

A very important aspect of air conditioning design is obviously the weather. Our system designs are based on our regions design conditions

Summer Outdoor Ambient 35 deg C Indoor 23 deg C
 Winter Outdoor Ambient 7 deg C Indoor 21 deg C

The indoor condition we are chasing is a comfort condition which will be in the region of 14 to 16 degrees below the outdoor ambient, if ambient conditions exceed the regions design.

Temperatures in the 40's do occur but they are not common, many clients over the past few years have chosen to emphasise these few day's as the basis for design, the end result being that equipment would need to be around 10-20% larger than is necessary — for what — the odd day here and there.

This isn't a sound choice to make—capital cost is higher—running cost is higher—comfort conditions will not be achieved—long term.

To explain our rational behind this we have included in this fact sheet details of our regions weather history from the 60's. What it does show is a very real need to address part load operation as the major weather condition rather than the peak load.

So what happens when we design at 35 deg C and the day is 40 deg C—let's make the following assumptions;

- The system we have designed will provide the design indoor condition of 23 deg C when the outdoor ambient temperature is at 35 deg C
- We have selected an Actron Air SRA18—the unit has a nominal capacity of 18.3kw and a net capacity to AS3823 of 16.0kw
- The peak block cooling load in your home is 22.1kw with the instantaneous cooling requirement being 15.47kw (ie not all areas of your home are at peak load at the same time, eg east v's west aspect)
- The system has several motorised zones.

We need to look at the expanded ratings of the Actron unit to assess it's performance at the actual ambient and space conditions. The table below shows that 35 deg C outdoor the system total capacity is 17.57kw—ample to meet the cooling load requirement in our example above.

COOLING PERFORMANCE													
AIR ENTERING		TOTAL CAPACITY KW	SENSIBLE CAPACITY - KW										
OUTDOOR DB - °C	INDOOR WB - °C		AT DB TEMPERATURE ON TO INDOOR COIL - °C										
			20	21	22	23	24	25	26	27	28	29	30
35	16	16.02	11.78	12.53	13.29	14.05	14.81	15.56					
	17	16.52	10.88	11.67	12.45	13.23	14.01	14.80	15.58				
	18	17.04	9.92	10.73	11.54	12.35	13.16	13.96	14.77	15.58	16.39		
	19	17.57	8.89	9.72	10.56	11.39	12.23	13.06	13.90	14.73	15.57	16.40	17.24
	20	18.10		8.63	9.49	10.35	11.21	12.07	12.93	13.80	14.66	15.52	16.38
	21	18.66			8.34	9.23	10.12	11.01	11.90	12.79	13.68	14.57	15.45
	22	19.23				8.03	8.95	9.86	10.78	11.70	12.62	13.53	14.45



Now lets look at the system capacity at 40 deg C, see table below.

COOLING PERFORMANCE			SENSIBLE CAPACITY - KW											
AIR ENTERING		TOTAL CAPACITY KW	AT DB TEMPERATURE ON TO INDOOR COIL - °C											
OUTDOOR DB - °C	INDOOR WB - °C		20	21	22	23	24	25	26	27	28	29	30	
40	16	15.26	11.59	12.31	13.03	13.75	14.47							
	17	15.73	10.75	11.49	12.24	12.98	13.72	14.46	15.21					
	18	16.21	9.84	10.61	11.38	12.15	12.91	13.68	14.45	15.21	15.98			
	19	16.71	8.87	9.66	10.45	11.25	12.04	12.83	13.62	14.41	15.21	16.00		
	20	17.21		8.63	9.45	10.26	11.08	11.90	12.72	13.53	14.35	15.17	15.98	
	21	17.72			8.37	9.21	10.06	10.90	11.74	12.58	13.43	14.27	15.11	
	22	18.25				8.08	8.95	9.82	10.69	11.56	12.43	13.30	14.17	
45	16	14.47	11.34	12.02	12.70									
	17	14.90	10.55	11.26	11.96	12.66	13.36	14.06	14.76					
	18	15.35	9.70	10.43	11.15	11.88	12.60	13.33	14.05	14.77				
	19	15.82	8.79	9.54	10.29	11.03	11.78	12.53	13.28	14.02	14.77	15.52		
	20	16.28		8.57	9.35	10.12	10.89	11.66	12.43	13.20	13.97	14.74	15.51	
	21	16.76			8.34	9.13	9.93	10.72	11.51	12.31	13.10	13.90	14.69	
	22	17.25				8.08	8.90	9.72	10.53	11.35	12.17	12.99	13.81	

