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A Reference Guide for Cryogenic Properties of Materials*

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Abstract

A thorough knowledge of the behavior of materials at cryogenic temperatures is critical for the design of successful cryogenic systems. Over the past 50 years, a tremendous amount of material properties at cryogenic temperatures have been measured and published. This guide lists resources for finding these properties. It covers online databases, computer codes, conference proceedings, journals, handbooks, overviews and monographs. It includes references for finding reports issued by government laboratories and agencies. Most common solids and fluids used in cryogenics are covered.

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Introduction

This is a guide to finding properties of materials at cryogenic temperatures. Over the last 50 years, a large amount of material properties at cryogenic temperatures have been measured and published. For the working engineer or scientist, the problem is frequently not that the desired material property is unknown at cryogenic temperatures but that it is unclear where to find the published data. The goal of this document is to make the properties easier to find. There are 2 caveats to this guide. The first is that it is not meant to be completely exhaustive. The second is that this is simply a guide to the scientific literature and inclusion in this list does not mean the data is somehow “better” or more accurate than other sources.

Databases

1. Cryogenic Information Center

This a commercial database issued on CD-ROM that contains references to more than 146,000 papers, books and technical reports specifically concerning cryogenics. The database includes the cryogenic database formally maintained by the US National Bureau of Standards. The citations go back as far as 1829. Many useful references for cryogenic material properties may be found in this database. The database permits searches by keyword, title, author and year among others. The citation listing is updated on a regular basis. Information regarding the Cryogenic Information Center may be found at: http://www.cryoinfo.org/

2. SPIRES

This is a free online database listing more than 500,000 papers, books, laboratory reports and preprints associated with high energy physics. The database permits searches by keyword, title, author and year among others. Properties of cryogenic materials are not an emphasis of this database. However, references to those properties measured during the development of high energy physics experiments and accelerators are frequently found here. Of particular value are the large number of reports from high energy physics laboratories worldwide that are referenced here. The SPIRES website may be found at: http://www.slac.stanford.edu/spires/hep/

3. DOE Energy Citations Database

This is a free online database of all energy related research funded by the US Department of Energy and its predecessors from 1948 to the present. The

database contains references to technical reports, papers, thesis and books. The database may be found at http://www.osti.gov/energycitations/
A related database, the DOE Information Bridge, contains full text versions of DOE funded work dating back to 1995. This database may be found at: http://www.osti.gov/bridge/
Both these databases permit searches by keyword, title, author and year among others. Both are regularly updated.
Since these databases deal with much more than the properties of cryogenic materials, the careful use of search terms is required to avoid drowning in irrelevant citations.

4. Defense Technical Information Center

This is a free online database that contains citations to technical papers and reports dating back to 1974. This database allows searches by keyword, title, author and year among others and is regularly updated. The database includes but is not limited to reports from Department of Defense contractors. The database contains references to cryogenic material properties but also to many other topics so careful searching is needed. The database may be found at: http://stinet.dtic.mil/

5. NIST Data Gateway

This is a free online database created by the National Institute of Standards and Technology (NIST). It provides links to online NIST property databases. The database allows searching by keyword, material or property. Both cryogenic and room temperature material properties are covered. The database may be found at: http://srdata.nist.gov/gateway/gateway

Handbooks & Overviews

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Conference Proceedings

1. Advances in Cryogenic Engineering, Volumes 1 – 48, Plenum Press

   These are the proceedings of the Cryogenic Engineering Conference / International Cryogenic Materials Conference which is held biannually (odd years) in North America. As roughly 50 % of this conference concerns cryogenic materials, these proceedings can be quite useful.

2. Proceedings of the International Cryogenic Engineering Conference

   These are the proceedings of the International Cryogenic Engineering Conference which is held biannually (even years) in Europe or Asia.

