SPUTTERING COMPONENTS®

Unbalanced TRM

Why is an unbalanced cathode required?

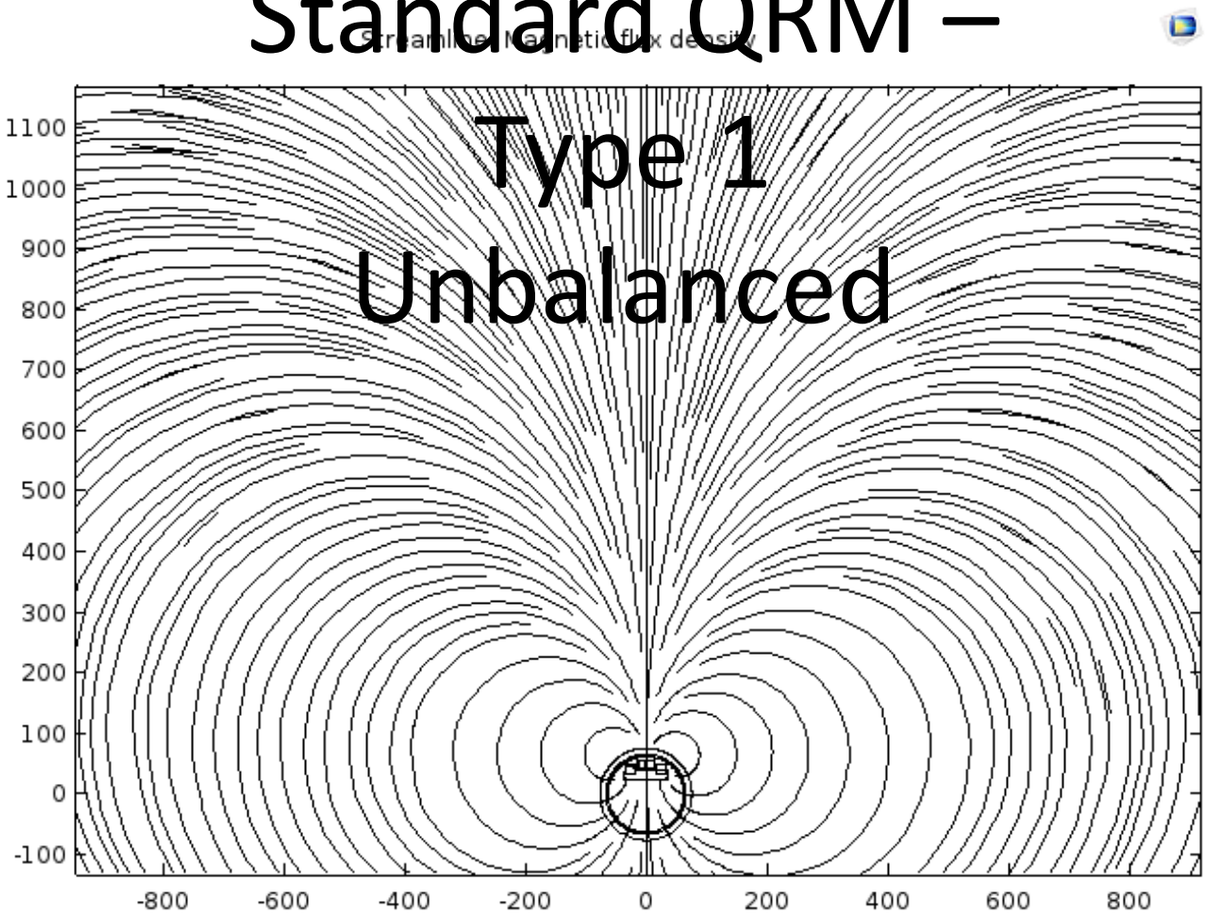
- Unbalanced cathodes essentially corral electrons coming out of the primary plasma confinement and force them into a column that is directed toward the substrate.
- If all of the electron current is flowing through a set cross sectional area the chance of creating more ions outside the primary confinement area greatly increases.
- The extra ion creation creates a beam of plasma extending from the target to the substrates and customers such as Duralar negatively bias their substrates to attract these ions.

