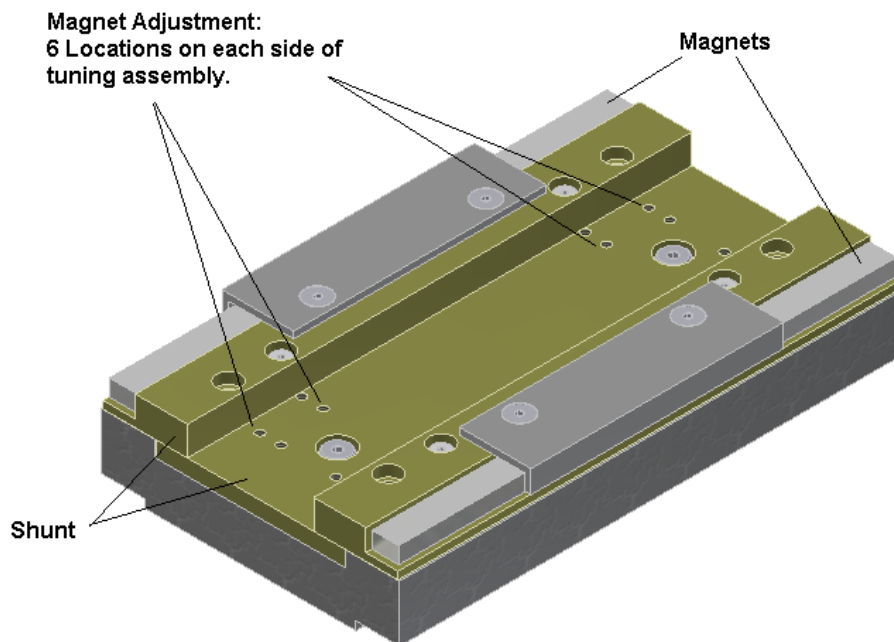


ASI-HLK –Replacement Magnetron Uniformity Tuning with the Installed Magnetic Tuning Assembly

Although Angstrom Sciences selects and groups magnets to achieve tolerances as tight as +/-1%, this alone does not guarantee produced thin film uniformity. Gas flow dynamics (distribution, pumping) anodes (location and symmetry), targets (grain size), and cathode orientation (tilt along both axis in reference to the substrate) are all major contributors to the final product. Often these issues are not found just within different coating systems, but can be within each system from coat zone to coat zone. Angstrom Sciences has installed a method to tune each magnetron relative to its location, so that the desired thin film uniformity can be achieved. Once tuned, it has been found that the magnetron will maintain the produced uniformity for the duration of target life.

(NOTE: Moving the magnetron, once tuned for a specific location, may require the magnetron to be further optimized for the new position.)

