Fermilab

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RESULTS OF MAGNETIC MEASUREMENTS OF COSMOTRON STEEL AT HIGH EXCITATION

1. Abstract

This report gives the results of the B vs. H measurements of cosmotron steel at excitations up to 1500 Oersted (∿120,000 Amp turns/meter). Such high excitations are normally not used, but they are of interest, and do exist at the inner diameter of large toroids used in Proton's experimental areas.

2. Discussion of the measurements

Measurements at high magnetizing forces up to about 1500 Oersteds, are cumbersome and not easily made. Published steel curves stop generally well below a 1000 Oersted. There is probably very little industrial interest in high excitation data, because it is not economical to operate steel much above 18 KG. Electrical grade steels require typically magnetizing forces up to about 100 Oersted at 18 KG. However, in the design of toroids, with an outer diameter to inner diameter ratio of 10 to 15, it is easily possible to end up with excitations of 1000 Oersted or more at the inner radius. It is of interest to be able to predict the value of B at such high excitations.

The measurements were performed by Arnold Engineering in Marengo, Illinois, at a small toroid sample taken from the cosmotron steel. The results are indicated in Curve #63725 and Curve #63851. The curves have an estimated accuracy of ± 3%, but are probably better. A copy of available magnetizing curves of USS C1010 low

carbon hot rolled steel plates is included for comparison. The cosmotron steel is C1010 steel and has similar characteristics as USS C1010 steel annealed at 1500°F. The United States Steel data lists a value H_c = -1.34 Oersted for this type of steel. The "Arnold Curves" indicate a value H_c = -1.38 Oersted.

