CIRCUIT CELLAR ONLINE

THE MAGAZINE FOR COMPUTER APPLICATIONS

Circuit Cellar Online offers articles illustrating creative solutions and unique applications through complete projects, practical tutorials, and useful design techniques.

RESOURCE PAGES

RESOURCE LINKS

A Guide to online information about:

Magnets

by Bob Paddock

In this month's Resource Page, I'll be covering magnets. I had an application, in which I needed a remote control that was virtually impervious to liquids, dust, and other contaminants, for use in the extremely nasty environment of a coal mine. A good way to accomplish this is by the use of magnetic coupling, which meant I needed to find some magnets.

Fully sealed Matric remote control stations are virtually impervious to liquids, dust, and other contaminants. Features that allow easy cleaning and maintenance
are built in with long field life in mind. Non-corrosive metals and state-of-the-art plastic enclosures ensure years of reliability.

I'll let you know right up front here that I'm not going to be covering refrigerator magnets, magnetic therapy, or even babe magnets.

Magnetic Units—Confused by magnetic units? Most people are! Download this carefully done table of the units from the Electromagnetic Technology Division of the Electronic and Electronic Engineering Laboratory of the National Institute of Standards and Technology.

WARNING: Some of the magnets listed here are so strong that they present serious hazards, such as pinched or crushed fingers, freezing hazards from cryogenics, or potential health effects, the causes of which are still unclear or unknown. Also, some magnets are prone to shattering. *You* are the person most responsible for your own safety.

Magnetism—Although scientists and researchers can harness the power of magnets for the semiconductor and microprocessing industries, they have yet to determine what a magnetic field is. Some current hypothesis can be found at http://www.technicoil.com/magnetism.html.

The Medieval Technology Pages: Magnets by Paul J. Gans. The year 1155 is where the first written reference to manufactured magnets has been found.

PC Micromagnetics Simulator allows you to construct a magnetic device or circuit and simulate the system response under the influence of external magnetic fields,

currents, or local field sources. The program is most useful as a tool in the development of initial device design concepts and their rapid iterative analyses before rigorous modeling is attempted. The software may also have potential pedagogical uses for classroom instruction of micromagnetics.

The PC Micromagnetic Simulator (SimulMag) is a personal computer-based magnetic design tool developed by John Oti while he was in the Electromagnetic Technology Division of the Electronic and Electronic Engineering Laboratory of the National Institute of Standards and Technology.

The Object Oriented MicroMagnetic Framework (OOMMF) project at ITL/NIST.

OOMMF is a project in the Mathematical and Computational Sciences Division (MCSD) of ITL/NIST, aimed at developing portable, extensible public domain programs and tools for micromagnetics. The end product is a completely functional, user-friendly micromagnetic code, with a well documented, flexible programmer's interface to allow developers outside the OOMMF project to swap their own code in and out as desired. The guts of the code are being written in C++ with a Tcl/Tk (and in the future, possibly OpenGL) interface. Target systems include a wide range of Unix platforms, Windows NT, and Windows 95/98. The open source scripting language Tcl/Tk is required to run OOMMF.

The NIST/EEEL magnetic technology effort home page has many interesting reports on leading-edge magnetic research.

µMAG—Micromagnetic Modeling Activity Group

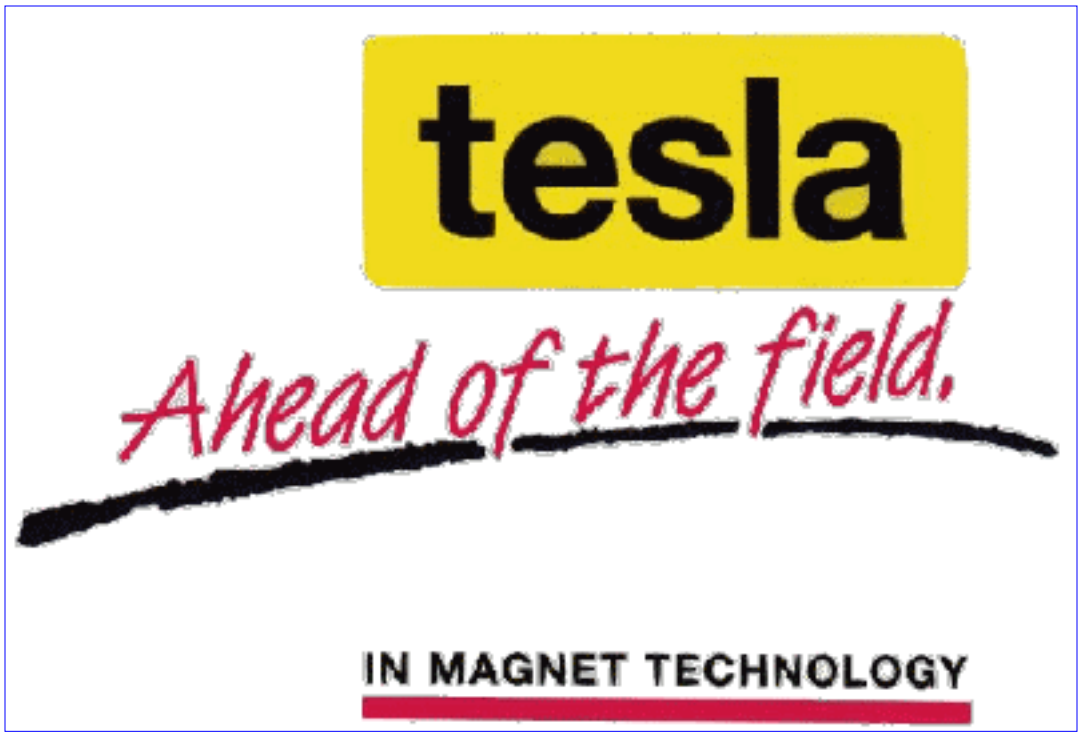
As part of the NIST Center for Theoretical and Computational Materials Science (CTCMS) mission to develop and apply state-of-the-art theoretical and computational materials science techniques, the micromagnetic modeling activity group (µMAG) was formed to address fundamental issues in micromagnetic modeling. Micromagnetics deals with magnetic materials on a mesoscopic scale, which is larger than the atomic scale, yet small enough that bulk material properties are an inadequate description of the material. Micromagnetic calculations find application in both permanent and soft magnetic materials, in magnetic recording media, and in magnetic devices such as recording heads and magnetic field sensors.

