Suction Vortex

The conditions in which tornadoes form include:

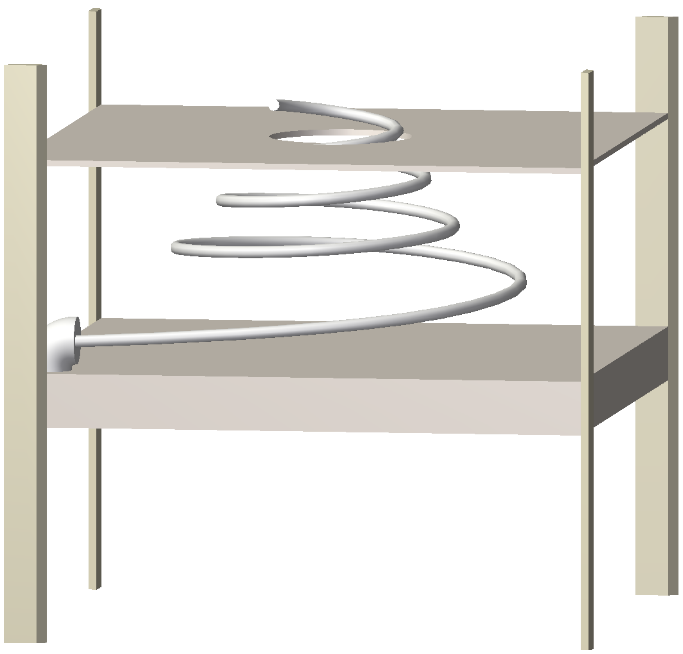
1. a low pressure aloft (i.e., the updraft within the thunderstorm),

2. a high pressure at the ground level coming from a "forced downdraft" (i.e., the rear flank downdraft), and

3. angular momentum in the inflow, due to interactions among the rear flank downdraft, the forward flank downdraft, and the surface winds.

And, of course, all of this occurs in an open-air system.

In these conditions, the air should converge as it approaches the source of the low pressure. In other words, the "funnel" should be pointing upward.

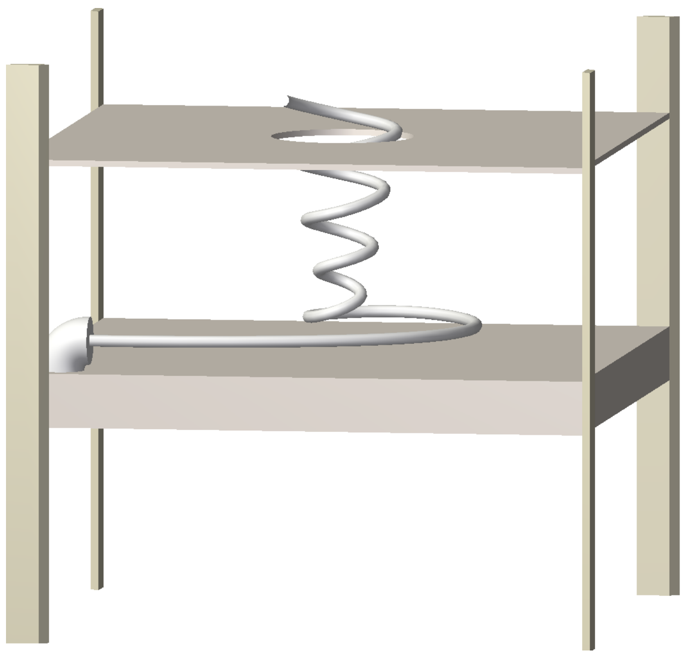


Tornadic Vortex

Contrary to the predictions of fluid dynamics, tornadoes behave very differently. Instead of the air converging in the direction of the flow, the air converges at the ground level, where an extreme low pressure has developed, *away from the source of the low pressure aloft*. Inside the vortex, the low pressure relaxes in the direction of the flow, and the vortex widens with proximity to the source of the low pressure. In other words, the "funnel" points downward.

A vortex with these properties has never been produced in the laboratory using realistic conditions, and off-the-shelf CFD programs given such conditions resolve into standard suction vortexes (such as at left), not tornadic vortexes.

The purpose of this experiment is to identify the force(s) responsible for vortexes with these characteristics.



Spatious Designs

743 Wilton Farm Drive
Baltimore MD 21228

DESIGNER
Charles L. Chandler

CLIENT
SCS-INC.US

FILENAME
Tornado Vortex Exp.vwx

Revisions
1. 2009-01-24 posted
2. 2009-08-05 removed toroidal winding
3. 2010-09-18 removed sealed enclosure, added tornadic current
4. 2011-01-07 added comments from Kevin Johnston
5. 2011-04-01 added electronics schematic from Kevin Johnston

Drawing List

PROJECT
Tornadic Vortex Test

TITLE
Definitions

SCALE
3/4"=1'-0"

SHEET
01

In any open-air system, kinetic energy should dissipate with distance from the source of the energy, due to friction. A concentration of kinetic energy, away from the source of the energy, is evidence of the presence of another force that has created a bottleneck in the flow. Vortexes strikingly similar to tornadoes have been demonstrated in the laboratory by pulling rotating air through a bottleneck. Once past the restriction, the low pressure relaxes in the direction of the flow, and the radius of the vortex expands. (See Ward, N. B., 1972: The exploration of certain features of tornado dynamics using a laboratory model. *Journal of the Atmospheric Sciences*, 29: 1194-1204.) But the scientists failed to demonstrate how such a bottleneck could exist *in situ*.