TRM-Bar™ for ITO Targets

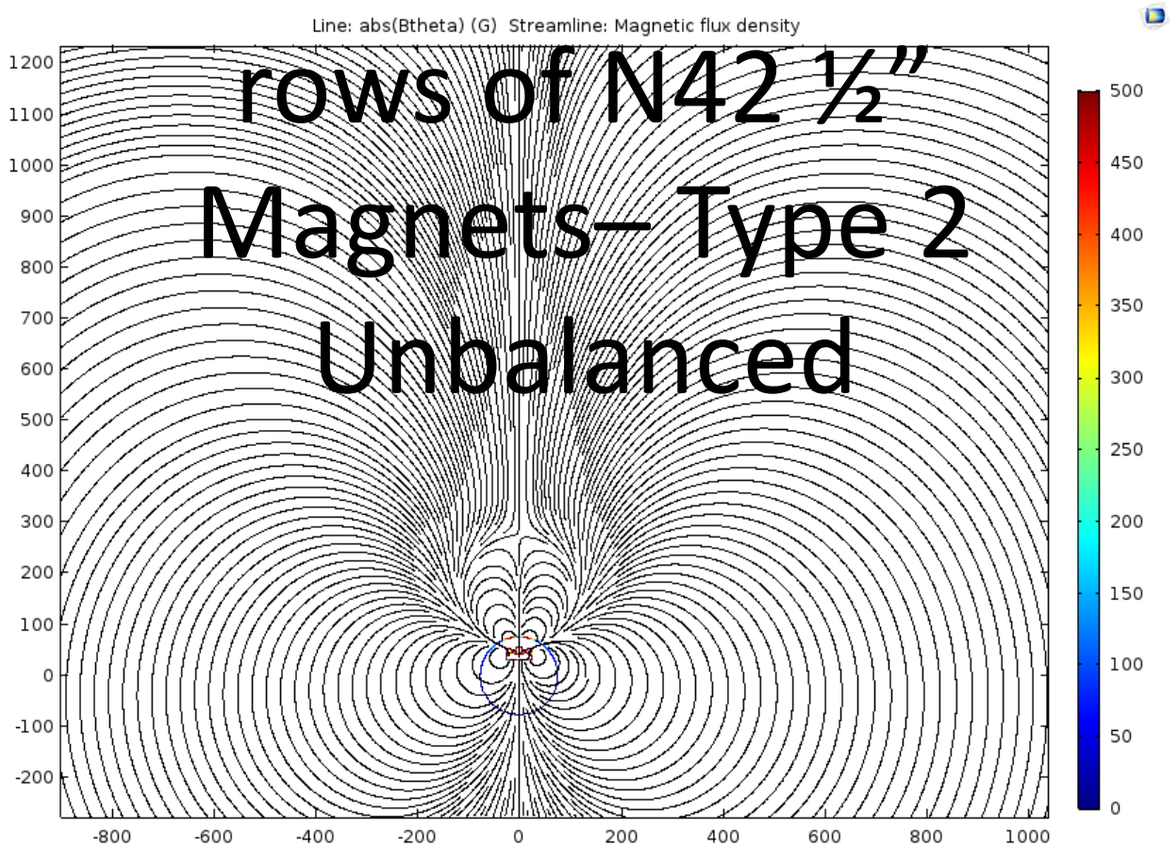
- It is believed lowering the sheet resistance of ITO film can be achieved by decreasing the sputtering angle of incidence
- The level of unbalance in a magnet bar directly impacts the sputter angle
- A type 2 unbalanced TRM magnet bar will offer a low sputter angle, strongest magnetic field, and the lowest plasma impedance that should decrease the resistivity of ITO film

Levels of Balance

Standard QRM – Type 1 Unbalanced



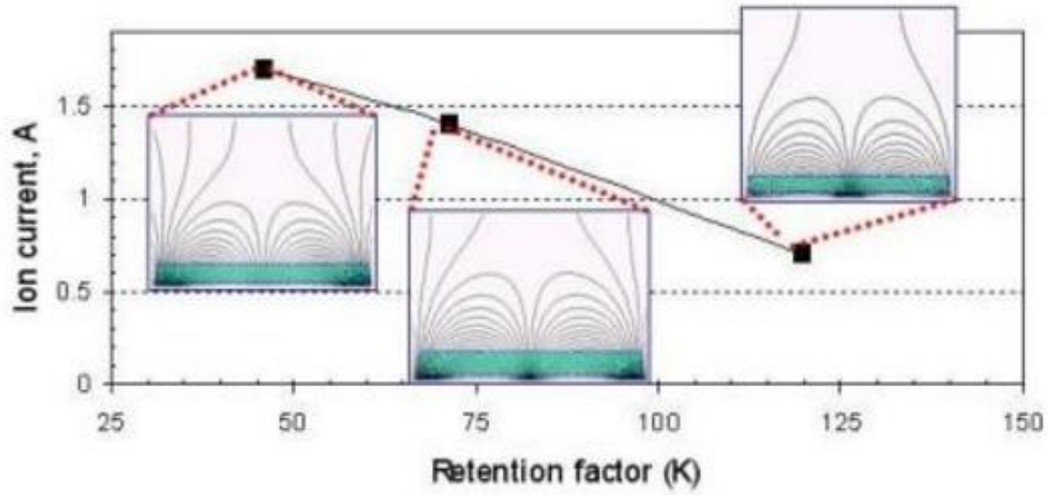
UTRM – Three rows of N42 ½” Magnets– Type 2 Unbalanced