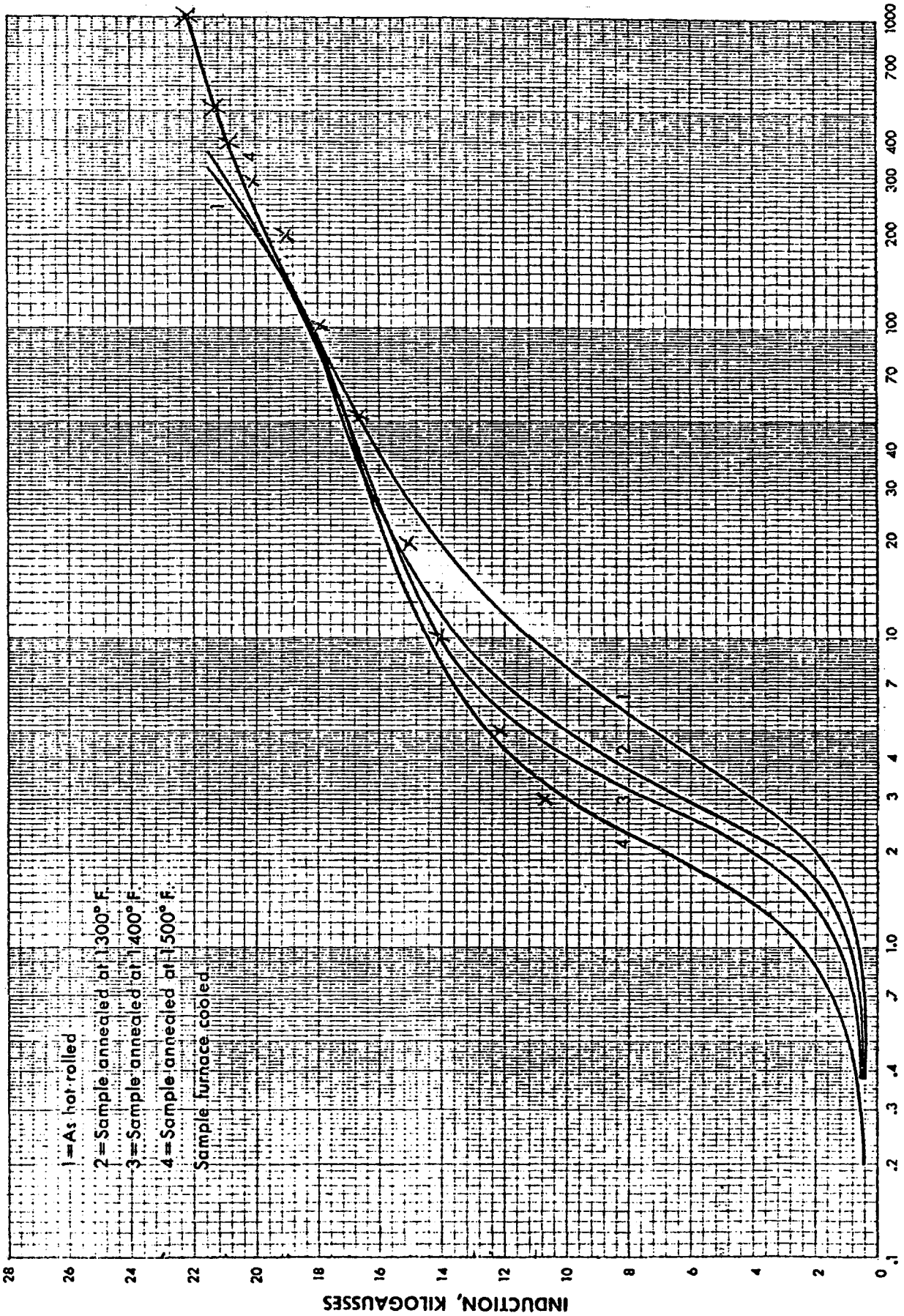
3. Acknowledgements

I am indebted to Arnold Engineering's Mrs. Paul Bowers and Dana White, who performed the measurements, which turned out to be much more cumbersome than originally thought.

ATV/be

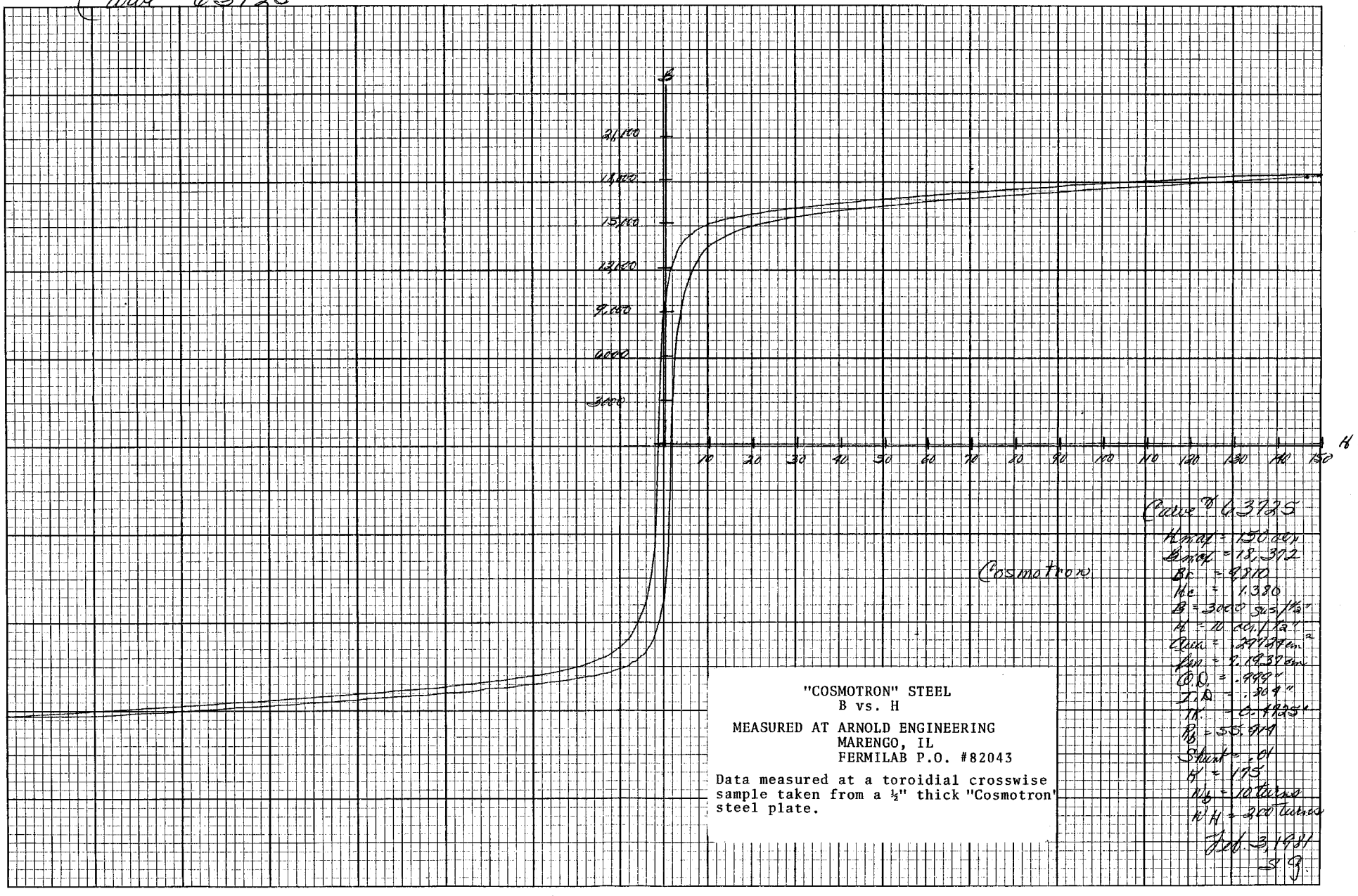
USS HOT ROLLED LOW CARBON STEEL PLATES
C1010 — OVER .250 INCHES
DC MAGNETIZATION

X Cosmotron C1010 steel plotted from curves #63725 and #63851



Test Conditions: Lengthwise samples tested in Fahy Permeameter.