Part of what µMAG does is to facilitate communication between people working in micromagnetics and related areas. They have sponsored a number of workshops and reports are available.

High-Energy Physics Made Painless

MAGNETS, PART I and MAGNETS, PART II .

If you are in a hurry to get off of the planet and your Star Gate is broken, Tesla Engineering might just have the parts you need to repair that high-energy fusion magnet particle accelerator power supply.



Tesla Engineering is a world leader in the design and manufacture of coils and magnet systems for Medical (MRI), Semiconductor, and scientific applications, including high-energy physics, nuclear fusion, and instrumentation.

Finite Element Method Magnetics—
a free magnetics finite element package for Win95/98/NT.

You can find links to many magnet societies and other magnet software at this site.

The Rare-earth Information Center (RIC) was established at the Ames Laboratory by the U.S. Atomic Energy Commission's Division of Technical Information in January of 1966 to service the scientific and technological communities by collecting, storing, evaluating, and disseminating Rare-earth information from various sources. In 1968, the support of RIC was transferred to Iowa State University's Institute for Physical

Research and Technology through grants from the worldwide Rare-earth industry.

Leaving science fiction aside, science does know scores of different ways to levitate things. These are discussed at The Real Levitation page.

Adams Magnetic Products Co. distributes and manufactures one of the largest selections of magnetic materials. In permanent magnets they offer Cast and Sintered Alnico, Hard Ferrite (Ceramic Magnets), Bonded Ferrite and Bonded Neodymium, Sintered Samarium Cobalt, Neodymium Magnets, and Magnetic Assemblies.

Rare-earth and Advanced Material Products

On the American Elements web site, click an element on the Periodic Table to see its associated products or go to an alphabetical product list. You can find excellent reference material to Rare-earth here.

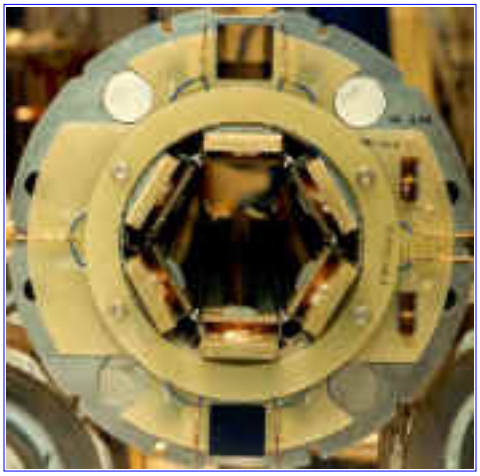
Analytical Scientific, Ltd. sells several magnet-related items such as their Eddy Current Kit. Young explorers can discover eddy currents with this amazing

demonstration of Lenz's Law. A moving magnetic field creates mysterious opposing forces, which make the magnet fall slowly through the tube. The kit includes a copper tube, two test plugs of similar size and weight (one steel and one neodymium magnet), two end caps for self-contained storage, and instructions.

The purpose of AZ Industries is to provide expertise in the field of magnetics to industries, commercial users, medical applicants, and energy conversations worldwide. AZ Industries performs practical research to provide answers to many problems and, at the same time, extend the limits of magnetic technology. A magnetics testing laboratory solves problems for many of AZ Industries'clients. AZ Industries has created many new and innovative products for any consumer.

AZ Industries, Inc. was created to manufacture precision magnets of various materials, sizes, and configurations. This custom work has continued to be their primary source of business. They are capable of producing custom precision magnets within short lead times.

Magnets in Your Future Online is updated a couple times a month with magnet industry news and related software announcements.



The Brookhaven National LaboratorySuperconducting Magnet Division (SMD) constructs magnets for use in particle accelerators such as the Relativistic Heavy Ion Collider (RHIC).

Superconducting Magnets for Future Colliders and Storage Rings was presented at a seminar in March of 2000, and gives a good overview of some of the problems at hand.

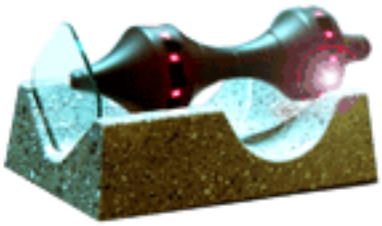
I always wondered where those magnetic door latches came from—now you and I both know, Bunting Magnetics Co.

As well as equipment for several other industries, here's what they provide:

- maintenance aids and magnetic tools
- magnets—including three pole magnets
- electromagnets
- metal detection equipment

They are the only site I saw that had a "shopping cart" system to let you order online.

Carlisle is a distributor who handles some of those cool "'toys" you see at gift shops and truck stops (or hamfests, which is where I picked up my magnet toy).



This thing actually makes a good seismometer. On the third floor of my office building, I can tell when someone walks into a room on the other side of the building or if the wind is blowing out side by how much it bounces, when it's not spinning.

CHINA RARE EARTH PERMANENT MAGNET LTD.
CHINA RARE EARTH PERMANENT MAGNET COMPANY

"China Rare Earth Permanent Magnet Ltd. is a main rare earth NdFeB permanent magnet manufacturer in China. They purchase neodymium and other rare metal directly from rare earth mine in the north of China, then they manufacture magnet by themselves."

Ceramic Magnetics, Inc.
A THOMAS & SKINNER COMPANY

Although Ceramic Magnetics doesn't really sell magnets persay, I thought their rotary transformers was worth a mention here. They let you transfer data, signals, and power between rotating elements for extended periods of time with little or no loss or distortion. This is effectively accomplished by means of ferrite-based rotary transformers.

