

Ductile Iron: The Steel Alternative

“Growing the Pie”

Application Focus Concast Bar vs Castings

Castings



Applications that are forged,
cast in steel, welded together

Cast to near net shape

Reduce the amount of
machining



Continuous
Cast Bar



Applications that are machined
from steel barstock

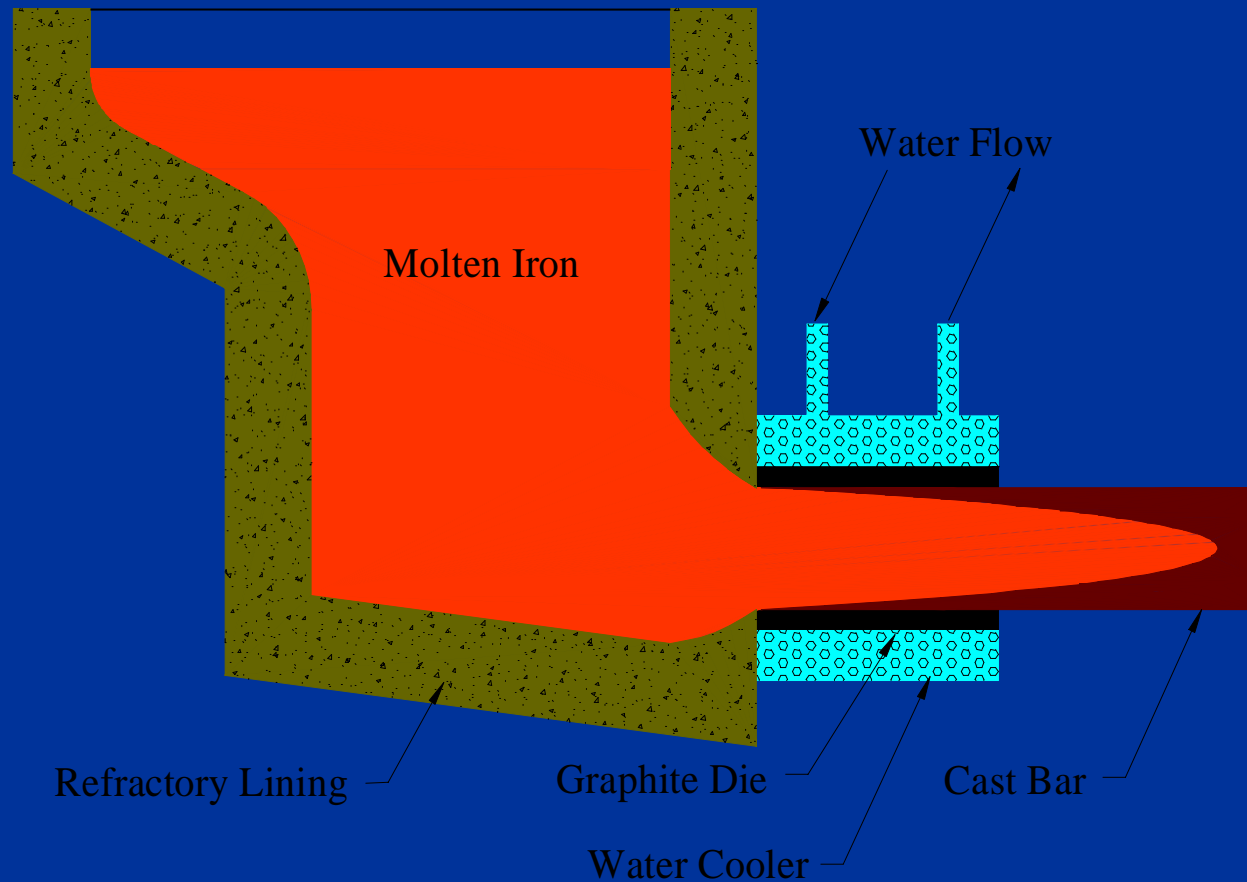
Replace with ductile iron

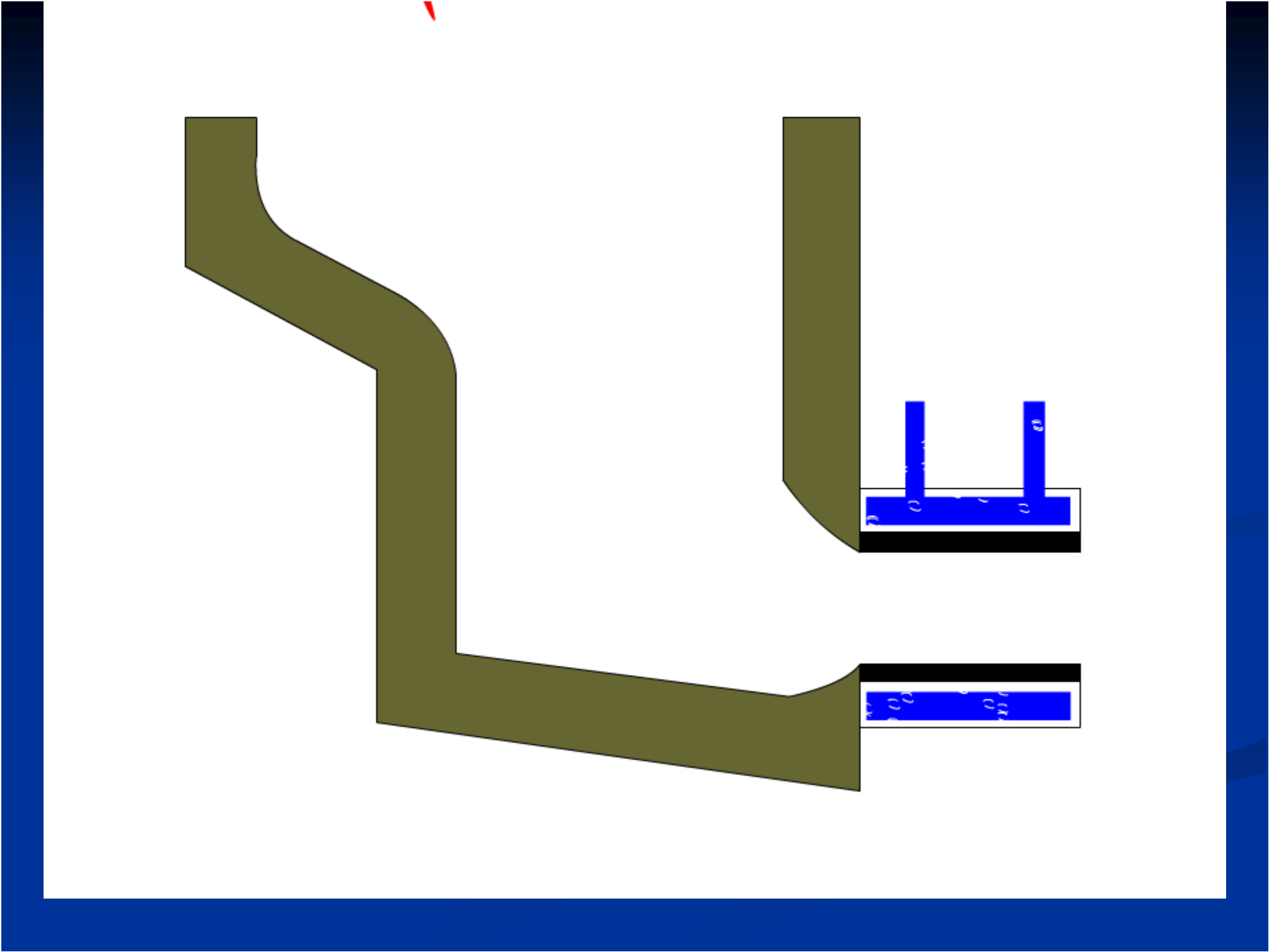
Improved machinability



Convert to ductile to
lower cost

Continuous Casting Process: Bar machine crucible, die assembly



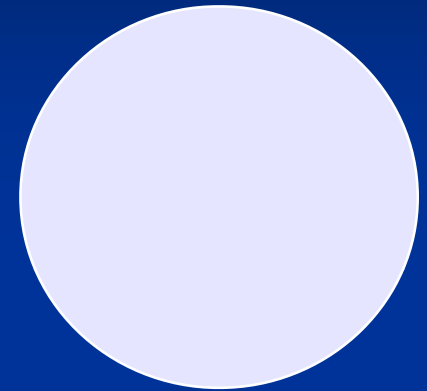


