

# More Than You Ever Wanted to Know About the Permanent Magnet Industry!



*by*  
**Walt Benecki**



## **MAGNETICS 2017**

*The International Forum on Magnetic Applications, Technologies & Materials*

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# The Big Picture

## 2016 Global Permanent Magnet Production

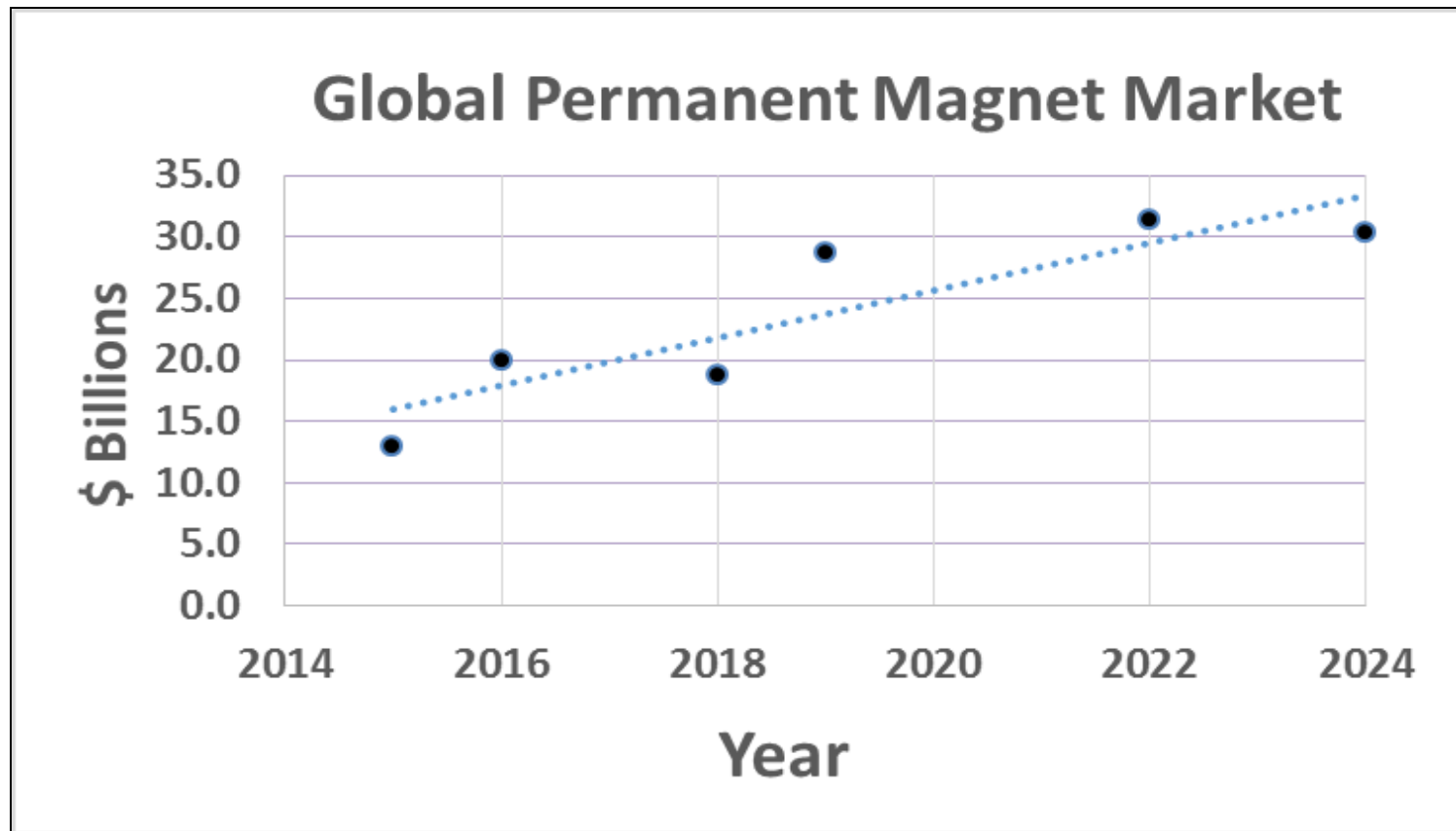
Magnet Type	Tons x 1,000	% by Weight	US\$ Million	% by Value
NdFeB	90	13.5	\$12,200	61.0
Ferrite	565	85.0	6,780	33.9
Samarium Cobalt	4	0.6	600	3.0
Alnico	6	0.9	420	2.1
TOTAL	665	100.0%	\$20,000	100.0%

