The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE INFORMATION REPORT

SAE J413

REAF. FEB2002

Issued 1932-01
Reaffirmed 2002-02

Superseding J413 FEB1995

Mechanical Properties of Heat Treated Wrought Steels

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—The figures in this SAE Information Report illustrate the principle that, regardless of composition, steels of the same cross-sectional hardness produced by tempering after through hardening will have approximately the same longitudinal[1] tensile strength at room temperature.

Figure 1 shows the relation between hardness and longitudinal tensile strength of 0.30 to 0.50% carbon steels in the fully hardened and tempered, as rolled, normalized, and annealed conditions. Figure 2 showing the relation between longitudinal tensile strength and yield strength, and Figure 3 illustrating longitudinal tensile strength versus reduction of area, are typical of steels in the quenched and tempered condition. Figure 3 shows the direct relationship between ductility and hardness and illustrates the fact that the reduction of area decreases as hardness increases, and that, for a given hardness, the reduction of area is generally higher for alloy steels than for plain carbon steels.

It is evident from these curves that steels of the same cross-sectional hardness have about the same strength characteristics, so that any one of several different compositions would yield the same results. For some specific application then, the first thing to be determined is what composition is required to obtain proper hardening in the size section involved. This information is not contained in mechanical property charts, but can be determined from published data or by means of a hardenability test. Methods of making this hardenability test and interpretation of the test results are provided in SAE J406b.

Having selected a steel that will through harden in the size section under consideration, the engineer must decide from the service stresses imposed on the finished part what tensile properties are required in the part. These tensile properties may then be converted to hardness values from the figures given here; and from Figure 4 showing the effect of tempering temperature on hardness, the appropriate tempering temperature to obtain this hardness can be selected. In Figure 4 the curves are approximate values to be used as a guide. Carbon steels and lean alloy steels, when fully hardened, will fall slightly below the curves and strongly alloyed steels will fall slightly above the curves.

Figure 4 showing the effect of tempering temperature on hardness is a summary of information contained in a large number of mechanical property charts published by steel companies, alloy suppliers, and users. These charts represent, as do the charts on tensile, yield strengths, and reduction of area, data on all SAE alloy and carbon steels with carbon contents of 0.30 to 0.50%.

1. Longitudinal means parallel to rolling direction.

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Mechanical property values obtained from these few summary figures will be as accurate as the information formerly available in a large number of charts, each representing an individual type of steel. For more exact information it would be necessary to make tests on samples from individual heats of steel.

NOTE—Mechanical properties in this report are monotonic and do not represent cyclic test loading conditions. Cyclic loading and cyclic material properties are described in SAE J1099.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J406—Methods of Determining Hardenability of Steels
SAE J1099—Technical Report on Fatigue Properties

