Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY

Status of B1pF Inner Yoke 2d and Coil End Geometry

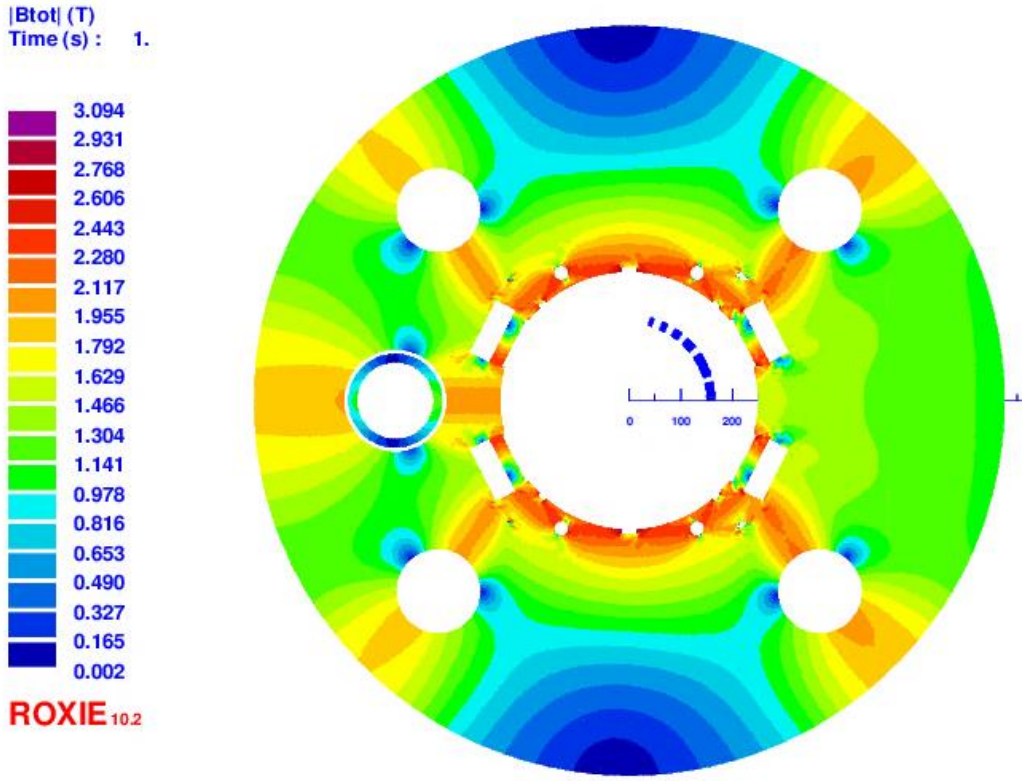
Ramesh Gupta

February 21, 2023

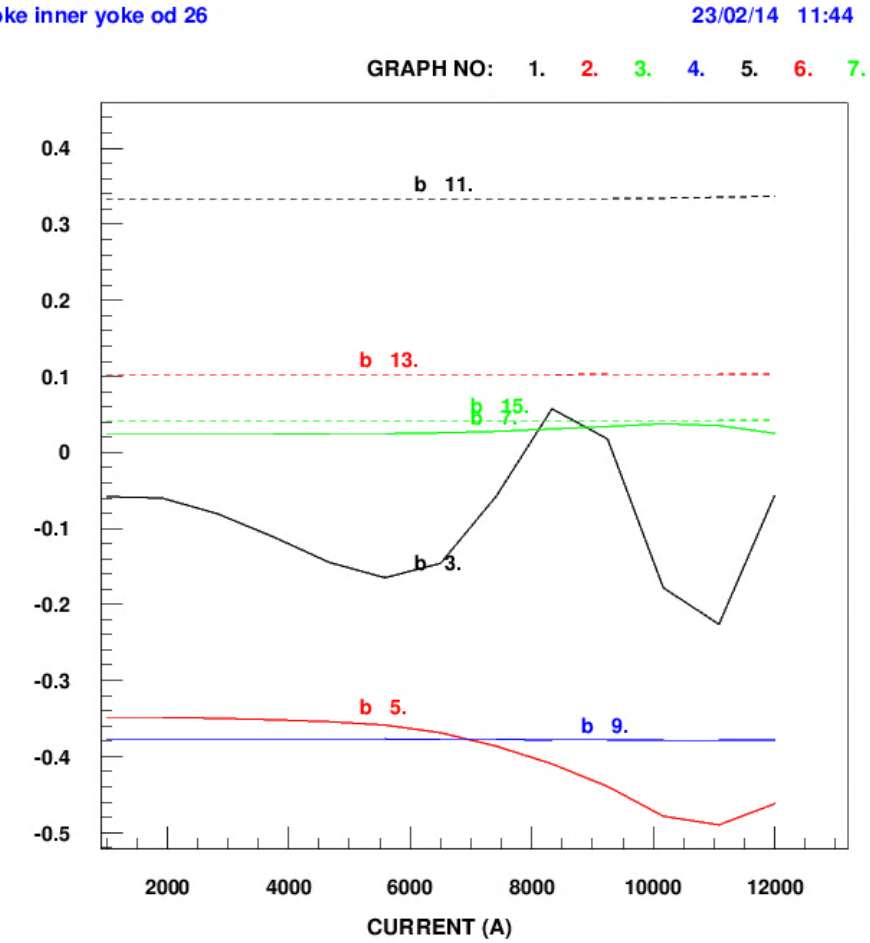
@BrookhavenLab

Results of the optimized yoke (presented earlier)

Large cutouts for 3d structure accommodated in inner yoke (~30 sq inch, more than ~20 sq inch originally requested).



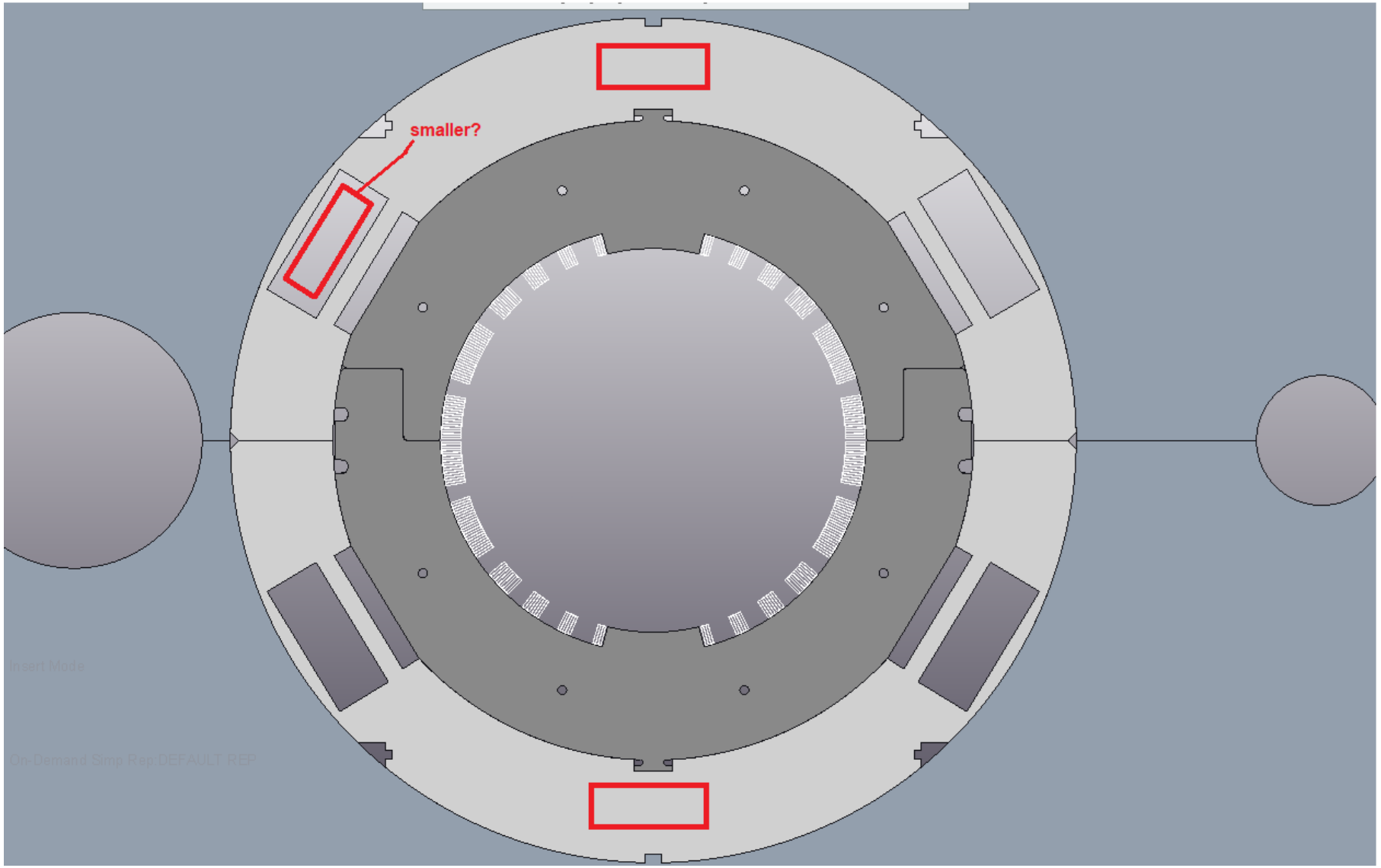
All harmonics remain low (<1/2 unit) in the entire range of operation