At 40 deg C the total capacity is 16.71kw also note at 45 deg C the total capacity is 15.82kw

With a higher ambient temperature our required design cooling load will of course also increase—the load at 35 deg C of 15.47kw will be more like 17.0kw (10% greater) at 40 deg C. But you can see that the equipment is able to deliver a capacity adequate to meet the load albeit that with the whole house operating, temperatures in some areas may rise slightly above the design setpoint of 23 deg C. You can limit this load and still maintain the design setpoint, quiet easily by switching off some unused zones eg a formal lounge zone.

By doing this you will be reducing the instantaneous load on the house, therefore even at ambients of 40 to 45 deg C the system will still have sufficient net capacity to meet the load and maintain the comfort condition.

Keep in mind that on a 40 deg C day, it isn't 40 deg the moment the sun comes up—with summer time we can usually expect this peak to occur during the hours 3pm to 7pm. The key to effective system operation then largely lies with the home owner, the way and the times you operate the system will be the difference between comfort conditions at the peak time of the day and frustration with poor performance.

Any air conditioning system is designed to keep a cool space cool.

On a summer's day (any not just an extreme day) switch the system on early (say 7am) let the unit work with the load—it has a very easy job to do—what is the greatest advantage is that the outdoor ambient temperature will be 10—20 deg C lower in the morning than it will be late afternoon. Just have a look at the weather history table on the following pages;

As an example lets look at Maryville recordings

Average FEB maximum 29.0 deg C
 Average FEB 9am temp 22.2 deg C
 Average FEB 3pm temp 27.2 deg C



Bottom line is—it's more efficient and cost effective to run the system for longer period of time working with the load than it is if you switch the unit on when you just can't stand the inside temperature any more.

Your air conditioning system has a thermostat, so although the system might be "on" your outdoor unit (it consumes the most power) will cycle on and off during the day when the load is light. At the peak part of the day it will no doubt run for greater periods of time to maintain the indoor conditions you have set. The alternative—run the system on demand will see the unit run at peak load—often without cycling—and you have sacrificed the indoor comfort condition.

Actual Case Study

One of our clients had a 15kw system installed in his home in Merewether. After 7 years operation he placed a service call, very frustrated at 9pm one February evening. The maximum temp in Newcastle that day was 42 deg C. Our client switched his system on when he arrived home from work just after 5pm—the indoor temperature was 39 deg C. When he placed the call at 9pm the indoor temperature was 29 deg C—he wasn't happy—we thought the system had done a pretty good job considering what it was asked to do.

Our client had a fully programmable time switch control but refused to use it "I'm not going to run the system when I'm at work it will cost too much ..." We persuaded our client to program the system and run it our way, we also fitted a timer to the compressor to record the hours run.

Three days later an almost identical weather pattern occurred and Newcastle's temperature soured beyond 40 deg C for the second time in a week. At 9pm that evening I called the client—

What is the indoor temperature ? Answer 23

What time is on the timer ? Answer 3.5 hrs

Our customer has never had another problem and uses the programmable feature all the time.

We set the system to start at 7am with an indoor setpoint of 27 deg C—at 2.30pm we reset the indoor setpoint to 23 deg C. The key was that we never let the house get hot, through the day we just made sure that the temperature was contained at less than 27 deg C, then just before the peak load occurred we set the system ready for the occupied setpoint (23 deg C).

Remember our client ran his system for 4hrs (5pm to 9pm) - and was totally dissatisfied at 29 deg C. We ran to work with the load from 7am— the space was at 23 deg C when occupied — but best of all our actual run time was 1/2 hr shorter.

