

Effects of EFP Solidity in Terminal Ballistics

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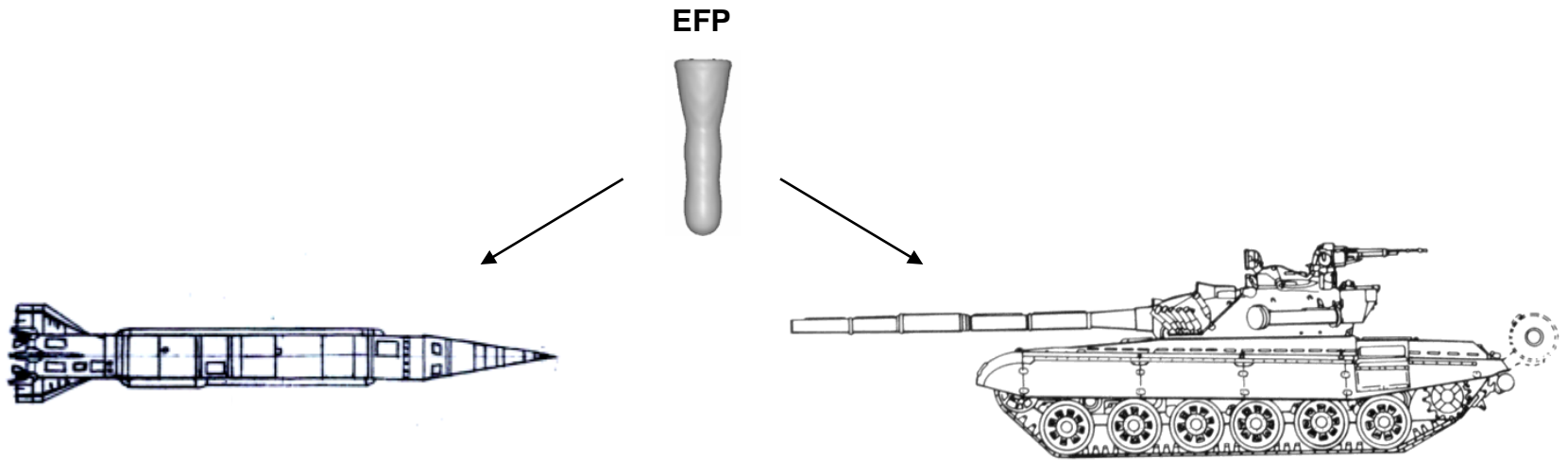
Outline

- **Motivation & Introduction**
- **Experimental Tests: Setup & Results**
- **Numerical Simulations**
- **Modeling Approach**
- **Summary**

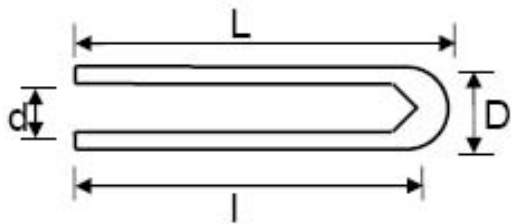
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Motivation: EFP-Code Development