Condensed Matter Web is a web site for researchers in the field of Condensed Matter Physics and publishes several journals such as the Journal Magnetism and Magnetic Materials.

CRYOMAGNETICS, INC.

Cryomagnetics Inc. is the only site that I came across that sells off-the-shelf superconducting magnets.

HILL & GILBERT
HYDRAULIC DIVISION LTD
PLANT HIRE, SALES AND SERVICE

If the superconducting magnets can't get the job done, maybe some old-fashioned brut force will with Hill & Gilbert's 24" to 65" magnets and generating equipment.

Daido Steel America, Inc. supplies radially oriented ring magnets.

Dexter has some interesting articles and graphics such as "Polarity of a Magnet."

Dipole Magnets is certain to draw its share of attention from users who enjoyed the hands-on, self-paced style of Forces and Vectors, two of WhistleSoft's popular tutorials released in 1998. This newest package covers the fundamentals of dipole magnets and the motion of charged particles, with an emphasis on focusing effects. It also offers an in-depth analysis of magnetic spectrometer devices.

Dipole Magnets consists of four basic sections: uniform bending magnets, nonuniform bends, fringe fields, and the Kerst-Serber equation. The unique hypertext environment provides a variety of avenues for working through the program. You can move in a linear fashion, building your understanding, or you can jump from one area to another, according to your interests. A short tutorial familiarizes you with program functions and operations, which are intuitive and easy to grasp. The interactive contents makes it simple to move from topic to topic, and a detailed concept map helps you fine-tune your studies. The hyperlinked index allows you access to specific phrases quickly, making Dipole Magnets suitable as a reference tool as well. A report card option is available upon exiting the program to help users keep track of their progress.

DURA MAGNETICS, INC.

Dura Magnetics is a comprehensive magnet company, providing magnets and magnetic solutions to industry. Available are:

- alnico, ceramic, rare earth (neodymium and samarium) bonded, and flexible
- sheet separators, press feeders, magnetic lifters, sheet handlers
- electromagnets round, rectangular, bipolar, custom power
- magnetic bases, pot magnet

EEC offers samarium-cobalt and neodymium-iron-boron magnets and magnet assemblies for a wide variety of applications that demand adherence to the most rigorous performance standards. Electron Energy Corporation was one of the first companies to manufacture rare earth (RE) permanent magnets for the marketplace after their discovery in the 1960s.

"Versatile, high quality and economical all describe our Plastalloy! products. Plastalloy rubber bonded strontium ferrite permanent magnet strip and sheet can be bent, twisted and flexed without loss of their high magnetic energy."—Electrodyne

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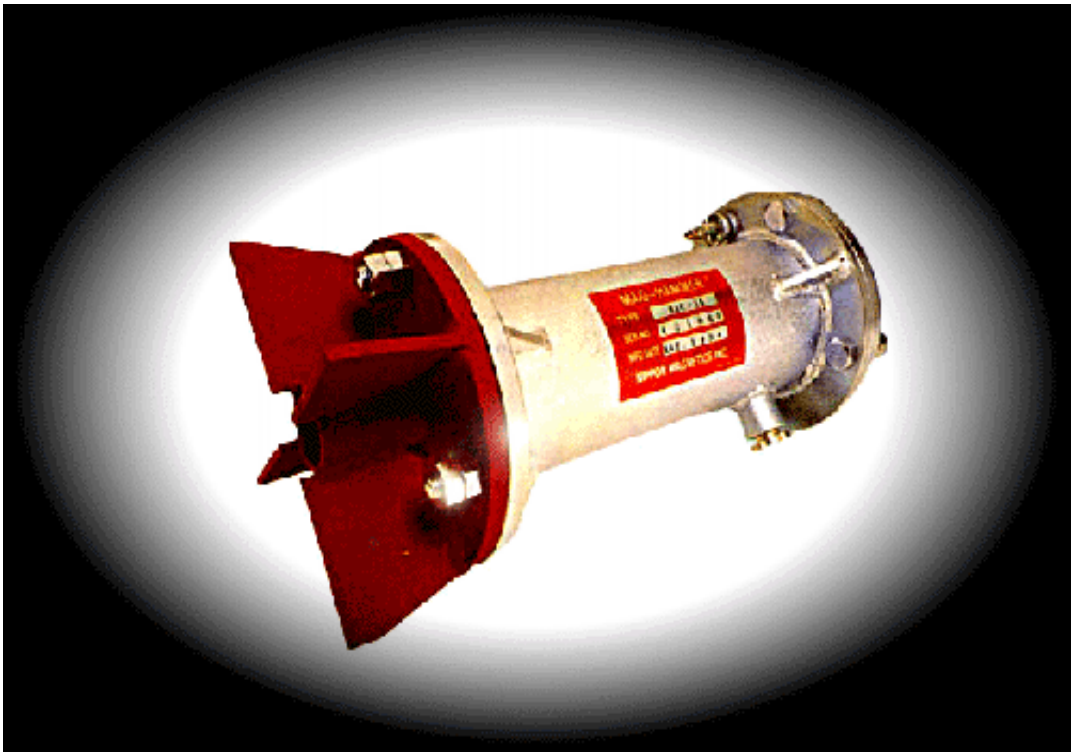
Earthbound Magnetics deals in permanent magnets, magnetisers, and measuring equipment.



Electromagnetic Hammers operates with two or three phases AC. They have a low maintenance as a result of their blindage. They do not need air system, have low installation cost, and high durability.

(Unfortunately I lost the URL to this in one of the daily Windoze crashes, if you recognize it please let me know. I've probably already moved to Linux or FreeBSD by the time you are reading this. How can any company that sells such buggy software have so much market share?)

Can't find a magnet exactly the shape you want? Try a liquid one.

