

What is a fluid?

In the context of this book, a fluid is a substance that continues to deform indefinitely under the action of non-isotropic forces.

In contrast, a solid is a substance which, under the action of any steady forces, deforms and then comes to rest with no further deformation.

In the above definition we referred to a “non-isotropic force” because if the substance were subjected to the same pressure on every part of its surface then it would clearly not deform continuously since the net force it experiences in all directions is zero.

We often think of a particular pure chemical at a given temperature and pressure as being either a fluid or a solid. However, this is not necessarily accurate. A phase diagram like that in figure 1 purports to define regions in the pressure/temperature space in which the substance behaves like a solid, a fluid or a gas. However, this does not take into account the fact that the substance may behave like a solid (as defined

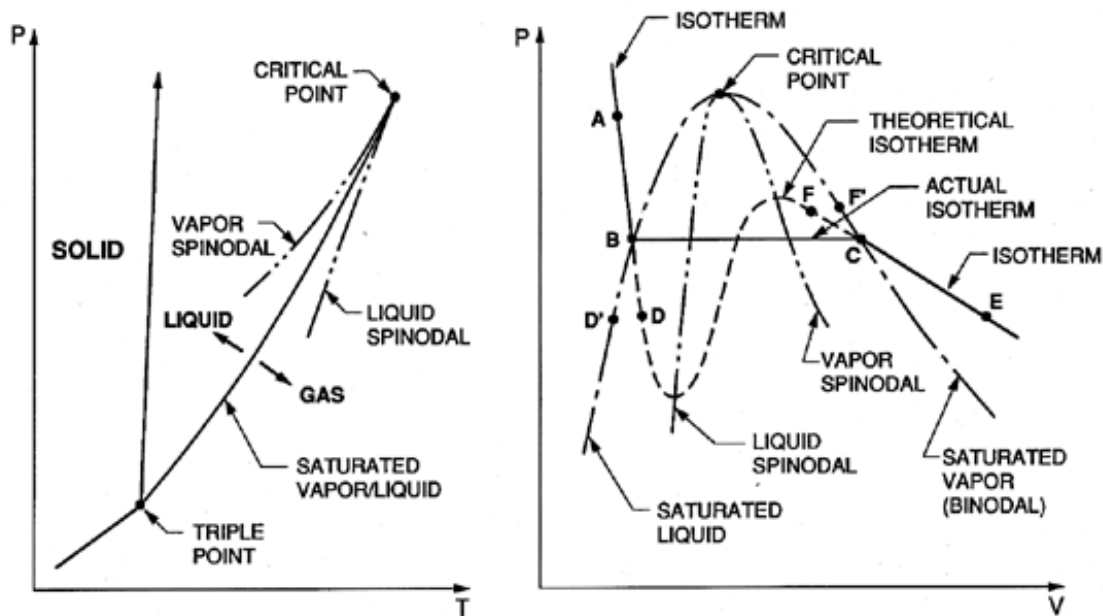


Figure 1: Typical phase diagrams for a substance like water.

above) under one type of applied deformation force and yet will behave like a fluid under a different type of applied deformation force. For example, glass at normal pressure and temperatures deforms like a solid under deformations applied for a short time but can be seen in medieval churches to flow like a liquid over times of the order of centuries. Another example is the earth’s mantle which transmits seismic waves like a solid but slowly circulates like a fluid over geological times to produce continental drift. Thus a description as a solid or fluid also depends on the duration of the observed deformation. In the present book we will not be concerned with this subtlety.