EFP Simulants: Cross Section Sketch and machined Projectiles



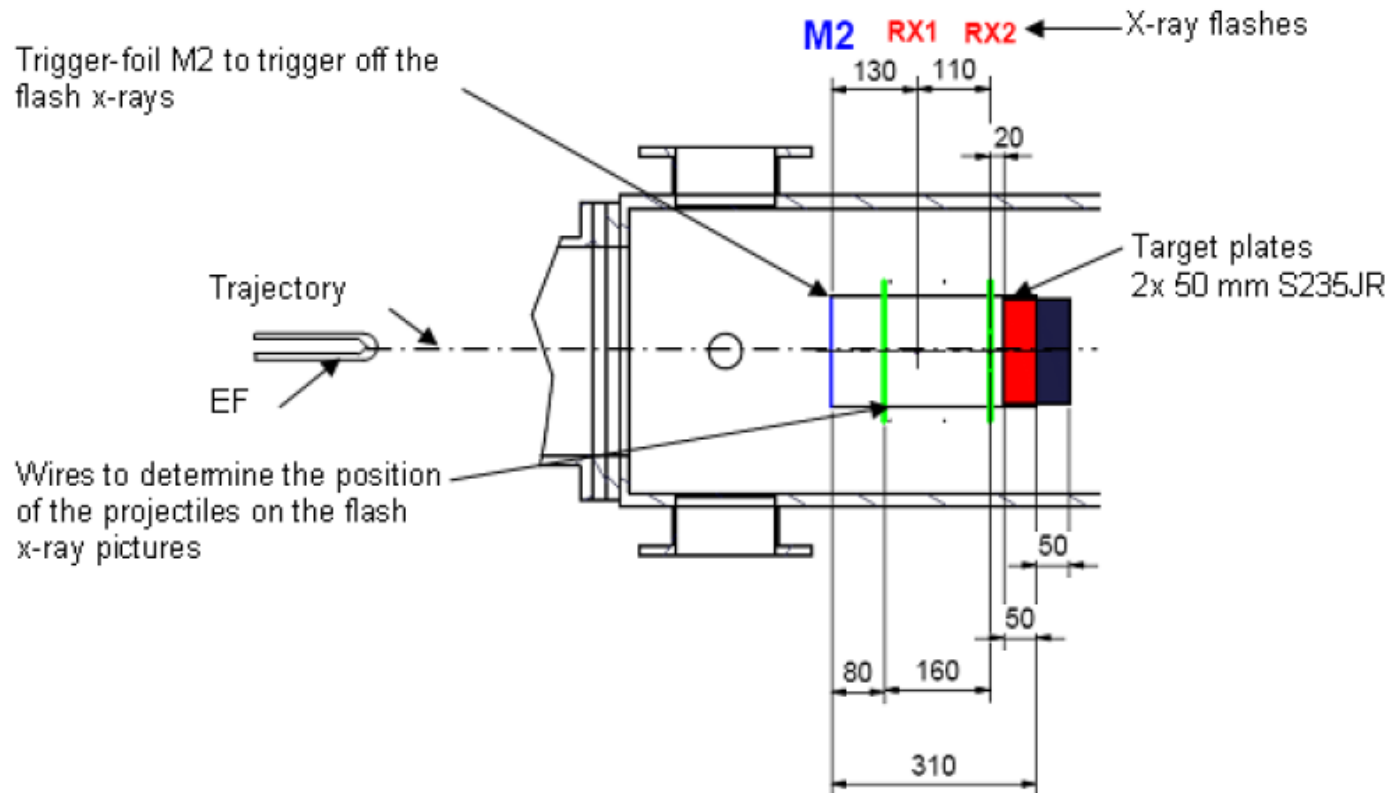
Dimensions of EFP simulants

Solidity	L [mm]	D [mm]	l [mm]	d [mm]
100 %	30	10	0	0
80 %	30	10	26.6	4.3
60 %	30	10	28	6.3

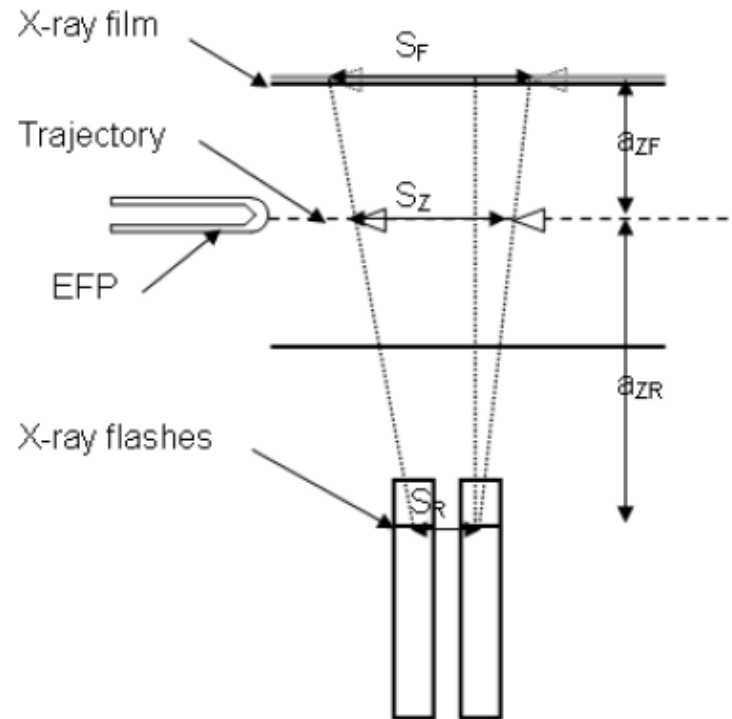
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Test Setup for DoP Tests