Curve # 63725



"COSMOTRON" STEEL
B vs. H

MEASURED AT ARNOLD ENGINEERING
MARENGO, IL
FERMILAB P.O. #82043

Data measured at a toroidial crosswise sample taken from a ½" thick "Cosmotron" steel plate.

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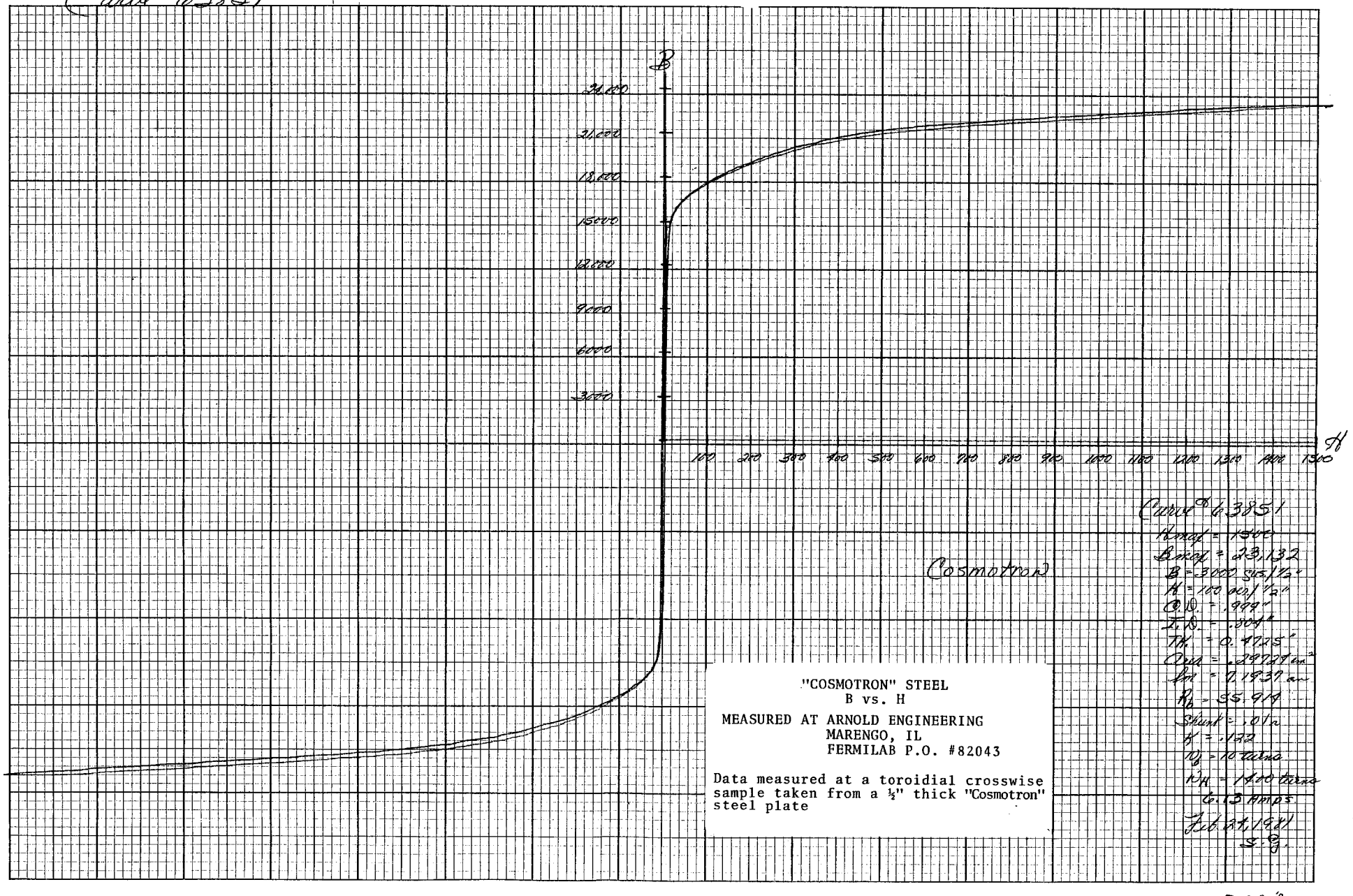
Curve # 63851



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