ASM Ready Reference

Thermal Properties of Metals

ASM Materials Data Series

Prepared under the direction of the
ASM International Materials Properties Database Committee

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Preface

This book is designed to serve the needs of the engineering and technical communities for high quality and comprehensive information regarding thermal properties of metals.

In 1997 the ASM International Materials Properties Database Committee sponsored and reviewed the ASM Ready Reference: Properties & Units for Engineering Alloys. The Committee recognized the need for consistency and equivalency, when integrating material property data from multiple sources into printed or electronic reference publications. The second book in the Ready Reference series applied the principles of consistency to selected electrical and magnetic properties of metals. This third book in the series continues integration from multiple sources for thermal properties of metals. The materials are sorted by a common materials hierarchy, and their property values are given in a consistent system of International Standard (SI) and customary units. The quality of the data and source of the data is also listed to enable the user to assess the data.

The book Chapters are broad categories of the major thermal properties covering thermal expansion, heat capacity, thermal conductivity, melt properties, and thermal emittance. Each chapter begins with a brief explanation of the property, derivation and conversion of the units used within, along with a discussion of other units that the reader may encounter. We trust this will be of benefit to the reader already familiar with the basics of thermal behavior. We do not attempt to present a textbook on thermodynamics in these brief introductions but seek to clarify possibly confusing terminology.

The first table of each Chapter summarizes values from low to high room temperature property value for major alloy groups. The subsequent data tables have the materials sorted by the material hierarchy. The complete hierarchy for materials found in this book is given in Table A.1 of the Appendix. As with the classification systems for materials in general use, the hierarchy is predominantly based on composition, but there are subdivisions that are application based.

Data Format

Data entries include the following:

- **Material name** may be a trade name, generic alloy, element, or description as assigned by a standards organization.
- **Temper** is listed as stated.
- **UNS number** is listed if known.
- **Property values in the preferred (SI) and alternate (customary) units.** The units used are those designated in the ASM Ready Reference: Properties & Units for Engineering Alloys. SI is the International System of Units (modernized Metric System). The customary units are English (lb. in.) units.
- **Qualifier** for the value. This is the qualifier as stated in the source of the data, such as typical, nominal, maximum. The most often used abbreviations are listed on the bottom of the page. The complete list is given in the Appendix Table A.2. Often the source document will list the data as “not for design” or “for information only.” The “not for design” is applicable to all values listed, as there is no documented quality control process in place. It is therefore not listed on each record. If the value was derived from the information given in the source, such as conductivity derived from resistivity, or if units were converted, a “d” follows the value. Unit conversions that are merely a change in the value by a power of 10, are not labeled as derived. Values without the “d” are those most directly attributable to the source. A value can be established by definition, or by specification. There is still latitude as to how strictly the standard controls the material. It may be a mandatory or non-mandatory requirement, or one that is at the mutual consent of the buyer and seller.
- **Reference to the data source listed in Table A.3 of the Appendix**
- **Temperature** for which the value is valid is listed.
- **Notes** may include product forms, sizes, or processing information for which the value applies. Common uses of the alloy may be listed.

Limitations on the Use and Interpretation of Data

This book is intended to provide the materials engineer, scientist, or other specialist with a comparative listing of materials and their magnetic and electrical properties, to aid in the material selection process. Just as most of the sources listed bear the caveat “not for design,” the compilation of this data requires the same warning. Great effort has been expended to assure that the source material has been faithfully duplicated, but ASM International has no formal program whereby the validity of the data can be assured. The source references allow further investigation by the reader. It is the reader’s responsibility to take the prudent engineering and quality assurance steps necessary to assure that any material selected meets the design requirements.

Significant Figures

Individual sources have listed values to varied significant figures in the same data sets. The significant figures in values with trailing zeros (50,000), are not determined without more information. ASTM standards list sufficient decimal places to improve the accuracy of conversion and reconversion of the data. They stress that this does not imply the need to test the material to an accuracy beyond what the specification or the referenced test specification demands. For this reason, although the value has been listed to the same number of significant figures as the original when no derivation was required, no comparison should be made as to the precision of the values based on the significant figures shown. Values shown as “derived” have at least as many significant figures as the original source. As the conversion calculations were done in mass, significant figures were added to some values to assure that all had sufficient significant figures to preserve the original accuracy.
Availability of Materials

As it is often useful to have a source of data for historical materials, obsolete materials and materials listed by former trade names are included in the alloy field. No attempt was made to verify the commercially availability of materials.

Call for Future Action

A material database must be a dynamic creation, under constant revision. We at ASM International, who have the dissemination of materials information at the core of our vision statement, ask that qualified parties contribute material data to the Society for the betterment of the technical community. Your suggestions, corrections, and comments are welcome. They can be sent to the addresses found on the title page.

Fran Cverna
July 2002