

CONTAINER VENTILATION STUDY

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Executive Summary

Innovex Engineering Corp was retained by Mr. Ron Parry to witness the testing of two different ventilation systems for 20 foot shipping containers. The purpose of the experiment was to compare two ventilation systems under the same environmental conditions. The first container was outfitted with a ventilation system from 360 Products called DRY-CON X consisting of two intake vents and two exhaust vents. The second container was outfitted with two typical louver intake vents and a whirlybird/turbine exhaust. The testing was conducted in Kamloops, British Columbia during the month of July 2024.

In nearly all test conditions observed the air flow measured at the vent intake was higher in the DRY-CON X than the comparable whirlybird/turbine vent. Furthermore, the DRY-CON X ventilation system maintained some air flow thru the vent during low ambient wind conditions while the whirlybird/turbine showed minimal to zero flow in the same condition. The results demonstrate that for the ambient conditions during the test period, the DRY-CON X venting system outperformed (83% of the time) the classic whirlybird/turbine vent system. The DRY-CON X vent provides a direct opening to the atmosphere and will not allow a pressure differential between inside and outside the container in normal conditions.

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1 Experiment Setup

1.1 Location and Date

The series of experiments were conducted on an industrial site in Kamloops, British Columbia Canada at 936 Yellowhead. The test was conducted from July 11 2024 thru July 28 2024.



Figure 1: satellite map of test location in Kamloops, British Columbia

1.2 Test configuration

Two identical containers (20ft length) were set up adjacent to each other oriented lengthwise in the north south direction. The first container had the DRY-CON X vents added to the end walls with two inlet vents on one end and two exhaust vent on the other end wall. The second container had one inlet vent added to each end wall and a 12" whirlybird/turbine installed on the roof. The whirlybird/turbine was brand new with double bearings that spins with no vibration or noise.