# What is a Reasonable Growth Forecast for the PM Industry?

- **Forecast “A” - \$13.0 Billion in 2015**
- **Forecast “B” - \$20.0 Billion in 2016**
- **Forecast “C” - \$18.8 Billion in 2018**
- **Forecast “D” - \$28.7 Billion in 2019**
- **Forecast “E” - \$31.4 Billion in 2022**
- **Forecast “F” - \$30.4 Billion in 2024**

# Total PM Market Growth Trend

**2015-2024 AAG =  $\pm 9.4\%$**



# Applications That Will Impact Tomorrow's Magnet Demand

(The Primary Drivers – Energy Efficiency & Climate Change)

- Hybrid & Electric Automobiles
- Wind Turbines
- Consumer Electronics
- Electric Bicycles
- Industrial Motors
- Appliance & HVAC Motors
- Energy Storage Systems
- Magnetic Refrigeration
- Magnetic Levitation Transportation



# US Magnet Industry Evolution

(Excluding Magnetic Assemblies)

## 1995 (19)

- **Arnold** (Ferrite/Alnico/SmCo/Bonded)
- **Crucible** (Ferrite/Alnico/NdFeB) **Closed**
- **Kane Magnetics** (Ferrite/Alnico/Bonded) **Closed**
- **Permanent Magnet Co.** (Alnico) **Closed**
- **General Magnetics** (Ferrite) **Closed**
- **Ugimag** (NdFeB) **Acquired/Closed**
- **TDK** (Ferrite)
- **Hitachi Metals** (Alnico/Ferrite/NdFeB)
- **Electron Energy** (SmCo)
- **Dynacast** (Bonded Magnets) **Acquired**
- **Thomas & Skinner** (Alnico/SmCo)
- **Magnequench** (NdFeB) **Relocated**
- **Tengam** (Bonded Magnets)
- **Magnet Applications** (Bonded)
- **Electrodyne** (Bonded)
- **RJF** (Bonded) **Acquired**
- **Magnum** (Bonded)
- **Magnetic Specialty** (Bonded) **Acquired**
- **Flexmag Industries** (Bonded) **Acquired**

## Today (9)



- **Arnold** (SmCo/Alnico/Bonded)
- **TDK** (Ferrite)
- **Hitachi Metals** (Ferrite/ NdFeB)
- **Electron Energy** (SmCo)
- **Thomas & Skinner** (Alnico)
- **Tengam** (Bonded)
- **Magnet Applications** (Bonded)
- **Electrodyne** (Bonded)
- **Magnum** (Bonded)

# The Permanent Magnet Action is (and will continue to be) in China!



- *Continued foreign investment*
- *A dominant position in RE raw material production*
- *75+% of global ferrite magnet production*
- *80+% of global NdFeB magnet production*
- *A continuing labor cost advantage vs US or Europe*
- *Significant government encouragement & support*

# An Outsider's View of the Permanent Magnet Industry

- A niche market – “*Only*” +/- \$20 Billion!
- Serves a number of “*Attractive*” applications
  - **Automotive** (Traditional, Hybrid, Electric)
  - **Computer and Consumer Electronics**
  - **Wind Turbines**
  - **Appliance, HVAC & Industrial Motors**
  - **Business Equipment**
- Reportedly, many magnet industry players enjoy “attractive returns” (*But some don't*)

