96	89.90	75.80	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 9.85	15.50	-30.06	--	--
INDOOR RH	%	41.98	55.00	27.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/87 - 11/02/87
DATABASE PERIODS RECORDED: 4615 (70.7% OF TIME INTERVAL)

SITE: 8

HOUSE SQUARE FEET: 1295.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 4

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.29	2.39	0.04	KWH	1338.27
CENTRAL A/C	KWH/15 MIN	0.09	1.23	0.00	KWH	401.43

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2241	1.8456	0.0309	WH/FT2	1033.412
TOTAL HOUSE	KWH/TON	0.1161	0.9560	0.0000	KWH/TON	535.314
CENTRAL A/C	WH/FT2	0.0672	0.9498	0.0000	WH/FT2	309.985
CENTRAL A/C	KWH/TON	0.0348	0.4920	0.0000	KWH/TON	160.572

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.63	15.00	0.00	HR	125.62
CENTRAL A/C CYCLES	CYC/15 MIN	0.03	2.00	0.00	CYCLES	120.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.00	2.93	0.00	LBS	9.76
TOTAL HOUSE GAS	CF/15 MIN	0.92	87.00	0.00	CF	4234.00
OUTDOOR TEMP.	DEG. F	72.47	99.20	45.07	--	--
INDOOR TEMP.	DEG. F	82.77	95.10	71.00	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	-10.29	11.60	-27.23	--	--
INDOOR RH	%	39.84	61.00	0.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 12119 (68.6% OF TIME INTERVAL)

SITE: 8

HOUSE SQUARE FEET: 1295.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 4

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.40	2.19	0.04	KWH	4828.53
CENTRAL A/C	KWH/15 MIN	0.14	0.62	0.00	KWH	1650.15

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3077	1.6910	0.0340	WH/FT2	3728.599
TOTAL HOUSE	KWH/TON	0.1992	1.0950	0.0000	KWH/TON	2414.265
CENTRAL A/C	WH/FT2	0.1052	0.4772	0.0015	WH/FT2	1274.252
CENTRAL A/C	KWH/TON	0.0681	0.3090	0.0000	KWH/TON	825.075

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.80	15.00	0.00	HR	767.97
CENTRAL A/C CYCLES	CYC/15 MIN	0.23	3.00	0.00	CYCLES	2771.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.20	1.95	0.00	LBS	2413.63
TOTAL HOUSE GAS	CF/15 MIN	0.57	8.00	0.00	CF	6886.00
OUTDOOR TEMP.	DEG. F	80.31	105.90	49.68	--	--
INDOOR TEMP.	DEG. F	81.86	95.30	70.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 1.55	24.60	-24.72	--	--
INDOOR RH	%	44.11	59.50	23.10	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 5232 (89.3% OF TIME INTERVAL)

SITE: 8

HOUSE SQUARE FEET: 1295.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 4

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.33	2.19	0.05	KWH	1728.27
CENTRAL A/C	KWH/15 MIN	0.07	0.57	0.00	KWH	347.41

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2551	1.6910	0.0363	WH/FT2	1334.574
TOTAL HOUSE	KWH/TON	0.1652	1.0950	0.0000	KWH/TON	864.137
CENTRAL A/C	WH/FT2	0.0513	0.4394	0.0015	WH/FT2	268.275
CENTRAL A/C	KWH/TON	0.0332	0.2845	0.0000	KWH/TON	173.703

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.83	15.00	0.00	HR	159.78
CENTRAL A/C CYCLES	CYC/15 MIN	0.11	1.00	0.00	CYCLES	594.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.09	1.95	0.00	LBS	490.93
TOTAL HOUSE GAS	CF/15 MIN	0.59	8.00	0.00	CF	3073.00
OUTDOOR TEMP.	DEG. F	74.50	98.10	49.68	--	--
INDOOR TEMP.	DEG. F	81.63	89.70	70.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 7.12	16.00	-24.72	--	--
INDOOR RH	%	42.58	59.10	23.10	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/87 - 11/02/87
DATABASE PERIODS RECORDED: 5228 (80.1% OF TIME INTERVAL)

SITE: 9

HOUSE SQUARE FEET: 2126.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 5

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.60	2.86	0.11	KWH	3119.46
CENTRAL A/C	KWH/15 MIN	0.23	1.09	0.00	KWH	1224.38

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2807	1.3472	0.0539	WH/FT2	1467.270
TOTAL HOUSE	KWH/TON	0.1989	0.9548	0.0000	KWH/TON	1039.806
CENTRAL A/C	WH/FT2	0.1102	0.5127	0.0000	WH/FT2	575.909
CENTRAL A/C	KWH/TON	0.0781	0.3633	0.0000	KWH/TON	408.126

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.58	15.00	0.00	HR	311.53
CENTRAL A/C CYCLES	CYC/15 MIN	0.10	1.00	0.00	CYCLES	544.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.20	2.93	0.00	LBS	1036.53
TOTAL HOUSE GAS	CF/15 MIN	1.34	36.00	0.00	CF	7017.00
OUTDOOR TEMP.	DEG. F	73.84	99.70	48.83	--	--
INDOOR TEMP.	DEG. F	80.48	88.70	73.10	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.64	18.10	-25.92	--	--
INDOOR RH	%	40.65	76.00	18.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 12976 (73.5% OF TIME INTERVAL)

SITE: 9

HOUSE SQUARE FEET: 2126.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 5

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.81	2.71	0.02	KWH	10508.18
CENTRAL A/C	KWH/15 MIN	0.24	0.95	0.00	KWH	3125.28

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3809	1.2748	0.0078	WH/FT2	4942.711
TOTAL HOUSE	KWH/TON	0.2699	0.9034	0.0000	KWH/TON	3502.736
CENTRAL A/C	WH/FT2	0.1133	0.4459	0.0000	WH/FT2	1469.995
CENTRAL A/C	KWH/TON	0.0803	0.3160	0.0000	KWH/TON	1041.750

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	5.20	15.00	0.00	HR	1124.04
CENTRAL A/C CYCLES	CYC/15 MIN	0.12	1.00	0.00	CYCLES	1499.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.30	2.93	0.00	LBS	3954.82
TOTAL HOUSE GAS	CF/15 MIN	1.26	38.00	0.00	CF	16286.00
OUTDOOR TEMP.	DEG. F	78.98	107.90	52.66	--	--
INDOOR TEMP.	DEG. F	81.49	91.20	68.72	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 2.52	24.50	-23.60	--	--
INDOOR RH	%	44.93	80.40	29.20	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 5856 (100.0% OF TIME INTERVAL)

SITE: 9

HOUSE SQUARE FEET: 2126.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 5

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.68	2.55	0.20	KWH	3963.02
CENTRAL A/C	KWH/15 MIN	0.17	0.93	0.00	KWH	976.27

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3183	1.1982	0.0958	WH/FT2	1864.078
TOTAL HOUSE	KWH/TON	0.2256	0.8491	0.0000	KWH/TON	1321.009
CENTRAL A/C	WH/FT2	0.0784	0.4351	0.0000	WH/FT2	459.176
CENTRAL A/C	KWH/TON	0.0556	0.3083	0.0000	KWH/TON	325.389

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.88	15.00	0.00	HR	281.51
CENTRAL A/C CYCLES	CYC/15 MIN	0.10	1.00	0.00	CYCLES	595.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.21	1.95	0.00	LBS	1248.31
TOTAL HOUSE GAS	CF/15 MIN	1.19	34.00	0.00	CF	6955.00
OUTDOOR TEMP.	DEG. F	76.21	98.50	52.66	--	--
INDOOR TEMP.	DEG. F	81.44	91.20	73.40	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.23	15.00	-23.60	--	--
INDOOR RH	%	43.99	76.50	29.50	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/87 - 11.02/87
DATABASE PERIODS RECORDED: 5968 (91.4% OF TIME INTERVAL)

SITE: 10

HOUSE SQUARE FEET: 1153.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 1

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.19	1.24	0.01	KWH	1154.42
CENTRAL A/C	KWH/15 MIN	0.06	0.85	0.00	KWH	387.12

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1678	1.0755	0.0087	WH/FT2	1001.212
TOTAL HOUSE	KWH/TON	0.0968	0.6200	0.0000	KWH/TON	577.211
CENTRAL A/C	WH/FT2	0.0563	0.7372	0.0000	WH/FT2	335.750
CENTRAL A/C	KWH/TON	0.0324	0.4250	0.0000	KWH/TON	193.560

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.51	15.00	0.00	HR	150.10
CENTRAL A/C CYCLES	CYC/15 MIN	0.05	2.00	0.00	CYCLES	289.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.05	0.98	0.00	LBS	269.38
TOTAL HOUSE GAS	CF/15 MIN	0.39	9.00	0.00	CF	2306.00
OUTDOOR TEMP.	DEG. F	74.30	106.20	46.21	--	--
INDOOR TEMP.	DEG. F	80.67	87.50	71.50	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.36	21.80	-27.84	--	--
INDOOR RH	%	42.86	61.00	9.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 15468 (87.6% OF TIME INTERVAL)

SITE: 10

HOUSE SQUARE FEET: 1153.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 1

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.25	2.02	0.02	KWH	3814.01
CENTRAL A/C	KWH/15 MIN	0.10	0.50	0.00	KWH	1503.68

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2149	1.7511	0.0191	WH/FT2	3307.917
TOTAL HOUSE	KWH/TON	0.1239	1.0095	0.0000	KWH/TON	1907.005
CENTRAL A/C	WH/FT2	0.0843	0.4345	0.0000	WH/FT2	1304.059
CENTRAL A/C	KWH/TON	0.0486	0.2505	0.0000	KWH/TON	751.841

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.83	15.00	0.00	HR	729.24
CENTRAL A/C CYCLES	CYC/15 MIN	0.12	2.00	0.00	CYCLES	1822.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.09	0.98	0.00	LBS	1355.66
TOTAL HOUSE GAS	CF/15 MIN	0.38	12.00	0.00	CF	5948.00
DHW GAS	CF/15 MIN	0.41	15.00	0.00	CF	6273.19
OUTDOOR TEMP.	DEG. F	80.70	111.50	50.28	--	--
INDOOR TEMP.	DEG. F	83.01	92.70	74.40	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 2.32	23.40	-24.97	--	--
INDOOR RH	%	45.68	67.40	33.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 4766 (81.4% OF TIME INTERVAL)

SITE: 10

HOUSE SQUARE FEET: 1153.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 1

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.20	1.67	0.03	KWH	957.71
CENTRAL A/C	KWH/15 MIN	0.07	0.48	0.00	KWH	319.29

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.1749	1.4501	0.0217	WH/FT2	830.623
TOTAL HOUSE	KWH/TON	0.1008	0.8360	0.0000	KWH/TON	478.856
CENTRAL A/C	WH/FT2	0.0581	0.4189	0.0000	WH/FT2	276.939
CENTRAL A/C	KWH/TON	0.0335	0.2415	0.0000	KWH/TON	159.644

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.82	15.00	0.00	HR	144.82
CENTRAL A/C CYCLES	CYC/15 MIN	0.08	1.00	0.00	CYCLES	362.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.05	0.98	0.00	LBS	243.02
TOTAL HOUSE GAS	CF/15 MIN	0.37	12.00	0.00	CF	1773.00
OUTDOOR TEMP.	DEG. F	76.76	104.10	50.28	--	--
INDOOR TEMP.	DEG. F	82.47	88.70	74.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 5.71	17.10	-24.97	--	--
INDOOR RH	%	43.41	58.20	33.30	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/28/87 - 11/02/87
DATABASE PERIODS RECORDED: 5162 (80.3% OF TIME INTERVAL)

SITE: 11

HOUSE SQUARE FEET: 1187.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.39	1.56	0.03	KWH	2015.70
CENTRAL A/C	KWH/15 MIN	0.17	0.95	0.00	KWH	900.15

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3293	1.3142	0.0253	WH/FT2	1698.104
TOTAL HOUSE	KWH/TON	0.1564	0.6240	0.0000	KWH/TON	806.288
CENTRAL A/C	WH/FT2	0.1469	0.8003	0.0000	WH/FT2	758.338
CENTRAL A/C	KWH/TON	0.0698	0.3800	0.0000	KWH/TON	360.060

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.05	15.00	0.00	HR	262.13
CENTRAL A/C CYCLES	CYC/15 MIN	0.27	2.00	0.00	CYCLES	1374.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.04	1.95	0.00	LBS	184.46
TOTAL HOUSE GAS	CF/15 MIN	1.33	13.00	0.00	CF	6885.00
OUTDOOR TEMP.	DEG. F	73.10	99.00	47.22	--	--
INDOOR TEMP.	DEG. F	79.45	89.00	72.20	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.35	19.20	-28.10	--	--
INDOOR RH	%	45.52	65.00	31.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 12720 (72.0% OF TIME INTERVAL)

SITE: 11

HOUSE SQUARE FEET: 1187.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.47	1.31	0.03	KWH	5979.55
CENTRAL A/C	KWH/15 MIN	0.20	0.55	0.00	KWH	2574.91

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3970	1.1019	0.0278	WH/FT2	5037.542
TOTAL HOUSE	KWH/TON	0.2356	0.6540	0.0000	KWH/TON	2989.775
CENTRAL A/C	WH/FT2	0.1706	0.4650	0.0000	WH/FT2	2169.234
CENTRAL A/C	KWH/TON	0.1012	0.2760	0.0000	KWH/TON	1287.453

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	6.34	15.00	0.00	HR	1343.50
CENTRAL A/C CYCLES	CYC/15 MIN	0.40	2.00	0.00	CYCLES	5150.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.25	1.95	0.00	LBS	3214.02
TOTAL HOUSE GAS	CF/15 MIN	1.30	12.00	0.00	CF	1649[illegible].00
OUTDOOR TEMP.	DEG. F	80.38	108.10	47.99	--	--
INDOOR TEMP.	DEG. F	79.04	92.70	74.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	1.34	26.60	-27.71	--	--
INDOOR RH	%	48.59	65.00	39.40	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 5156 (88.0% OF TIME INTERVAL)

SITE: 11

HOUSE SQUARE FEET: 1187.00
A/C NOMINAL TONS: 2.00
NUMBER OF OCCUPANTS: 3

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.42	1.20	0.04	KWH	2144.22
CENTRAL A/C	KWH/15 MIN	0.15	0.52	0.00	KWH	786.82

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3512	1.0101	0.0362	WH/FT2	1806.413
TOTAL HOUSE	KWH/TON	0.2085	0.5995	0.0000	KWH/TON	1072.109
CENTRAL A/C	WH/FT2	0.1286	0.4423	0.0000	WH/FT2	662.877
CENTRAL A/C	KWH/TON	0.0763	0.2625	0.0000	KWH/TON	393.409

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.81	15.00	0.00	HR	413.37
CENTRAL A/C CYCLES	CYC/15 MIN	0.38	2.00	0.00	CYCLES	1974.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.21	1.95	0.00	LBS	1080.44
TOTAL HOUSE GAS	CF/15 MIN	1.33	12.00	0.00	CF	6854.00
OUTDOOR TEMP.	DEG. F	74.68	99.20	47.99	--	--
INDOOR TEMP.	DEG. F	78.72	85.60	74.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 4.04	20.10	-27.71	--	--
INDOOR RH	%	47.36	60.40	39.40	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	8/26/87 - 11/02/87
DATABASE PERIODS RECORDED:	5619 (84.8% OF TIME INTERVAL)
SITE:	12
HOUSE SQUARE FEET:	1441.00
A/C NOMINAL TONS:	3.00
NUMBER OF OCCUPANTS:	6

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.54	1.56	0.00	KWH	3031.53
CENTRAL A/C	KWH/15 MIN	0.32	1.26	0.00	KWH	1780.88

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3749	1.0859	0.0000	WH/FT2	2103.776
TOTAL HOUSE	KWH/TON	0.1801	0.5216	0.0000	KWH/TON	1010.529
CENTRAL A/C	WH/FT2	0.2200	0.8744	0.0000	WH/FT2	1235.862
CENTRAL A/C	KWH/TON	0.1057	0.4200	0.0000	KWH/TON	593.626

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	4.68	15.00	0.00	HR	438.22
CENTRAL A/C CYCLES	CYC/15 MIN	0.01	2.00	0.00	CYCLES	43.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.29	1.95	0.00	LBS	1611.36
TOTAL HOUSE GAS	CF/15 MIN	0.76	12.00	0.00	CF	4282.00
OUTDOOR TEMP.	DEG. F	73.46	99.20	48.40	--	--
INDOOR TEMP.	DEG. F	81.23	90.10	71.80	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 7.77	13.40	-28.07	--	--
INDOOR RH	%	33.96	77.00	19.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/27/87 - 11/02/87
DATABASE PERIODS RECORDED: 5956 (91.2% OF TIME INTERVAL)

