Factors Affecting Spatial Resolution in Pulsed Eddy Current Inspection of Pipe

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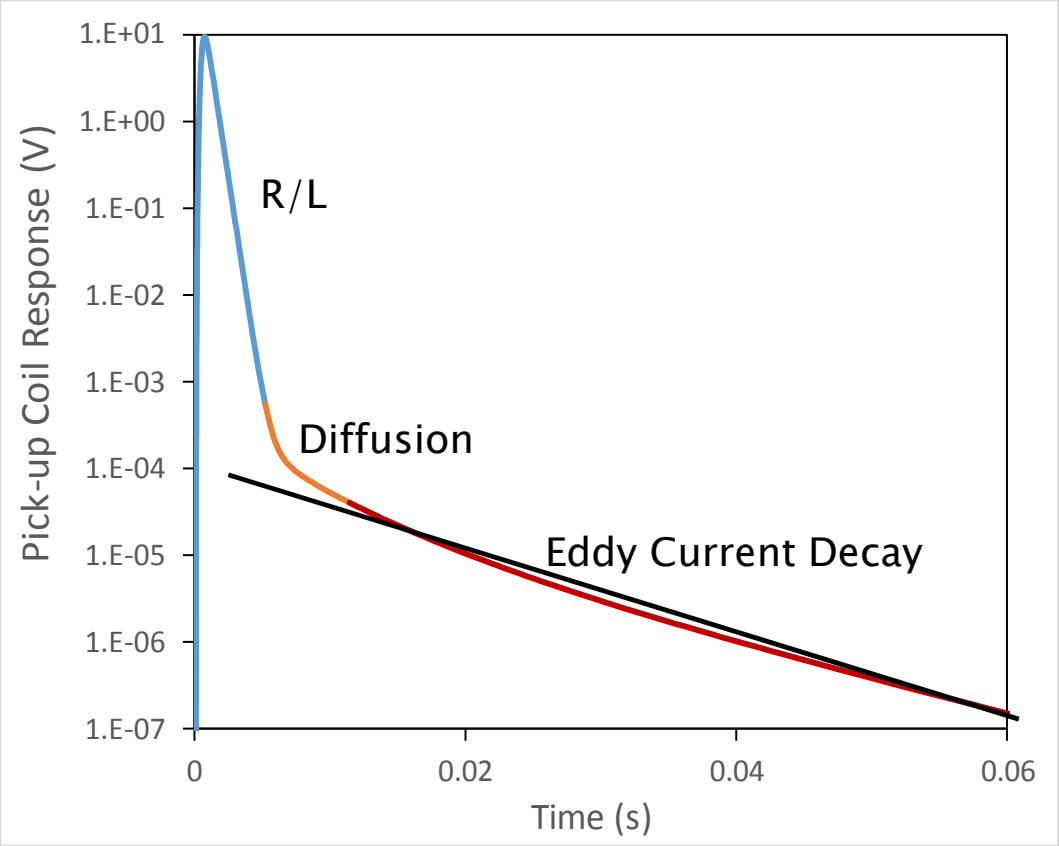
Edmonton, Alberta

Outline

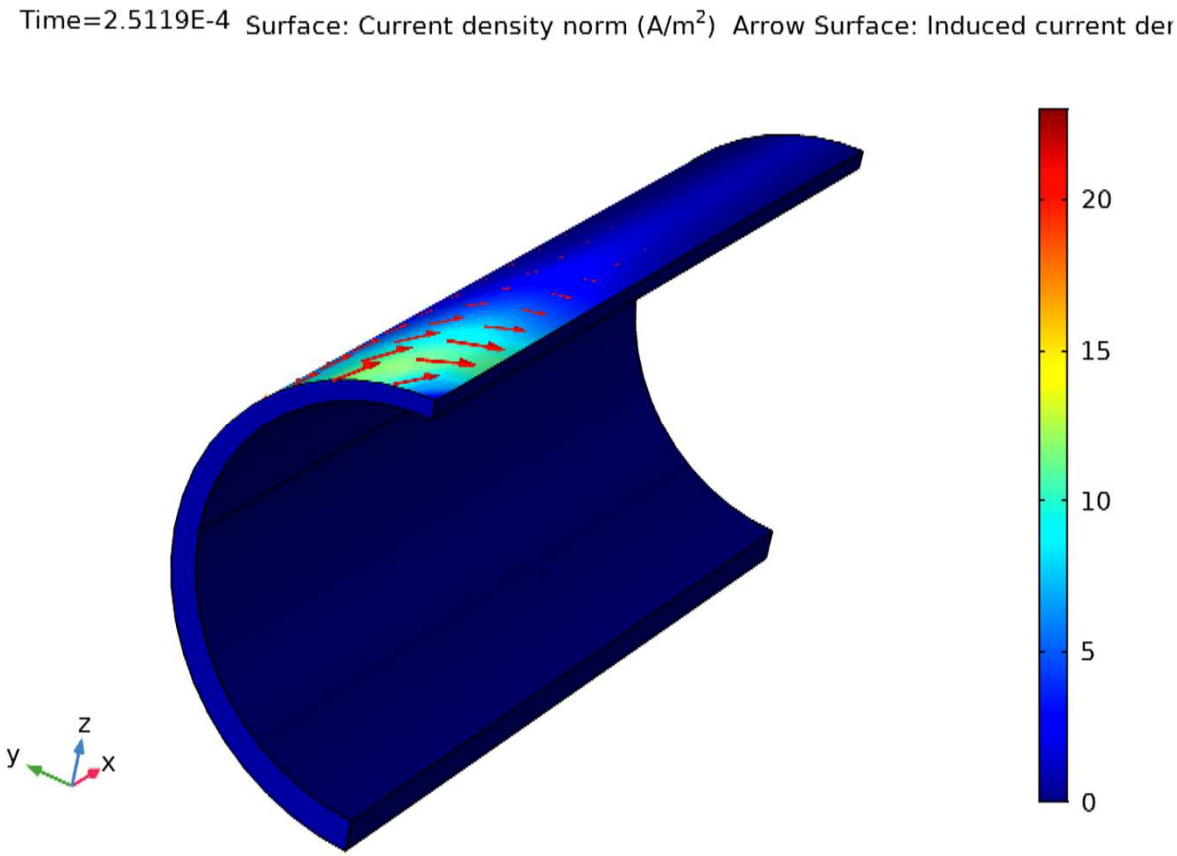
- Motivation
- Basics
- Probe Geometry
- Resolution
- Summary
- Acknowledgements