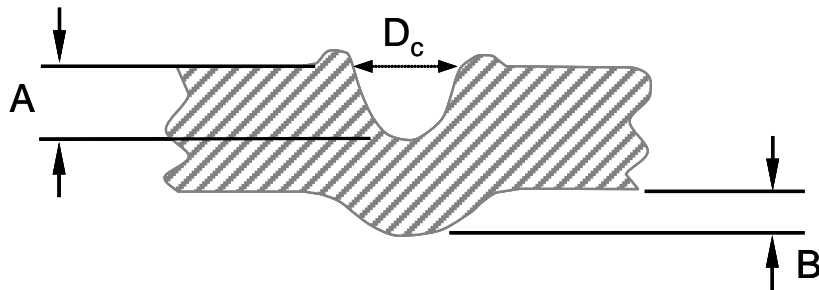


Velocity Evaluation Procedure from FXR Captures



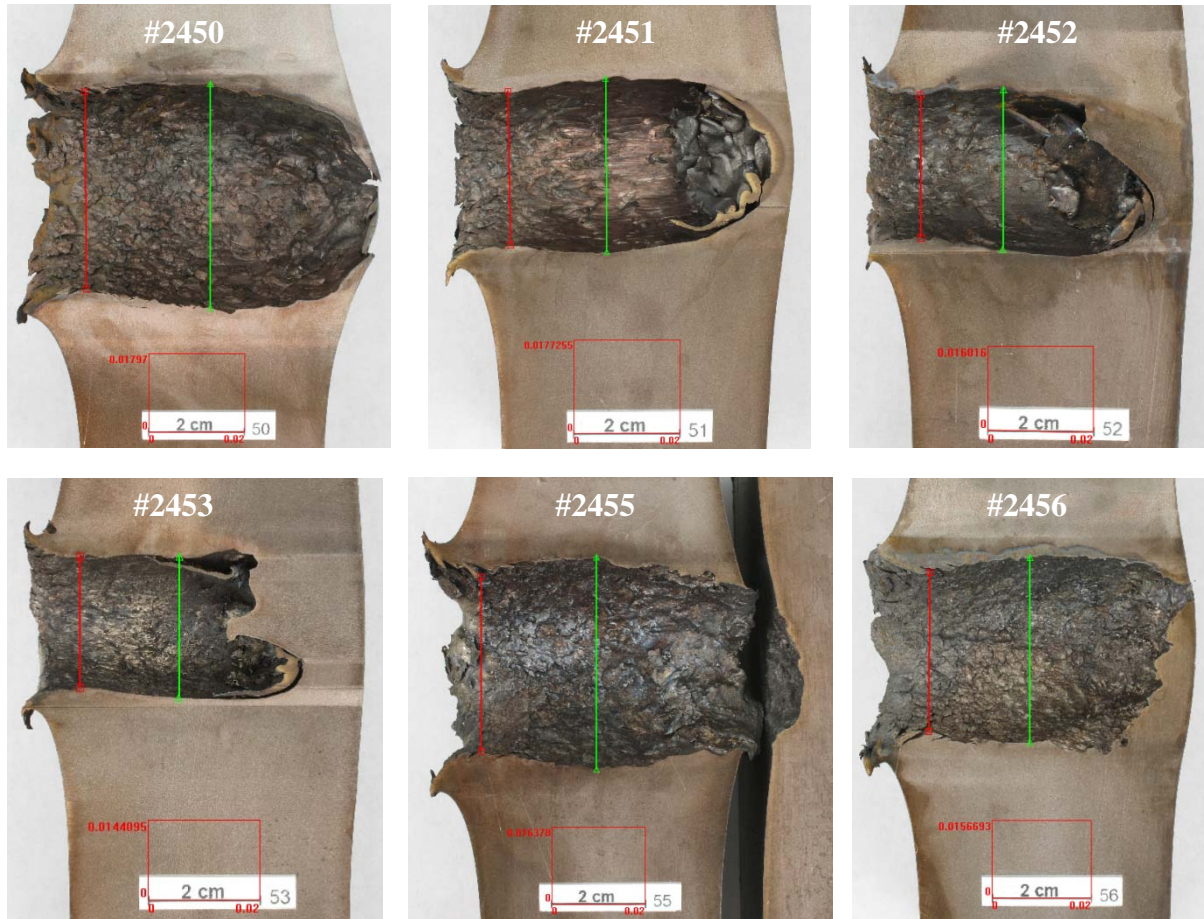
$$S_Z = \frac{S_F \cdot a_{ZR} + S_R \cdot a_{ZF}}{a_{ZR} + a_{ZF}}$$

