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Report of Referee C -- LG18284/Hirsch

In this well written and clearly organized paper, the author analyzes what happens in a cylindrical type-I superconductor in an external magnetic field when the temperature changes. Based on thermodynamic considerations he concludes that no entropy production should take place inside the sample during the process. On the other hand, from an analysis of the process within the two-fluid model he finds that the conventional theory does predict a finite amount of dissipation. Therefore he concludes that the conventional theory of superconductivity is incomplete.

In view of the potentially far-reaching consequences of these findings it therefore seems appropriate to carefully check all possible flaws of the presented reasoning. Previous referee reports have criticized the simplistic approach taken by the author. This is certainly a valid point. However, no hint has been given as to what physics may be missing and I find that the author's response to this criticism makes sense.

Nevertheless, even within the present context of the two-fluid model (with the condensate described by the London equations) the analysis can and should be taken one step further. My point is that the entropy production should contain not only the Joule-heat term, but definitely also a (grad T)^2 term due to the heat flow, and perhaps also other terms due to thermoelectric effects and condensate flow. The (grad T)^2 term is present also in the simplest problem of heat transfer between a sample and a reservoir and it does contribute to the equilibrium entropy increase in that case. For this reason it could happen that small changes of the (grad T)^2 contribution (caused by superconductivity) compensate the Joule heat term.

A more careful study should therefore combine a time- and position-dependent temperature field T(t,r) with a wave-like equation for the EM field with a prescribed profile of lambda(t,r) which is consistent with T(t,r). Such an approach would, inter alia, correct the unphysical space-time behavior of the Faraday field E(t,r).

In conclusion, the manuscript should not be published in its present form. In order to make the paper publishable, the author should make a more complete study of entropy production, including the (grad T)^2 term.