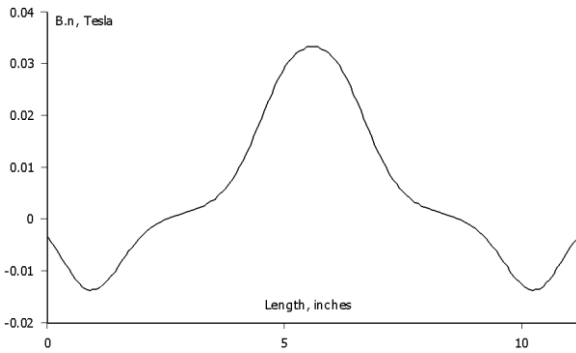
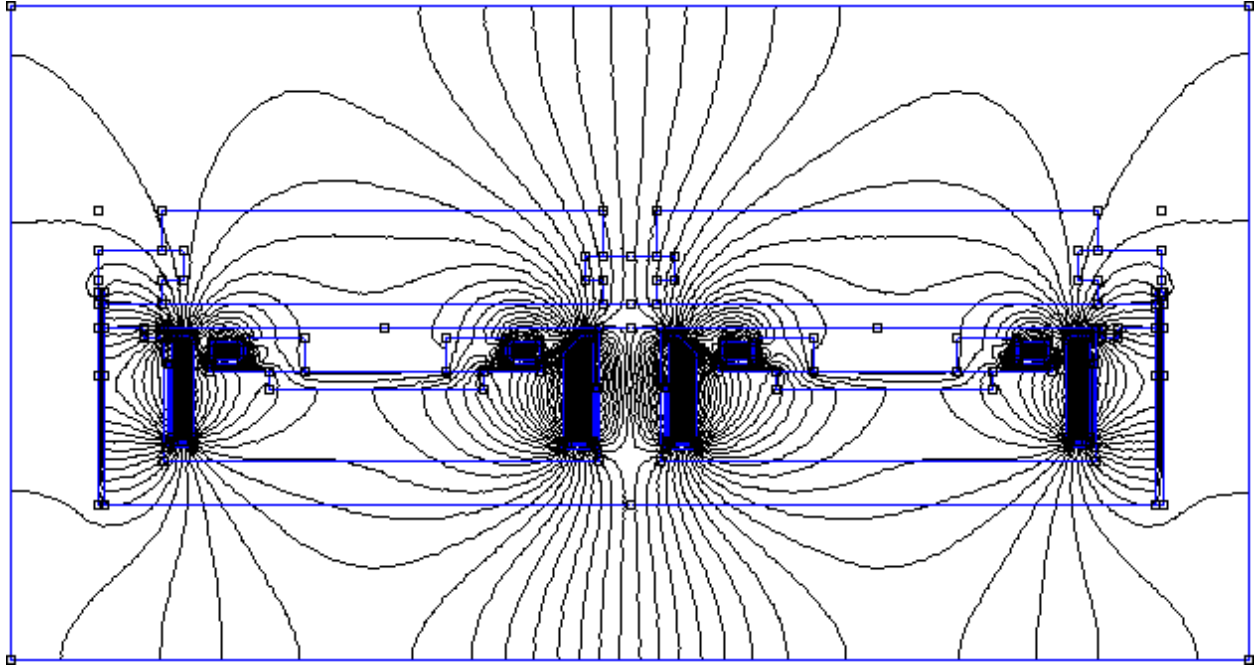
The ASI-HLK magnetron is designed with a secondary (tuning) set of magnets installed between the primary magnets, running the length of the magnetron, on each side of the cathode. The tuning magnets are assembled in modules, each 6" in length. The initial position of the tuning magnets is the intermediate position and they can then be adjusted in / out depending on your tuning profile needs. It has been found that uniformity variations as high as +/-10% can be tuned out and stabilized to better than +/-2% over target life.



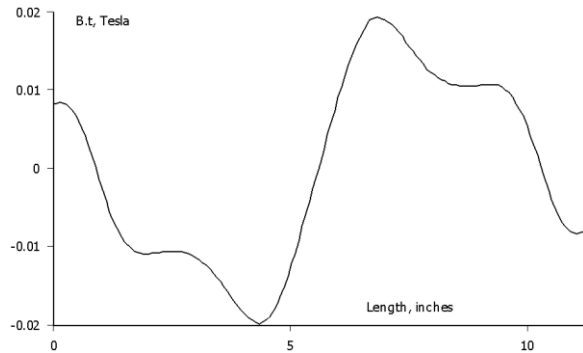
The following pages show the effects on the magnetic field relative to changes to the tuning magnetics as well as an example of changes to the produced thin film in a typical system.

Tuning Magnet Assembly - Fully Extended

(Provides a "broad" racetrack = Higher Target Utilization, lower deposition rate)