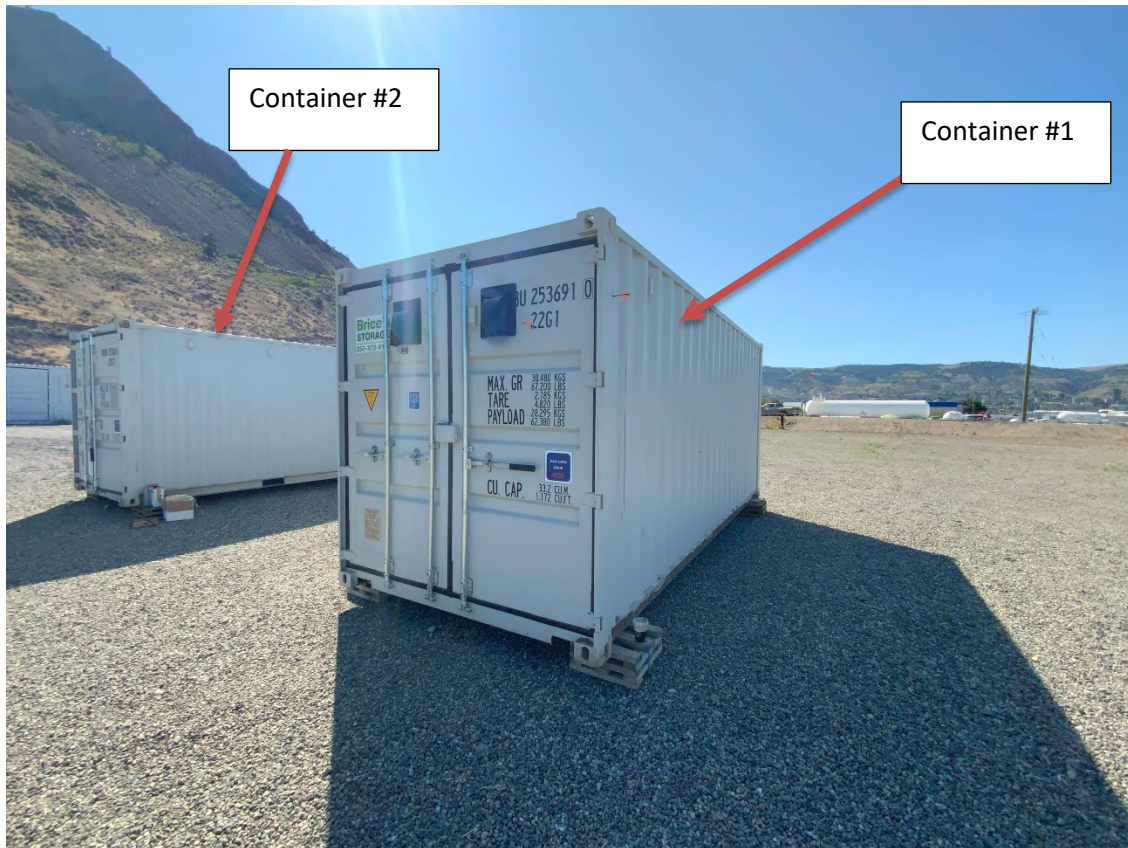


Figure 2: two identical containers set up adjacent to one another

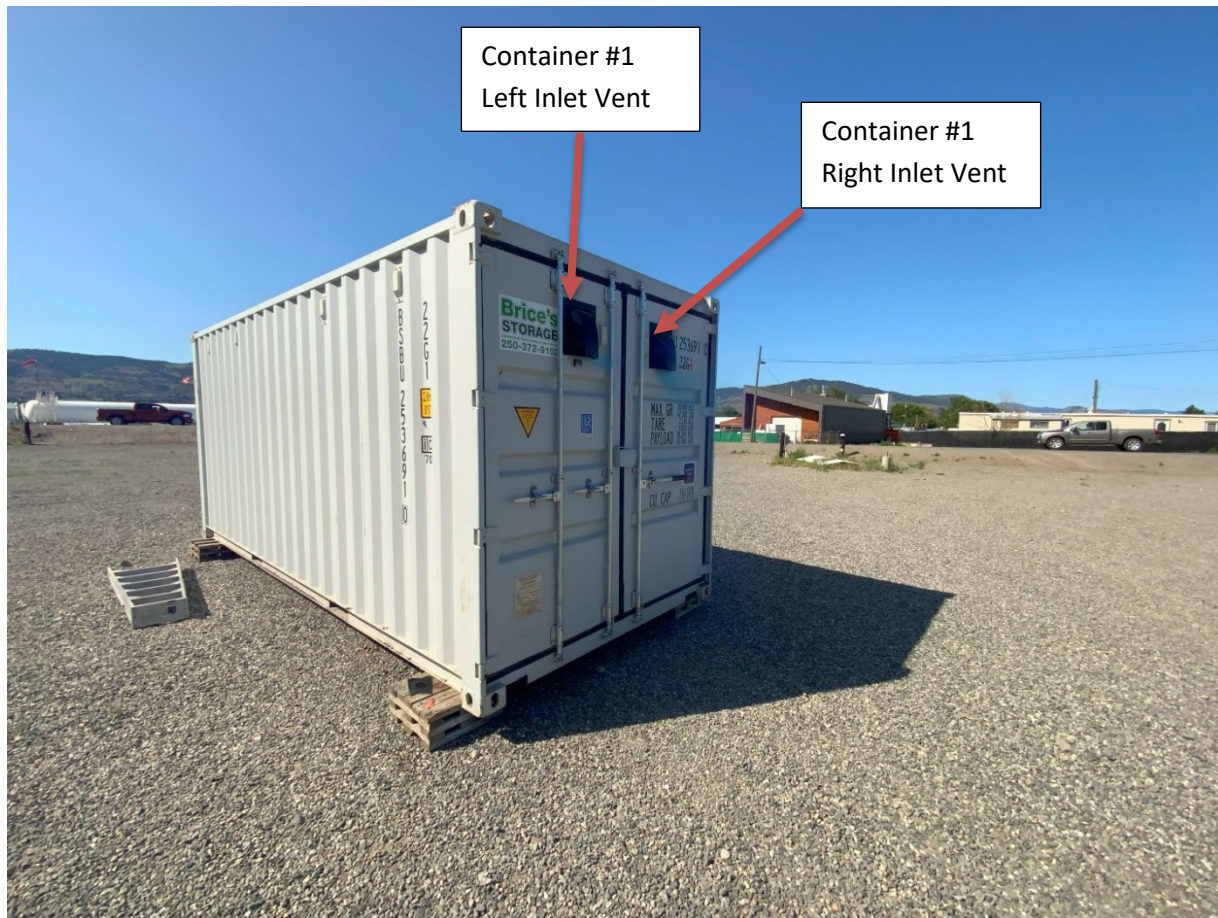


Figure 3: Container #1 inlet vents



Flat Wall Intake

Physical specs for the intake can be found at www.360productsnorthamerica.com/technical-data. The vents were installed by cutting out an opening on the wall approximately 8"x8" and mounting with adhesive per the manufacturer's install instructions. The hole cut out in the container provides a direct venting path to the outside and will not allow the container to build internal pressure.



Figure 4: Container #1 exhaust vents



Physical specs for the exhaust can be found at www.360productsnorthamerica.com/technical-data



Figure 5: Container #1 inlet vents

Container #2 vent placement and quantity were installed as recommended per FCABC shipping container (see excerpt form FCABC)

- Two – 0.3 m X 0.3 m openings for containers 6m or less
- Two – 0.5 m X 0.5 m openings for containers over 6m
- Both openings will be covered by open grate wire mesh with greater than 50% free area
- Higher opening will also have a wind vent device, designed to generate a venturi effect during low wind speeds