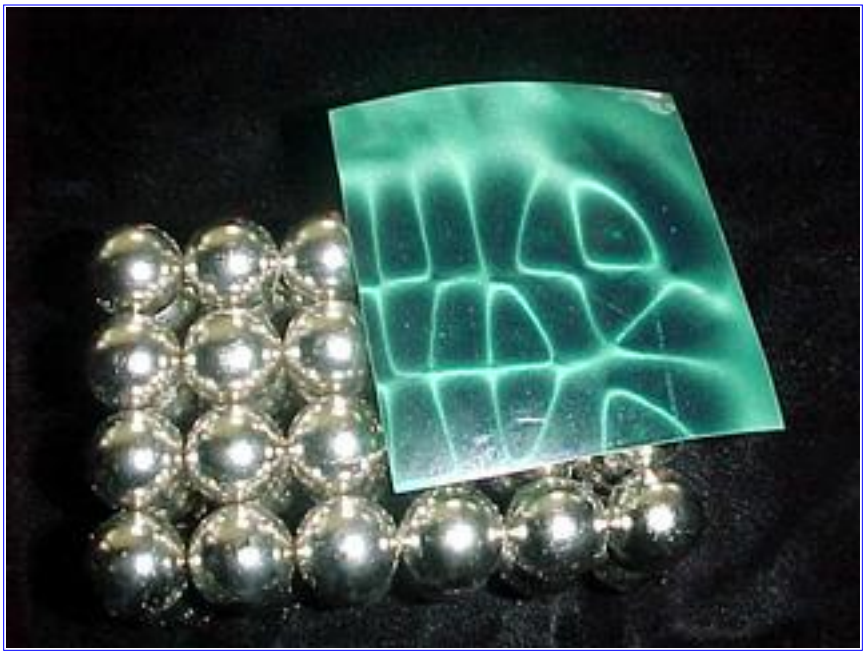
World-renowned as the pioneer in magnetic fluid technology, Ferrofluidics Corporation creates commercial applications for its technology by synthesizing a ferrofluid for an existing product (e.g., audio loudspeakers) or integrating its technology with applications engineering to develop new ferrofluid-based products (e.g., rotary seals).

FORCEFIELD

ForceField is a small business that provides surplus magnets to hobbyist, experimenters, inventors, and so on.

Be sure to check out their other demo pages about diamagnetic levitation (certain materials are diamagnetic such as
Bismuth, which means that when they are exposed to a magnetic field, they induce a weak magnetic field in the opposite direction), superconductors, and magnetism FAQ.

Probably the most interesting thing at ForceField is the magnetic field viewing film images.



Group Arnold claims to be one of the largest magnetic products manufacturers in the world.

- Site Highlights:
  - Search Magnetics Patent Database
  - List of Magnetic Industry Consultants
  - Directory of Magnetics Companies
  - The Magnet Gateway: Search the magnetics industry across the Internet!
  - Magnetic Industry New Updates almost daily.

Magnetics Technology Center

The Magnetic Technology Center has everything related to magnets that you can think of and things you'd never think of.

Hitachi Metals America, Ltd.

Hitachi Metals America (HMA) is the only U.S. manufacturer offering a full line of permanent magnets. Their capabilities include cast and sintered alnico, ceramic (Ferrite), samarium cobalt, and neodymium-iron-boron magnets.

IEEE Magnetics Society Web Page.

IMAG

IMAG Indústria e Comércio de Componentes Eletrônicos Ltda. is a 100% Brazilian Company specialized in the manufacturing and sales of electronic components. They supply soft ferriets for applications such as antenna rods, balun cores, and impeder cores.

Of most interest to me is that they seem to deal mostly with barium ferrite. In some circles, barium ferrite magnets have taken on a ledgen of having esoteric properties, such as being able to increase blood oxygenation levels, interaction with gravity, or used in over-unity generators (for a specific example, look for information at Floyd Sweet Vacuum Triode Amplifier, one possible explanation deals with lattice twisting of magnetic domains).

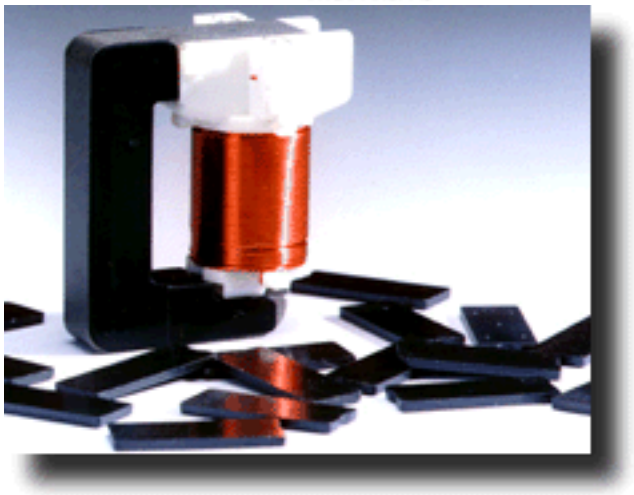
Legend has it that because of these applications barium magnets were banned in the USA more than 20 years ago. Despite looking over the years, no one as been able to show me a definitive legal document showing such a ban exists. If you know where I can find it, let me know.

The Feynman Lectures on Physics, Addison-Wesley, New York, Vol II, if I recall correctly, does lend some credence to the legends. This is because Barium has a dielectric constant that can be changed or modulated with applied voltage. I've been told that barium titaninate and lithium titaninate crystals are used in modern optical-switching networks because of this property. Do you know where I can get some of them?

Industrial Magnetics, Inc. provides both permanent and electro-magnetic devices for holding, lifting, fixturing, conveying, and separating metal. Serving a wide variety of industries such as food, feed, and grain, chemical, automotive, material handling, conveying, recycling, plastics, and many more.

Jobmaster Magnets—"Strongest in the Magnetic Field."

All sorts of flexible magnets, ceramic or ferrite magnets, alnico bars, rods, and castings, rare earth magnets including...
neodymium, samarium-cobalt, many types of magnetic assemblies including...magnetic sweepers, badge magnets,
lifting magnets, places you'd never expect there'd be a magnet but there still is...