Cast iron bar Products

Rounds, Rectangles, Special Shapes



Round Bars
.750" to 20.00" diameter

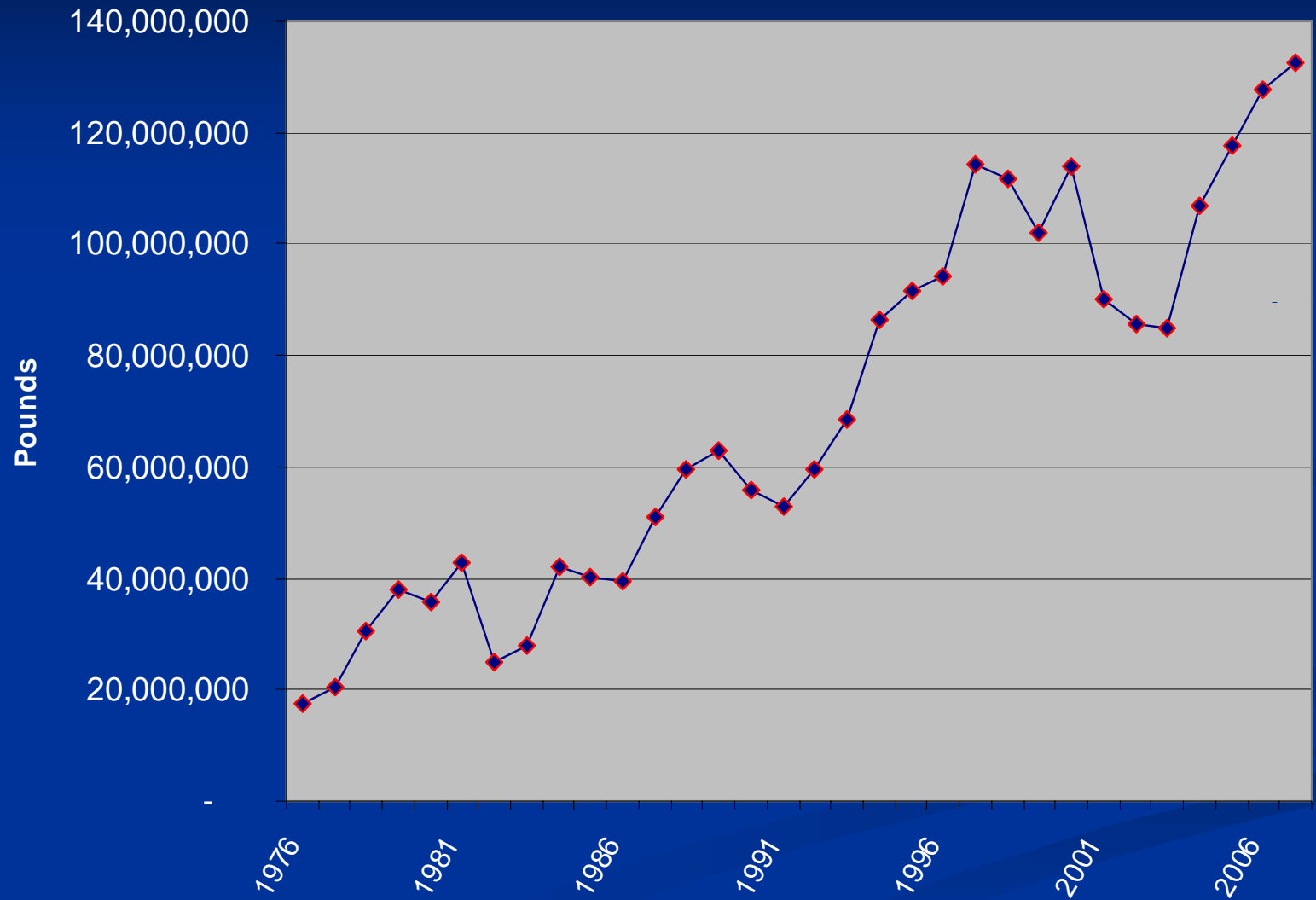


Rectangles
.750"X1.50" up to 26" Square

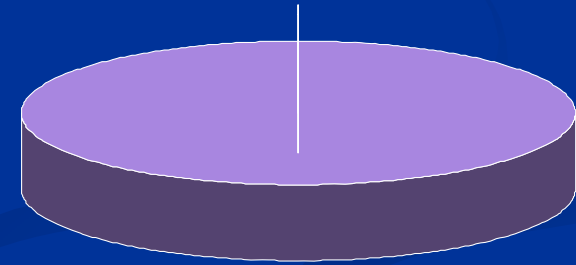
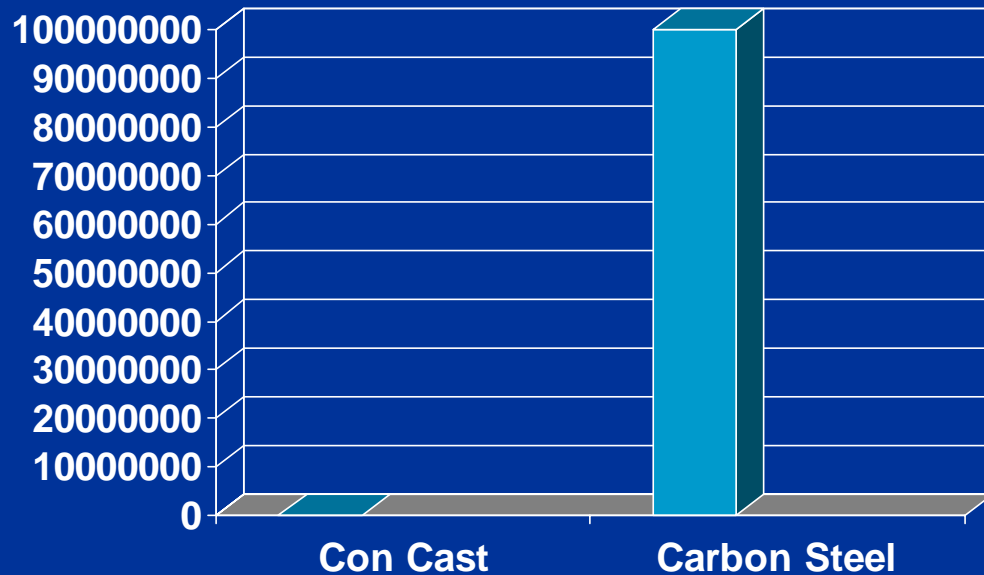