SITE: 13

HOUSE SQUARE FEET: 1419.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.34	2.06	0.02	KWH	2045.85
CENTRAL A/C	KWH/15 MIN	0.15	0.95	0.00	KWH	922.78

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2421	1.4517	0.0141	WH/FT2	1441.736
TOTAL HOUSE	KWH/TON	0.1145	0.6867	0.0000	KWH/TON	681.939
CENTRAL A/C	WH/FT2	0.1092	0.6695	0.0000	WH/FT2	650.303
CENTRAL A/C	KWH/TON	0.0517	0.3167	0.0000	KWH/TON	307.593

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.68	15.00	0.00	HR	265.56
CENTRAL A/C CYCLES	CYC/15 MIN	0.31	6.00	0.00	CYCLES	1823.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.18	1.95	0.00	LBS	1043.35
TOTAL HOUSE GAS	CF/15 MIN	0.52	121.00	0.00	CF	3114.00
OUTDOOR TEMP.	DEG. F	73.25	98.70	47.46	--	--
INDOOR TEMP.	DEG. F	79.82	84.60	58.02	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.57	16.30	-26.63	--	--
INDOOR RH	%	41.06	60.00	28.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL:	5/01/88 - 10/31/88
DATABASE PERIODS RECORDED:	13513 (76.5% OF TIME INTERVAL)
SITE:	13
HOUSE SQUARE FEET:	1419.00
A/C NOMINAL TONS:	2.50
NUMBER OF OCCUPANTS:	2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.43	1.93	0.02	KWH	5771.34
CENTRAL A/C	KWH/15 MIN	0.17	0.78	0.00	KWH	2357.32

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3012	1.3587	0.0141	WH/FT2	4067.166
TOTAL HOUSE	KWH/TON	0.1710	0.7712	0.0000	KWH/TON	2308.519
CENTRAL A/C	WH/FT2	0.1230	0.5504	0.0000	WH/FT2	1661.113
CENTRAL A/C	KWH/TON	0.0698	0.3124	0.0000	KWH/TON	942.900

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	3.73	15.00	0.00	HR	838.61
CENTRAL A/C CYCLES	CYC/15 MIN	0.20	2.00	0.00	CYCLES	2673.48
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.19	4.88	0.00	LBS	2588.73
TOTAL HOUSE GAS	CF/15 MIN	0.43	9.00	0.00	CF	5807.28
OUTDOOR TEMP.	DEG. F	79.24	105.90	51.79	--	--
INDOOR TEMP.	DEG. F	82.94	90.50	73.90	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 3.70	19.40	-23.91	--	--
INDOOR RH	%	41.80	62.20	30.90	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 4266 (72.8% OF TIME INTERVAL)

SITE: 13

HOUSE SQUARE FEET: 1419.00
A/C NOMINAL TONS: 2.50
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.43	1.87	0.02	KWH	1813.72
CENTRAL A/C	KWH/15 MIN	0.13	0.71	0.00	KWH	537.45

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3005	1.3150	0.0141	WH/FT2	1278.171
TOTAL HOUSE	KWH/TON	0.1705	0.7464	0.0000	KWH/TON	725.487
CENTRAL A/C	WH/FT2	0.0890	0.5032	0.0000	WH/FT2	378.766
CENTRAL A/C	KWH/TON	0.0505	0.2856	0.0000	KWH/TON	214.978

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.67	15.00	0.00	HR	189.66
CENTRAL A/C CYCLES	CYC/15 MIN	0.17	2.00	0.00	CYCLES	725.48
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.14	1.95	0.00	LBS	617.21
TOTAL HOUSE GAS	CF/15 MIN	0.43	9.00	0.00	CF	1833.28
OUTDOOR TEMP.	DEG. F	75.84	99.30	51.79	--	--
INDOOR TEMP.	DEG. F	81.90	88.40	74.30	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 6.06	15.20	-23.91	--	--
INDOOR RH	%	41.49	53.00	30.90	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 8/30/87 - 11/02/87
DATABASE PERIODS RECORDED: 5381 (86.2% OF TIME INTERVAL)

SITE: 14

HOUSE SQUARE FEET: 1970.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.43	3.31	0.01	KWH	2314.64
CENTRAL A/C	KWH/15 MIN	0.08	0.96	0.01	KWH	425.77

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2194	1.6802	0.0051	WH/FT2	1174.960
TOTAL HOUSE	KWH/TON	0.1441	1.1033	0.0000	KWH/TON	771.544
CENTRAL A/C	WH/FT2	0.0402	0.4873	0.0051	WH/FT2	216.127
CENTRAL A/C	KWH/TON	0.0264	0.3200	0.0000	KWH/TON	141.891

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	1.17	15.00	0.00	HR	104.53
CENTRAL A/C CYCLES	CYC/15 MIN	0.04	3.00	0.00	CYCLES	239.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.09	1.95	0.00	LBS	464.58
TOTAL HOUSE GAS	CF/15 MIN	1.00	21.00	0.00	CF	5390.00
OUTDOOR TEMP.	DEG. F	73.30	108.40	47.21	--	--
INDOOR TEMP.	DEG. F	--	--	--	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	--	--	--	--	--
INDOOR RH	%	63.53	84.00	37.00	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 5/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 16048 (90.9% OF TIME INTERVAL)

SITE: 14

HOUSE SQUARE FEET: 1970.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.65	2.93	0.03	KWH	10416.65
CENTRAL A/C	KWH/15 MIN	0.26	0.87	0.01	KWH	4238.22

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.3307	1.4875	0.0147	WH/FT2	5287.648
TOTAL HOUSE	KWH/TON	0.2172	0.9767	0.0000	KWH/TON	3472.234
CENTRAL A/C	WH/FT2	0.1342	0.4422	0.0041	WH/FT2	2151.549
CENTRAL A/C	KWH/TON	0.0882	0.2903	0.0000	KWH/TON	1412.855

OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	5.05	15.00	0.00	HR	1350.47
CENTRAL A/C CYCLES	CYC/15 MIN	0.15	2.00	0.00	CYCLES	2359.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.28	2.93	0.00	LBS	4507.31
TOTAL HOUSE GAS	CF/15 MIN	0.47	15.00	0.00	CF	7532.00
OUTDOOR TEMP.	DEG. F	80.69	119.20	50.55	--	--
INDOOR TEMP.	DEG. F	79.24	87.10	70.50	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	1.44	37.30	-21.63	--	--
INDOOR RH	%	61.53	83.70	43.20	--	--

AUSTIN OPERATIONAL SUMMARY

MONITORED INTERVAL: 9/01/88 - 10/31/88
DATABASE PERIODS RECORDED: 5134 (87.7% OF TIME INTERVAL)

SITE: 14

HOUSE SQUARE FEET: 1970.00
A/C NOMINAL TONS: 3.00
NUMBER OF OCCUPANTS: 2

SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	KWH/15 MIN	0.45	2.93	0.03	KWH	2298.90
CENTRAL A/C	KWH/15 MIN	0.14	0.87	0.01	KWH	725.34

NORMALIZED SITE POWER QUANTITIES

	UNITS	15-MINUTE DEMAND AVE	MAX	MIN	USAGE OVER UNITS	INTERVAL USAGE
TOTAL HOUSE	WH/FT2	0.2284	1.4875	0.0147	WH/FT2	1166.957
TOTAL HOUSE	KWH/TON	0.1500	0.9767	0.0000	KWH/TON	766.302
CENTRAL A/C	WH/FT2	0.0719	0.4422	0.0041	WH/FT2	368.188
CENTRAL A/C	KWH/TON	0.0472	0.2903	0.0000	KWH/TON	241.800

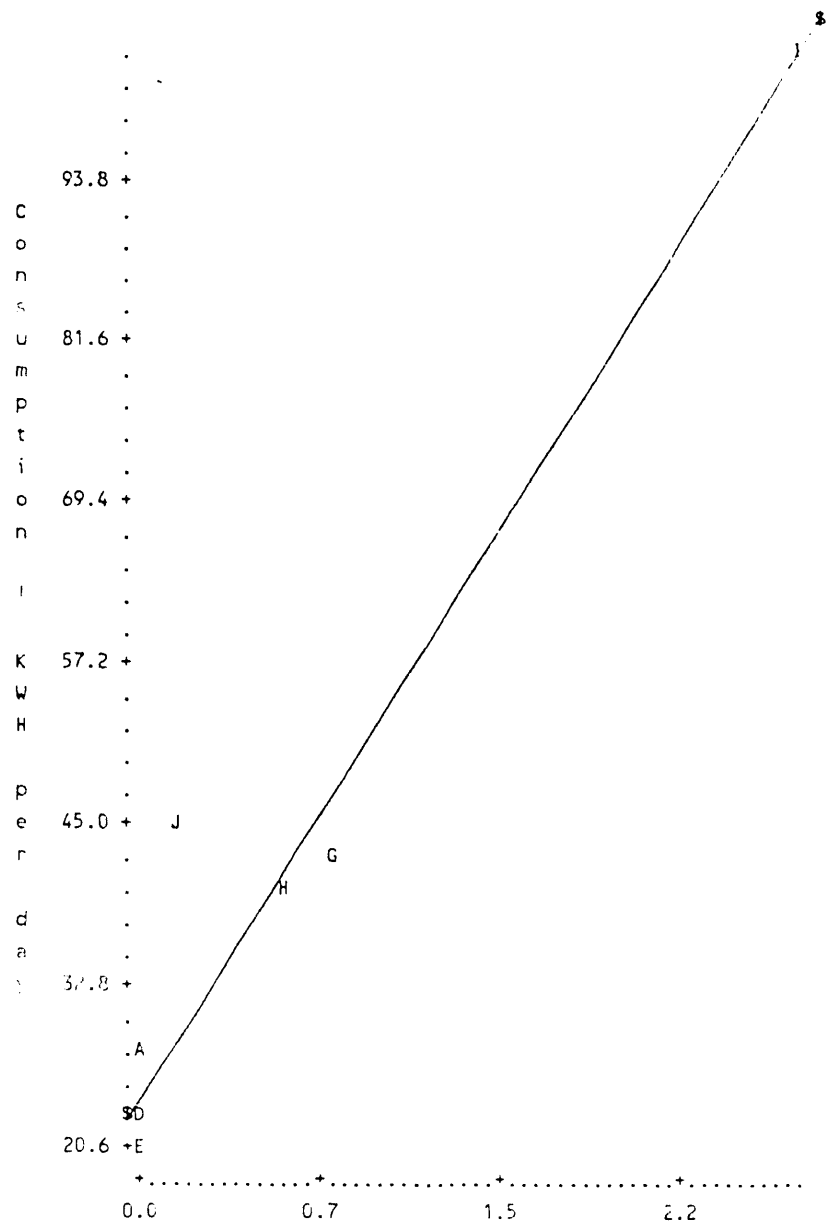
OTHER SITE DATA

	UNITS	AVE	MAX	MIN	UNITS	TOTAL
CENTRAL A/C RUNTIME	15 MIN	2.47	15.00	0.00	HR	211.56
CENTRAL A/C CYCLES	CYC/15 MIN	0.10	1.00	0.00	CYCLES	522.00
CENTRAL A/C CONDENSATE	LBS/15 MIN	0.14	1.95	0.00	LBS	721.27
TOTAL HOUSE GAS	CF/15 MIN	0.41	13.00	0.00	CF	2116.00
DHW GAS	CF/15 MIN	0.27	15.00	0.00	CF	1405.00
OUTDOOR TEMP.	DEG. F	75.50	106.60	50.55	--	--
INDOOR TEMP.	DEG. F	78.81	85.00	70.50	--	--
OUTDOOR MINUS INDOOR TEMP.	DEG. F	- 3.31	27.60	-21.63	--	--
INDOOR RH	%	62.55	82.20	50.80	--	--

APPENDIX C

PRISM REGRESSION PLOTS

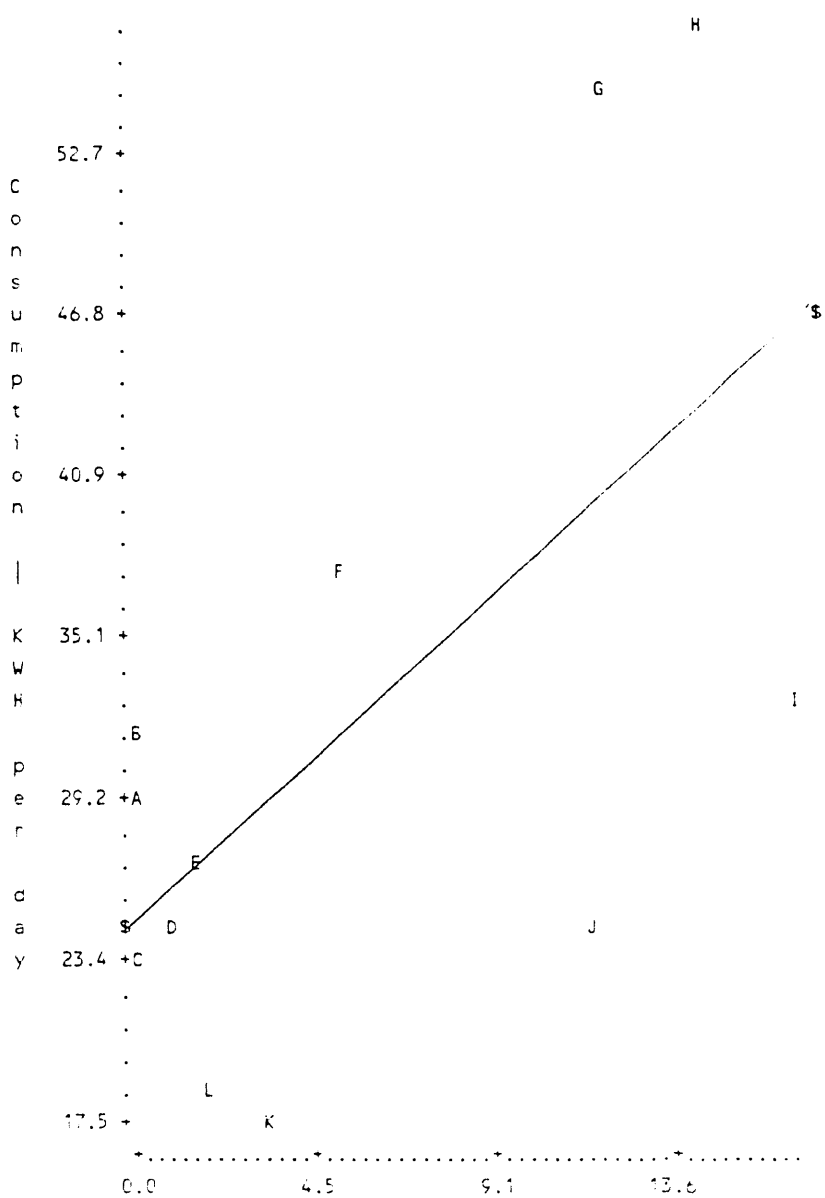
House:H101 PRE ,alpha= 25.23,beta= 28.53,R2= 0.9444



PERIODS:

A	DEC	8,1986	to JAN	7,1987
	JAN	8,1987	to FEB	8,1987
	FEB	9,1987	to MAR	8,1987
D	MAR	9,1987	to APR	6,1987
E	APR	7,1987	to MAY	5,1987
	MAY	6,1987	to JUN	4,1987
G	JUN	5,1987	to JUL	6,1987
H	JUL	7,1987	to AUG	4,1987
I	AUG	5,1987	to SEP	2,1987
J	SEP	3,1987	to OCT	4,1987
	OCT	5,1987	to NOV	2,1987
	NOV	3,1987	to DEC	6,1987

