

# Powder Forming Using Dynamic Magnetic Compaction

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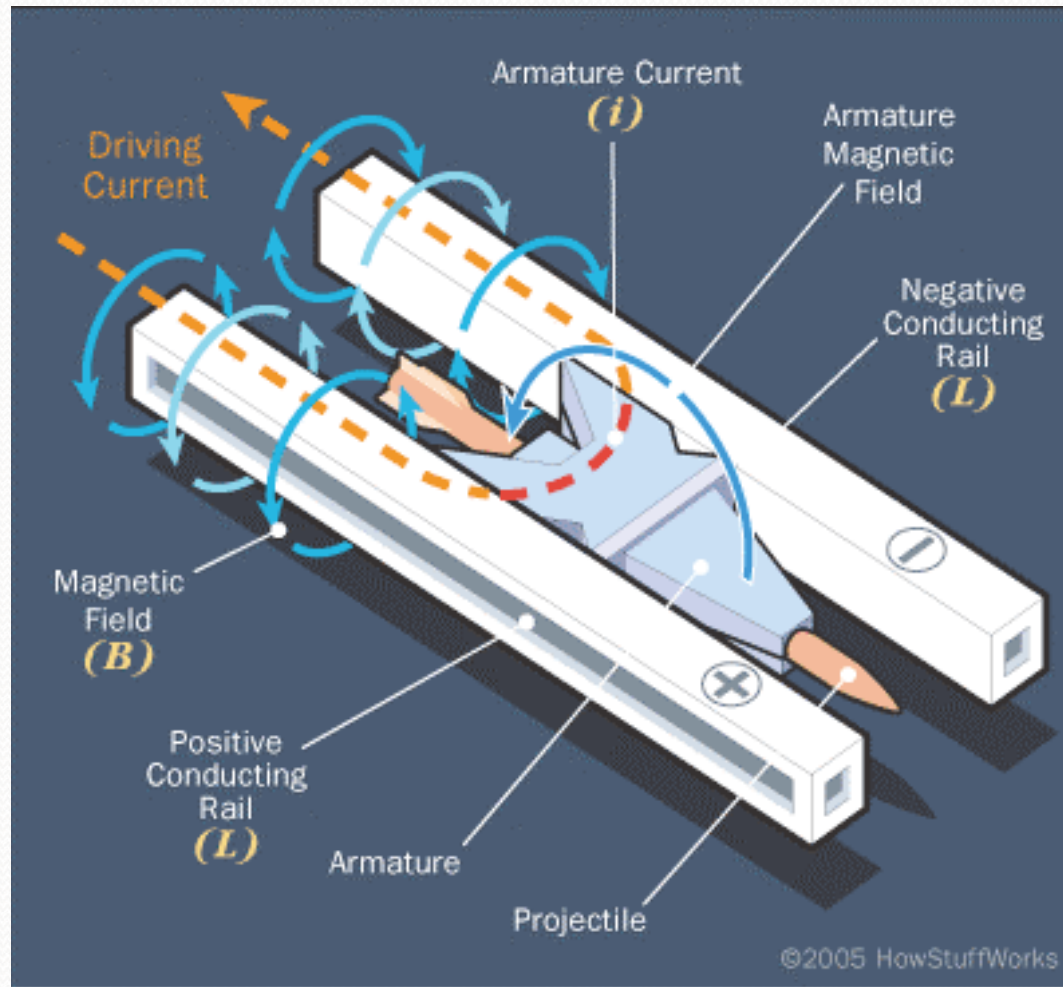
IAP Research, Inc.

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

International Conference on High Speed Forming 2010



# Railguns - Magnetics at Work



# 28 Years of Development at IAP



# The Big Bang – a Record Test



**Test conducted January 31, 2008**



# Business Thrusts

## ➤ Railguns

- ❑ Support the Navy and Army thrust to field a system

## ➤ Power Electronics

- ❑ Technology development for high power density
- ❑ Product development for Navy applications
- ❑ Product development for commercial applications

## ➤ Advanced Materials and Processes

- ❑ Nano composite materials – magnetics, bearings, medical
- ❑ Advanced FRP for railgun application
- ❑ Rail materials and coatings
- ❑ Armature advanced materials and designs
- ❑ Magnetic pressing of powder materials and metals

