RIPS 2017
RUSSIA INTERNATIONAL PERFORATING SYMPOSIUM

Influence of formation parameters on the perforating result in dependence of the shaped charge type

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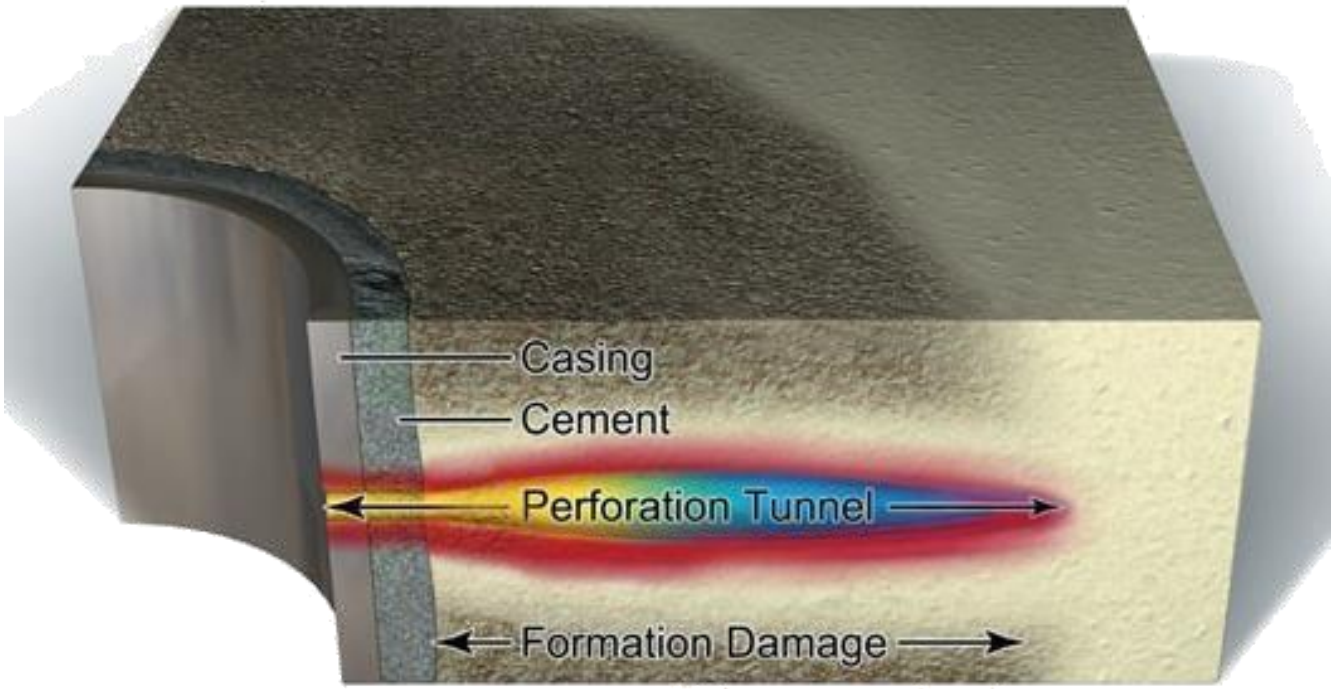
Agenda

- Why are we perforating
- Perforating systems
- API RP 19B / SS-05
- Test results
  - Test shots in differing formation types
  - Effects of differing shaped charge types

Why is perforating important?



Perforating Systems

Deep Penetrating (DP)

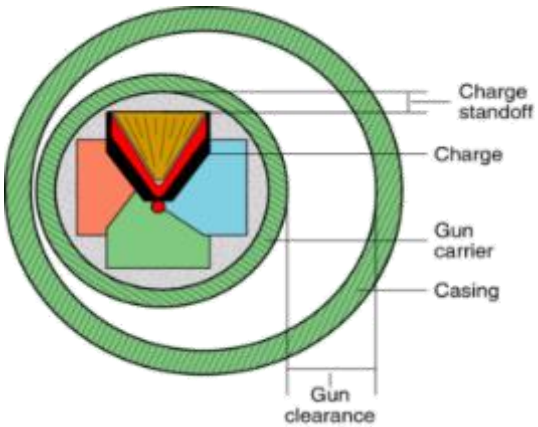
Good Hole (GH)