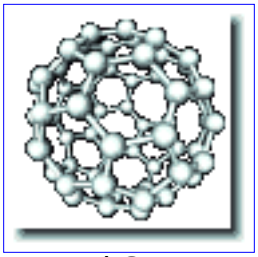


Kane Magnetics International serves OEM's who require magnets and magnetic

assemblies for automotive systems, appliances, medical, power generation, and office products. The company works with sintered, extruded, and injection-molded ferrites, rare earths (including extruded neodymium, injection-molded neodymium, compression-molded neodymium, and injection-molded and extruded samarium cobalt).

Technical data can be found under the 'Site Map'.

In the global scheme of things I was surprised to find that KMI is in my backyard.

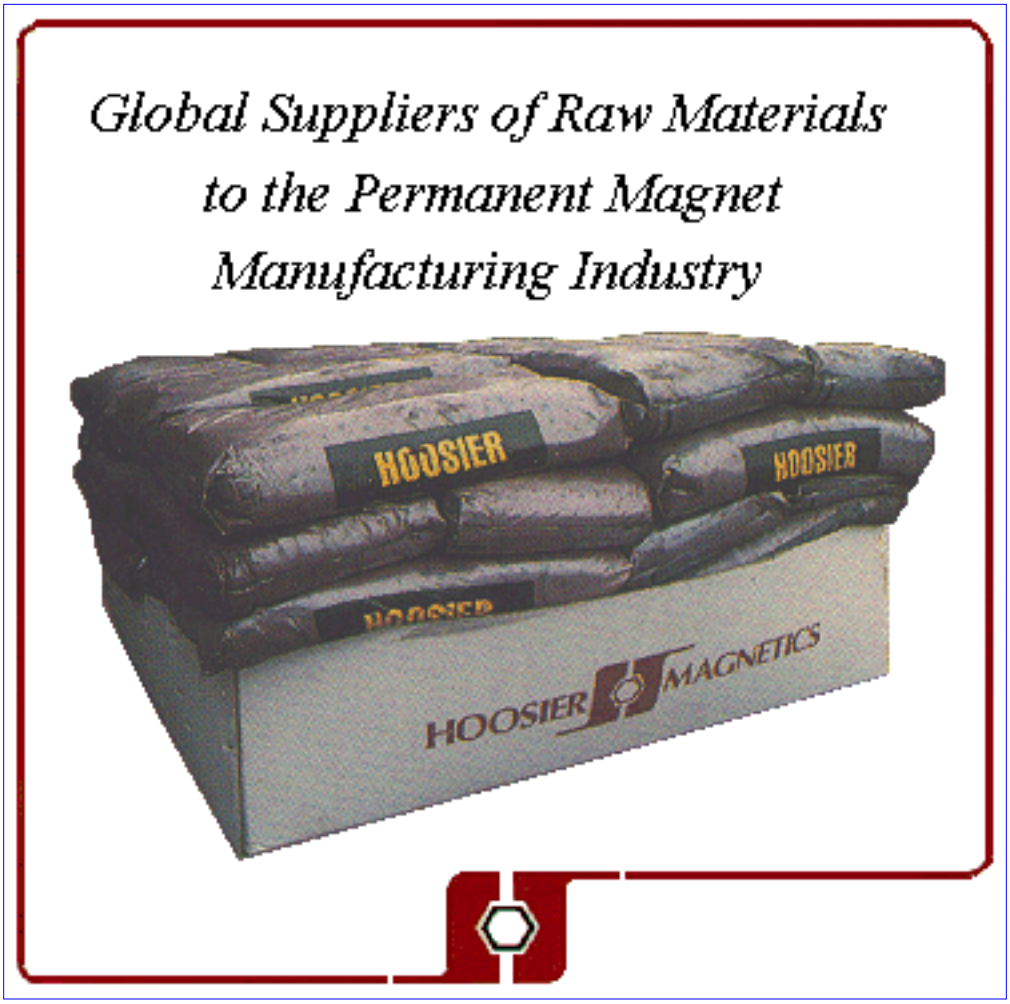


Magnets and GMR Materials
Solid State Physics
M. Hewat

These pages illustrate the 3-D structures of inorganic materials in the ILL's ICSD-for-www database.

The database is used by scientists at the European High Flux Reactor, Synchrotron, and elsewhere for studying the atomic structure of materials.

This index page links to descriptions of the ILL Diffraction Group neutron instruments and some of the experiments carried out using them. It points to various crystal databanks and other sites of interest to crystallographers and, in particular, ICSD for www database.



By reading this resource page you learn about several places that make magnets, but who makes the stuff magnets are made from? For one, Hoosier Magnetics Inc.

Indigo Instruments offer permanent magnets in steel, neodymium, strontium ferrite, and alnico in disk, bar, block, horseshoe, and U-shape for use in science, educational, industry, and magic.

Want to build your own magnetically levitated train...science fair scale?

INTERMAG seems to make a lot of products, such as custom designed refrigerator magnets, lifters, and magnetic pulleys, but I found their site hard to navigate. You had to go to each page by clicking on a left or right arrow. I could not find anything like a site map.

International Magnaproducts Incorporated (IMI) is a manufacturer's sales agent for permanent magnet producers
worldwide. Established in 1982 as a result of customer requests for new and unique magnetic materials, IMI was formed to locate the best producers in the world. IMI's mission is to assist in the design and supply of cost effective magnetic materials for their customers.

Magne-View is a micro-encapsulated film, which enables the user to view a static magnetic field such as commonly emitted by permanent magnets or electromagnets. Simply placing the film directly on the surface of the magnetic material in question can instantly reveal a magnetic field of any shape or pattern. Sold by the square foot.

They are available in bonded ferrite, bonded neodymium, bonded samarium cobalt, bonded alnico, ferrites/ceramics, alnico (cast and sintered), samarium cobalt, neodymium, wire-drawn alnico, and manganese aluminum carbon.

Science@NASA presents
Magnetars
The strongest magnets in the Galaxy!

From the 29 September 1998 NASA Space Science News Update:
web story: **A crusty young star makes its presence felt**
plus: **New Magnetar Images & Animations**
plus: What would it be like to visit a Magnetar?

