Thin Gauge Grain Oriented Electrical Steels
for Transformers/Cores

Arnold Magnetic Technologies helps enable the efficient electrification of machines using advanced materials — including high-performance magnets and precision thin metals for motors and transformers. They're smaller, run faster, cost less and have higher efficiency.

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Arnold's Grain Oriented Electrical Steels (GOES)

Arnold Magnetic Technologies starts with a 3% silicon steel processed under carefully controlled conditions at one of several DFARS compliant US based plants. The base steel arrives at Arnold in a "pickled" state which allows Arnold to roll it down to very thin gauges. After rolling to a final thickness of:

- 0.001" (0.025mm)
- 0.002" (0.05mm)
- 0.004" (0.10mm)
- 0.006" (0.15mm)

the steel then goes through further processing. This post-processing can include annealing and/or adding an insulating coating.

Arnold Magnetic Technologies is continuously developing new processing techniques to reduce cost and improve the steel's electromagnetic performance. The result is a better core at a lower cost. By reducing the initial **Purchase Price** and reducing the operating losses, the **Total Cost of Ownership** of a core using Arnold's Thin Gauge GOES can be less than a core using standard gauge steel.
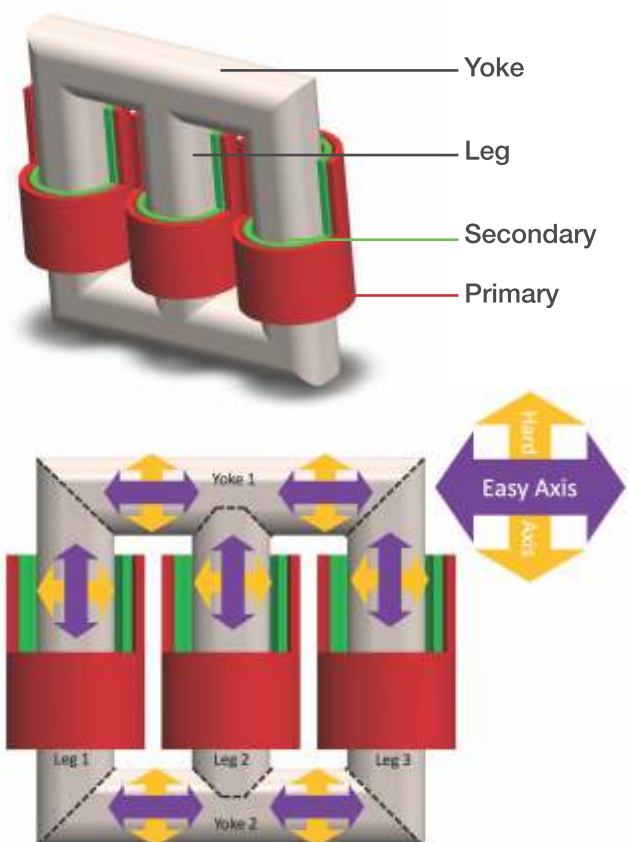
Grain Oriented Electrical Steel Cores

A grain oriented core must be constructed with the preferred magnetic direction in mind. This can limit geometry options, but the end result can be a smaller/more efficient design.

The image on the right shows the basic design of a 3-Phase transformer. The basic configuration has several Cores (Yoke or Legs) with a primary and secondary winding.

Hiding the Primary and Secondary winding shows the core component. This design will use two Yokes, one on the top and one on the bottom along with three legs.

The preferred magnetizing direction (Easy Axis) is shown with the purple arrow. The Hard Axis is shown with the gold arrow.

Is a GOES Steel the Right Choice?
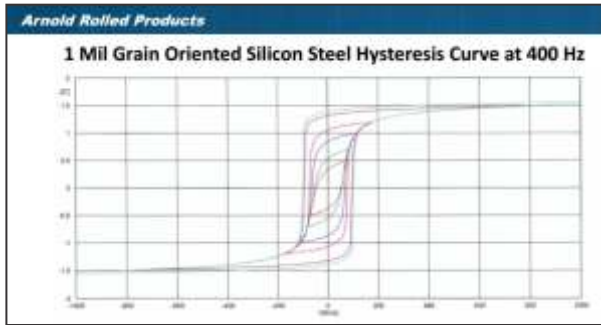
Arnold has many support options when evaluating a Grain Oriented Electrical Steel. Arnold can supply material data including BH curves and loss data for each of the materials.