# The Insider's View of the Permanent Magnet Industry

- **High volume applications (~75% of the \$'s)**
  - Require substantial up-front infrastructure investment
  - Often dozen's of worthy competitors
  - Eventual customer priority: **Price/Quality/Service**
  - ***Generally lower margins*** (with ongoing price pressure)
- **Low volume applications (~25% of the \$'s)**
  - Potentially lower up-front investment
  - Fewer *direct* competitors
  - Customer priority: **Service/Quality/Price**
  - ***Generally higher margins***




# How to Make **Money** in the Permanent Magnet Industry

## *“High Volume”*

- Invest serious money in capacity & automation
- Maintain investment in new or incremental technology to stay “a step ahead”
- Be aggressive to assure ongoing cost reductions
- *Think “Global”*

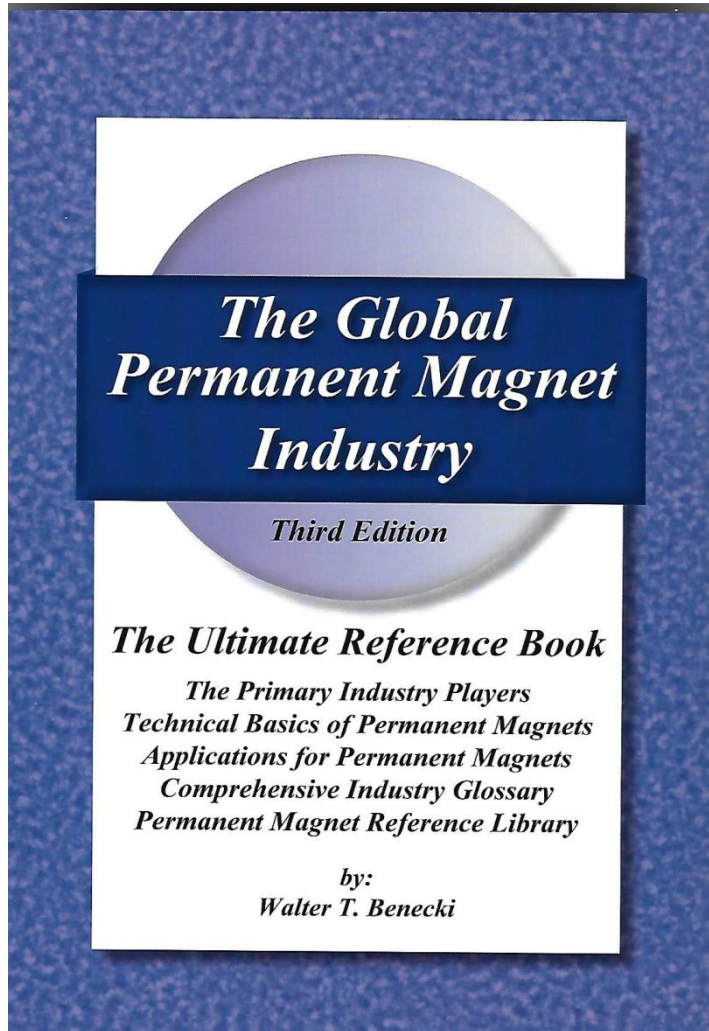
## *“Low Volume”*

- Distribute & add value
- Offer engineering and design assistance
- Don’t be distracted by high volumes! 
- Source from China and establish strong partners & alliances
- *Think “Niche”*

# Perceptions About the Global Permanent Magnet Industry

- **“There are 100-150 magnet producers located in Ningbo”...**
- **“About 50 companies are selling magnets on the Internet”...**
- **“Automotive” constitutes the largest number of permanent magnet applications...**
- **“The Permanent Magnet industry currently represent an attractive investment opportunity”...**

# The Global Permanent Magnet Industry



- A Comprehensive Industry Directory
- The Technical Fundamentals of Permanent Magnets
- Applications Using Permanent Magnets
- Extensive Industry Glossary
- A Technology and Application Library

# **Section 1**

## **A Comprehensive Magnet Industry Directory**

- The most accurate and extensive permanent magnet industry directory available – **anywhere!**
- More than 3,000 hours of research over 6+ years
- Detailed identification and description of each magnet industry participant
- Includes 1,350 companies in over 60 countries!