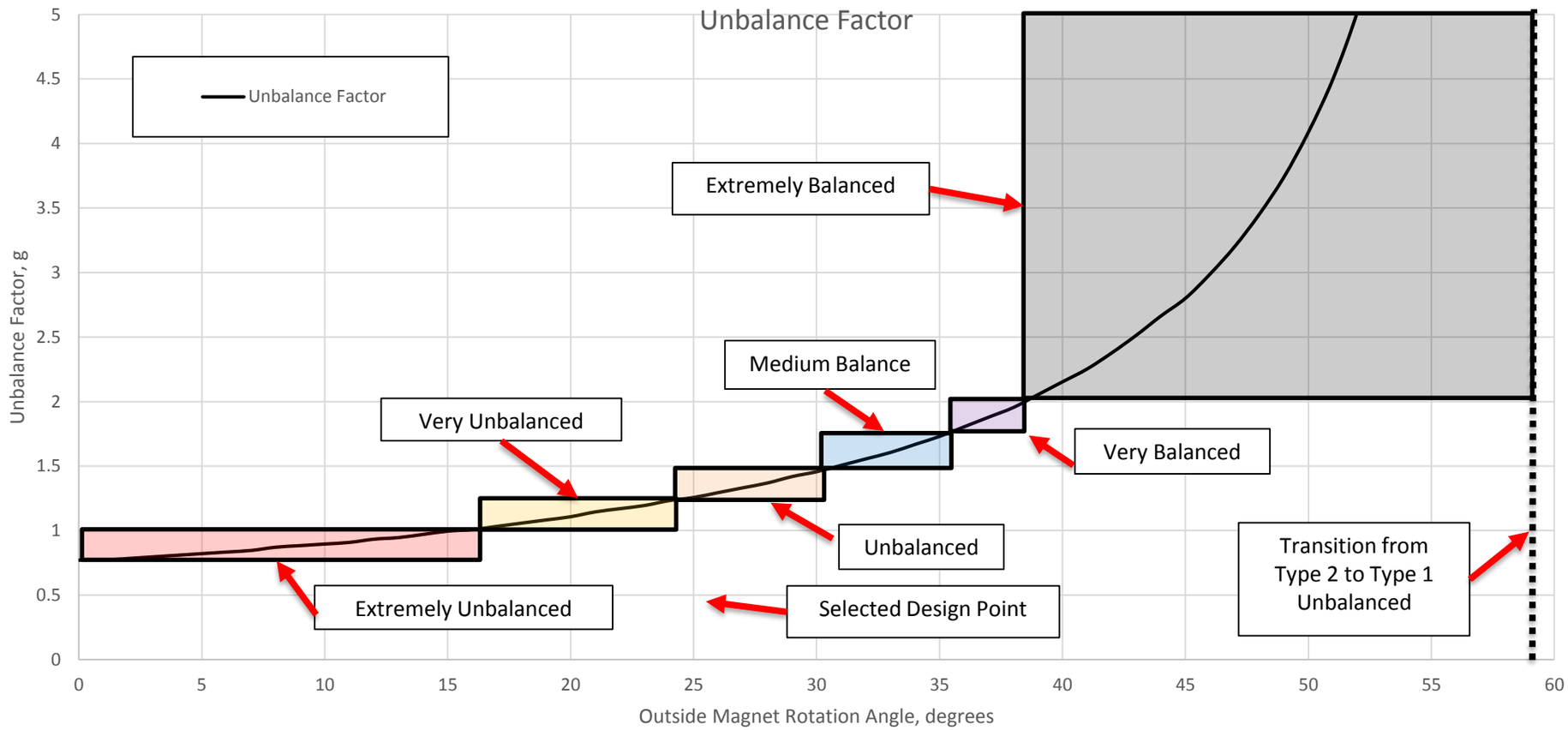
How does unbalance factor affect the customer's process

- Customer's need ion current on their substrates to achieve the film density and hardness specifications that their applications require

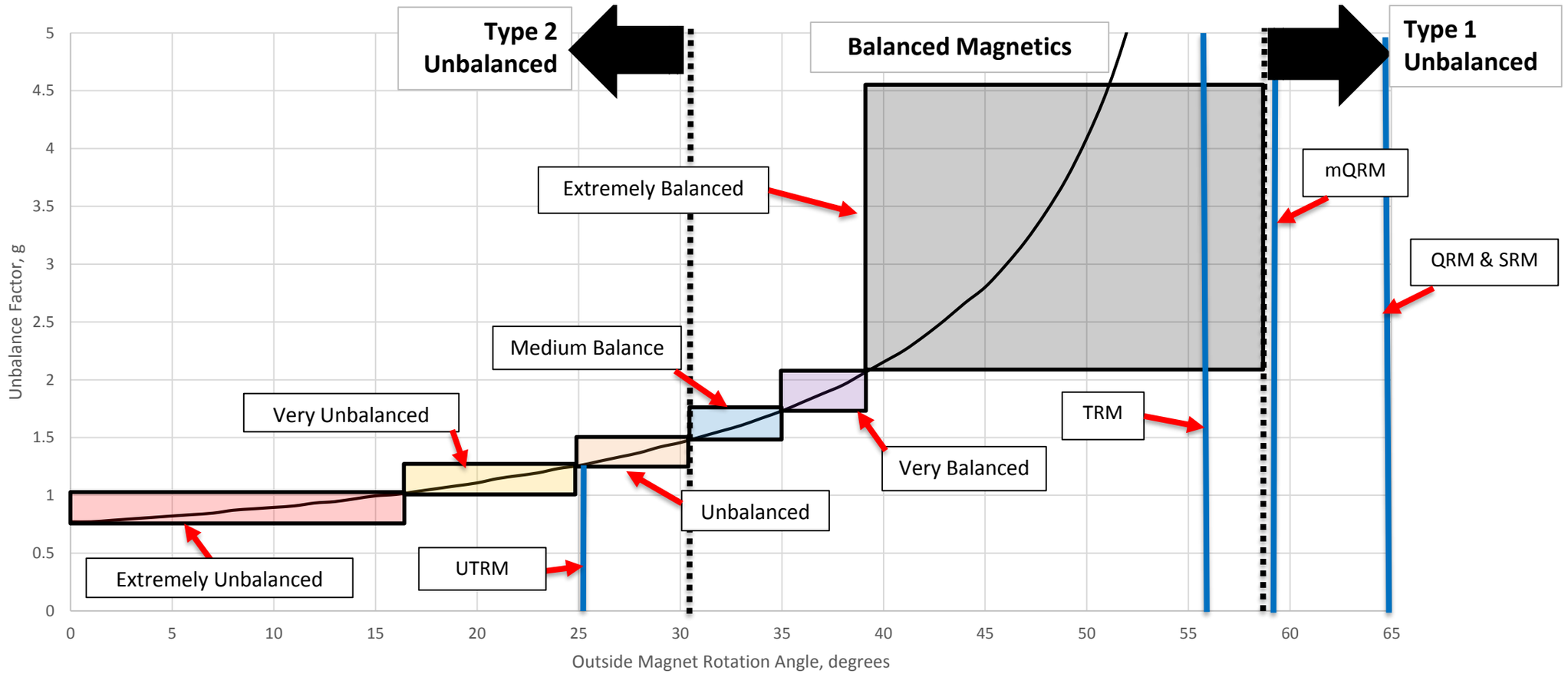
Group Number	Group Description	K factor (typical)	$g=Z_{Bz=0}/W_{1/2}$
I	Extremely balanced	200	g≥2.00
II	Very balanced	150	1.75≤ g <2.00
III	Medium balanced	125	1.50≤ g <1.75
IV	Unbalanced	100	1.25≤ g <1.50
V	Very unbalanced	60	1.00≤ g <1.25
VI	Extremely unbalanced	40	g<1.00