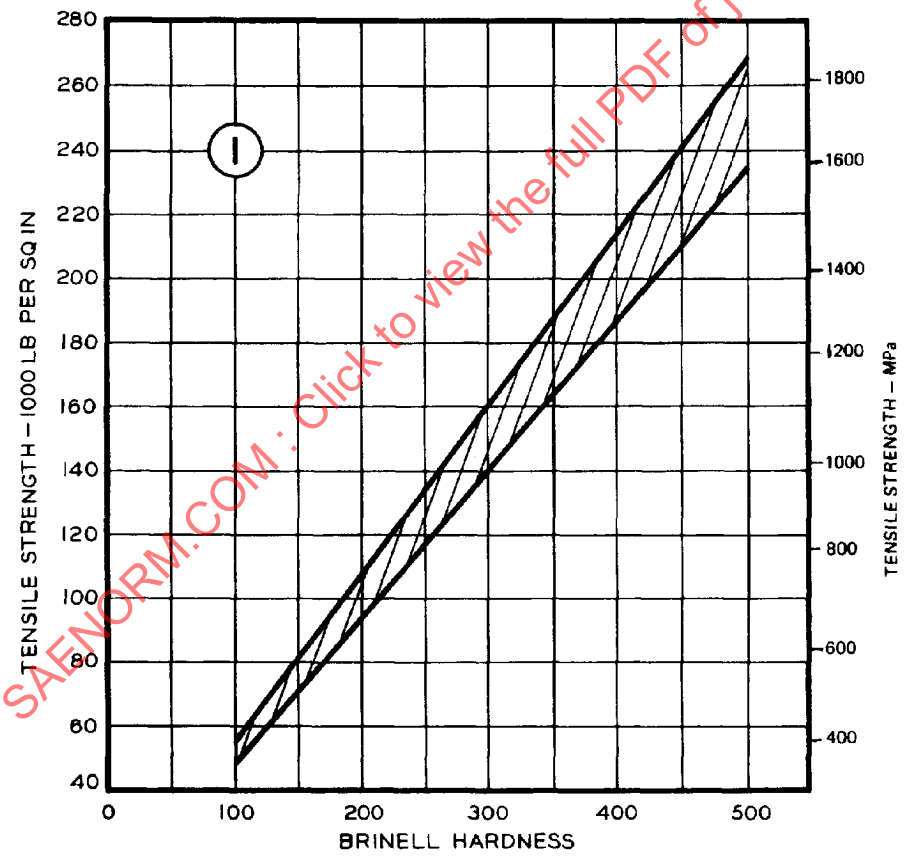

FIGURE 1—RELATIONSHIP BETWEEN HARDNESS AND LONGITUDINAL TENSILE STRENGTH OF 0.30 TO 0.50% CARBON STEELS

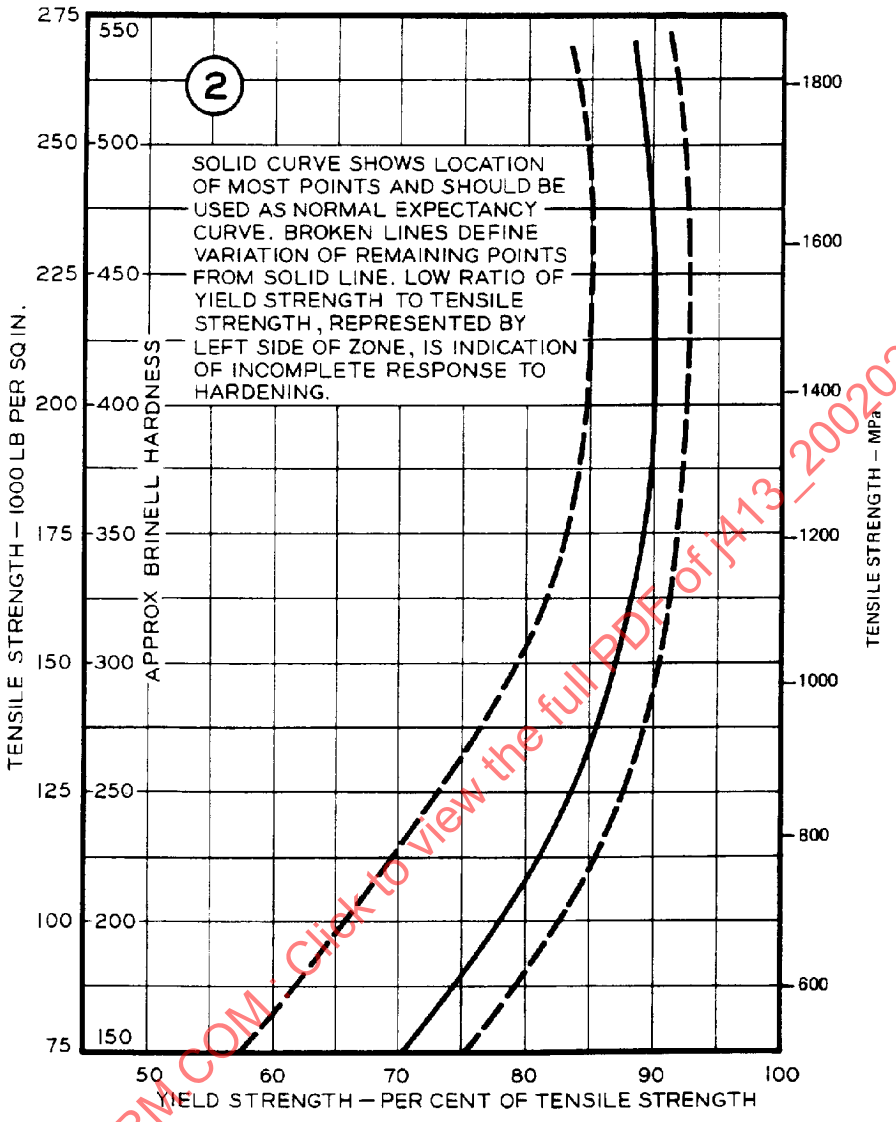

FIGURE 2—RELATIONSHIP BETWEEN LONGITUDINAL