# Directory Qualifications

- ***“Manufacturers”*** - companies who produce the basic permanent magnet materials, including NdFeB , SmCo, sintered ferrite, Alnico, or bonded magnets.
- ***“Distributors”*** - companies who purchase basic magnets from magnet manufacturers and provide local stocking and application engineering assistance for their customers. (Some are simply “resellers”)
- ***“Fabricators”*** - companies who “add value” to basic magnets. Includes motor sub-assemblies, magnetic separation systems, and holding or lifting magnets.  
*(Excluding promotional and therapy magnets)*

# Directory Segmentation

- **The Americas** (North, Central & South America)
- **Europe-Africa** (Western & Eastern Europe plus the Middle East)
- **Mainland China** (Mainland China, Hong Kong and Taiwan)
- **Asia-Pacific** (Japan, Russia, India, New Zealand and Australia)

# Directory Expansion & Enhanced Segmentation

Region	2 <sup>nd</sup> Edition	3 <sup>rd</sup> Edition
North-South America	214	273
Europe & Middle East	147	259
Asia-Pacific	669	-
Mainland China	-	670
Pacific Rim	-	148
Total	1,030	1,350

# Directory Example

## **Alpha Magnetics Pty Ltd.**

22/15 Macquarie Place Boronia VIC 3155 **Australia**

Phone: +61 3 9729 8633 Fax: +61 3 9729 8137

Web Site: [alphamagnetics.com.au](http://alphamagnetics.com.au)

Email: [sales@alphamagnetics.com.au](mailto:sales@alphamagnetics.com.au)

***Alpha Magnetics manufactures a range of industrial magnetic equipment for tramp metal removal and product purification. They also carry large stocks of NdFeB, ferrite and Alnico magnets, suitable for all industrial purposes. Alpha is a licensee of the Bunting Magnetics Co., USA.***

# Did You Know....?

There are over **100**  
companies selling  
magnets on the  
**Internet**

There are about **125**  
company names  
starting with the word:  
**“Ningbo”**

There is a large and  
growing magnet  
industry in **India**

Globally, there are  
**500+** companies  
producing **Separation,**  
**Holding and Lifting**  
**Products**

## Section 2

# The Basics of Magnet Technology

*(Authored by Dr. Stanley Trout)*

- **An Overview Providing the Basic Technical Understanding of Permanent Magnets**
- **Essentially: “Magnetism for Dummies”**
  - *The Three Magnetic Vectors*
  - *Magnetic Hysteresis*
  - *Thermal Characteristics of Permanent Magnets*
  - *The Four Major “Permanent Magnet Families”*
- **Ideal Technical Introduction for Novices and “Newbies” to the Permanent Magnet World**

## Section 3

# Permanent Magnet Applications

*(Edited by Dr. John Ormerod)*

- **Automotive**
- **Industrial & Commercial**
- **Consumer Products**
- **Military & Aerospace**
- **Medical**

# Over 1,200 Applications

- **Industrial & Commercial (537)**
- **Consumer Products (222)**
- **Military & Aerospace (184)**
- **Medical (154)**
- **Automotive (142)**

# Permanent Magnets = Motors!

(Book Excerpt: *Hard Ferrite Magnet Applications*)

Application Area	% of Total Production by Weight
Automotive Motors	18%
Appliance Motors	13
HVAC Motors	12
Industrial/Commercial Motors	12
Loudspeakers	11
Separation Equipment	8
Holding & Lifting Equipment	6
Advertising/ Promotional Products	5
MRI	3
All Other	12
TOTAL	100%

# 1,200+ Applications!

*(A Small Listing Example)*

- *Convertible Top Controls*
- *Air Bag Systems*
- *Trunk Closers*
- *Dental Drills*
- *Elevator Doors*
- *Flywheel Storage Systems*
- *Magnetic Fasteners*
- *Liquid Level Switches*
- *Golf Cart Motors*
- *3-D Printing Systems*
- *Laser Weapon Systems*
- *Sub-Sea Pumps*
- *Security Tags*
- *Autopsy Saws*
- *Magnetic Bandages*
- *Pacemaker Pumps*
- *Surgical Robots*

