1) **Eight Steps to A Dry Shipping Container- Without Power**

Contributing Variables and Remedies for Eliminating Condensation

The following is prioritized by the biggest bang for the buck. Please note; every location and climate zone will be a little different, but the following 7 steps should resolve most condensation issues.

The following 6 steps is pretty much mandatory- the basic starting point

1. Container must be placed on good draining ground, not in a low wet area
2. Exposure to wind, in a sunny area, but a shaded roof can be very beneficial (sounds a little conflicting).
3. A min. separation of 1ft. from neighbouring buildings or other conex, for airflow (drying) purposes
4. Never sit on the ground, always on a beam at each end, allowing airflow underneath
5. The roof must be kept clear of leaves, soil, algae, moss, etc. Regular maintenance required in some areas.
6. If rusted or a dark color, paint white (gloss), especially the roof to reflect the heating effects of the sun. Good reports on this silicone roof paint: GacoFlex s2100 https://gaco.com/product-details/gacoflex-s2100/
7. **Ventilation is the next step:** Install proper ventilation that will encourage multiple air exchanges per day. Some locations will need more air flow then others. Three choices: A powered fan system, spinning rooftop turbine, or our “360 Wall Mount” exhaust vent. The air must be driven; louvers, hooded vents and other passive products do not create airflow. See “Ventilation Requirements”.

8. **If condensation persists, Insulation is the next option:** Closed cell spray insulation is the most effective due to it fills all air pockets and also works as a vapor barrier: We have seen extremely low RH in containers with just the ceiling done. In the real tough situations the walls might also have to be sprayed. ½” – ¾” appears sufficient. There are companies that will spray it (over $1000), or there are “Do it Your Self Products“ ($300-$600).

**Important Tips**

- Avoid bringing wet materials or equipment into the container, same goes with wet shoes when entering. The extra moisture could be sufficient to initiate condensation, only adding to the work load of the above advantages.
- A full container often has fewer problems than an empty one. Displacement reduces the interior air volume, which in turn reduces the interior moisture content.
- The best method of monitoring the interior atmosphere is with a humidity gauge. We have been using the small digital units, located about half way up a wall. You don’t want to go in every day to check (especially with wet shoes), but it is the best way to monitor the RH and to see the results of your moisture control efforts.

**Note:** All the points listed here will offer your conex the best possible chance of being condensation free. Depending on the severity of the containers moisture problem you might require insulation, more vents or even a roof. Interior conditions will vary depending on climate, geographical conditions and seasons.

If all else fails you might need a roof structure, or bring in power. The roof (peaked or lean-to) will keep the sun off as well as due and rain. The overhang will keep water from the sides and saturating the conex base. In the hot humid areas like Florida a dehumidifier would be the last but effective option.
2) Ventilation Overview

**Stock Container Vents:** Are usually mounted on the upper side walls, 4 - 8 units per container. They are as passive as you get, worse still they only have an air passage way of 3/8 sq. in, about the size of a dime. Proper ventilation needs a driving force with direction, and to provide sufficient air exchanges for size of the enclosure. Our passive intake vent below has about 60 times the airflow capacity of these stock vents.

**Airflow Direction and Drive:** The overall goal is to pull air from one end thru to the other where it’s exhausted. An open port concept that lets the wind blow in is not ideal. Air borne particles including mist, moisture, pollen, ash ect will be blown inside. Normally fans are used to exhaust, pushing out air from one end, same as our “360 Wall Vent”. Most places have sufficient winds to drive a good exhaust. See the following site for winds in your area. [https://www.wunderground.com/history/](https://www.wunderground.com/history/) The spinning turbines are good exhaust units, but the installations are complex due to having to seal on the corrugated metal roof. They are mechanically dependent and are known for allowing water and insects inside.

**Our Exhaust Vent “360 Wall Vent” - Drives the Airflow:** An easy install, with no moving parts, a bug screen, water proof and exhausts 3-4 Cu Ft / min with every 1 mph of wind. The patented vent cover manages all winds, any direction, turbulence, gusts and can still exhaust with air movement as low as ½ mph. To take best advantage of your local winds, vent location is important. To allow vent installation on any of the four walls we have adapter plates to insure the best location for the exhaust vent is always possible.

**Our “Intake Vent” A Passive Container Vent:** Fits almost anywhere on a container, preferably installed on the less windy side and shady side. Two styles; one for the side wall profile and another one for the back end.
3) **Determining Vent Quantity: Exhaust and Air Intake**

The following two variables determine the daily air exchanges inside of an enclosure, key for effective ventilation.

1) Calculate the volume of the enclosure / container

2) Attempt to assess the winds on location. Direction, speed, duration, does it change direction through the day, is it gusty and turbulent?