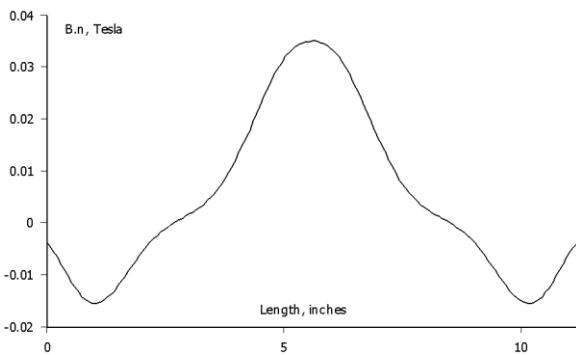
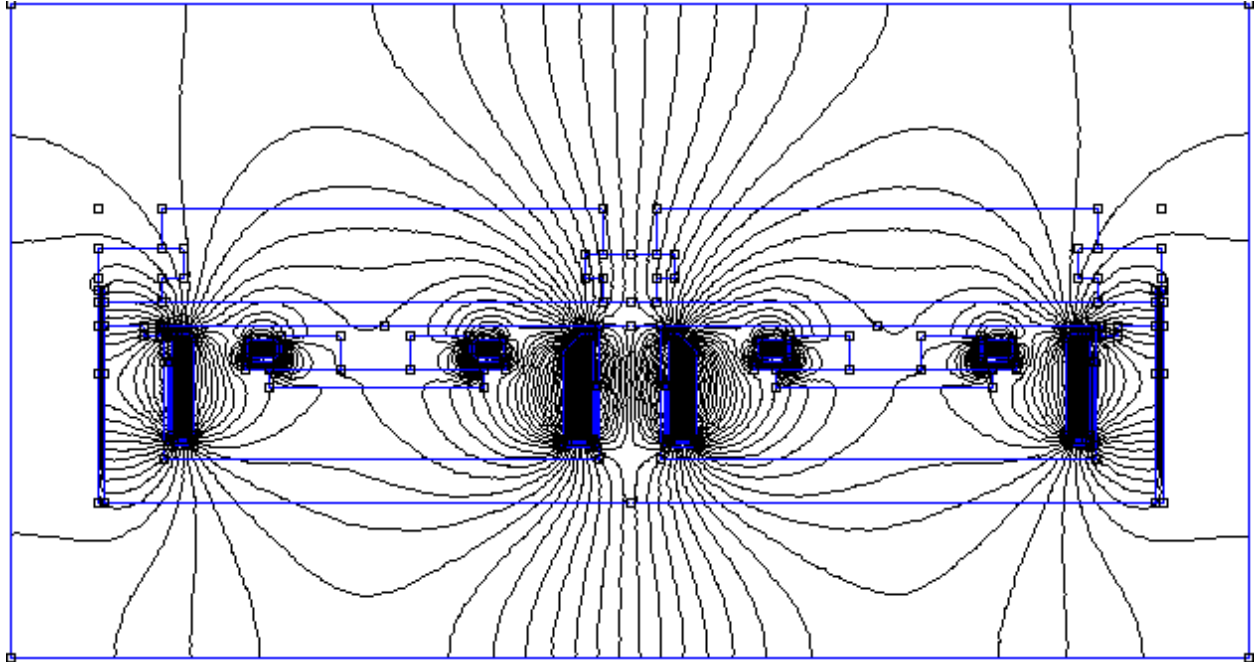
"Normal" Magnetic Field
(Fully Extended Shunts)



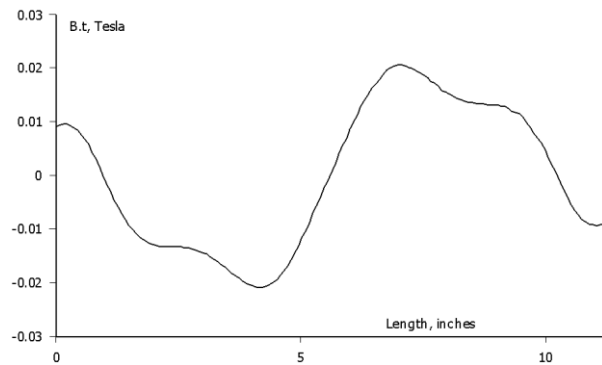
"Tangential" Magnetic Field
(Fully Extended Shunts)

Tuning Magnet Assembly Intermediate Position

(Provides “moderate” racetrack = Less Target Utilization, higher deposition rate)