Motivation

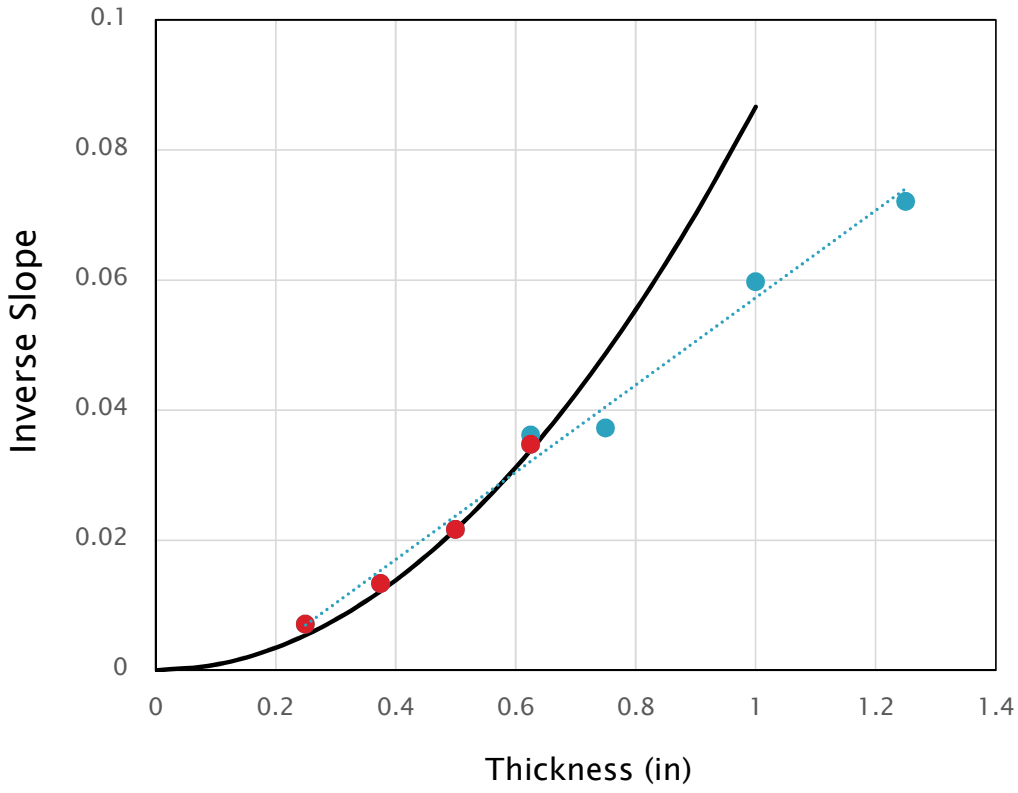
Basics


1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Pick-up Coil Response (V)
R/L
Diffusion
Eddy Current Decay
0
0.02
0.04
0.06
Time (s)

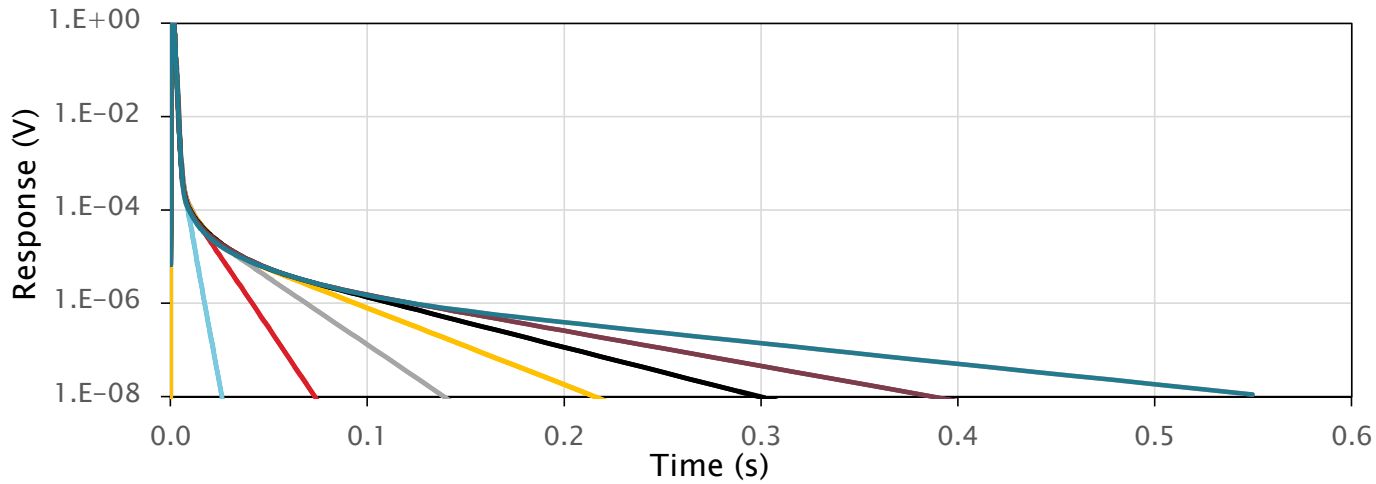
Basics II


Time=2.5119E-4 Surface: Current density norm (A/m²) Arrow Surface: Induced current der
20
15
10
5
0
z
y
x