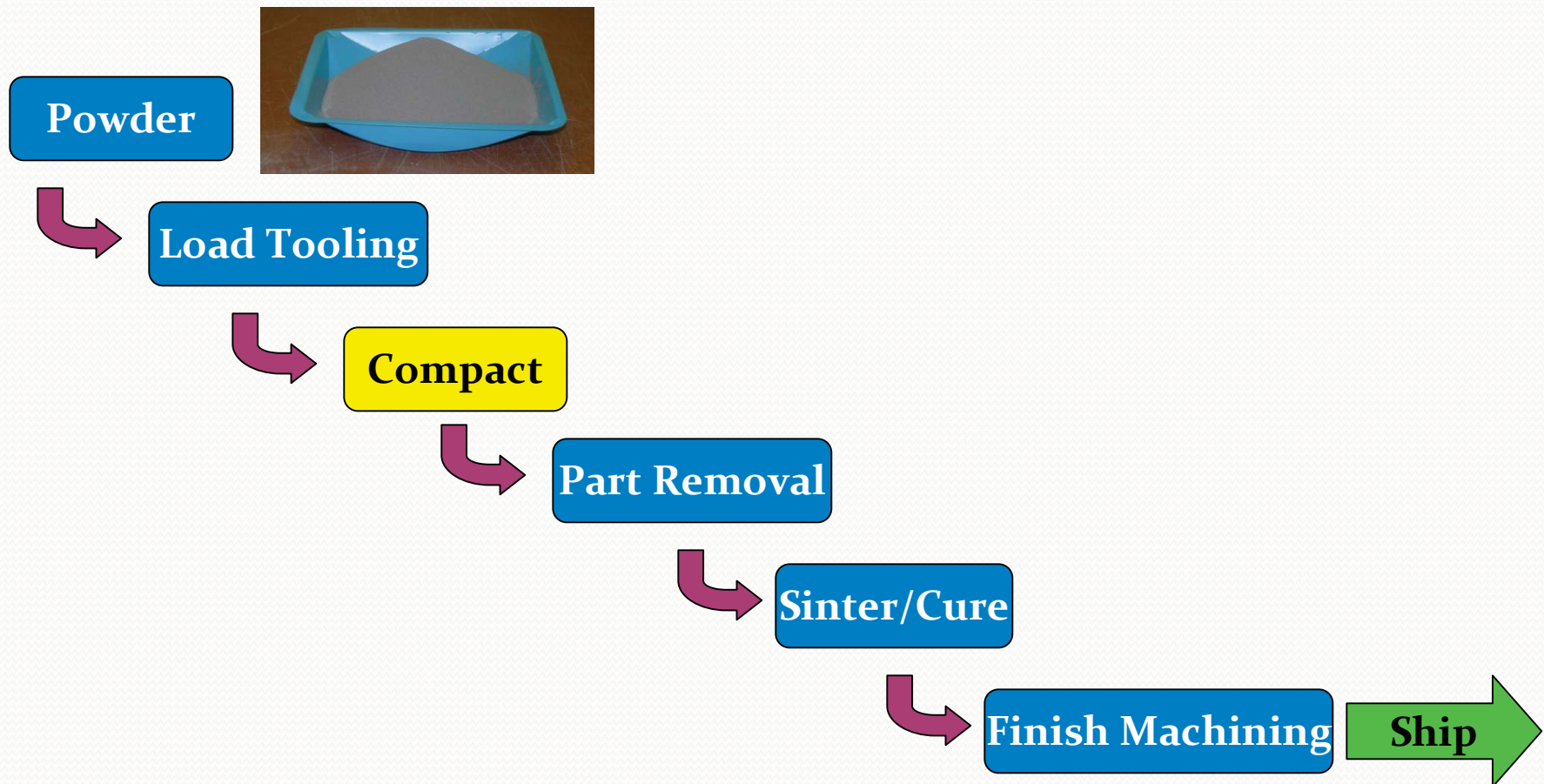


# Presentation Outline

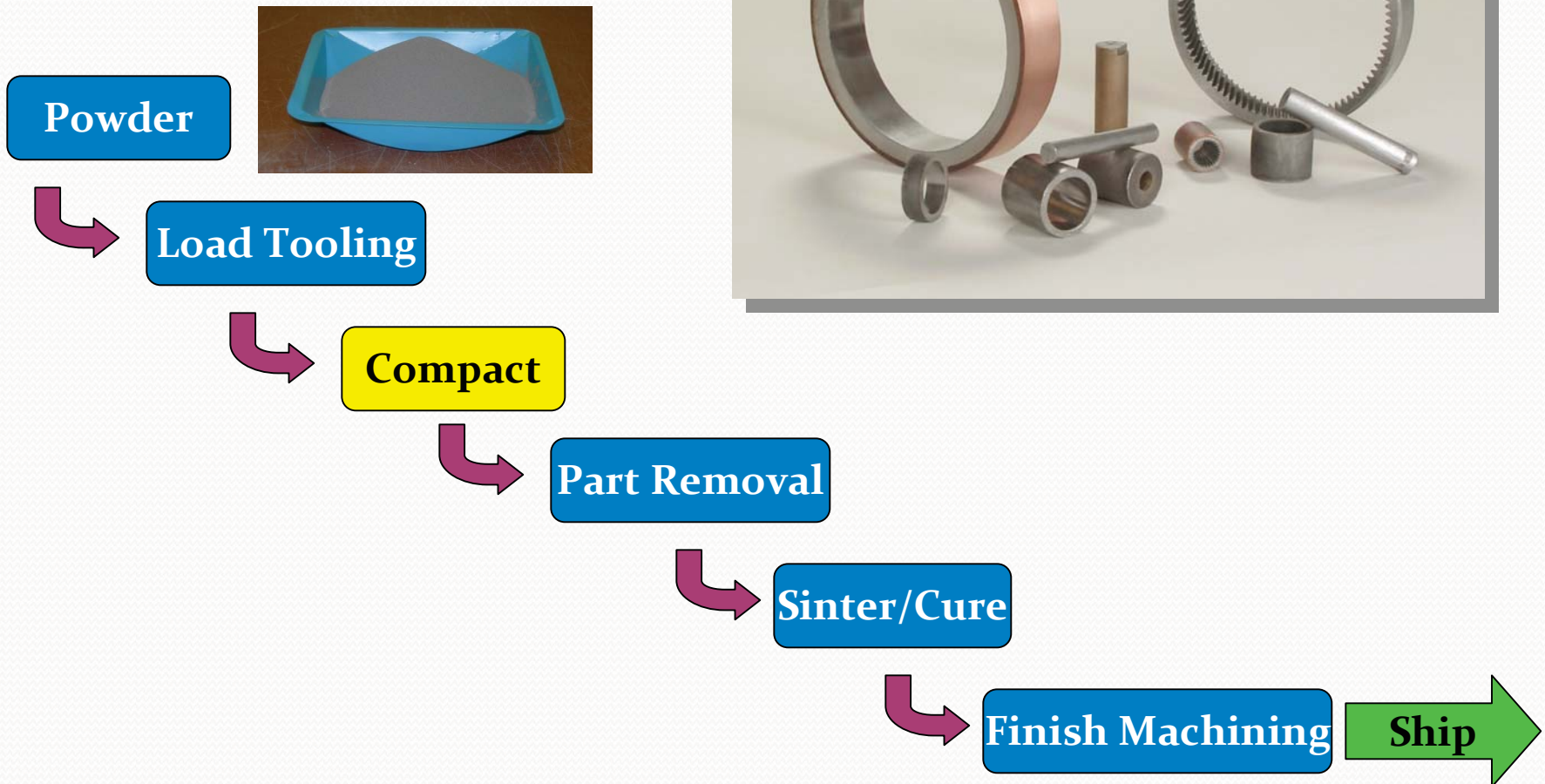
- **Powder material processing basics**
- **Dynamic Magnetic Compaction (DMC) process**