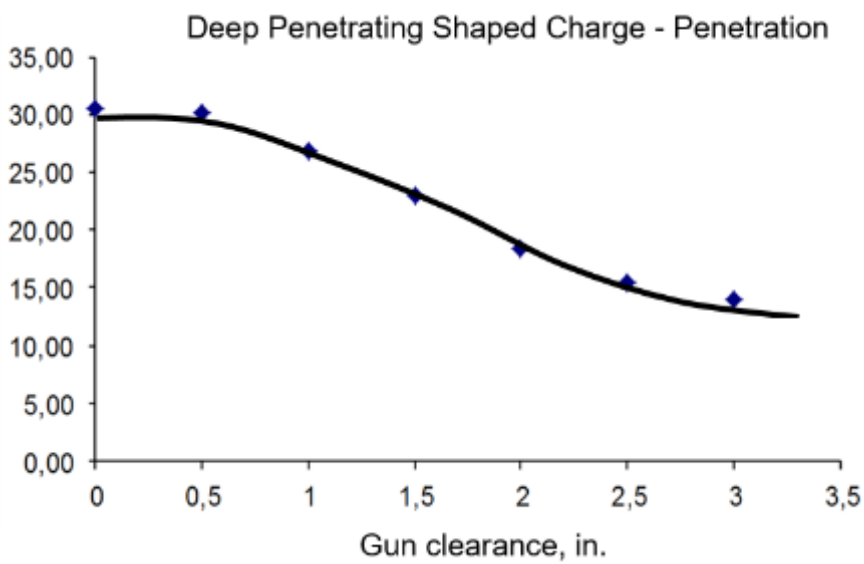
Big Hole (BH)

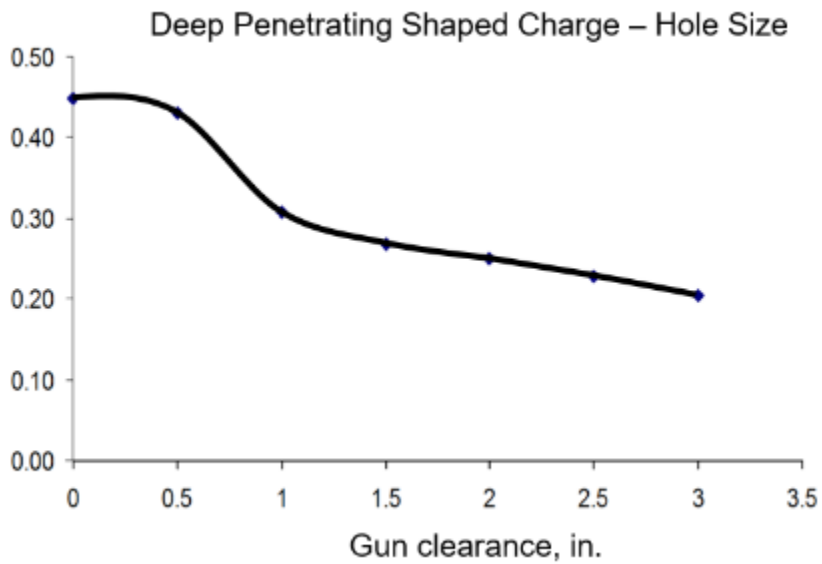
Slotted Hole

Perforating Systems

Influences on perforating results







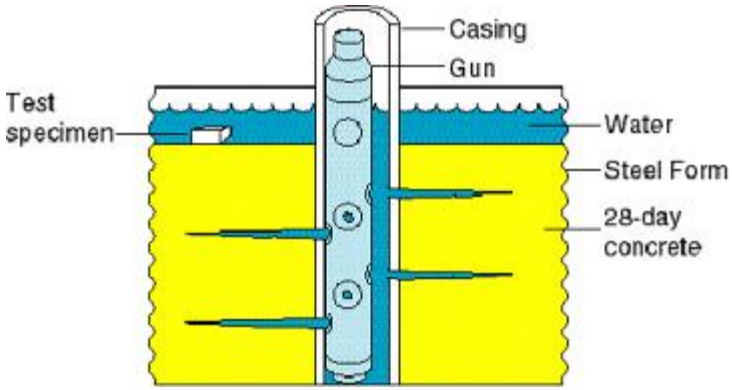
Perforating Systems

Influences on perforating results

Deep Penetrating Shaped Charge

Target	Penetration Inches	Variance %
API Section 1 concrete	24.0	6.0%
QC Berea (confined)	21.3	6.7%
Austin Chalk Slab	25.0	6.4%
Limestone Slab (Std. Bedford)	18.3	4.7%
Berea Slab	17.8	10.%
Grey Ohio Sandstone Slab	15.7	5.1%
Nugget Sandstone Slab	9.7	6.0%

