Flow Visualization
MCEN 4228
Team Project 2

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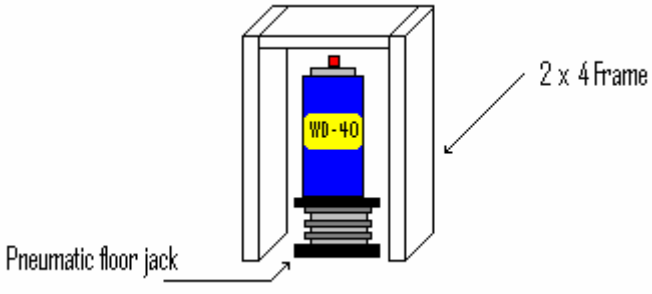
The purpose of this image is to authentically capture the behavior of a flammable liquid when it is propelled with velocity past an open flame.

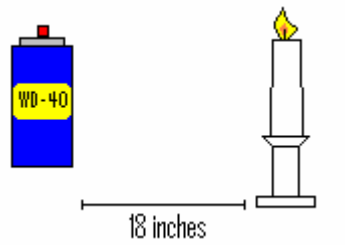
Interest was initially *sparked* in this project while investigating the fire breathers. Fire breathers are a group of people that can give the appearance that they can spit flames from their mouth. The intent of this image is to replicate the same behavior demonstrated by the fire breathers without risking any personal injury or destruction. There were many experiments with the different types of liquid we where going to use. Some of the preliminary photos were taken of spray paint, hair spray, and gasoline in a spray bottle. The most viable image was finally created using WD-40 as the flammable liquid and a common candle as the source of flame.

The flow in this project was controlled to insure that the safety of the individuals and the equipment. A 2 x 4 frame was created to hold the can of WD-40. This frame was secured to the ground and a pneumatic floor jack that could be controlled remotely was used to apply pressure to the button that controlled the spray.



A candle was used to provide a constant source of flame. The candle was positioned eighteen (18) inches away from the spray can. To take a picture the first step was to

fasten the 2 x 4 frame to the ground in the area where the experiment was to be completed. Then a candle would be positioned a predetermined distance from the can.



Next the candle would be lit. As the operator took cover, the jack would be raised until the can would expel its contents into the path of the flame. The flame that would appear was approximately six feet. There was no additional light added to the system. The flash on the camera was turned off and the picture was taken at approximately 10:30 pm so there was no light extraneous light.

The visualization technique that was used for this experiment was a photographic representation of combustion. As the stream of WD-40 enters into the open flame, the solvent propellant within the can ignites. The result is a huge flash of light from a turbulent flame. The heat from the flame causes instabilities in the air surrounding the flame which causes the appearance of vortices and other turbulent behavior within the flame. Since the flow is obviously turbulent we can conclude that the Reynolds number is greater than 6,000.

The field of view for this particular photograph is approximately five feet by five feet. The approximate distance from the object to the lens is three feet on average. The camera used to capture this photo graph was the Canon Digital IXUS 700, with 7.1 mega pixel resolution using a one-chip color area sensor. The focal length for the picture was 7.7 millimeters. The lens aperture was recorded as 5.7. The shutter speed for the picture

was recorded as 1/1002 seconds. Photoshop was utilized to crop the image and to adjust contrast levels.

This image reveals many of the characteristics that are associated with turbulent flow. The picture represents turbulent flame propagation, and demonstrates how a flame becomes laminar as it travels farther from the source. Also represented is how the heat in the flame warms the air and causes the flame to rise. I feel that the most artistic part of the photo is the vortex of fire that is represented in the lower left of the flame. One thing that I would like to change with the behavior being represented is a number of flames in the same photo. I believe that a photo that can capture the same behavior from three different sources could be interesting. I was unable to capture a photo along these lines because the danger associated with this type of experiment. I was trying to keep the number of variables to a minimum so that I could assure the safety for the team.