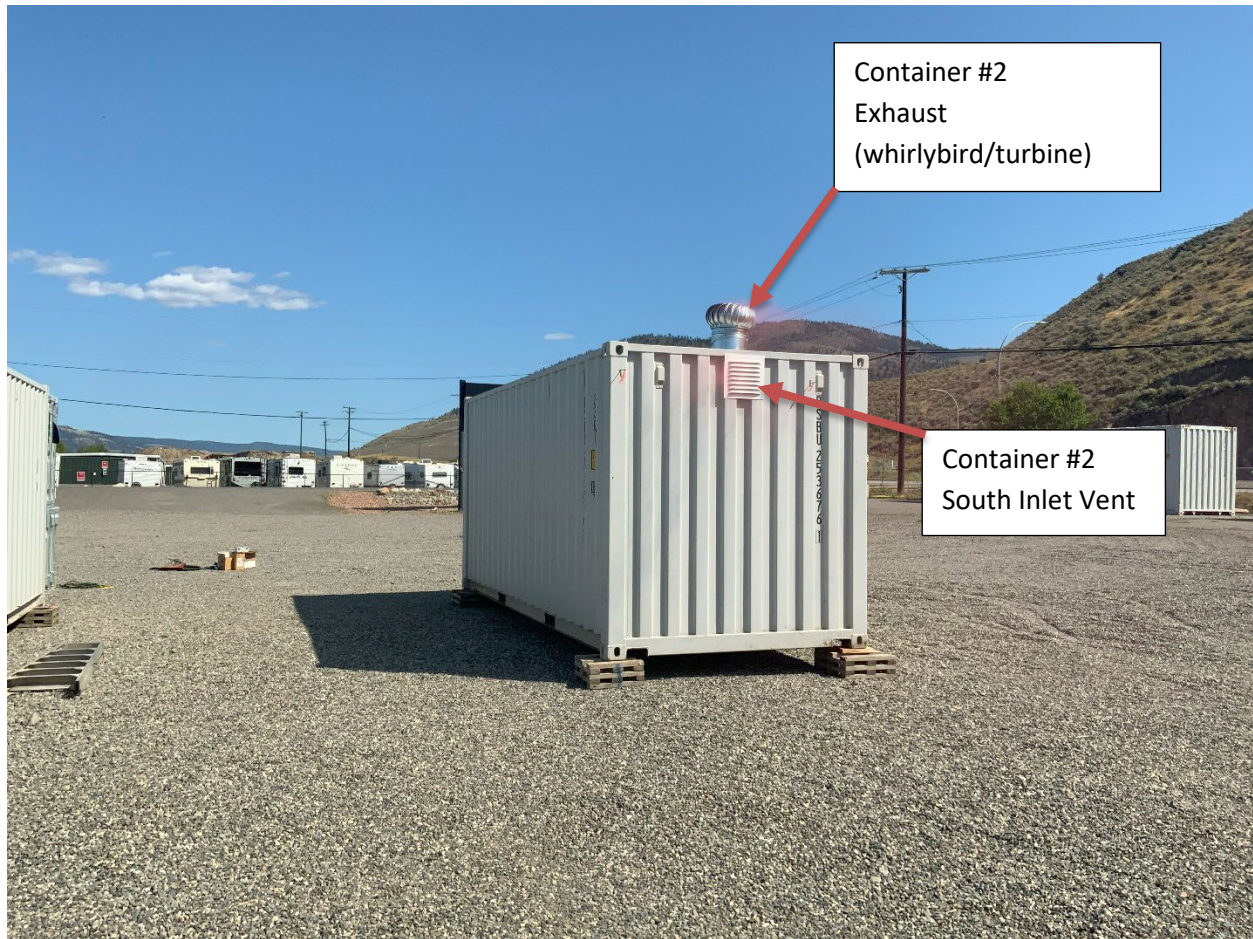


Figure 6: Container #2 exhaust vent

1.3 Test equipment and procedure

A flow anemometer was utilized during the study to measure the wind speed entering the container thru the intake vents.

The measurements were captured and recorded twice daily by Mr. Jesse Huberty. The handheld probe was placed in the center of the vent opening to record the speed of air moving thru the vent opening.



Figure 7: Anemometer air flow device

The temperature inside the containers were also recorded during each vent flow measurement with a digital thermocouple.

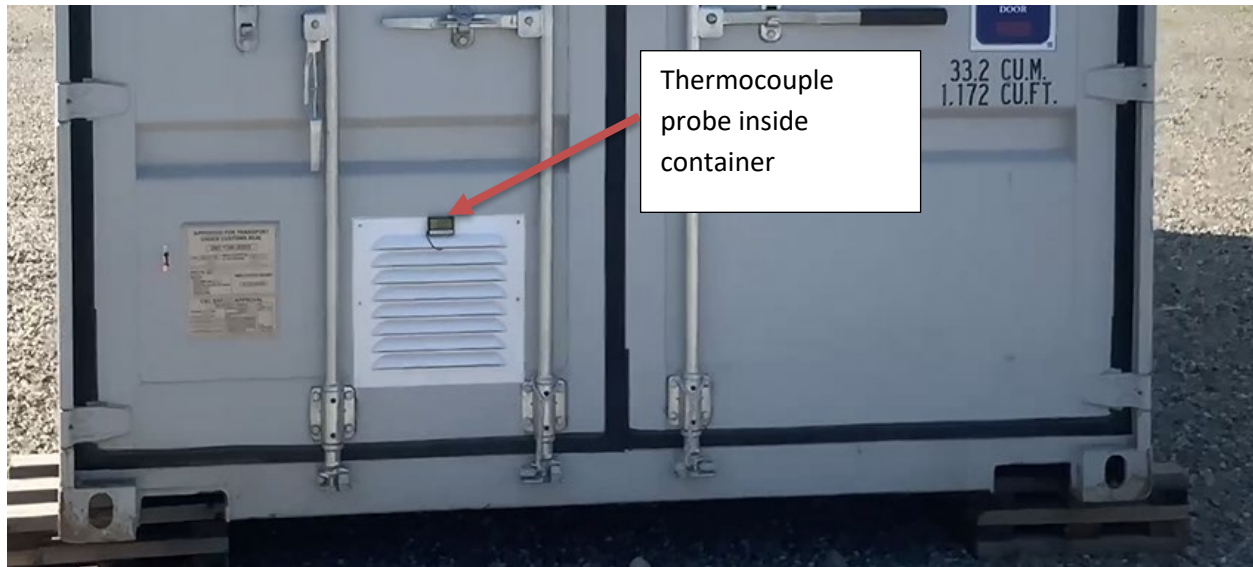


Figure 8: thermocouple temperature

2 Results

The following table shows the data captured during the test period from July 11 thru 28th.