API RP 19B



Recommendations of the American Petroleum Institute for evaluating shaped charges

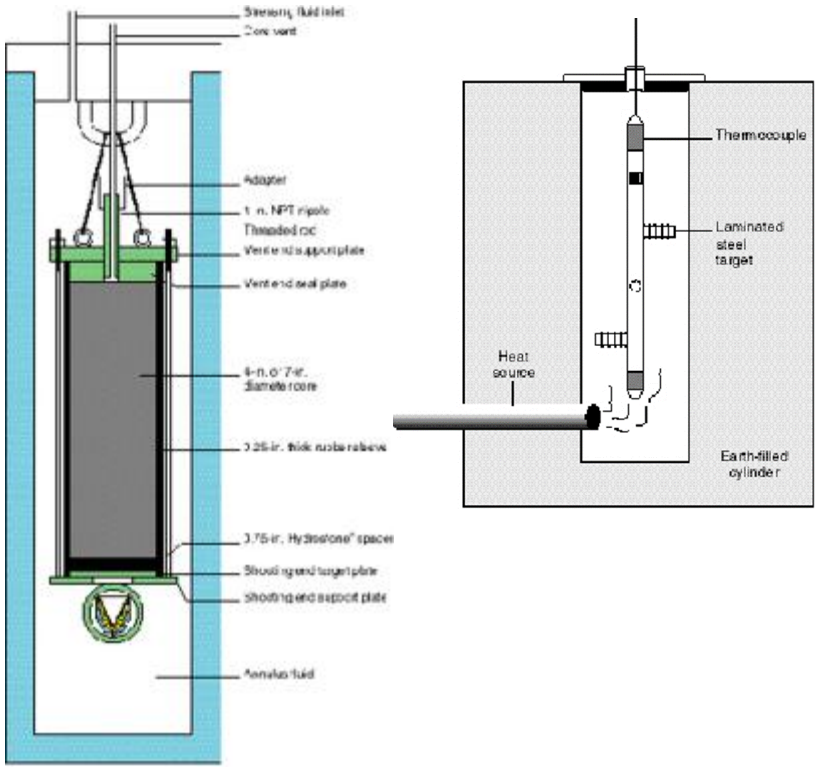
Sections 1 to 4

Section 1. Performance of a perforating system in a concrete target under ambient conditions