Basics

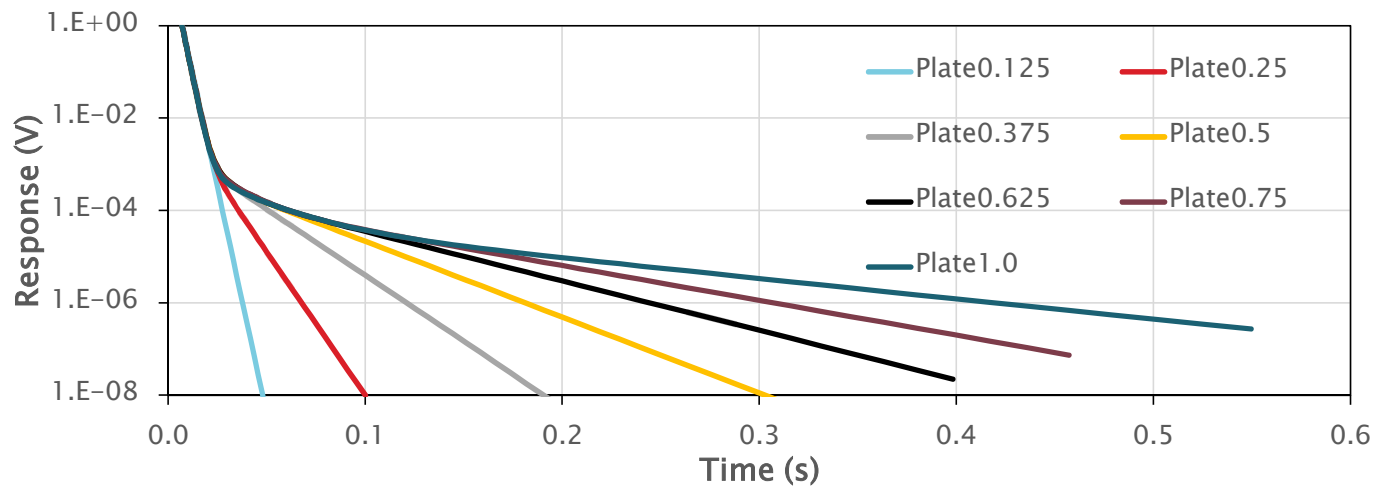

0.1
0.08
0.06
0.04
0.02
0
Inverse Slope
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Thickness (in)