Evaluation of Impact Depth and Crater Diameter



DEPTH OF PENETRATION =
A (HOLE DEPTH) - B

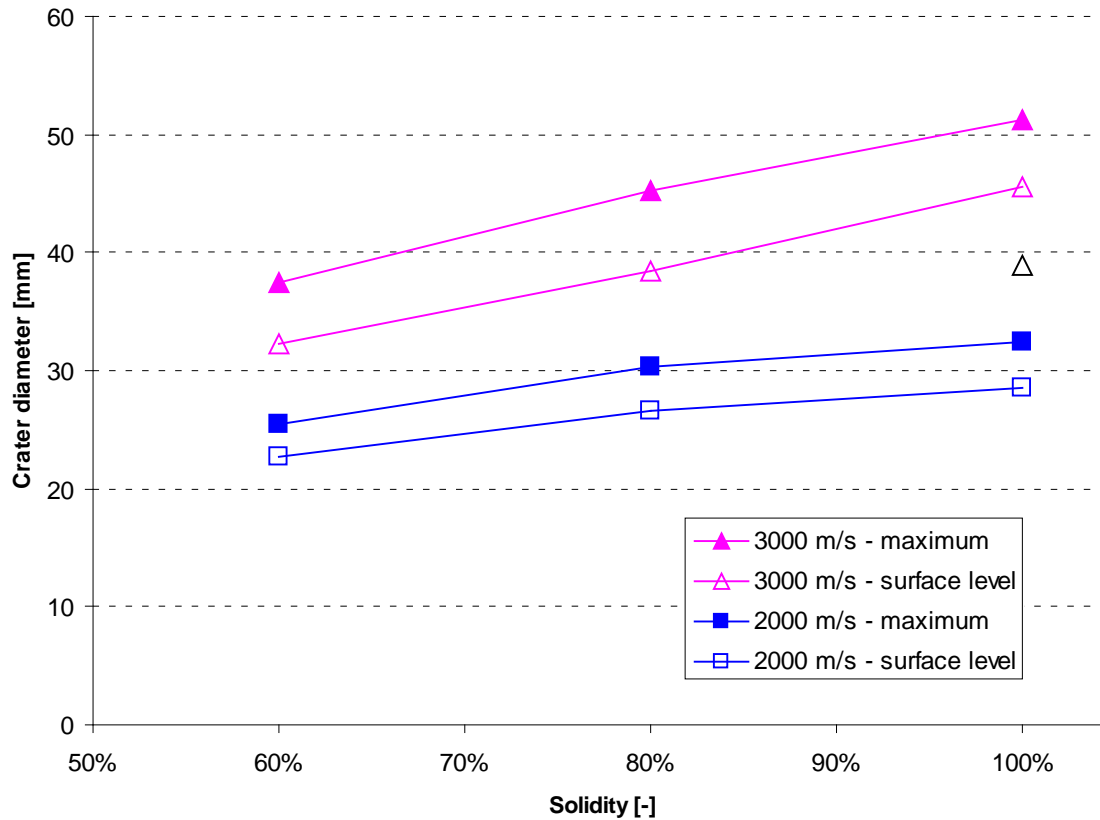
Evaluation of Crater Diameters and DoPs



Results of Crater Diameters and DoPs with different Solidity Ta-EFP Simulants

Test #	Solidity	V [m/s]	Crater diameter [mm]	DoP [mm]
2450	100%	2914	39.0	60.4
2451	100%	2075	28.6	53.0
2455	80%	2936	38.5	60.0
2452	80%	2087	26.6	42.4
2456	60%	3129	32.3	53.7
2453	60%	2041	22.7	39.1

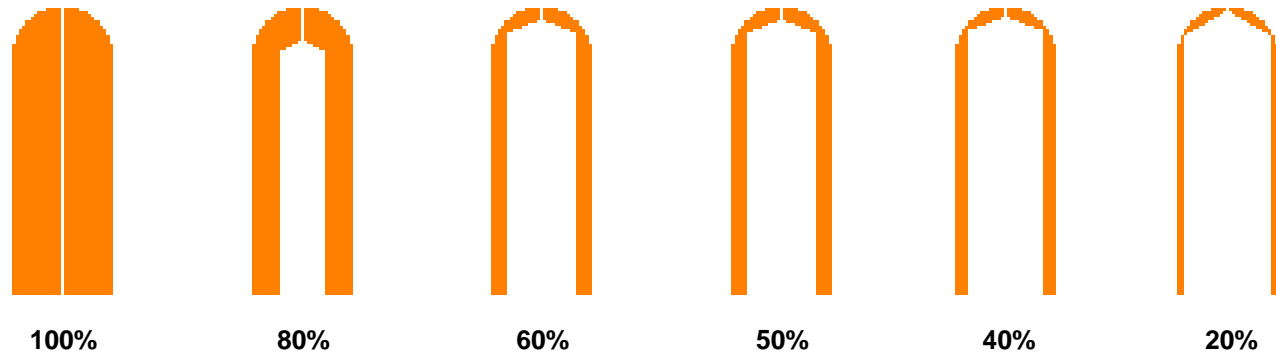
Results of Crater Diameters with Different Solidity Ta-EFP Simulants