DATE	TIME	WIND SPEED (M/S)	TEMP OUT (C)	NOTES: SUN/SHADE/RAIN/ GUSTY	CAN 1 DRY-CON X				CAN 2 TURBINE			
DATE	TIME	OUTSIDE WIND SPEED (M/S)	TEMP OUT (C)	NOTES: SUN/SHADE/RAIN/ GUSTY	INSIDE TEMP (C)	DRY-CON X AIR SPEED LEFT VENT (M/S)	DRY-CON X AIR SPEED RIGHT VENT (M/S)	TOTAL airflow (CFM)	INSIDE TEMP (C)	TURBINE AIR SPEED NORTH VENT	TURBINE AIR SPEED SOUTH VENT	TOTAL airflow (CFM)
7/11/2024	12:00:00 PM	1.78	36	Sunny and Gusty	34	0.25	0.30	19.7	33	0.152	0.05	19.9
7/11/2024	3:00:00 PM	1	42	Hot with light wind	41	0.2	0	7.0	37	0	0.2	19.7
7/12/2024	12:00:00 PM	0.5	37	minimal wind	35	0.1	0.1	7.0	33	0	0	0.0
7/12/2024	2:00:00 PM	0.4	38		37	0	0.1	3.5	35	0	0	0.0
7/13/2024	9:45:00 AM	0.3	39		32	0	0	0.0	35	0	0	0.0
7/13/2024	12:45:00 PM	0.6	39	Gusting to 1.3	40	0	0	0.0	35	0	0	0.0
7/13/2024	2:15:00 PM	1	45	Rotated cans 90 degrees. Block one 360 intake vent and reading on other vent went from .4 to 1.1	44	0.1	0.3	14.1	44	0	0	0.0
7/13/2024	4:30:00 PM	2.1	41	Sun hits 360 can first	40	0.7	0.7	49.2	40	0.4	0	39.3
7/14/2024	5:30:00 AM	1.3	20		19	0.3	0.3	21.1	19	0.3	0	29.5
7/15/2024	9:00:00 AM	0.5	30	360 exhausts moving air well	29	0.2	0.1	10.5	28	0.1	0	9.8
7/15/2024	12:00:00 PM	1.3	42	whirly bird not moving	39	0.3	0.4	24.6	38	0.1	0	9.8
7/15/2024	2:50:00 PM	1.4	48	whirly bird not moving	44	0.2	0.3	17.6	50	0	0	0.0
7/16/2024	8:30:00 AM	0.3	25	whirly bird not moving	25	0.1	0	3.5	27	0	0	0.0
7/16/2024	12:00:00 PM	1.2	42	whirly bird not moving	38	0.3	0.2	17.6	38	0	0	0.0
7/16/2024	3:00:00 PM	1.7	42	whirly bird not moving	38	1.2	0.9	73.8	45	0.3	0	29.5

7/17/2024	9:55:00 AM	0.1	28	Sun Hits 360 can first	28	0.1	0.1	7.0	26	0	0	0.0
7/17/2024	12:30:00 PM	1.2	43		39	0.6	0.9	52.7	39	0.1	0	9.8
7/17/2024	3:30:00 PM	1.1	49	whirly bird turned for about 15 minutes. Exhaust ranging from .1 to .7 outwards	47	0.1	0.4	17.6	49	0.1	0	9.8
7/18/2024	7:15:00 AM	0.1	24	whirly bird not moving. Blocked one 360 intake and other vent jump to .5 and held. removed block and dropped to .3	23	0.2	0.1	10.5	24	0	0	0.0
7/18/2024	12:15:00 PM	0.5	43	whirly bird not moving	41	0.4	0.2	21.1	41	0.2	0	19.7
7/18/2024	3:45:00 PM	0.5	51	Blocked one intake vent and speed instantly jumped to .5 and hed steady. Removed while still testing and instantly dropped to .3 also picks up on the exhaust side when we block one vent. Maybe we can get away with just 1 intake and exhaust for 20'?	47	0.3	0.1	14.1	51	0	0	0.0
7/19/2024	8:30:00 AM	1.8	26	whirly bird moving. seems to take alot of wind to get moving and if isnt consistant it seems to stop and have a hard time moving again	26	1.2	0.6	63.3	27	0.1	0	9.8
7/19/2024	12:00:00 PM	2.3	42		39	0.3	0.4	24.6	39	0.1	0	9.8
7/19/2024	3:00:00 PM	2.5	45		44	0.2	0.3	17.6	52	0.2	0	19.7
7/22/2024	9:00:00 AM	0.7	27		21	0.1	0	3.5	27	0	0	0.0
7/22/2024	12:30:00 PM	1.2	40	whirly bird not moving	38	0.3	0.4	24.6	40	0.1	0	9.8
7/22/2024	2:45:00 PM	1.5	41	whirly bird not moving	39	0.2	0.4	21.1	45	0.1	0	9.8
7/23/2024	8:30:00 AM	0.7	20	whirly bird not moving	20	0.1	0	3.5	20	0	0	0.0
7/23/2024	12:30:00 PM	0.8	35	whirly bird does not move to .9 or more wind speed we have noticed.	35	0.2	0.1	10.5	35	0	0	0.0
7/23/2024	2:45:00 PM	0.9	41		37	0.3	0.1	14.1	49	0.2	0	19.7
7/24/2024	5:30:00 AM	0.2	14		14	0	0.1	3.5	14	0	0	0.0
7/24/2024	12:30:00 PM	1.2	26	.2 Reading on 360 exhaust blowing outwards. Whirly bird not moving	24	0.1	0.3	14.1	26	0	0	0.0