Core



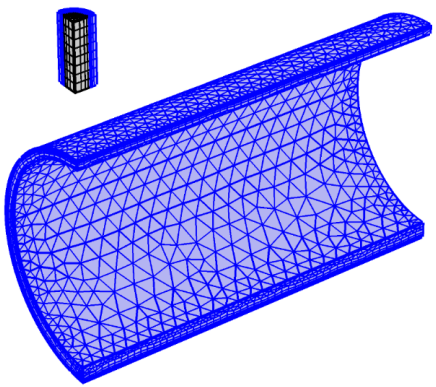
Air

Flat Plates

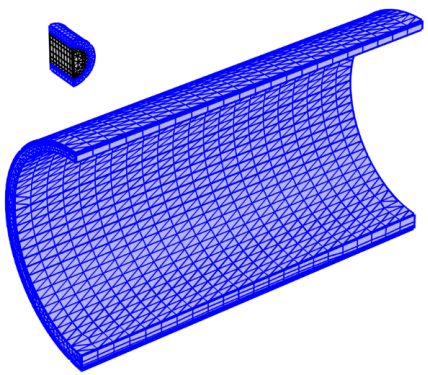


Ferrite
$\mu_r = 50$

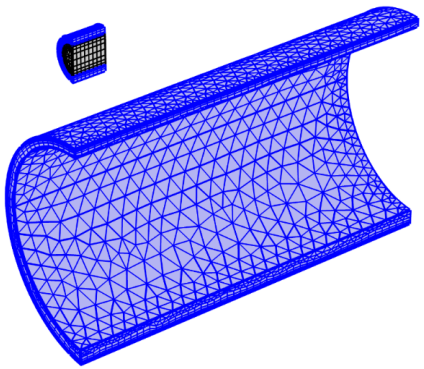
Probe Geometry – ¼ model



Radial



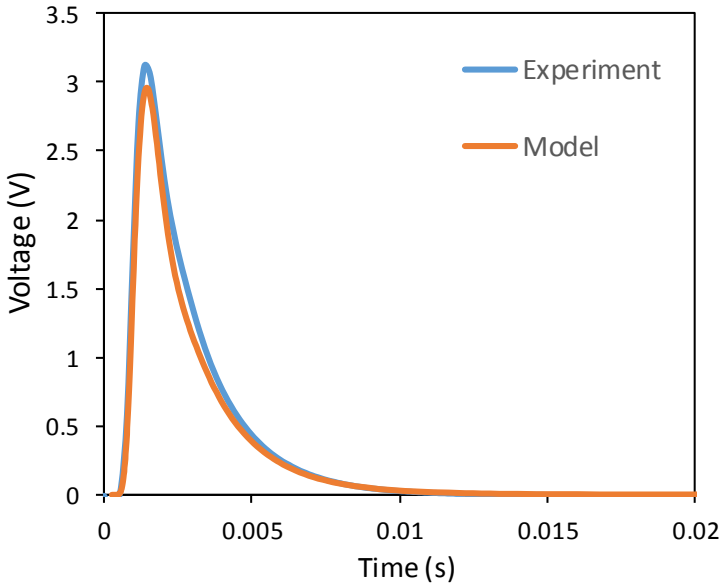
Transverse

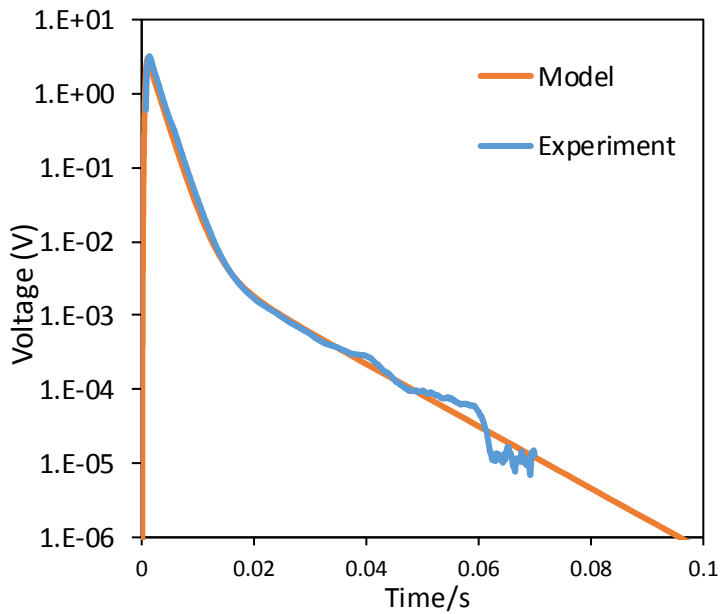


Longitudinal

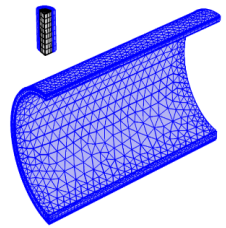
Symmetry provides the rest of the model

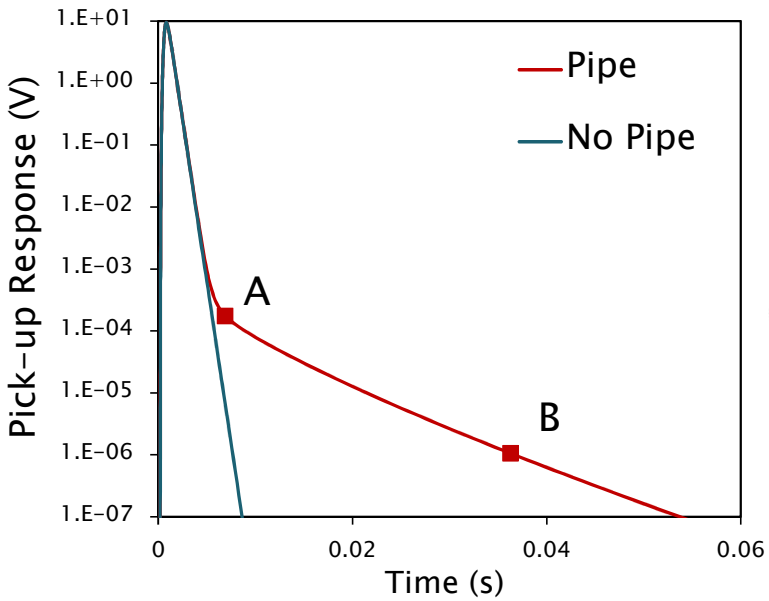
Model Validation