The force that restricts the airflow, and that generates the extreme low pressure away from the source of the low pressure, is, by definition, non-fluid dynamic. In a tornado, the only non-fluid dynamic force present is the electric force. The following assertions are made.

1. The inflow to a tornado is bearing a positive charge, which induces a negative charge in the Earth, resulting in an electrostatic attraction of the air to the Earth.

2. As the air flows toward the tornado, its proximity to the ground introduces friction, slowing it down. This creates the bottleneck, and causes the low pressure in the vortex to extend all of the way to the ground.

3. The low pressure inside the vortex increases the conductivity of the air, allowing the flow of electrons, from the main negative charge region inside the storm down through the tornado, attracted to the positively-charged inflow.

4. The electrons flowing down through the tornado neutralize the positive charge in the tornadic inflow. Once the charge is neutralized, the air is no longer attracted to the Earth, and the air is then free to ascend. Hence the air is released from the bottleneck.

5. The updraft inside the tornado is ultimately motivated by several factors. As the air flows along the ground toward the tornado, skin friction generates heat. The neutralization of its charge inside the vortex also generates heat. As the air rises inside the tornado, it is exposed to resistive heating from the flow of electrons through the vortex. All of these heat sources increase the buoyancy of the air, which combines with the low pressure aloft, resulting in a high vertical velocity. And this, combined with the bottleneck created by skin friction near the ground, results in an extreme low pressure, away from the source of the low pressure.

The present apparatus will attempt the recreate the relevant aspects of these *in situ* conditions within a controlled environment.

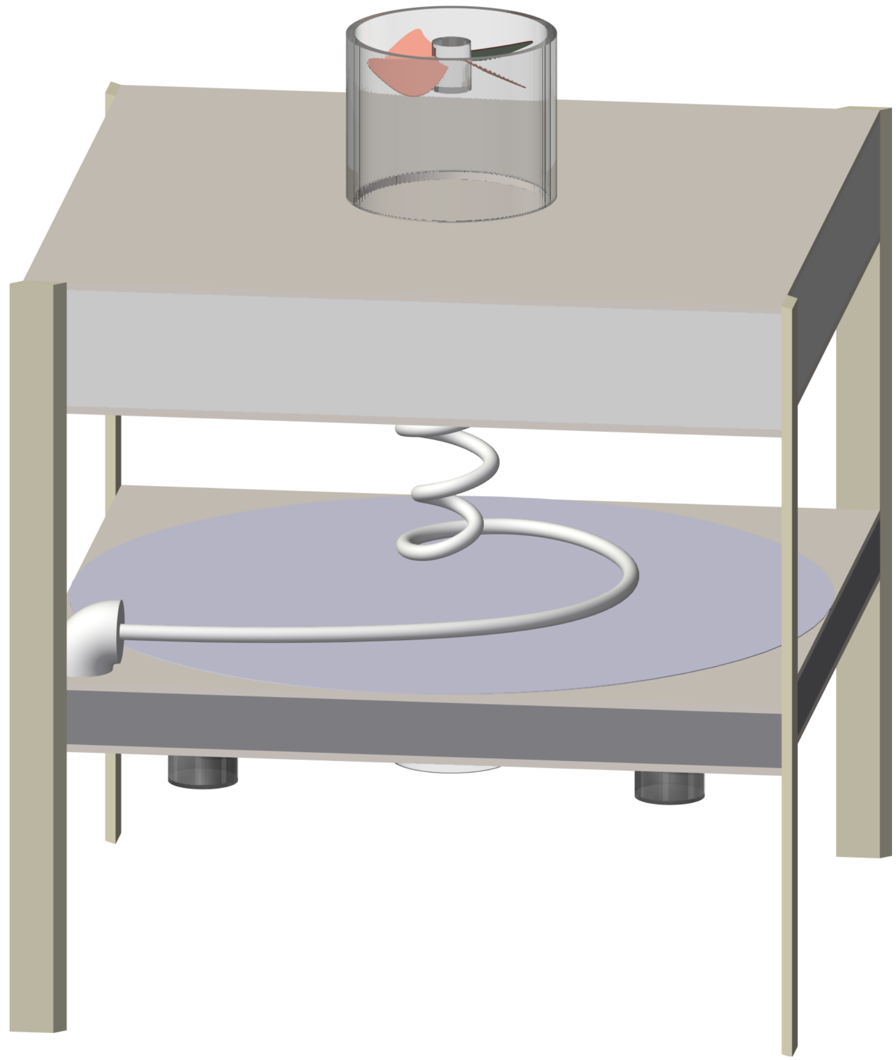
Fans on top of the upper platform will pull air through a single, central inlet in the bottom of that platform (not shown), establishing the primary flow field, analogous to a mesocyclone. The speed of the fans will be sufficient to create a weak vortex in the "mesocyclonic" inflow of ambient air up into the upper platform.