Special Shapes

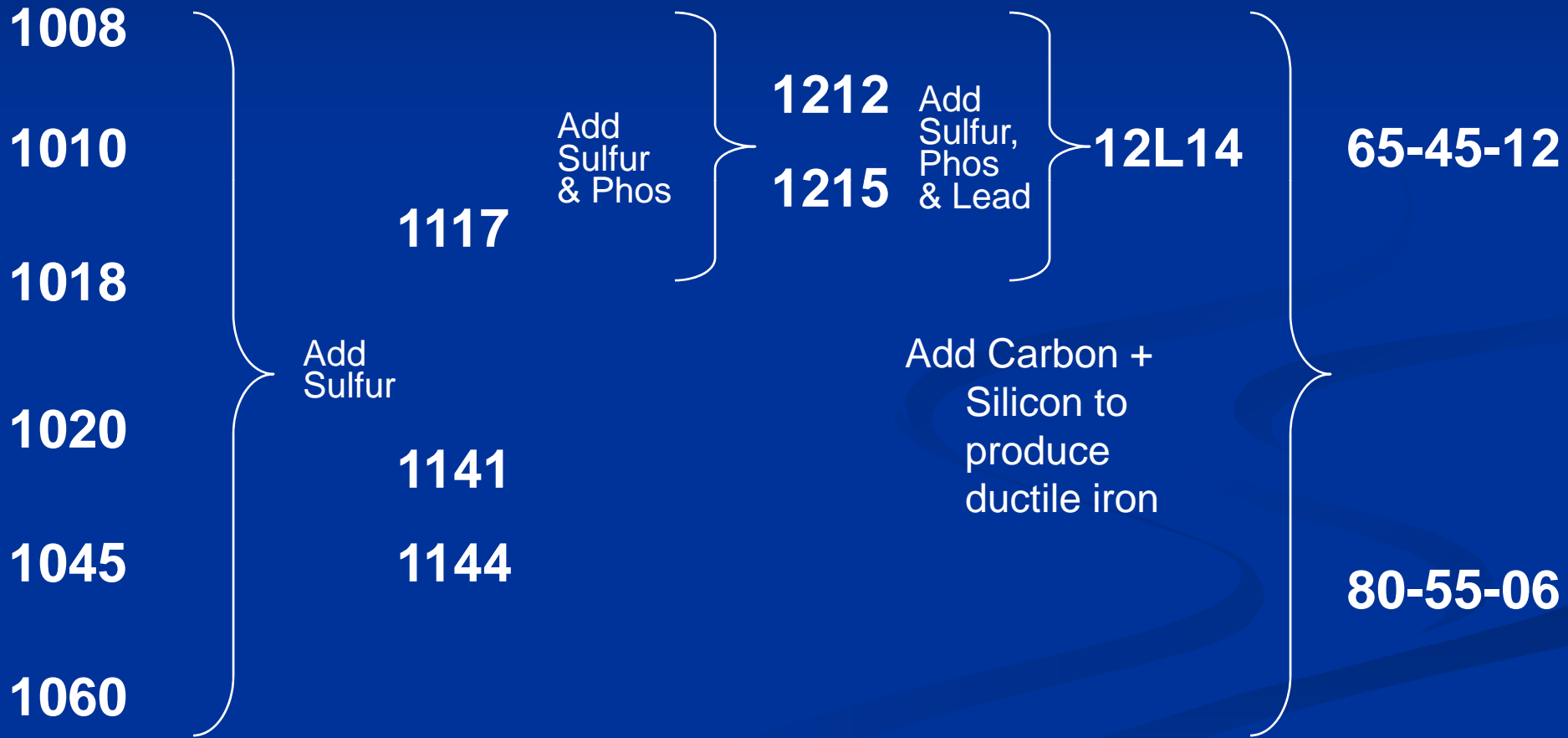
Concast Bar Shipments 1976 - 2007



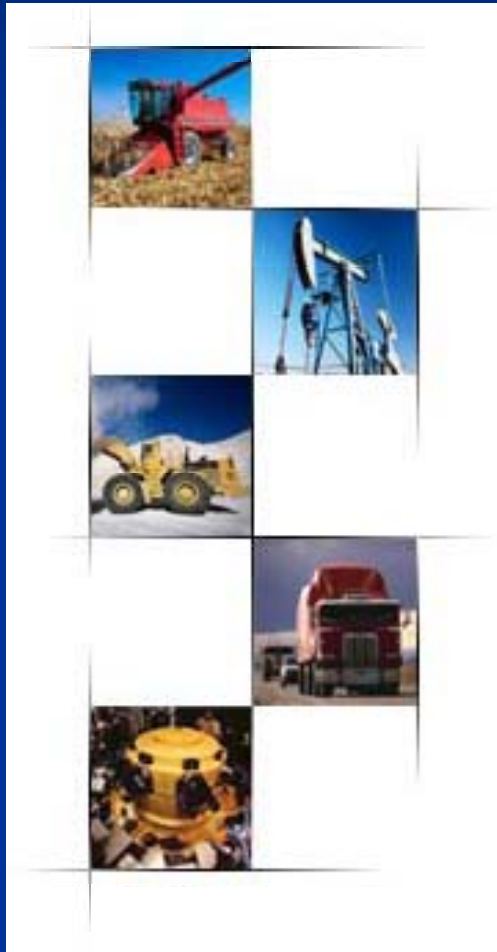
Current Cast Bar Market relative to carbon steel sales



Machinability Improvements



Industries Served



- Fluid Power
- Machine Tool
- Off Road Equipment
- Heavy Truck/ Diesel
- Lawn and Garden
- Compressed Air/
Refrigeration
- Railroad
- Pump and Valve
- Steel Mill
- Automotive
- Oil & Gas
- Alternative Energy

Success Stories

Excessive Gear Noise / Automotive

Customer Using 1141 Carbon Steel



- High Cost of Additional Grinding
- Increased Scrap
- Production Bottlenecks
- Delivery Problems

Solution

Convert to 80-55-06 Ductile Iron 2" Diameter Bar

- Reduced Gear Noise to Acceptable Levels
- Decreased Cycle Times
 - Eliminated Additional Grinding
 - Improved Machinability



Result – Quieter Balance Shaft Assembly for Nissan, Hyundai and Daimler Chrysler

Heat Treat Bottlenecks / Chain Roller

Customer Using 1117 Steel



- 12 Hour Heat Treat Cycle Time because of the Need to Carburize.
- Heat Treat Department Working Overtime to Try to Keep up with Production.