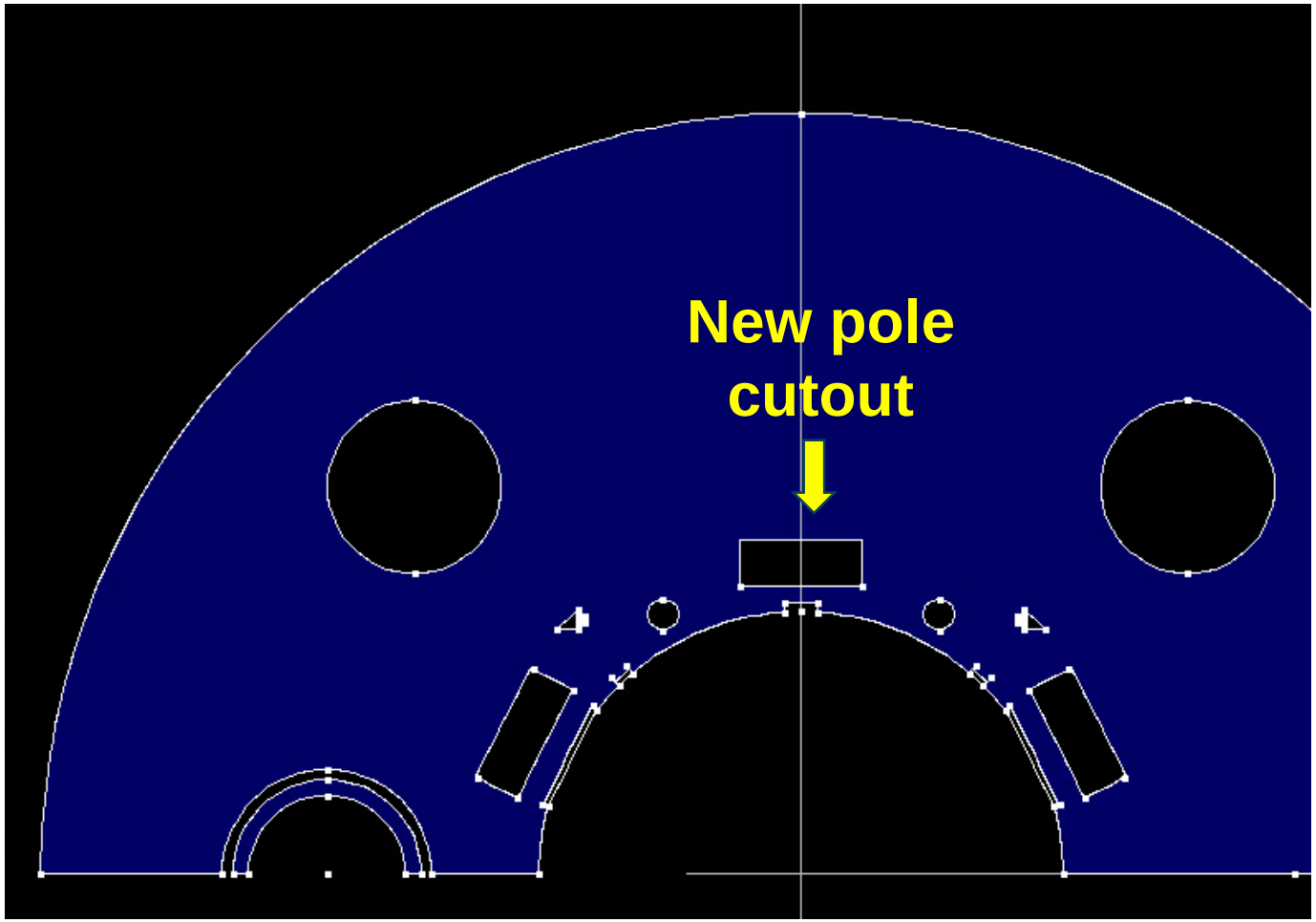
- **Tuning shims for 4 to eight geometric harmonics.**
- **Also, shown tuning for saturation induced harmonics.**

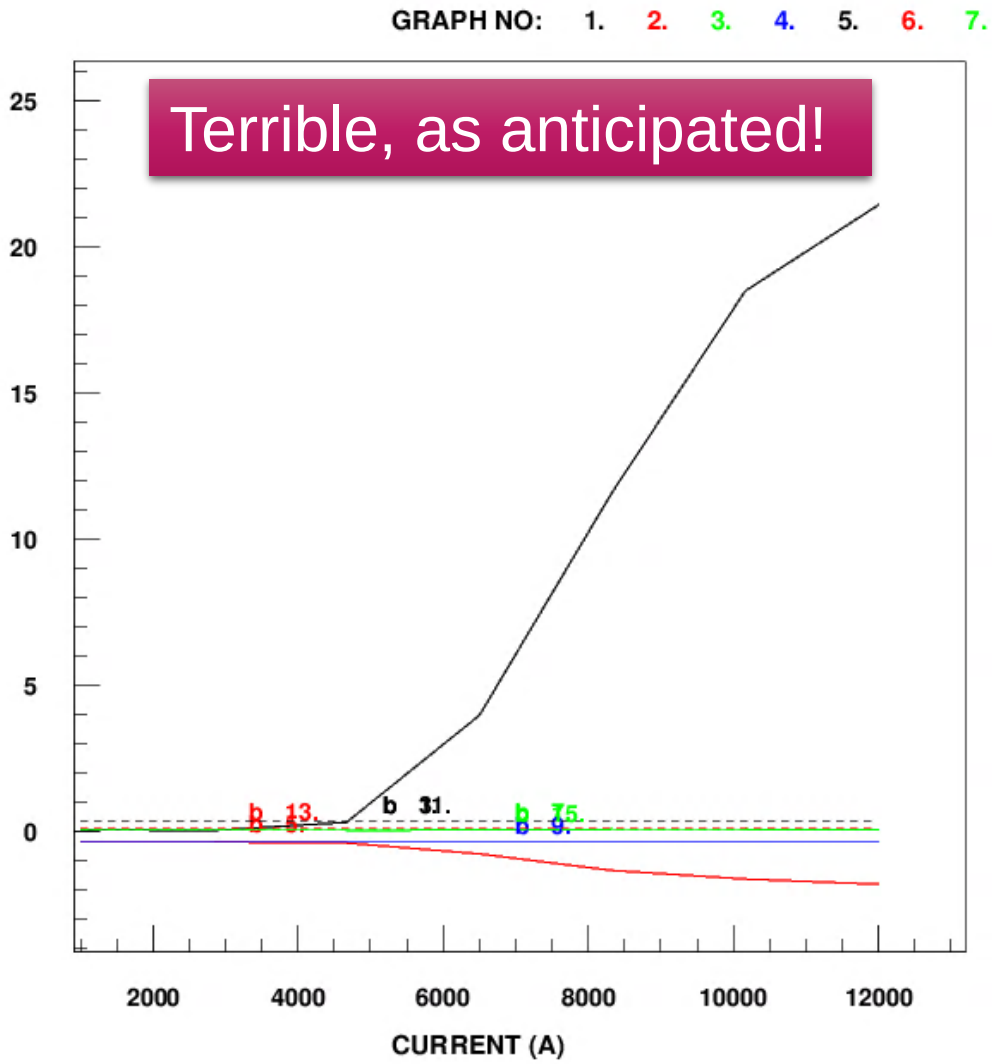
Revised Request (cutout at 6 places)