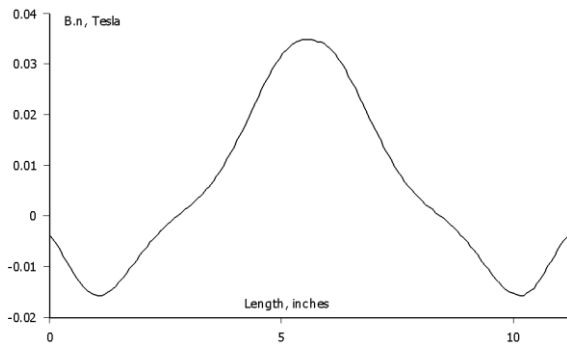
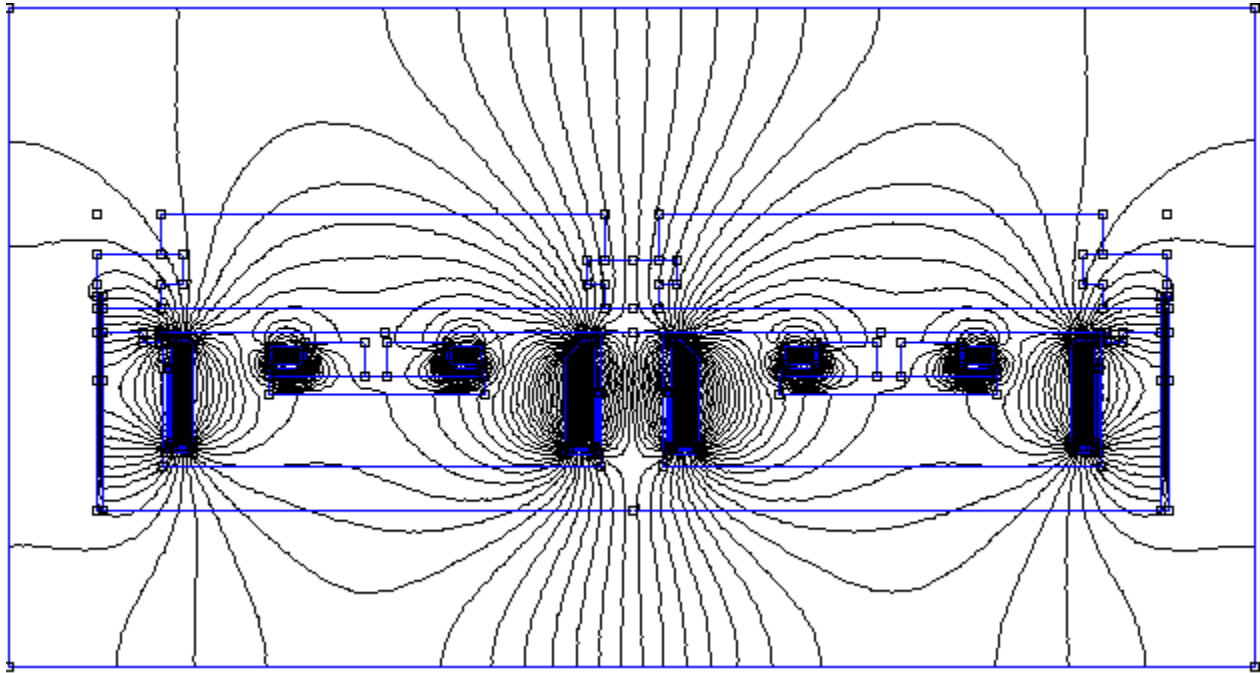
“Normal” Magnetic Field
(Intermediate Shunt Position)



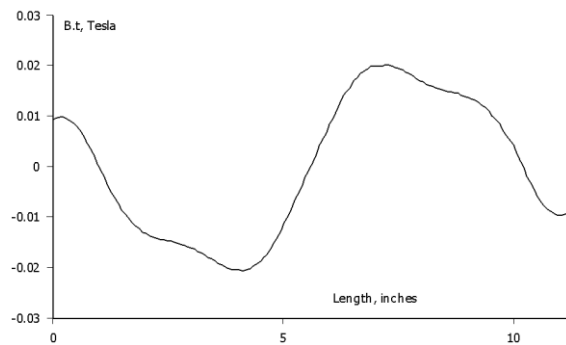
“Tangential” Magnetic Field
(Intermediate Shunt Position)

Tuning Magnet Assembly Fully Retracted

(Provides a “narrow” racetrack = Lower Target Utilization, higher deposition rate)



“Normal” Magnetic Field
(Retracted Shunt Position)