Solution

Convert to 65-45-12 Ductile Iron

- Heat-treat cycle time reduced to 4 hours
- Machining speeds increased
- Customer realized \$175,000 per year in manufacturing cost savings



Diesel Engine Application / HEUI Fuel Rail

*Originally designed in Al, switched to Steel because of
pressure requirements*

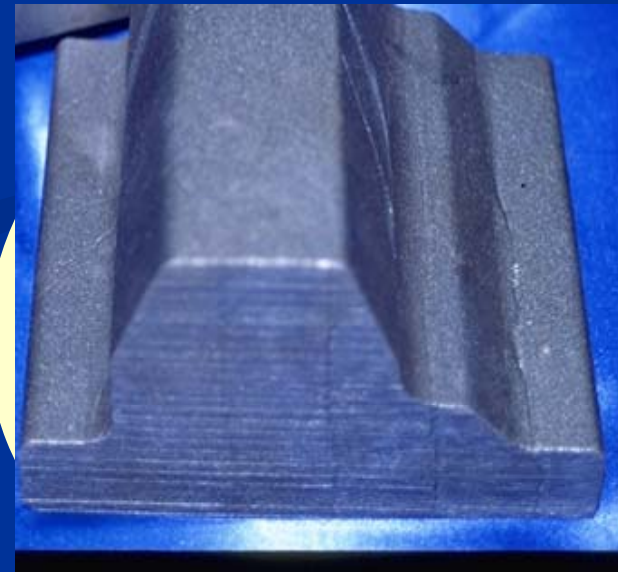


- Gun drilling 2 holes took more than 30 minutes.
- Customer tried 2 piece design with holes milled but gasket would not hold pressures.

Solution

designed special die/cooler configuration to cast shape

- Once Dura-Bar was able to cast the shape, the machine shop worked with the OEM to get it approved.
- Gun drilling reduced to 5 minutes per hole.
- Sole source for the part for over 10 years.
- No recalls, product failures or major quality over the life of the project.



Machining and Heat-Treat Cost Savings Calculations

Machining Cost Savings

Steel Machining

Turning speeds are rarely above 700 sfm.

Drilling is slow, around 150 sfm, pecking required.

Deburring can be a significant cost

Ductile Iron

Turning speeds start at 800 sfm, up to 1800 sfm is very possible.

Drilling speeds start around 600 sfm.

Deburring can be eliminated or dramatically reduced

Cost Savings Guidelines

Machining

- 75% of the increase in rough turning can be applied to cycle time reduction:
600 to 1200 sfm = 1.5 more parts/hr
- Assume fixed shop rate costs to be \$75/hr.
- Drilling, milling and other non-turning operations will be increased by the same percentage as rough turning.

Simple Example

Steel vs Ductile Iron Machining Cost

Carbon Steel

Rough turning speed: 600 sfm

10 parts per hour
\$75/hr fixed cost
\$7.50/part

Ductile Iron

Rough turning speed:
1200 sfm

$2 \times 75\% = 150\%$ expected
productivity increase

15 parts per hour
\$75/hr fixed cost
\$5.00/part

Heat-Treat Savings

Low Carbon Steels:
Carburizing

Approximately 30
minutes/0.001" depth
of hardness.

0.030" case depth
requires 12 – 15
hours cycle time

Ductile iron:

Carburizing not
required.

Assume 1 hr per inch
section thickness.

Average cycle time will
be < 4 hrs for q&t.

Cost Savings Guidelines

Heat treating

- Assumptions:
 - \$150/hr fixed heat treat cost
 - Batch size of 2000 lbs
 - Cost to heat treat will be 7.5 cents per pound per hour in the furnace.
- Carburizing can add \$0.75 – 1.00 per pound to the cost of the part.
- Heat treating ductile iron can be 50% less than cost to carburize

Handling Objections

Cast iron is brittle:

Difference between 12% elongation and 25% is more perception as long as part does not require crimping operation and loads are below yield strength.

Article on the importance of elongation??

Cast iron is dirty:

Perception rather than reality – most people think about machining sand cast gray iron which can be dirty to machine. Ductile iron is relatively clean by comparison.

Growing the Market

- Promote ductile iron as an “engineered metal”.
- Property comparisons to steel grades being substituted.
- Processing comparisons: welding, heat-treating, surface coatings.
- Quantify and promote heat treat cost savings, especially against low-carbon carburized steel parts.
- More information on success stories – ductile as an alternative to steel.