

Considerable difficulty was experienced in obtaining the proper temper of these punches. They were made from Novo steel, turned to the required shape and tempered by heating in covered crucibles to a white heat, then plunging in thick oil and drawing out by heating again to a dull straw colour.

In the drawing out process they appeared to lose temper, there being apparently some difficulty in obtaining just the proper degree of reheating.

Several were not drawn out, but failed soon by cracking. Reference to curves 18, 20, and 21 will show the original design of these punches and their change in shape after the stated times of service.

It would seem that the sphere and paraboloid tend to retain their original shape much better than the cone, due to the point of the cone being under much more severe conditions of stress than the other two.

It may also be observed that the tendency of the cone curve is to gradually approach that of the paraboloid, while the paraboloid would tend to assume the spherical shape. This condition is exemplified farther on in the values of the hardness factor.

The term "Hardness Factor" should be here explained as the value obtained by dividing the projected area of indent at surface of specimen into the load applied, giving, in this case, the value of the hardness factor in pounds per square inch; for example, an area of .2 sq. inches obtained with, say, a .75" sphere, under a load of 80,000 lbs., would give a hardness factor of 400,000 lbs. per sq. inch; with a load of 40,000 lbs. an area of .1 sq. inch would be expected, though the value will be slightly more, as will be noted and discussed farther on.

It will thus be seen that careful measurement of the maximum diameter is necessary, as the area, and, consequently, the hardness factor would vary as the square of the diameter.

The Wicksteed machine was employed throughout the indentation test for these bars, and was found to give much more satisfactory results than the Emery machine, a uniform loading being obtained by setting the weight at the desired position and floating the lever arm by the hydraulic pressure from the accumulator, the load being thus never exceeded, while the rate of loading may be made fairly constant by watching the hydraulic pressure gauge.

Two indentations were made with each punch for each bar at loads of 40,000, 60,000, 80,000, and 100,000 lbs.

The 60° cone failed after a few trials, and further experiments with this type were not considered advisable. The results obtained