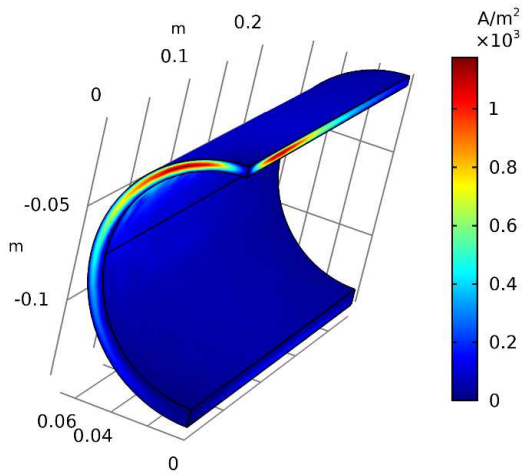




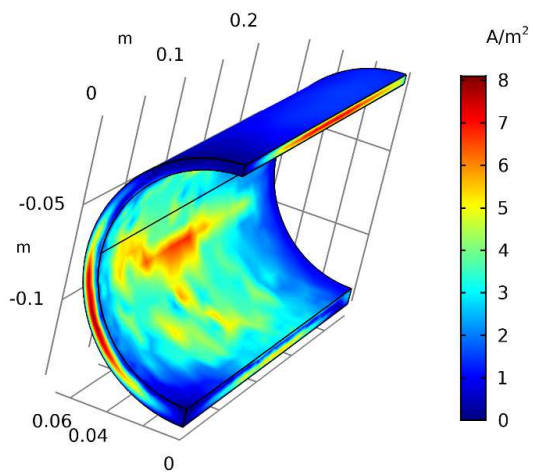
Probe Geometry II – Radial





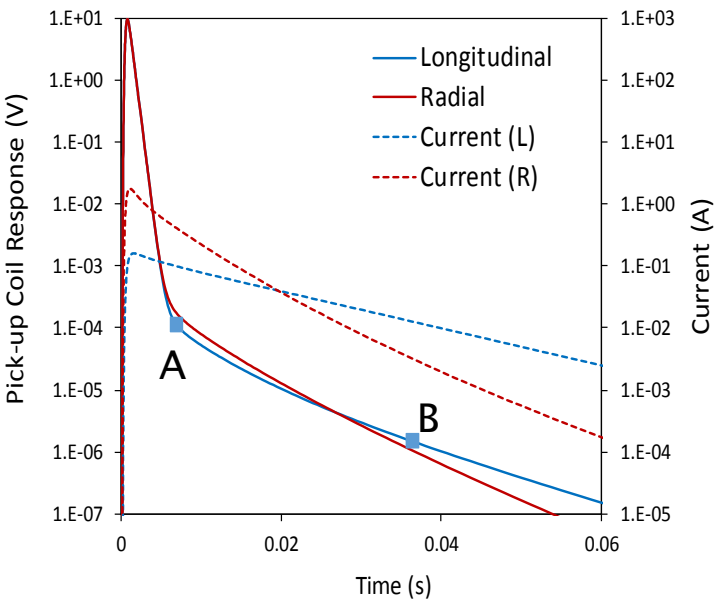


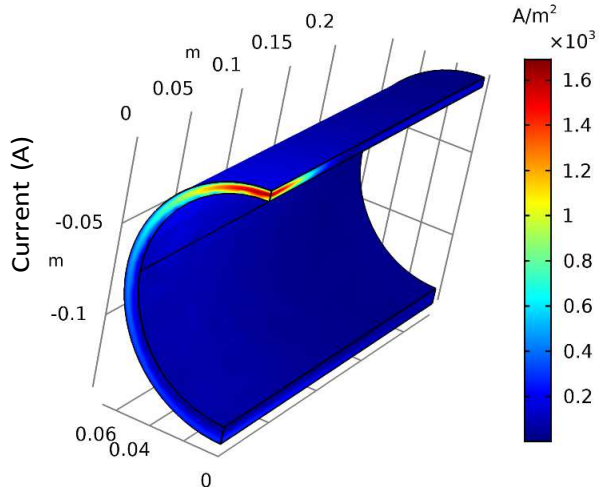
A



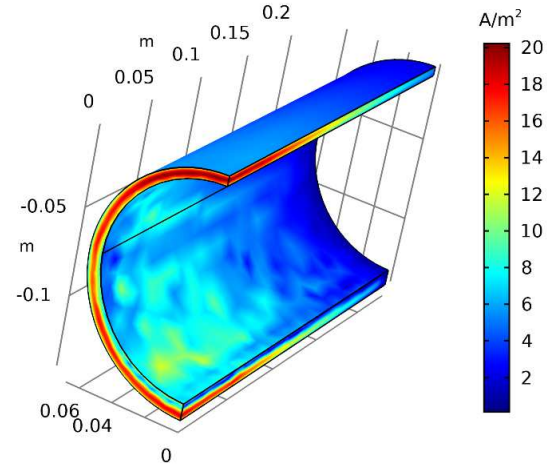
B

Probe Geometry III – Longitudinal



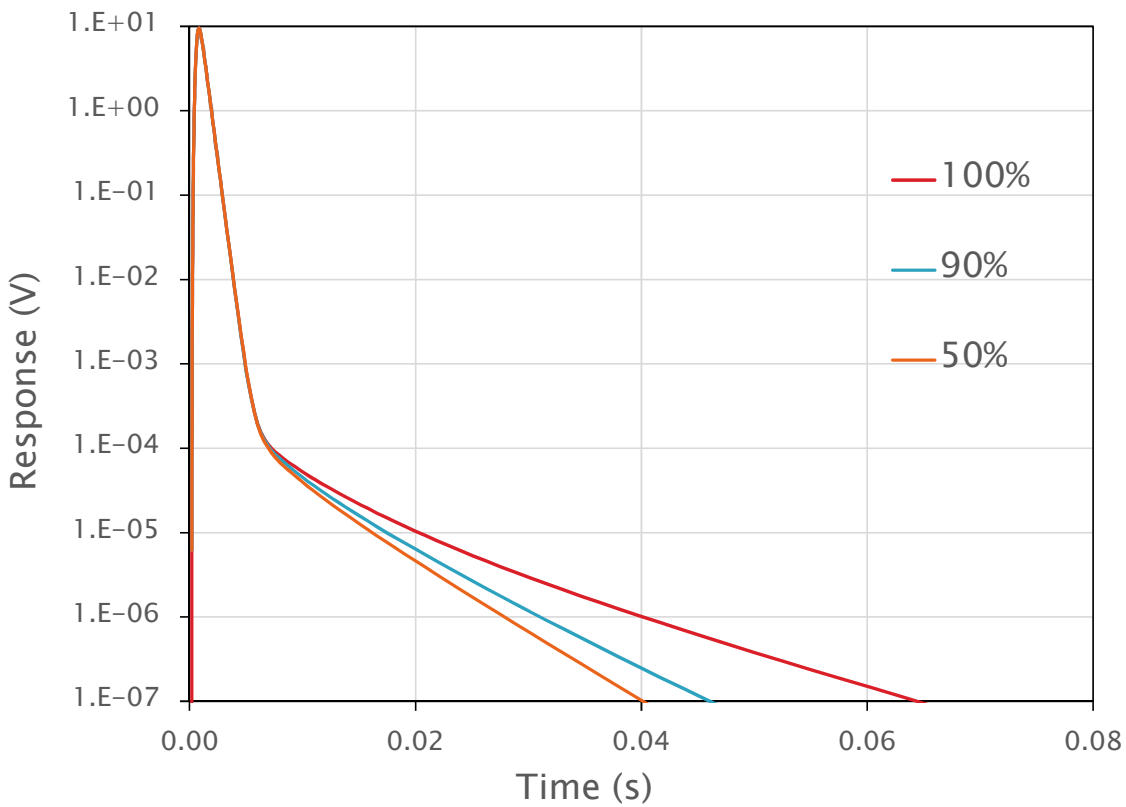


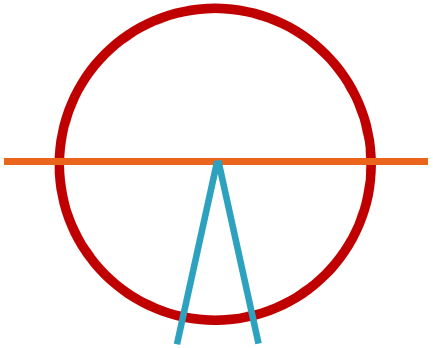
A



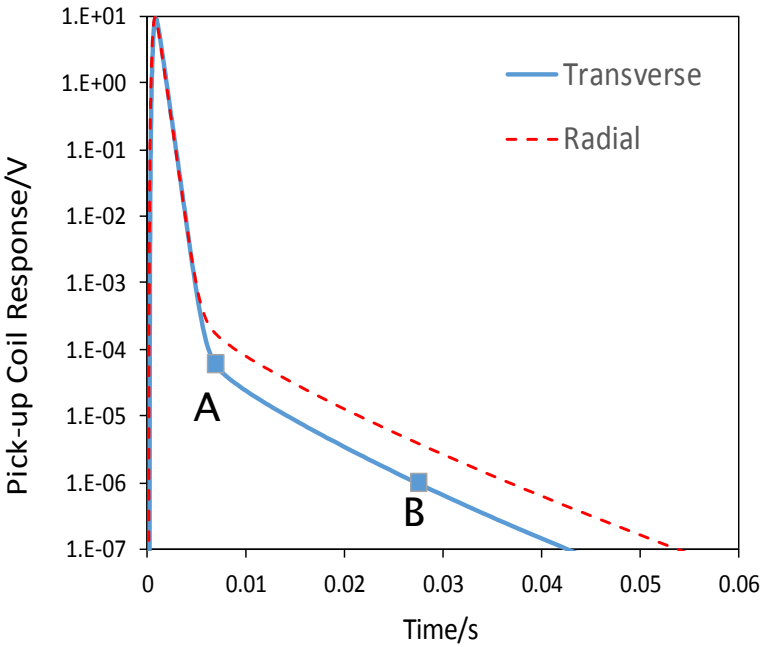
B

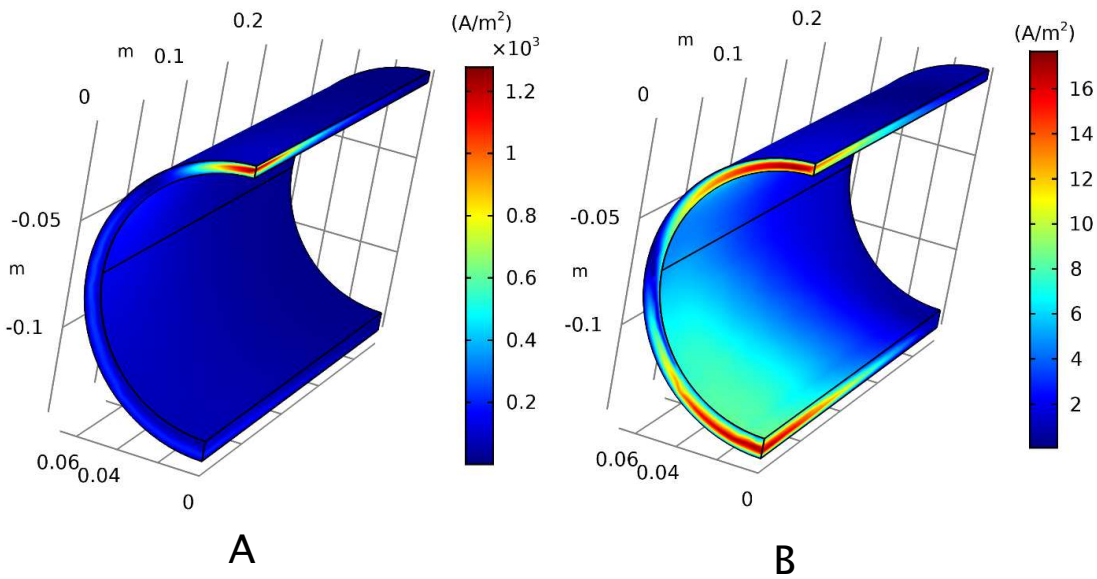
Probe Geometry IV – Longitudinal