## Section 4

# The Language of the Permanent Magnet Industry

*(Edited by Dr. Stanley R. Trout)*

- An extensive magnet industry glossary  
*(390+ Listings)*
- Defines the fundamental language of the permanent magnet industry – from both a *business and technical perspective*
- Excellent introduction and a reference source for both experts and novices

# The Language of the Magnet Industry

## *(A Few Examples)*

- **Bastnasite** - A yellowish to reddish-brown rare earth fluorocarbonate mineral, a common source of rare earth elements.
- **CMMDA** – The China Magnetic Materials Device Association. CMMDA is associated with the Southwest Institute of Applied Magnetism of China. Membership represents a relatively small percentage of the total Chinese magnet industry. [www.chinamagnet.org](http://www.chinamagnet.org).
- **Eddy Current Separator** – An eddy current separator uses a powerful magnetic field to separate metals from non-metals (usually in mixed garbage or recycling streams). When a magnetic field is applied to a conveyor belt carrying a thin layer of mixed waste, any electrically conductive and nonmagnetic materials, such as aluminum or copper are thrown off the belt, and nonmetals simply fall off the end of the belt.
- **Isostatic Pressing** – A pressing method where the pressure is applied equally in all directions, it usually provides a higher degree of alignment and higher magnetic properties, compared to axial pressing.
- **JABM** – The Japan Association of Bonded Magnetic Materials. A consortium of Japanese bonded magnet producers and related companies. Regularly sponsor conferences on magnetic materials and maintain proprietary global magnet production statistics.

## Section 5

# A Comprehensive Industry Library

- Covers 1985 - 2016 (30+ years)
- A compilation of over 165 reference books:
  - 47% Permanent Magnet Basics & Magnetic Technology
  - 27% Permanent Magnet Motors
  - 26 % Other Specialty Applications (*including magnetic bearings, energy storage systems, magnetic refrigeration, sensors, disk drives, magnetic separation equipment, wind turbines and MRI*)
- World-wide in scope and much easier (and faster!) than searching the Internet

# Library Example

**Design of Brushless Permanent-Magnet Motors;**  
***J.R. Hendershot and T.J.E. Miller, Magna Physics &***  
***Oxford Science Publications, Melbourne, Florida,***  
***1995. ISBN-10: 0198593899***

**Summary:** *This book offers a comprehensive guide to the design and performance of brushless permanent magnet motors. Topics range from electrical and magnetic design to materials and control. The authors stress both practical and theoretical aspects of the subject, and relate the material to modern software-based techniques for design and analysis.*

**So Let's Visit Some of the Earlier  
Assertions About the Global  
Permanent Magnet Industry....**

# The Reality About the Global Permanent Magnet Industry

- “There are between 100-150 magnet producers located in Ningbo” **Incorrect – there are way more than 200!**

# The Reality About the Global Permanent Magnet Industry

- “There are between 100-150 magnet producers located in Ningbo” Incorrect – there are way more than 200!
- “About 50 companies are selling magnets on the Internet” **Incorrect – there are more than 125 Internet sellers!**

# The Reality About the Global Permanent Magnet Industry

- “Automotive” constitutes the largest number of permanent magnet applications **No way – Industrial/Commercial applications by far represent the largest number of magnet applications!**

# The Reality About the Global Permanent Magnet Industry

- “Automotive” constitutes the largest number of permanent magnet applications No way – Industrial/Commercial applications by far represent the largest number of magnet applications!
- “The Permanent Magnet industry currently represent an attractive investment opportunity” **It depends! – Many players in the industry (especially in China) are suffering from over-capacity and intense price competition. However, some (both in Japan and China) are delivering excellent financial performance.**

# **Our Original Objective 2009-2011**

- **Initially, our intent was to construct a comprehensive magnet industry directory.**
- **The early thought was to make some money.**

# Today's Objective

## 2015-2017

- As the invested hours mounted, along with an expanding scope, it became clear that this initiative was not to be a “money maker”.
- But the book has now hopefully evolved to be a valuable resource for our industry.

