

# Non-Newtonian Viscosity and the Falling Piston

## Application Note 104

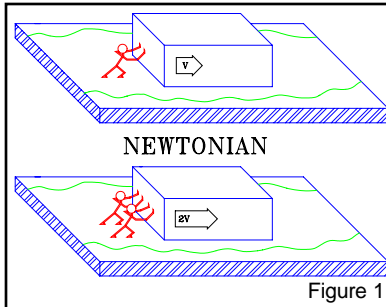


Figure 1

Figure 1 shows two surfaces with a fluid between them. A force is applied to the top surface and thus it moves at a certain velocity. The ratio of the Shear Stress (Force) / Shear Rate (Velocity) will be the viscosity. Note that as the force is doubled then the velocity doubles. This is indicative of a Newtonian fluid, such as motor oil.

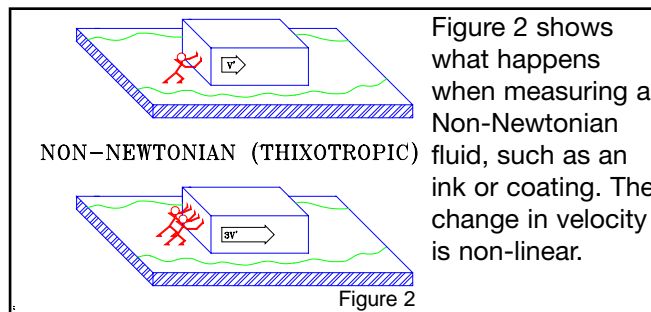


Figure 2

Figure 2 shows what happens when measuring a Non-Newtonian fluid, such as an ink or coating. The change in velocity is non-linear.

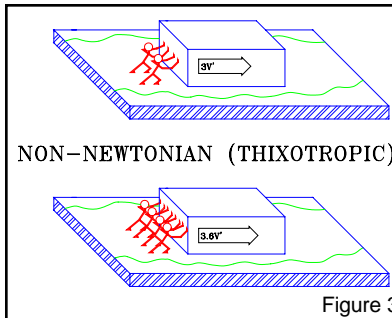


Figure 3

Figure 3 shows what happens when the force is increased even more. Note, that while the force was doubled the relative increase in speed is not linear. Process viscometers apply more force than efflux cups and thus will measure this non-linear response. It is for this reason that when process vis-

cometers are to display viscosity, as efflux cup seconds, they need to be calibrated to the specific efflux cup and fluid being measured. Once calibrated they will track changes in viscosity and can display viscosity in efflux cup seconds.

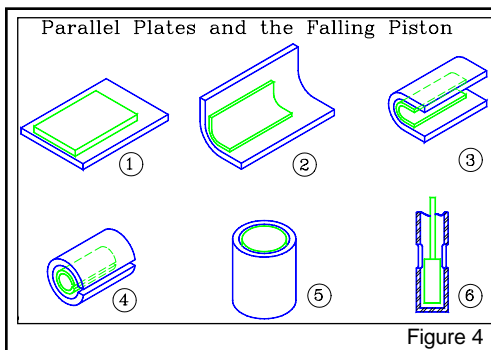


Figure 4

Figure 4 shows how the Falling Piston is an embodiment of the theoretical measure of viscosity.

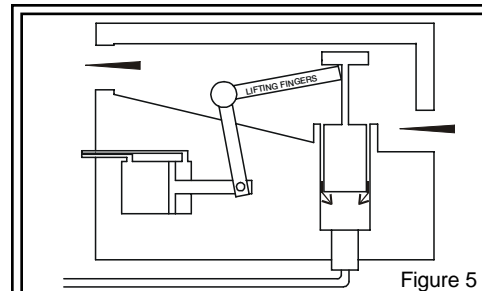


Figure 5

Figure 5 shows a cross section of our viscometer. The piston is raised up by raising up the lifting fingers, thus drawing a sample of ink into the space beneath the piston. After a preset time the

lifting fingers are pulled back down thus allowing the piston to fall by gravity. The time it takes to fall is a measure of viscosity. This is typically between one and two seconds.