3. Applied Superconductivity Conference, IEEE Transactions on Magnetics

4. Proceedings of the Magnet Technology Conference

Journals

1. *Cryogenics*, Elsevier Science – Monthly refereed journal covering all aspects of cryogenic engineering and science

Properties of Fluids

I. Computational Codes

1. HEPAK

This is a commercial product that calculates the thermophysical properties (both state and transport properties) of Helium. The program is valid for a wide range of helium temperatures and pressures including the superfluid regime. More details about this program may be found at http://www.cryodata.com/

2. GASPAK

   A commercial product very similar to HEPAK except that it calculates state and transport properties for ~~a~~ 33 different fluids including Helium, Hydrogen, Oxygen, Neon, Carbon Dioxide, Nitrogen and various refrigerants. More details about this program may be found at http://www.cryodata.com/

3. NIST 12 (NIST Thermodynamic and Transport Properties of Pure Fluids Database)

   A commercial program created by the National Institute of Standards & Technology very similar in nature to GASPAK. More details about this program may be found at http://www.nist.gov/srd/nist12.htm

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Properties of Solids

I. Computational Codes

1. Cryogenic Material Properties Program (CMP)

   This is a commercial product that allows the calculation of material properties for 35 different materials including G-10, aluminum alloys, stainless steel alloys and titanium. The properties available include: yield strength, thermal conductivity, electrical resistivity and thermal expansion. The valid temperature range is generally between less than 4 K up to the melting point. Information about this program may be found at: http://www.cryoinfo.org/

2. CRYOCOMP and METALPAK

   These are commercial software packages that permit that calculation of material properties for a number of solids. CRYOCOMP will produce properties for 60 different solids including copper, stainless steels, and aluminum. Properties include: specific heat, thermal conductivity, and electrical resistivity. Mechanical properties are not covered. The properties are generally calculated between 1 K and 300 K. METALPAK is similar to CRYOCOMP except that it calculates properties for 14 metals. More details about these program may be found at http://www.cryodata.com/

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This is a guide to finding properties of materials at cryogenic temperatures. Over the last 50 years, a large amount of material properties at cryogenic temperatures have been measured and published. For the working engineer or scientist, the problem is frequently not that the desired material property is unknown at cryogenic temperatures but that it is unclear where to find the published data. The goal of this document is to make the properties easier to find. There are 2 caveats to this guide. The first is that it is not meant to be completely exhaustive.Â Many useful references for cryogenic material properties may be found in this database. The database permits searches by keyword, title, author and year among others. The citation listing is updated on a regular basis. This paper presents property data and information describing the various cryogenic applicat2ons for nonmetallic materials. Until very recently, this classification of materials was usually ignored for structural applications at cryogenic temperatures. Basically, there are three reasons for the reluctance of designers to use this ' . family of materials. First, there were essentially no cryogenic mechanical and physi-cal property data available. I want to research various the properties of various materials, namely tensile strength at cryogenic temperatures (~20K). I was wondering if a freely available database of material properties exists. temperature material-science. Share.Â Asking for help, clarification, or responding to other answers. Making statements based on opinion; back them up with references or personal experience. Use MathJax to format equations. MathJax reference. To learn more, see our tips on writing great answers. Draft saved. Cryogenic Application Guide. Quality flow control products paired with expert advice. Â©2018 Rego. Globe valves gate valves check valves relief valves high pressure valves needle valves diverters regulators manifolds cylinder equipment.Â Quality materials, innovative, long-lasting design and operational excellence are built into every product we manufacture. That is how we can offer a 10-year product warrantyâ€”double that of other companies. Designed, manufactured and 100% tested in the USA.Â APPLICATION. Liquid cryogenic delivery systems. The key to fast freezing and fresher foods. Chilling, freezing, preservation and carbonation are just some of the ways cryogenic gases help preserve and transport foods and beverages.