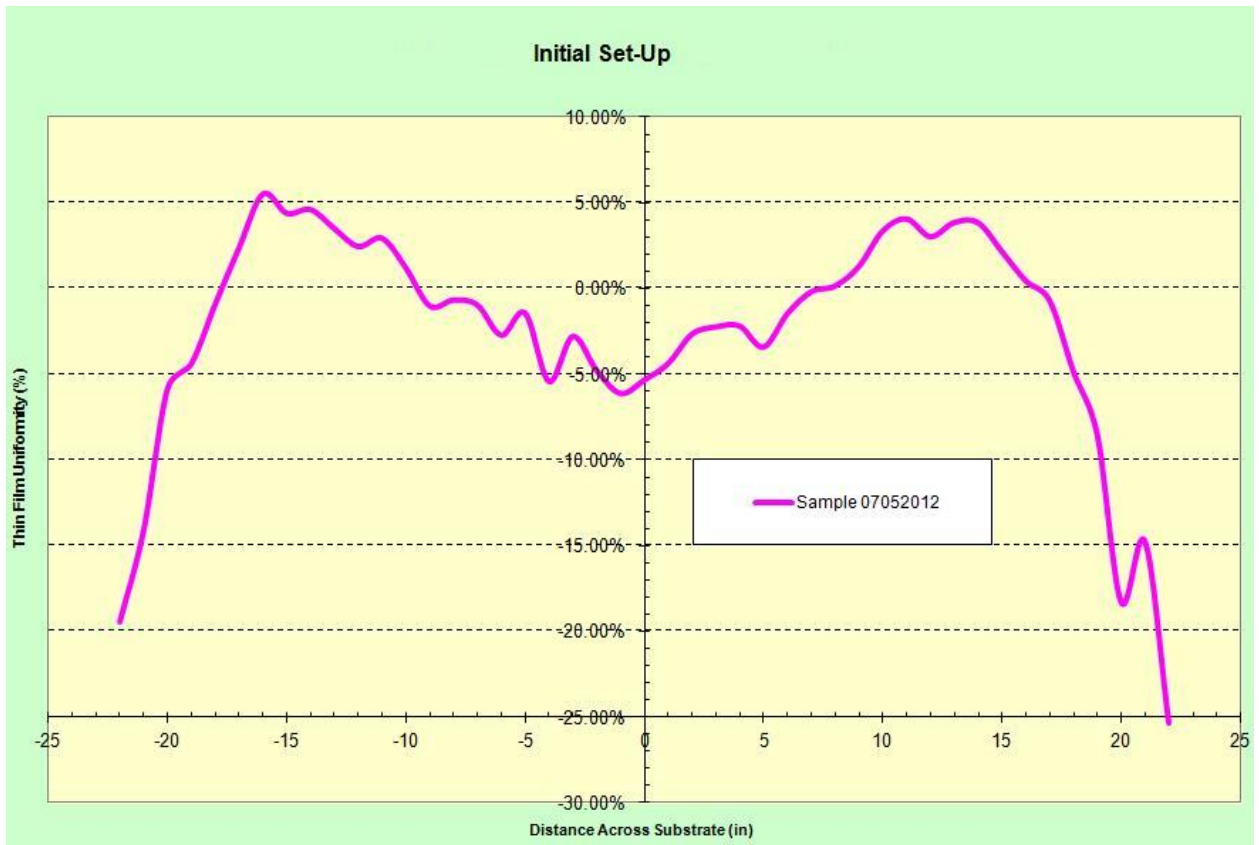
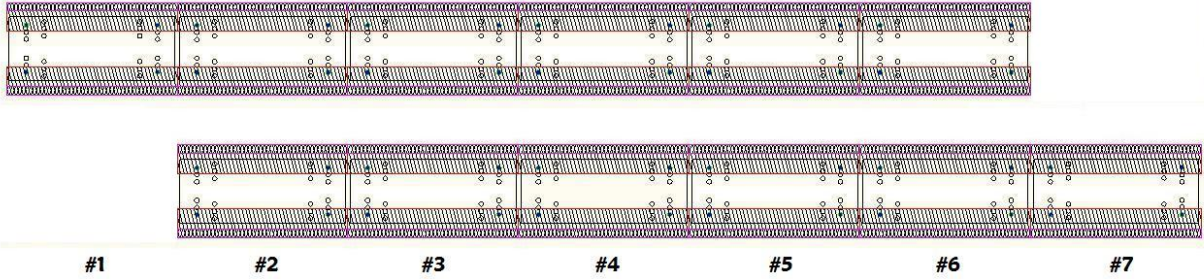
“Tangential” Magnetic Field
(Retracted Shunt Position)