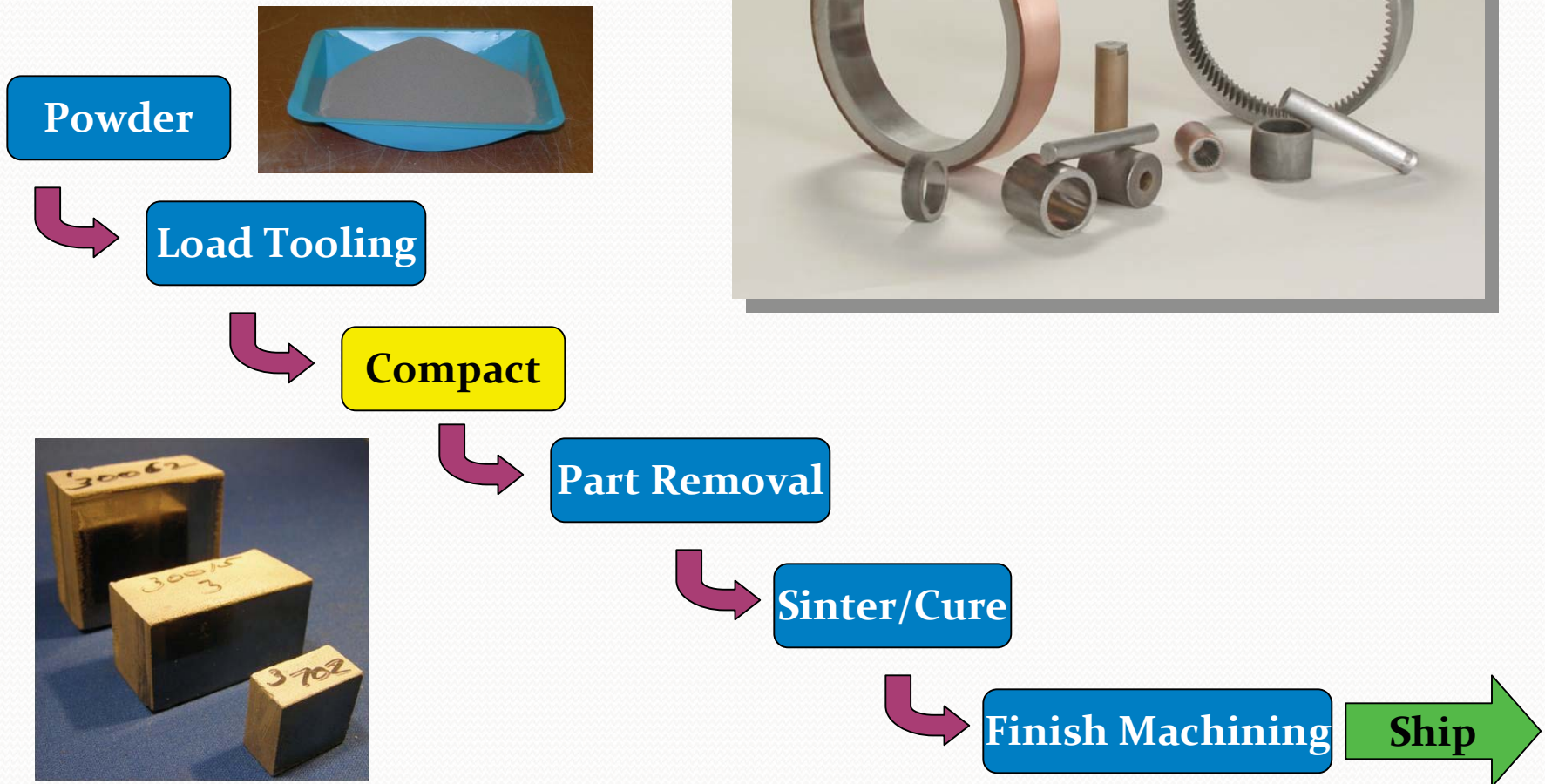
# All Powder Processes Have The Same Steps



