

# Fire Tornado



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**MCEN 4151**

**Get Wet**

I have always been fascinated with fire and enjoy playing with fire, as bad as that may sound, so I wanted the subject of the Get Wet image to be a flame. Since almost everyone is familiar with fire, the goal was to photograph a flame in a way not many have seen before. This led to the decision to photograph a flame vortex. My friend, Carl Marvin, has done extensive work with photography in various lighting conditions, so I had him help me with setting up and executing the shot.

To set up the flame, I placed a 10-centimeter plate on an overturned bowl and poured rubbing alcohol onto the plate. Next, I rolled aluminum screen into a cylinder with a diameter of approximately 40 centimeters and suspended the cylindrical screen vertically around the plate using string anchored at points on two opposing walls. I then lit the rubbing alcohol and spun the aluminum screen around the flame. See Figure 1 in the appendix for the setup of the experiment.

The characteristic swirls in fire are created by the shear forces between the rising air in the flame and the relatively stationary air around it. See Figure 2 in the appendix for a visual representation of the shear. As air heated by the flame rises through the top of the cylinder, more is drawn in under and through the rotating cylindrical screen. The air spun by the screen causes the flame rising from the plate to twist as seen in the Get Wet image.

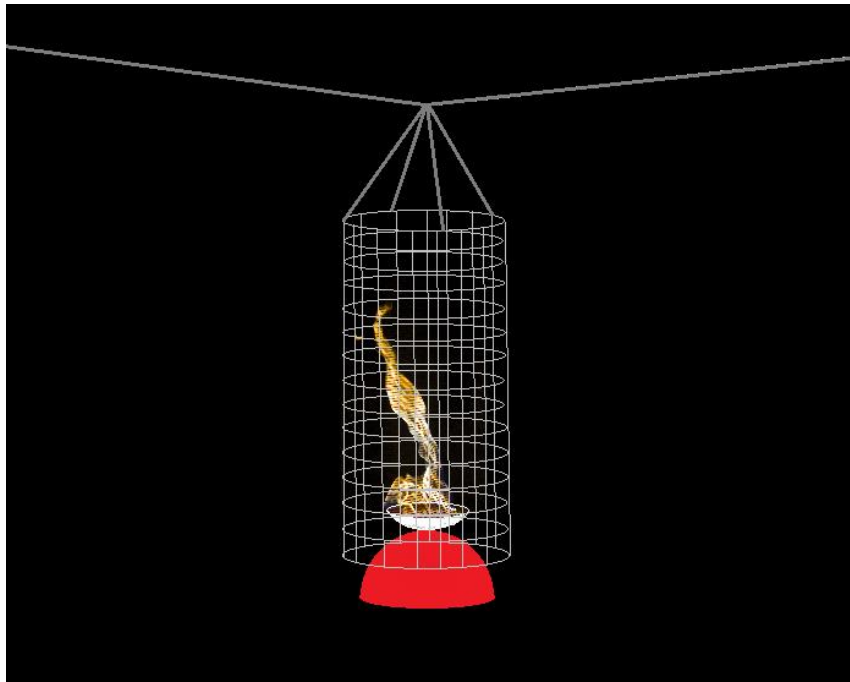
The sole component intentionally in this image is the flame. No background was needed, and no alternate light source was used since the flame produces its own light. To better visualize the flame, it was set up in a dark garage. This allows for better contrast and permits the flames to stand out. Unfortunately, the screen can also be seen in the image as blurry lines across the flame which tend to be distracting and subtract from the overall impact of the flame.

This photo was taken using a Canon EOS Rebel T2i DSLR camera placed so that the flame took up almost the entire frame, approximately 2 meters away. This ensures a fine resolution of 2121 pixels wide and 3732 pixels tall at 240 pixels per inch. Several practice shots were taken before the screen was spun to make sure the focus was correct. The combined F-stop of  $f/4$ , exposure time of  $1/160$  second, and ISO of 400 were ideal for capturing enough light with minimal motion blur and noise. The captured image had more orange than the original flame. Editing the hues and contrast with Adobe Photoshop brought back the yellow color of the spiraling flame as well as the blue glow at the base near the plate, a characteristic of burning alcohol.

Overall, I am very pleased with the outcome of the image. The colors are bright and vivid, the contrast brings out the details, and there is just enough motion blur to hint at the flame's motion without losing clarity. If there is anything I would improve on this, it would be to get rid of the screen in favor of a better vortex-producing technique such as fans and curved baffles to help circulate the air. A more powerful fire source would be needed as the rubbing alcohol flames are easily blown out with excess air.

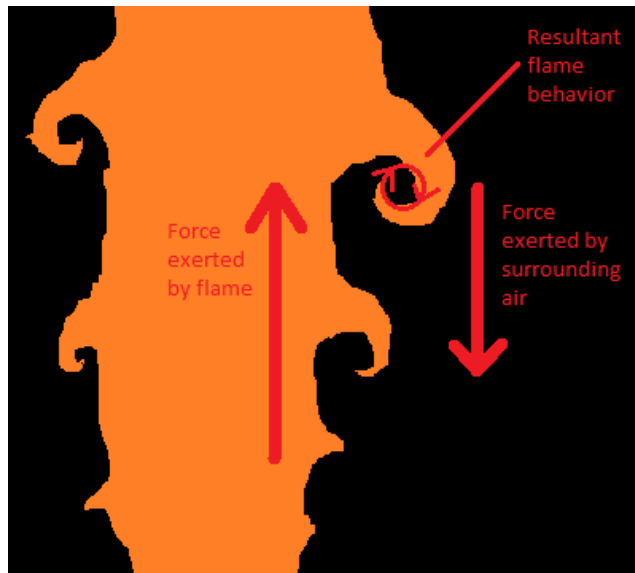
**Appendix:**

**Figure 1**



*The spinning cylindrical aluminum screen is suspended with string over the upside-down bowl and plate with rubbing alcohol.*

**Figure 2**



*Flame curl created by shear forces*