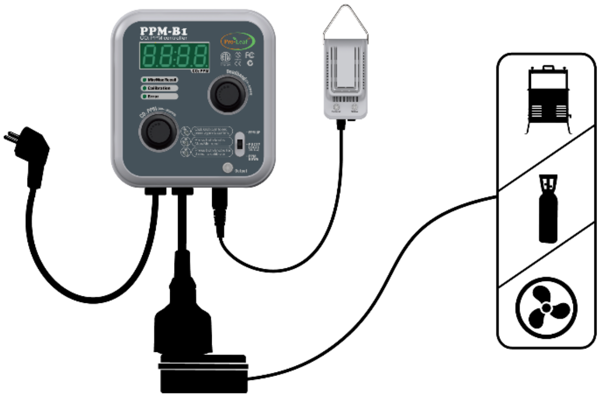
Pro-Leaf CO_2 Controllers – B1 & B2 Explained

Pro-Leaf B1

B1 is a 'closed loop system' CO_2 controller that interfaces with an air conditioner to control the heat load produced by HID or LED lighting.

A dehumidifier may also be recommended for closed systems in hot climates or a humidifier in cool climates.

A closed loop system generally is entirely sealed and has no extraction fans operating during the lights on period, which allows for the efficient use of introduced $C0_2$. You are relying on the B1 CO_2 controller, the air conditioner, and the dehumidifier/humidifier to maintain grow room temperature & humidity.



The heat load of HID or LED lighting will require sufficient air conditioning and can be expensive to maintain grow room parameters in hot Australian summers.

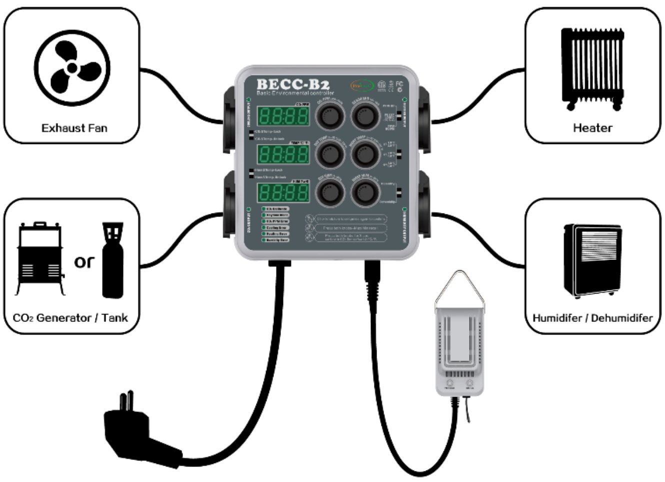
LED Lighting Recommended for Closed Loop Systems:

Closed loop systems will suit the reduced heat load of LED lighting. Less radiant heat means ideal conditions for closed loop $C0_2$ rooms. A minimum of 500 W (Reverse Cycle AC) per every 1000 W of LED light is recommended. A minimum 1000 W of AC per every 1000 W of HID lighting is recommended.

Pro-Leaf B2

B2 is an 'open loop system' CO_2 controller that has both heat and humidity overrides for your extraction fans.

- Your fans (and humidifier if using one) plug directly into the B2.
- If the room gets too hot (say 32°C is your chosen maximum temperature) it switches the extraction fans to **on** (opens the room).
- If the room gets too humid (say 85% is your chosen maximum humidity) it will again switch the extraction fans **on**.
- Extraction fans stay on until both the temperature and humidity return to your minimum settings (Perhaps 28°C and 50% humidity). Only then will fans turn **off** so that the B2 can re-dose the room with CO_2.



Pro-Leaf CO_2 Controllers – B1 & B2 Explained

As every climate is different, the temperature and humidity parameters you choose must be realistic for your location, or the controller will be forever telling your fans to vent the area. This will waste a lot of CO_2 which can become expensive. Hot and humid climates will experience higher ambient temperatures and humidity. A more expensive (to set up) 'closed loop system' may be better suited for the tropics. Bringing air into your room that is hotter and wetter than your chosen parameters will result in the controller not working efficiently. Therefore, the B2 'open loop system' is more suited to mostly dryer, temperate climates.