7/24/2024	2:45:00 PM	0.4	25		25	0.2	0.2	14.1	26	0	0	0.0
7/25/2024	5:30:00 AM	0.2	16		16	0.2	0	7.0	16	0.1	0	9.8
7/25/2024	6:15:00 PM	0.3	24	.6 coming out 360 exhaust port	23	0.3	0.4	24.6	25	0.1	0	9.8
7/26/2024	5:30:00 AM	0.2	11		10	0	0	0.0	12	0	0	0.0
7/26/2024	11:20:00 AM	0.4	32		28	0.1	0.2	10.5	31	0	0	0.0
7/26/2024	6:15:00 PM	0.3	37	whirly bird not moving	36	0.1	0	3.5	39	0.1	0	9.8
7/28/2024	5:30:00 AM	0.4	15	whirly bird not moving	13	0.1	0	3.5	15	0	0	0.0
7/28/2024	1:45:00 PM	0.2	41	Wind blow south to north. Worst possible for can direction. still getting .1 out of 360 exhaust. whirly bird spinning occasionally	40	0.1	0.2	10.5	48	0	0	0.0
7/28/2024	5:50:00 PM	1.3	38	north south wind still. whirly bird spinning	37	0.2	0.1	10.5	41	0	0	0.0

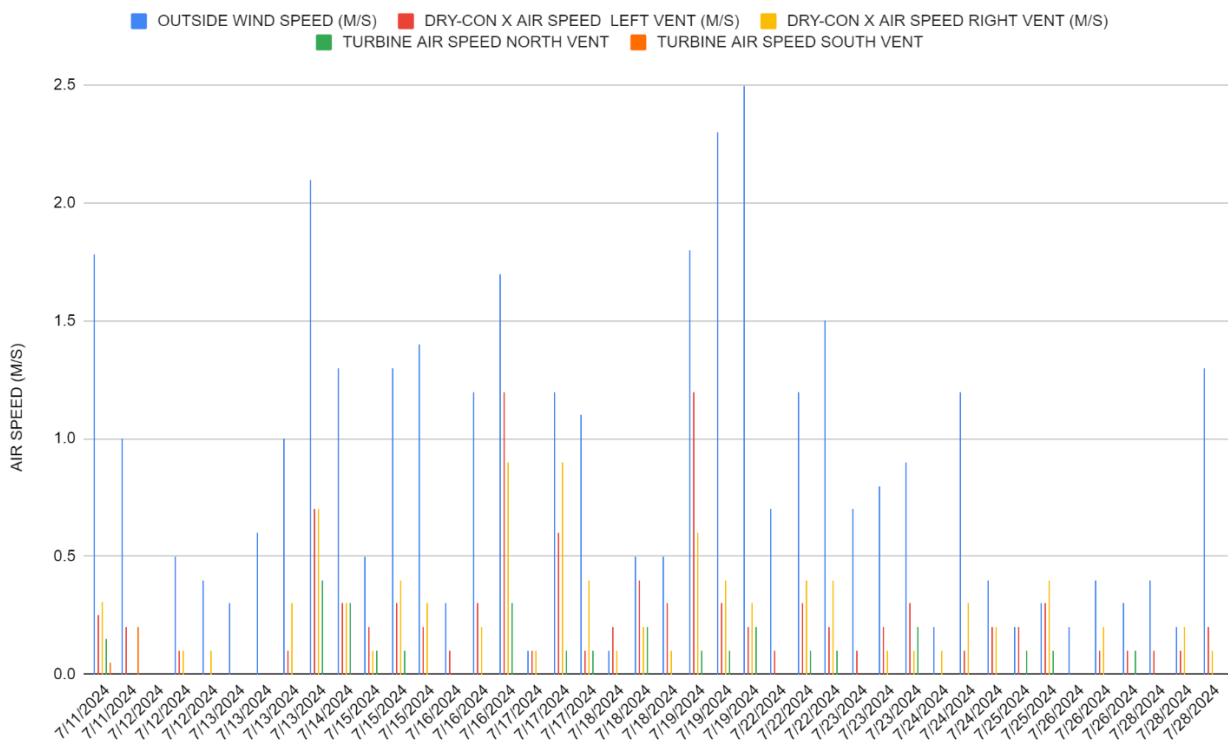


Figure 9: Air speed on intake vents for DRY-CON X vs whirlybird/turbine vents

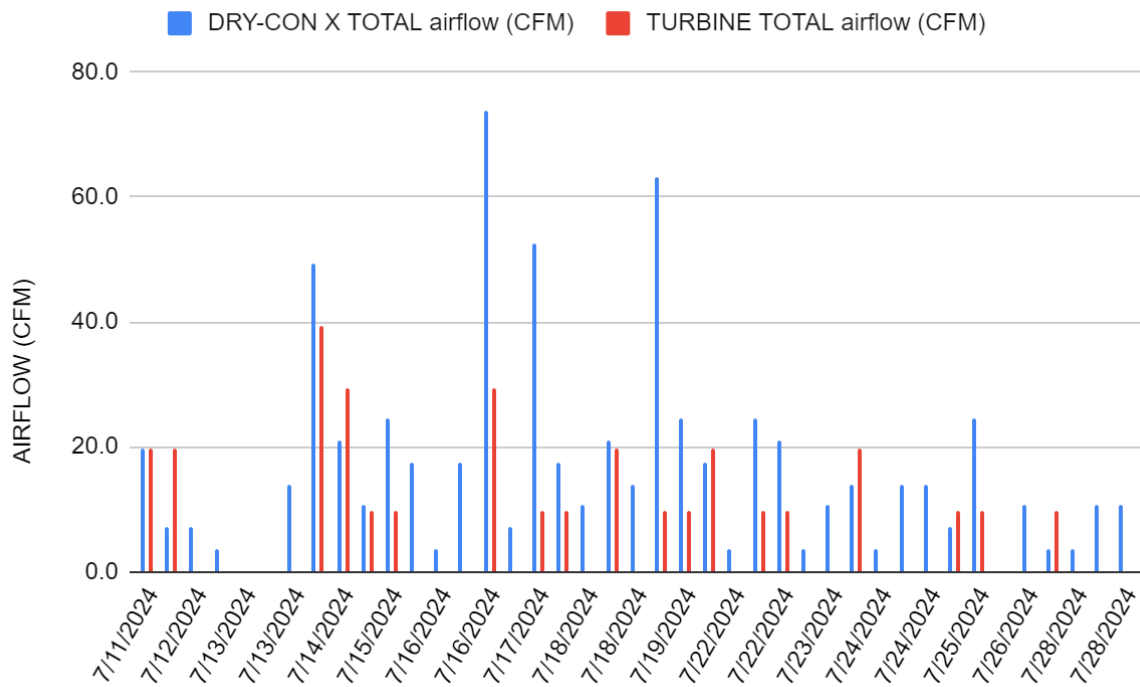


Figure 10: Air flow on intake vents for DRY-CON X vs whirlybird/turbine vents