Tuning Example: Effects of Shunt Adjustment on Produced Thin Film Uniformity

Initial Set-Up – (1m Substrate width 1.5m cathode length):

All tuning magnets set to a common position

Results: $\sim\pm 5\%$ Thin Film Uniformity



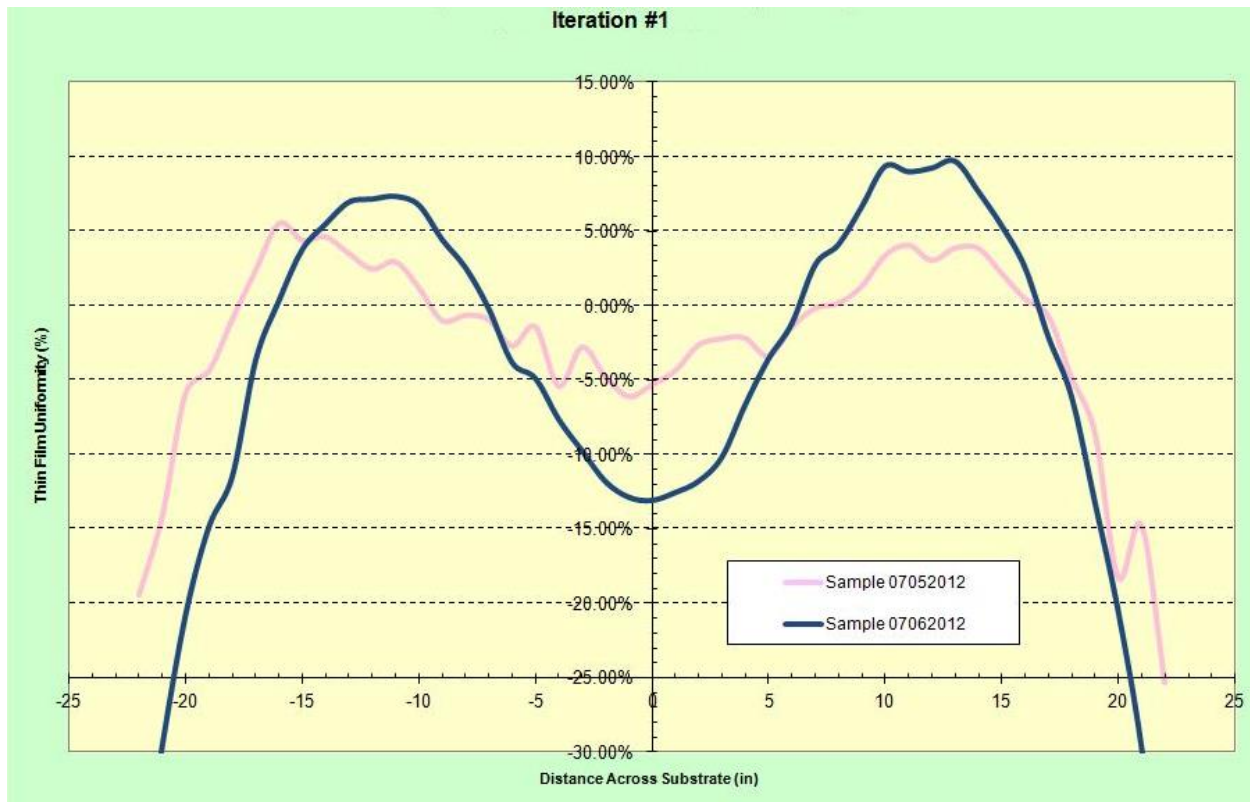
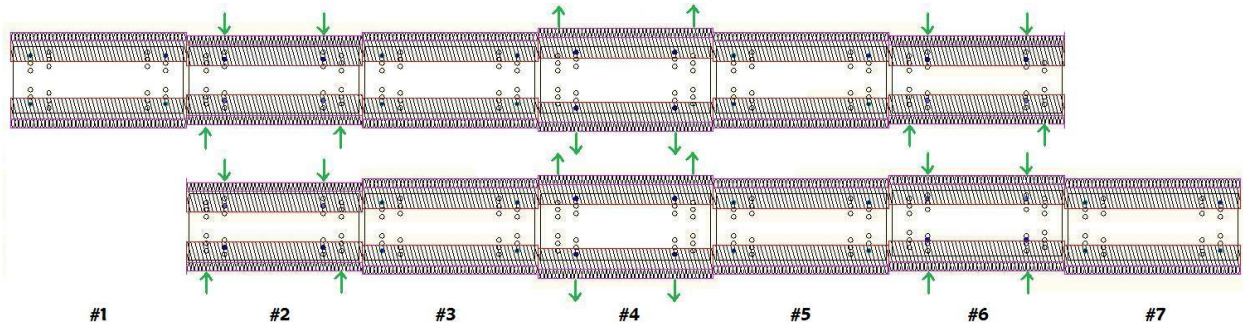
Tuning Example – Iteration #1: Effects of Shunt Adjustment on Produced Thin Film Uniformity