Inside the lower platform, air will be humidified, ionized, and then forced out across the top of the lower platform, analogous to the rear flank downdraft.

The top of the lower platform will be be covered with a piece of sheet metal connected to ground, so that it will act as a solid conductor, analogous to the Earth. The ionized air will induce an opposite charge in the sheet metal, and then be attracted to it.

To neutralize the positive charge in the tornadic inflow clinging to the lower platform, a set of negative ion generators will be attached to the underside of the upper platform. The free electrons so generated will be attracted to the positive ions below, and will flow downward, through the reduced resistance in the vortex. Where such electrons neutralize the positive charge, the air will be free to respond to the low pressure above.

The experiment will be considered successful if it can develop an extreme low pressure, away from the source of the low pressure, with the fastest air speeds where the friction is the greatest, using only fluid dynamic and electric forces within realistic ranges.



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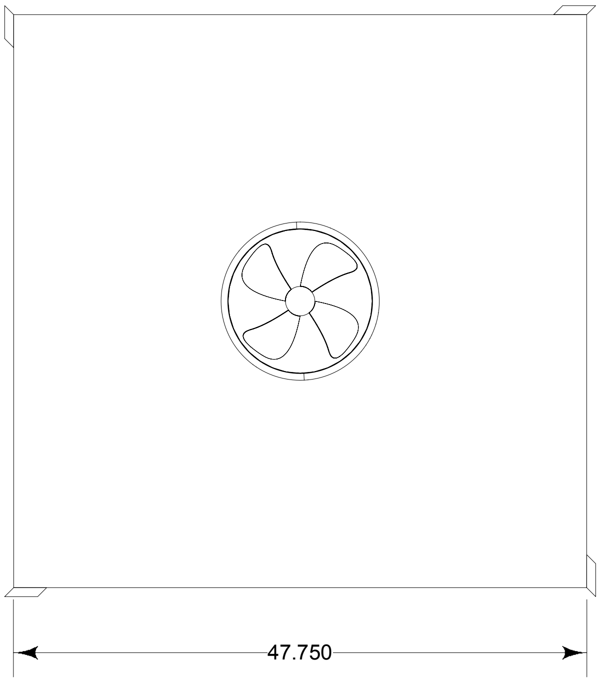
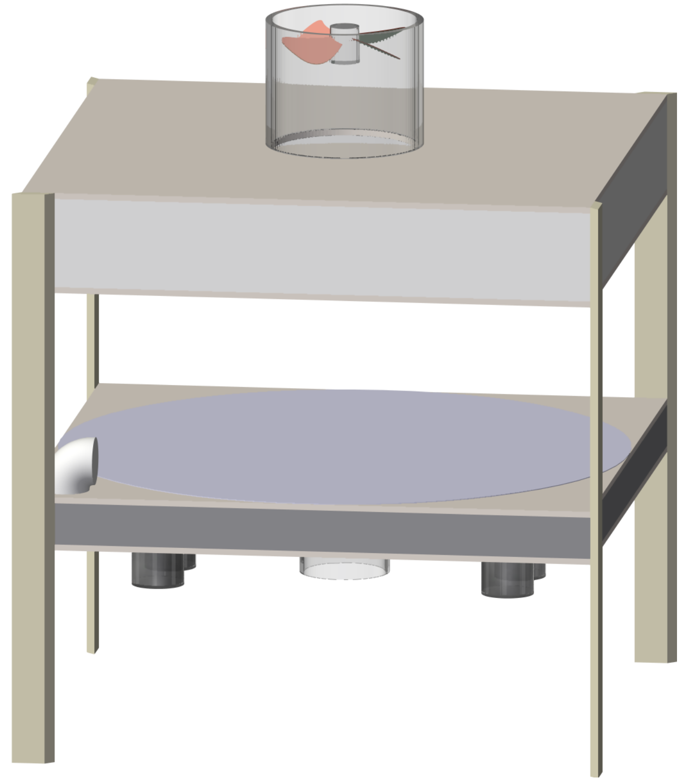
Notes

