



Hardenability data may be used to estimate hardnesses obtainable with any steel in new machine parts not yet in production and not similar to any parts on which production experience is available. Various hardenability application methods are described in the selected references, Section 2.1, 23 to 25. It appears none of these methods are precise, but these are often useful for estimation purposes. Final correlation on actual parts is necessary.

## 2. REFERENCES

### 2.1 Applicable Publications

The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

#### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

1. SAE J417 Hardness Test and Hardness Number Conversion
2. SAE EA 406 Hardenability Prediction Calculator
3. W. E. Jominy and A. L. Boegehold, "A Hardenability Test for Carburizing Steel," ASM Transactions, Vol. 26 (1938, No. 2, pp 574–599)
4. J. L. Burns, T. L. Moore, and R. S. Archer, "Quantitative Hardenability," ASM Transactions, Vol 26 (1938), No. 1, pp 1–33
5. W. E. Jominy, "A Hardenability Test for Shallow Hardening Steels," ASM Transactions, Vol. 27 (1939) pp 1072–1085
6. Symposium on Hardenability of Alloy Steels, ASM 1939
7. M. Asimow and M. A. Grossmann, "Hardening Characteristics of Various Shapes," AMS Transactions, Vol. 28 (1940) pp 949–977
8. "Standardization Sought in Determining the Hardenability of Steels" (A symposium), SAE Journal, Vol. 49, No. 1 (July 1941) pp 266–293
9. A. E. Focke, "Hardenability of Steel," Iron Age, Aug. 20, 1942 pp 37–40; Aug. 27, 1942, pp. 43–51; Sept. 3, 1942, pp 56–59
10. Morse Hill "The End-Quench Test: Reproducibility," ASM Transactions, Vol. 31 (1943), P 923 ff.
11. Symposium on the Hardenability of Steel, Special Report No. 36, British Iron and Steel Institute, 1946
12. G. K. Manning, "End Quench Hardenability Versus Hardness of Quenched Rounds," Metal Progress, Vol. 50, No. 4 (October 1946) pp 674-650
13. E. W. Wienman, R. F. Thomson, and A. L. Boegehold, "Correlation of End Quenched Test Bars and Rounds in Terms of Hardness and Cooling Characteristics," ASM Transactions, Vol. 44 (1952) pp 802–834
14. G. K. Manning, "Comparison of Tests of Hardenability of Shallow Hardening Steels," SAE Journal, Vol. 61, July 1953, pp 30–36
15. D. J. Carney, "Another Look at Quenchants, Cooling Rates and Hardenability," ASM Transactions, Vol. 46 (1954), pp 882–925

16. John Birtalan, R. G. Henley, Jr., and A. L. Christenson, "Thermal Reproducibility of the End-Quench Test," ASM Transactions, Vol. 46 (1954), P 928 ff
17. M. A. Grossman and R. L. Stephenson, "The Effect of Grain Size on Hardenability," ASM Transactions, Vol. 29 (1941), pp 1–19
18. M. A. Grossmann, "Hardenability Calculated from Chemical Compositions," AIME Transactions, Vol. 150 (1942) pp 227–259
19. I. R. Kramer, S. Siegel, and J. Brooks, "Factors for the Calculation of Hardenability," ASM Transactions, Vol. 163 (1946), p 670 ff
20. C. F. Jatzczak and D. J. Girardi, "Multiplying Factors for the Calculation of Hardenability of Hypereutectoid Steels Hardened from 1700 F," ASM Transactions Vol. 51 (1960) p 335 ff
21. E. Just, "New Formulas for Calculating Hardenability Curves," Metal Progress, November 1969, pp 87–88
22. C. F. Jatzczak, "Determining Hardenability from Composition," Metal Progress, Vol. 100, No. 3 (September 1971), p 60
23. D. H. Breen, G. H. Walter, C. J. Keith, and J. T. Sponzilli, "Computer-Based System Selects Optimum Cost Steels," Metal Progress, I: Dec. 1972, p. 42; II: Feb. 1973, p. 76; III: April 1973, p. 105; IV: June 1973, p. 83; V: Nov. 1973, p. 43
24. C. S. Siebert, D. V. Doane, and D. H. Breen, "The Hardenability of Steels," American Society for Metals, Metals Park, OH 1977, p 64 ff
25. D. V. Doane, J. S. Kirkaldy, "Hardenability Concepts with Applications to Steel," The Metallurgical Society of AIME, Warrendale, PA 1978
26. C. T. Kunze and G. Keil, "A New Look at Boron Effectiveness in Heat Treated Steels," Symposium on Boron Steels, TMS-AIME, Milwaukee, WI Sept. 18, 1979
27. W. Hewitt, "Hardenability - Its Prediction from Chemical Compositions," Heat Treatment of Metals, Vol. 8, 1981, pp 33–38
28. Deb. M. C. Chaturvedi and A. K. Jena, "Analytical Representation of Hardenability Data for Steels," Metals Technology, 1982, Vol 9, p 76
29. J. M. Tartaglia and G. T. Eldis, "Core Hardenability Calculations for Carburizing Steels," Met. Trans., Vol. 15A, No. 6, June 1984, pp. 1173–1183

## 2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

### 2.2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

ASTM A 255 End-quench Test for Hardenability of Steel