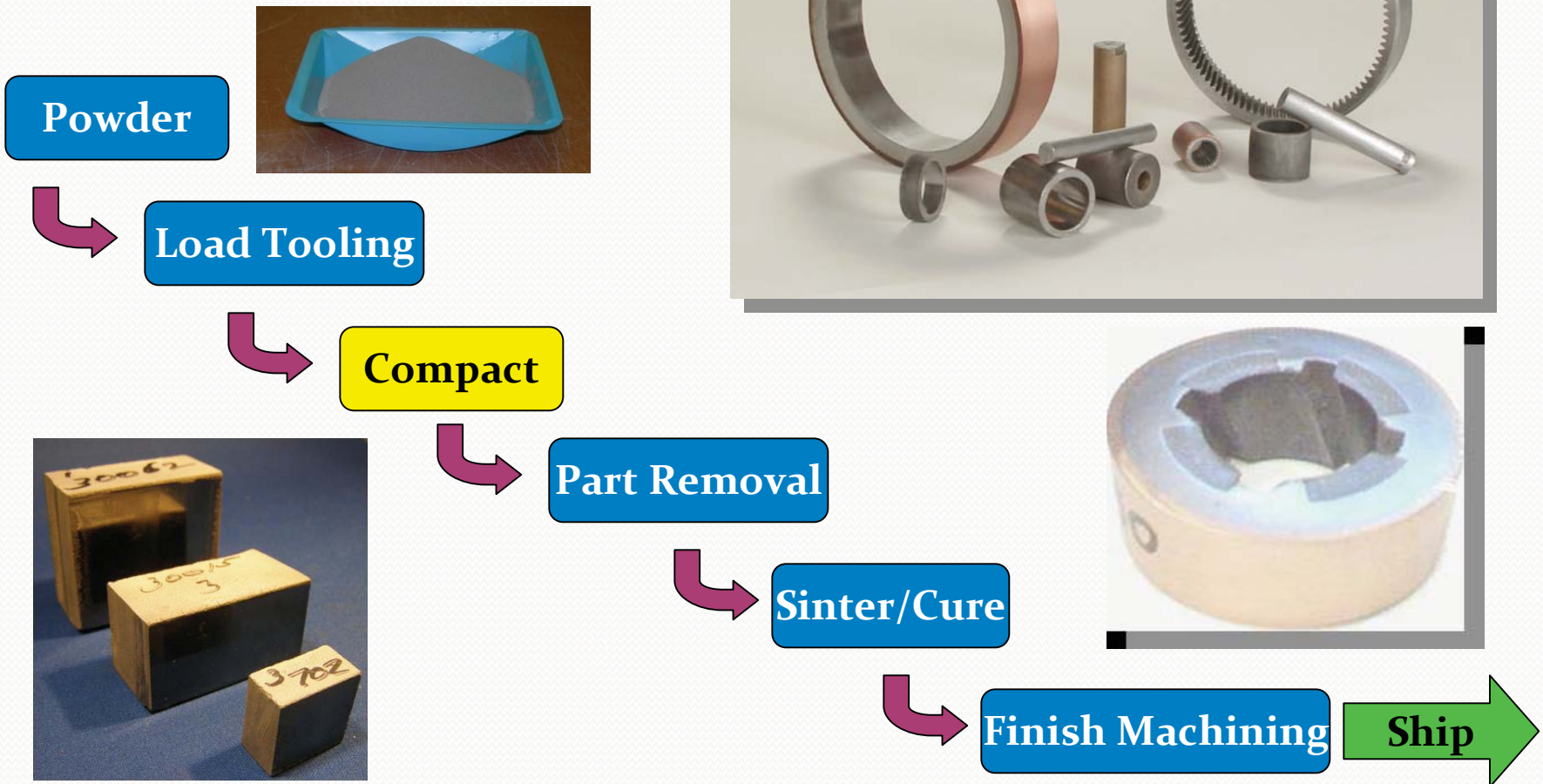
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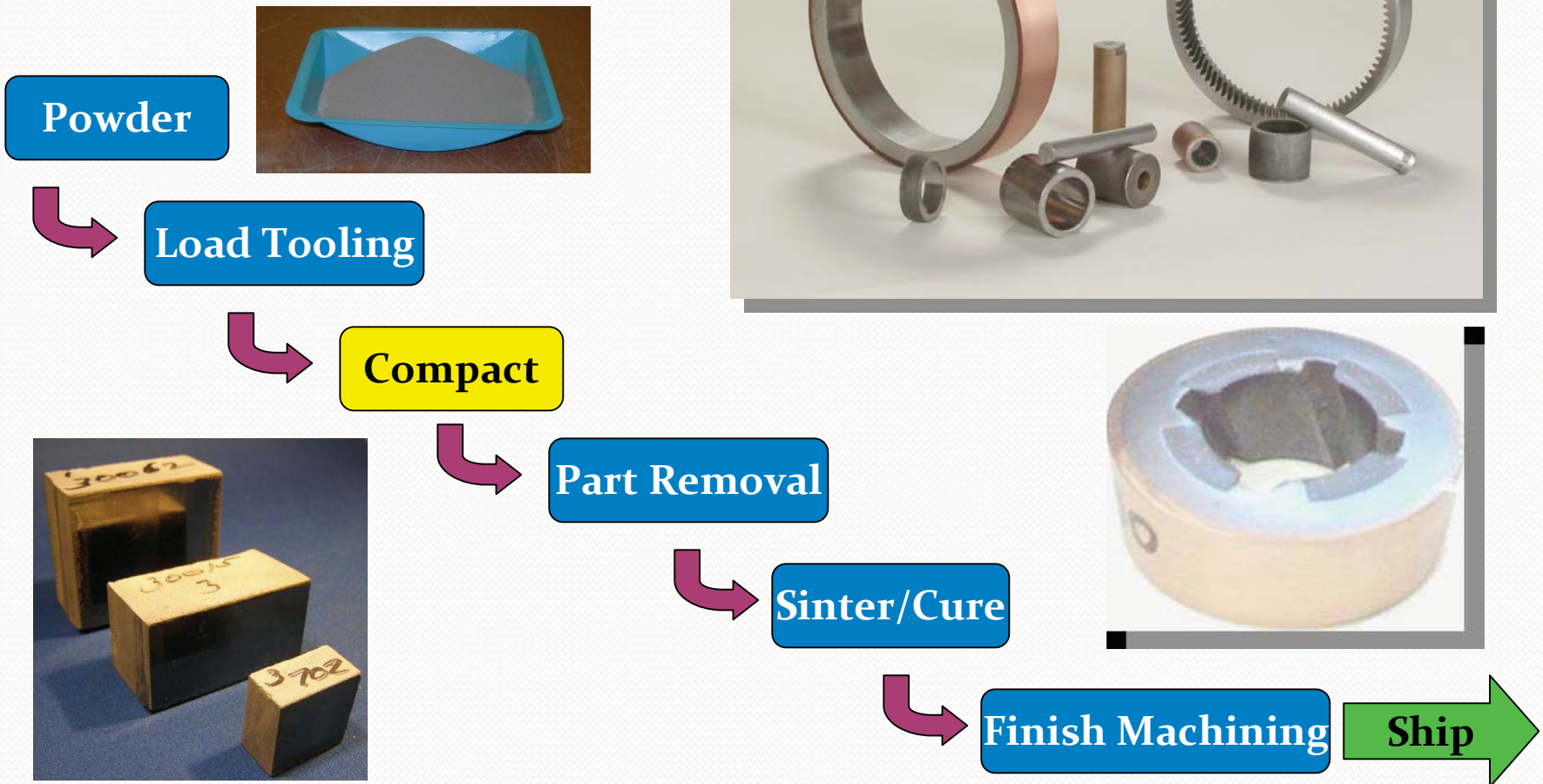
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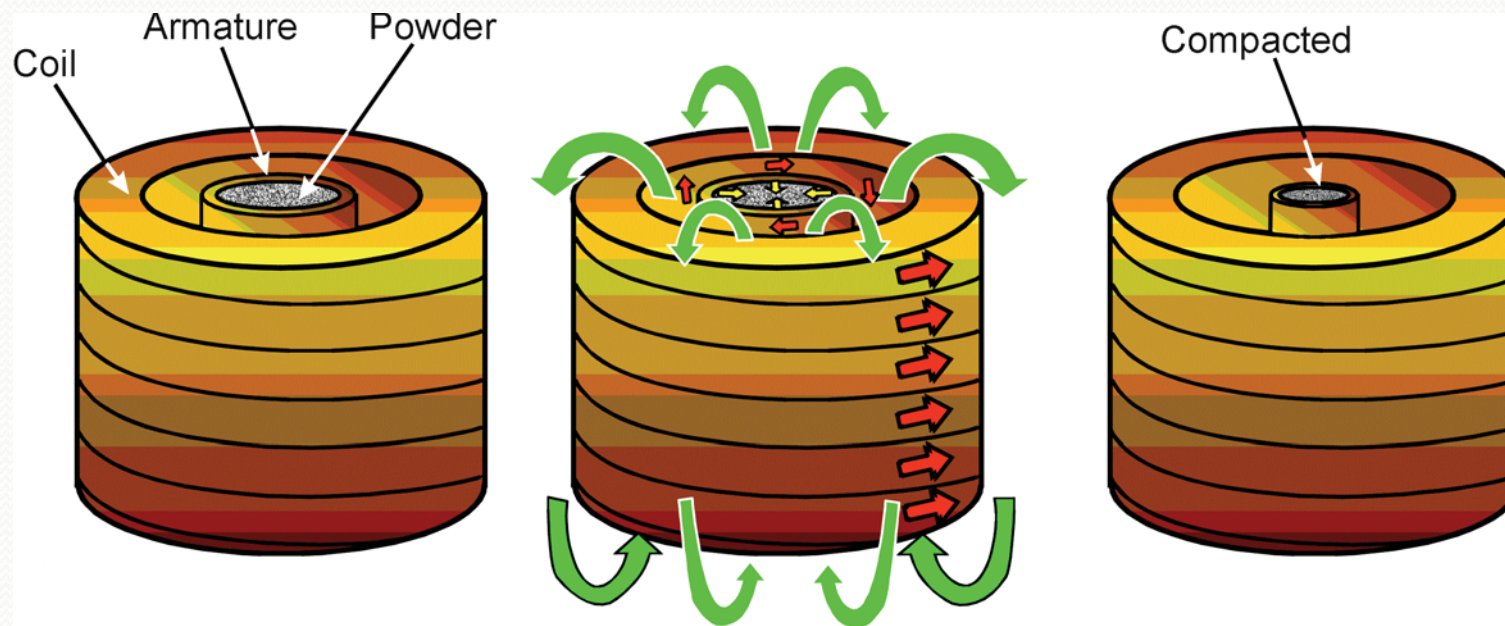
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# How Dynamic Magnetic Compaction (DMC) Works