Conclusion—It actually costs less to run the system all day that it does running on demand.

Part Load is the more important issue.

As was noted on the first page of this fact sheet—PART LOAD is a more important issue to consider.

Your air conditioning system will spend much more time at part load than it will at peak load.

To help understand this we have attached tables detailing our regions average peak temperatures since the 60's. Two tables are provided—CESSNOCK and MARYVILLE, they depict our regions conditions for direct coastal and inland areas.

Let's just summarise the CESSNOCK figures.

The peak Summer Mean Max Temperature	29.6 deg C in January
The Mean number of days per year at or above 40 deg C	1.4 days
The Mean number of days per year at or above 35 deg C	14.5 days
The Mean number of days per year at or above 30 deg C	52.0 days
The Mean Summer temperature at 9am	22.4 deg C
The Mean Summer temperature at 3pm	27.5 deg C

We know it's a hot topic GLOBAL WARMING—so even the worst predictions have the ambient temperatures rising 1.8 to 4.0 deg C by 2100. The issue is one that shouldn't be ignored but it has little impact on the selection of your air conditioning system right now.

Every effort should however be made to ensure that the most effective and efficient system be selected. Actron Air have in recent years developed the ESP and ESP Plus systems, which apply the most intuitive technology available to deliver air conditioning equipment as efficient as possible ongoing product development in 2007 will ensure even greater efficiency through new control and system design.

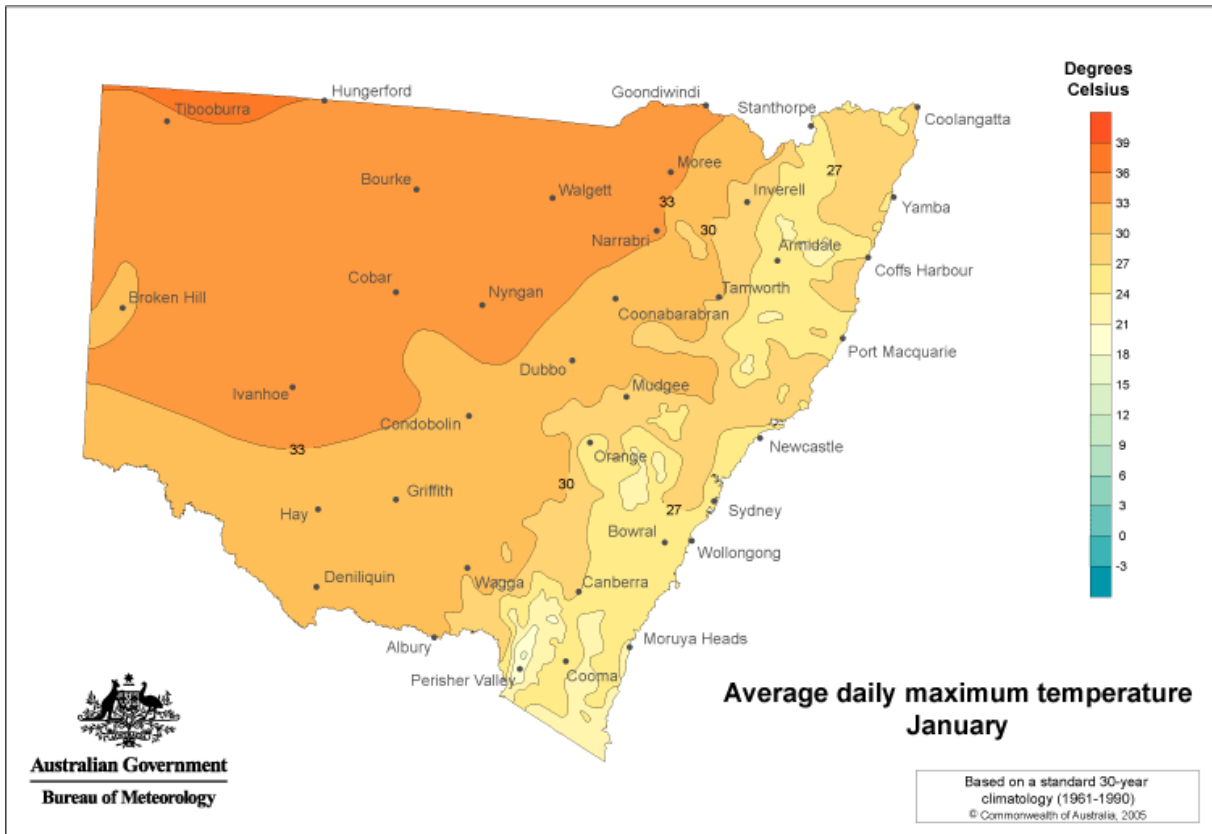
ESP is not the answer for all clients Technology like ESP and ESP Plus comes at an extra cost but the long term savings