   **Wind Speeds**
   - 1-2 mph: not even noticeable and usually present
   - 3 mph: a slow walking speed, hardly noticeable
   - 4-5 mph: a slight breeze
   - 6-7 mph: a light wind
   - 8-9 mph: a little windy
   - 10 -12 mph: a good wind. White caps form on the water

The following table is based on our “**360 Wall Vent**”, this wind powered exhaust vent is the ventilation driver. With an average draw rate of 3 cu. ft / min/1 mph. These numbers do not reflect the additional gusts, turbulence, rising thermals or the vents max draw rate of 4 cu ft. This Exhaust vent is the primary, it powers the ventilation process, it must be subjected to as much air movement as possible.

<table>
<thead>
<tr>
<th>Example</th>
<th>Volume</th>
<th>Exhaust Vents</th>
<th>Average wind speed / day</th>
<th>Exhausted air volume / hr</th>
<th>Completed air exchanges / day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td>20' container 1300 cu ft.</td>
<td>1</td>
<td>3 mph</td>
<td>540</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>40' container 2600 cu ft.</td>
<td>1</td>
<td>3 mph</td>
<td>540</td>
<td>5</td>
</tr>
<tr>
<td>Example 2</td>
<td>20' container 1300 cu ft.</td>
<td>1</td>
<td>5 mph</td>
<td>900</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>40' container 2600 cu ft.</td>
<td>1</td>
<td>5 mph</td>
<td>900</td>
<td>8</td>
</tr>
<tr>
<td>Example 3</td>
<td>40' container 2600 cu ft.</td>
<td>2</td>
<td>5 mph</td>
<td>1800</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>53' High cube 3900 cu ft.</td>
<td>3</td>
<td>5 mph</td>
<td>2700</td>
<td>16</td>
</tr>
</tbody>
</table>

**Please Note:** This table is to show the relevance of wind speed. If low, more vents might be required. In many locations 10 mph is common; if that is the case a 40' container might only need 1 exhaust primary @ 16 exchanges /day.

**Air Intake (a passive vent that feeds the exhaust “360 Wall Vent”): Recommend 1 Intake for every 2 Exhaust Vents**

A container is almost airtight, intake vents are required. Do not count on the small rectangular stock vents. With three exhaust vents you should consider adding a second intake vent. In the event you already have a passive vent such as the metal hooded units, they will also work (they are all passive). Our water tests revealed the louvered vents created mist from rain splashing against the louvers, not the best choice.

**How Many Air Exchanges?** Ten air exchanges per day in the PNW might be sufficient to eliminate condensation but not necessarily in Florida.

Arizona might get by with less than 10 a day. At this point it appears the exchange range can vary from 10 -20 / day.

Every climatic region is going to be a different, that is why its beneficial to have as many things in your favor as possible, such as the first few steps on page 1.

Now that you have an idea for vent requirement, installation location is important to catch the most wind as possible.
4) Vent Location Design

The first drawing below is for local winds that are predominately consistent in direction. The colored arrows indicate incoming winds directions. "EX" is Exhaust, "IN" is Intake, note the colors, as per the wind directions. The second drawing is when winds have little consistency or it comes in from two opposite direction on a regular bases. The numerous vent designations are to show the many acceptable locations. Regardless what end the door is on, the vents should be placed according to the wind directions. More wind hitting the exhaust the better. If possible try to have the exhaust vents on the sunny side and intake on the shady side. We have adapter plates to allow installation on any of the walls. Determine the ideal location for the exhaust first, and then plan for the intake at the opposite end, preferably in the shade.

- The intake vent is not designed for a door mount install.
- Door mounted exhaust vent will inhibit the doors from open fully to latch to the side walls.
- Door mounted exhaust vent does not require an adapter plate
- The back end wall profile is different to the side walls; note the different products for each.
- For extreme light wind areas, more vents would be required with exhaust on the sunny side, for thermals
The port must always be mounted in the up position so that the interior port opening is facing up, louvers down. There is not a large flange area; care must be taken on the cut-out for the port. Plan the port location considering both minimum wind obstructions and vent body location. Also consider physical obstructions on both the inside and outside of the vent. Use recommended or equivalent sealants and fasteners that will not rust, careful not to damage the flange. The three inside louvers are designed for deflecting heavy rain and subsequent splash up. The rear water protection gutter is sized to allow for no airflow obstruction. Please note the port has been designed for maximum draw in the lightest of wind. The clearances and proper fit of the vent body is imperative.

Due to the precise series of shapes, angles and clearances of the vent body, it cannot be distorted or it may not function in all wind conditions as designed. The lightweight plastic is to allow for flex and return to its original shape. Due to its ability to manage all wind directions the vent body can be placed vertically or horizontally depending on the application and available space. If it’s a vertical install (container) do not secure the sides of the port, only in the center of the top and bottom flange (fasteners on the sides will interfere with the placement of the vent body). For a horizontal install secure the port with one fastener on each side. The vent body must fit properly on top of the port to fit into the side indents located on the vent body flange surface. Use two fasteners on the top flange (see below) to help secure the seal the top of the port.

