Parameters of soviet electrical steel.

Eugene V. Karpov

In this article are mentioned the experimentally taken magnetic parameters of the wide-spread types of silicon steel.

All the lovers of lamp technique sooner or later begin to deal with the matter of production of an output transformer.
There are enough of sensible design recommendations in the web, but it may be wise to have the characteristics of magnetic materials for a successful use of them. And there is a certain problem.
Generally, in classic manuals the characteristics of old and already not-produced materials are listed, and the information about modern materials is generalized and incomplete.
This emptiness is being filled in a peculiar way – by the speculations at the level of "pique jackets" and myth-making.

I hope this short publication will fill the lack of information more constructively.

What had been measured and how.

The material samples were the standard cores.
The 3408, 3413 (Э330), 3423 (Э360) steel types do not raise doubts, the new cores, used for the trial, were extracted from the factory package. But the possibility of 3411(Э310) steel being tested is approximately 95%.
Actually, a pair of transformers TC-180-2 was taken from the heap, and cores were derived from them.
It is that steel type which is mentioned in Technical Conditions for these transformers; besides, the review of the parameters of core losses in strong fields approximately matched the characteristics of 3411 steel type.
Actually, the steel type of these cores is rather academic in nature; their accessibility is more important for the amateurs.
The tape thickness of the cores is 0.08 mm (with 3408, 3423 steel types) and 0.35 mm (with 3413, 3411 steel types).
All the cores were made during the period between 1970 and 1980.

A trial coil with a number of turns depending on the average length of magnetic line (to achieve the desired field strength at the fixed maximum value of the driving voltage) was put upon the core.

The measuring of the parameters of basic magnetization curve was performed on the unit similar to the one described by Tsykin.
Balance was monitored by selective voltmeter, and the bridge was excited by a powerful transistor amp with its own level of distortion does not exceed 0.05% and the small output resistance.
Nonlinearity of the magnetizing current was controlled by a spectrum analyzer on low-resistance shunt, connected in series with the trial winding. The relative value of the current of harmonics was being calculated by the following formula:

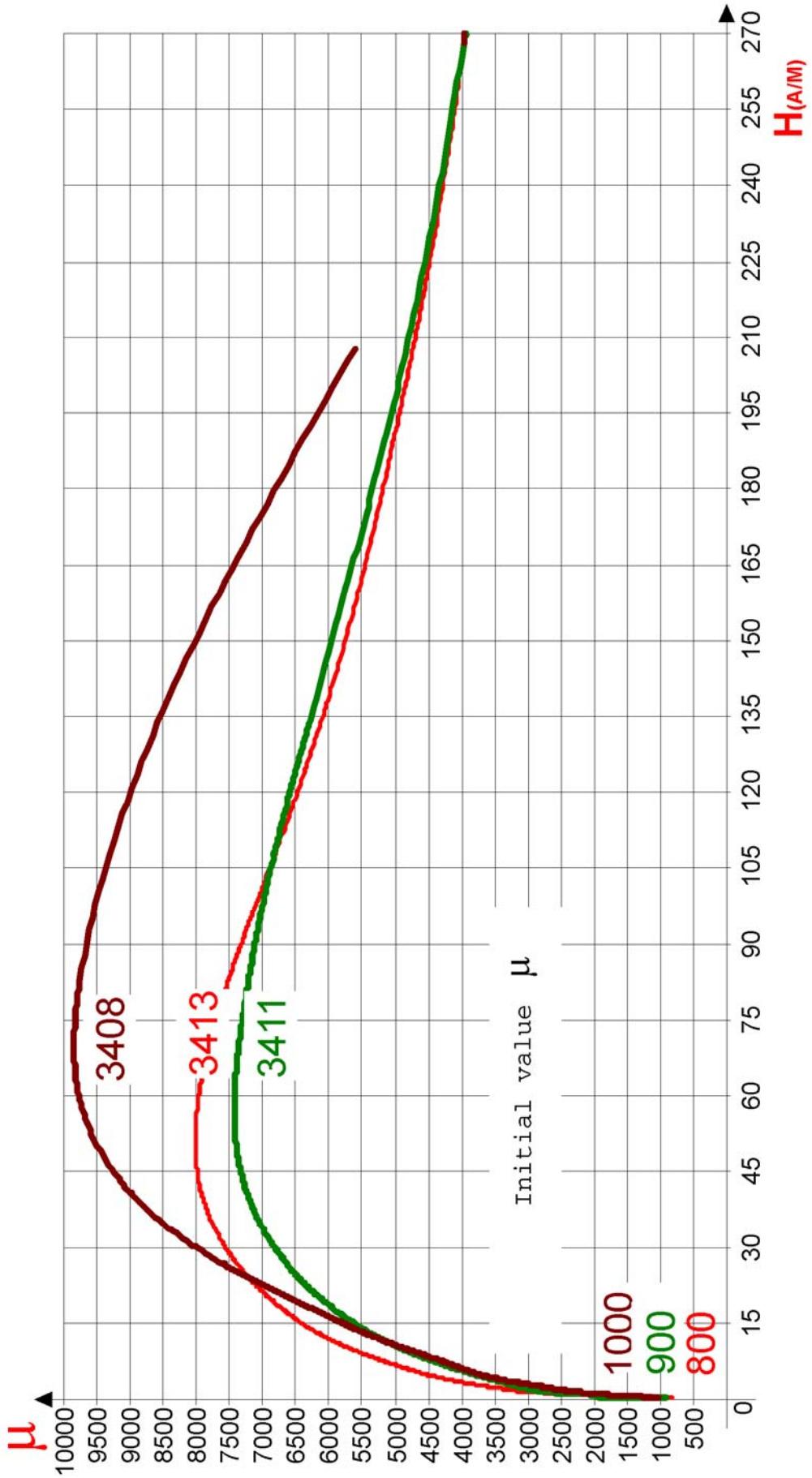
$$\mathrm{Kn} = 20 \cdot \log \frac{\mathrm{In}}{\mathrm{I1}} (dB),$$