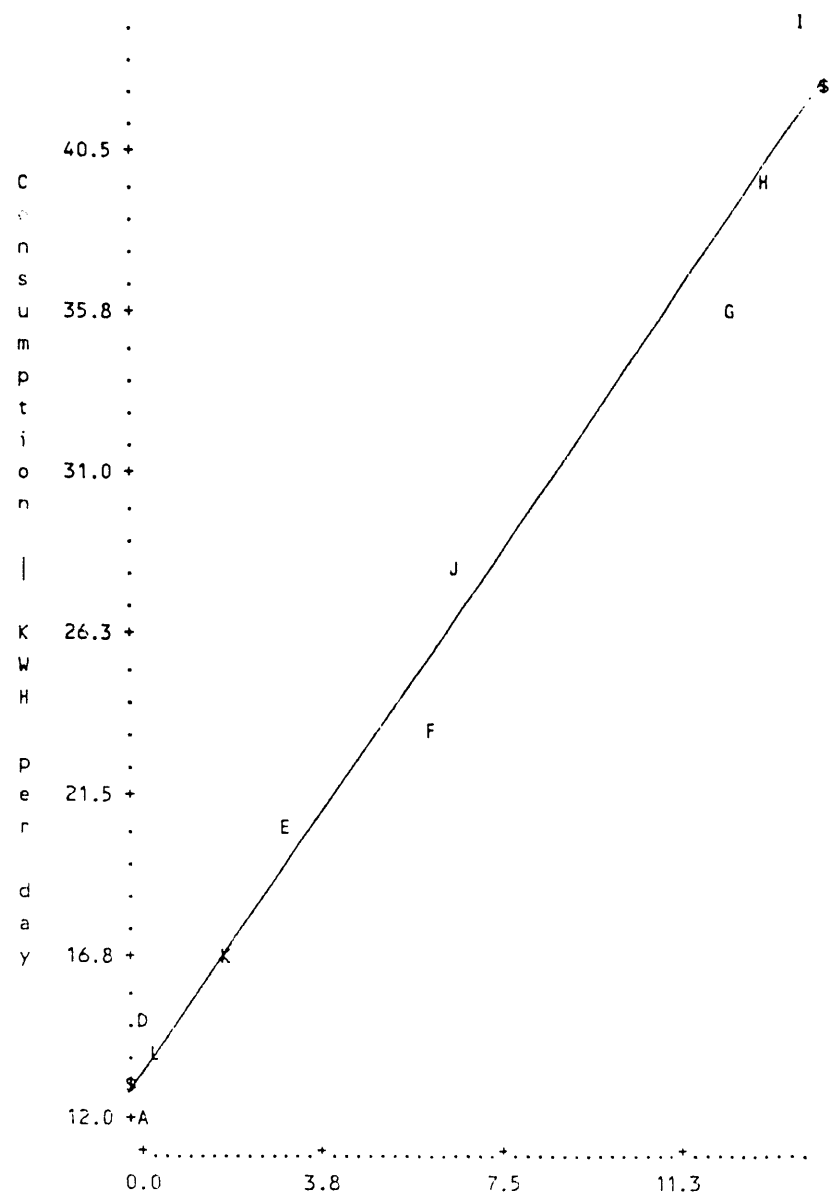
House:H101 POST ,alpha= 24.72,beta= 1.26,R2= 0.3731



PERIODS:

A	DEC	7,1987	to	JAN	6,1988
B	JAN	7,1988	to	FEB	7,1988
C	FEB	8,1988	to	MAR	7,1988
D	MAR	8,1988	to	APR	5,1988
E	APR	6,1988	to	MAY	4,1988
F	MAY	5,1988	to	JUN	5,1988
G	JUN	6,1988	to	JUL	5,1988
H	JUL	6,1988	to	AUG	3,1988
I	AUG	4,1988	to	SEP	1,1988
J	SEP	2,1988	to	OCT	3,1988
K	OCT	4,1988	to	NOV	1,1988
L	NOV	2,1988	to	DEC	4,1988

House:H102 PRE ,alpha= 13.00,beta= 2.08,R2= 0.9801

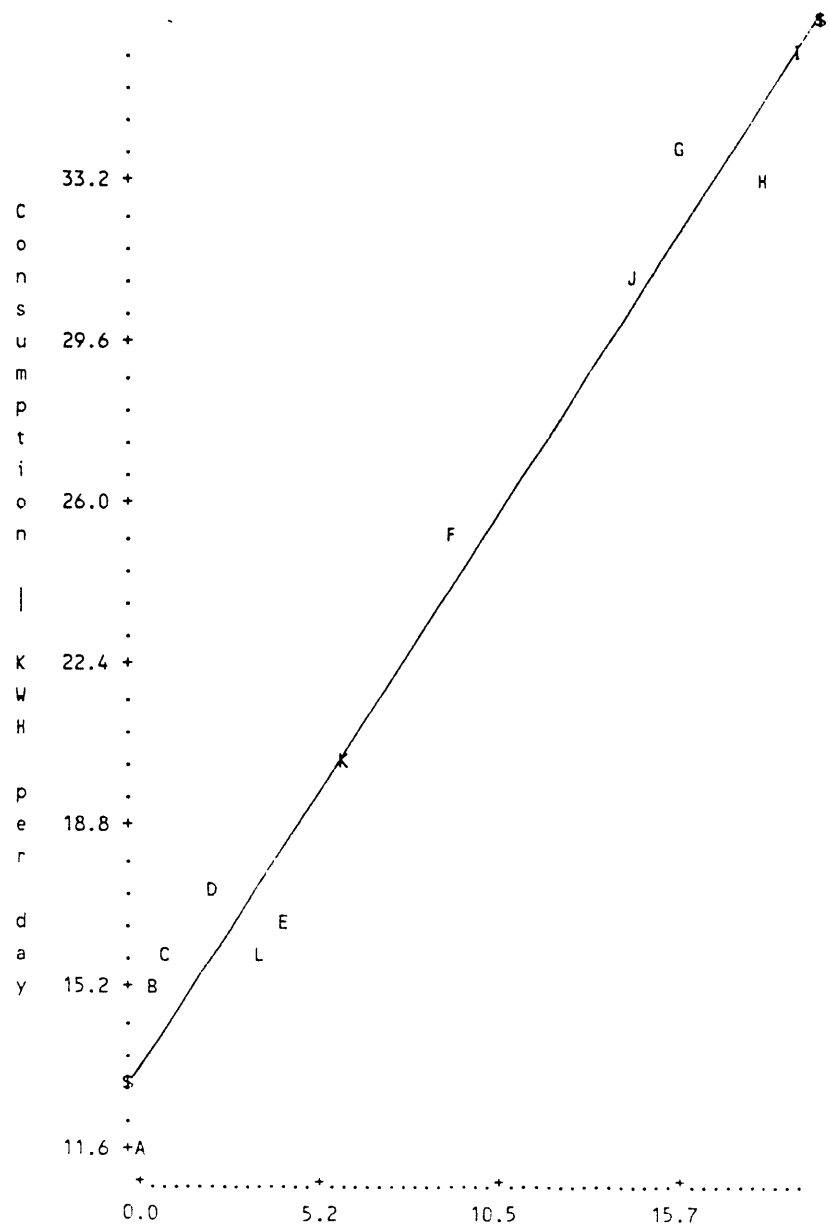


Cooling degree-days per day, base tau = 70.6

PERIODS:

A	DEC	10,1986	to JAN	11,1987
	JAN	12,1987	to FEB	10,1987
	FEB	11,1987	to MAR	10,1987
D	MAR	11,1987	to APR	8,1987
E	APR	9,1987	to MAY	7,1987
F	MAY	8,1987	to JUN	8,1987
G	JUN	9,1987	to JUL	8,1987
H	JUL	9,1987	to AUG	6,1987
I	AUG	7,1987	to SEP	7,1987
J	SEP	8,1987	to OCT	6,1987
K	OCT	7,1987	to NOV	4,1987
L	NOV	5,1987	to DEC	8,1987

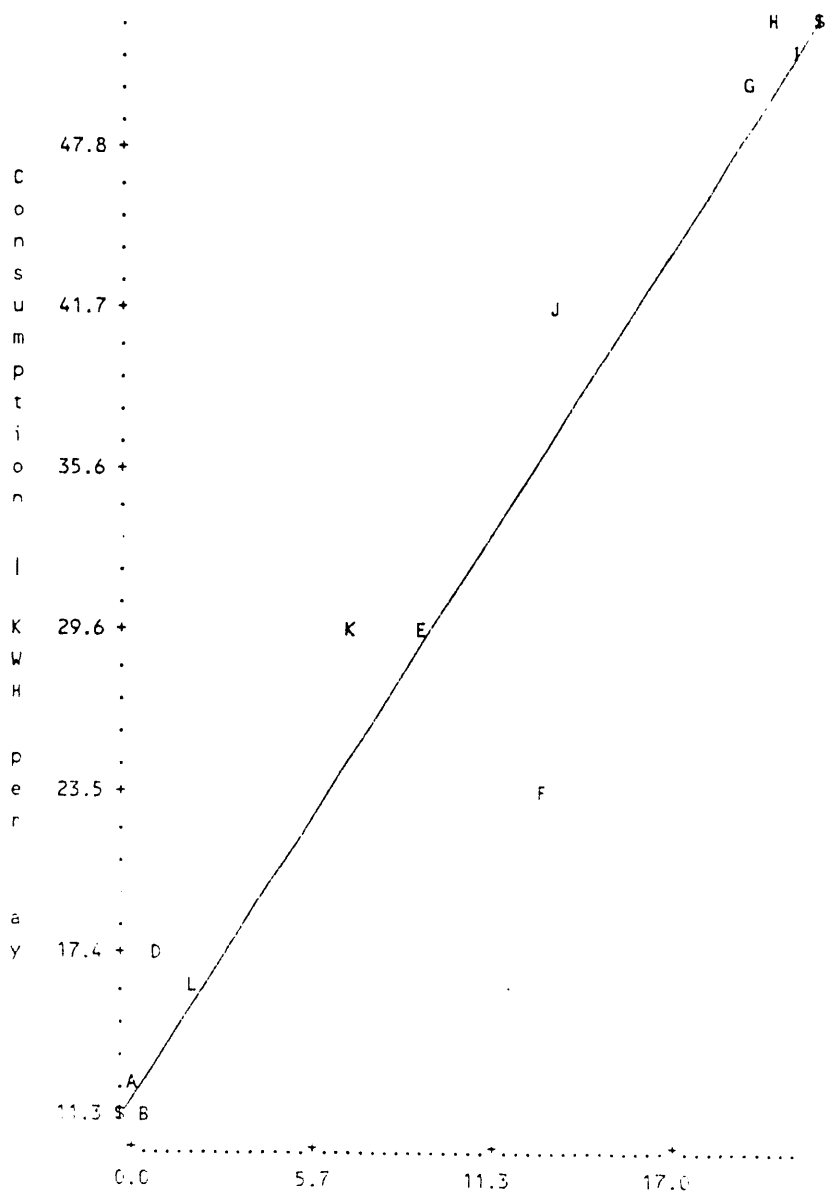
House:H102 POST ,alpha= 13.46,beta= 1.18,R2= 0.9668



PERIODS:

A	DEC	9,1987	to JAN	10,1988
B	JAN	11,1988	to FEB	9,1988
C	FEB	10,1988	to MAR	9,1988
D	MAR	10,1988	to APR	7,1988
E	APR	8,1988	to MAY	8,1988
F	MAY	9,1988	to JUN	7,1988
G	JUN	8,1988	to JUL	7,1988
H	JUL	8,1988	to AUG	7,1988
I	AUG	8,1988	to SEP	6,1988
J	SEP	7,1988	to OCT	5,1988
K	OCT	6,1988	to NOV	3,1988
L	NOV	4,1988	to DEC	6,1988

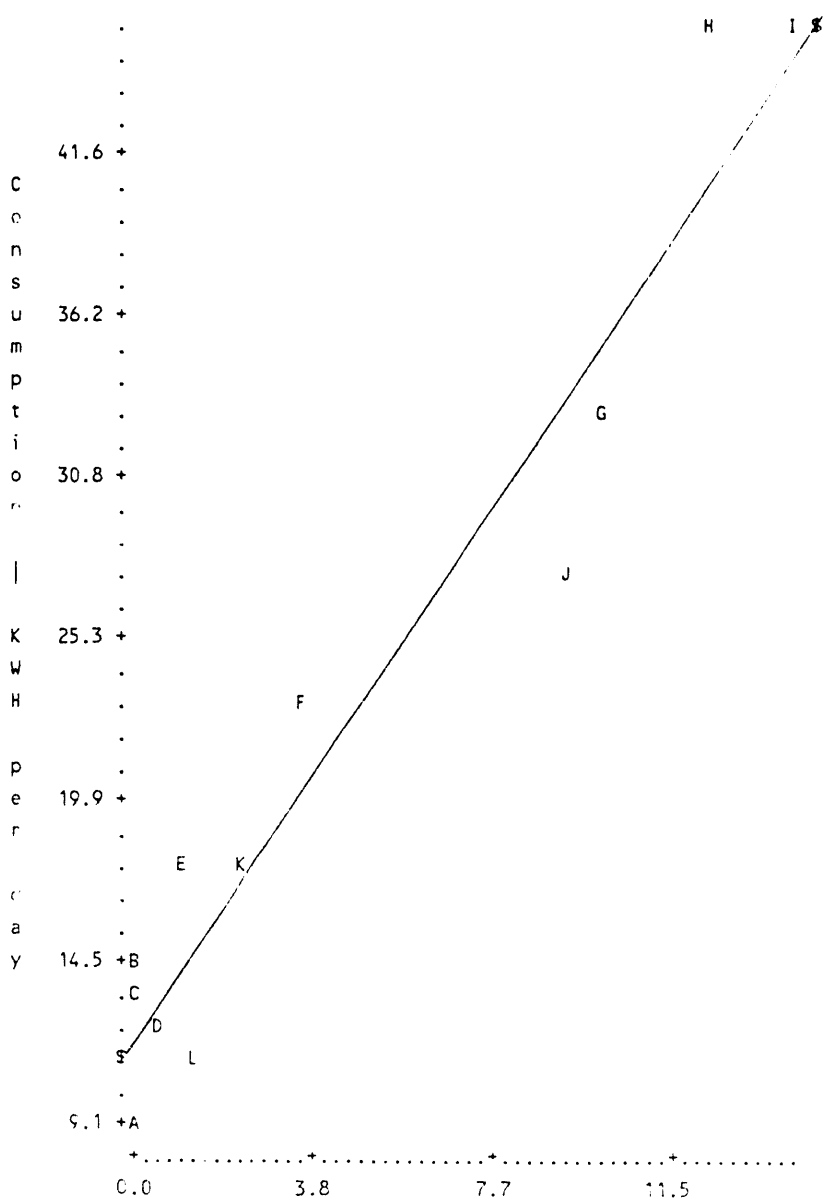
House:H103 PRE ,alpha= 12.38,beta= 1.88,R2= 0.9151



PERIODS:

A	DEC	10,1986	to	JAN	11,1987
B	JAN	12,1987	to	FEB	10,1987
	FEB	11,1987	to	MAR	10,1987
D	MAR	11,1987	to	APR	8,1987
E	APR	9,1987	to	MAY	7,1987
F	MAY	8,1987	to	JUN	8,1987
G	JUN	9,1987	to	JUL	8,1987
H	JUL	9,1987	to	AUG	6,1987
I	AUG	7,1987	to	SEP	7,1987
J	SEP	8,1987	to	OCT	6,1987
K	OCT	7,1987	to	NOV	4,1987
L	NOV	5,1987	to	DEC	8,1987