**Ductile and brittle powder materials can be compacted**

- Current
- Magnetic Flux
- Magnetic Pressure



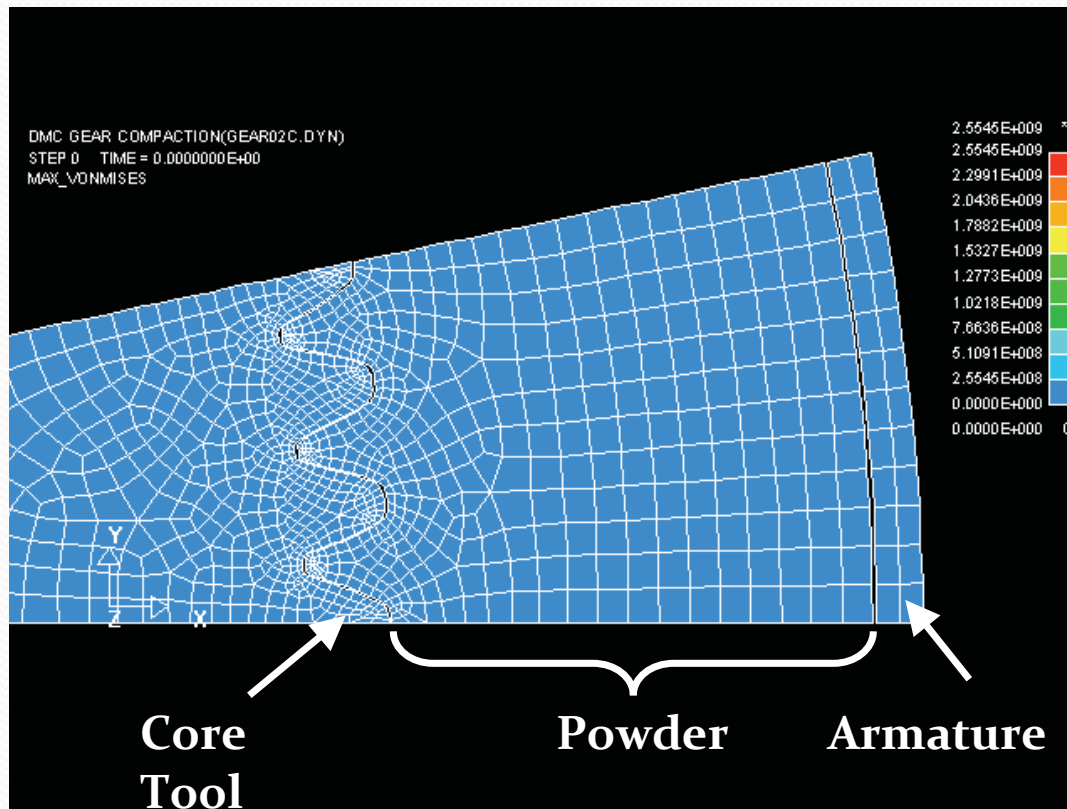
# DMC Can Made Precise Parts



- AGMA 9 rating
- Conventional process machines forged blanks



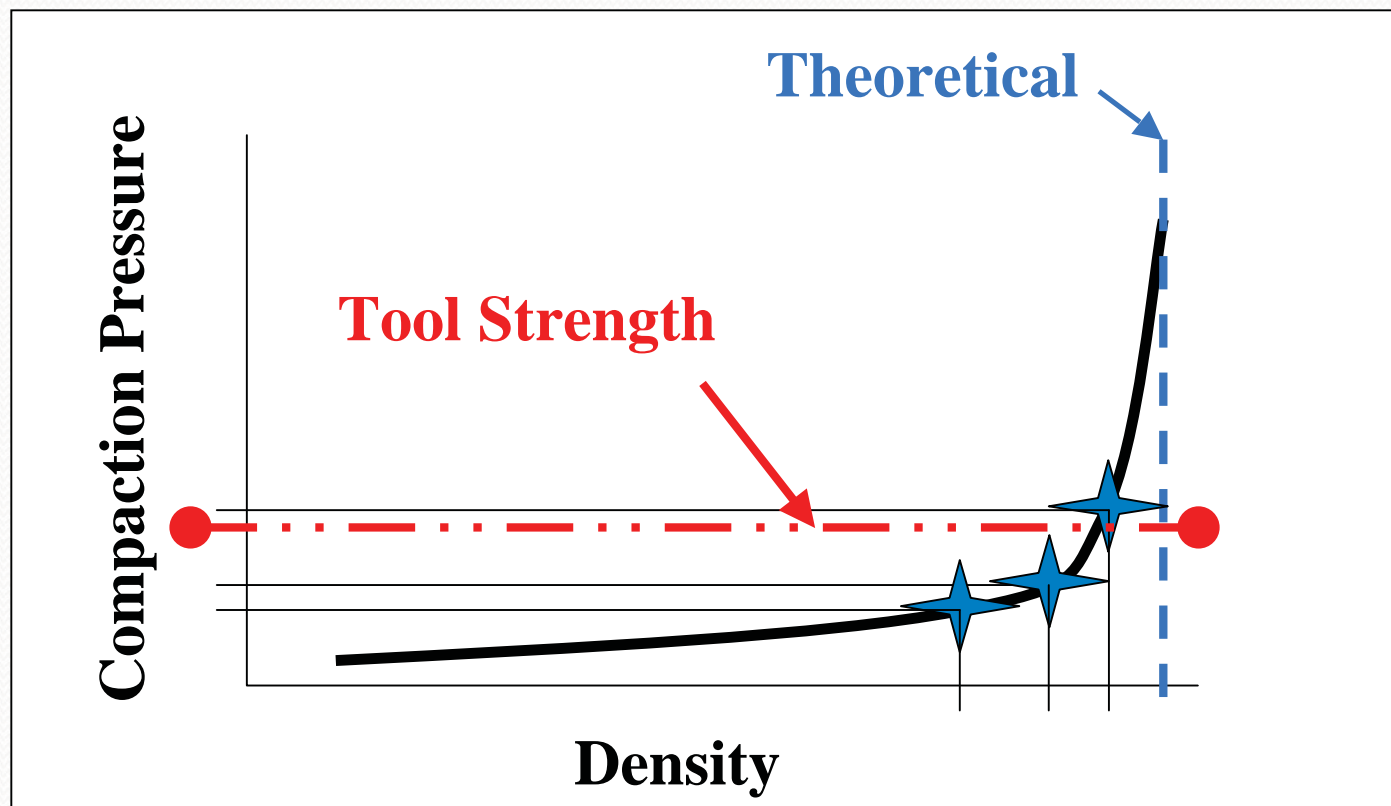
# Armature Kinetic Energy Compacts The Powder



