

Tornado by Ned Kahn

Assembly and Maintenance

GENERAL INFORMATION:

The Tornado exhibit creates air movements with the combination of a large fan at the top and air blowing out of columns generating a vortex, or "Tornado." The vortex can be seen when the mist from the fog machine is caught in this air movement.

The Tornado exhibit consists of a laminated wood frame base containing a fog machine (Ultrasonic humidifier) and water tank, which supports four 3-1/2" diameter aluminum columns. These columns, in turn, hold up a laminated wood frame top section in which are mounted a fan, four blowers and four spotlights.

initial Set-up:

Assembling the exhibit essentially requires sliding the four columns into the base, fishing the power cord through one specially slotted column, and positioning the top section over the four aluminum columns. Setting the top down on the tubes however will require three to four people, two of which should be tall. You will need an 8 foot step ladder, and possibly some towels to pad the column tops.

1. Remove the drain cover and drain tray. Locate the aluminum flange in the base section marked "Ø". This flange is intended for the column, which is fitted with a 10-foot extension power cord. Note a 1/2 inch x 3" slot in one end of the column. This is the bottom end. The aluminum flanges in the base section have set screws, which secure the columns from rotating. Be sure the set screws are not preventing the columns from being inserted completely into the flanges on assembly. They are not to be tightened until the Tornado is up and running and tuned for best performance.

2. Install the columns. The columns have small holes drilled along their length but not symmetric to each end. The longer portion without these holes goes into the base section.

Orientation: Install the column with the power cord into its marked socket and pull the cord through the slot about 1 foot into the base section. Check that the end of the cord, on the top side, is firmly held, and has enough length to pull up the cord through the top section.

Next, position two of the other three tubes into the base. The empty socket will leave room to hoist the top section by hand over the other three tubes. If they jam in the lower sockets, check that the set screws are backed out of the bore. Orient the holes in the columns so they point toward their adjacent column, clockwise. Then twist the tubes so that they point inward, toward the center, about 22 1/2 degrees (split the angle formed by the tube, its clockwise neighbor, and the center of the exhibit).

At this point, it is recommended to put towels over the ends of the three pipes to prevent scratching the laminate during the next procedure.

3. Install the top section: Remove the black Masonite dust panels on top of the upper section to access the 4 blower motors, and a central fan assembly. Find the blower motor closest to the power strip. Orient it so that it is the one which will receive the column with the power cord. Loosen the blower motor so it can be rotated over to one side to gain access to the extension power cord in the tube.

Lift the top section over the empty socket in the base, then over the three tubes leaving room to drop the fourth one in. It will take 3 or 4 people to do this. Two people should be tall enough to make the initial reaches, and to hold the section up while alignment occurs. As soon as the top section is in place, but before it actually "drops" in, someone must go up the 8 foot ladder and pull the power cord up from the column, through the hole where the blower motor was rotated out of the way. Then the top section can be lowered into place, and the hard part is now done.

4. ELECTRICAL HOOK UP

Bottom Feed Electrical: This exhibit is designed to take power from the top. This manual is tailored for "top power input". Taking

power from below, or ground level, is accomplished in the following manner:

A. Drill an access hole in an appropriate place on the floor of the base section large enough to get an extension cord through to the outside. If the hole is large enough to allow an entry for mice, incorporate some form of screening over the hole. The extension cord should have a plug on one end and we have provided a duplex receptacle on the other end.

B. Turn the extension cord in the column around so the female end is in the top section.

C. The Wiring:

1. All top section components plug into the power strip in the top section.
2. The top section power strip plugs into the cord leading into the column.
3. Plug the cord coming out of the column in the base section into the duplex, or power strip in the base section.
4. The humidifier is plugged into the "step down" transformer.
5. The "step down" transformer, exclusively for the humidifier, is plugged into the duplex in the base section.
6. The power strip in the base section is plugged into an external power supply via the hole drilled in the base section.

Powering from above.

Find the slot in the upper flange which accepts the power cord between the blower motor and flange. Re-attach the blower motor and plug the cord into the power strip. Check that all the other cords are plugged into the power strip as well. Install the four 150 watt spot lights securely into the upper section. Check that the lights point towards the center of the base.

At the base section plug the humidifier into the power cord going into the column. Pour 1 to 2 gallons of distilled water into the water

tank and check for leaks. Inspect the plumbing and look for disconnected hoses all along the feed lines, and overflow/drain lines.

5. Power up: Plug the system in from the top side. The lights should come on, the fan should start up, the blowers will begin blowing air out of the vertical holes in the columns, and the humidifier will begin accepting water into its own reservoir. The humidifier will not start for several minutes when it is first turned on. (It must fill its own reservoir through a very small nozzle.)

The humidifier may be set up to produce mist with just two of its four nozzles. One or two of the four fogging units can be disconnected internally to reduce the water usage (which also reduces the vapor density). This provides an adequate supply of mist so long as the transducers are kept clean. The other two units may be reconnected as needed. (The active units will eventually wear out or you may decide more mist is necessary.) A connection procedure is described later.

Observe the humidifier until it begins to generate fog. See that all four vapor streams are functioning. They are very small, but quite visible. As soon as fog is apparent re-install the stainless steel drain tray. The drain tray tubes fit into the PVC manifold tubes and can be aligned by sticking your fingers into the stainless steel tubes and feeling for the manifold below.

6. Tuning the system: Once everything is in place and powered for a few minutes, a tornado will appear, provided the room drafts do not overpower the exhibit's own air currents.