Best case scenario (B2):

- Set Max temp to 32°C / Min to 22°C.
- Set Max humidity to 75% / Min to 50%
- Set CO_2 ceiling to 1800 ppm
- Set CO_2 floor to 800 ppm

1. CO_2 turns on and lifts room level to 1800 ppm
2. Plants use the elevated CO_2 over time, and it drops to 800 ppm (say 40 mins for example).
3. Fans don't have to engage because temp and humidity are perfect throughout this period.
4. The sniffer unit detects low CO_2 levels (800ppm) and doses the room again back up to 1800 ppm.
5. Repeat.

REALITY CHECK – Difficult to achieve & maintain without adequate air con and a large dehumidifier.

Most likely scenario (B2):

- Set Max temp to 40°C / Min temp to 28°C
- Set Max humidity to 85% and Min humidity to 60% in early flower (Reduce humidity settings to Max 70% / Min 55% for last 4 weeks to lessen the chance of mould)
- Set CO_2 ceiling to 1800 ppm
- Set CO_2 floor to 800 ppm. CO_2 turns on and lifts room level to 1800 ppm

1. Plants use CO_2, but room heats up to 40°C within 20 mins of dosing – controller switches extraction fans on to extract heat build-up.
   Or
2. Plants use CO_2, but humidity rises and hits 85% within 20 mins of dosing – controller switches extraction fans on to vent humidity.

Sometimes you cannot maintain the perfect parameters for the time it takes to deplete all the CO_2.
The benefits of increased CO_2 levels are significantly reduced if grow room temperature and humidity are not correct. Plants will tolerate higher ambient temperatures when enriched with supplemental CO_2 with 40°C as the upper limit.

OTHER IMPORTANT NOTES:

CO_2 Saturation Point:
Never exceed 1800 ppm of CO_2. It is toxic above 2100 ppm to both plants and humans. 1800 ppm is high enough to be considered saturation point. 1500 ppm is ideal.

External Timers are not required with B1 & B2:
Both B1 & B2 are the timers, except they don't work on time. They work on CO_2 ppm levels. They will switch the regulator on for as long as it takes for the CO_2 to reach the desired ceiling level that you set (usually 1800 ppm). That is what the sniffer unit is for. It sniffs the CO_2 levels constantly. No external timer is required.

Pro Leaf CO_2 Regulator/Flow Meter/Solenoid

The regulator must be used with the supplied white washer to ensure a leak proof seal between gas bottle thread and regulator nut & tail. Failure to use this washer will result in a gas leak and loss of CO_2. The temperature of CO_2 when delivered through a regulator from a gas cylinder can vary based on several factors, including the ambient temperature, the flow rate, and the specific design of the regulator. However, here are some key points to consider:

1. **Ambient Temperature**: The temperature of CO_2 will generally be close to the ambient temperature because the gas cylinder is typically stored at room temperature.
2. **Expansion Cooling**: When CO_2 is released from the high pressure in the cylinder to a lower pressure through the regulator, it undergoes expansion. This can cause the temperature of the CO_2 to drop significantly, a phenomenon known as the Joule-Thomson effect.
3. **Flow Rate**: Higher flow rates can lead to more noticeable cooling effects, whereas lower flow rates may result in less temperature drop.

In practical terms, CO_2 can exit the regulator at a temperature lower than the ambient temperature, potentially even below freezing if the flow rate is high enough. This is why frost or ice can sometimes form on the regulator or the CO_2 lines. **High flow rates and the resulting low temperature, risk freezing open the regulator, flowmeter & solenoid. This will result in the solenoid not closing and dumping the entire contents of the gas bottle into the room. A maximum flow rate of 0.5 to 1 litre per minute (L/min) is recommended to avoid this situation occurring.**

Materials Needed:

1. CO_2 bottle (cylinder)
2. CO_2 regulator
3. Flow meter
4. Solenoid valve
5. CO_2 controller with ppm sensor
6. Tubing for CO_2 distribution
7. Timer (if not integrated into the CO_2 controller)
8. Hose clamps or fittings (as needed)

Step-by-Step Instructions:

1. Setup and Safety Precautions:

- **Check for Leaks:** Ensure that all connections are secure and check for leaks using a soap and water solution before fully opening the CO_2 bottle. Do not overtighten brass fittings as they may spilt.
- **Ventilation:** Make sure the grow room is well-ventilated but can be sealed during CO_2 enrichment periods to maintain desired levels.
- **Safety Gear:** Wear appropriate safety gear such as gloves and eye protection when handling the CO_2 bottle and setting up the system.