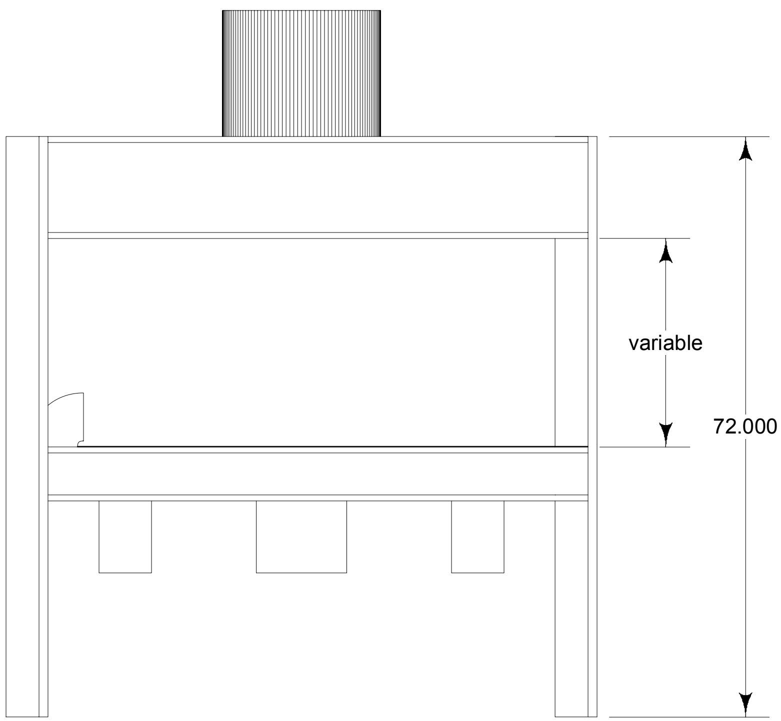
PROJECT
Tornadic Vortex Test

TITLE
Strategy

SCALE	SHEET
1"=1'-0"	02







Comments

There will be 4 fans on top, to pull the air upward, analogous to a mesocyclone, while there will only be 1 fan at the bottom pushing air toward the centerline, analogous to a rear flank downdraft. As the mesocyclone draws in much more air than the tornado, this is correct.

The reason for using 4 small fans in the corners of the top platform, instead of 1 big fan in the middle, is that we need to generate negative ions in the mesocyclonic inflow, analogous to the powerful negative charge in the hook echo, and we need these ions to be attracted to the positive charge below, not the grounded fan casing(s) above. So the fan(s) have to be as far as is practical from the ion generators. Furthermore, we cannot allow the air pressure to decrease as it travels from the ion generators toward the fan(s) as it normally would. The reason is that lower-pressure air is a better conductor, and this would set up a low-resistance path to the fan casing(s) that we can't have. So the upper platform will be a vacuum chamber, where the lowest pressure at the large intake hole will be split into 4 paths, each with 1/4 the low pressure of the intake hole itself. Hence, the electrical resistance will increase in the direction of the flow inside the vacuum chamber, discouraging the flow of electrons toward the fan casings.

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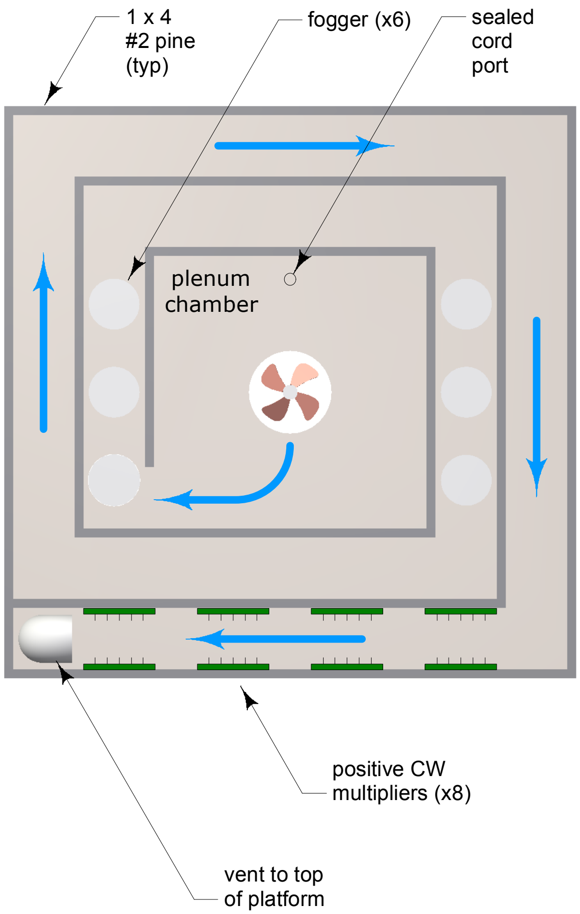
Notes
1. The height of the platforms will be set simply by driving drywall screws through the 1x4 legs into the platforms.
2. All surfaces will be coated with black epoxy paint. The black color will allow the photography to be over-exposed, improving the visibility of the vortex. The paint itself will make the wood in the apparatus impervious to moisture, and the epoxy will insulate the parts.