If the tornado is not forming, and there is sufficient fog, and the blowers and fan are working, check the orientation of the holes in the columns. Looking down on the exhibit from the top, they should be pointed in a clockwise direction at approximately 45 degrees angle toward the center. If everything is in position and nothing forms there is a draft problem.

Unless the Tornado exhibit is in an area with almost no drafts, it will require baffles to block surrounding air currents. The baffles provided are acrylic panels, 36" wide, and tall enough to fill the space between the top and the bottom. These baffles must be adjusted to the particular draft characteristics for the space. To determine where, and how many panels to use, first operate the exhibit and observe how the surrounding air currents affect the forming vortex funnel. Take into consideration changing air patterns caused by doors

being left open or closed, air conditioning and/or air movement equipment going on and off, and passerby traffic.

The object is to use as little baffling as possible to attain an interesting and fluid "tornado" effect. The baffles may be cut down to 24 inches in width, or any suitable width desired. It is possible to employ only one baffle if the draft currents allow.

Start by positioning one baffle by hand. Vary the angle and observe. Consider the air current conditions and how they may change from day to day, or hour to hour. If the vortex is not forming add the 2nd baffle directly opposite to the first (fig 1b) and adjust, and observe. If the air currents are still too powerful try relocating the baffles in various configurations. Once the proper effect is attained install the hardware.

Some Tornado columns may produce a whistling sound. Locating of the whistling column, which is difficult to hear, is done by blocking the air holes off to momentarily stop the sound. The solution is hanging a rope inside the column with four 2" cube pieces of foam rubber staggered along its length. The rope is held in place by clamping the end underneath the blower flange. Ropes are supplied by the Exploratorium for exhibits that whistle during assembly.

If a municipal drain is accessible, the stainless steel drain tray can be connected to it. First the extra pipe welded to the bottom must be drilled out through the tray bottom. Connect a hose from the municipal sewer to this pipe that is long enough to allow the drain tray to be lifted from the base and set aside without having to disconnect it while inspecting the inside.

Maintenance:

Every few days, the water level of the exhibit should be checked by removing the water tank cap on the top of the base with an allen wrench and checking the level inside the tank. If the level is low, fill the tank with distilled water. The tank holds a total of 7 gallons so it can be filled with a 5 gallon water jug.

Distilled Water: Minerals found in regular tap water, and filtered water will leave calcium, magnesium, and silica deposits on the piezoelectric transducers in the fog machine. This can reduce the life span of transducers. Deposits will also be most readily noticed on the black drain cover prematurely if distilled or purified water is not used.

Every 12 weeks, the exhibit should be checked for any moisture accumulation inside the cabinet, and mineral deposits inside the humidifier.

1. Avoid filling the water reservoir, if equipped with one, for a few days before cleaning, so it will be easy to remove.
2. Remove the 4 allen screws that hold the drain cover plate (black round panel with holes) and remove the plate.
3. Lift out the steel drain tray by pulling up on the handles to expose the humidifier.
4. Drain the water out of the tray and clean it with a cloth or paper towels.
5. The PVC top cover will lift out of the fog machine.
6. The fog machine (humidifier) has switches for level control and "low water". The unit will automatically shut down when low on water. The switches are in the reservoir and should be manually checked with each routine maintenance. (However be careful not to power the transducers without water over them, since this overloads the electronics.)
7. Clean inside the fog machine by absorbing dirty water with paper towels or a cloth. Wash all of the interior surfaces down with a sterilizing solution consisting of a tablespoon of liquid bleach in 1/2 liter of water. This will sterilize any bacterium that can become air borne during operation. Give the solution a few minutes to soak then carefully wipe the inside and transducers on the bottom of the tank. It is recommended to sterilize the humidifier and water tank four times a year.
8. If the tube that connects the fog machine to the water tank appears dirty, remove and clean the tube.
9. If sludge is apparent in the tank, rotate the black plastic latch that holds the water tank by loosening the allen screw. Remove the water tank and clean with paper towels. The tank should also be sterilized as in step #6. Slide the tank back into place and secure the latch.
10. Fill the tank with filtered water.
11. Replace the PVC cover on the fog machine.

12. Replace the steel drain tray. The tray needs to drop down into the PVC pipes on the fog machine cover. If you look through the holes into the tray, it is easier to line up the tubes with the sockets.

13. Replace the metal drain tray cover with the four screws.

14. If the humidifier has a difficult time starting, check for air bubbles in the fill tube that connects the tank to the fog machine. Topping off the water tank should push the bubble through the tube. Jiggling the tube or sliding it off of one of its hose barbs can vent the bubble out if topping off the tank is inconvenient.

15. If the humidifier has poor output, even after cleaning, than one or more of the transducers may be bad. Transducers and boards are replaceable. Unplug the humidifier and remove the drain line. Remove the inlet hose from the water tank and plug it with a suitable object. Lift the humidifier from the base of the exhibit and drain it. First test the unit in a place that you can fill it with enough water to lift the float switches, and plug it in while observing the disc shaped transducers in the bottom of the reservoir. They should produce a stream that spurts over the top of the humidifier. Keep track of the discs that are not operating and proceed to the next step.

Find a suitable location to work on the humidifier assembly and remove the top cover to access the transducers. The transducers are bolted to the stainless steel plate in the bottom of the tank. Remove the two bolts that retain the transducer to replace the unit. DO NOT remove the fasteners in the corners of the plate since these seal the plate to the bottom of the plastic sump. DO NOT power up the circuit board with the piezoelectric transducers disconnected from the circuit board. This will destroy the power transistor on that board. Replace the bad transducers and boards, and reconnect the plumbing for another test. Remember, running the unit without water over the transducers will damage the electronics, so don't override the float switches, or plug it in while upside down.