Cutout at pole is expected to make a significantly negative impact on saturation

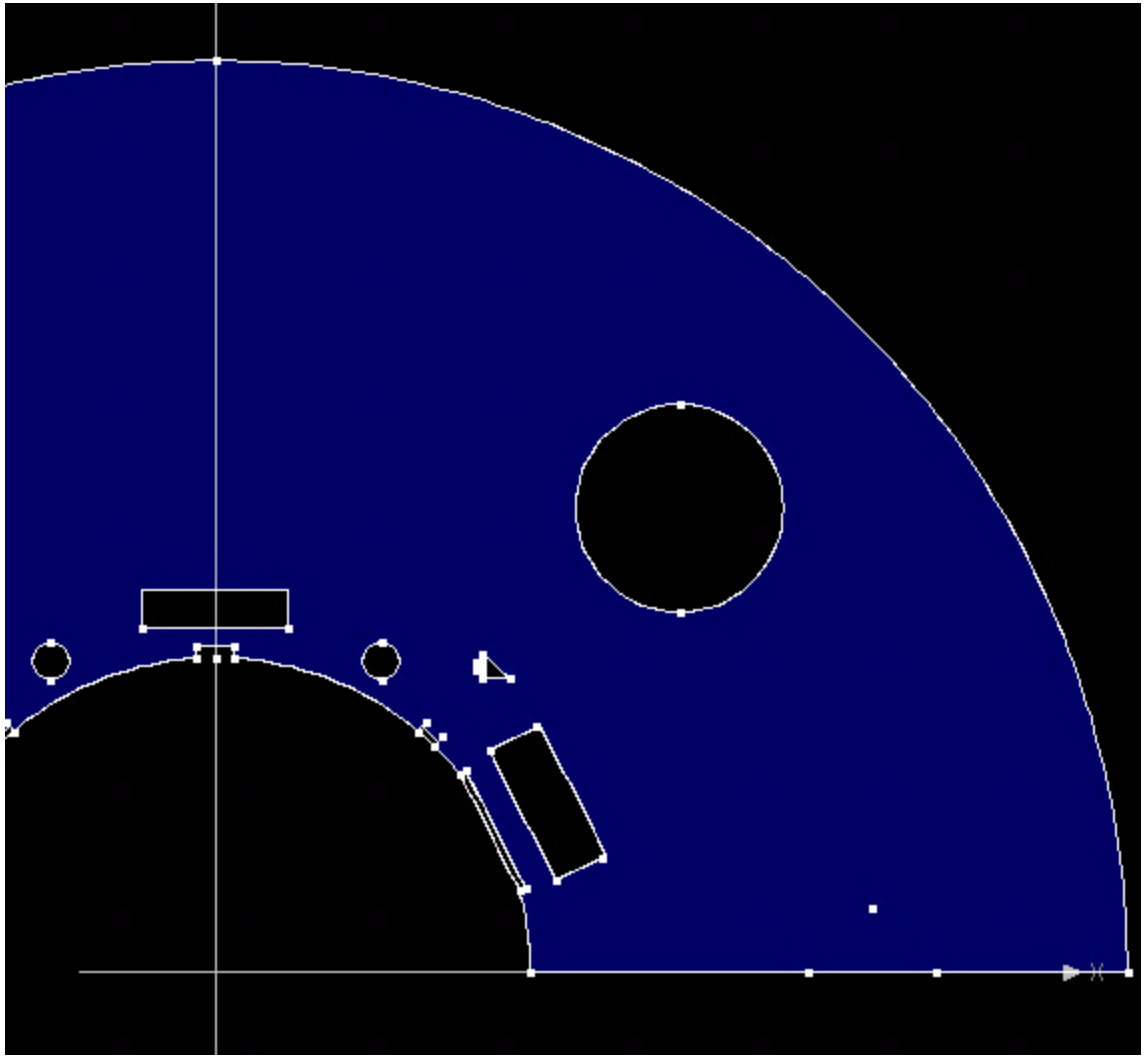


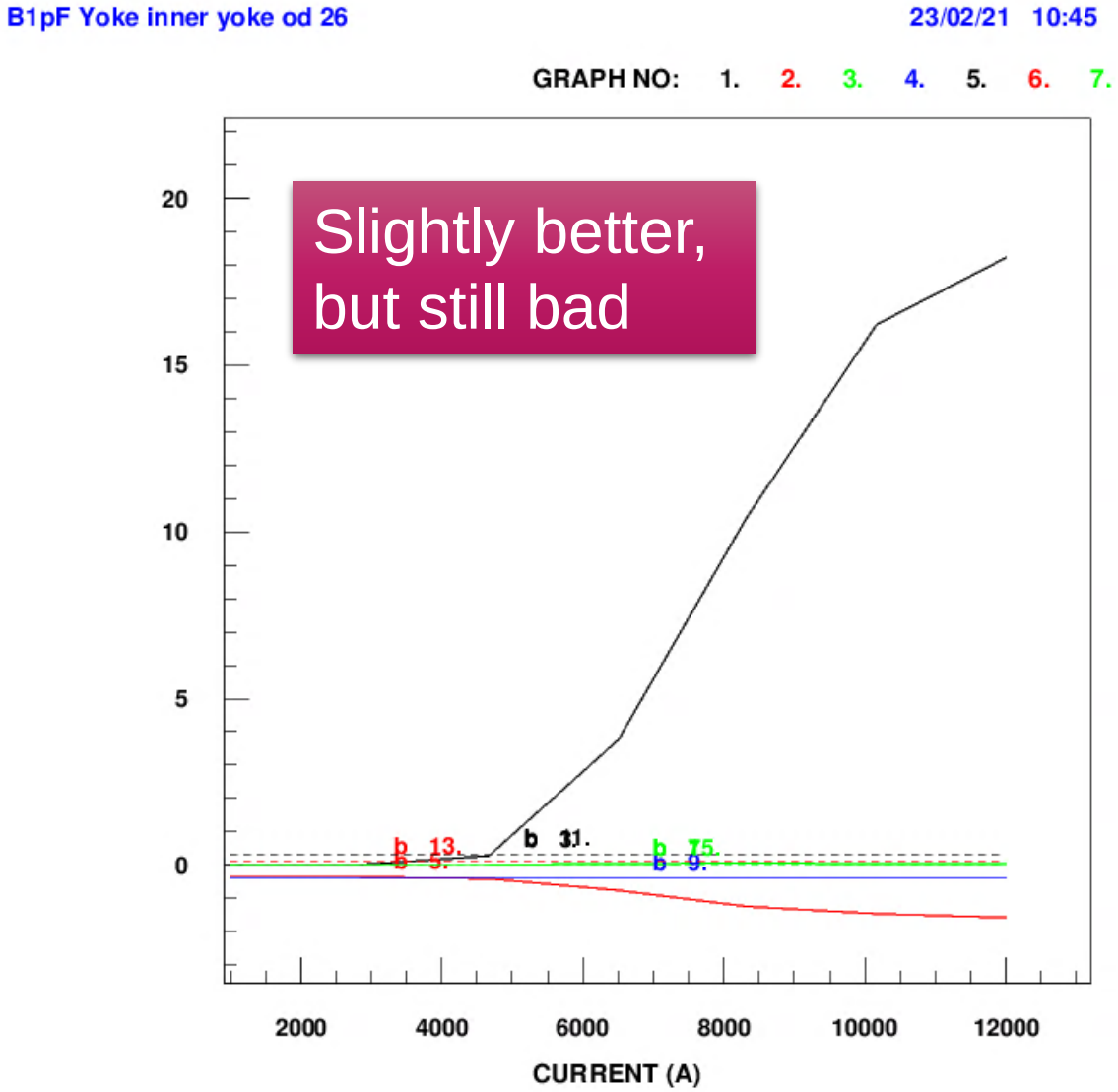
Impact of Cutout on Iron Saturation