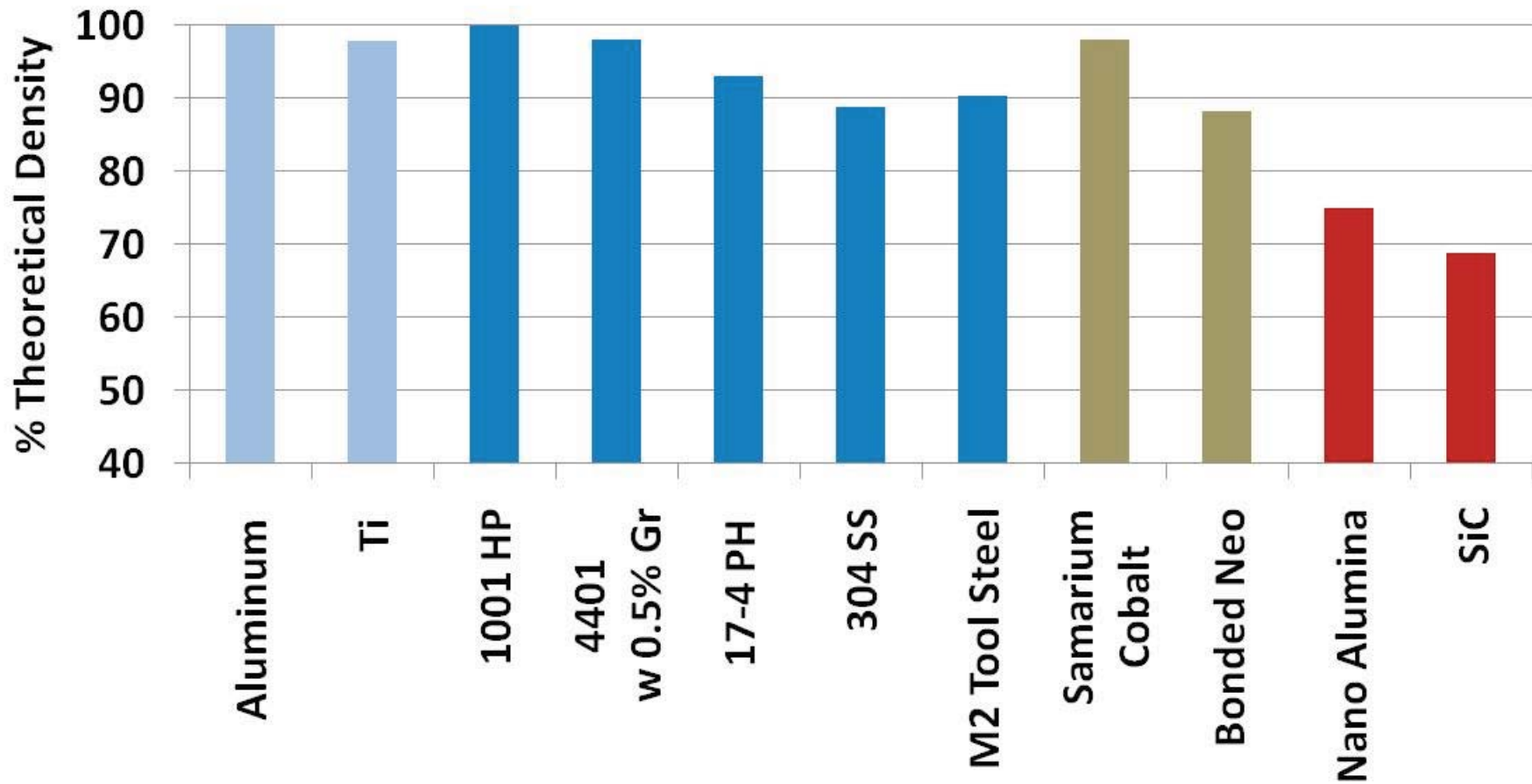
- Magnetic pressure launches armature
- Powder and core tool stop armature



# High Pressures Give High Density



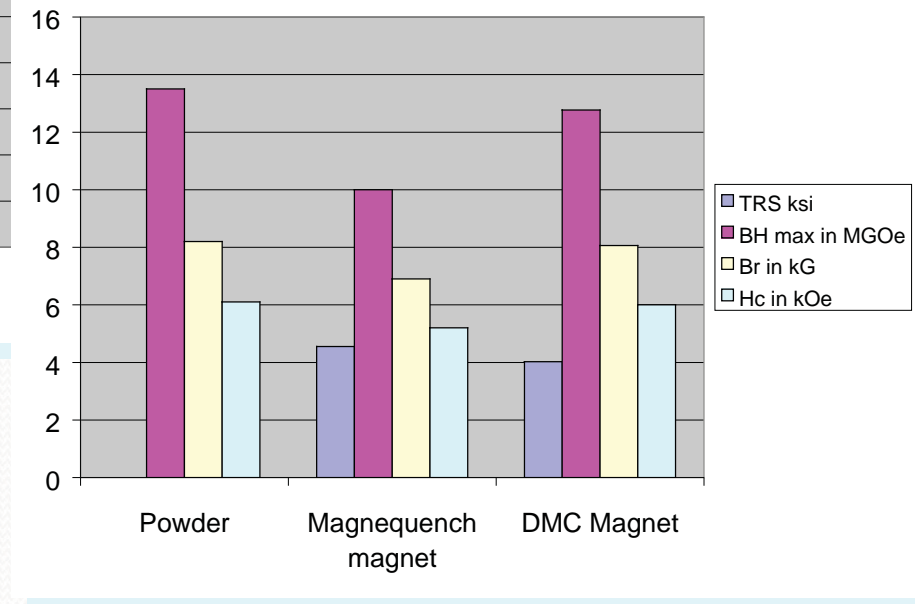
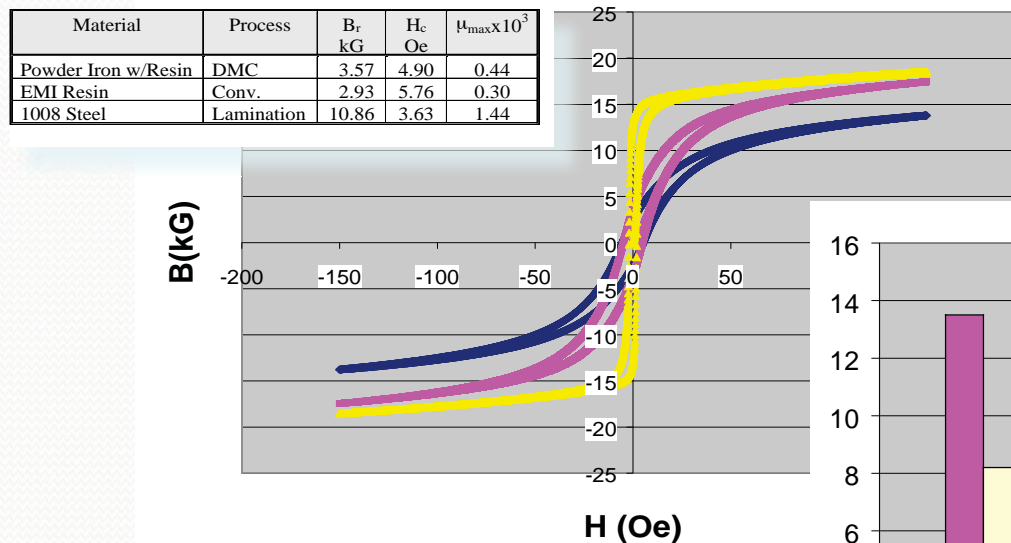
# DMC Creates High Density Green Parts