All cathodes measured on a balance factor scale



SCI magnet bars plotted on a magnetic unbalance factor scale



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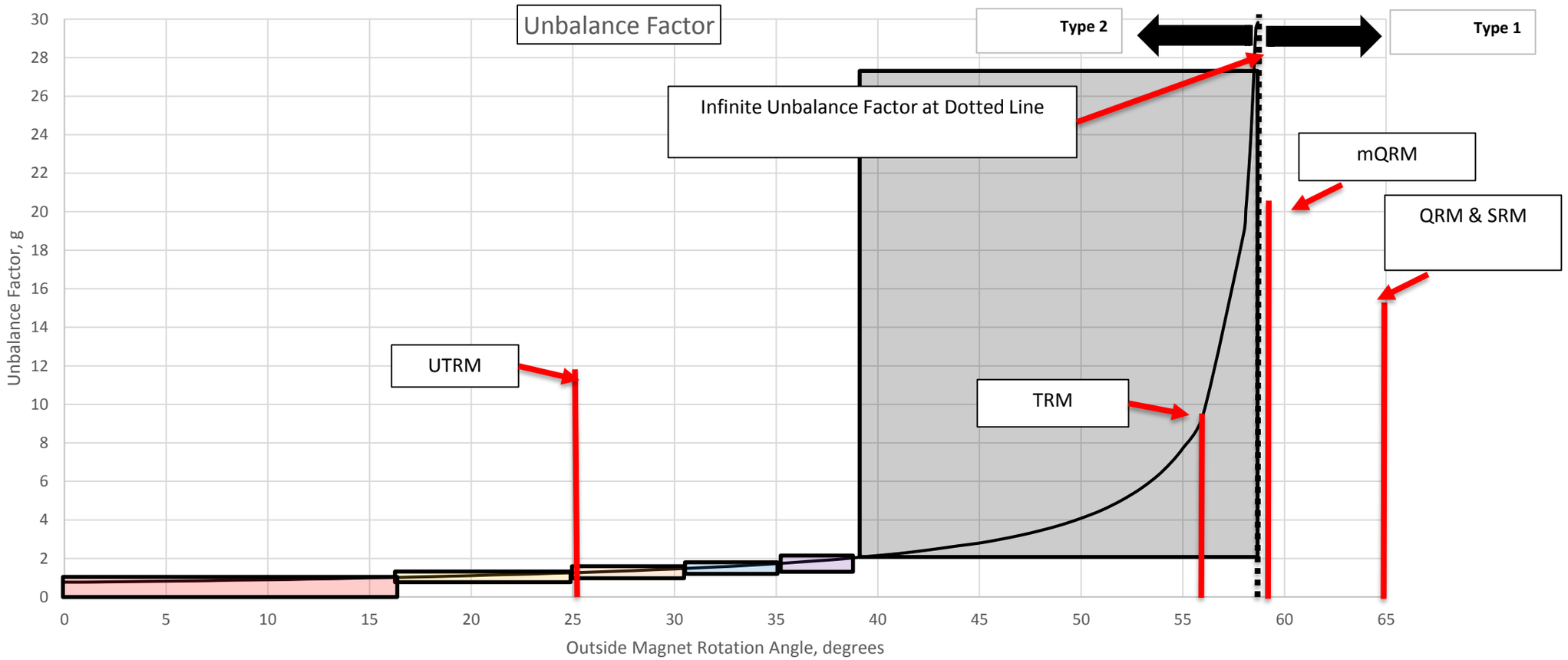
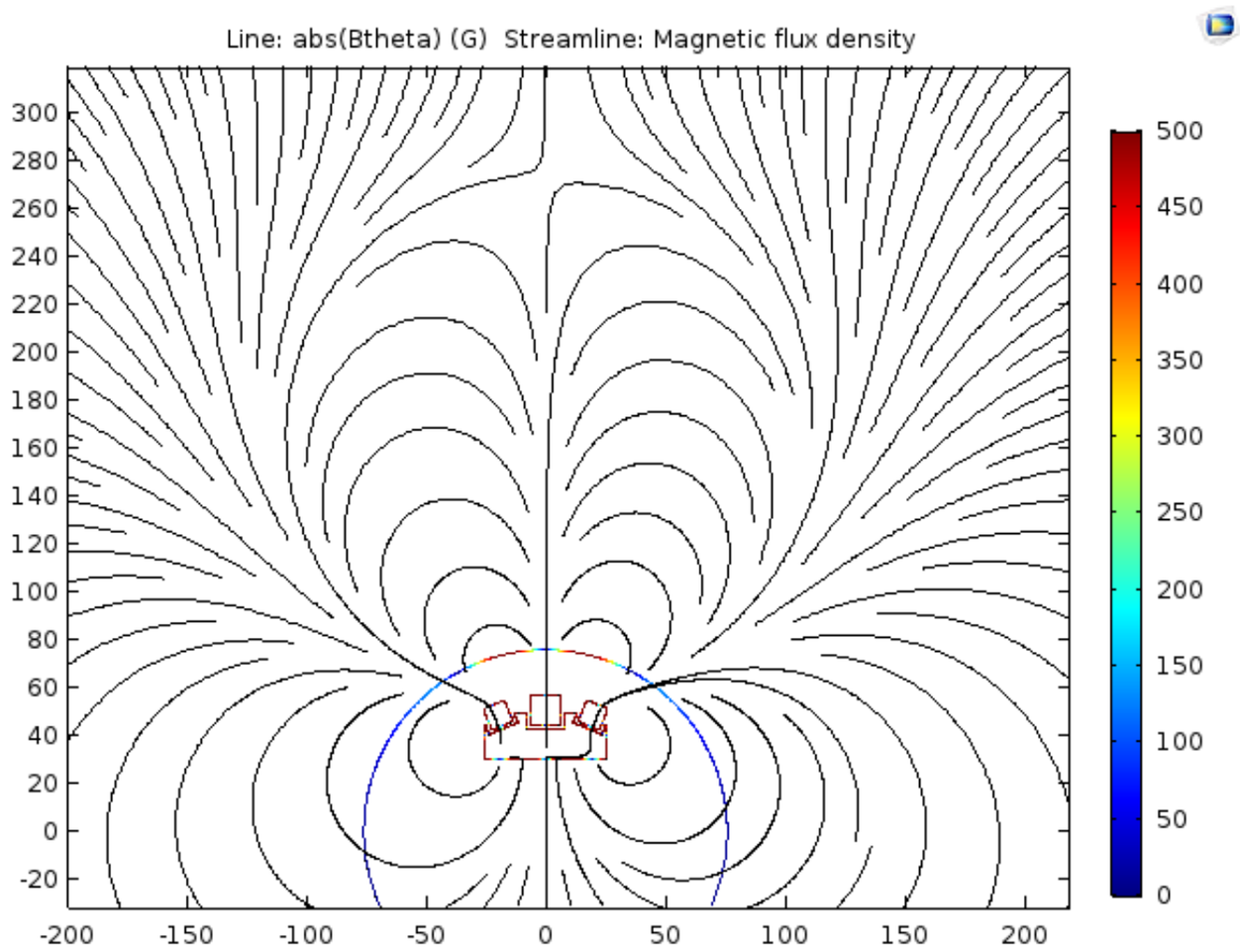
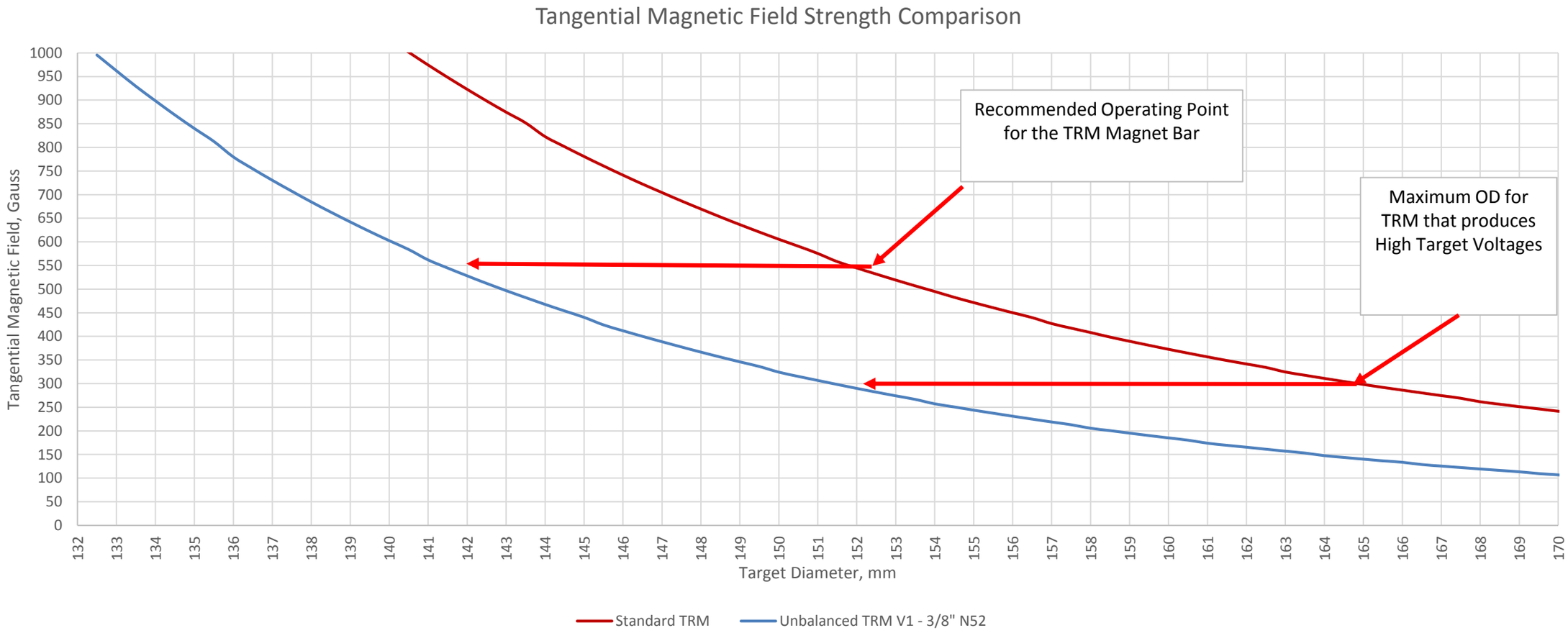


