Purpose: This work aims to quantify and minimize a dose calibration curve discrepancy observed for an a-Si flat panel megavoltage imager that occurs when the spectral quality of a lower energy (6 MV) beam is changed from that for an open field due to beam hardening.

Methods and Materials: This investigation considered a Varian aS500 EPID. In the first phase, Monte Carlo simulations modeled spectral changes to a generic 6 MV photon beam as it passed through different thicknesses of steel shot compensator material. A comprehensive model of the detector was also used to simulate the dose absorbed by the integral phosphor layer for the conventional detector configuration, and for configurations including an additional, external copper plate placed in direct contact with the EPID and elevated 154 cm above it. The second phase consisted of measuring EPID dose calibration curves in open and steel-shot attenuated beams for the various EPID configurations. The modulation transfer function (MTF) and the contrast-to-noise ratio (CNR) were also monitored for each configuration using a standard quality assurance phantom.

Results: The discrepancy between open and attenuated beam calibration curves was observed to be as much as 6% at 6 MV. To reduce the maximum discrepancy to < 4%, copper thicknesses of 1.0 cm or 0.3 cm were required in the contact and elevated configurations, respectively. Adding the copper reduced the CNR by 28% or 8%, respectively, and the MTF for a given spatial frequency by 38 ± 1% or 13 ± 1%, respectively.

Conclusion: Beam hardening can cause significant dosimetric discrepancies for a-Si EPIDs calibrated in open fields. Addition of an external copper plate can substantially reduce the discrepancy, but at a cost of reduced image quality.