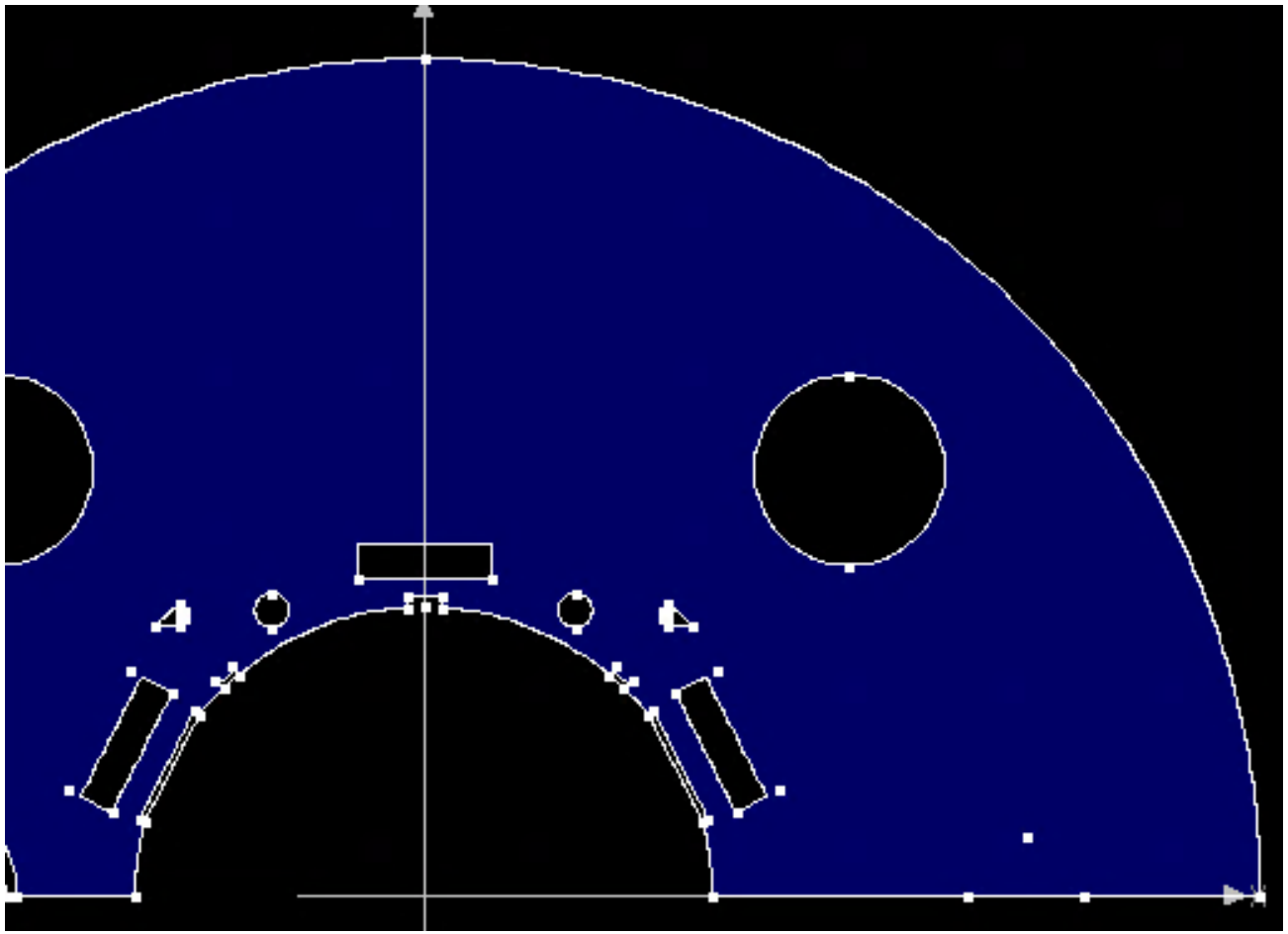


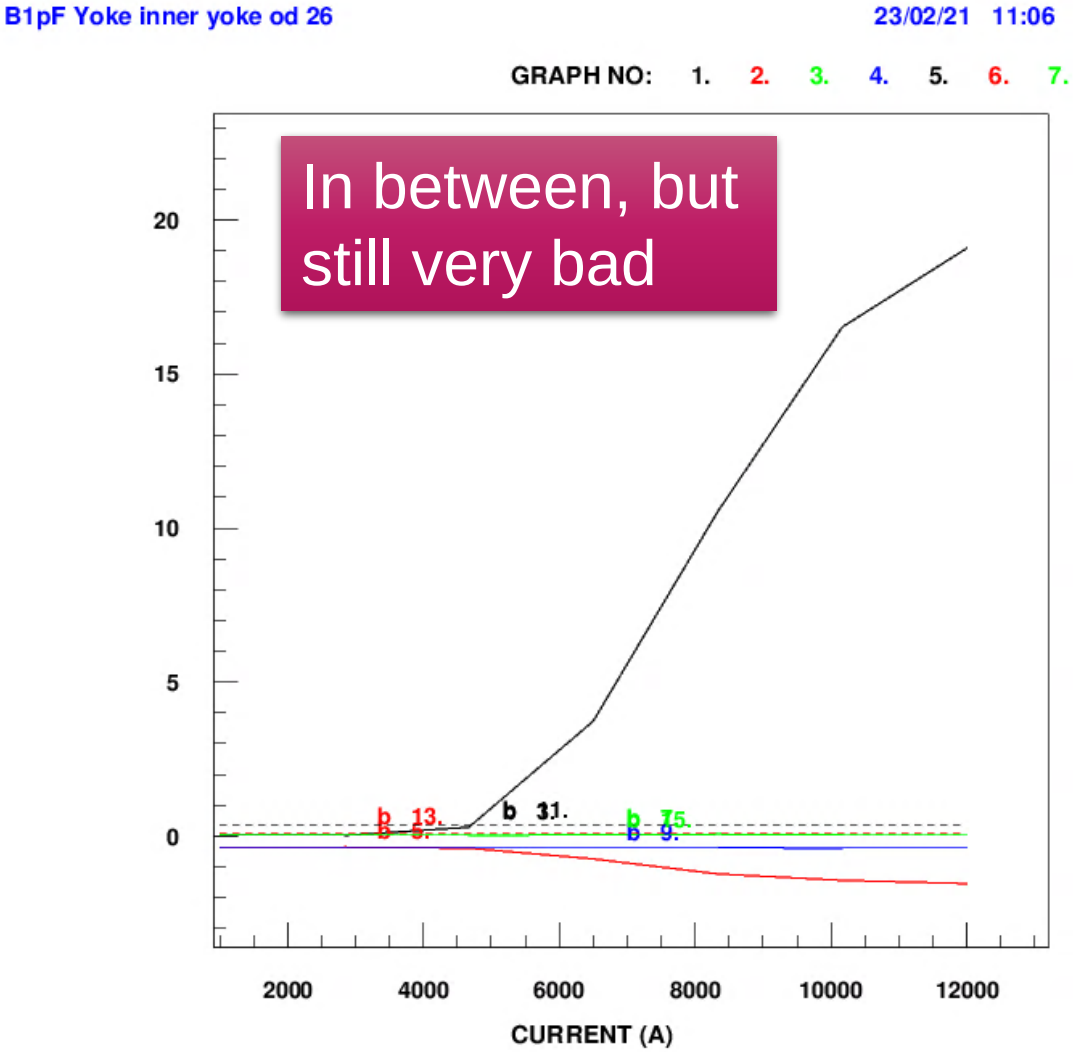
Impact of Cutout on Iron Saturation (size of pole cutout reduced by 2/3)





Impact of Cutout on Iron Saturation (size of all cutouts reduced by 2/3)