Probe Geometry V – Transverse





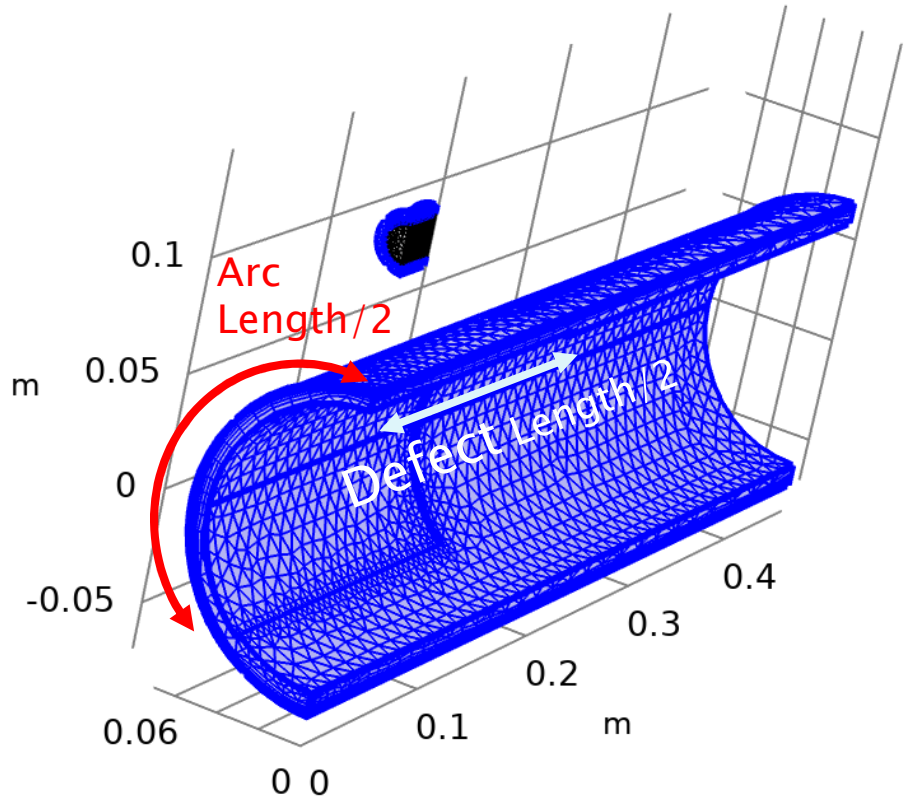
Probe Geometry VI – Summary

All probes
- Get information from delocalised eddy currents

Longitudinal Probe provides
- Information from directly below the probe
- Most confined eddy currents
- Best intensity

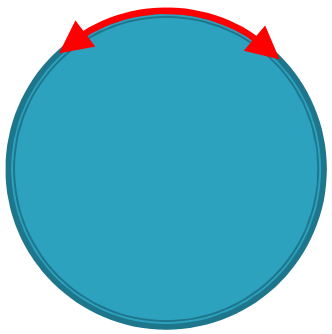
Resolution I

ProbeLength	0.04[m]
DriverID	0.020 [m]
DriverTurns	750
PickUpID	18[mm]
PipeOD	140.5[mm]
LiftOff	50[mm]
PipeLength	18.25*2[in]