Rick Hoadley, under the disguise of Magnet Man, shows many cool experiments with magnets, that are quite educational.

If you don't look at any other site I list on this Resource Page look at this one. Lots of "hands on," complete with schematics.

This site describes some of the products and activities of the Magnet Applications Group, in particular, the wide range of bonded magnet products.

Bonded magnets can be produced in an infinite variety of shapes, magnetic characteristics, and with a wide range of physical and mechanical properties.

Magstar Int. Specializes in Custom Molded Magnets. Insert molding provides closer concentricity and better balance, resulting in more consistent quality parts, tighter tolerances than cast or sintered magnets, and no secondary finishing operations.

They offer flexible magnetic sheeting and strip in standard rolls or cut to your specifications. For more specialized applications, they offer a wide variety of custom profiles.

I wonder what "Applet Crashed" would have inflicted on me had it not done me the favor of crashing first...

MAGNETIC MATERIALS PRODUCERS ASSOCIATION

The Magnetic Materials Producers Association (MMPA) is a trade association representing manufacturers of finished permanent magnets or soft magnetic products. Founded in 1959, the MMPA is dedicated to educating users and purchasers on appropriate applications for magnetic material.

Develop Industry Standards—MMPA develops, maintains, and distributes industry standards. These are regularly reviewed and revised by MMPA Technical Committees to present current industry technology and terminology. See their Technical Publications.

Magnetic Component Engineering, Inc.

Available through them are:

Samarium cobalt, neodymium iron boron, ceramics, alnicos, magnetizing services, stabilization and calibration services, and test equipment such as helmholtz coils, fluxmeters, and so on.

The only company in the world that can guarantee a minimum energy product of 48.5 MGOe in NdFeB! Check out their N5062.

Magnequench provides powders to magnets through subassemblies and magnetization.

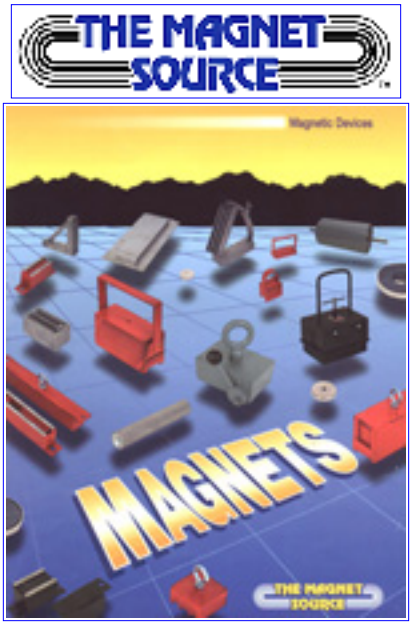
You can find links to these among others:

- Rare-Earth Information Center
- Free Magnetics Finite Element Package for Win95/98/NT.
- Magnequench Technical Resources

- New Application of High Energy Magnets

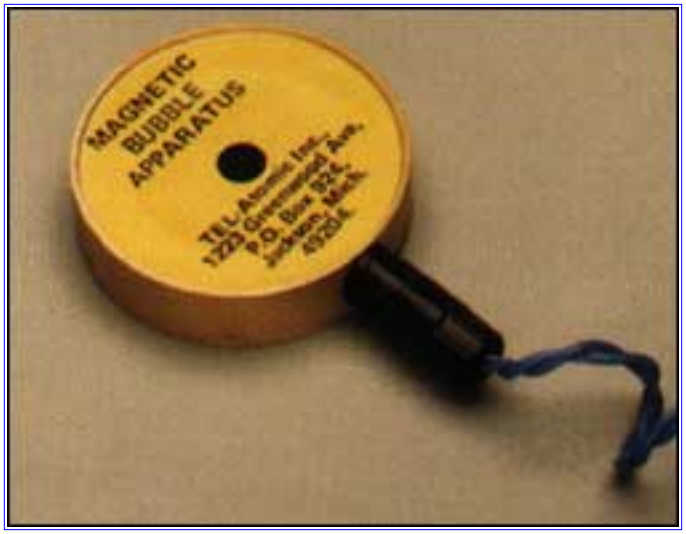
Magnet Sales & Manufacturing Company, Inc. supplies neodymium iron boron, samarium cobalt, alnico ferrite, and flexible magnets. The most interesting thing I found on their site was the online magnetic calculations tools, as well as other magnet design information.

- Quick Comparison Chart of Magnetic Materials
- Frequently Asked Questions - Magnetics 101.
- Design Guide - most everything you must know about magnets.
- Glossary of Magnetic Terms
- Properties of Magnet Materials
- Magnet Calculation Tools - useful tools to calculate flux densities, permeance coefficients, unit of measure conversions, and so on.



The Magnet Source has a list of magnetic related products from A to Z. Make sure you check out the Cow Magnet, brought to you by the letter C, and the several other interesting products brought to you by other letters.

They also offer consulting, design, and prototyping to get your project started. Using technologies such as injection molding of plastics, metal stampings, welding, and adhesive bonding to make your total magnet assembly.



MAGNETIC BUBBLE APPARATUS

Lab experiments can be performed to let you demonstrate:

- magnetic domains in a Ferrimagnetic garnet (FMG)
- formation of magnetic bubbles
- The Barkhausen effect.
- plotting of hysteresis loops

In 1908, Weiss proposed his domain theory to explain the magnetic properties of materials. It is for these kinds of experiments that this apparatus has been developed.

Do you remember "Bubble Memories"?

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magnetweb

by Princeton Electro-Technology, Inc.

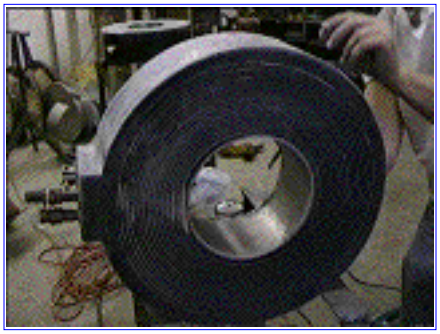
Magnetweb provides:

- permanent magnet design
- directory of magnet suppliers (This could have been this Resource Page if I'd found it sooner.)
- directory of magnetic equipment
- calendar of meetings and courses

NEOSID

Neosid supplies ferrite and iron powder cores, impeders, and permanent magnets.