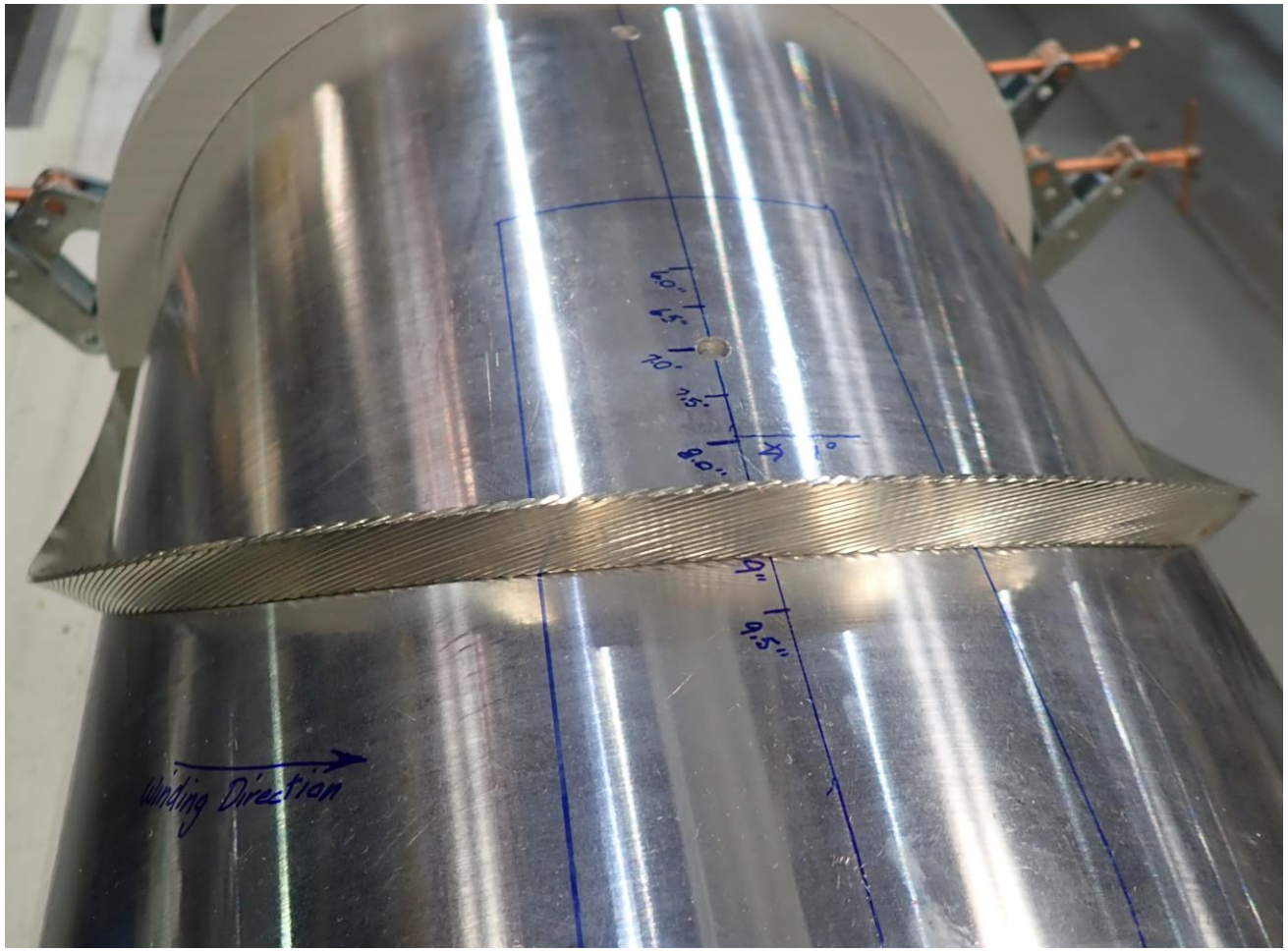


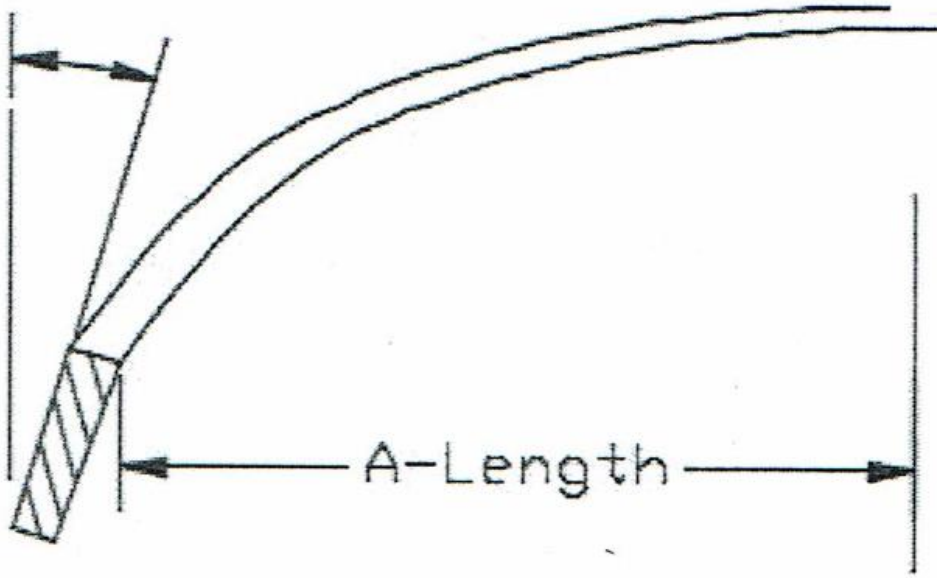


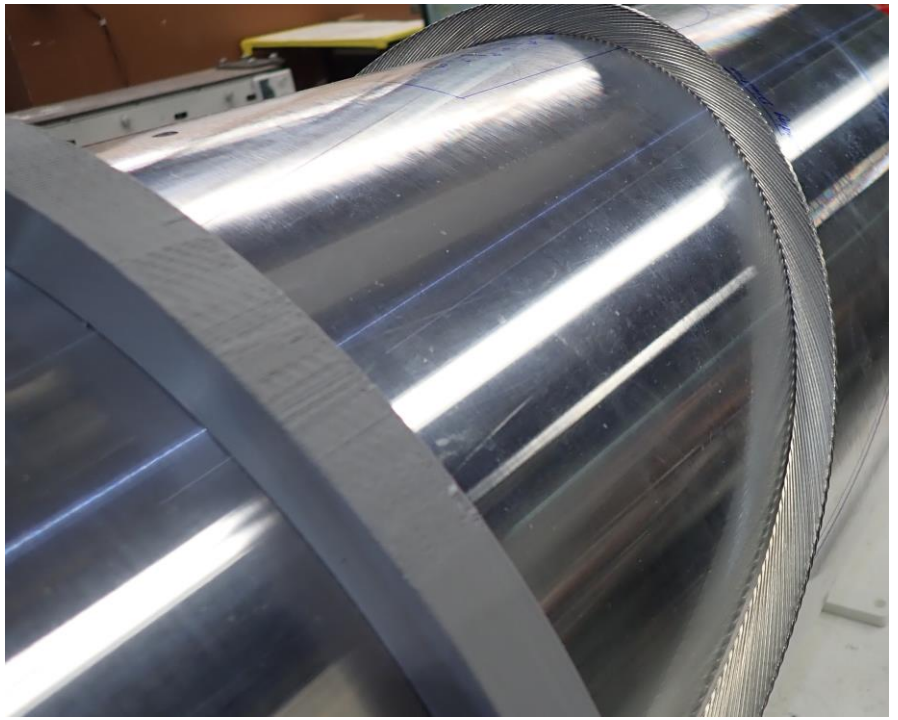
Large cutout at pole has a major negative impact on yoke saturation!

Needs more work to find a solution which satisfies the demanding requirements of both mechanical (3d) and magnetic (2d) design.

Free Winding of the Midplane Turn (strain naturally minimized)