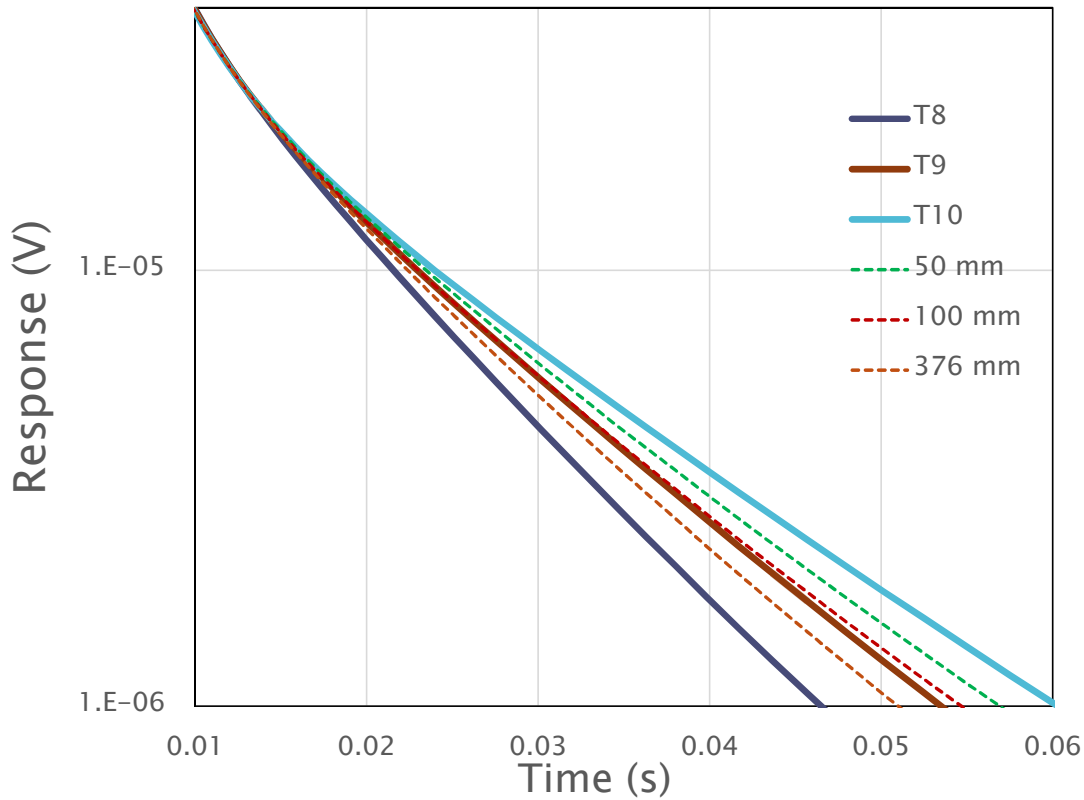


Resolution II – Angular Length

Thickness	10 mm
Defect Depth	2 mm
Defect Length	100 mm

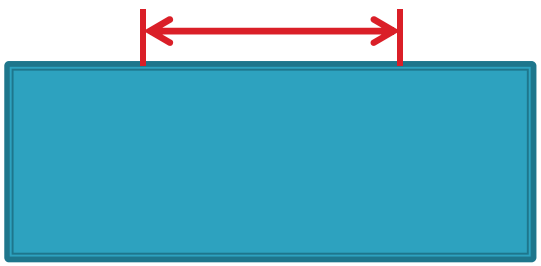


Longitudinal probe

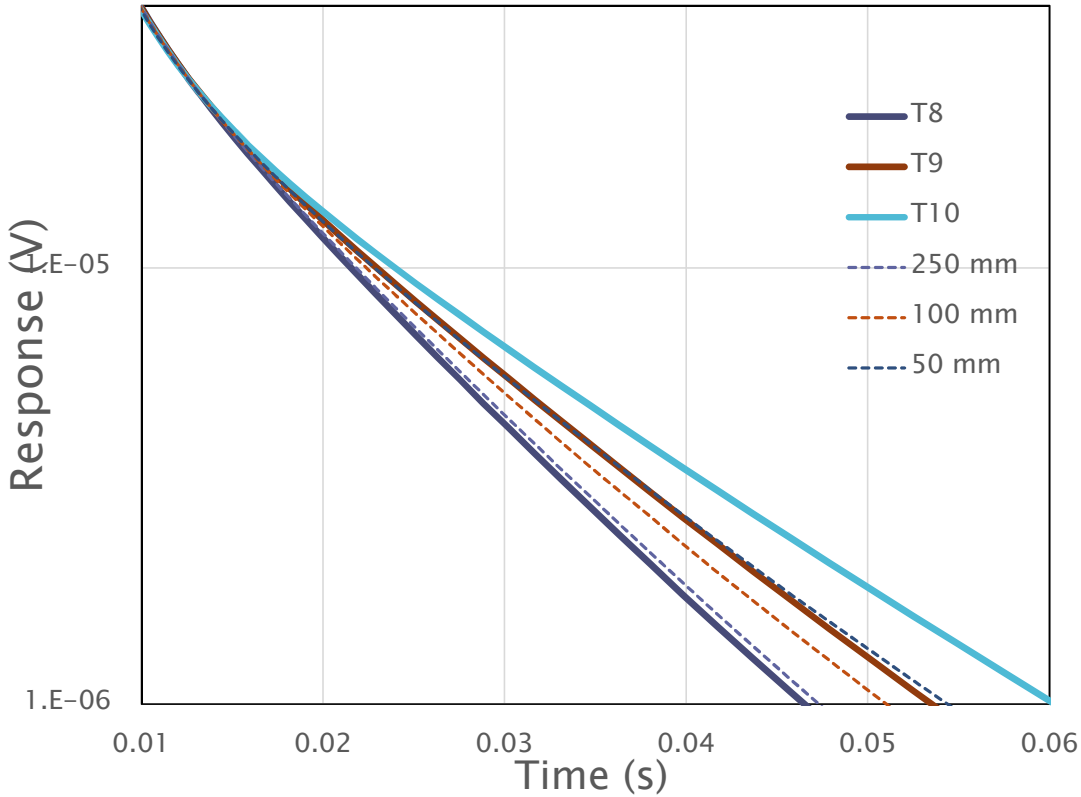


Resolution III – Defect Length

Thickness	10 mm
Defect Depth	2 mm
Angular Length	376 mm



Longitudinal probe



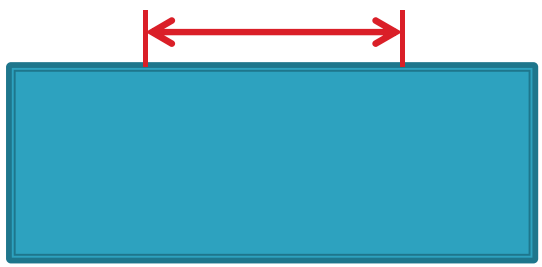
Resolution IV – Summary

Longitudinal probe

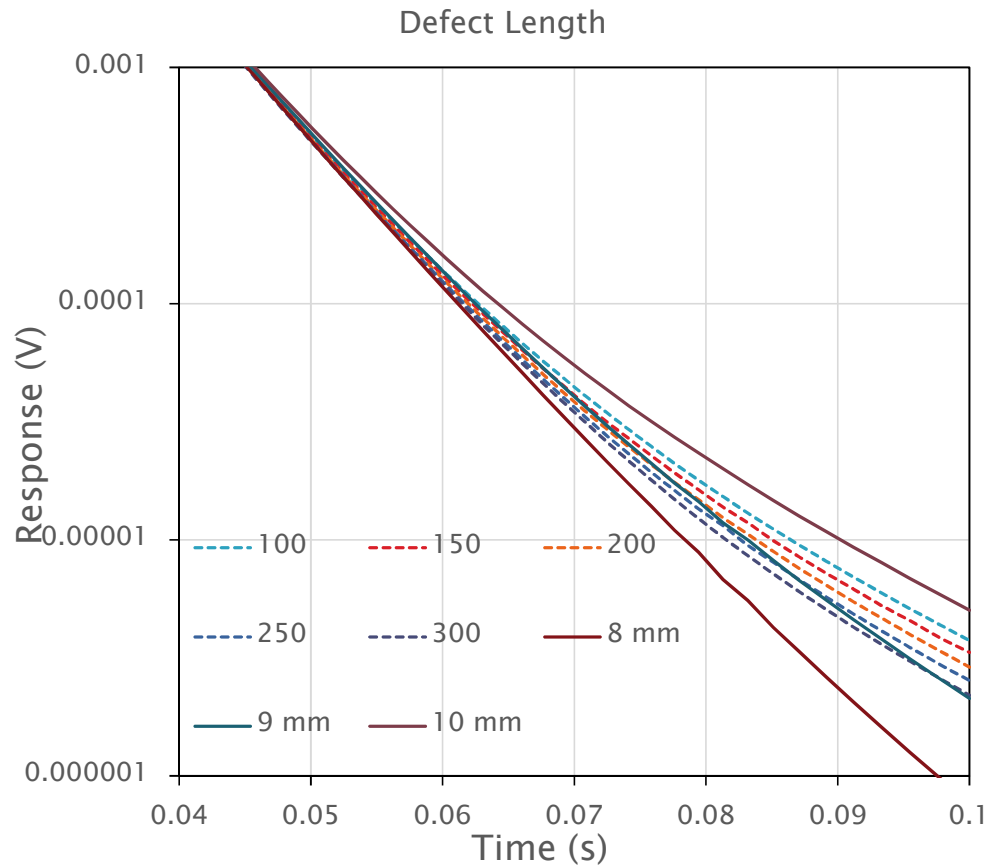
- Footprint covers nearly the whole circumference
  More sensitive to arc length than longitudinal length
  Wall thickness has little effect on footprint