# Comparison of Editions

<b>“The Global Permanent Magnet Industry”</b>	<b>Second Edition</b>	<b>Third Edition</b>
<b>Publication Date</b>	<b>2014</b>	<b>2017</b>
<b>Directory - # Listings</b>	<b>1,020</b>	<b>1,350</b>
<b>Glossary Content</b>	<b>336</b>	<b>394</b>
<b>Basics of Magnetics</b>	<b>-</b>	<b>New</b>
<b>Applications for Magnets</b>	<b>-</b>	<b>New</b>
<b>Magnet Library</b>	<b>-</b>	<b>New</b>
<b>Total Pages</b>	<b>208</b>	<b>340</b>
<b>Selling Price</b>	<b>\$395 + S&amp;H</b>	<b>\$395 + S&amp;H</b>

# Who Should Find Value


- **Companies supplying goods and services to the permanent magnet industry**
- **Magnet manufacturers wanting to identify potential customers or distributors**
- **Magnet manufacturers or distributors interested in identifying new markets or new applications**

# Who Should Find Value

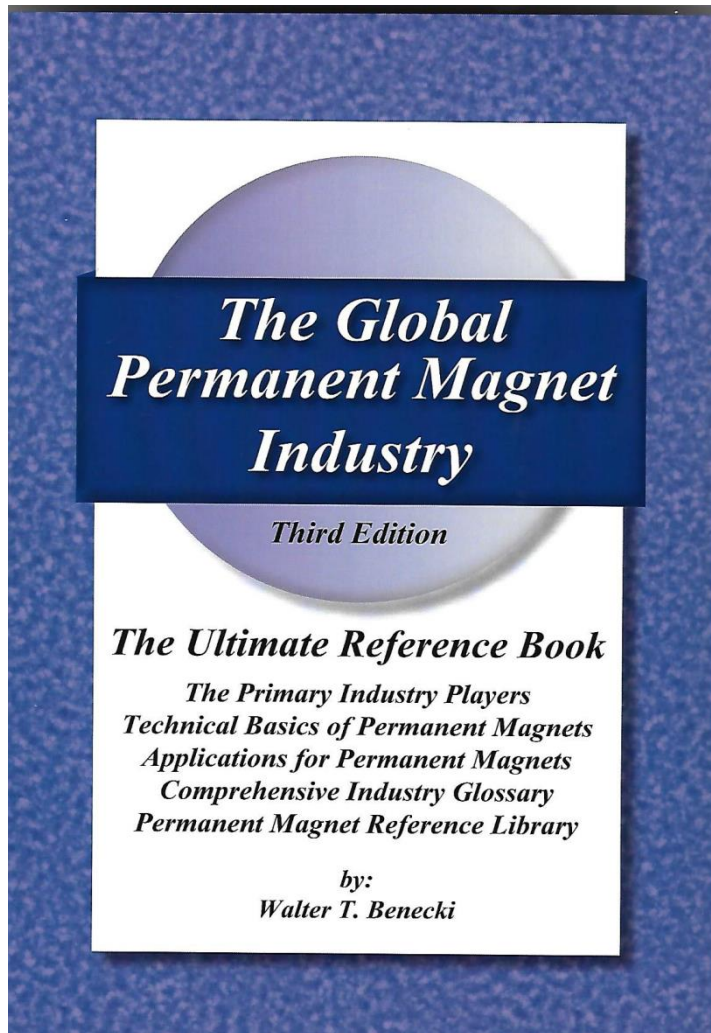
## (continued)

- **Those wishing to establish, expand or assure a reliable permanent magnet supply chain**
- **Companies researching acquisitions, investment or divestment opportunities**
- **Industry participants seeking the opportunity to simply improve their overall “Magnet IQ”**