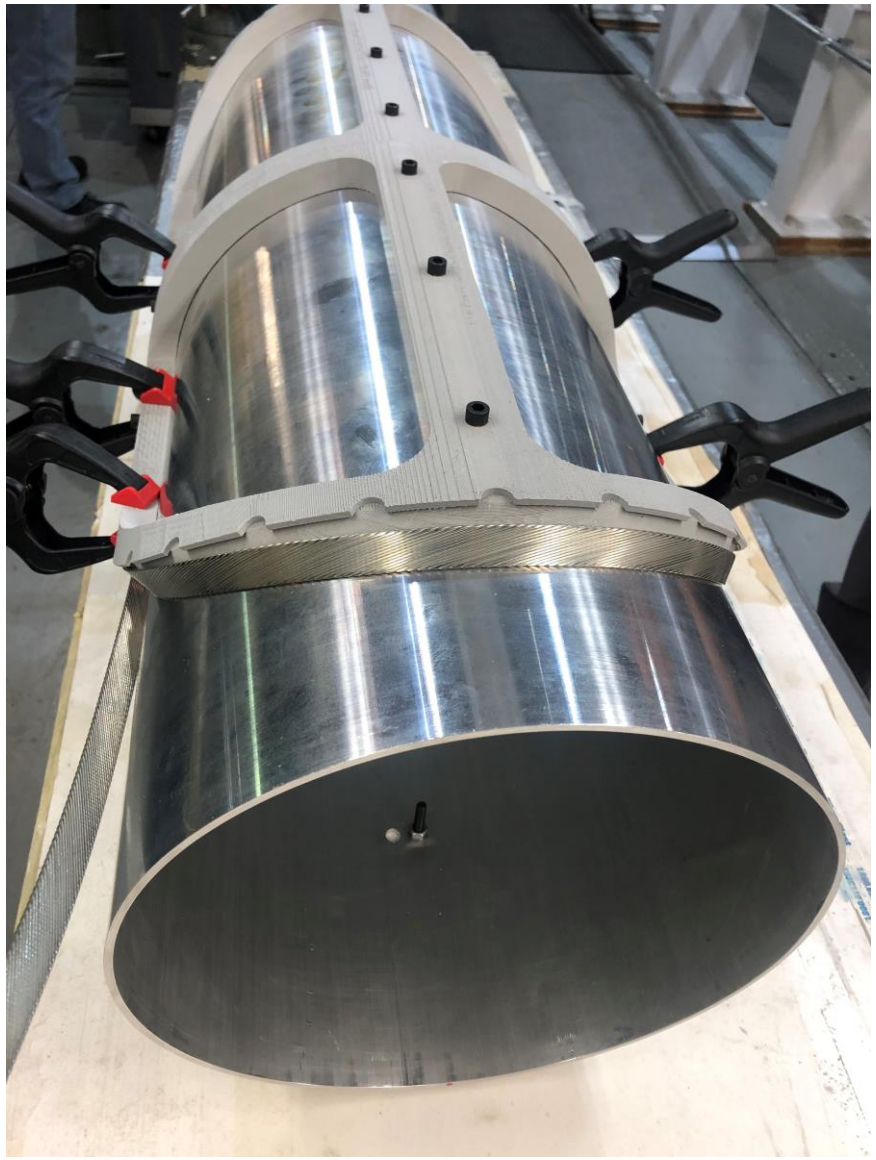


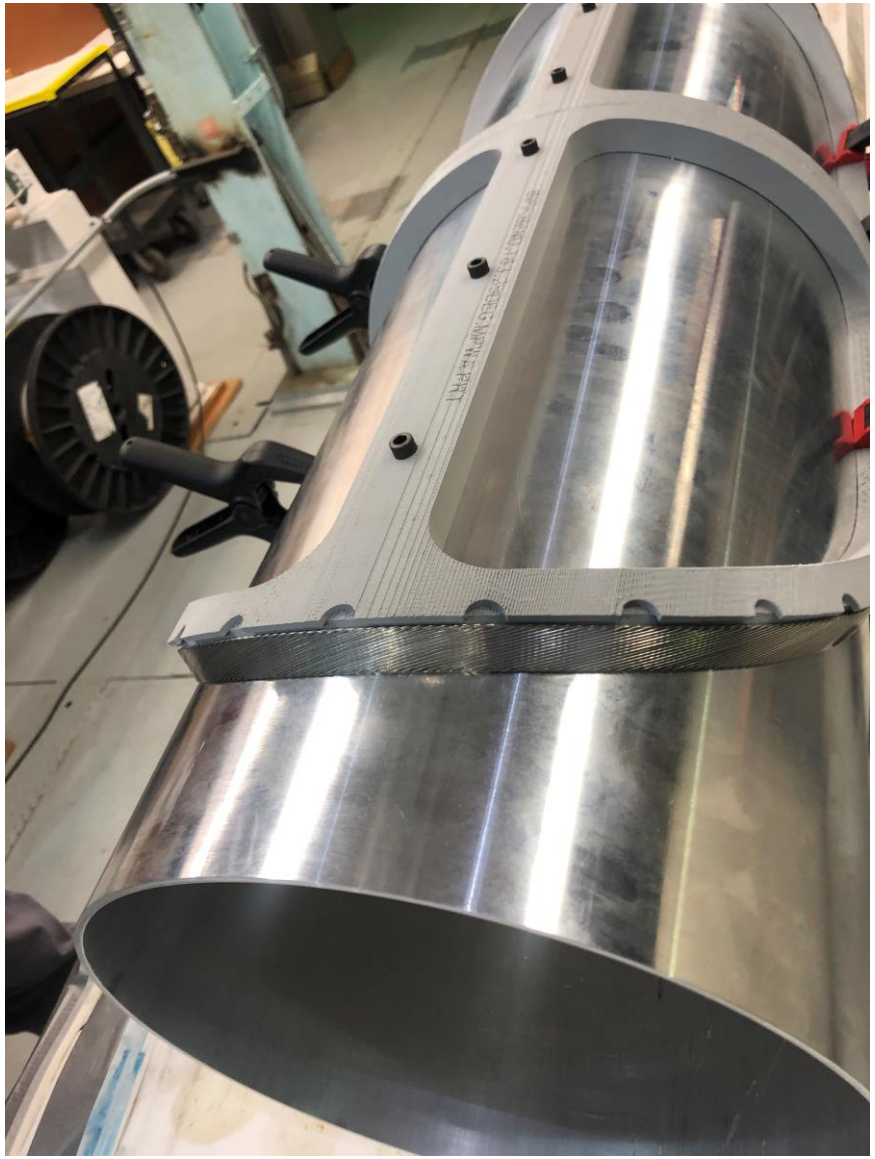
Winding of the Midplane Turn on Mandrel

(optimized with ROXIE and BEND)

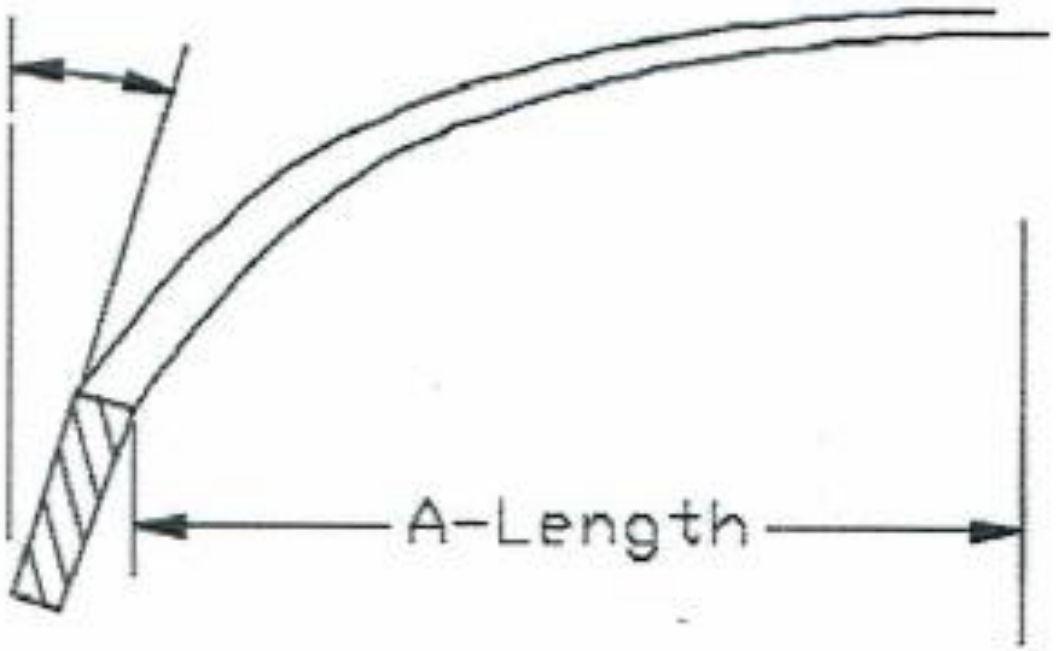
Tilt angles:
~54º (ROXIE) &
~25º (BEND)

***36 degree in ROXIE INPUT since it is defined differently**





Systematic Study of the Natural Layout of the Midplane Turn



- In all cases, natural layout gives tilt angles much smaller than those used in ROXIE and smaller than in BEND.
- There is almost no change till 7.5". May be acceptable even beyond that.
- Cable stays on the tube (in some cases a gentle push is required)

B1pF Coil End **Cable fit/form checks**

Clamp cable to part straight section - extending free from back end of printed spacer.

Set end turn length to "A" dimension.

Measure turn angle from vertical at apex of turn and an point 1/2 way to apex.

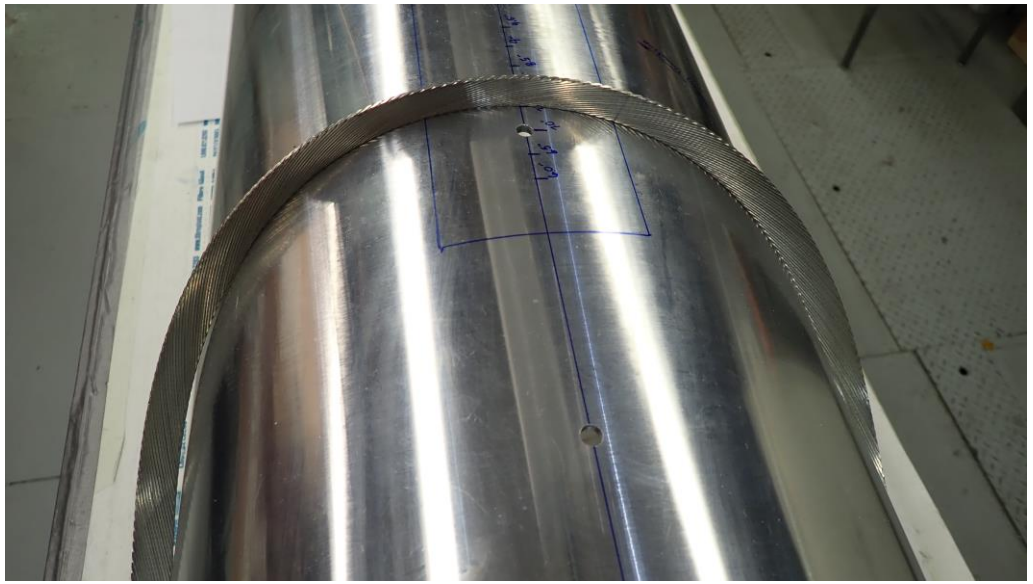
Note any gaps between cable and mandrel.