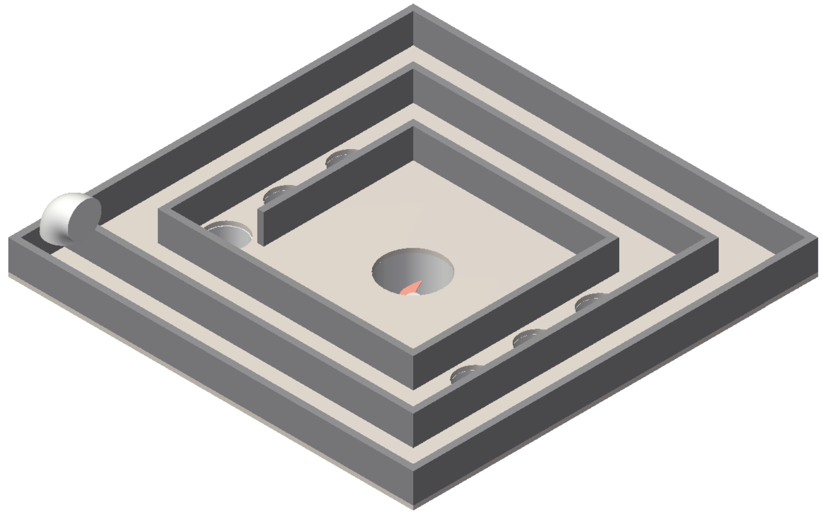
PROJECT
Tornadic Vortex Test

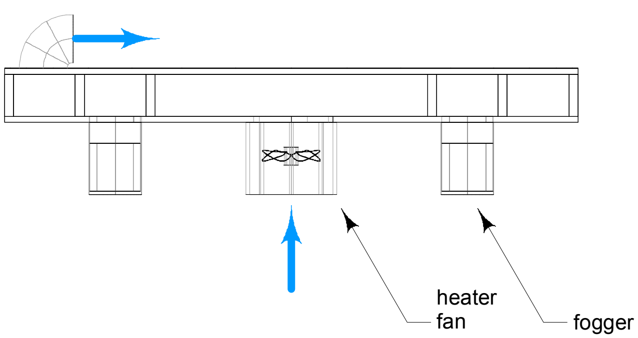
TITLE
Overall Dimensions

SCALE
3/4"=1'-0"

SHEET
03







Comments

There have been numerous discussions on how to humidify and ionize air. This design attempts to address the issues in a relatively practical way.

The air has to be humidified first, and then ionized. The reason is that if it was ionized first, then the charged air would subsequently be forced into proximity with the humidifier, which is an electrical appliance of some sort, and which therefore is grounded. Hence we would expect the charge in the ionized air to go to ground right there, eliminating the ionization. So we humidify the air first, and *then* ionize it.

But this presents another problem. Moist air is a better conductor than dry air. So when moist air passes through an ionization lattice, we expect the charge to follow the moisture back to the grounded humidifier. To reduce the charge loss, we force the air through a maze within the lower platform, to increase the distance from the humidifiers to the ionizer lattice, thereby increasing the electrical resistance. The increase in pressure due to friction in the maze will also increase the resistance of the air slightly.

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5. 2011-04-01 added electronics schematic from Kevin Johnston

Notes

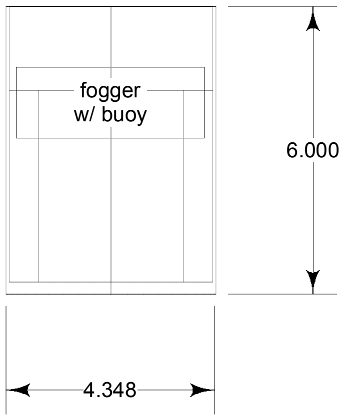
1. The purpose of this assembly is to create a supply of warm, humid, positively-charged air traveling across the top of the lower platform, analogous to the air coming from the rear flank downdraft that flows into the tornado.
2. The fan will exhaust air into the plenum, where it will be humidified by foggers, and then ionized by Cockcroft-Walton multipliers before being vented out the top.
3. The top and bottom MDF panels will be attached to the 1x4 frame with drywall screws, and with foam weatherstripping to create an air seal.

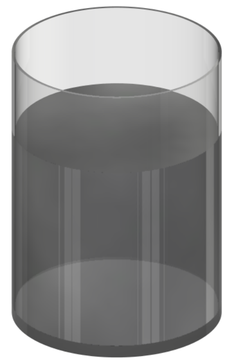
PROJECT
Tornadic Vortex Test

TITLE
Lower Platform

SCALE
3/4"=1'-0"

SHEET
04





Ocean Mist Maker MDC01 fogger + buoy

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4. 2011-01-07 added comments from Kevin Johnston
5. 2011-04-01 added electronics schematic from Kevin Johnston

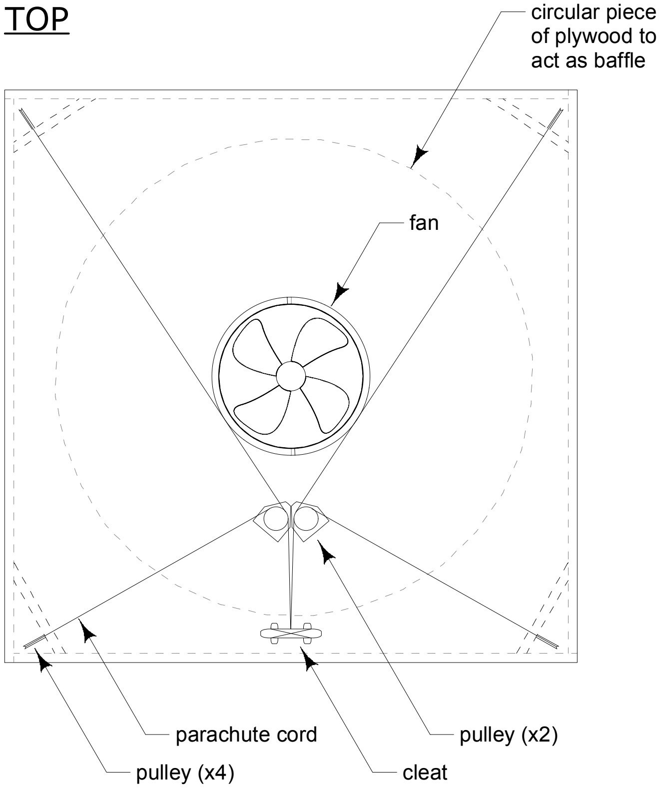
Notes
1. Humidification will be accomplished with ultrasonic foggers.
2. Each unit will be a glass jar, with a fogger submerged in water.
3. The lids of the jars will be screwed to the bottom of the platform, and sealed with weatherstripping, since the plenum needs to be airtight.