TENSILE STRENGTH AND YIELD STRENGTH FOR QUENCHED AND TEMPERED STEELS

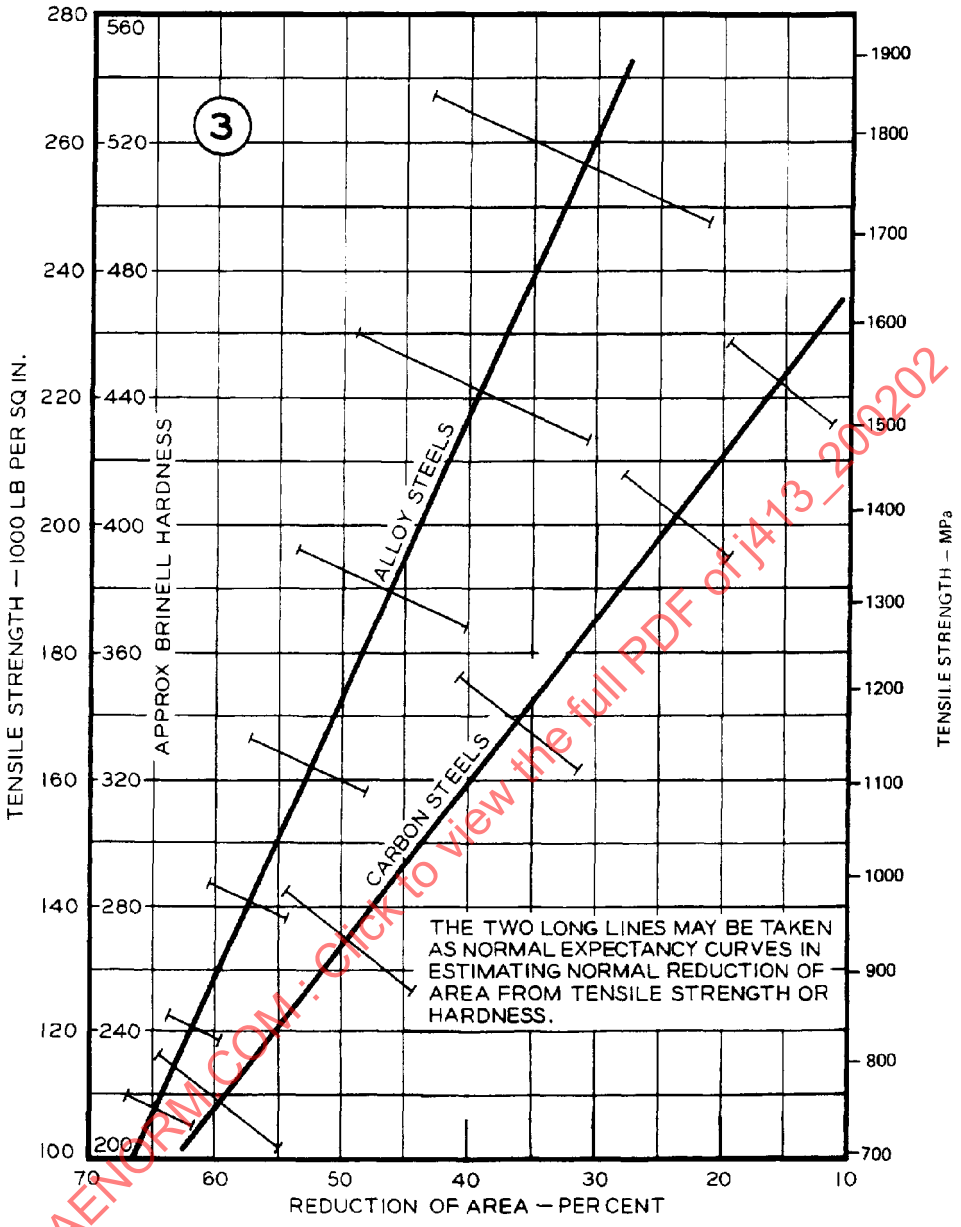

FIGURE 3—RELATIONSHIP OF LONGITUDINAL TENSILE STRENGTH TO REDUCTION OF AREA FOR QUENCHED AND TEMPERED STEELS