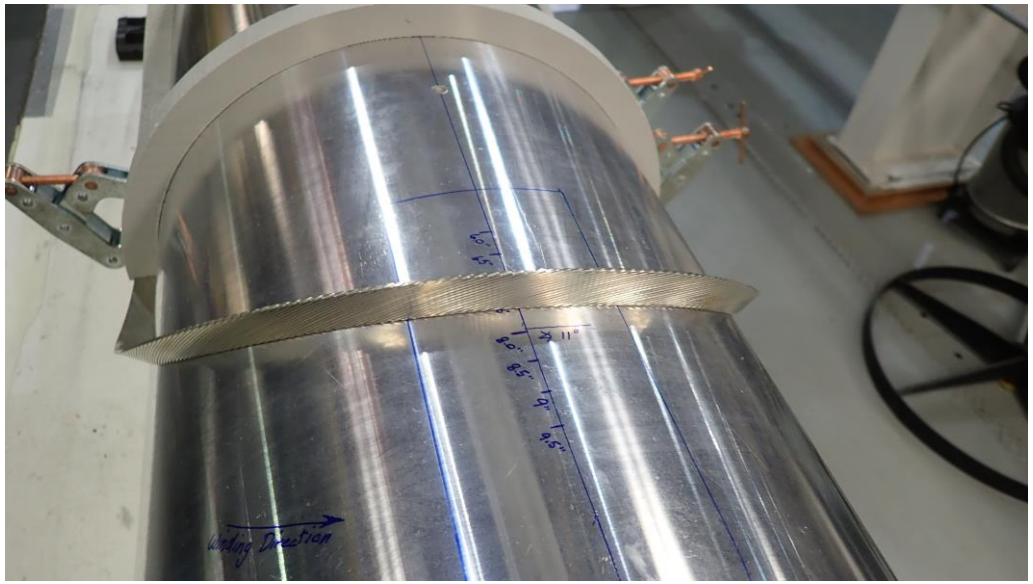
Photograph cable in each position.

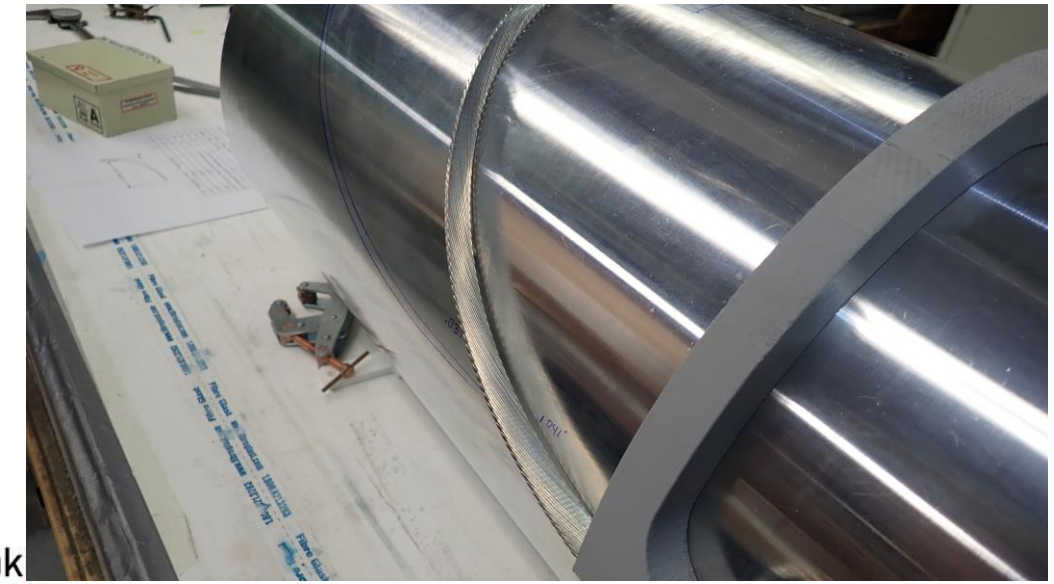
Reference: ROXIE/BEND ~9.25"

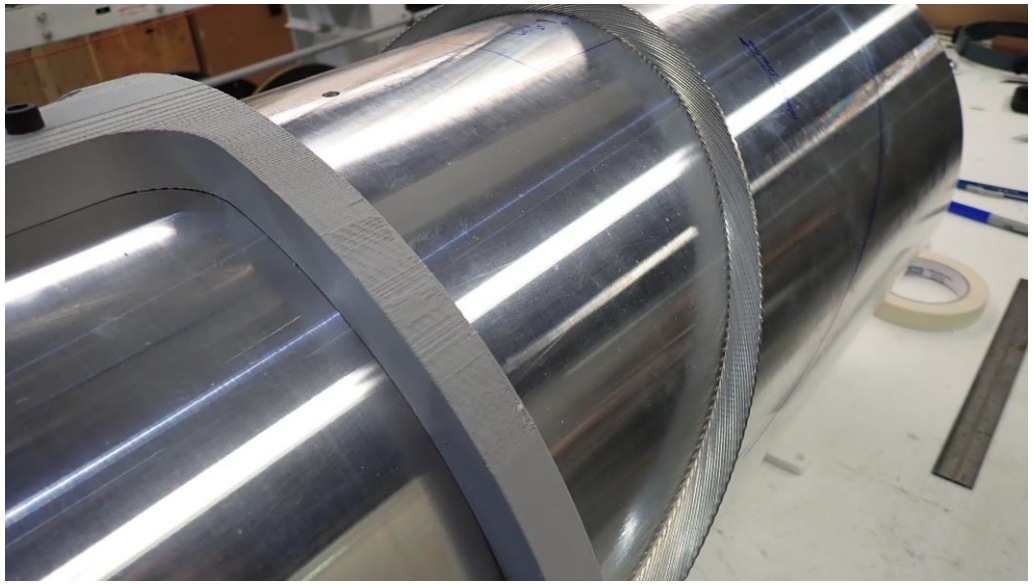
"A" Length	Angle apex	Angle 1/2 way	Notes
9.5	7°		.052" / .077"
9.0	8°		Enter ApexGap: .021", Exit ApexGap .062"
8.5	9°		Enter Apex gap: .008", Exit gap .062"
8.0	9°		" " " .006" " " .047"
7.5	8.7°		" " " .008" .047"
7.0	10.5°		.015" .047"
6.5	12.3°		Enter Apex .015" Exit Apex .041"
6.0	12.3°		

Photos for A-length = 7.5”

