Purpose: A new Canadian primary standard for high dose rate (HDR) brachytherapy calibrations has been developed, offering improved accuracy through the use of a Pb wedge to determine the scatter component k_{sc} at each measurement position.

Methods: The new HDR standard calibrates ¹⁹²Ir brachytherapy sources in terms of air-kerma strength (S_K). An HDR brachytherapy calibration rig was manufactured and commissioned. This rig utilizes a low (0.5 m) aluminum table to which is mounted a motorized single-axis linear stage. An afterloader feeds an ¹⁹²Ir source vertically up through a fixed 1 m tall PMMA tube column attached to the table. A second 1 m PMMA tube column is attached to a movable carriage on the linear stage and supports a spherical graphite ionization chamber. A series of 10 measurements are made with the source-to-detector distance varying from 10 cm to 55 cm in 5 cm increments. The largest correction factor, k_{sc} (scatter from the stage, walls, floor and ceiling) is determined using a Pb-wedge technique to block the direct beam and allow a direct measurement of scatter at each distance. The small distance correction is then a simple matter to determine, allowing a more accurate determination of the source strength based on distance squared.

Results: : Measurements with a Pb-wedge technique for determining k_{sc} demonstrated that the scatter component for each position varied, in contradiction to the constant-scatter supposition of the alternative 7-distance measurement calculation. These measurements were supported by EGSnrc Monte Carlo simulations. The disagreement between these two techniques for determining k_{sc} represent an (S_K) difference of approximately 0.4%.

Conclusions: The new HDR brachytherapy calibration capability demonstrates higher accuracy through a more accurate scatter correction. This standard will participate in a formal international comparison for HDR brachytherapy, tentatively scheduled for 2011.