- Up to 30% for ESP
- Up to 55% for ESP Plus

Cannot be ignored—along with operating cost savings we are actively reducing greenhouse gas emissions, so the savings are not just for the product user the environment is also a winner.

The ESP system allows the air conditioning system to modulate capacity between 10-100%, whilst the ESP Plus gives us the added advantage of directly modulating air flow volume from 20-100%. ESP and ESP Plus is the ultimate solution to part load operation—it's there at 100% when it's needed but trims back and provides just enough capacity when the load is lighter—end result is a more comfortable air conditioning system and a greatly reduced operating cost.





**Weather Detail CESSNOCK Airport
 Data 1968 to 2004**

Source Australian Bureau of Meteorology

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Daily Max Temp deg C	29.6	29	27	24.2	20.5	17.9	17.2	19.3	21.9	25.0	26.3	28.7	23.9
Mean No Days >= 40 deg C	0.8	0.3	0	0	0	0	0	0	0	0	0.2	0.1	1.4
Mean No Days >= 35 deg C	4.8	2.9	0.8	0	0	0	0	0	0	0.6	1.6	3.8	14.5
Mean No days >= 30 deg C	12.8	9.6	5.9	0.8	0	0	0	0.1	0.9	4.6	6.5	10.7	52.0
Highest Max Temp deg C	43.4	44	38.4	33.6	28.9	25.3	23.6	30.0	34.9	38.6	41.8	40.8	44
Mean 9am air temp deg C	23.0	22.2	20.5	18.1	14.3	11.0	10.0	13.3	16.0	19.0	20.0	22.1	17.5
Mean 3pm air temp deg C	28.1	27.2	25.9	23.1	19.3	16.8	16.3	18.4	20.8	23.1	24.6	27.1	22.7
Mean RH 9am	71	81	84	77	85	85	81	77	72	65	66	68	76
Mean RH 3pm	51	57	58	53	62	61	54	48	49	49	49	49	53

Weather Detail MARYVILLE
Data 1964 to 1993

Source Australian Bureau of Meteorology

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Daily Max Temp deg C	27.6	27.4	26.2	23.9	20.6	17.8	17.4	18.8	21.1	23.3	24.6	27.0	23.0
Mean No Days >= 40 deg C	0	0.2	0	0	0	0	0	0	0	0	0.1	0.2	0.6
Mean No Days >= 35 deg C	1.5	1.2	0.3	0.1	0	0	0	0	0	0.3	0.7	1.9	5.9
Mean No days >= 30 deg C	6.2	4.5	2.7	0.5	0	0	0	0	0.6	2.4	3.0	5.9	25.7
Highest Max Temp deg C	41.3	41.1	40.1	37.2	28.7	24.4	27.1	28.3	34.9	37.5	41.5	42.2	42.2
Mean 9am air temp deg C	23.4	23.1	22.1	19.3	15.6	12.6	11.5	13.1	16.3	19.3	20.5	22.6	18.3
Mean 3pm air temp deg C	25.8	25.8	24.6	22.5	19.5	16.9	16.5	17.7	19.6	21.2	22.8	25.1	21.5
Mean RH 9am	72	76	74	73	77	77	74	69	64	63	67	68	71
Mean RH 3pm	65	67	65	61	64	62	57	53	55	61	62	61	61