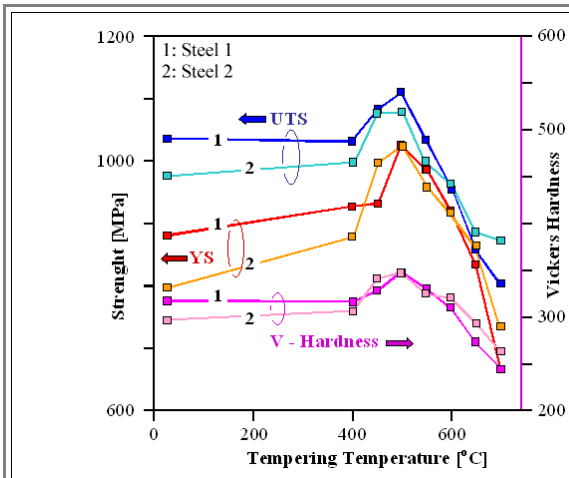
Yield Strength and Hardness

Illustration

The claim is that yield strength and hardness measure more or less the same property of metals: the onset of plastic deformation.

Here is the "proof". A series of real measurement taken from some more or less randomly selected publication about some steels.



Hardness, yield strength (YS) and ultimate tensile strength (UTS) are closely related

Source: S.K. Dhua[a,*], Amitava Ray[a], D.S. Sarma[b], "Effect of tempering temperatures on the mechanical properties and microstructures of HSLA-100 type copper-bearing steels" Materials Science and Engineering **A318** (2001) 197-210

The relevant data are:

- *Specimen:* The two steels are "high-strength low-alloy" steels (HSLA) with slightly different concentrations of alloying elements.
- *Tempering* in this context means that the samples were held at different temperatures ranging from 400–700°C for 1 h, followed by quenching in water. Then tensile tests and hardness measurements were done.
- Why this procedure changes the properties you will find out later; a taste treat can be found here.
- Of course, you can also read the paper, here is the link.

If we look very close, hardness is not just related to the yield stress YS but also to the ultimate tensile strength (UTS); the correspondence might even a bit better than to the yield strength.

It doesn't matter much, however. As long as the relation between UTS and yield strength is roughly constant (as in the picture above), a hardness measurement is good enough. If it's not, you simply can't describe the material very well with just giving single numbers.