where: I1 – current of the first harmonic,
In – current of the n-th harmonic.

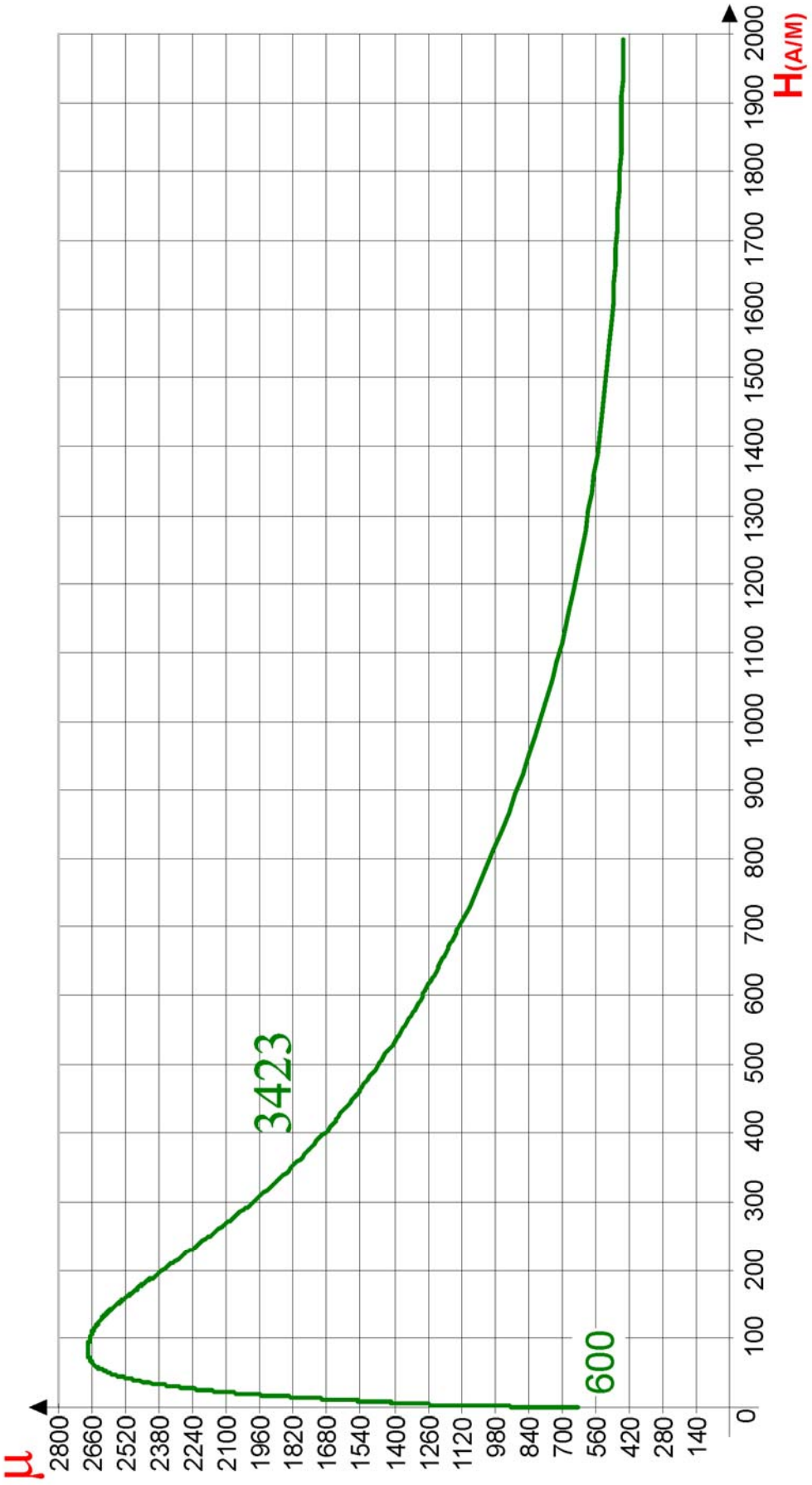
The test was conducted several times and for multiple cores. Amazingly, the parameter spread between different cores turned out to be quite small; possibly this is because the cores were from the same run and taken from the same crate. All the measurements were taken at the frequency of 30 Hz at bipolar magnification of material. Before each of the trials the core was demagnetized