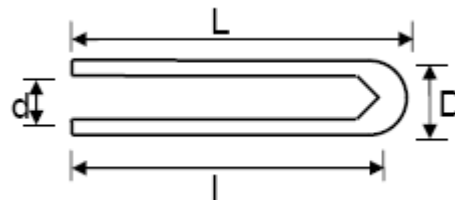
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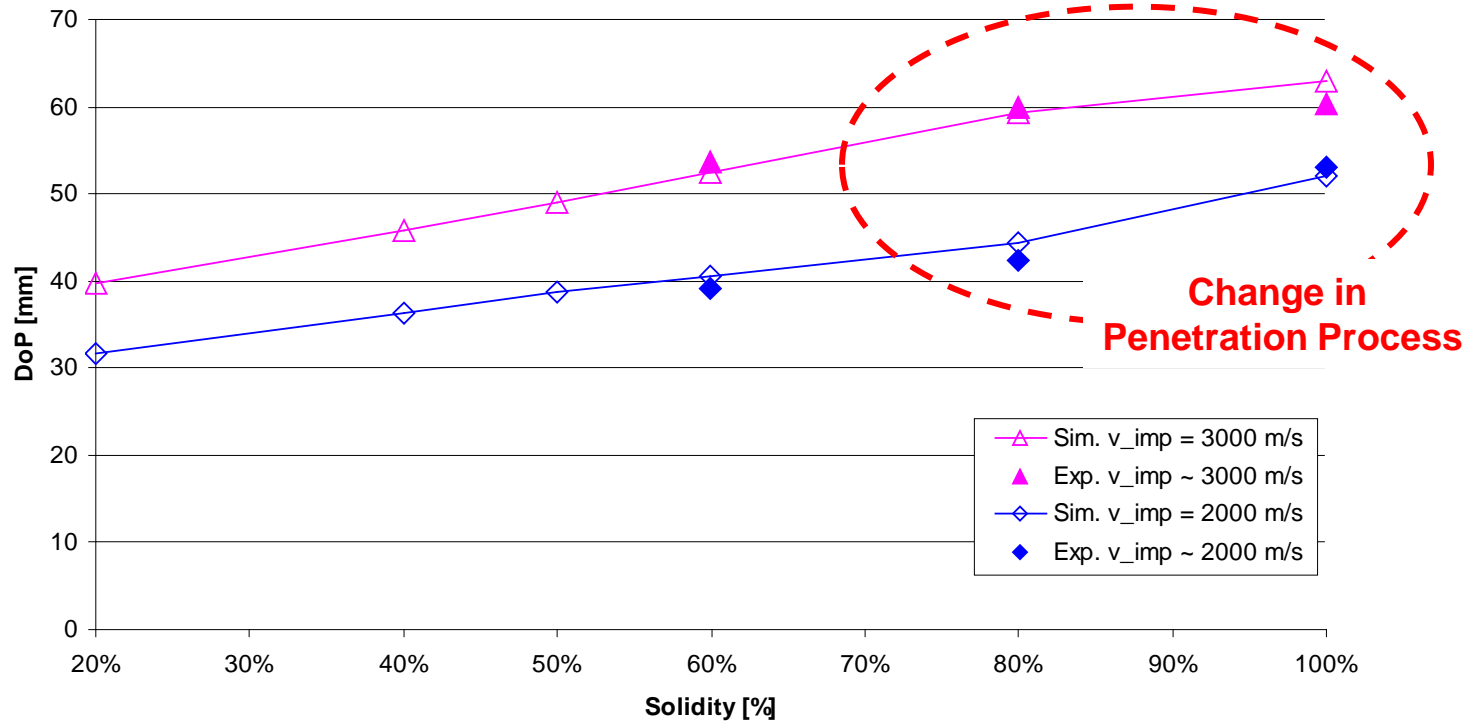
Investigated Constant Dimensions EFPs of Different Solidity



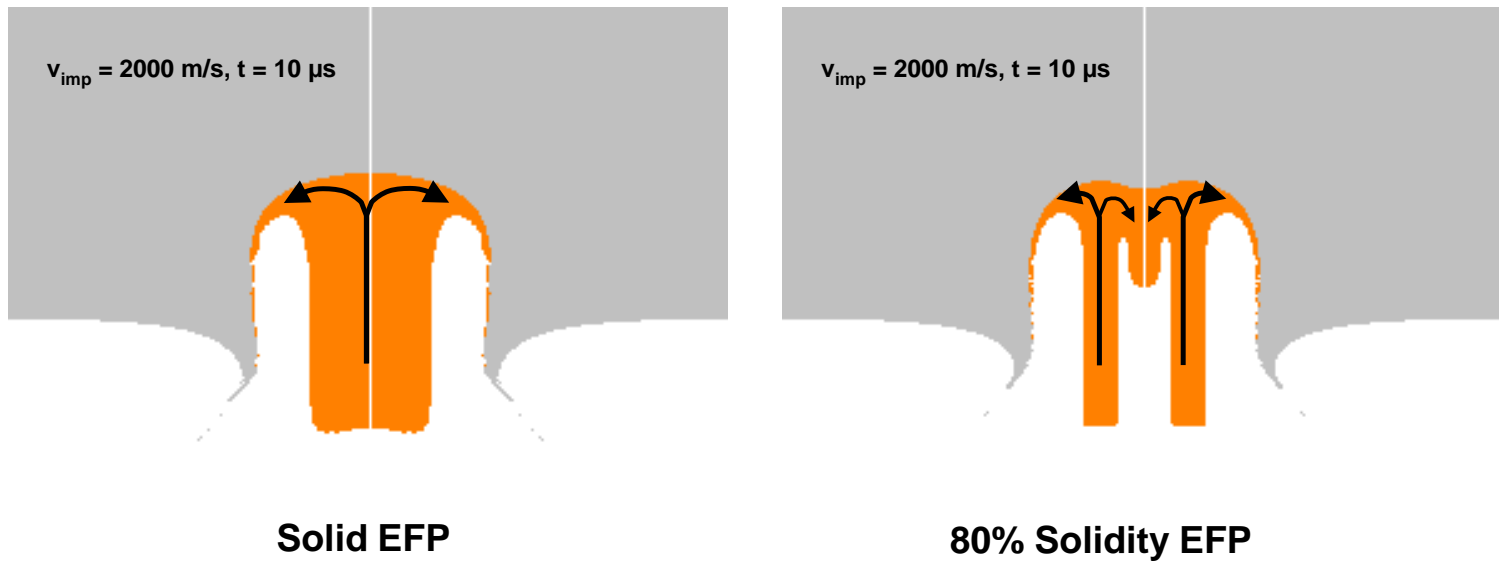
Solidity	100%	80%	60%	50%	40%	20%
Bore diameter d [mm]	0.0	4.3	6.3	7.2	7.8	8.9
Bore length l [mm]	0.0	26.6	28.0	28.6	29.9	29.5