For the first iteration, effects of changing the magnets in the **WRONG** direction are shown. In this case the uniformity will get worse than the initial profile.

Change: Move tuning magnets closer together where the thin film is “thicker” and move tuning magnets apart where the thin film is thinner.

Note: The green arrows indicate that the tuning magnets were moved. If the arrows are found only on one side of the tuning magnets, then only that side of the tuning magnet assembly was adjusted.

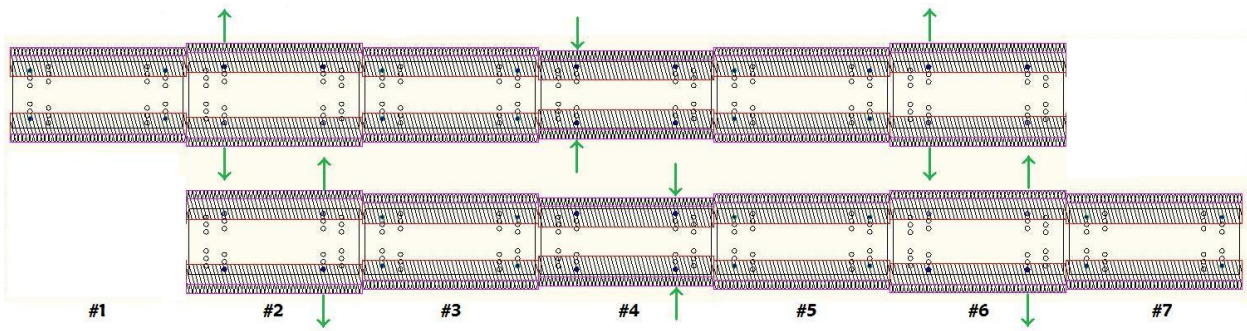
Result: Uniformity moved to +/- 12%



Tuning Example – Iteration #2: Effects of Shunt Adjustment on Produced Thin Film Uniformity

Change: Adjust tuning magnets “in” to increase deposition rate in the locations where the film is too thin, and, adjust tuning magnets “out” to decrease deposition rate in the locations where the thin film is thick.