PROJECT
Tornadic Vortex Test

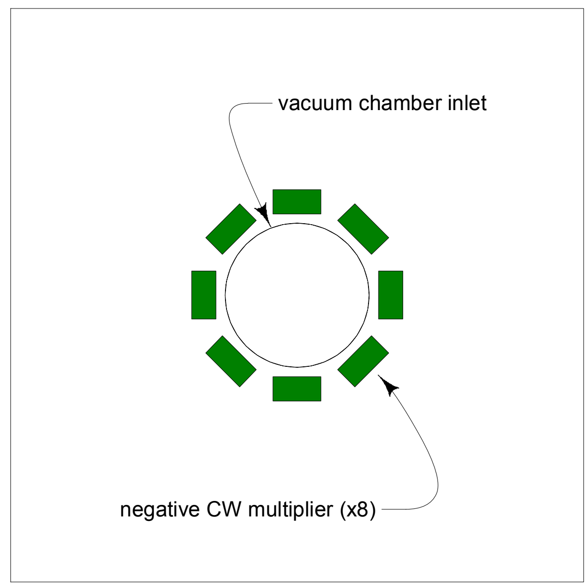
TITLE
Fogger Assembly

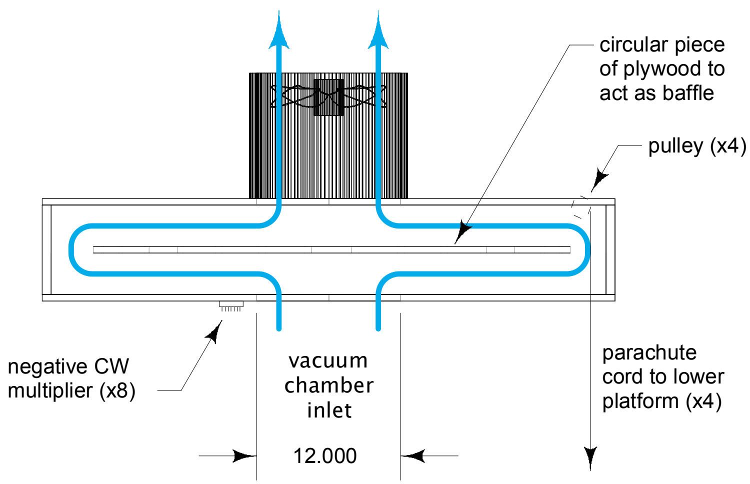
SCALE	SHEET
3"=1'-0"	05

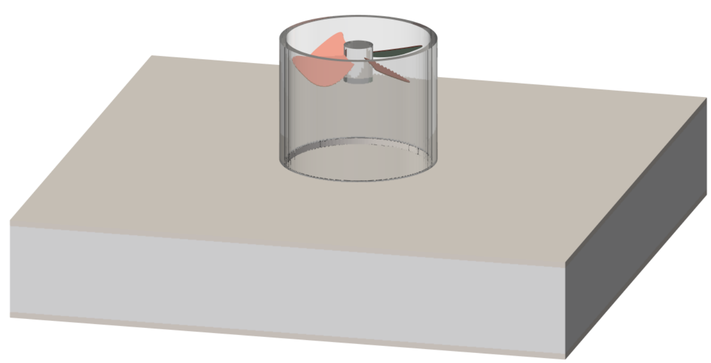
TOP



BOTTOM







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5. 2011-04-01 added electronics schematic from Kevin Johnston

Notes

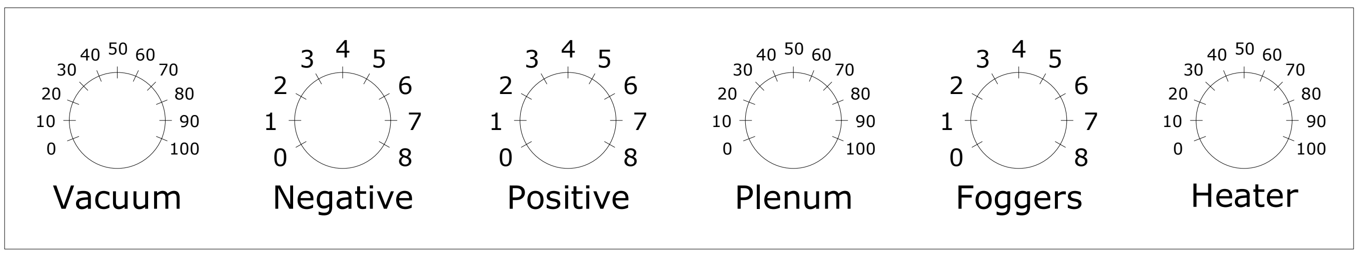
1. The fan mounted above the upper platform will pull air through a large hole in the bottom of the platform, creating a low pressure analogous to a mesocyclone.
2. The large hole at the bottom of the platform will be lined with Cockcroft-Walton multipliers to generate negative ions. This will supply the electrons that will flow down through the vortex, to neutralize the positively charged air coming out of the lower platform.
3. The circular baffle will provide separation between the ionizers and the grounded fan casing, so the ions won't go to ground in the fan casing.