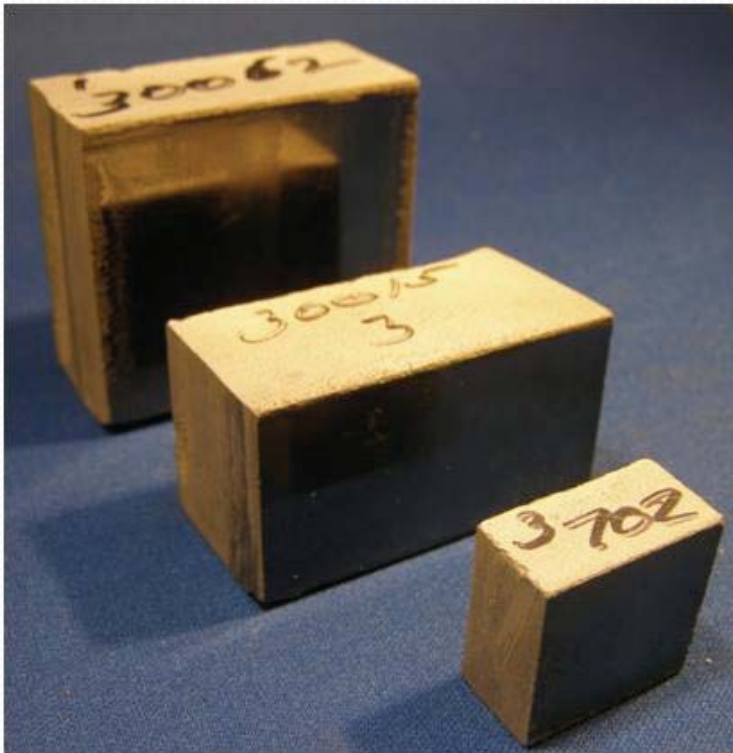
# Density Improves Magnetic Properties



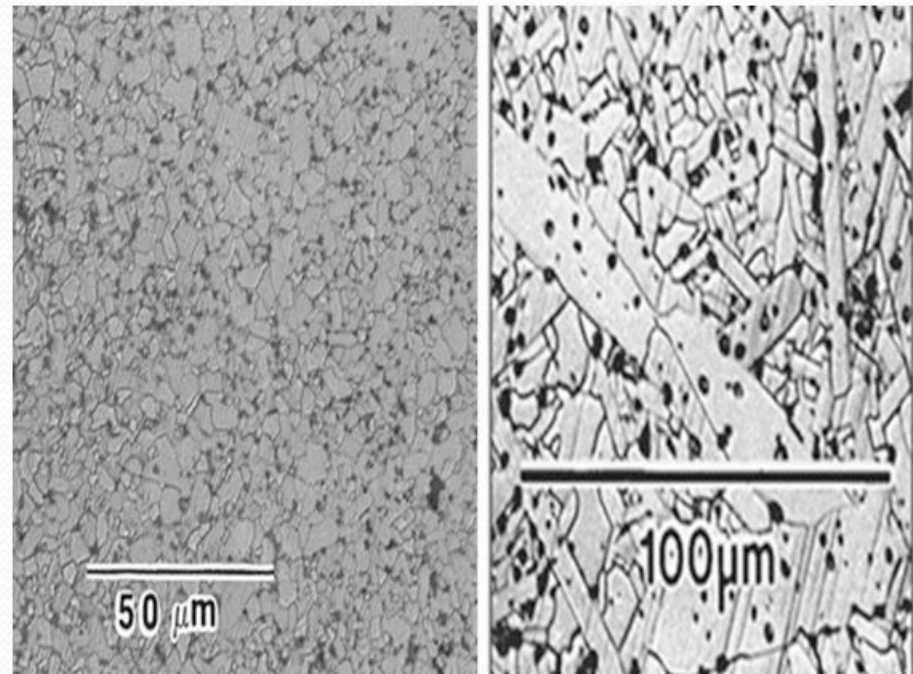
Doubled  
rotational speed  
capability



# Dynamic Compaction For Ceramics



**Successful tile size  
scaled-up through  
process development**



a) DMC & PS

b) CONV & PS

- **DMC delivers high density compacts**
- **Fine microstructures**



# DMC Pressing Feature Summary

- DMC compactions deliver high density
  - ❑ Kinetic process => High compaction pressure
  - ❑ Metal material properties like wrought
  - ❑ Promotes a fine grain structure
- DMC a natural for radial pressing
  - ❑ High L/D part shapes
  - ❑ Net shaped parts
- DMC can produce flat (non round) part shapes



# Questions?

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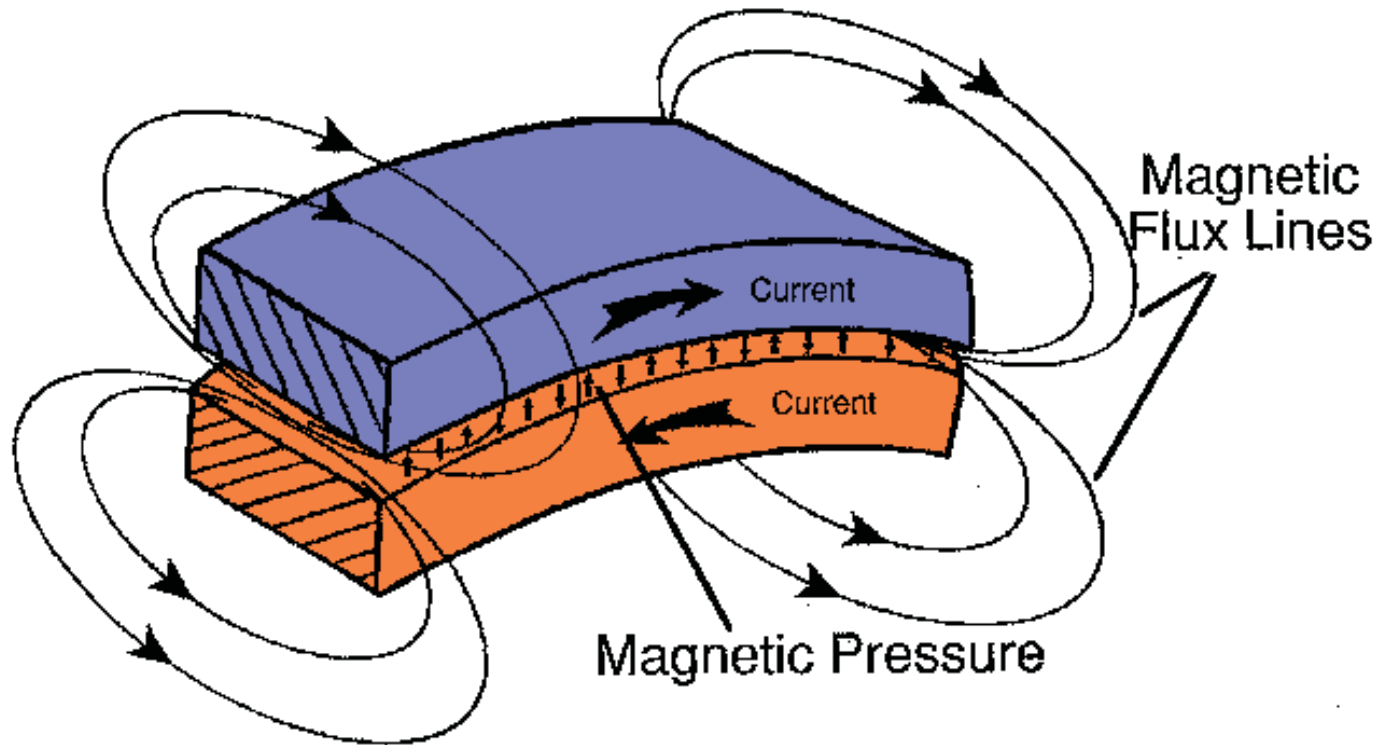