Resolution V – Defect Length

Thickness	10 mm
Defect Depth	2 mm
Angular Length	376 mm



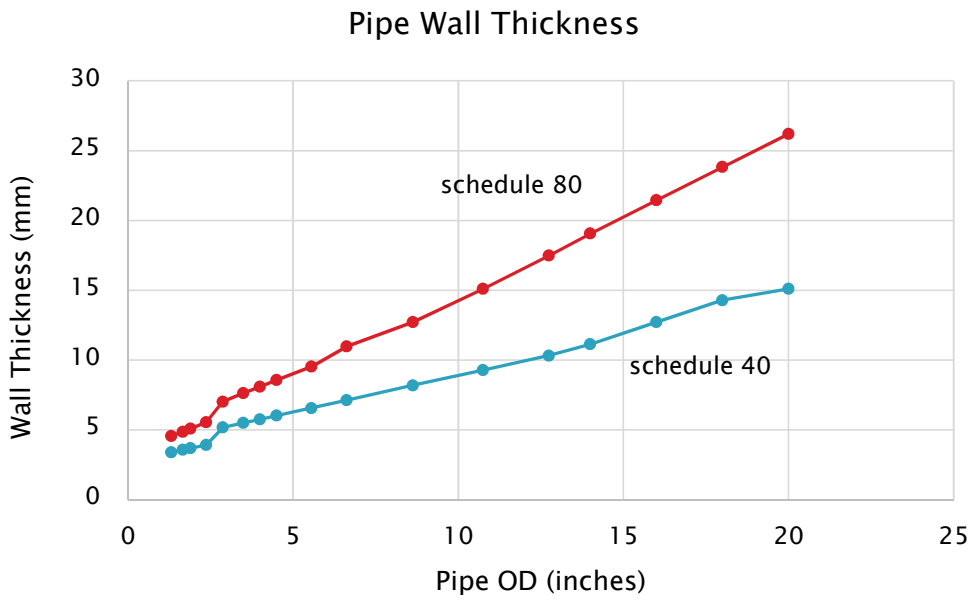
Radial probe



Summary

- Best resolution obtained with longitudinal probe
- Eddy currents go all the way around the pipe (at least for diameters 6” or less)
- Wall thickness has little effect on footprint
- More sensitive to defect arc length than longitudinal length

Summary

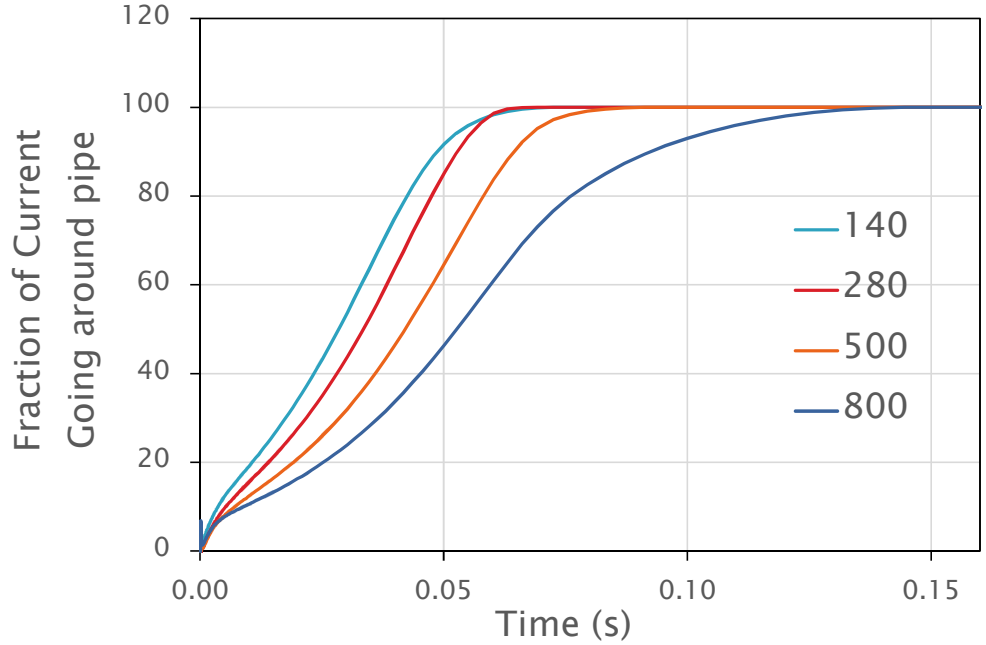


Low inductance
air core
low # of turns on a ferrite core)

Acknowledgements

- NSERC-CRD
- Mequaltech

Questions

Pipe Diameter

10 mm wall