2. Connecting the Equipment:

1. **Attach the Regulator to the CO_2 Bottle:**
    - Securely attach the CO_2 regulator to the top of the CO_2 bottle. Use a wrench to ensure it is tightly connected but do not overtighten.
2. **The Flow Meter:**
    - This will measure and control the flow rate of CO_2 being released.
3. **The Solenoid Valve:**
    - The solenoid valve will control the on/off flow of CO_2 based on the signals from the CO_2 controller. Check operation by turning power to solenoid on/off, a clicking sound will indicate opening & closing.
4. **Setup the CO2 Controller:**
    - Place the CO_2 controller sensor in the grow room, ideally at plant canopy level to accurately measure CO_2 concentrations.
    - Connect the CO_2 controller's output to the solenoid valve. This connection allows the controller to open and close the solenoid based on CO_2 levels.

3. Tubing and Distribution:

1. **Attach Tubing to the Solenoid Valve:**
    - Secure the tubing to the solenoid valve's outlet using hose clamps or fittings as needed.
2. **Distribute Tubing in the Grow Room:**
    - Run the tubing throughout the grow room, placing it above the plants. Make sure the tubing has small holes or emitters to evenly distribute the CO_2.

4. Setting Up the System:

1. **Set the Desired CO_2 Level:**
    - Set the CO_2 controller to maintain 1500 ppm. Follow the controller's manual (see above) for specific instructions on how to set the desired ppm level.
2. **Regulate CO2 Flow:**
    - Adjust the flow meter to deliver the appropriate amount of CO_2. A flow rate of 0.5 to 1 litre per minute (L/min) is generally effective for small to medium-sized grow rooms. Fine-tune this rate based on room size and controller readings. Beware of freezing the solenoid open.
3. **Timing the CO2 Release:**
    - Use the integrated timer on the CO_2 controller or an external timer to synchronize CO_2 release with the grow lights on cycle. Introduced CO_2 is effective during photosynthesis, which occurs when lights are on.

5. Monitoring and Adjustments:

1. **Monitor CO2 Levels:**
    - Regularly check the CO_2 levels displayed on the controller to ensure they remain at the desired 1500 ppm.
2. **Adjustments:**
    - If CO_2 levels are not being maintained, adjust the flow meter or the duration of CO_2 release periods. Ensure there are no leaks or blockages in the tubing.
3. **Maintenance:**
    - Periodically check all connections, tubing, and equipment for wear and tear or leaks. Replace components as needed to maintain system integrity.

6. Additional Tips:

- **Monitor Plant Response:** Observe your plants for signs of CO_2 toxicity (e.g. leaf burn) and adjust levels accordingly.

Why use CO_2 enrichment?

A plant leaf uses CO_2 during the process of photosynthesis, which can be summarised in the following steps:

1. **CO_2 Uptake:** CO_2 enters the leaf through small openings called stomata. These stomata can open and close to regulate gas exchange.
2. **Transport to Chloroplasts:** Once inside the leaf, CO_2 diffuses into cells and eventually reaches the chloroplasts, which are the organelles where photosynthesis occurs.
3. **Photosynthesis:** Inside the chloroplasts, CO_2 is used in the Calvin cycle, a series of chemical reactions that convert CO_2 and water into glucose (a type of sugar) using the energy captured from the sun or artificial light by chlorophyll (the green pigment in leaves). This process also releases oxygen as a byproduct.
4. **Energy Storage:** The glucose produced is then used by the plant for energy and growth or stored as starch for later use.

Through this process, plants convert CO_2 into organic compounds that are essential for their growth and development, while also releasing oxygen into the atmosphere. Increasing ambient CO_2 levels will result in accelerated plant growth & flowering.

CO_2 is heavier than air and will fall to the ground in enriched CO_2 rooms, an oscillating fan at ground level aimed upwards is required to push CO_2 back into the plant canopy. The stomata on the underside of the leaf opens to receive the extra CO_2.