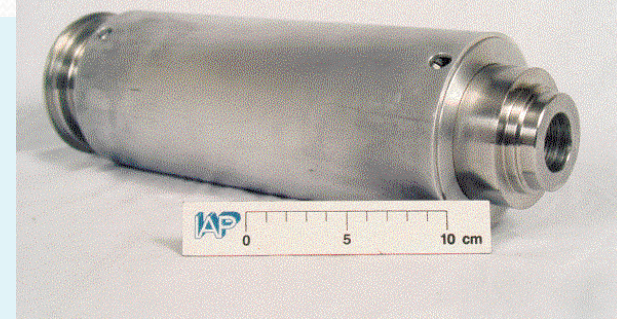
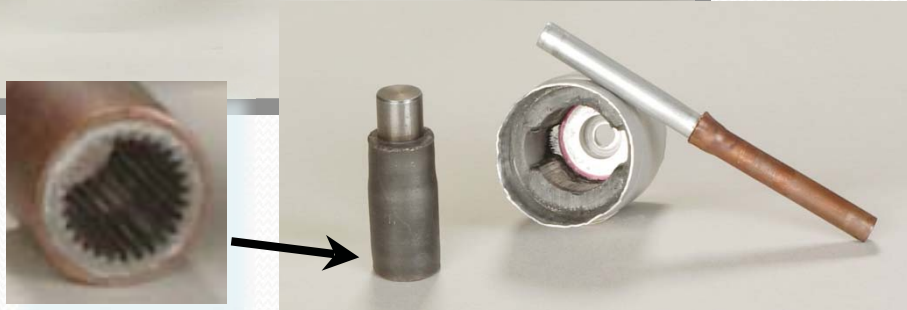
# Supplemental Charts



# Opposing Currents Generate Magnetic Pressure



# Magnetic Pressing Metal Forming and Assembly

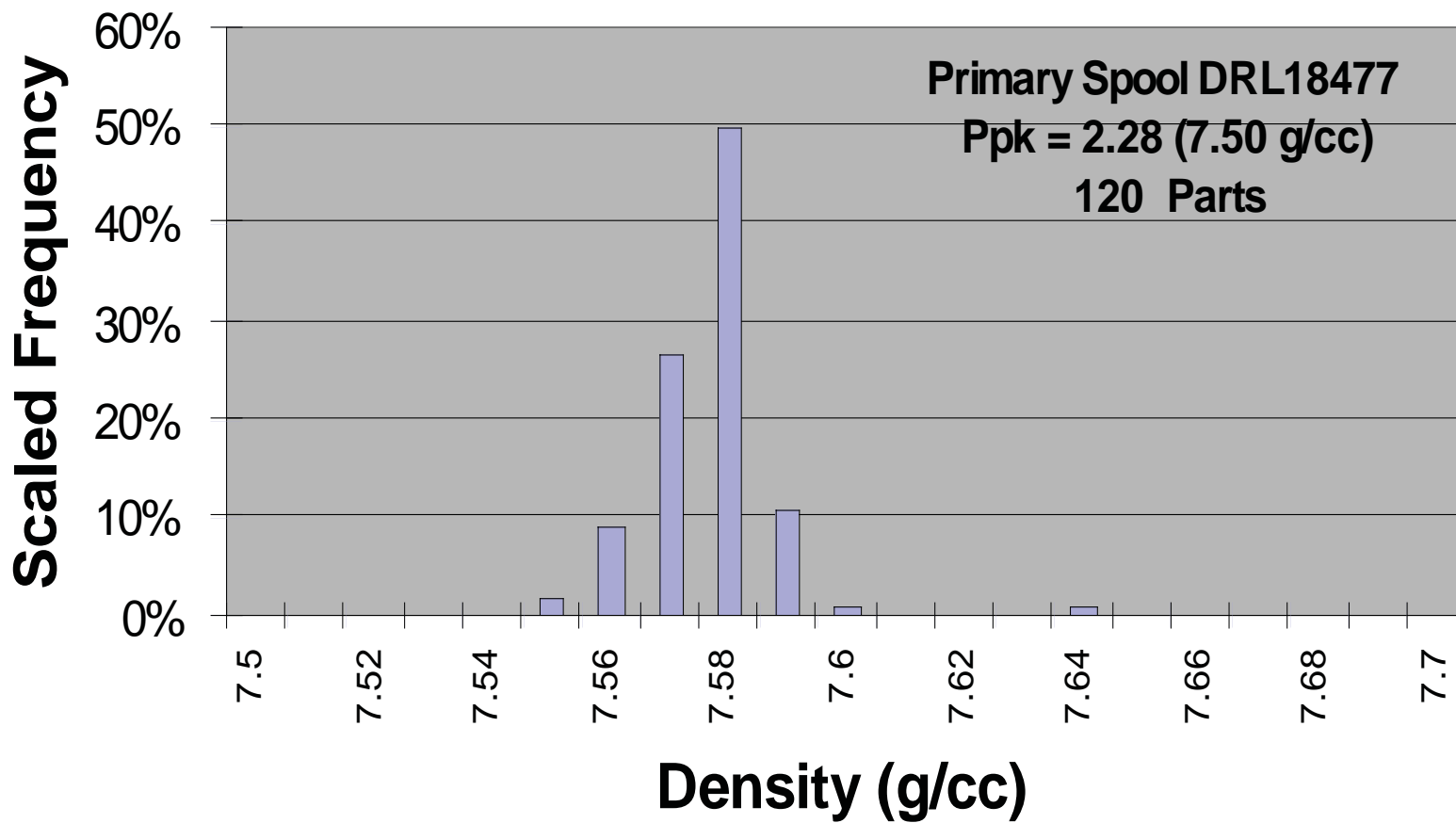


# Pencil Core Dimensional Requirements Met



Parameter	Average Value	Range	Maximum Value	Minimum Value	PPK
Density(g/cc)	7.57	0.097		7.50	2.08
Length(mm)	77.17	0.460	77.67	76.67	1.76
Diameter (mm)	13.22	0.094	13.32	13.12	2.45

# Process Capability



# MAGNEPRESS® Systems



Power  
Supplies

Cables

Coil

Operator  
Panel