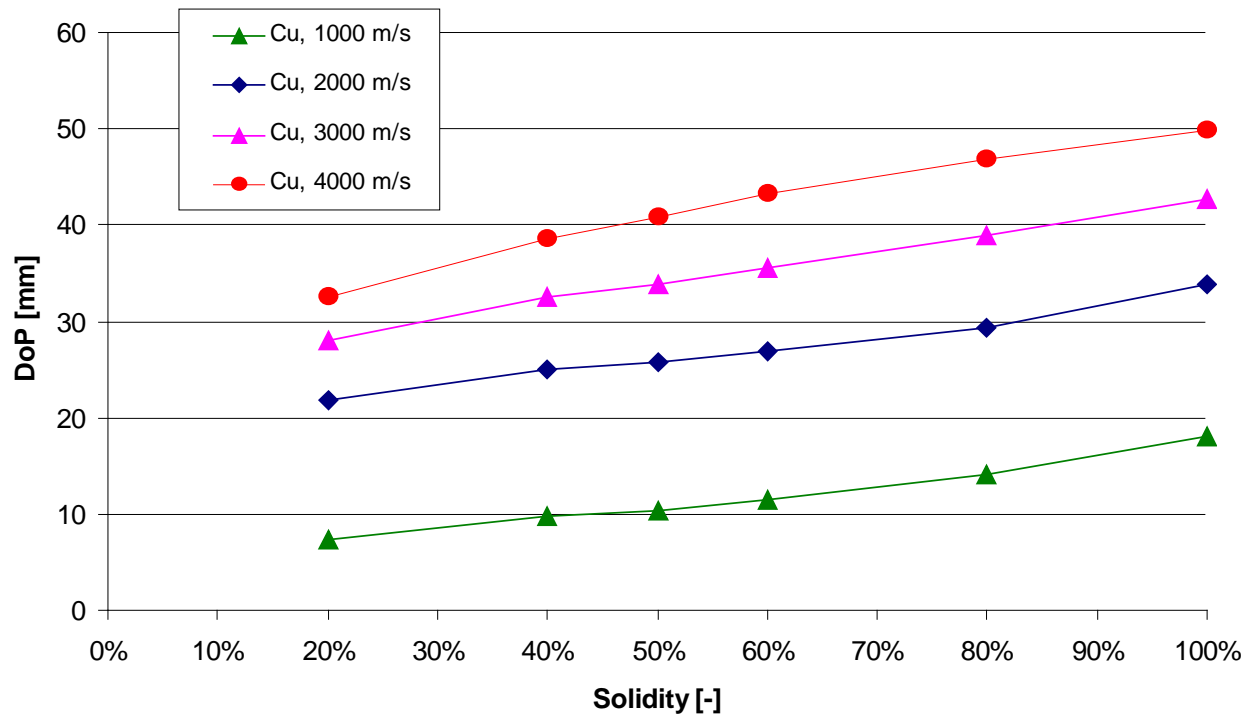
Numerical and Experimental DoP of different Solidity Ta-EFPs