The mounting locations indicated do not have to be precise, that is why they are not predrilled. As long as the port is properly sealed and the vent body is positioned properly over the port unit, it will function as designed. If used on a sealed enclosure or room with no air inlet (such as a shipping container) an intake vent will be required to allow the proper exhaust volume. See “Container Air Intake”. **Container door installation:** mark for the port cut out 5 ¾” x 5 1/4”, centered on the upper panel, mount vertically equal distant from the vertical latching bars (if there is a choice, the bars furthest apart). Also centered between the upper and lower panel welds so the vent body mounts flush. Use a good sealant; Sikaflex, 3M 5200 or equivalent. For a wall mount install, the port will come attached to the appropriate adapter plate (as per your design location, side or back), please see “Exhaust Vent Plates” for detailed installation.
**6) Air Intake Vent Designed for a Container Wall**

This vent is designed to allow air into a container to feed our “360 Wall Vent” as it exhausts. There are two versions; one fits into the side wall profile of any container, the other fits in the rear or back wall profile as pictured below. The purpose is to allow air in from the opposite end of the ventilation driver, the exhaust.

The only difference of the two versions is the shape of the screened port that fits into the wall profile. To be installed at the top under the structural cross member to allow for a proper seal. The ABS plastic is 1/4” gauge with the dimensions below. The aluminum screen has a port area of approximately 22 sq. In.

The cut out is not crucial but we suggest 5” wide and 5-6” high. Three SS self- tapping screws down each side, or rivets. Do not over tighten or use tapered screws, could possibly damage the ABS. Do not install on a seamed valley, as pictured. Use a good sealant, Sikaflex, 3M 5200 or equivalent. To prevent rust lines running down the exterior walls, ensure all the metal filings are removed.

Like any passive vent, it will not drive the ventilation but will allow an inflow of air to allow air exchanges.
Wall Adapter Plate for Universal Exhaust Installation

Please note the side wall plate is 11” wide and the back wall is 10” wide. The two plates are not interchangeable; they will come with the port attached. Insure the plate is positioned properly and the intake is facing up. The small sealant shelf on the plate (top) fits under the conex roof support beam.

To prevent rust lines running down the exterior walls, ensure all the metal filings are removed.

The seal is important; use a good sealant, sikaflex, 3M 5200 or equivalent.
Install the plate first, with the 2 top and bottom screws, about 1" from the ends

Position the vent cover over the port and secure with four additional self tapping screws

Sealant along the top edge
Sealant down both sides
Sealant on the outer edge
Part Specifications

Parts: External Vent Body with mounting flange; 14. 1/8” x 9.5” x 4 1/8”

Internal Port with exhaust screen, water proofing and attachment flange. 7” x 7” x 5 3/4”

Composite: ABS  Color: Black  Port Bug screen: mesh 18 x 16, aperture .0445” x .0515”

Attachment: A good exterior caulking must be used on the port to wall seal; the vent body should also be sealed. Do not use tapered screws; flat head with a washer or rivets depending on the wall material. Note, the vent construction is a light gauge plastic; a tapered fastener could split the mounting flange. See Drawings.

Installation: Determine the location of vent; see “Vent Location” below.

The vent body can be placed vertically or horizontally depending on the application and available space. The square port must always be mounted in the up position so that the interior port opening is facing up, outside louvers down. If it’s a vertical install do not secure the sides of the port, only in the center of the top and bottom flange (fasteners on the sides will interfere with the placement of the vent body) the vent body will secure the sides of the port. For a horizontal install secure the port with one fastener on each side. The vent body must fit properly on top of the port to fit into the side indents located on the vent body flange surface. Use two fasteners on the top flange approximately 6” apart to ensure a secured water seal for the top of the port. The wall mounting surface should be vertical within a couple degrees to ensure reliable water protection.

Cut out requirement: 5 1/4” x 5 1/4”. Flange width 1”

Note: The vent protrudes 4 1/8” off the exterior mounting surface and protrudes 5” on the inside. Watch for door opening clearances and interior obstructions. The vent will prevent a container door from opening to its side wall latching point.

Air flow Specifications

Minimum threshold: less than ½” mph of external air movement

Operational incoming wind angles: All

High Pressure Block (preventing blow-in): 99%

Draw rate (exhaust volume): 4 cu ft / min / for every 1 mph with wind direction 90 degrees to the tunnel.

3 cu ft / min / for every 1 mph with wind direction parallel to the tunnel.

Vent Mounting Location

If possible choose the most exposed wall to the wind. The vent was designed around objects (container door latches) in close proximity of the exhaust ports, but further distance away the better. Even thermals rising above a paved driveway or wall subjected to the sun creates a good draw. Neighbouring buildings and large obstacles create turbulence and gusts, these areas are also good for driving the exhaust. If the location consists of a row of buildings or containers this often creates a wind tunnel effect, with a more consistent low turbulent horizontal wind. In this case a vertical install would provide maximum draw.

Important Note: This vent performs as stated. It will inhibit wind generated high pressure, simultaneously creating a low pressure close to as stated. We cannot guarantee a condensation free enclosure or a fume free environment with the use of this vent, due to the numerous variables such as; enclosure size, location, exposure to wind, intake, and the actual physical characteristics of the application.