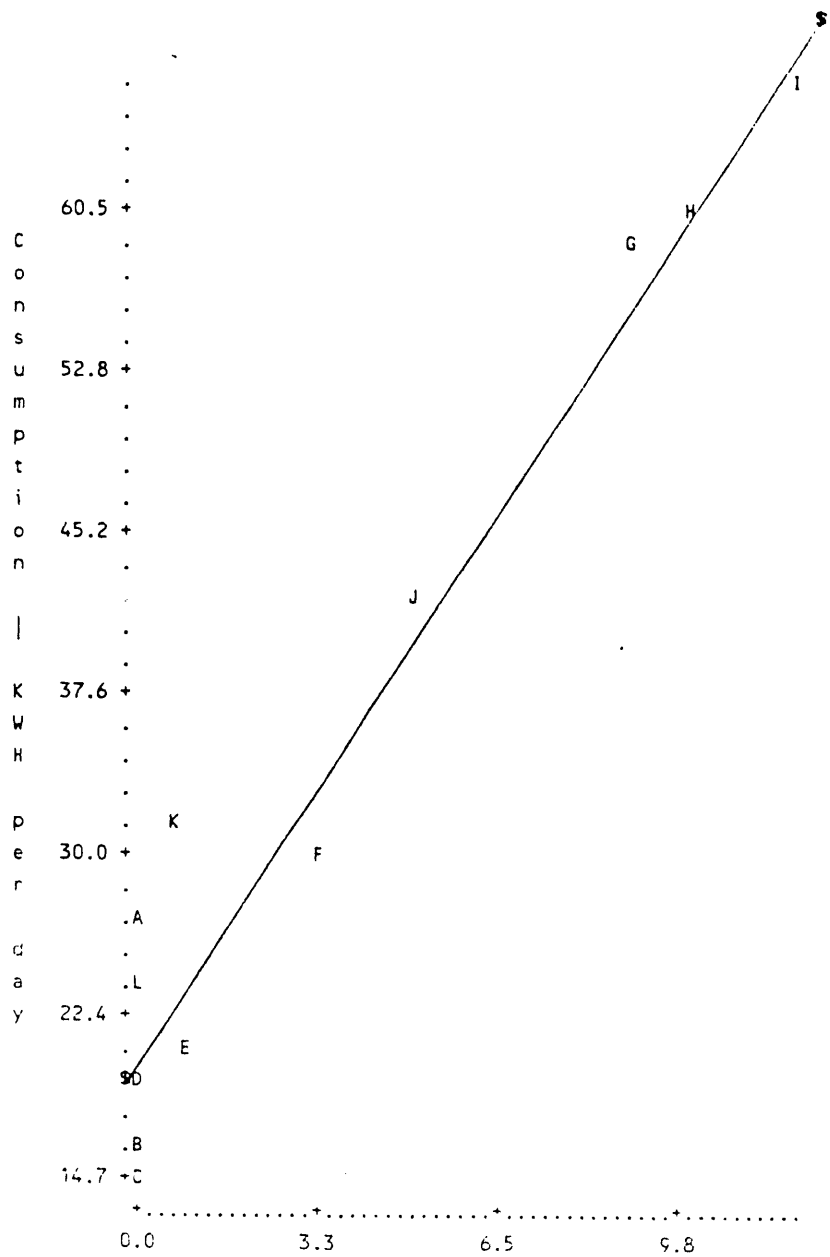
House:H103 POST ,alpha= 12.10,beta= 2.35,R2= 0.9363



PERIODS:

A	DEC	9,1987	to JAN	7,1988
B	JAN	8,1988	to FEB	8,1988
C	FEB	9,1988	to MAR	8,1988
D	MAR	9,1988	to APR	6,1988
E	APR	7,1988	to MAY	5,1988
F	MAY	6,1988	to JUN	6,1988
G	JUN	7,1988	to JUL	6,1988
H	JUL	7,1988	to AUG	4,1988
I	AUG	5,1988	to SEP	5,1988
J	SEP	6,1988	to OCT	4,1988
K	OCT	5,1988	to NOV	2,1988
L	NOV	3,1988	to DEC	5,1988

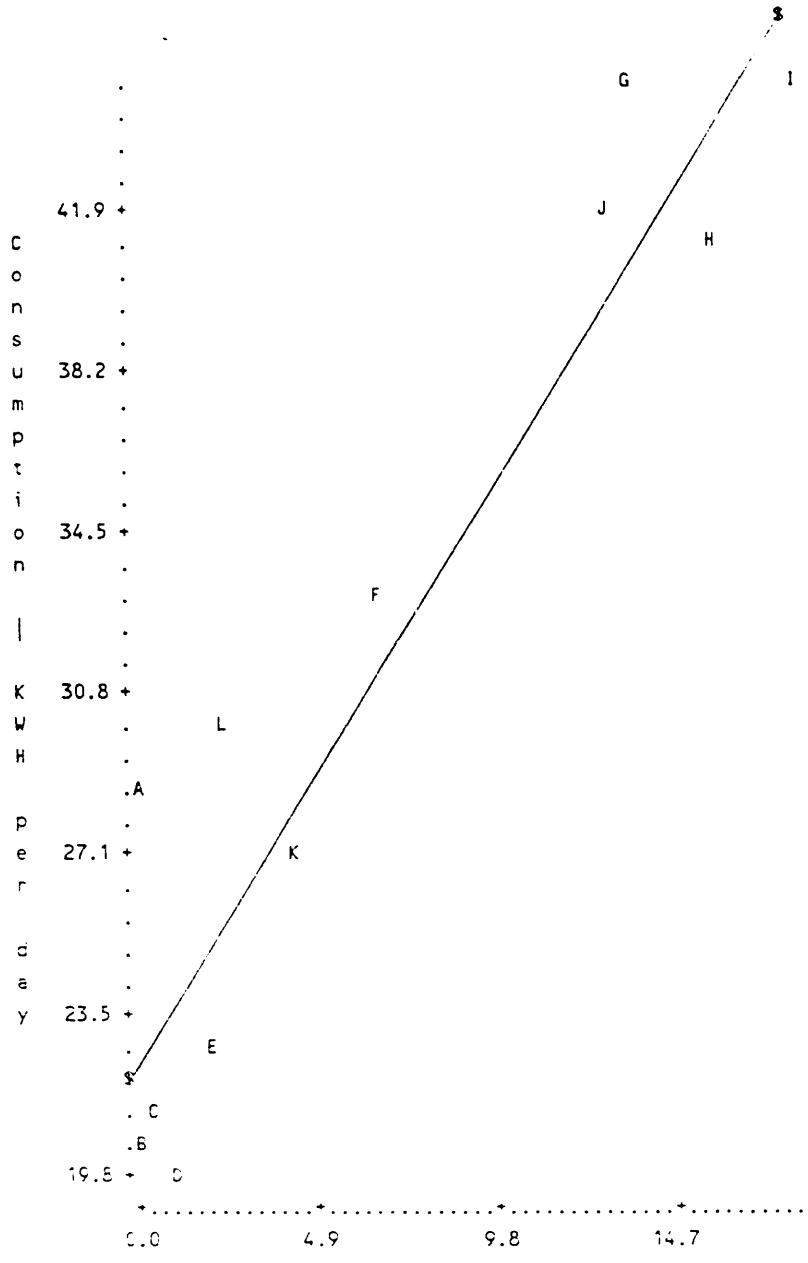
House:H104 PRE ,alpha= 20.57,beta= 3.98,R2= 0.9470



PERIODS:

A	DEC	8,1986	to JAN	7,1987
B	JAN	8,1987	to FEB	8,1987
C	FEB	9,1987	to MAR	8,1987
D	MAR	9,1987	to APR	6,1987
E	APR	7,1987	to MAY	5,1987
F	MAY	6,1987	to JUN	4,1987
G	JUN	5,1987	to JUL	6,1987
H	JUL	7,1987	to AUG	4,1987
I	AUG	5,1987	to SEP	2,1987
J	SEP	3,1987	to OCT	4,1987
K	OCT	5,1987	to NOV	2,1987
L	NOV	3,1987	to DEC	6,1987

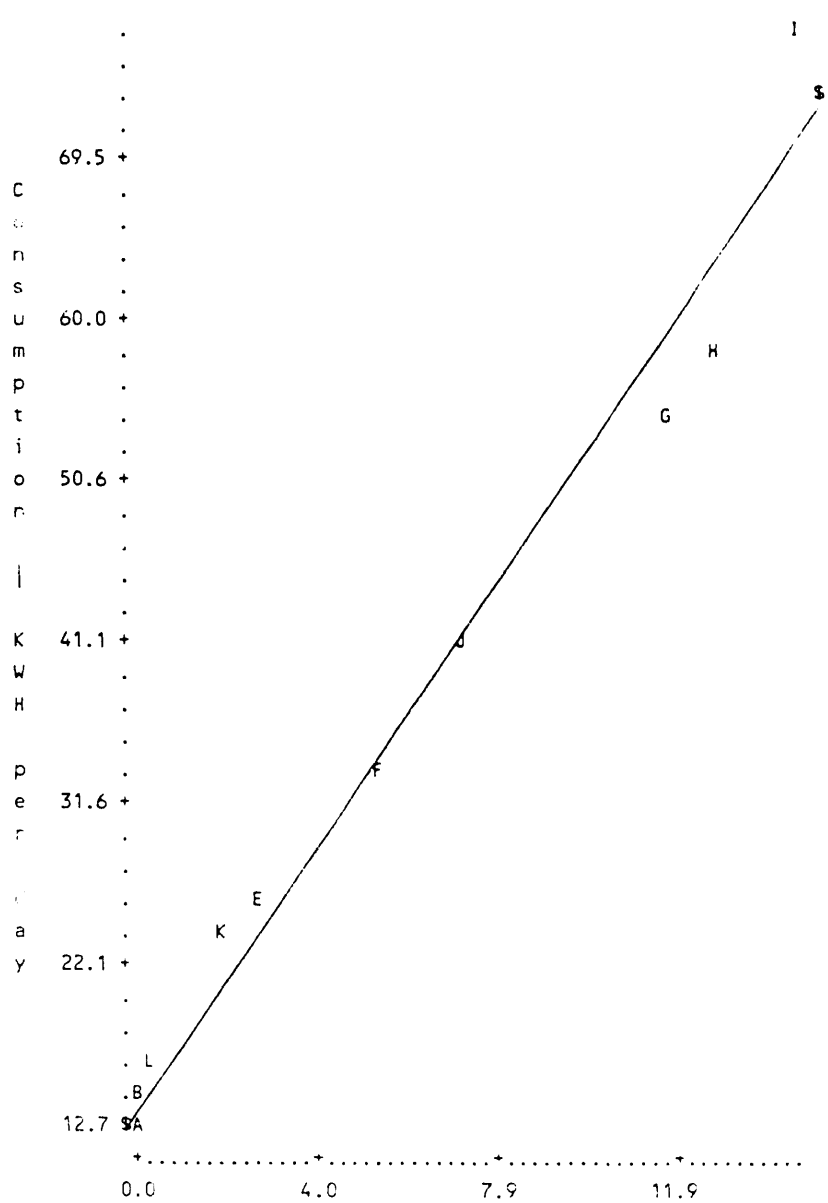
House:H104 POST ,alpha= 22.70,beta= 1.35,R2= 0.8829



PERIODS:

A	DEC	7,1987	to JAN	6,1988
B	JAN	7,1988	to FEB	7,1988
C	FEB	8,1988	to MAR	7,1988
D	MAR	8,1988	to APR	5,1988
E	APR	6,1988	to MAY	4,1988
F	MAY	5,1988	to JUN	5,1988
G	JUN	6,1988	to JUL	5,1988
H	JUL	6,1988	to AUG	3,1988
I	AUG	4,1988	to SEP	1,1988
J	SEP	2,1988	to OCT	3,1988
K	OCT	4,1988	to NOV	1,1988
L	NOV	2,1988	to DEC	4,1988

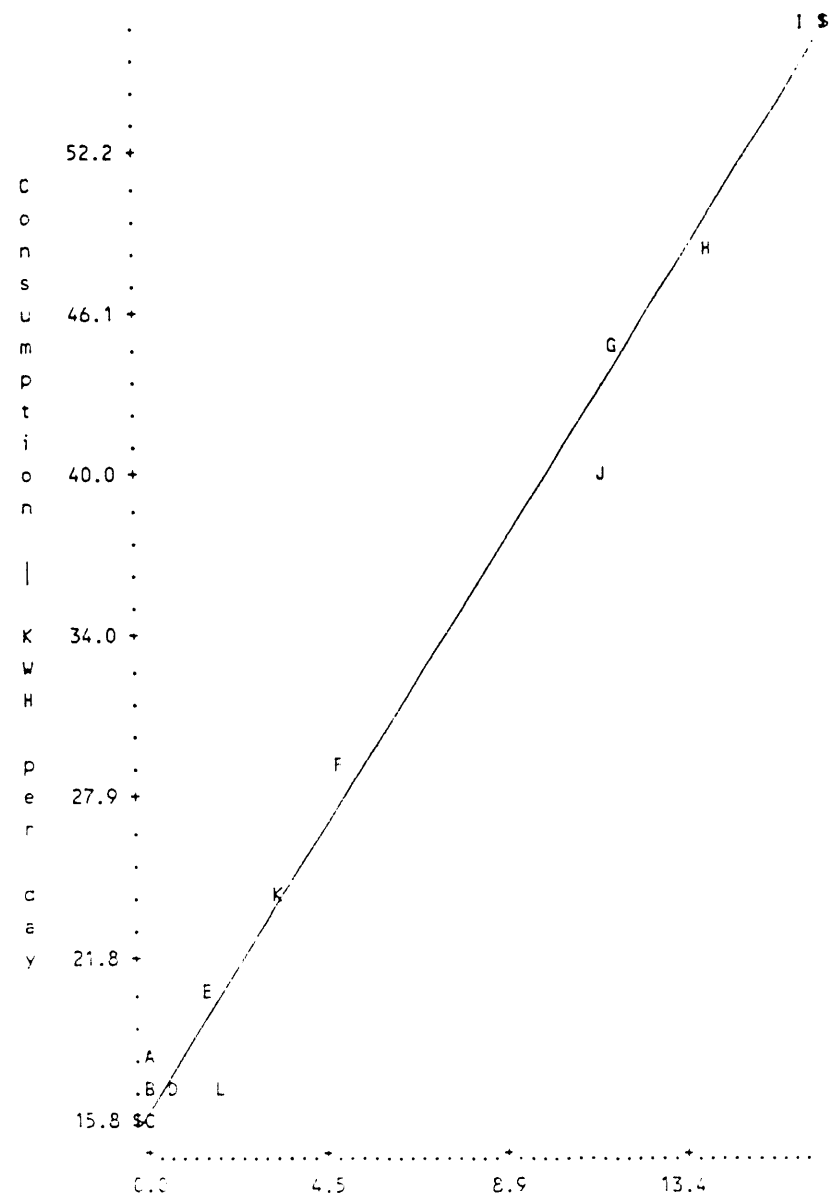
House:H105 PRE ,alpha= 14.23,beta= 3.88,R2= 0.9814



PERIODS:

A	DEC	8,1986	to	JAN	7,1987
B	JAN	8,1987	to	FEB	8,1987
	FEB	9,1987	to	MAR	8,1987
	MAR	9,1987	to	APR	6,1987
E	APR	7,1987	to	MAY	5,1987
F	MAY	6,1987	to	JUN	4,1987
G	JUN	5,1987	to	JUL	6,1987
H	JUL	7,1987	to	AUG	4,1987
I	AUG	5,1987	to	SEP	2,1987
J	SEP	3,1987	to	OCT	4,1987
K	OCT	5,1987	to	NOV	2,1987
L	NOV	3,1987	to	DEC	6,1987

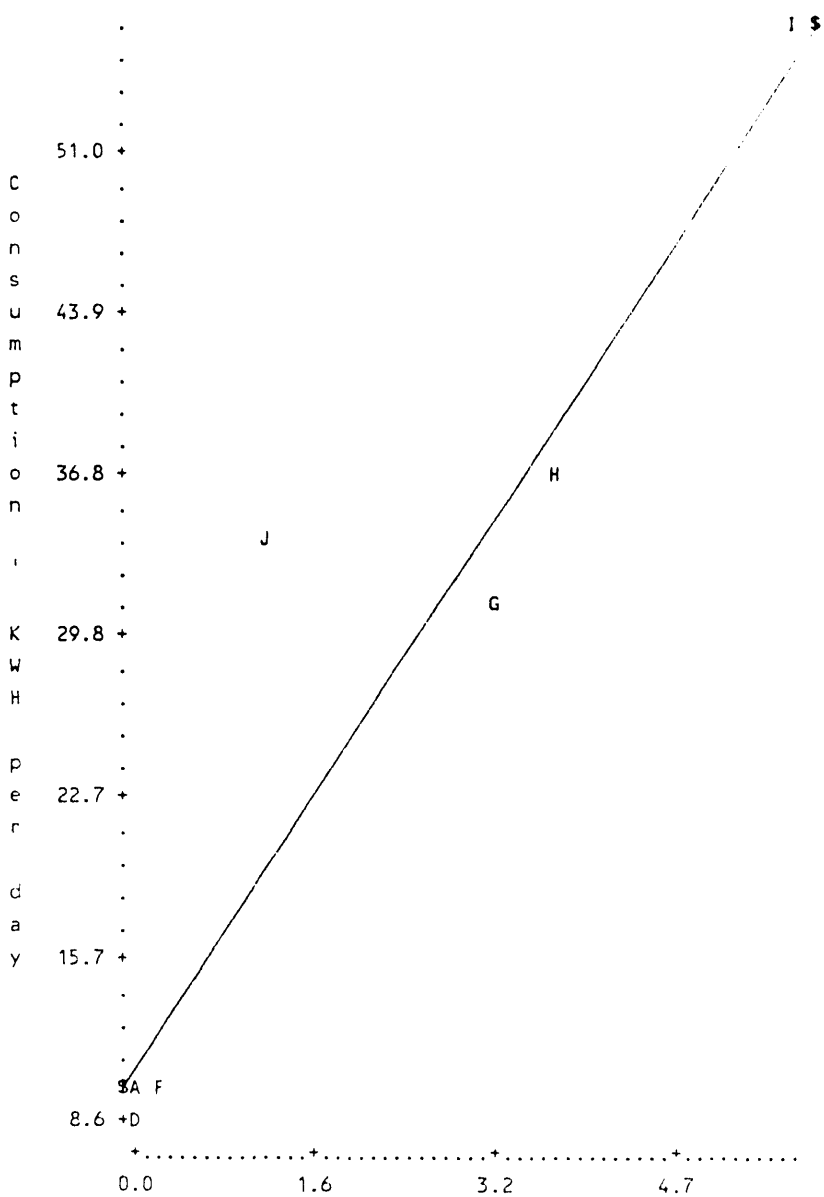
House:H105 POST ,alpha= 16.29,beta= 2.38,R2= 0.9854