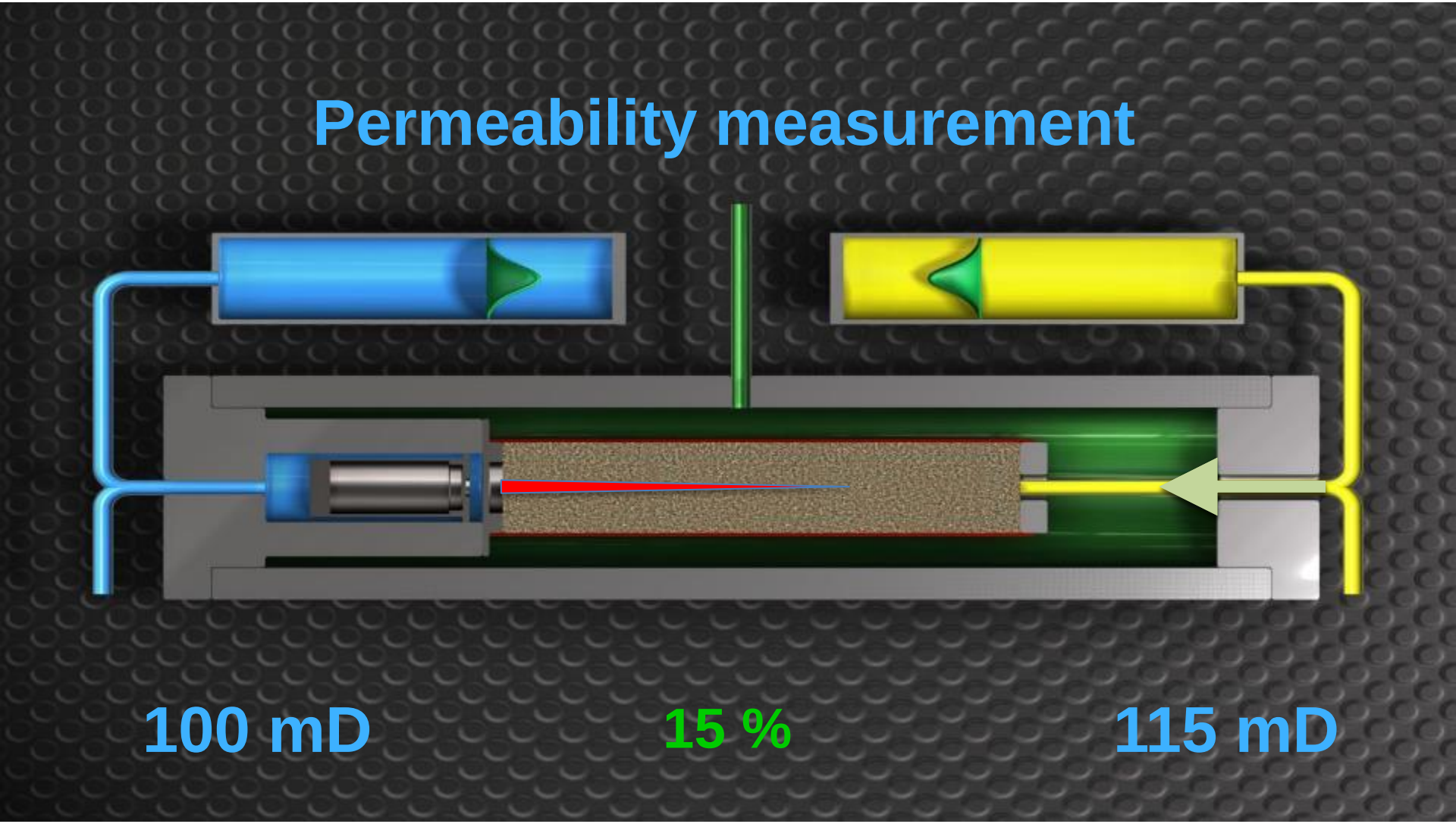
Section 2. Performance of a shaped charge in a stressed Berea sandstone column

Section 3. Performance of a perforating system in steel in elevated temperatures

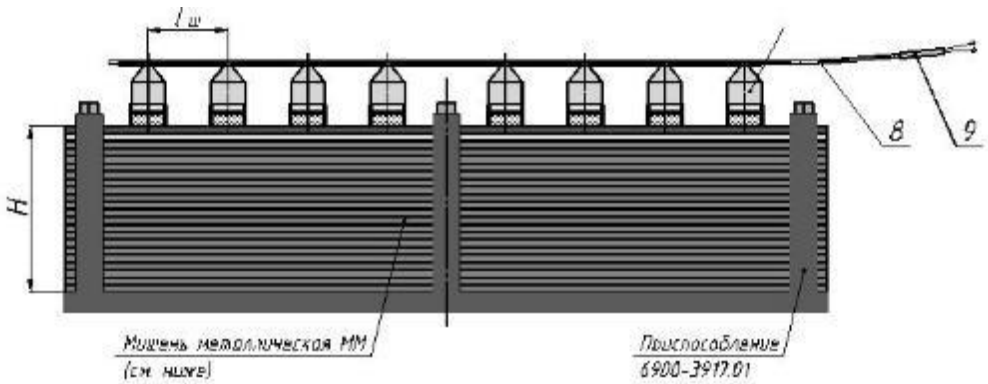
Section 4. Performance of a shaped charge in a stressed formation stone column under borehole conditions