Initial Unbalanced Magnet Bar Design

- Standard TRM pole piece
- N52 3/8” magnets on outside rows
- 416 Stainless Steel Block for center row
- 300 gauss at 152 mm OD
- 550 gauss at 142 mm OD

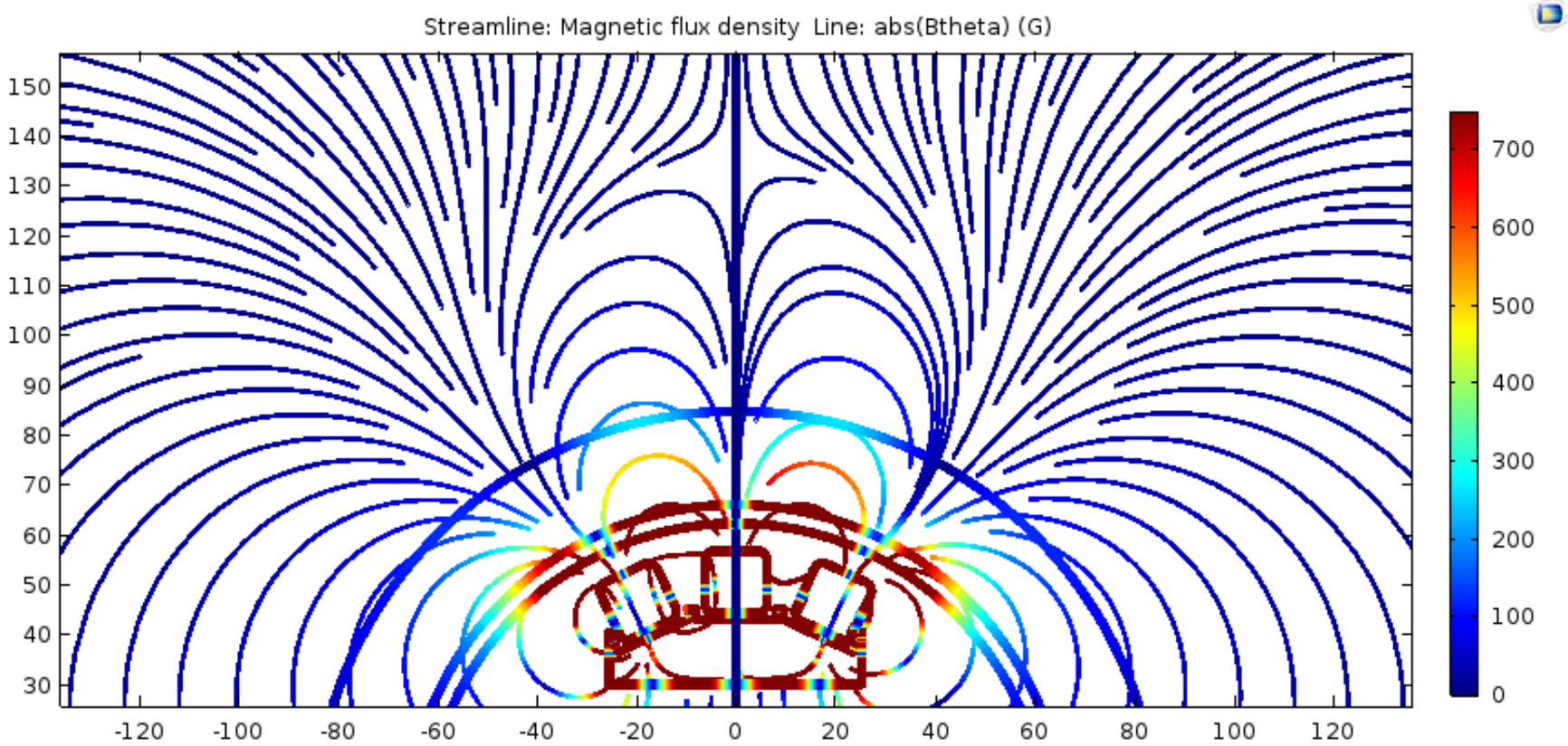


Initial Unbalanced Magnet Bar Design

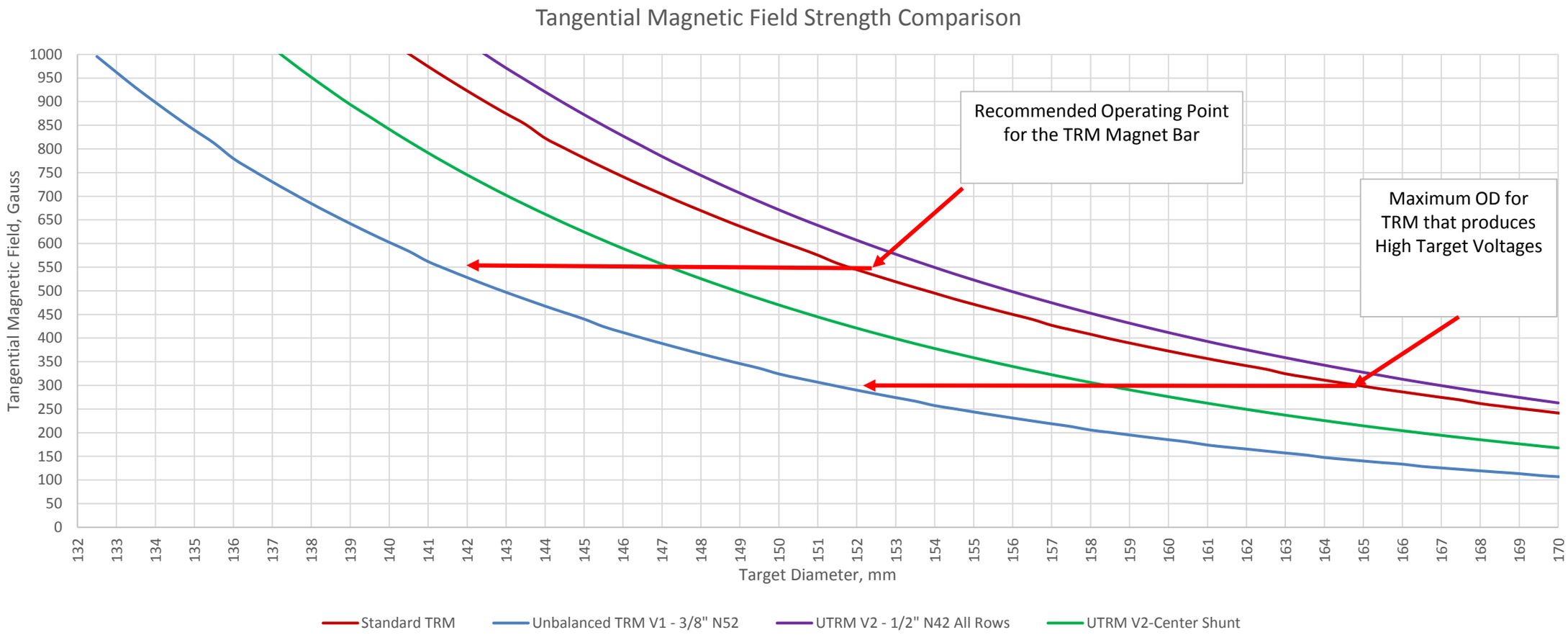