The chart on the left shows a typical hysteresis curve of a 1 Mil (0.0254mm) Grain Oriented Electrical Steel.

How to choose the best material?
Just going with the thinnest steel may not provide the lowest losses. The chart on the right compares the Iron Loss/Frequency versus frequency. As the chart shows, the thinnest steel has greater iron losses at low frequencies but has a much flatter loss trajectory as frequency increases.
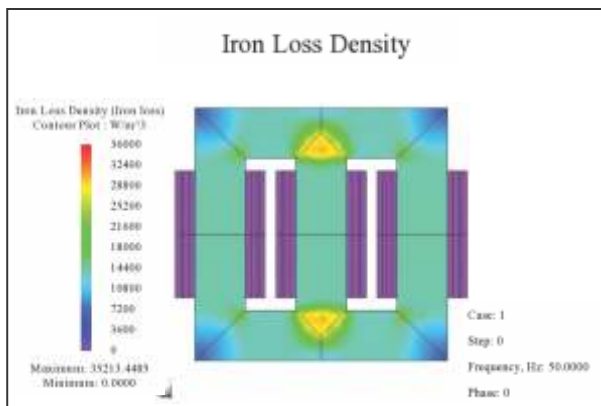
This means that at low frequencies, thicker steel will perform better. Knowing the end application is necessary to determine the best material.
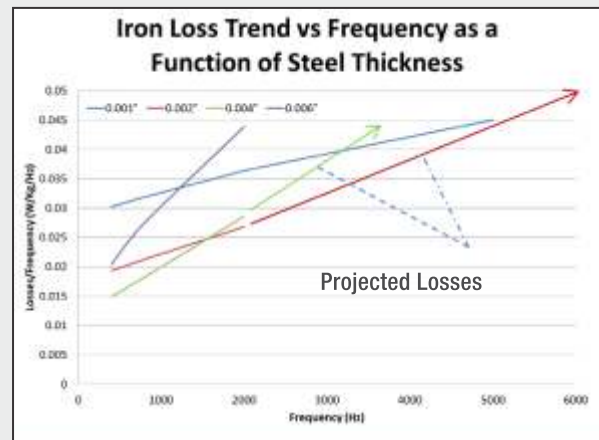
Arnold can also help you by
modeling your design and providing performance data on different material choices.

The image on the left shows the flux density of the 3-Phase Transformer.

By using advanced modeling techniques,
Arnold can help determine how each material will perform in the final application.

The chart at the right shows the Iron Losses at three operating frequencies for the 3-Phase Transformer above. As the chart shows, at 400Hz, the 0.002" thick steel will have the lowest losses. But at 8000Hz, the 0.001" steel will have the lowest losses.
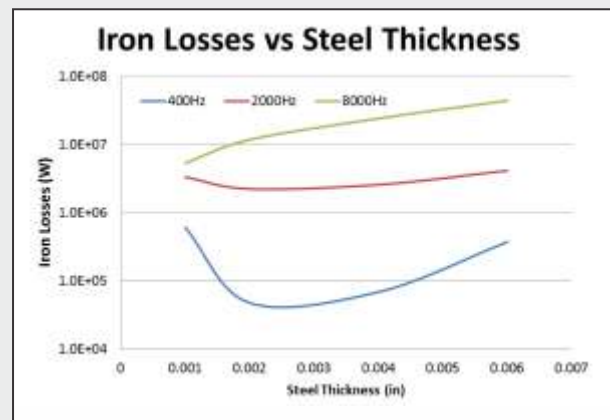
About Arnold Magnetic Technologies

Arnold Magnetic Technologies helps enable the efficient electrification of machines through advanced materials, including high-performance magnets and precision thin metals for motors and transformers that can run faster with higher efficiency and lower costs in smaller packages. Arnold's materials, engineered components and systems are proven in the most demanding automotive, aerospace, energy exploration, industrial and medical applications.

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Learn more about Arnold's performance materials at **arnoldmagnetics.com.**

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