

however, to obtain this punch in time for service, but it is certain that it would give a higher value of hardness factor than the .75" diameter sphere, as seen in the higher values obtained in the case of the paraboloid.

From the curves the yield point appears to vary directly as the hardness factor, .150 of its value in the case of the .75" sphere, and .143 in the case of the cone and paraboloid, and probably very close to this value in the case of a sphere .5" diameter. The maximum load curve is a straight line up to a hardness factor of about 425,000 lbs., then bends over to meet the yield point for higher carbons.

The percent reduction in area curve may also be fairly taken as straight from 200,000 lbs. hardness factor — .10% carbon steel — to 450,000 lbs. hardness factor — about .70% carbon steel, having a value of about (59 — .000109 H) for the .75" sphere and (61 — .000111 H) for the 90° cone and paraboloid, H being the hardness factor in each case. Refer to curve 44 and curve 45 for tabulated results.

Coming now to the relation between the percentage carbon and hardness factor (curve 43), as obtained by the sphere, cone, and paraboloid, it would seem that, other conditions being equal, the percentage of carbon varies directly as the hardness factor for steel, running up to about .90%.

With a further increase of carbon a maximum hardness factor would soon be reached and the curves would then tend to bend down.

To illustrate the practical value of this relation it is interesting to refer to a test made on a piece of rail, broken while in service on the Grand Trunk Railway line and sent to the laboratory to ascertain, if possible, the cause of its failure. A traverse test was made, giving a normal value by Young's Modulus. Indentations were then made giving a value of 427,000 lbs. per sq. in. for a hardness factor, with a load of 80,000 lbs., using the .75 inch sphere, indicating from curve 43 a probable percentage of carbon present of about .68. A chemical analysis subsequently made gave from .66 to .70% carbon, with .60% phosphorus, .78% manganese, and .07% silicon.