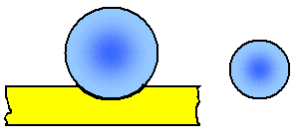
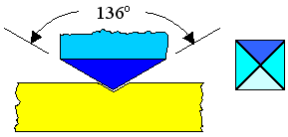
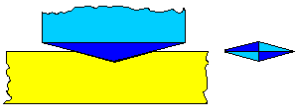
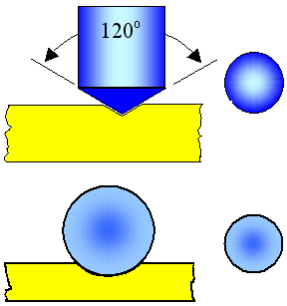
3.3.2 Ways to Measure Hardness

When you measure hardness, you press some hard and small object (the indenter) into the material to be tested with sufficient force to leave a permanent impression. The means that you always deform plastically or fracture you specimen locally. The "size" of the indentation gives you the hardness number.

- Methods differ by the material used for the indenter, its size and geometry, how you press, and how you measure.
- Since hardness plays a big role in sword blade lore, I give you an overview of the various methods employed.

Type	Indenter			Procedure
	Description	Geometry	Shape	
Brinell	10 mm sphere Variable load			Hardness number from load, depth and diameter of indentation.
Vickers	Diamond pyramid; square base			Hardness number from load and width of indentation.
Knoop	Diamond pyramid; rectangular base			Hardness number from load and depth of indentation.
Rockwell **A** **C** **D**	Diamond cone			Hardness number from fixed load and depth of indentation.
Rockwell **B** **F** **G**	1/16 inch steel sphere			
Rockwell **E** **H**	1/8 inch steel sphere			

The fact that there are many ways to measure hardness, producing different numbers for the same specimen, graphically demonstrates that each method has it pros and cons. I won't go into that, however.
As far as steel is concerned, numbers are usually given in either Vickers or Rockwell. With the figure from before you can easily convert from one scale to the other.

- Once more: No hardness test can compete with a tensile test; the latter gives far more information and numbers useful for calculations. But hardness tests are relatively cheap, easy to do, and in particular applicable to very small samples and samples with weird shapes.

Just to put hardness in perspective, the following table gives the Vickers hardness of some common materials. Note that there are variations for one and the same material not only for steel but for almost everything. The number given thus must be seen as a typical harness.

Metals	Vickers hardness		Ceramics	Vickers hardness
Tin (Sn)	5		Limestone	250
Aluminum (Al)	25		Magnesia (MgO)	500
Gold (Au)	35		Window glas	550
Copper (Cu)	40		Granite	850
Pure iron (Fe)	80		Quartz (SiO_2)	1200
Good tin bronze (Cu + 10% Sn)	220		"China" (Mostly Al_2O_3)	2500
Mild steel	140		Tungstencarbide (WC)	2500
Hardened steel	900			
Polymers				
Polypropylene	7		Polyvinylchloride (PVC)	16
Polycarbonate	14		Epoxy	45