Stronger UTRM Design – UTRM V2

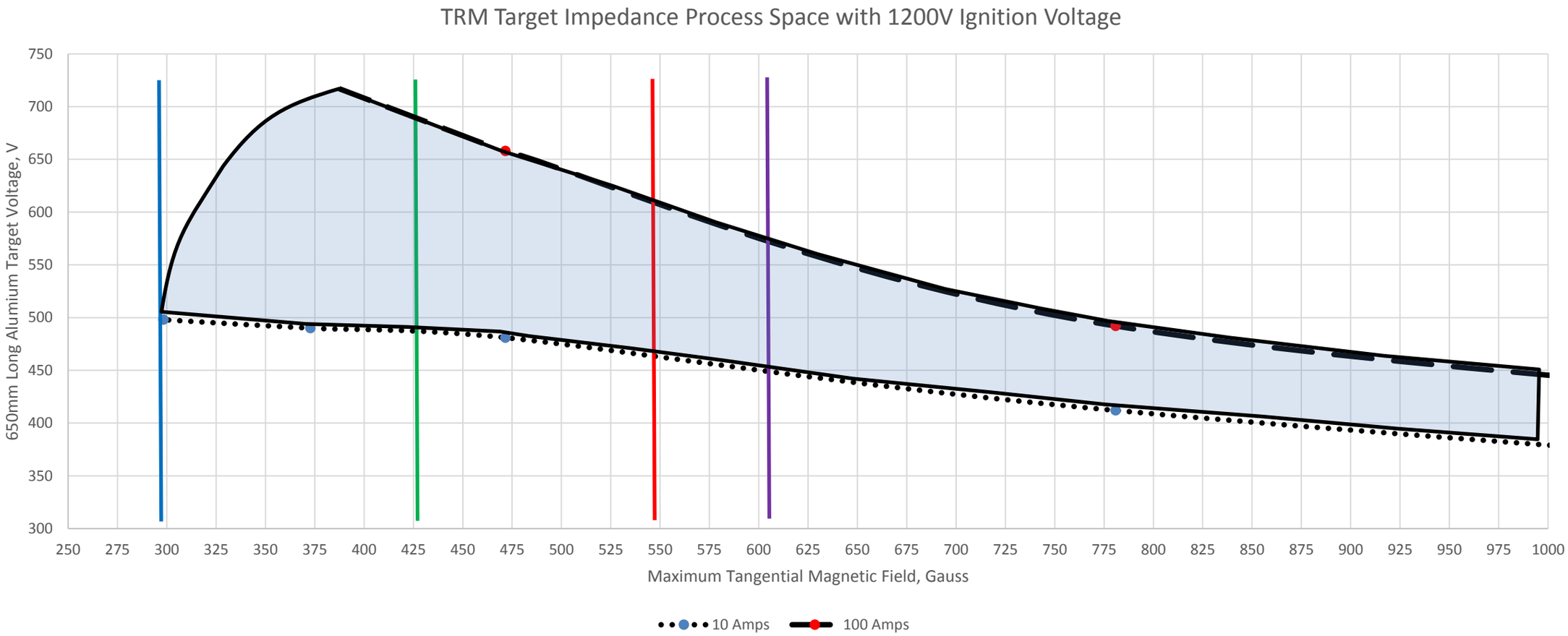
- Use Existing TRM magnet angles – 22.5 degrees
- Use Standard N42 x ½” inch square cross sections for all rows
- 600 gauss at 152 mm OD
- Secondary confinement 243 gauss at 152 mm OD so it shouldn’t create spurious plasma