Material Specifications	
Sintered Neodymium-Iron-Boron	Bonded Neodymium-Iron-Boron
Sintered Rare Earth Cobalt	Alnico
Anisotropic Sintered Ferrite	Isotropic Sintered Ferrite
Pot Magnets	



New England Techni-Coil, Inc. (NETC) custom manufactures electromagnetic coils and magnets.

Sometimes when working on these Resource Pages, I come across a site I just don't know what to say about, and this is one of those times. What follows is directly from their "English" site. I do give them a A+ for effort, and their list of past and upcoming conferences is a good one.

http://www.siyuan.com/magnete/index.html

"Magnetic Materials and Devices Shows

Introduction: This website is a display for all manufactures of magnetic materials and devices to show their company and
products, especially for the domestic company.

The product contains: all kinds of ferrite , rare earth permanent magnet : NdFeB, AlNiCo , SmCo , applicable products and rare earth magnet equipment.

This website is suitable for all company , factory , institiute , college , and so on... all have something about magnet.

The website is now in double languages: Chinese(GB) , English . We'll develope in Germany , Japanese , France and Spainish .

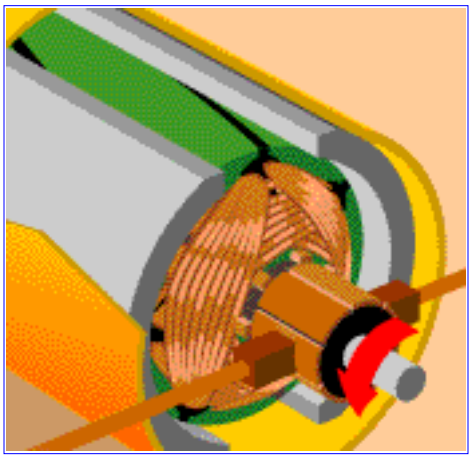
News and Evens: list the news and evens about magnet all over the world . Welcome to give us information or others."

SG Magnets Limited supplies magnetic components and assemblies to the automotive, consumer electronics, and industrial sectors. Their products are designed to match the requirements of OEM manufacturers of motors, stepper motors, sensors, solenoids, and fast actuators.

Stanford Magnets Company

Under their Permanent Magnet Products page are several bits of useful information, such as a *How to Choose Permanent Magnet Materials, How to Choose the Correct Grade of Permanent Magnet Materials*, and a *Glossary.* This site has some

information on loud speakers, as well.



Systems International supplies Arc Magnets for motors.

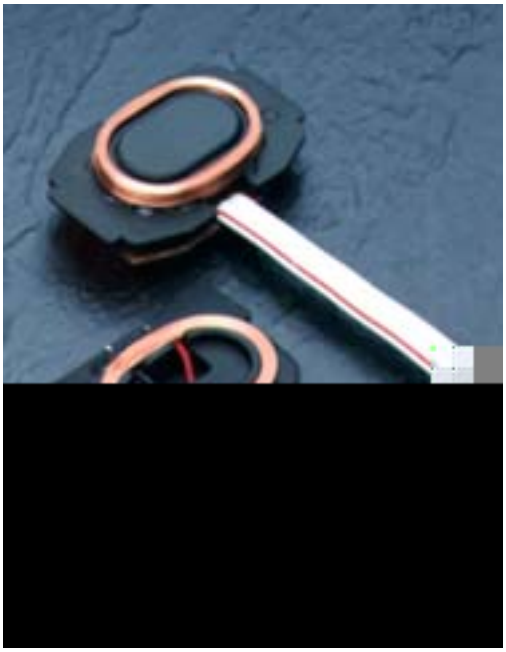
Systems International is an OEM magnets supplier that supplies a variety of magnets including sintered and bonded NdFeB, SmCo, ceramic-ferrite, and alnico magnets. Their magnets are available in a variety of shapes and sizes including block, ring, arc segment, disk, cylinder, rotor, and more.

S.U.N. Engineering, Inc.
10031 East 52nd Street, Tulsa, OK 74146 USA

S.U.N Engineering, Inc. does not make or sell magnets, but they have a good Magnet FAQ. It especially highlights the increase in the power of magnets in the last few years. They make equipment for the pipe-line industry, used for testing and locating trouble spots.

TDK

TDK makes composite magnets: neodymium-plastic, rare-earth-plastic, ferrite-plastic, and ferrite-rubber bonded.



What I found even more interesting than TDK's magnets are their contactless battery charger transducer that solve the problems associated with contacts on a remote handset and charger base.

Designed to transmit a minimum of 0.5 W of energy across a 4-mm gap, the system supplies enough power to recharge a 600-maH nickel cadmium or nickel-metal hydride battery in 6 h, and because there are no terminals installed in the handset, housing costs are lower and corrosion, contamination, and battery shorts are virtually eliminated.

TDK's Contactless Charger features a flat "transferance" area, an extremely light weight receive unit, high system efficiency (greater than 60%), an automatic charge rate control, and short circuit protection. With an input of 140 V_{DC} supplied directly from the rectified AC mains, there is no need for costly step-down transformers.

TDK's contactless battery charger transducer is ideal for cordless telephones and small cordless home appliance applications.

Yuxiang Magnetic Materials Industry Co., Ltd. seems to sell it all right down to magnetic powders and magnetizers if you want to build your own magnet.