# Acknowledgements

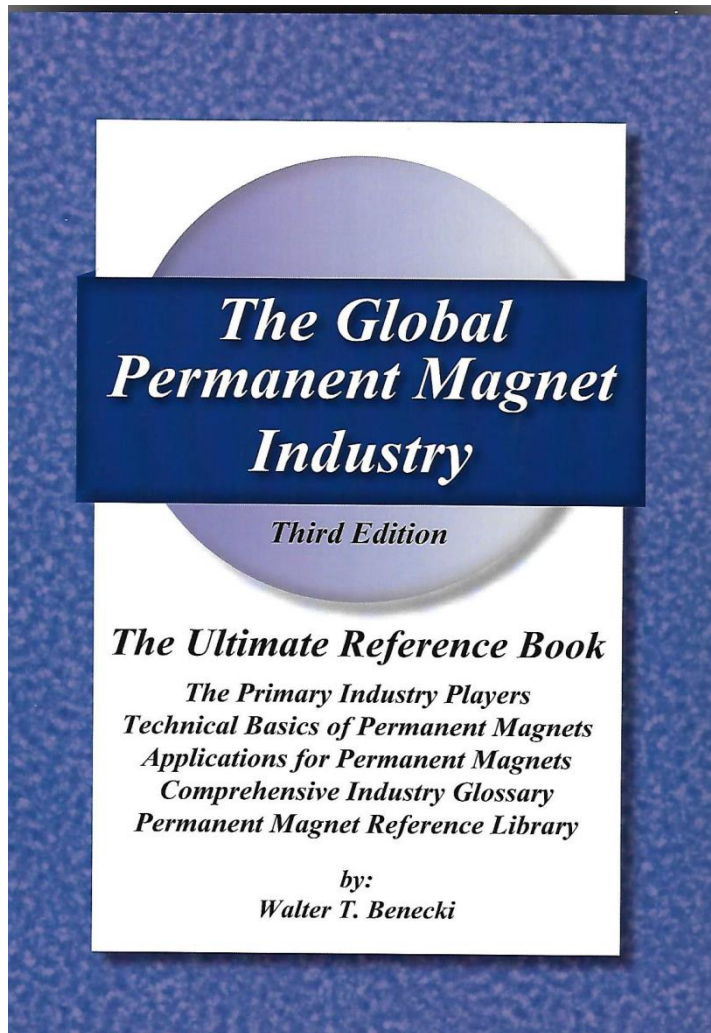
- Dr. Stanley Trout
- Dr. John Ormerod
- Dozens of Contributors
- And a Few Critics 

# Third Edition Now Available



- Available January 2017
- *The Final Edition!*
- A Unique Source of Magnet Industry Info
- *65+% More Content*
- *Contact Author Regarding Volume Purchases*

# Third Edition Now Available



- This valuable reference book contains extensive detailed information regarding our industry, as well as an introduction to the technology and the many applications of permanent magnets
- *Here are a few examples....*

# Just in Case You are Asked....

- **Question: What are the main reasons for using magnets?**

# Just in Case You are Asked....

- **Question:** What are the main reasons for using magnets?
- **Answer:** Here are 5 primary reasons:
  - To detect a magnetic field (sensors)
  - To create a force or torque (motors)
  - To generate a voltage (generators)
  - To create a uniform & strong magnetic field (MRI)
  - To utilize the magnetic field to hold or separate materials (magnetic separation equipment)

# Just in Case You are Asked....

- **Question: What is a “shuttering magnet”?**

# Just in Case You are Asked....

- **Question:** What is a “shuttering magnet”?
- **Answer:** Shuttering magnets are used in the process of manufacturing precast concrete. The shuttering magnet assembly is used to hold the framework in place prior to casting.

# Just in Case You are Asked....

- **Question: Is Earth Panda a Hitachi Licensee?**

# Just in Case You are Asked....

- **Question:** Is Earth Panda a Hitachi Licensee?
- **Answer:** *Earth Panda Advance Magnetic Material Company* was established as a manufacturer of NdFeB magnets in 1993 and, yes, they became a Hitachi Licensee in 2013.