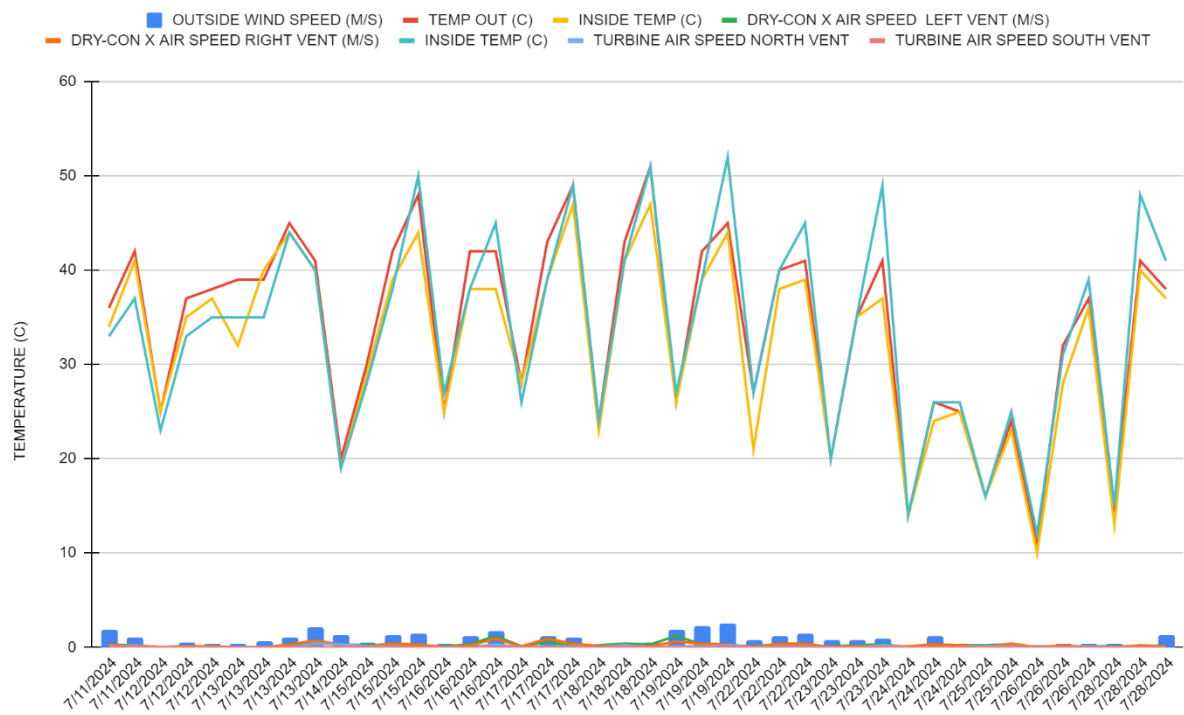


Figure 11: Temperature outside and inside containers

2.1 Result discussion

The data collected resulted in 41 measurements over the duration of the test to compare the two containers. During the test period, the ambient condition varied from no ambient wind up to a maximum recorded of 2.5 M/s wind speed. The ambient temperature also varied from a low of 10C up to 51C. These ranges do cover a fair amount of wind and temperature ranges but do not cover the full year of what would be expected during the cold seasons.

In nearly all measurement points taken the DRY-CON X vents generated higher air flow (83% of the time) compared to the traditional whirlybird/turbine vents. During higher ambient wind speeds (in excess of 2.0 m/s) the DRY-CON X vents produce more than twice the air flow as compared to the whirlybird/turbine (see figures 9 and 10). During low ambient wind speed (less than .5 M/s) the DRY-CON X vents demonstrated some airflow movement while the whirlybird/turbine showed minimal to none. The DRY-CON X exhaust vent creates a venturi effect that draws flow out of the container even under low ambient wind conditions. It was observed that the whirlybird/turbine did not spin with air speeds less than 0.5 M/s.

3 Conclusion

The DRY-CON X vent demonstrated that air flow was detectable in nearly all ambient conditions experienced even low ambient air speed. The DRY-CON X vent consistently demonstrated higher air flow into the container (83% of the time) than the whirlybird/turbine container under the experimental conditions. The DRY-CON X vent provides a direct opening to the atmosphere and will not allow a pressure differential between the inside and outside in normal conditions.

The results presented within this report are exclusively from the experiment conducted under the environmental conditions and test configuration noted herein. Extrapolating this data set to predict performance under other conditions is not recommended.