Introduction

The rheometer is used to measure the viscosity of materials. The viscosity of a material is its resistance to flow. A basic rheometer has two parts, one fixed plate and one moveable plate parallel to each other. The material to be studied is placed on the fixed plate while the moveable plate is brought into contact with the material. The moveable plate has an area, A, and is subjected to a force, F. This force causes the later of liquid next to the moving plate to be displaced at a certain velocity. The movement of that layer of fluid influences the next lower layer to move, but its velocity is less than the first layer. The reduction in velocity from layer to layer is caused by the tendency of the second layer of fluid to resist movement, ie viscosity.

$$(F/A) = \eta \, (dv/dx)$$

Where η is the viscosity of the liquid.

Start Up

1. **Do not use this equipment without proper training.**

2. **Sign into the log book.**

3. Make sure the machine and area surrounding it are clean.
4. Plug in air filter. *Outlet is under cabinet to the right of the rheometer.*
5. Turn on air.
   It is extremely important to turn on the air before using the rheometer.
   If you do not turn on the air you risk damaging the head of the rheometer.
6. Turn on the rheometer. The switch is on the white controller under the table.
7. Unlock the air bearing.
   a. In the drawer under the rheometer is a burgundy plastic container with a clear lid containing an allen wrench to remove the screw that locks the air bearing in place. (Figure 1) Put the wrench and screw back into the container and place the container back in the drawer.
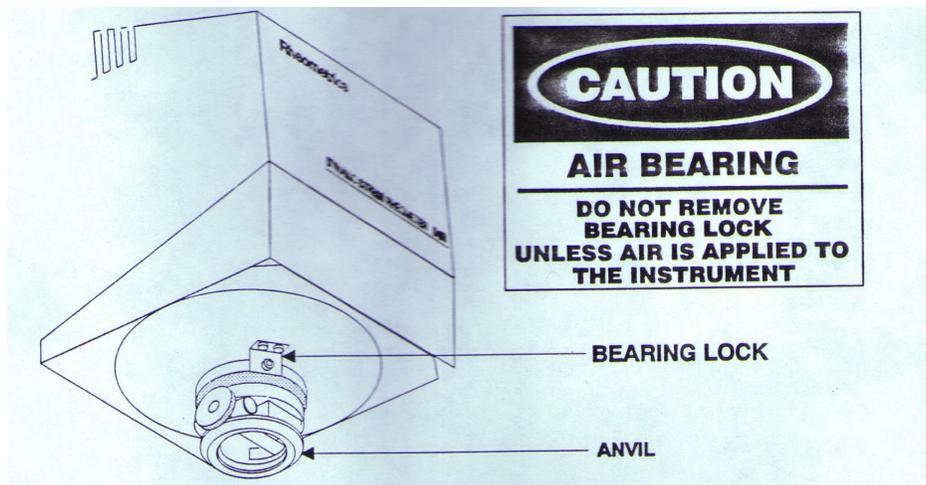

CAUTION

AIR BEARING

DO NOT REMOVE
BEARING LOCK
UNLESS AIR IS APPLIED TO
THE INSTRUMENT

BEARING LOCK

ANVIL

Figure 1 - location of air bearing lock

Software

1. To access the rheometer software at the C: prompt type:
   a. cd rhios↵
   b. rhios↵.
2. Check to make sure the geometry is set to cone & plate. Set-up →geometry.
3. To set the type of test:
   a. Test → Program New Test → Steady Rate Sweep Default Test.
   b. The parameters appropriate for the laboratory are under the file name polymers processing (shear rate 10^{-4} to 10^{1}).
4. To connect the computer with the rheometer: Utilities → Host Link ON
5. To set temperature:
   a. Run → Change Test Conditions
      then
   b. Run → Start Test → Edit Test.

Performing a Run

1. Place a small amount of polymer on the plate, enough to cover the surface. Let the polymer melt. Lowering the cone until it just touches the polymer, via the hand crank on top of the rheometer, aids in speeding up the melt process.
2. Once the polymer has melted, decrease the gap between the cone and the plate until polymer slightly oozes off the plate.
3. Less material is better when trying to perform a run.
4. Lower the shield.
5. Click the start button on the screen.
6. Once the run is over, clicking on the button that says ABC will show you the raw data for the graph.

Changing the Head in the Upper Fixture

1. Additional heads are located in a wooden box in the cabinet to the right of the rheometer.
2. The box contains a special wrench to pop the head out of the fixture.

Shutting Down

1. Clean the cone and plate with acetone to remove any residual polymer.
2. Lock the air bearing with the screw.
3. Turn off the controller.
4. Exit the software to DOS.
5. Turn off air.
6. Unplug the air filter.
7. Loosen the knob on the anvil and remove the upper fixture. (Figure 2)
8. Insert the wrench half way into the opening above the head.
9. Push down on the head to remove it from the fixture.
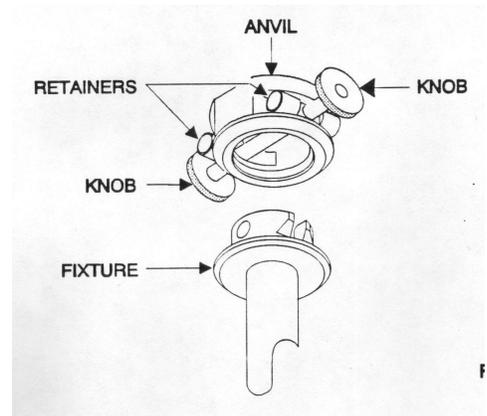10. Push the new head into the fixture.
11. Put the fixture back into the anvil and tighten the knobs.

Figure 2 – Fixture and anvil