API RP 19B Section 4



SS-05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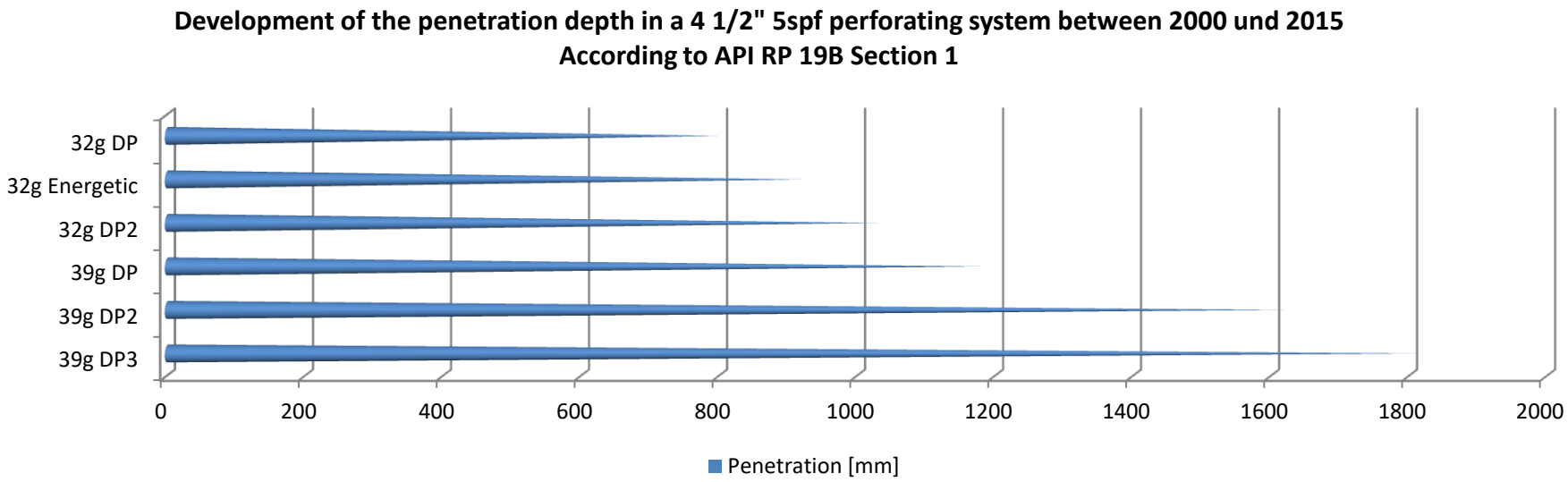
Мишень металлическая ММ
(см. ниже)
Приспособление
6900-3917.01

SS-05 vs. API Section 1

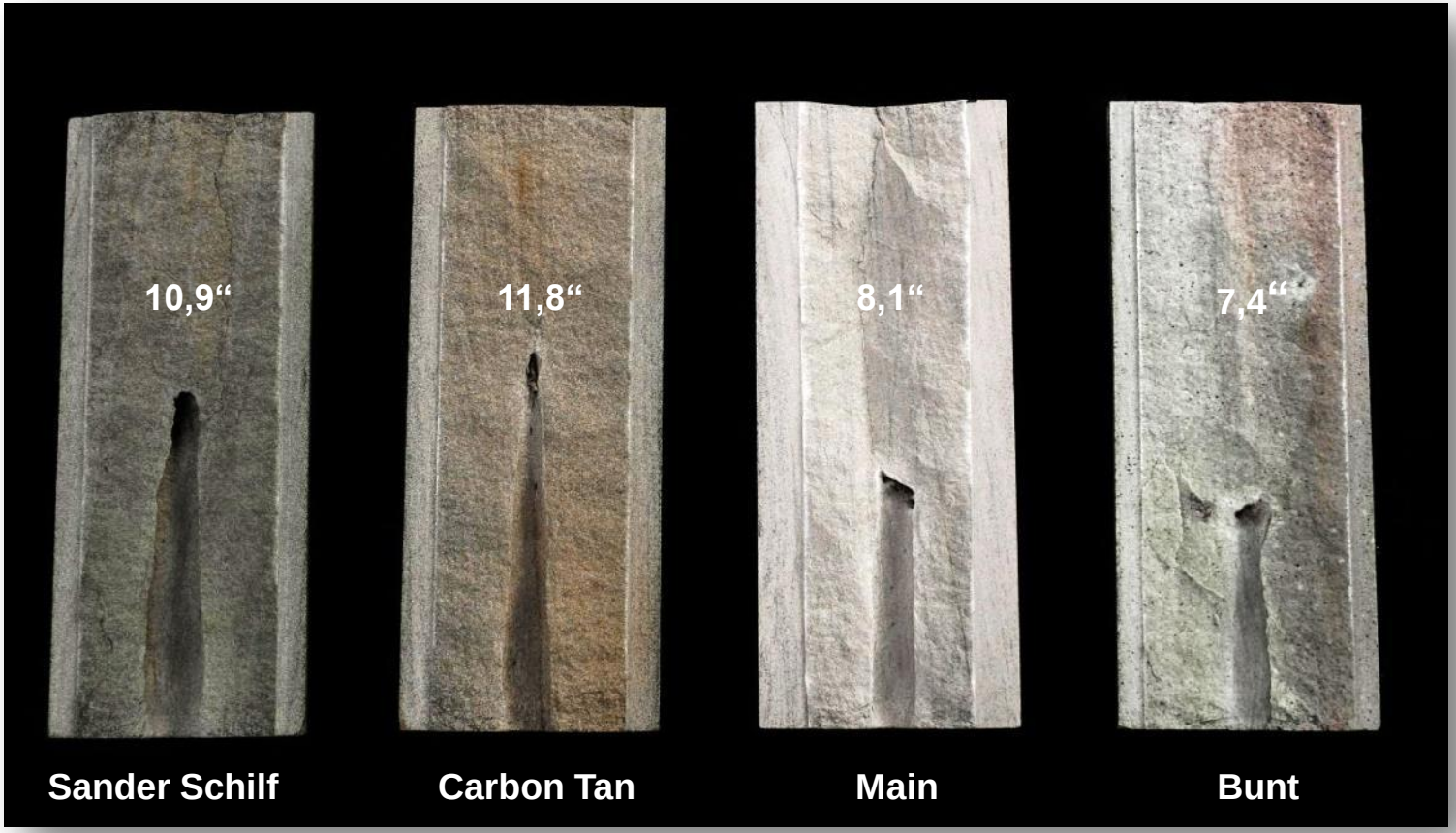
Charge Type	EX type	SS-05		Calculated SS-05 TTP in Concrete	API 19b Data Sheet		Difference API Section 1 to SS-05	
		EHD (mm)	TTP in Steel (mm)	TTP (mm)	EHD (mm)	TTP (mm)	EHD (mm)	TTP (mm)
6,5g DP	RDX	6,65	124	546	6,1	592	-9%	8%
25g DP	HMX	8,95	320	1408	10,16	1435	12%	2%
26g DP	HMX	10,3	232	1020,8	9,14	1083	-13%	6%