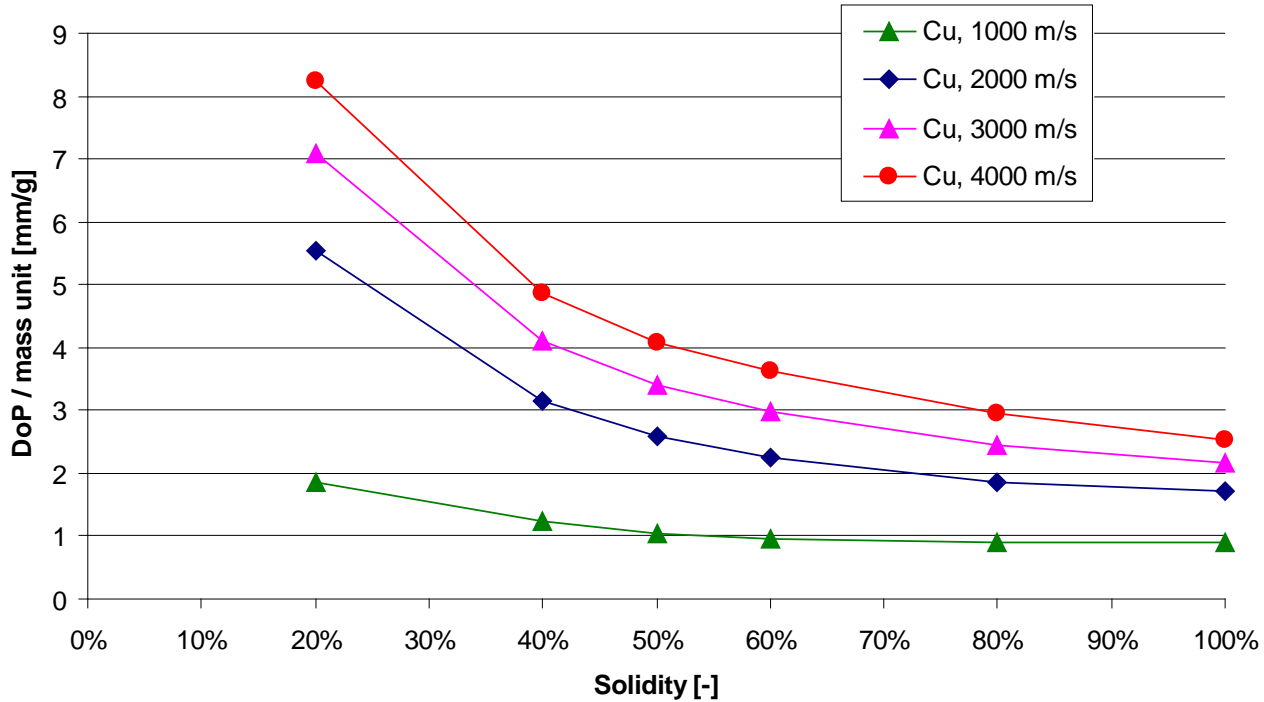
Change in Erosion Pattern from Solid to Hollow Projectiles



Numerical Penetration Depths of Different Solidity Cu-EFPs



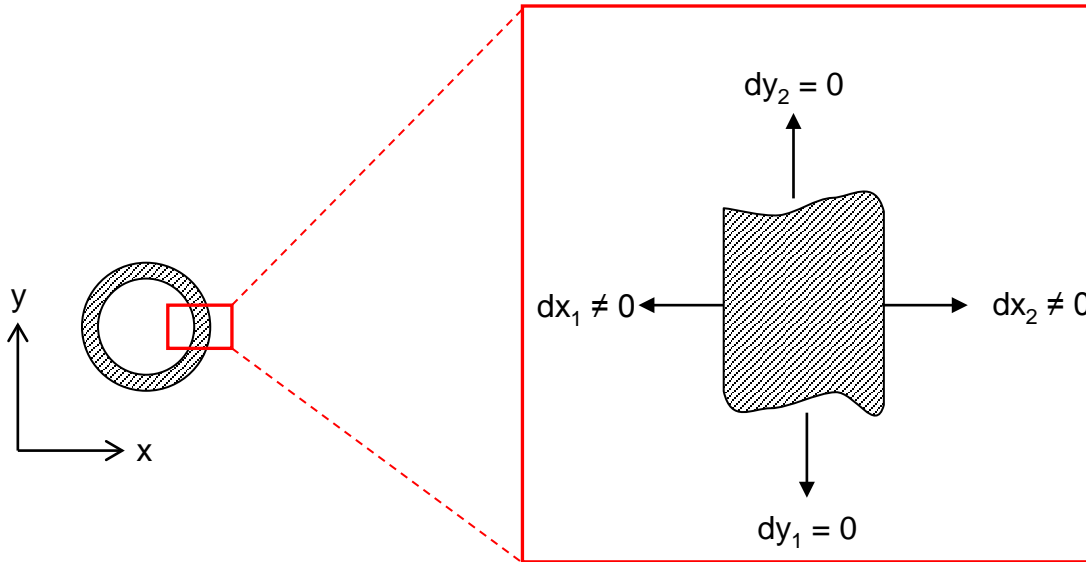
DoP / Mass Unit vs. Solidity of Cu-EFPs for Different Impact Velocities