PERIODS:

A	DEC	7,1987	to JAN	6,1988
B	JAN	7,1988	to FEB	7,1988
C	FEB	8,1988	to MAR	7,1988
D	MAR	8,1988	to APR	5,1988
E	APR	6,1988	to MAY	4,1988
F	MAY	5,1988	to JUN	5,1988
G	JUN	6,1988	to JUL	5,1988
H	JUL	6,1988	to AUG	3,1988
I	AUG	4,1988	to SEP	1,1988
J	SEP	2,1988	to OCT	3,1988
K	OCT	4,1988	to NOV	1,1988
L	NOV	2,1988	to DEC	4,1988

House:H106 PRE ,alpha= 10.65,beta= 7.76,R2= 0.9165

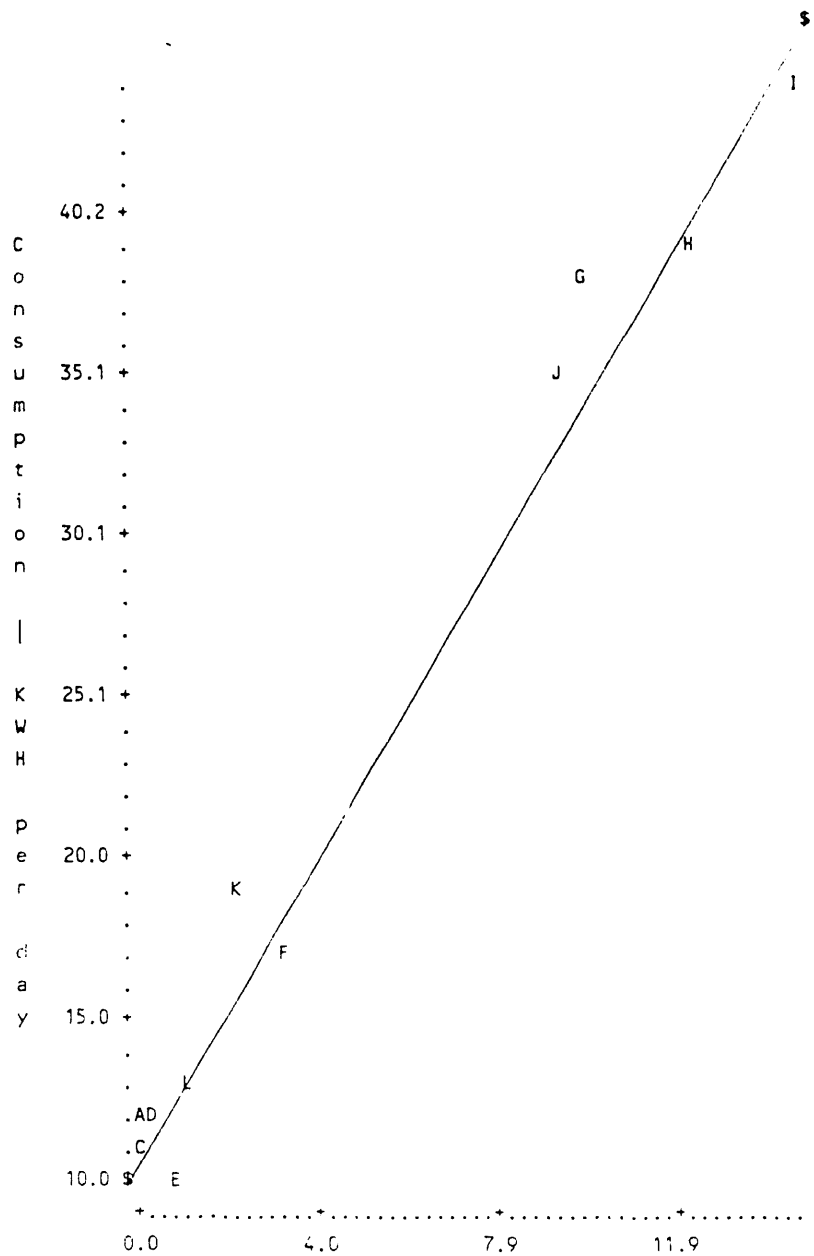


PERIODS:

A	DEC	8,1986	to JAN	7,1987
	JAN	8,1987	to FEB	8,1987
	FEB	9,1987	to MAR	8,1987
D	MAR	9,1987	to APR	6,1987
	APR	7,1987	to MAY	5,1987
F	MAY	6,1987	to JUN	4,1987
G	JUN	5,1987	to JUL	6,1987
H	JUL	7,1987	to AUG	4,1987
I	AUG	5,1987	to SEP	2,1987
J	SEP	3,1987	to OCT	4,1987
	OCT	5,1987	to NOV	2,1987
	NOV	3,1987	to DEC	6,1987

Cooling degree-days per day, base tau = 79.7

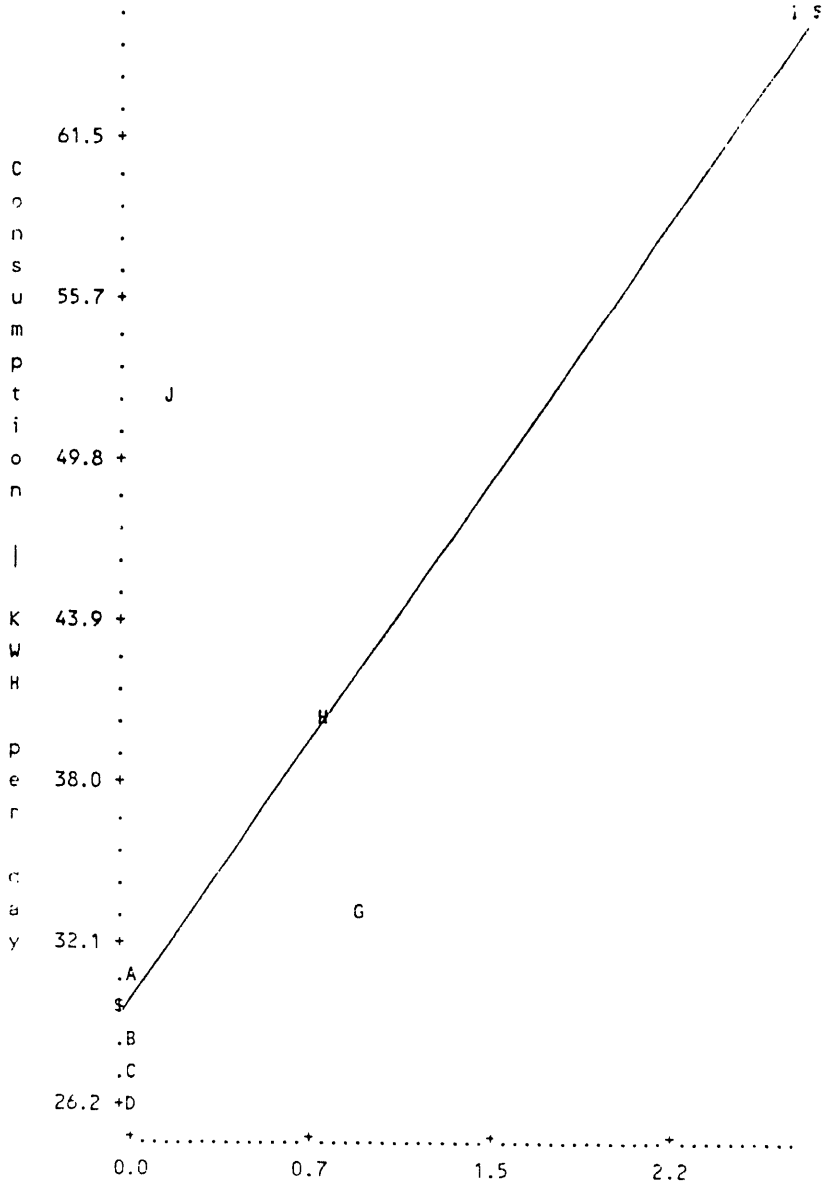
House:H106 POST ,alpha= 11.04,beta= 2.40,R2= 0.9766



PERIODS:

A	DEC	7,1987	to	JAN	6,1988
	JAN	7,1988	to	FEB	7,1988
C	FEB	8,1988	to	MAR	7,1988
D	MAR	8,1988	to	APR	5,1988
E	APR	6,1988	to	MAY	4,1988
F	MAY	5,1988	to	JUN	5,1988
G	JUN	6,1988	to	JUL	5,1988
H	JUL	6,1988	to	AUG	3,1988
I	AUG	4,1988	to	SEP	1,1988
J	SEP	2,1988	to	OCT	3,1988
K	OCT	4,1988	to	NOV	1,1988
L	NOV	2,1988	to	DEC	4,1988

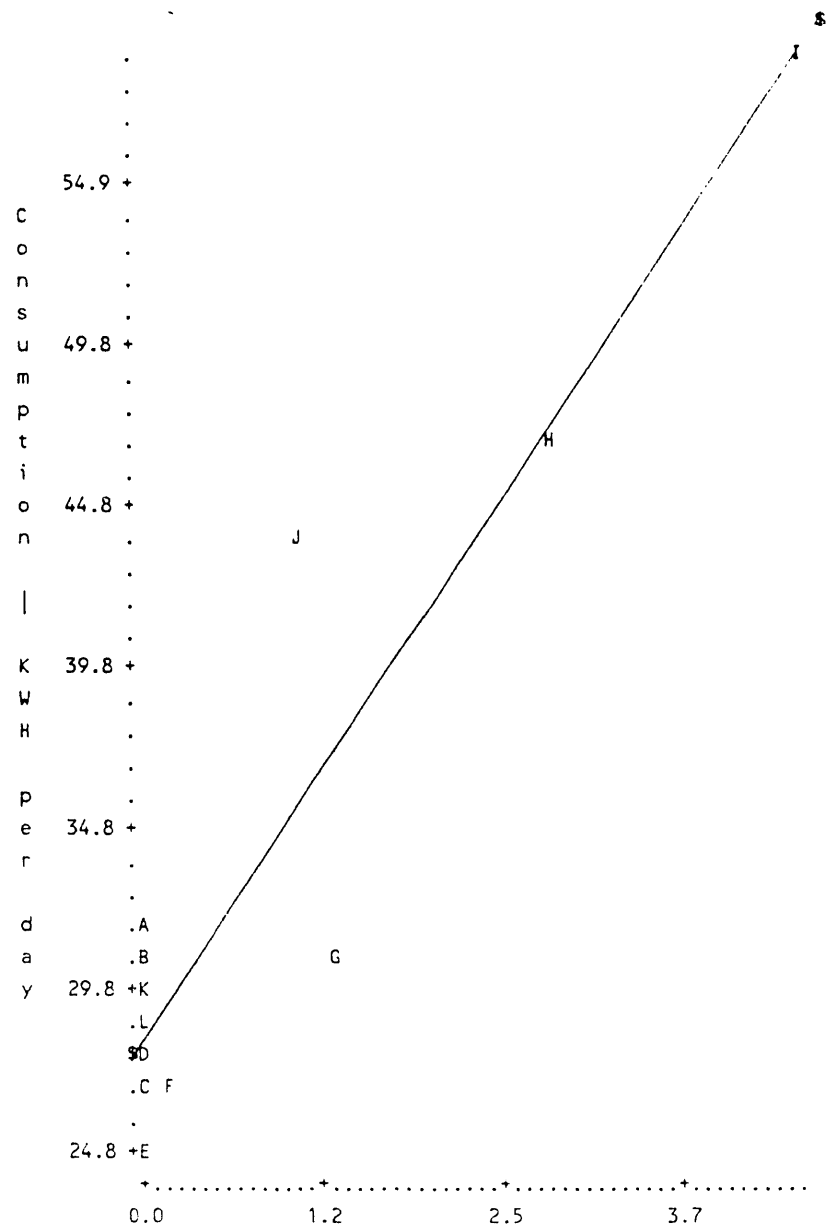
House:H107 PRE ,alpha= 30.07,beta= 13.01,R2= 0.7050



PERIODS:

A	DEC	9,1986	to JAN	8,1987
B	JAN	9,1987	to FEB	9,1987
C	FEB	10,1987	to MAR	9,1987
D	MAR	10,1987	to APR	7,1987
	APR	8,1987	to MAY	6,1987
	MAY	7,1987	to JUN	7,1987
G	JUN	8,1987	to JUL	7,1987
H	JUL	8,1987	to AUG	5,1987
I	AUG	6,1987	to SEP	3,1987
J	SEP	4,1987	to OCT	5,1987
	OCT	6,1987	to NOV	3,1987
	NOV	4,1987	to DEC	7,1987

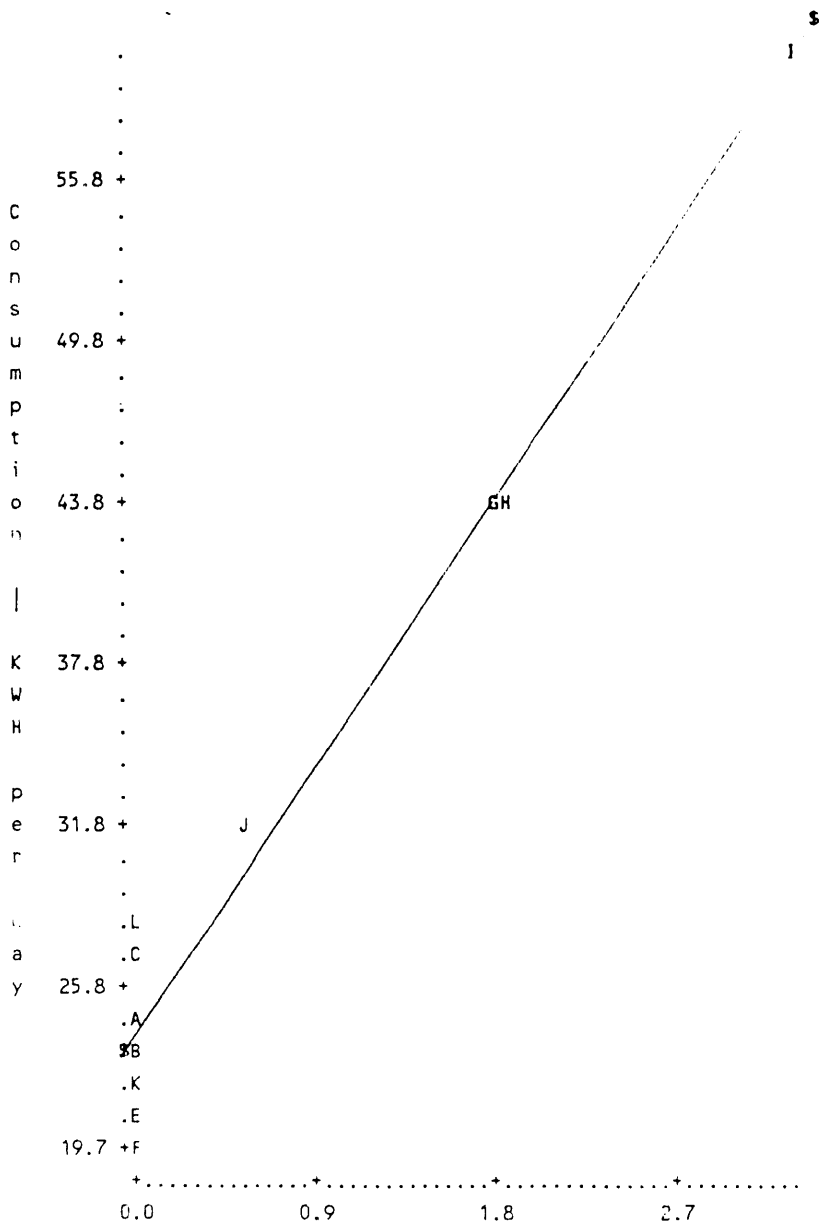
House:H107 POST ,alpha= 28.51,beta= 6.70,R2= 0.8739