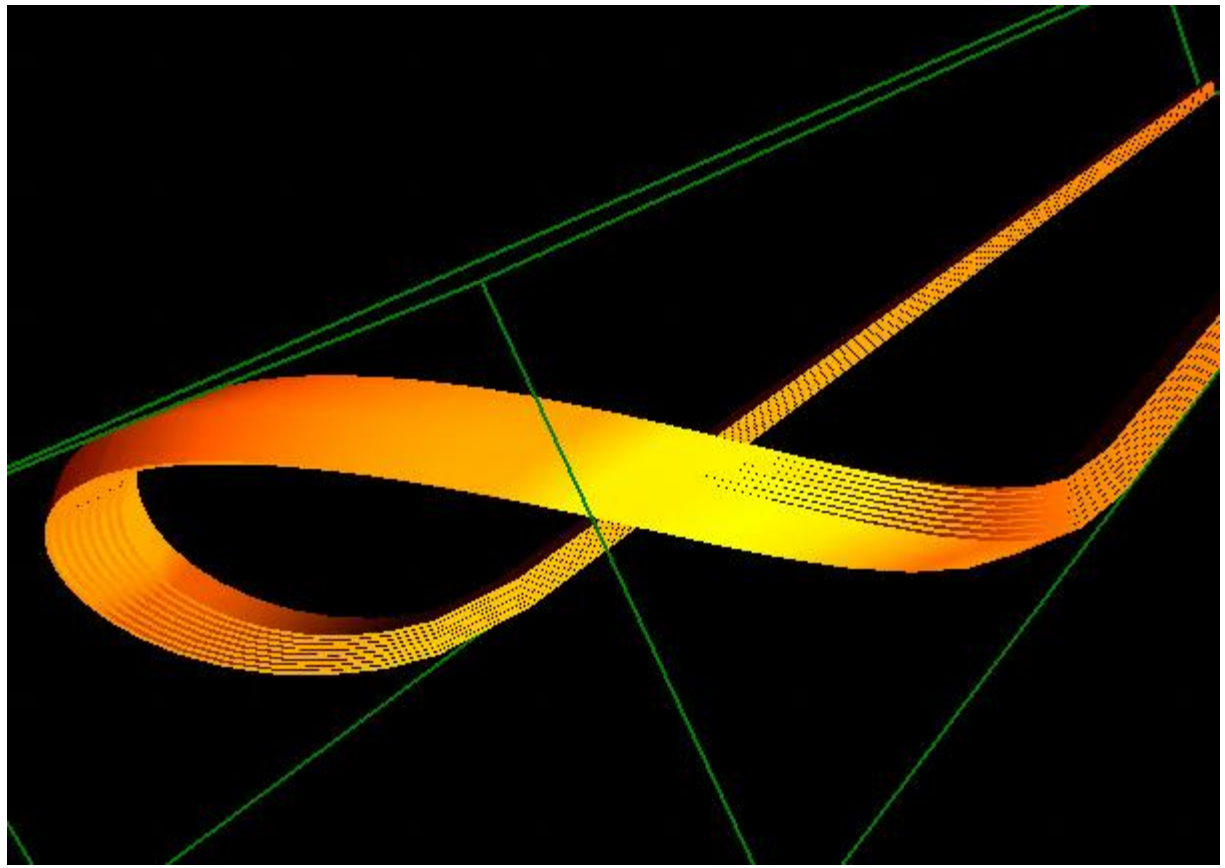


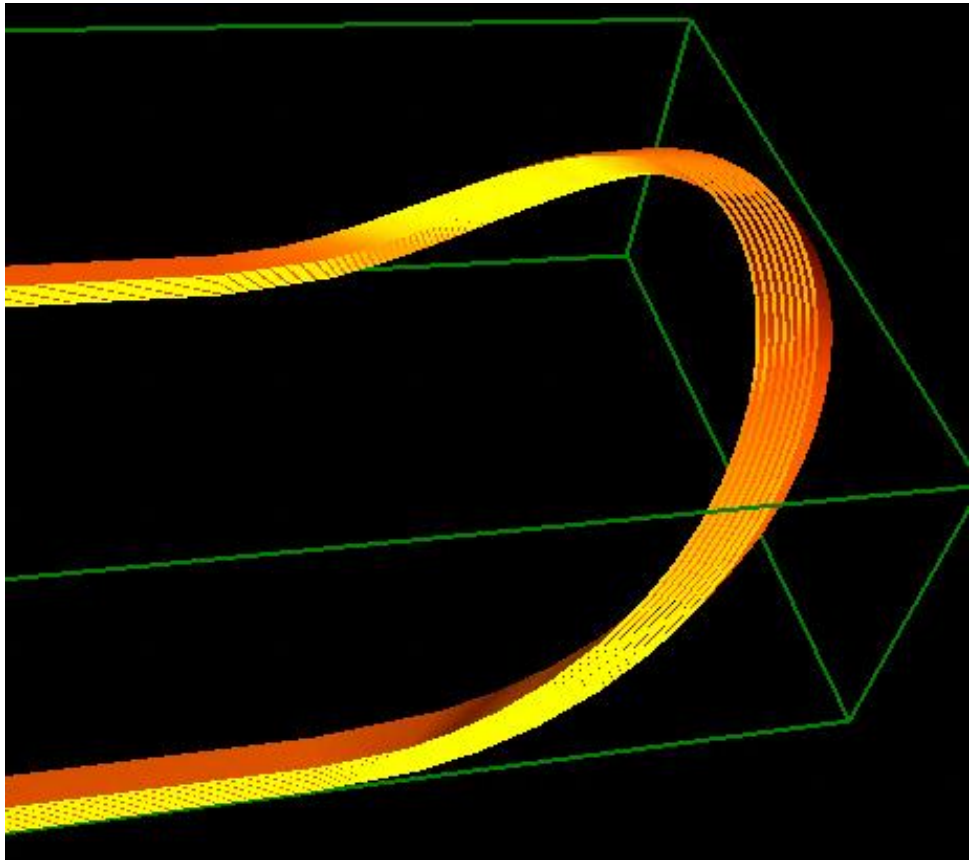






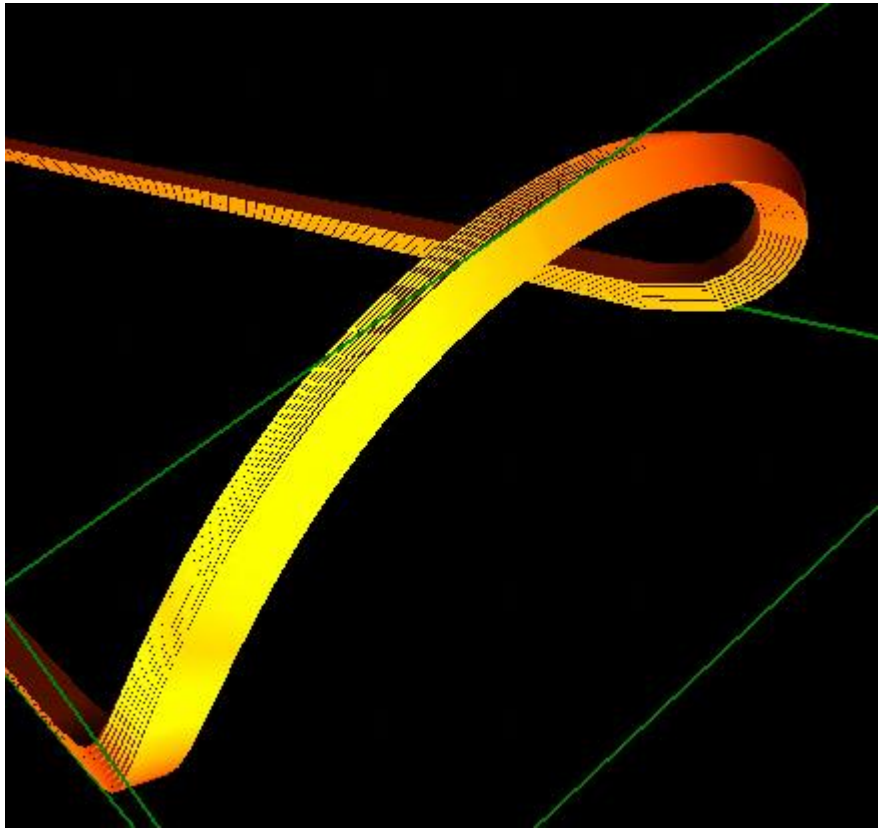
A-length 9.25” (ROXIE B/A=1), Tilt 54º (ROXIE BETA =36)

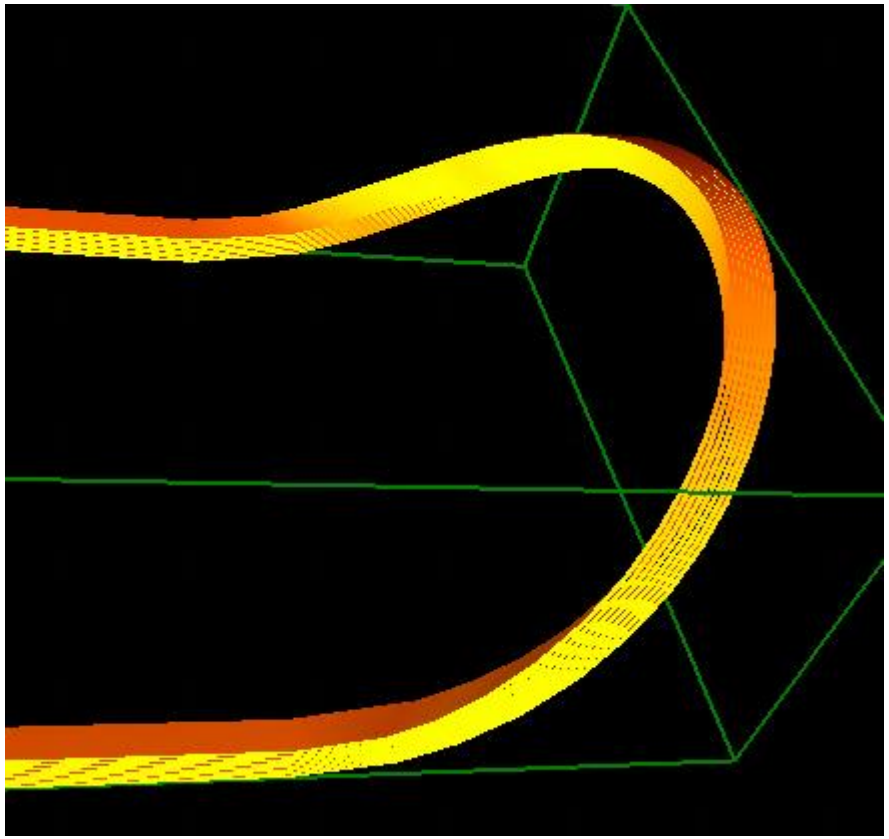




ORIGINAL CASE – ENDS optimized with ROXIE

A-length 7.5” (ROXIE B/A=0.81, Tilt 9º (ROXIE BETA = 81)





Check how it looks in a CAD Model

Variations in layout for A-length = 7.5”

Study of what happens if we are not able to follow the natural path in ROXIE (plus a limited study of changes in cable path during curing, collaring, energizing, etc.)