1. (40 points) The figure shows the E-I stamping for a transformer core which is made by laminating and interleaving the shapes shown (alternating E-I and I-E) with a total of ninety-six each of the E and I shapes. The thickness of each lamination is 0.625 mm and the gap between the E and I part is 0.5 mm. The material has a relative permeability of 1500. The transformer steps down 120 V RMS to 68 VRMS and is designed for 60 Hz.

(a) Find the maximum flux that can be used in the transformer core.
(b) From this, derive the minimum number of turns required to avoid saturation of the iron on the primary.
(c) From the wire gauge tables, find the largest diameter wire which can be used in the primary, allowing half the area of the open region to be used for this purpose. Do the same for the secondary.
(d) Calculate the total $I^2R$ loss in both windings when the transformer is delivering $4 \text{ ARMS}$ to a load, and thus the efficiency of the unit as a whole at this nameplate rating.