PERIODS:

A	DEC	8,1987	to JAN	7,1988
B	JAN	8,1988	to FEB	8,1988
C	FEB	9,1988	to MAR	8,1988
D	MAR	9,1988	to APR	6,1988
E	APR	7,1988	to MAY	5,1988
F	MAY	6,1988	to JUN	6,1988
G	JUN	7,1988	to JUL	6,1988
H	JUL	7,1988	to AUG	4,1988
I	AUG	5,1988	to SEP	5,1988
J	SEP	6,1988	to OCT	4,1988
K	OCT	5,1988	to NOV	2,1988
L	NOV	3,1988	to DEC	5,1988

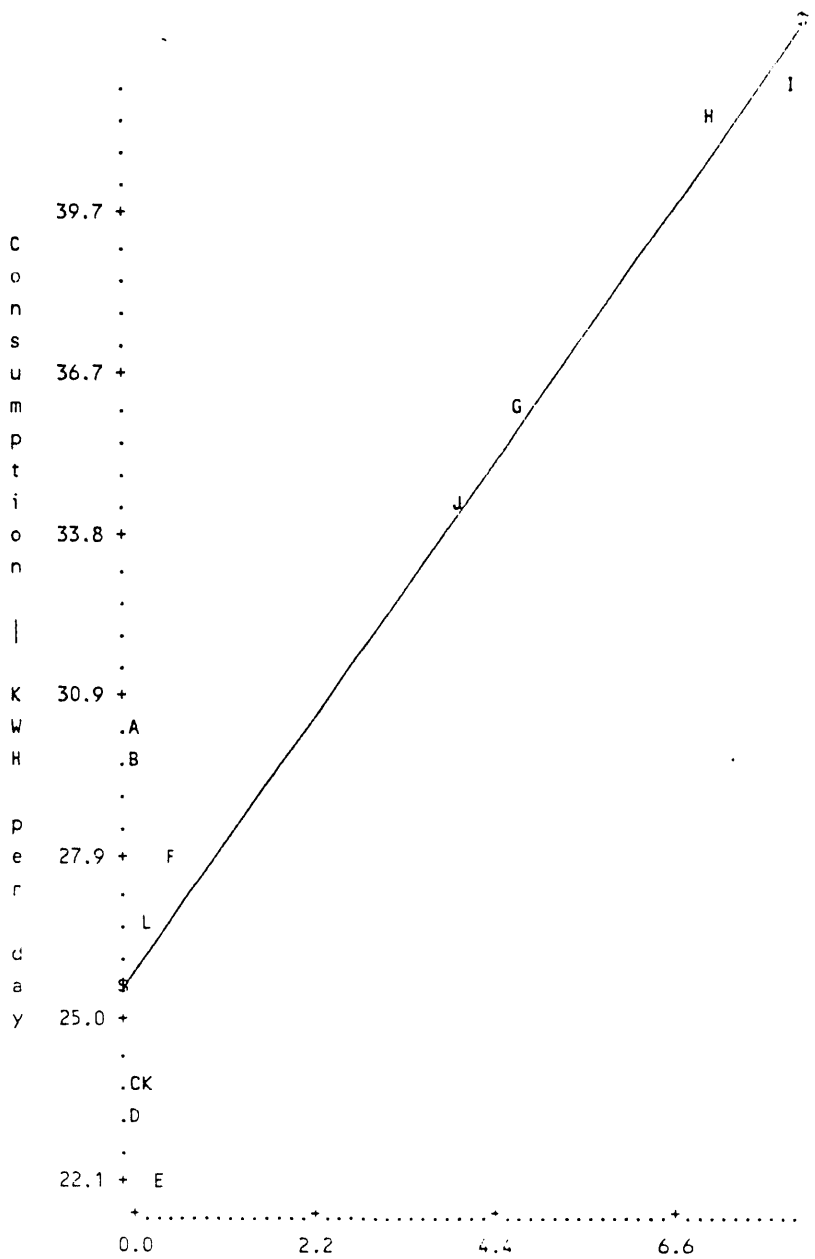
House:H108 PRE ,alpha= 24.38,beta= 11.03,R2= 0.9622



PERIODS:

A	DEC	10,1986	to	JAN	11,1987
B	JAN	12,1987	to	FEB	10,1987
C	FEB	11,1987	to	MAR	10,1987
	MAR	11,1987	to	APR	8,1987
E	APR	9,1987	to	MAY	7,1987
F	MAY	8,1987	to	JUN	8,1987
G	JUN	9,1987	to	JUL	8,1987
H	JUL	9,1987	to	AUG	6,1987
I	AUG	7,1987	to	SEP	7,1987
J	SEP	8,1987	to	OCT	6,1987
K	OCT	7,1987	to	NOV	4,1987
L	NOV	5,1987	to	DEC	8,1987

House:H108 POST ,alpha= 25.83,beta= 2.14,R2= 0.8597

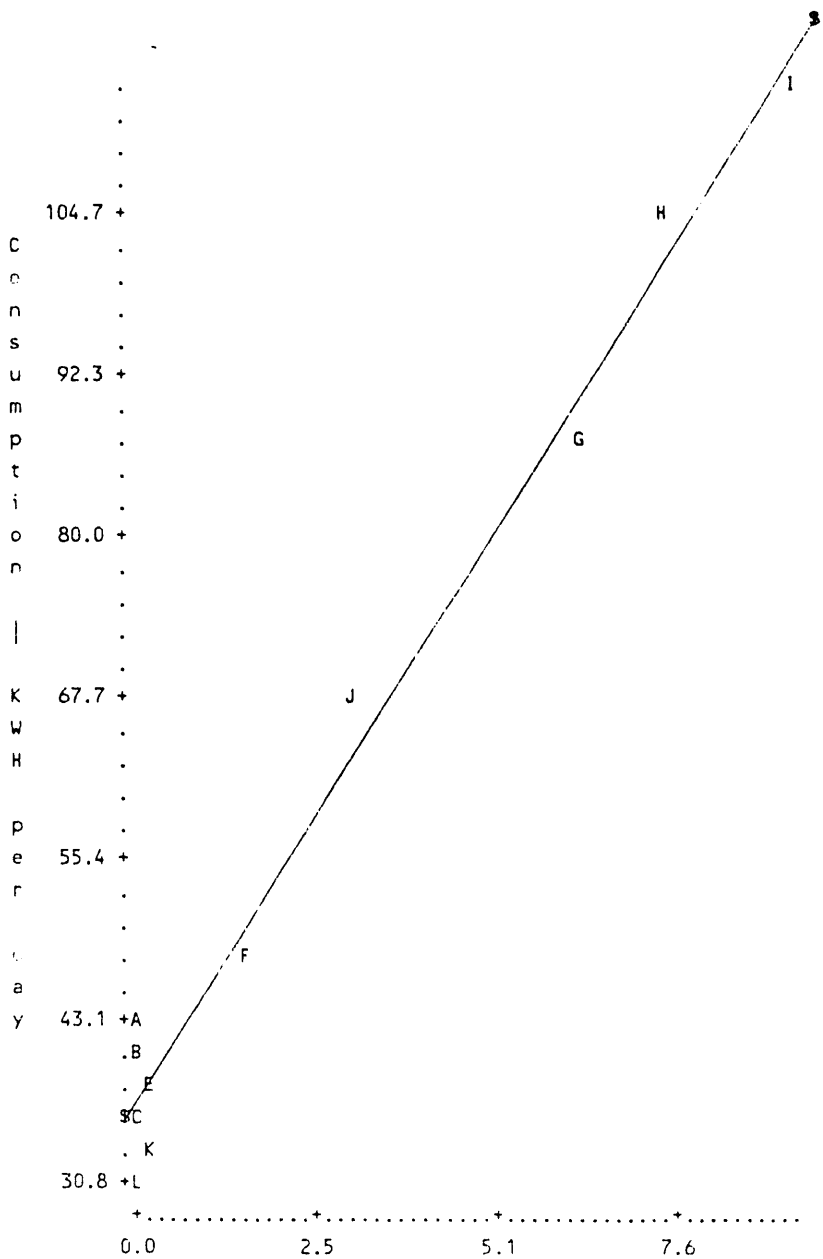


Cooling degree-days per day, base tau = 78.0

PERIODS:

A	DEC	9,1987	to	JAN	10,1988
B	JAN	11,1988	to	FEB	9,1988
C	FEB	10,1988	to	MAR	9,1988
D	MAR	10,1988	to	APR	7,1988
E	APR	8,1988	to	MAY	8,1988
F	MAY	9,1988	to	JUN	7,1988
G	JUN	8,1988	to	JUL	7,1988
H	JUL	8,1988	to	AUG	7,1988
I	AUG	8,1988	to	SEP	6,1988
J	SEP	7,1988	to	OCT	5,1988
K	OCT	6,1988	to	NOV	3,1988
L	NOV	4,1988	to	DEC	6,1988

House:H109 PRE ,alpha= 36.51,beta= 8.54,R2= 0.9834

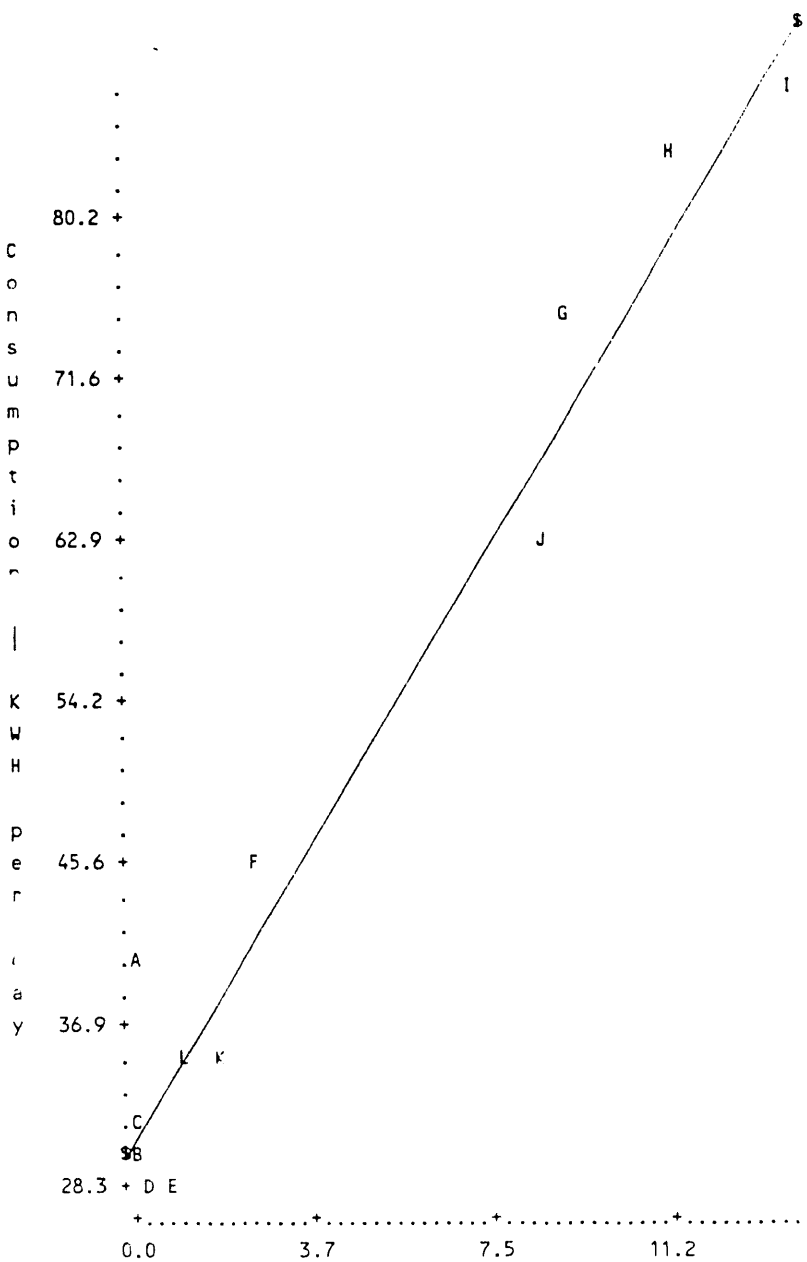


PERIODS:

A	DEC	8,1986	to	JAN	7,1987
B	JAN	8,1987	to	FEB	8,1987
C	FEB	9,1987	to	MAR	8,1987
	MAR	9,1987	to	APR	6,1987
E	APR	7,1987	to	MAY	5,1987
F	MAY	6,1987	to	JUN	4,1987
G	JUN	5,1987	to	JUL	6,1987
H	JUL	7,1987	to	AUG	4,1987
I	AUG	5,1987	to	SEP	2,1987
J	SEP	3,1987	to	OCT	4,1987
K	OCT	5,1987	to	NOV	2,1987
L	NOV	3,1987	to	DEC	6,1987

1

House:H109 POST ,alpha= 30.89,beta= 4.33,R2= 0.9593

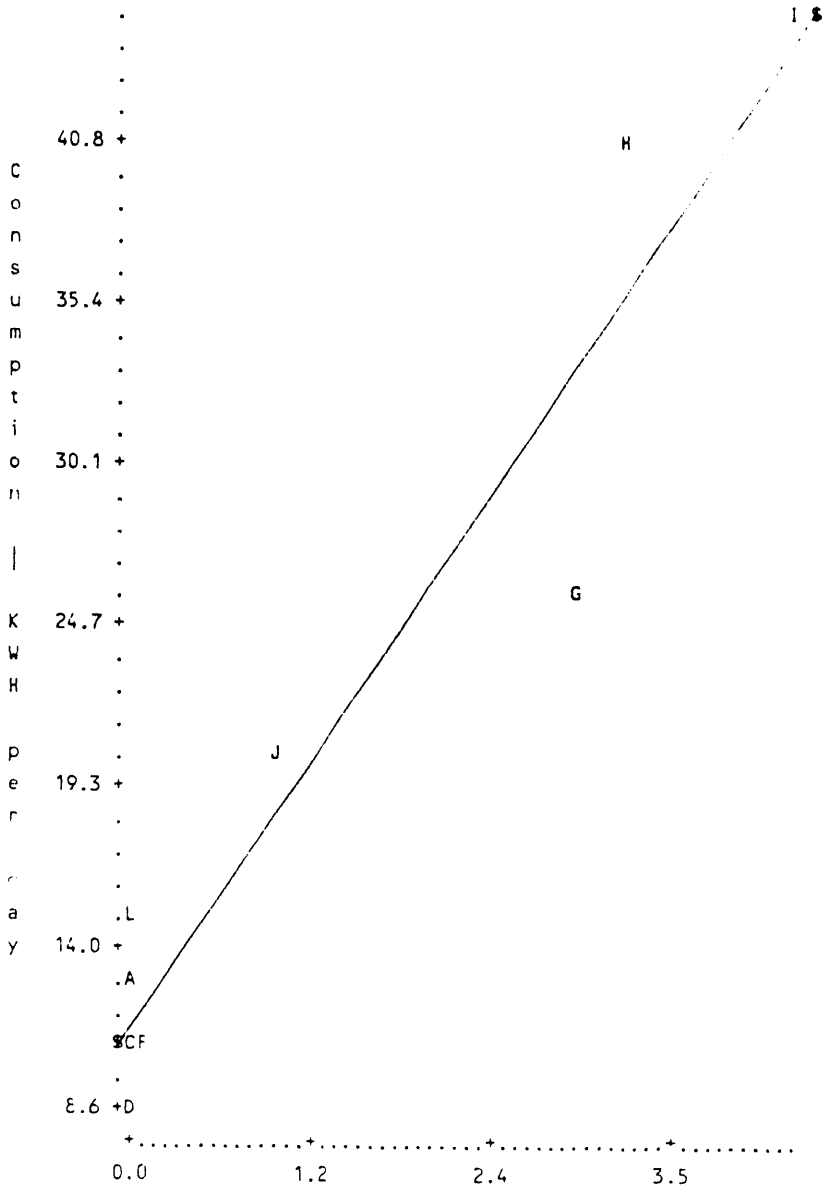


Cooling degree-days per day, base tau = 73.3

PERIODS:

A	DEC	7,1987	to	JAN	6,1988
B	JAN	7,1988	to	FEB	7,1988
C	FEB	8,1988	to	MAR	7,1988
D	MAR	8,1988	to	APR	5,1988
E	APR	6,1988	to	MAY	4,1988
F	MAY	5,1988	to	JUN	5,1988
G	JUN	6,1988	to	JUL	5,1988
H	JUL	6,1988	to	AUG	3,1988
I	AUG	4,1988	to	SEP	1,1988
J	SEP	2,1988	to	OCT	3,1988
K	OCT	4,1988	to	NOV	1,1988
L	NOV	2,1988	to	DEC	4,1988

