

GROUP 3

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This image was one of a series that attempted to freeze Worthington jets. Different liquids were used for both the moving and static liquids. The intent was to choose fluids that provided sufficient contrast to see what fluid dynamics were occurring at the height of the jet. The secondary intent of the image was to further expand the group's experience in varying setups and fluid flow scenarios.

The setup used in this image was a small stainless steel dish, filled with whole milk. The shaft of the Worthington jet in the image is approximately 3mm in diameter, and the height is approximately 14mm. Since this image was captured at the very peak of the jet, the fluid was not actually moving at this time. Therefore, the Reynolds number is zero. Upon closer inspection of the image, there appears to be some motion blur at high contrast edges. However, this happens to be a focus issue. At such a close distance, the depth of field is very short, and the focus can change dramatically in a short distance. This is evident by the small droplets in the top right of the image, that are in perfect focus. Of note in the image is the linear pattern in the shaft of the jet and the asymmetrical distribution of dye and milk in the head. This shows that the droplet may have had some rotational inertia before hitting the milk, and retained it after rebounding. The shaft, however, was resistant to this motion, and therefore displays the linear pattern, parallel to the upwards heave of the jet.

Blue food coloring was used as the dye, in undiluted form. Cold whole milk was used as the static fluid. The combination of these two provided the contrast necessary to visualize the flow in the jet. The lighting used was a combination of two steady-state flood lights, approximately two feet away, and a Nikon Speedlight, timed for $1/64^{\text{th}}$ of a second. This image may have been better captured in direct sunlight, allowing a smaller aperture and deeper depth of field.

The size of the field of view in the original image was approximately 6 inches across, at a distance of 12 inches from the lens. However, after cropping, the field of view is approximately 2 inches wide. The equipment used was a Nikon D200 SLR, with a 60mm f/2.8 micro Nikkor lens, capturing 3872 pixels in width, and 2592 pixels in height. The cropped image is 1745 pixels wide and 1534 pixels high. The shutter speed was $1/200^{\text{th}}$ of a second, with an aperture setting of f/13. The ISO setting was 400. Other than cropping, there has been no alteration to this image.

The image reveals some neat physics that humans would not be able to visualize in real time. The human eye can tell that this phenomenon happens, but cannot gather enough information to really study the jet. I particularly enjoy the dense feeling of the milk in this image. It seems that the fluid is resisting the change in position. However, this is exactly what I disliked about the image as well. I feel that the image is not emotionally powerful, since there is not violent action occurring in it. I would rather do this experiment with skim milk in the future, which I feel is less dense and viscous. Alternately, it would be interesting to attempt this with non-Newtonian fluids, and see the reaction of a droplet with their surface.