



AIRCOSAVER Demo / Measuring Guidelines

Any innovative product that promises energy savings is required to demonstrate these in demos to potential clients. The following guidelines shall support AIRCOSAVER distributors in doing demo and reference measurements.

Please read these demo guidelines before starting reference measurements and demos.

Before you start: Some basic diagnostics

Before you start measuring energy consumption please observe one full AIRCOSAVER cycle. The easiest way to do this is to follow the status codes of the AIRCOSAVER LED. At any given moment the LED will tell you exactly in which phase the AIRCOSAVER is in.

Here is a list of phases and what they mean (applicable from software version 4.x). 1 flash = status 1, 2 flashes = status 2, etc.)

Phase	Meaning
1	Relay open. Compressor off. 1 minute initial offtime (protection against short power cuts)
2	Relay closed. Sensing for cooling or Standby if aircon is not cooling properly or if heating is activated. Minimum 2 minutes.
3	Relay closed. Compressor on. Sensing for thermodynamic saturation. Length varies depending on heatload, efficiency and some other factors.
4	Relay closed. Dynamic learning & adaptation to you specific room and aircon unit – the length of this phase varies, depending on heatload and whether the thermostats setpoint can be reached.
5	Relay open. Anti short cycle time. Compressor off.
6	Relay open. Waiting for temperature hysteresis (in many applications this phase will be short or not even visible).
7	Relay closed. Sensor has short or open connection or the temperature reading is outside of defined measuring range (can occur during extreme heating).

For diagnostic purposes it is helpful to check

1. If you can observe phase 1 (compressor off for 1 minute) when the AIRCOSAVER is connected to its power supply. After 1 minute the compressor will come on and the AIRCOSAVER moves on into phase 2. This indicates that you are using the correct switching wire to the compressor.
2. If the AIRCOSAVER moves onwards from phase 2 into phase 3 (and onwards). This indicates that the temperature sensor is positioned correctly and that your aircon is cooling properly. If your AIRCOSAVER remains in phase 2, the first thing to check is if the AIRCOSAVER's temperature sensor is positioned fully in the cold supply air to the room, close to the evaporator coils.

During a regular cycle the AIRCOSAVER will go in this order: Phase 1 (first cycle only), Phases 2, 3, 4, 5, 6 (6 can be very short). Then the cycle starts again with 2, 3, 4 and so on.

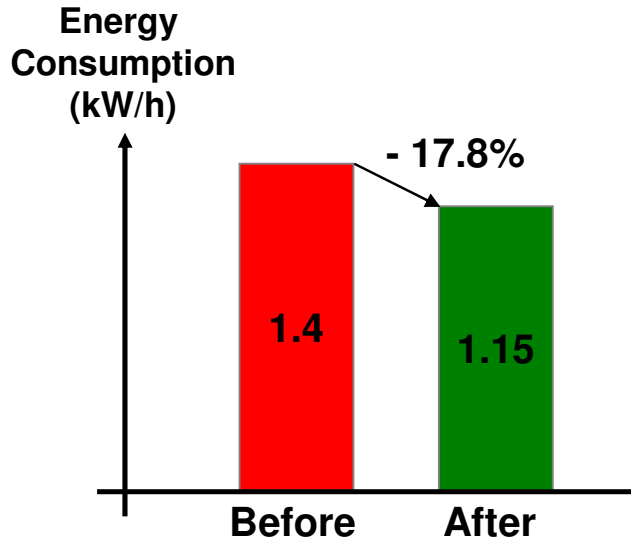
If you have been able to observe these stages, let's begin the measurements.

Basic measurement principle: Before and after comparison

No matter in which way the measurements are done, the basic principle is always the same: We need to make a simple before and after comparison of the aircon system's energy consumption (kWh), for example one day with the AIRCOSAVER and one day without the AIRCOSAVER.

Testing can be done in real-life applications or in special laboratory testing situations.

Make sure that the conditions in the day-to-day or week-to-week comparisons in terms of ambient temperature, ambient humidity and heat load in the testing room **are as equal as possible** (similar number of occupants in the room, same heat from lighting, same frequency of opening of doors / windows etc.).



Duration of Measurement

Generally, the rule is: The longer the better.

If you only measure for very short periods of time (let's say for one hour or so) then the measurements will not be very precise and any variations in testing conditions will have a large influence on the results. Over time, these tend to even out.

More importantly, in such a short measurement interval, the AIRCOSAVER has no chance to fully adapt its settings to your aircon system and to the current heatload.

If you only have very short time available for measurement, we suggest to measure for at least 2 hours with and 2 hours without the AIRCOSAVER.