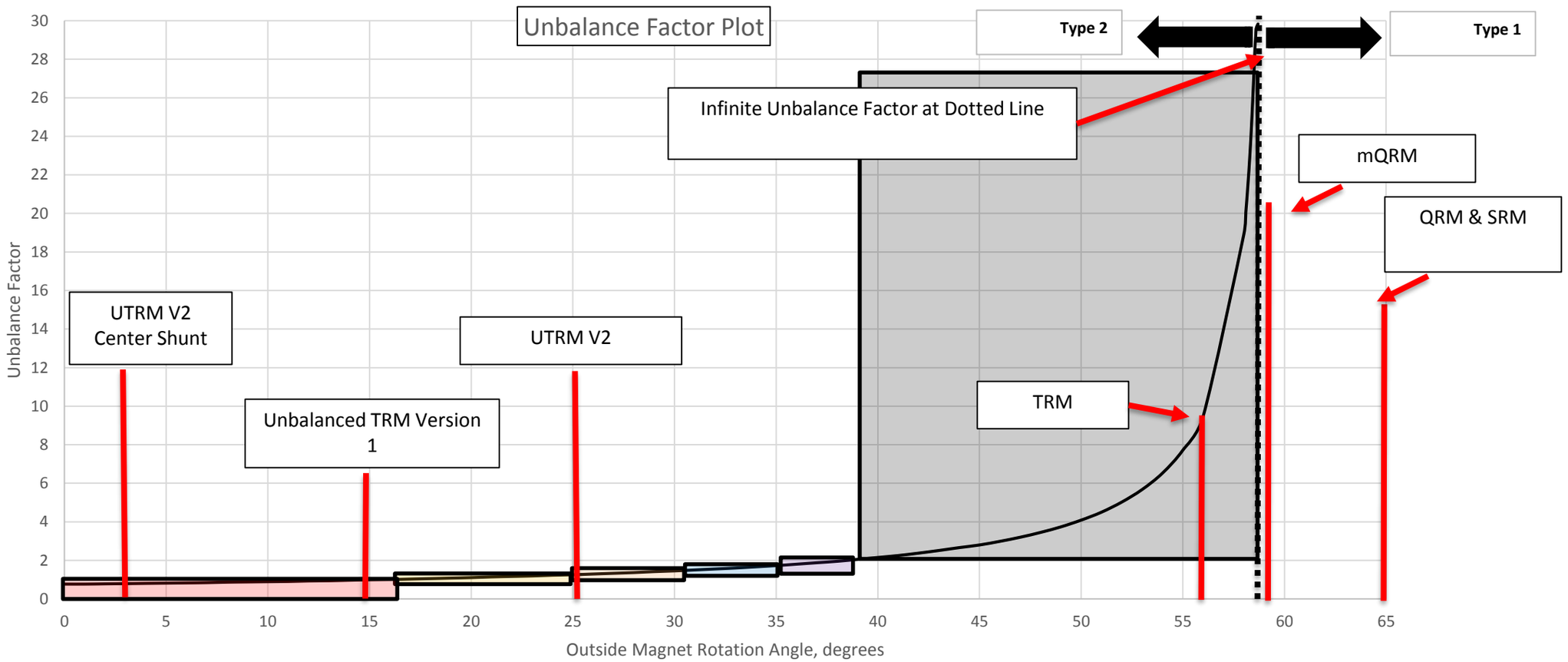
Stronger UTRM Design



Impact on Plasma Impedance



Unbalance Factor Comparison



Unbalance Factor Difference…

- Customer's need ion current on their substrates to achieve the film density and hardness specifications that their applications require

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