PROJECT
Tornadic Vortex Test

TITLE
Upper Platform

SCALE
3/4"=1'-0"

SHEET
06



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4. 2011-01-07 added comments from Kevin Johnston
5. 2011-04-01 added electronics schematic from Kevin Johnston

Notes

1. The main enclosure will be a NEMA-1 (general purpose) grounded steel box.
2. Input and output will be 120 VAC.
3. The ionizers and foggers are not fitted with variable control for each appliance, so experimental variability will be accomplished simply with the number of appliances that are switched on, assuming that one is not enough, and all of them will be plenty. So these will be controlled with SP8T switches.
4. The fans and the heater will be controlled by rheostats.

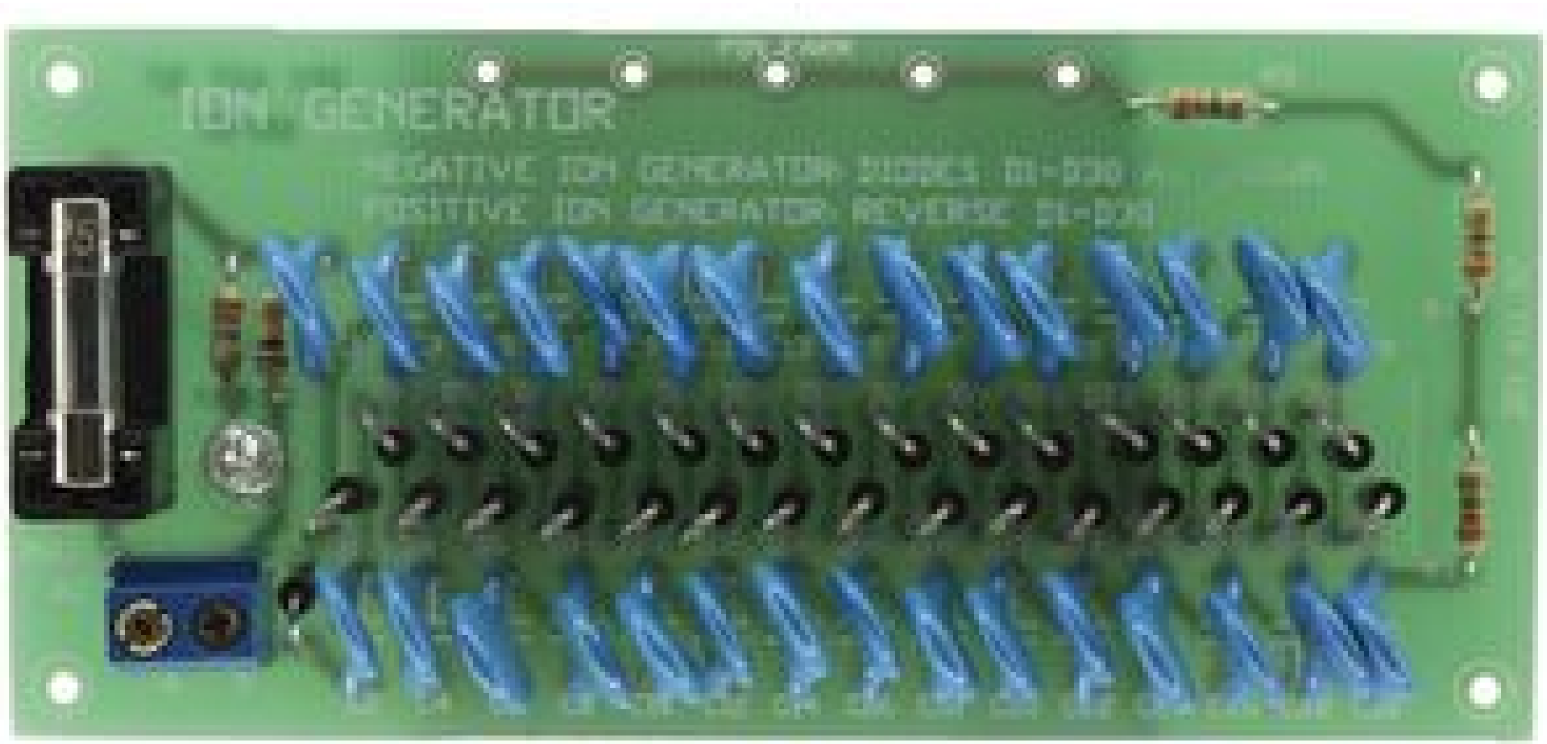
PROJECT
Tornadic Vortex Test

TITLE
Control Panel

SCALE	SHEET
3"=1'-0"	07

Caution: High Voltage!
Only certified personnel should build such devices.