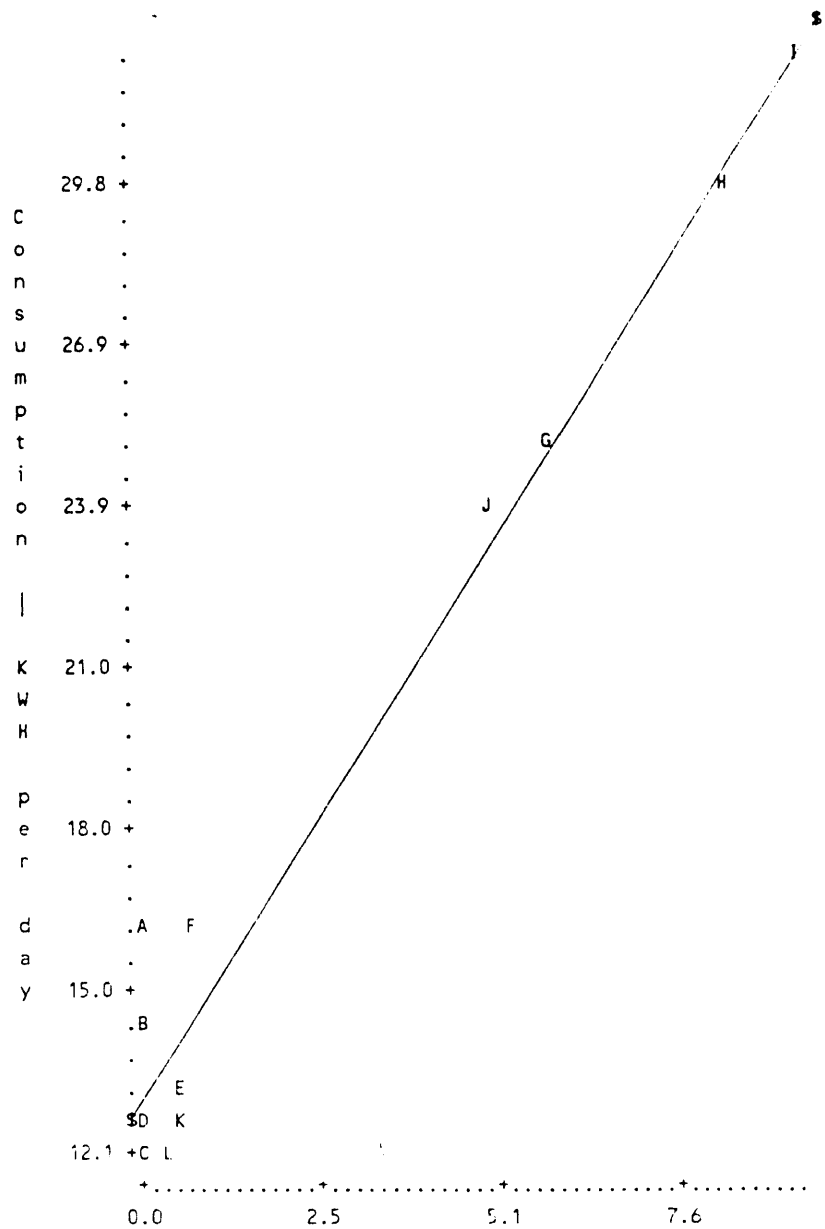
House:H110 PRE ,alpha= 11.44,beta= 7.57,R2= 0.9279



PERIODS:

A	DEC	10,1986	to JAN	11,1987
	JAN	12,1987	to FEB	10,1987
C	FEB	11,1987	to MAR	10,1987
D	MAR	11,1987	to APR	8,1987
	APR	9,1987	to MAY	7,1987
F	MAY	8,1987	to JUN	8,1987
G	JUN	9,1987	to JUL	8,1987
H	JUL	9,1987	to AUG	6,1987
I	AUG	7,1987	to SEP	7,1987
J	SEP	8,1987	to OCT	6,1987
	OCT	7,1987	to NOV	4,1987
L	NOV	5,1987	to DEC	8,1987

House:H110 POST ,alpha= 13.16,beta= 2.05,R2= 0.9654

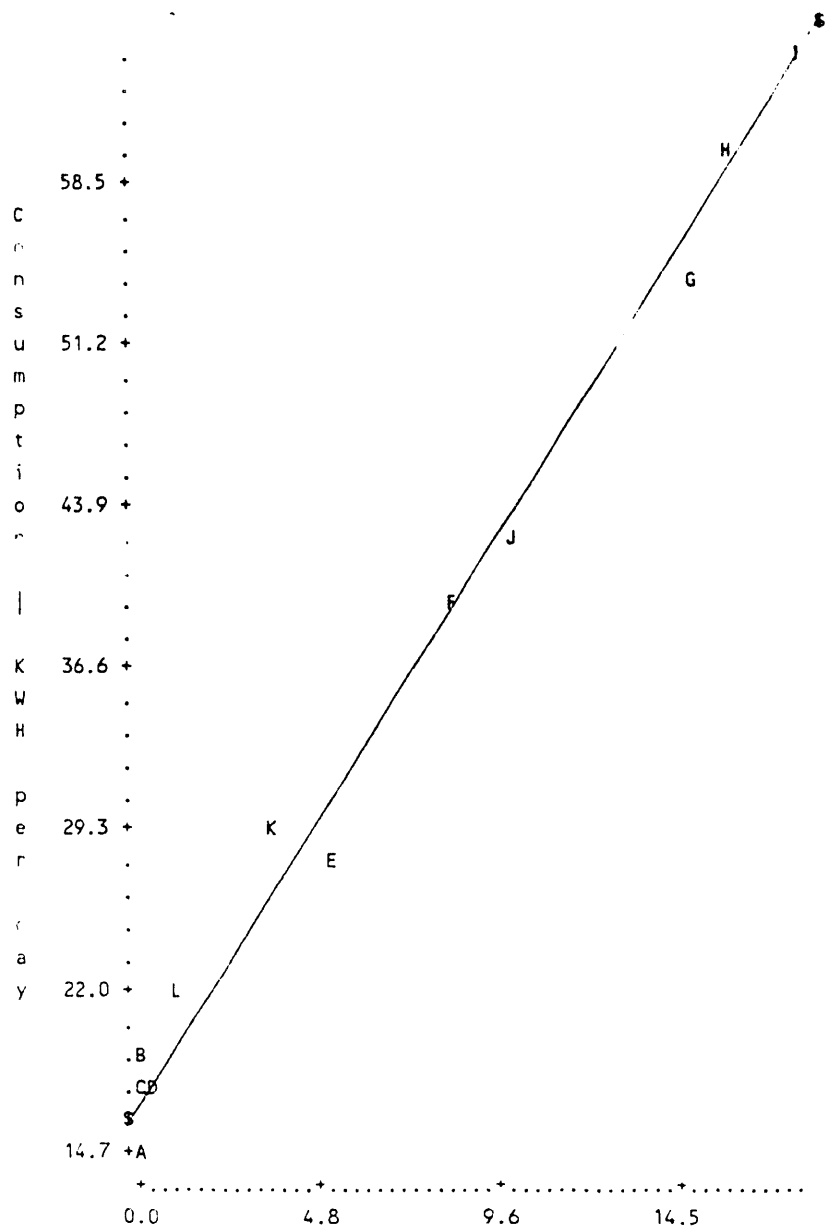


PERIODS:

A	DEC	9,1987	to JAN	10,1988
B	JAN	11,1988	to FEB	9,1988
C	FEB	10,1988	to MAR	9,1988
D	MAR	10,1988	to APR	7,1988
E	APR	8,1988	to MAY	8,1988
F	MAY	9,1988	to JUN	7,1988
G	JUN	8,1988	to JUL	7,1988
H	JUL	8,1988	to AUG	7,1988
I	AUG	8,1988	to SEP	6,1988
J	SEP	7,1988	to OCT	5,1988
K	OCT	6,1988	to NOV	3,1988
L	NOV	4,1988	to DEC	6,1988

Cooling degree-days per day, base tau = 76.8

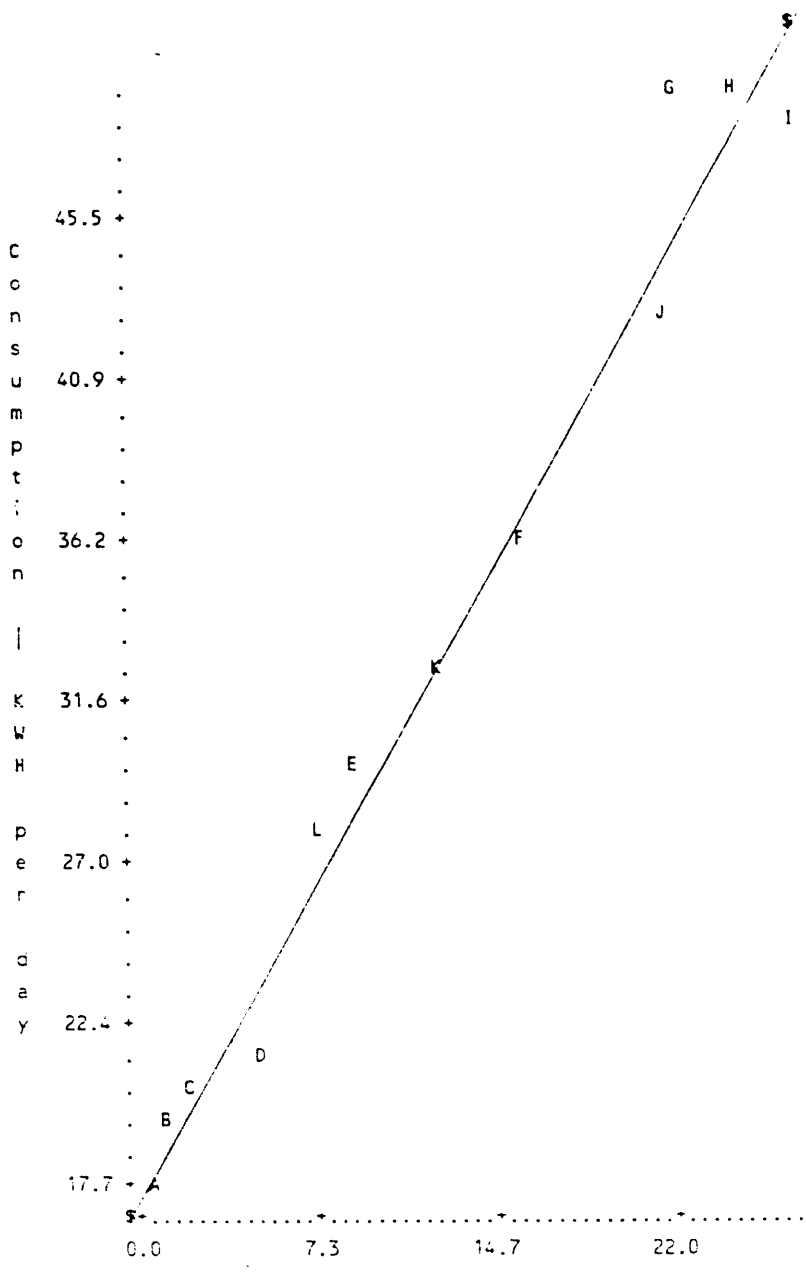
House:H111 PRE ,alpha= 17.42,beta= 2.61,R2= 0.9905



PERIODS:

A	DEC	8,1986	to JAN	7,1987
B	JAN	8,1987	to FEB	8,1987
C	FEB	9,1987	to MAR	8,1987
D	MAR	9,1987	to APR	6,1987
E	APR	7,1987	to MAY	5,1987
F	MAY	6,1987	to JUN	4,1987
G	JUN	5,1987	to JUL	6,1987
H	JUL	7,1987	to AUG	4,1987
I	AUG	5,1987	to SEP	2,1987
J	SEP	3,1987	to OCT	4,1987
K	OCT	5,1987	to NOV	2,1987
L	NOV	3,1987	to DEC	6,1987

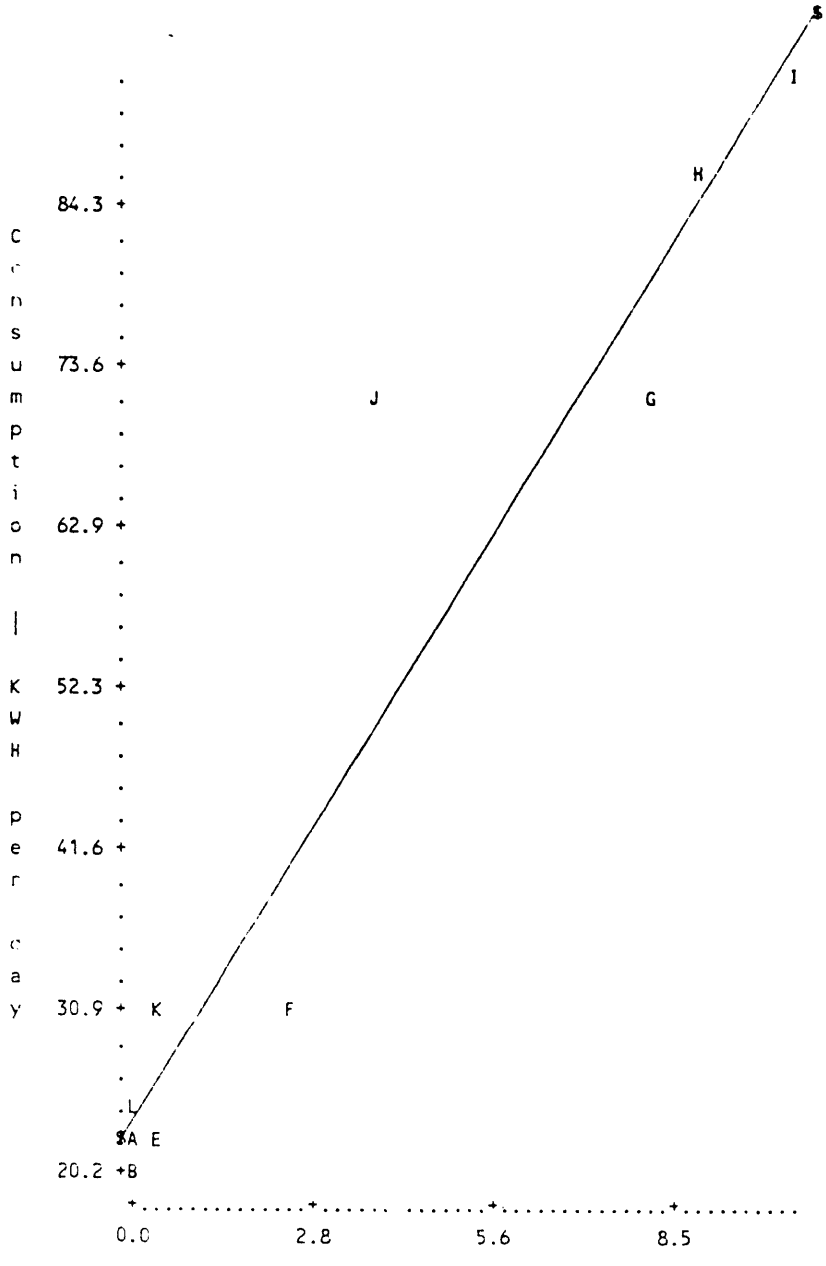
House:H111 POST ,alpha= 17.66,beta= 1.24,R2= 0.9755



PERIODS:

A	DEC	7,1987	to JAN	6,1988
B	JAN	7,1988	to FEB	7,1988
C	FEB	8,1988	to MAR	7,1988
D	MAR	8,1988	to APR	5,1988
E	APR	6,1988	to MAY	4,1988
F	MAY	5,1988	to JUN	5,1988
G	JUN	6,1988	to JUL	5,1988
H	JUL	6,1988	to AUG	3,1988
I	AUG	4,1988	to SEP	',1988
J	SEP	2,1988	to OCT	3,1988
K	OCT	4,1988	to NOV	1,1988
L	NOV	2,1988	to DEC	4,1988