Evaluation Results



Evaluation Results

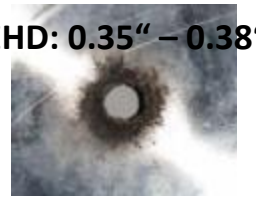
Evaluation Results – 26g DPEX



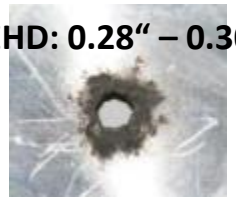
Evaluation Results – Main Sandstone

EHD: 0.37“ – 0.41“

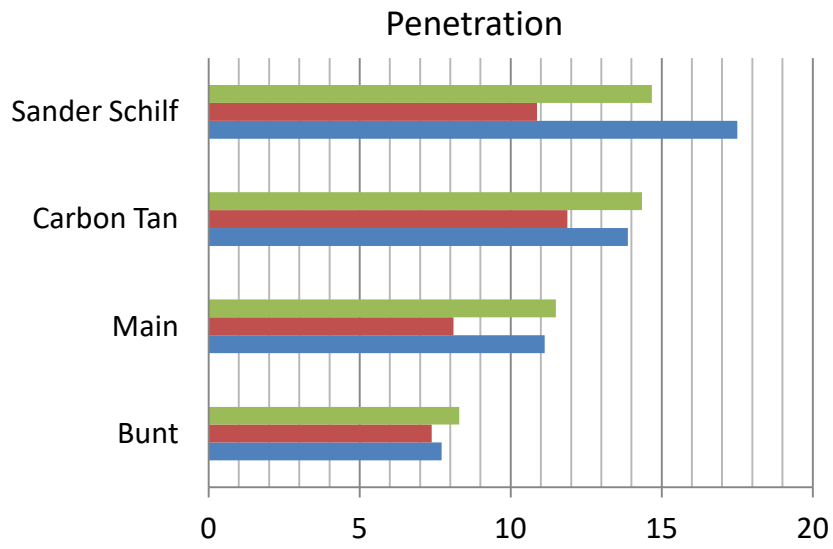
EHD: 0.35“ – 0.38“

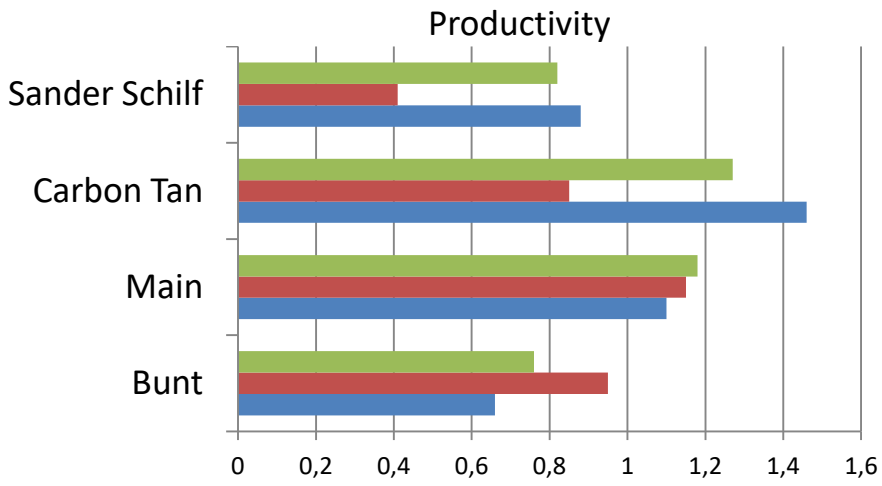