# Just in Case You are Asked....

- **Question:** Can we source **FeCrCo** magnets from China?

# Just in Case You are Asked....

- **Question:** Can we source **FeCrCo** magnets from China?
- **Answer:** Actually, there are more than a dozen Chinese suppliers of FeCrCo magnets. Here are a just a few examples:
  - Beijing Futong Magnet-Elect Co., Ltd.
  - Hangzhou Dun Ben Magnet Co., Ltd.
  - Hangzhou SDM Magnetism Co., Ltd.
  - Ningbo Jinhong Magnets Mfg. Co., Ltd.
  - Yangyi Magnetic Co., Ltd.

# Just in Case You are Asked....

- **Question: What are the advantages of permanent magnet motors?**

# Just in Case You are Asked....

- **Question:** What are the advantages of permanent magnet motors?
- **Answer:** There are a number of advantages:
  - Usually more energy efficient
  - Normally require less maintenance
  - Simplified construction and reduced package size
  - Often deliver higher torque and power density

# Just in Case You are Asked....

- **Question:** Have you ever heard of **Gauss Magneti?**

# Just in Case You are Asked....

- **Question:** Have you ever heard of **Gauss Magneti**?
- **Answer:** Sure.....Gauss Magneti is a manufacturer of lifting and magnetic separation assemblies. They are located in Brescia, Italy.

# Just in Case You are Asked....

- **Question:** Can you recommend a few good technical books about **magnetic bearings**?

# Just in Case You are Asked....

- **Question:** Can you recommend a few good technical books about **magnetic bearings**?
- **Answer:** Yes.....here are three examples:
  - **Magnetic Bearings and Bearingless Drives:** Akira Chiba, Tadashi Fukao et al; Newnes Publishing, **2005**.
  - **Magnetic Bearings: Theory, Design, and Application to Rotating Machinery:** G. Schweitzer, E. Mason, et al.; Springer Press, **2009**.
  - **Digital Control for Active Magnetic Bearings in High-Speed Permanent-Magnet Synchronous Machine with 40000 rpm and 40 kW:** Chip Rinalni Sabirin; Shaker Verlag GmbH, **2015**.

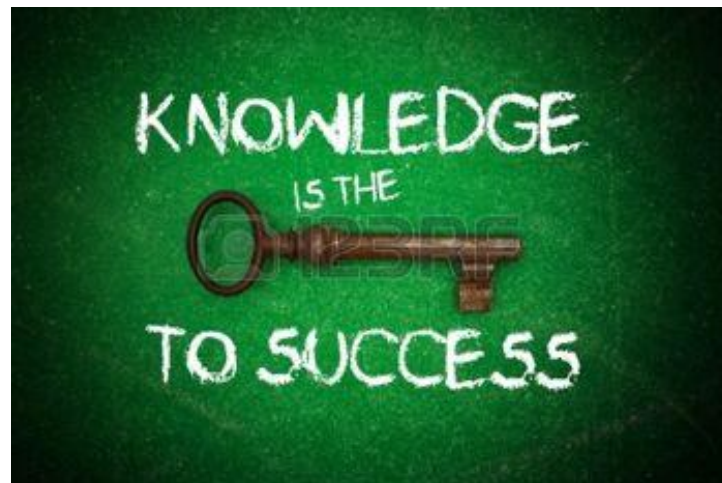
# Just in Case You are Asked....

- **Question:** Can you help us identify a permanent magnet **distributor located in Ontario, Canada?**

# Just in Case You are Asked....

- **Question:** Can you help us identify a permanent magnet **distributor located in the Toronto, Canada area?**
- **Answer:** Certainly.....here are four:
  - **Graybon Magnetic Products (Mississauga)**
  - **Jobmaster Magnetics Canada (Oakville)**
  - **MMG Canada (Toronto)**
  - **ONCore Magnetics (Brampton)**

**All of these questions (and  
thousands more) are answered in the  
Third Edition of:  
“The Global Permanent Magnet  
Industry”!**



# Where You Can Purchase

[www.waltbenecki.com](http://www.waltbenecki.com)



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