For future references it is also useful to record the software version of your AIRCOSAVER on the measurement report. You can find this version information on the small white sticker on the side of your AIRCOSAVER and on the white cardboard box, it is something like 2.2, 3.6, 4.1 etc.).

Which values can / should be measured?

Measurements can be done in various forms and levels of detail, depending on the effort you want to invest and which equipment you have available. Very simple and quick measurements start with the consumed energy in kWh, more complex measurements include a whole range of further information:

1.) Consumed energy in kWh (or close approximations) – essential

This is the essential measurement. Your clients usually pay for consumed true power in kWh. Therefore, the most important thing to measure is the consumed KiloWattHours (kWh) over the testing period.

kWh is the consumed true power in Watts, as opposed to kVA which defines the apparent power if your aircon's power factors is not 1.



As a side note, most aircon systems have a power factor of 1 or very close to it anyway thanks to internal power factor correction measures. Therefore, the potential for power factor correction on aircon systems is extremely limited.

In any case, true kWh is usually what the client pays for in his energy bill, not kVA. The AIRCOSAVER does not change the power factor (cos phi) of an aircon systems.

If you can not measure for the same time intervals with and without the AIRCOSAVER, it is a valid approach to calculate the kWH consumption per hour and compare these values.

The kWh values can either be recorded (logged) continuously in intervals - for example every 5 or 15 minutes - or can be taken at the end of the measurement period as a total - do not forget to record the duration of each test.

If you have no option to measure kWh consumption, you can measure the Ah (Ampere hour) consumption since Voltage does not change substantially, and Amps x Volts = Power in Watts (at power factor 1). So the Ah consumption is proportional to the kWh measurement and shows the same savings percentage.

Alternatively, but more imprecise, you could record the runtime of the compressor. Assuming constant current, this also gives a (rougher) first indication of the savings. Use this option only if no other measurement options are available.

The power readings can be either single phase or 3-phase, depending on your aircon unit.

2.) Indoor temperature – optional, recommended

The aim of the AIRCOSAVER is to achieve energy savings without compromising on the cooling comfort.

Therefore, it makes sense to also measure the indoor temperature. You might say that the thermostat takes care of the room temperature and that is actually correct. The AIRCOSAVER software (from version 3.x onwards) recognizes the thermostat status and takes it as an input into the algorithm.

That means it understands if the thermostat is being reached at all or not and gradually adapts its settings accordingly. Nonetheless, a separate temperature measurement in the room can be helpful to illustrate that the same room temperatures are being achieved.

This value is usually recorded in intervals with a data logger, for example every 15 minutes.

3.) Ambient (outdoor) temperature – optional, recommended

In order to confirm that testing conditions in the before and after case are very similar, it is worth to also record the ambient temperature. Like the indoor temperature, this value is typically logged in intervals.

4.) Indoor and Outdoor humidity – optional

To datalog these values completes the picture of testing conditions and performance but can require more extra equipment.

5.) Compressor cycle pattern

The data logging of the compressor on/off cycles is more of an informative measurement.

However, it can be helpful when discussing the results with a client, for example when discussing the slightly more frequent cycling of the compressor with the AIRCOSAVER.

Appendix A: Measuring Equipment

The following is a list of some selected equipment suppliers for data logging instruments.

Simple single-phase plug-in kWh meters

For some quick demos on single phase aircons, a simple plug-in kWh meter will already be sufficient.

In many countries aircon units are plugged into a dedicated power point so if you plug the single-phase meter into this power point and then plug the aircon unit into it, you only measure the energy that is consumed by this aircon unit.



These simple devices are available for every type of plug format and can record, kWh, power factor and measurement duration. They will sometimes also directly give you the kW per hour (kW/h) value.

ZIMMER

This is really the “Mercedes” and quite expensive.

<http://www.zes.com/>

HOBO

In the past used by our engineers before and worked well: Hobo loggers.

Hobo loggers have been used for kWh and RH measurements by our partner in Puerto Rico. These are good value and from my point of view recommendable.

<http://www.onsetcomp.com>

ACR

Also used were instruments from ACR systems, especially for simple temp. measurements the ACR smartbutton. I think at least their smartreader2 has both temp and RH channels. ACR seems also recommendable in terms of value for money.

<http://www.acrsystems.com/products/>

FLUKE

The classic but also quite expensive.

<http://www.fluke.com>

ATAL

Dutch company. Offers single phase and 3 phase recording and monitoring equipment.

<http://www.atal.nl>



Appendix B: Some Examples

Please refer to <http://www.aircosaver.com/references.php>

More examples are available on request.