To evaluate the cryogenic properties of the produced joints as well as the stir zone material, tensile tests and U-notched Charpy impact tests were conducted in a temperature range from 20 1C to Ã€196 1C. Two tensile specimens and one impact specimen were used for each material/temperature condition. To examine the weld properties, transverse tensile tests were used.Â To study the mechanical properties of the stir zone material only, longitudinal tensile tests were performed. These specimens were cut parallel to the weld centerline; had a gauge section of 16 mm in length, 3 mm in width and 1.5 mm in thickness; and included stir zone material only.Â (For interpretation of the references to color in this gure legend, the reader is referred to the web version of this article.) Understanding the properties of cryogenic fluids and the cryogenic properties of materials is vital to the safe operation of cryogenic systems. This chapter describes the properties of typical fluids used in cryogenics including helium, nitrogen, oxygen and hydrogen as they relate to safety. Lists of suitable and unsuitable materials for cryogenic systems are given and material properties most linked to safety are discussed. Unique safety issues such as the impact of ionizing radiation on liquid nitrogen and the flammability hazards associated with charcoal adsorbers are also covered. Referenc... @inproceedings{Schwartzberg1964CRYOGENICMD, title={CRYOGENIC MATERIALS DATA HANDBOOK}, author={F. Schwartzberg and S. H. Osgood and R. D. Keys and T. Kiefer}, year={1964} }. F. Schwartzberg, S. H. Osgood, +1 author T. Kiefer. Published 1964. Engineering. Abstract : The background, organization, and maintenance of the Cryogenic Materials Data Handbook are discussed. An experimental program and its accomplishments in the past year are described. Handbook insert reports 12 and 13 were distributed in the past year.Â A Reference Guide for Cryogenic Properties of Materials. J. Weisend. Engineering. 2003. 2. PDF. Save. â€¢ reference. â€" G. Hartwig: â€žPolymer Properties at Room and Cryogenic Temperaturesâ€œ, 1994, Plenum Press. Materials - others.Â The stem itself must by its design allow for such misalignments, any guiding of it in the valve body must be protected against friction. Any flexible connection of the valve plug to the valve stem must be designed such that vibration of the plug due to the fluid flow is prevented and no damage of the plug, the seat or the seal occurs. A flexible and clearance-free clutch device must protect the valve stem from any misalignments introduced from the actuator. The valve bore and plug must be fabricated with a tolerance allowing for a rangeability of at least 1:100. Sealing system.

In physics, cryogenics is the production and behaviour of materials at very low temperatures. The 13th IIR International Congress of Refrigeration (held in Washington DC in 1971) endorsed a universal definition of â€œcryogenicsâ€ and â€œcryogenicâ€ by accepting a threshold of 120 K (or â€“153 Â°C) to distinguish these terms from the conventional refrigeration. This is a logical dividing line, since the normal boiling points of the so-called permanent gases (such as helium, hydrogen, neon, nitrogen, oxygen, and... I want to research various the properties of various materials, namely tensile strength at cryogenic temperatures (~20K). I was wondering if a freely available database of material properties exists. temperature material-science. Share.Â Asking for help, clarification, or responding to other answers. Making statements based on opinion; back them up with references or personal experience. Use MathJax to format equations. MathJax reference. To learn more, see our tips on writing great answers. Draft saved. â€¢ Properties of Solids in Low Temperature. â€“ Specific heat â€“ Thermal expansion/contraction â€“ Electrical resistivity â€“ Thermal conduction â€“ Mechanical properties â€“ Vacuum properties. â€¢ Materials. â€“ Stainless Steel â€“ Copper â€“ Brass and Bronze â€“ Aluminum alloys. â€“ Indium â€“ G10, G11 â€“ Special materials. Properties of Solids in Low Temperature. Specific heat.Â â€¢ When cryogenic apparatus elements are made of different material, after cool down the apparatus components can be strongly stressed. Therefore expansion elements, as compensation bellows, and special material shapes (U, Z) should be considered in apparatus design. â€¢ Thermal expansion coefficient is strongly changed down to 50 K and after is almost temperature independent. It contains a tremendous amount of knowledge about cryogenic fields and properties of materials. It describes advances in cryogenic fundamentals which are covered by the reviews of cryogenic principles and low-loss storage systems. It also presents a detailed discussion over topics like cryogenic insulation, low-temperature thermometry, modern liquefaction processes, and helium cryogenics.Â It serves as a reference book for industrialists and academicians working with cryogenic engineering. It is a guiding book for M.E. Cryogenics and M.E. Refrigeration students who are in search of project / research topics. 8. â€œAdvances in Cryogenic Engineeringâ€ by Timmerhaus.