House:H112 PRE ,alpha= 23.37,beta= 6.87,R2= 0.9172



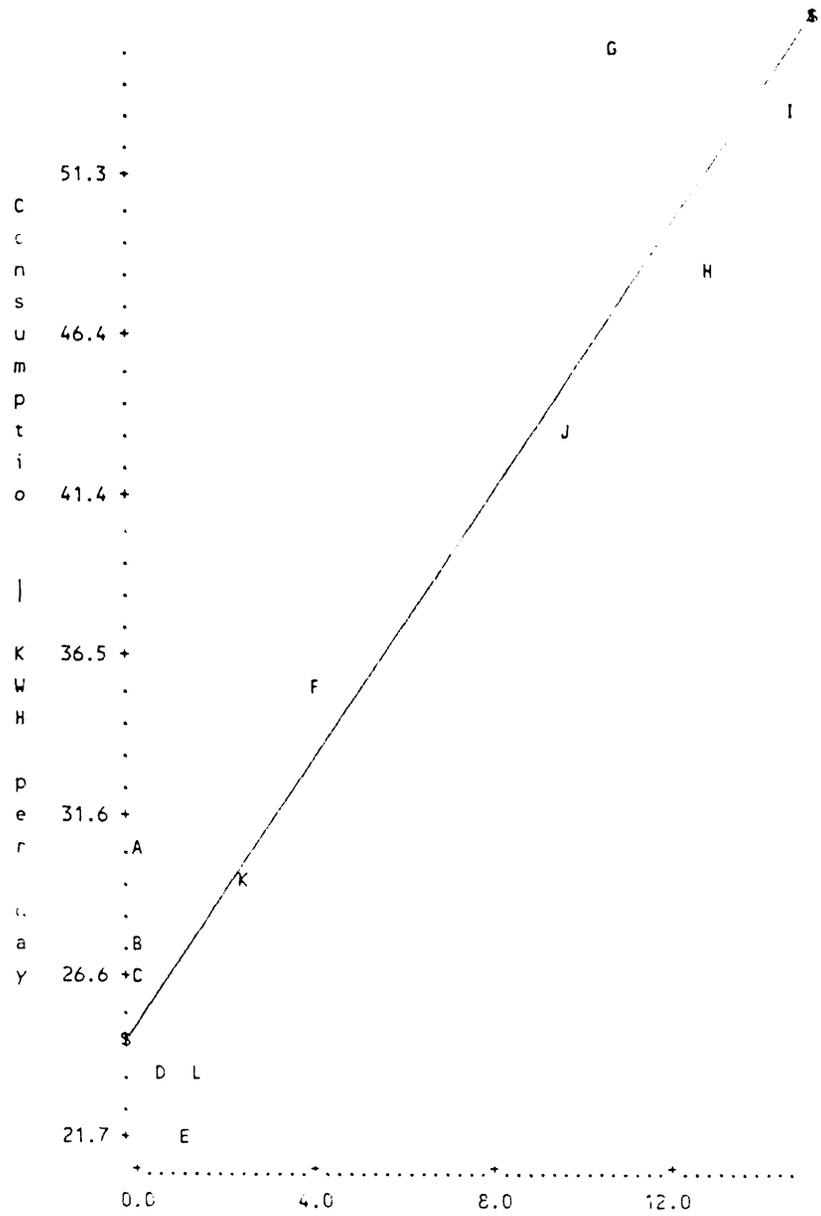
Cooling degree-days per day, base tau = 74.7

PERIODS:

A	DEC	9,1986	to	JAN	8,1987
B	JAN	9,1987	to	FEB	9,1987
	FEB	10,1987	to	MAR	9,1987
	MAR	10,1987	to	APR	7,1987
E	APR	8,1987	to	MAY	6,1987
F	MAY	7,1987	to	JUN	7,1987
G	JUN	8,1987	to	JUL	7,1987
H	JUL	8,1987	to	AUG	5,1987
I	AUG	6,1987	to	SEP	3,1987
J	SEP	4,1987	to	OCT	5,1987
K	OCT	6,1987	to	NOV	3,1987
L	NOV	4,1987	to	DEC	7,1987

1

House:H112 POST ,alpha= 25.05,beta= 2.05,R2= 0.8840

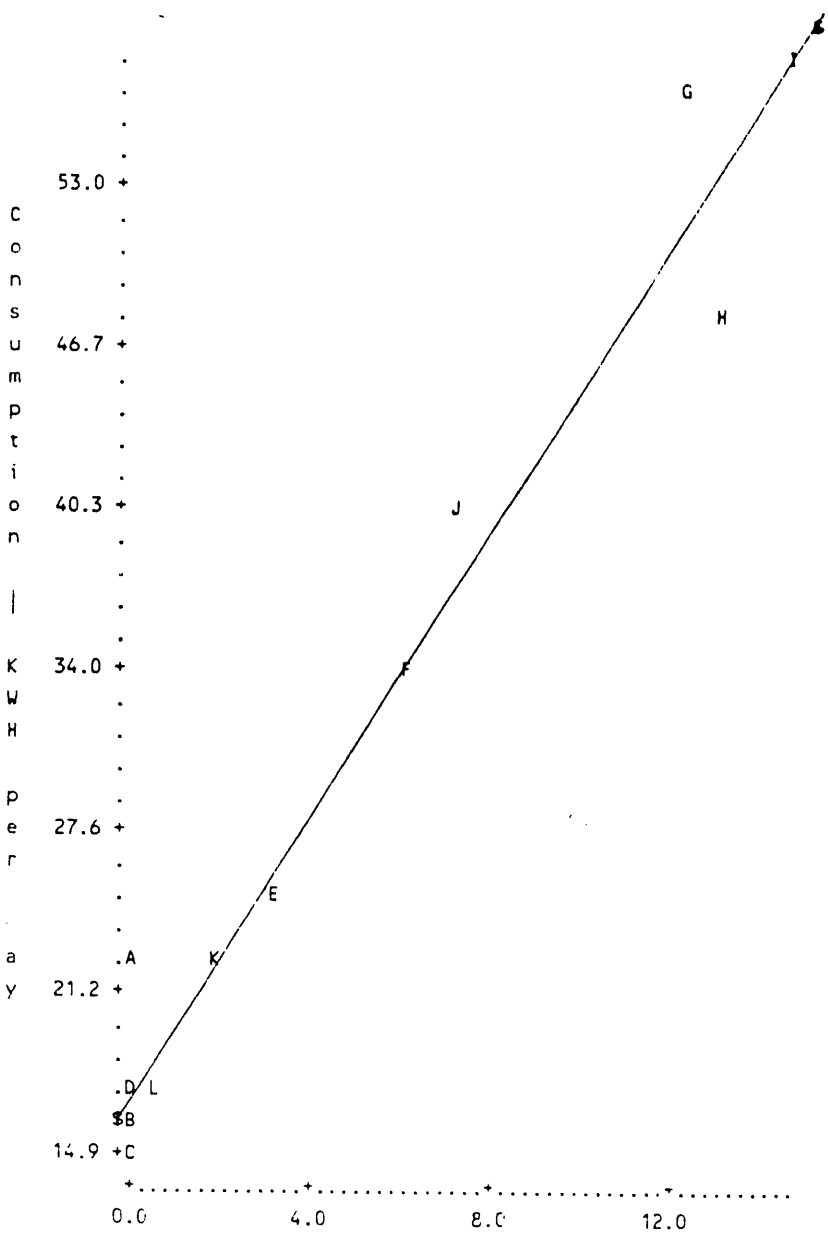


PERIODS:

A	DEC	8,1987	to	JAN	7,1988
B	JAN	8,1988	to	FEB	8,1988
C	FEB	9,1988	to	MAR	8,1988
D	MAR	9,1988	to	APR	6,1988
E	APR	7,1988	to	MAY	5,1988
F	MAY	6,1988	to	JUN	6,1988
G	JUN	7,1988	to	JUL	6,1988
H	JUL	7,1988	to	AUG	4,1988
I	AUG	5,1988	to	SEP	5,1988
J	SEP	6,1988	to	OCT	4,1988
K	OCT	5,1988	to	NOV	2,1988
L	NOV	3,1988	to	DEC	5,1988

1

House:H113 PRE ,alpha= 17.36,beta= 2.78,R2= 0.9644



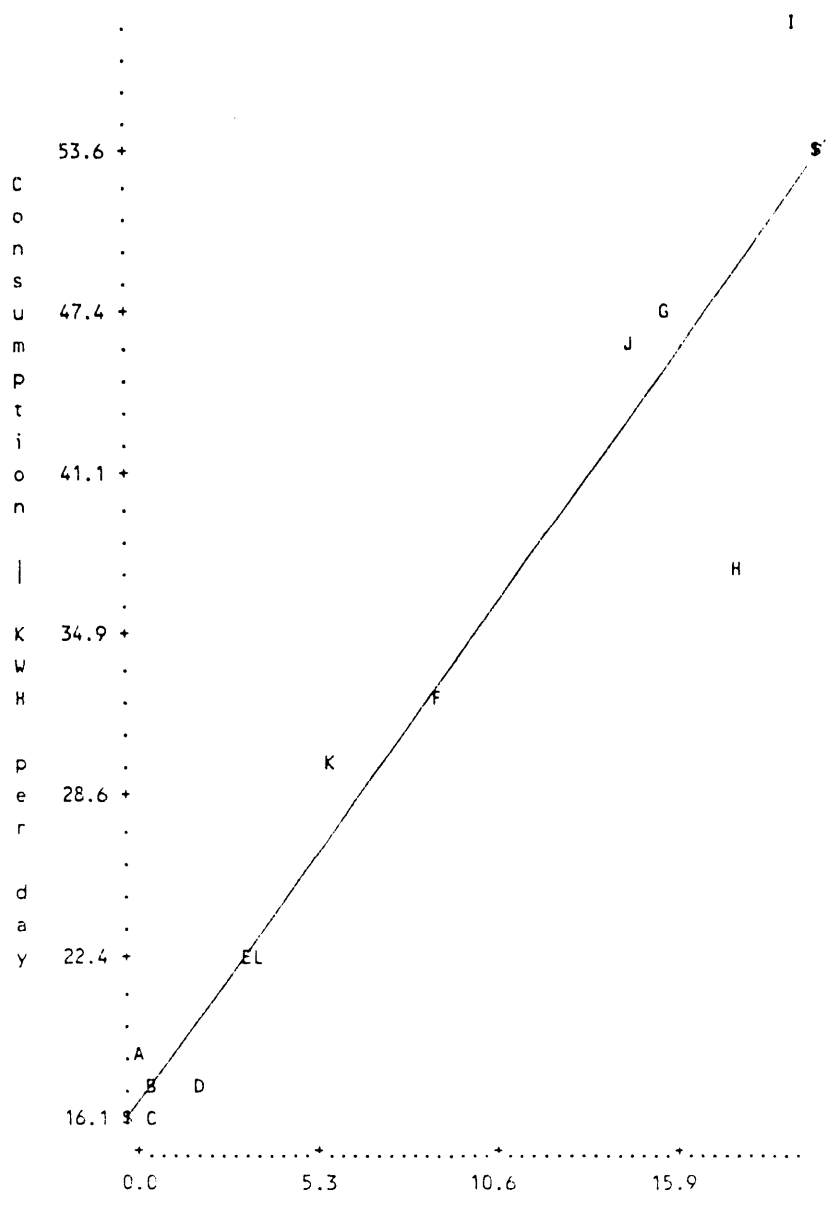
Cooling degree-days per day, base tau = 70.3

PERIODS:

A	DEC	9,1986	to	JAN	8,1987
B	JAN	9,1987	to	FEB	9,1987
C	FEB	10,1987	to	MAR	9,1987
D	MAR	10,1987	to	APR	7,1987
E	APR	8,1987	to	MAY	6,1987
F	MAY	7,1987	to	JUN	7,1987
G	JUN	8,1987	to	JUL	7,1987
H	JUL	8,1987	to	AUG	5,1987
I	AUG	6,1987	to	SEP	3,1987
J	SEP	4,1987	to	OCT	5,1987
K	OCT	6,1987	to	NOV	3,1987
L	NOV	4,1987	to	DEC	7,1987

1

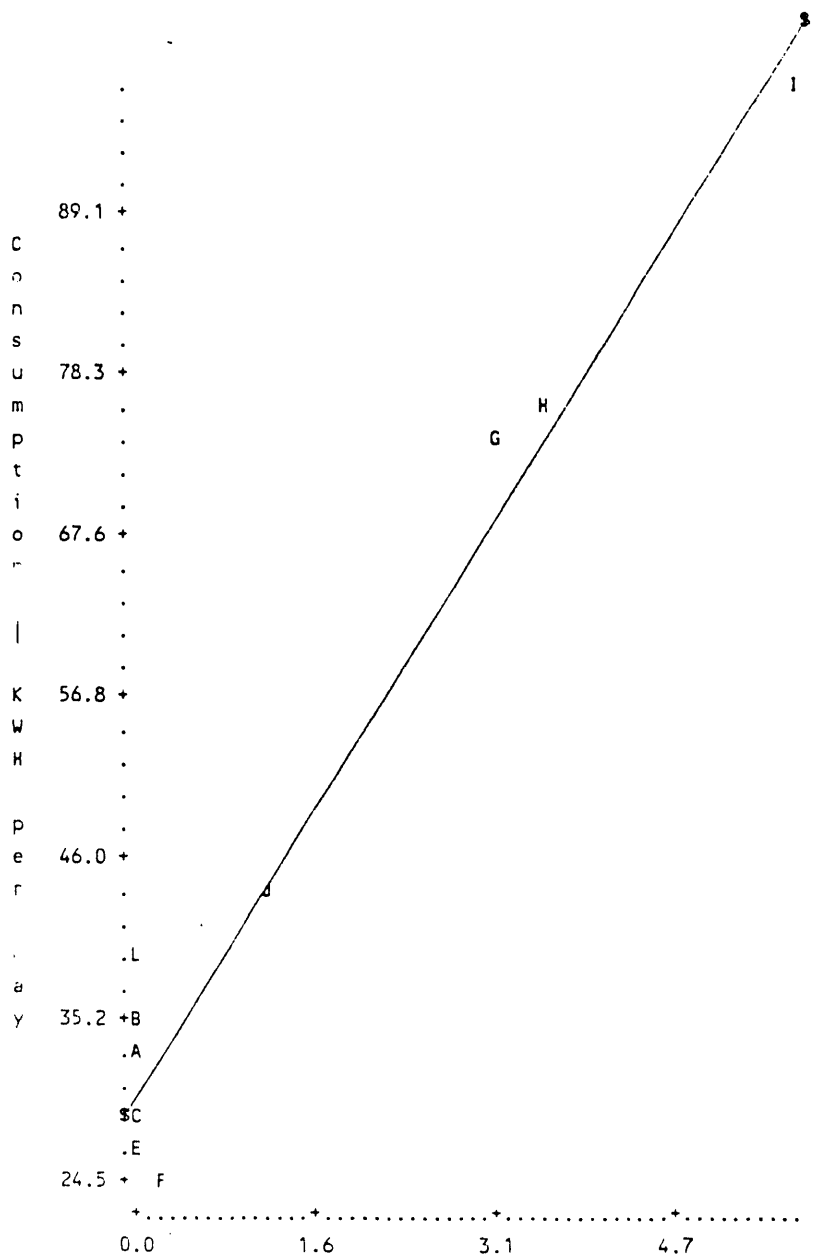
House:H113 POST ,alpha= 16.66,beta= 1.83,R2= 0.9040



PERIODS:

A	DEC	8,1987	to	JAN	7,1988
B	JAN	8,1988	to	FEB	8,1988
C	FEB	9,1988	to	MAR	8,1988
D	MAR	9,1988	to	APR	6,1988
E	APR	7,1988	to	MAY	5,1988
F	MAY	6,1988	to	JUN	6,1988
G	JUN	7,1988	to	JUL	6,1988
H	JUL	7,1988	to	AUG	4,1988
I	AUG	5,1988	to	SEP	5,1988
J	SEP	6,1988	to	OCT	4,1988
K	OCT	5,1988	to	NOV	2,1988
L	NOV	3,1988	to	DEC	5,1988

House:H114 PRE ,alpha= 30.41,beta= 12.33,R2= 0.9595



Cooling degree-days per day, base tau = 79.8

PERIODS:

A	DEC	8,1986	to	JAN	7,1987
B	JAN	8,1987	to	FEB	8,1987
C	FEB	9,1987	to	MAR	8,1987
	MAR	9,1987	to	APR	6,1987
E	APR	7,1987	to	MAY	5,1987
F	MAY	6,1987	to	JUN	4,1987
G	JUN	5,1987	to	JUL	6,1987
H	JUL	7,1987	to	AUG	4,1987
I	AUG	5,1987	to	SEP	2,1987
J	SEP	3,1987	to	OCT	4,1987
	OCT	5,1987	to	NOV	2,1987
L	NOV	3,1987	to	DEC	6,1987

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