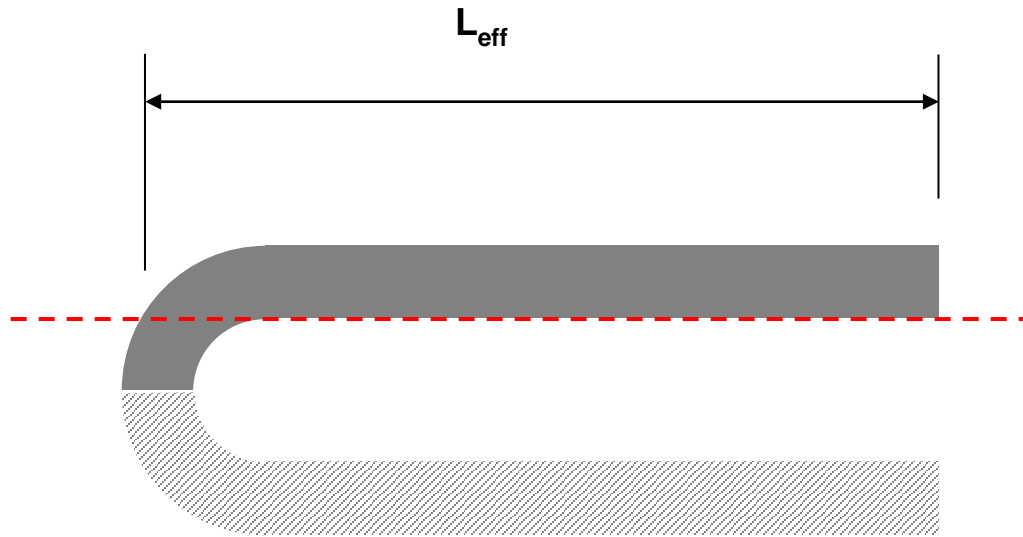
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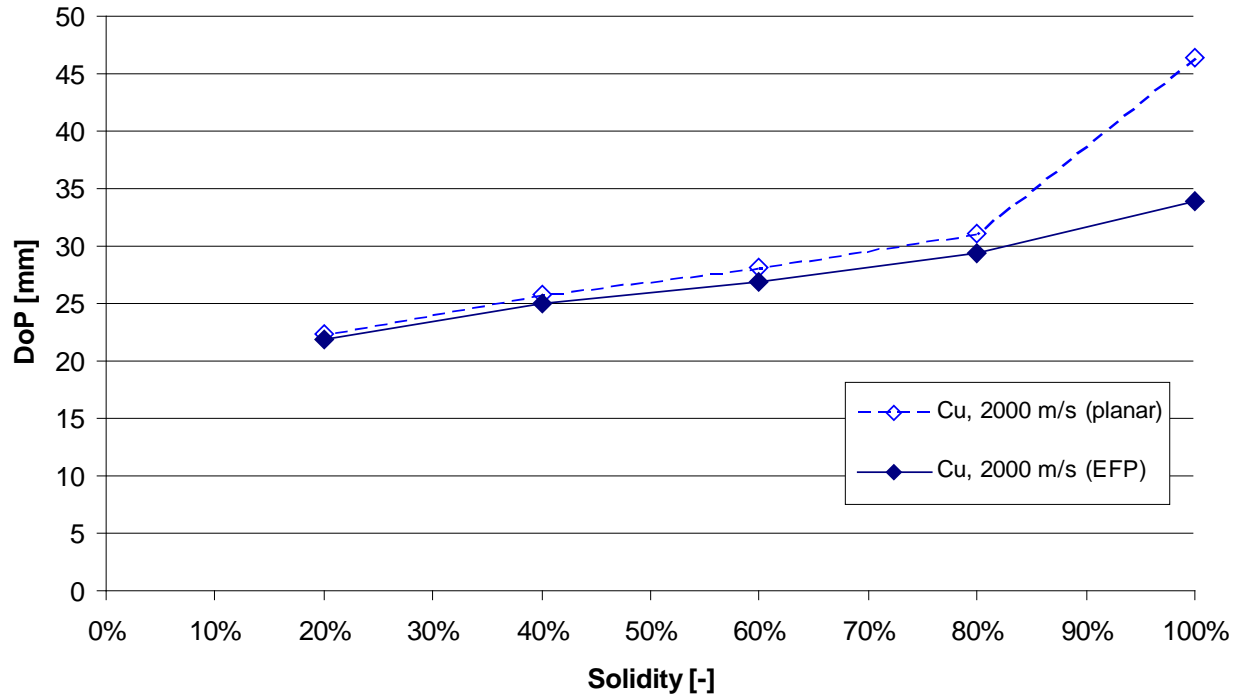
Possible Displacements on Infinitesimal Element of Hollow EFP (simplified)



Definition of Effective Length for Planar Simplification



Comparison of EFP and Equivalent Shell Impact @ $v_{imp} = 2000$ m/s



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- Investigation of the Influence of EFP Solidity on Penetration Performance
- Experimental DoP Tests with Ta-EFPs with different Solidities were performed
- Numerical Simulations with Cu- EFPs and Ta-EFPs of different Solidities
- Change in DoP Process from Solid to Hollow EFP required Extension of existing Penetration Model
- Good Agreement with Experimental Results

Thank you !

Any Questions ?

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