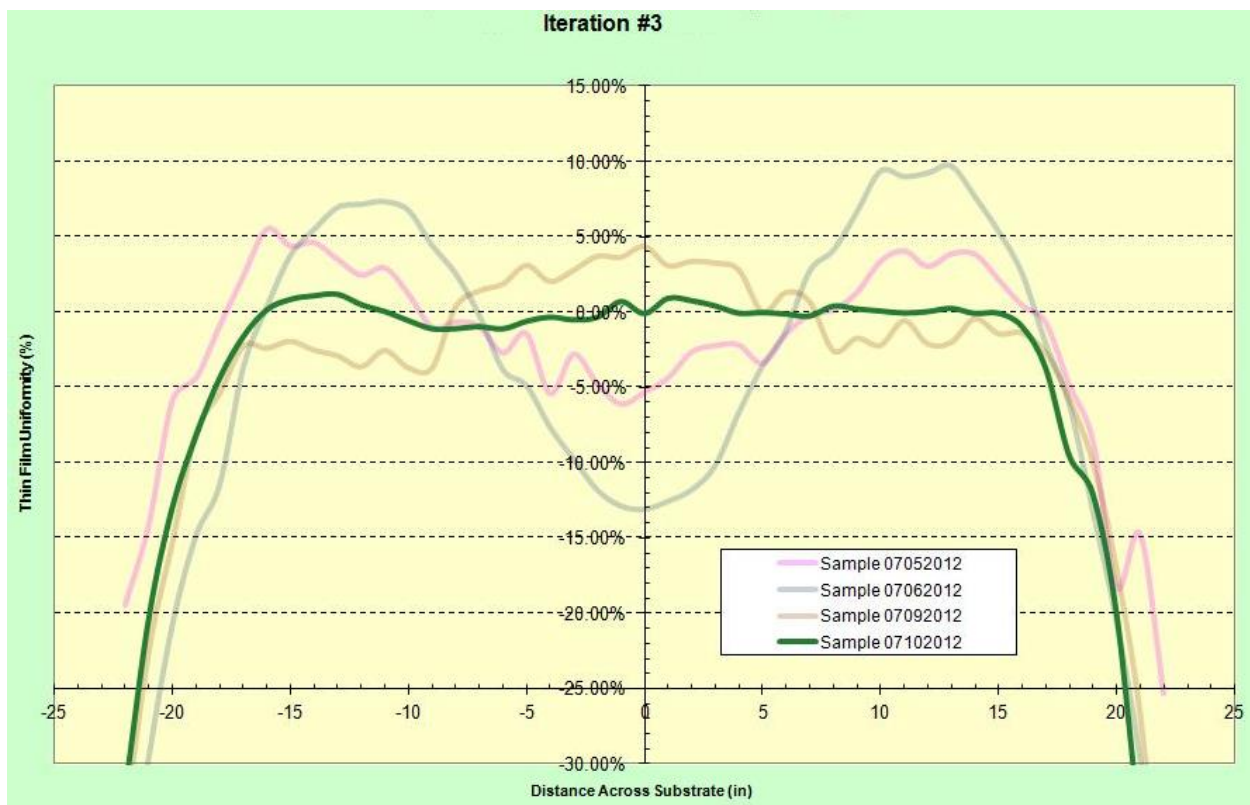
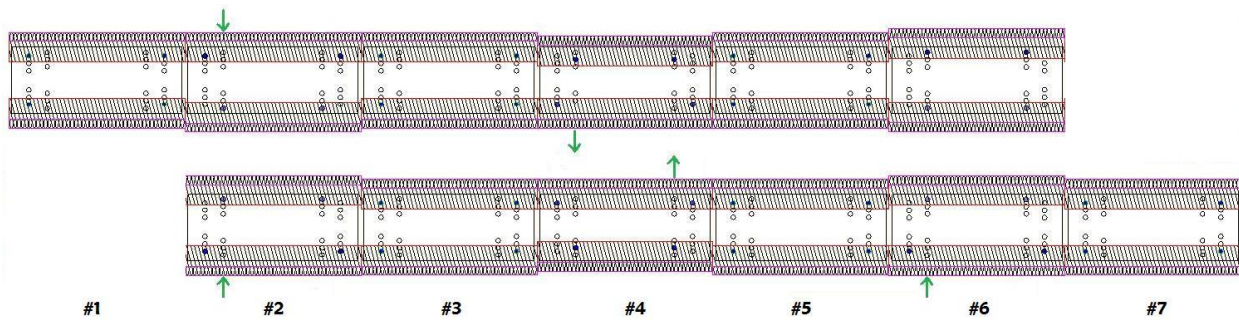
Result: Uniformity improved to +/- 4%



Tuning Example – Iteration #3: Effects of Shunt Adjustment on Produced Thin Film Uniformity

Change: Final Adjustment - Adjust tuning magnets “in” to increase deposition rate in the locations where the film is too thin, and, adjust tuning magnets “out” to decrease deposition rate in the locations where the thin film is thick. For fine adjustments, only 1 side of the tuning magnet is adjusted.

Result: Uniformity improve to +/- 1.5%



Although not done for this example, the user might want to make 1 more adjustment to achieve better than +/-1%. In this case, move only 1 tuning magnet in position #2, by 1 hole OUT.