Philmore 80-570 Ion Generator
(Cockcroft-Walton Multiplier)
110 VAC in, 5 kVDC out



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Notes

PROJECT
Tornadic Vortex Test

TITLE
Ion Generators

SCALE
none

SHEET
08

Qty	Dimensions	Description	Supplier
?	1" x 4" x 8'	boards -- for feet and for platform ribs	
4	47.75" x 47.75"	1/2" particle board (MDF) -- for top and bottom of upper and lower platforms	
1	quart	flat black epoxy paint	
?		foam weatherstripping -- to seal platforms	
1 lb.	1 1/4"	drywall screws -- for screwing together the platform pieces	
1	47.75" x 47.75"	sheet metal -- to form the plane conductor at the bottom	
20	10" x 10"	plastic grass mats -- for increasing skin friction of lower platform	http://www.sourcingmap.com/artificial-plastic-lawn-grass-turf-decor-for-
1	4"	PVC 90 elbow	
16	2" x 4"	Cockcroft-Walton multipliers	http://store.qkits.com/moreinfo.cfm/QK57
12	1.5" dia x 1.25" h	Ocean Mist Maker MDC01 ultrasonic fogger -- to humidify the air	http://www.oceanmistmaker.com/humidifierwholesales.html
12	4" dia x 2.5" h	Ocean Mist Maker K011 buoy -- to control the depth of the fogger	
12	4.25" dia x 6" h	glass jar with metal lid -- sump for fogger	
2	50W, 12"	DC fans	www.grainger.com/Grainger/items/4WT42
2		PVC pipe (?) -- for fan housings	http://www.usplastic.com/catalog/item.aspx?sku=26314
3	2.000	SP8T switches -- to control ionizers and foggers	http://elcodis.com/parts/1815816/19101-08UL.html
1		power distribution box (mains & control input, PWM/CW/etc output)	
1		control panel	www.factorymation.com/s.nl/it.A/id.4327/.f?sc=2&category=4838
2	1000W	flood light -- to illuminate the vortex	
2	4' tall	lamp stands	
1		camera -- for photography and videography	
1		thermo/hygrometer -- to measure ambient and RFD air (Exo Terra PT2470)	www.exo-terra.com/en/products/combometer.php
1		barometer -- to measure ambient atmospheric pressure	
1		anenemometer -- to measure airspeed	www.maine-hardware.com/viewproduct.php?i=B0002WZRKE
1		air ion counter	www.trifield.com/content/air-ion-counter/
		drive belt	http://global-hose.com/Belts.aspx

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Notes

PROJECT
Tornadic Vortex Test

TITLE
Parts List

SCALE
none

SHEET
09

Test Procedure

1. Leave the ground wire for the plane conductor at the bottom (the sheet metal) disconnected.
2. Turn on the lower heater-fan, and let it run for 10 minutes, to pre-heat the lower platform. This will get the walls of the air channel warmer than the humidified air that will pass through it later, discouraging condensation on the walls that would provide a path to ground for the ionized air.
3. Turn on the foggers. Wait for the humidity to rise until a vortex becomes visible below the upper platform (i.e., the "mesocylonic" vortex).
4. Use an anemometer to measure the speed of the air coming out of the fans, so that this can be correlated with the PWM settings in successive trials, without having to measure the air directly (especially after it is charged).
5. Set the humidistat to maintain that humidity for the duration of the trials.
6. Wait until the humidity stablilizes.
7. Take photography/videography of the vortex in this state, and record all parameters.
8. Turn on the ionizers. Allow the airflow to stabilize. At this point, the ground wire for the sheet metal should still be disconnected, so the air shouldn't be binding to the lower platform. In this configuration, a shallow wedge of condensation should form, but it will not project to the lower boundary, and there will not be organized rotation at the bottom.
9. Take photography/videography of the vortex in this state, and record all parameters.
10. Connect the ground wire for the plane conductor. The vortex should then bind to the bottom of the enclosure.
11. Take photography/videography of the vortex in this state, and record all parameters.
12. Turn off the ionizers, but leave the upper fans running, as well as the lower heater-fan, with the foggers still running, to clear out charges that could have built up in the platform.
13. Turn off the foggers, and let the fans run another 10 minutes, to clear out any condensation that could have formed in the lower platform, and that could short out the ionizers on re-start.
14. Turn off everything, and discharge potentials with a ground wire.
15. Disconnect all equipment from AC mains.

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Notes

PROJECT
Tornadic Vortex Test

TITLE
Test Procedure

SCALE	SHEET
none	10

Year: _____		Ambient			Upper		Hght	Lower				photo video	Comments
Mo-Dy	Hr:Mi:Sc	mb	°C	RH	m/s	kV	cm	kV	m/s	RH	°C		

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Notes
1. Specify time to the second if a photo (with a timestamp) is taken.
2. mb is the millibars of ambient pressure.
3. RH is the relative humidity in percents.
4. m/s is the rate of flow measured in the center of the stream, into the upper fan and out of the lower fan.
5. kV is the reading on the voltmeter showing the total voltage applied to the needle matrices (negative for the upper and positive for the lower). It does not mean the degree of resulting space charge.
6. Hght is the height in cm of the upper platform above the lower.
7. If there is an associated photo or video, mark with P or V.

PROJECT
Tornadic Vortex Test

TITLE
Data Sheet

SCALE	SHEET
none	11