The averaged results of the measurements are given below, in the form of the graphs.

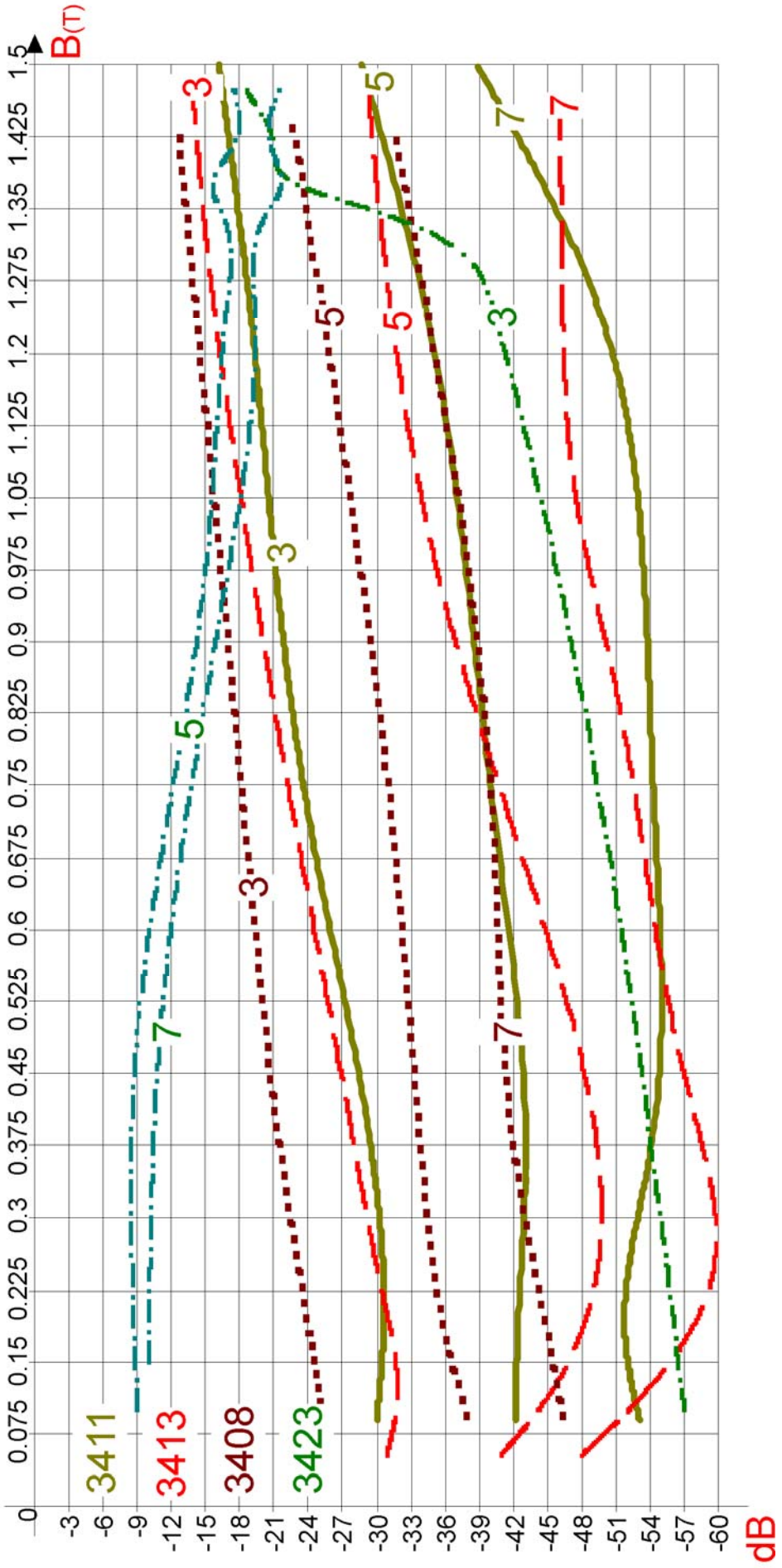
Normal magnetization curves



Apparent permeability dependence on magnetic force



Apparent permeability dependence on magnetic force



Harmonic level dependence on magnetic induction value