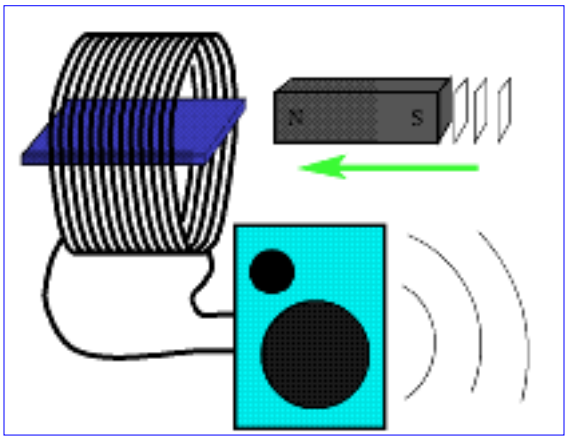
For as long as there have been magnets, there have been attempts to get perpetual motion from them. No page of mine would be complete without a couple attempts of my own....

Free energy with wires and magnets - can you come out ahead? The basics of magnets and wires for free energy buffs.

- Prepared by Tom Napier. [Tom says you can't come out ahead.]

The *Cold Stone file* shows there is a anomaly you can exploit at some level of scale, in this case the Barkhausen Effect.

"The magnetization of a ferromagnetic substance by an increasing magnetic field takes place in discontinuous steps rather than continuously. The effect results from the orientation of magnetic domains. It was first observed by H. Barkhausen (1881-1956) in 1919." - Xrefer



See *Hysteresis and Avalanches* by James P. Sethna. The cynical might just wonder about the funding of this research, paid for by the US Goverment through the Department of Energy (DOE #DE-FG02-88-ER45364), the National Science Foundation (NSF #DMR-9419506), and through the Cornell Theory Center.

"Barkhausen effect: series of sudden changes in the size and orientation of ferromagnetic domains, or microscopic clusters of aligned atomic magnets, that occurs during a continuous process of magnetization or demagnetization. The Barkhausen effect offered direct evidence for the existence of ferromagnetic domains, which previously had been postulated theoretically.

Heinrich Barkhausen, a German physicist, discovered in 1919 that a slow, smooth increase of a magnetic field applied to a piece of ferromagnetic material, such as iron, causes it to become magnetized, not continuously but in minute steps. The sudden, discontinuous jumps in magnetization may be detected by a coil of wire wound on the ferromagnetic material; the sudden transitions in the magnetic field of the material produce pulses of current in the coil that, when amplified, produce a series of clicks in a loudspeaker. These jumps are interpreted as discrete changes in the size or rotation of ferromagnetic domains. Some microscopic clusters of similarly oriented magnetic atoms aligned with the external magnetizing field increase in size by a sudden aggregation of neighboring atomic magnets; and, especially as the magnetizing field becomes relatively strong, other whole domains suddenly turn into the direction of the external field." - Encyclopedia Britannica

Perhaps the most interesting variation on this device is known as the Barkhausen Effect Battery.

A coil with many thousands of turns of fine wire, such as wire wrap wire, or 30-gauge magnet wire, wound on a metal core prone to the Barkhausen effect, that has many transition pulses per second, will induced (weak) electromagnetic current in a load placed across the Barkhausen effect coil. With large coils and highly nonlinear magnetic fields, this voltage may be used to drive simple circuits, such as low-powered tunnel diode transmitters when the detecting coil is tuned to resonance

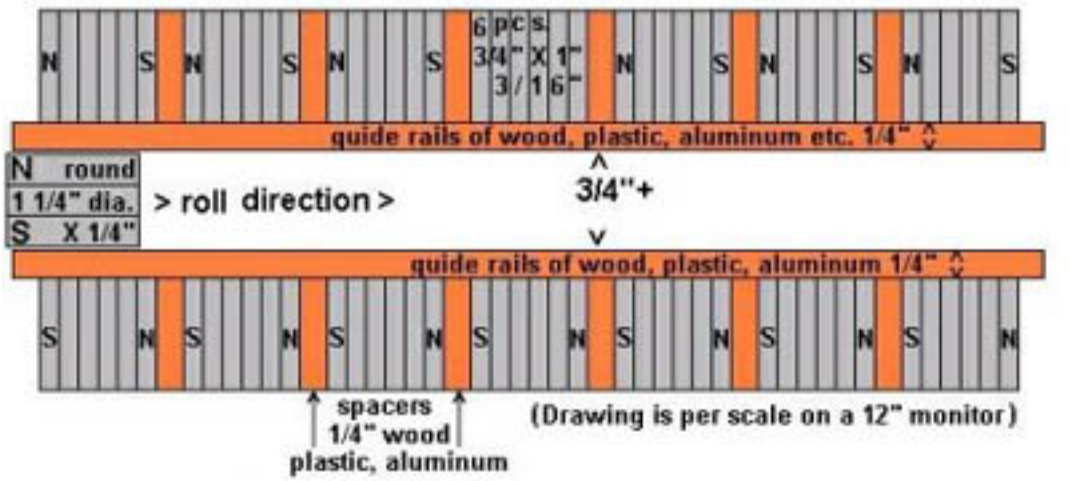
at the background transition rate.

From the Keelynet Archives:

TOMI - Theory of Magnetic Instability
- 02/04/95 freely shared by Stuart Harris.
More here.

Videos in .ASF format can be found here.

Ken Hickman's variation:



Linear permanent magnet motor very similar to the " TOMI ", it is believed that the guide rails could be curved to cause the round magnets to go in a continuous circle perpetual motion, this could also be assembled onto a wheel with a nonmagnetic rim which would run until the wheel bearings wear out.

I have a working model of this device, using the small Radio Shack experimental magnets the potential is awesome. The accelleration of the rolling magnet is astounding. With stonger magnets, and configured into a wheel this could have serious permanent magnet motor potential.

The multiple rectangular, and the round magnets can be replaced with single magnets the sizes are not real critical. The spacing between the rectangle magnets can be important for best results 1/4 the magnets length seems to work the best. The diameter of the round magnet will also have a bearing on perfomance.

According to Mr. Harris, you can get continuous motion by setting a sires of ramps up in a circle, the inclines of which are straight, where the declines form bends in the "track". A simple-to-construct variation would be a teeter-totter or see-saw because this was not self-starting, he favored a gerbil exercise wheel style of construction. Four ramps properly placed in side of the wheel cause the wheel to rotate as the magnet "runs" around the wheel.

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