EHD: 0.28“ – 0.30“



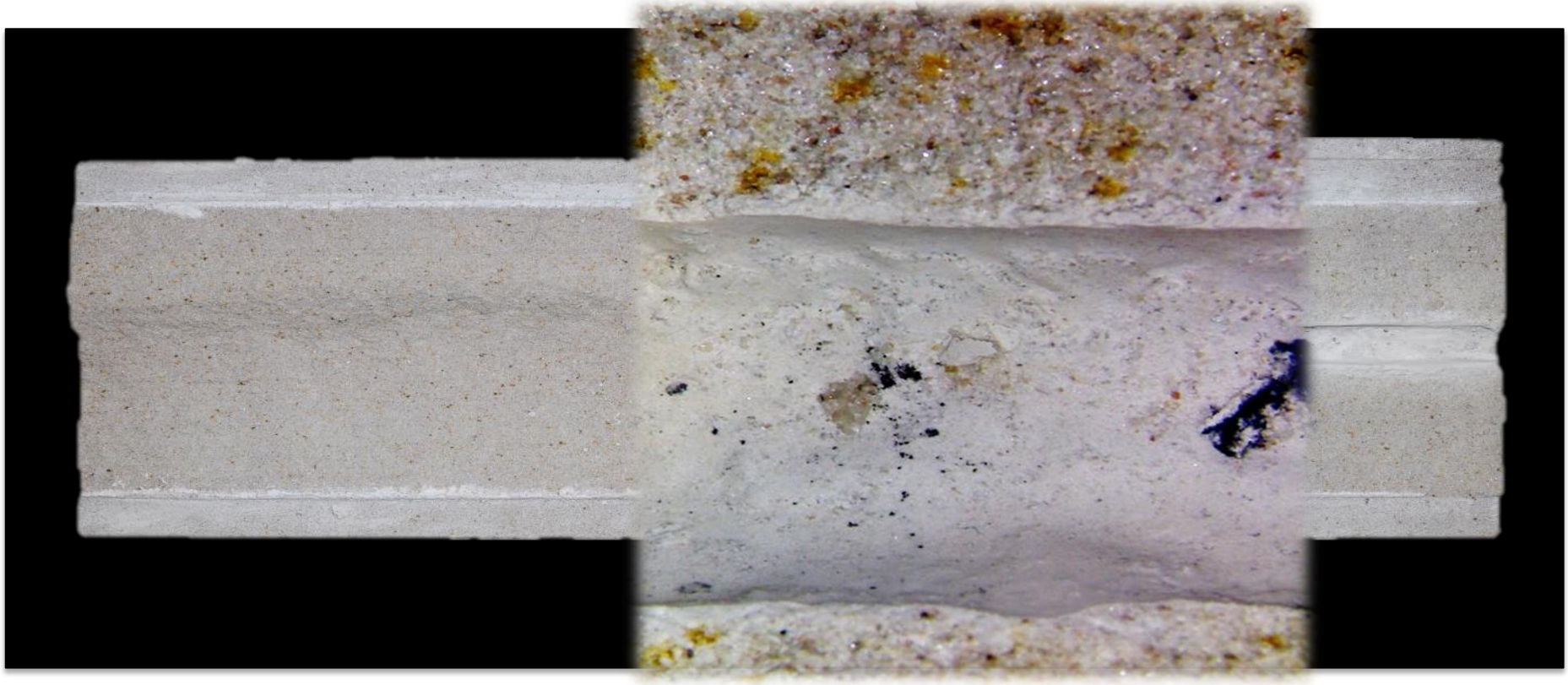
Penetration / Productivity Results



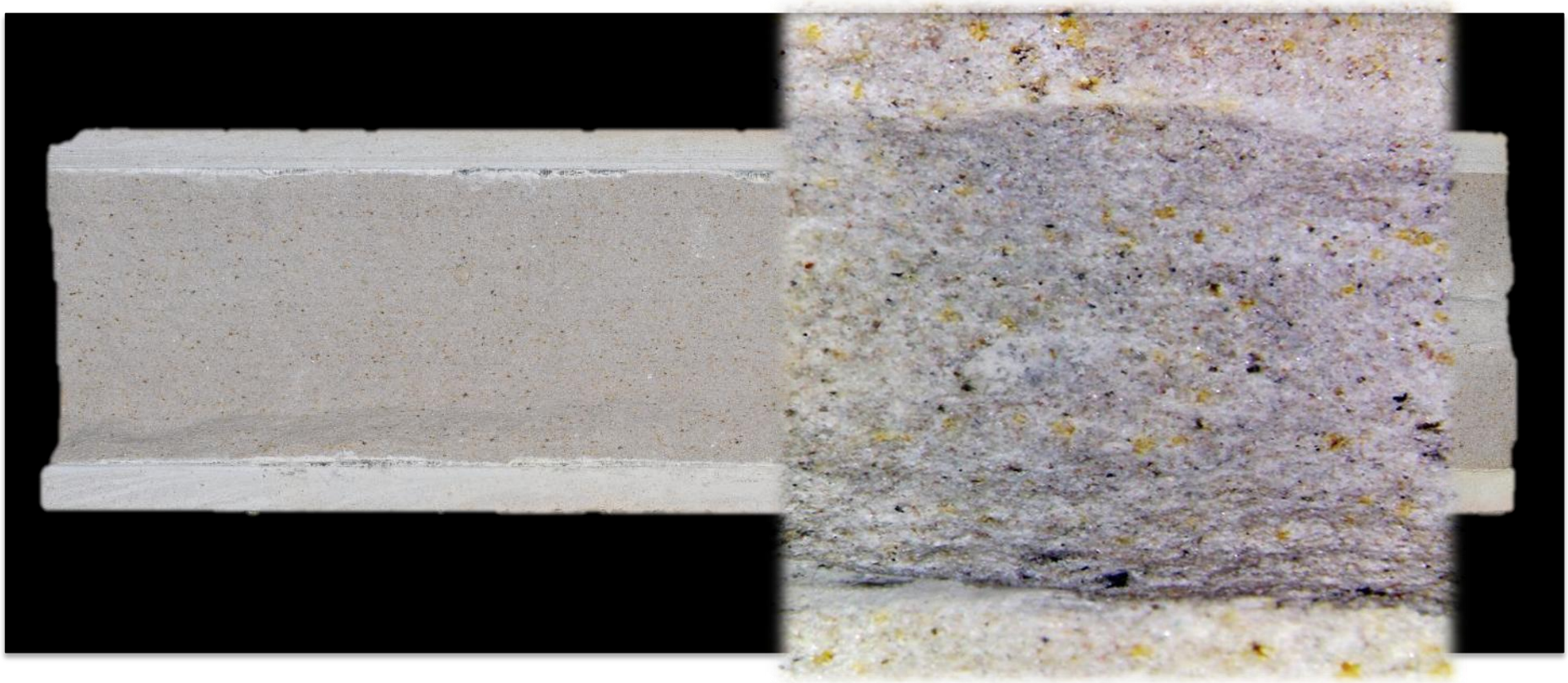


- 26g HRO: 36.4“ (concrete)
- 26g DPEX: 32.1“ (concrete, API 19b)
- 26g DP: 42.6“ (concrete, API 19b)

26g DP – Bunt Sandstone (11400 PSI)

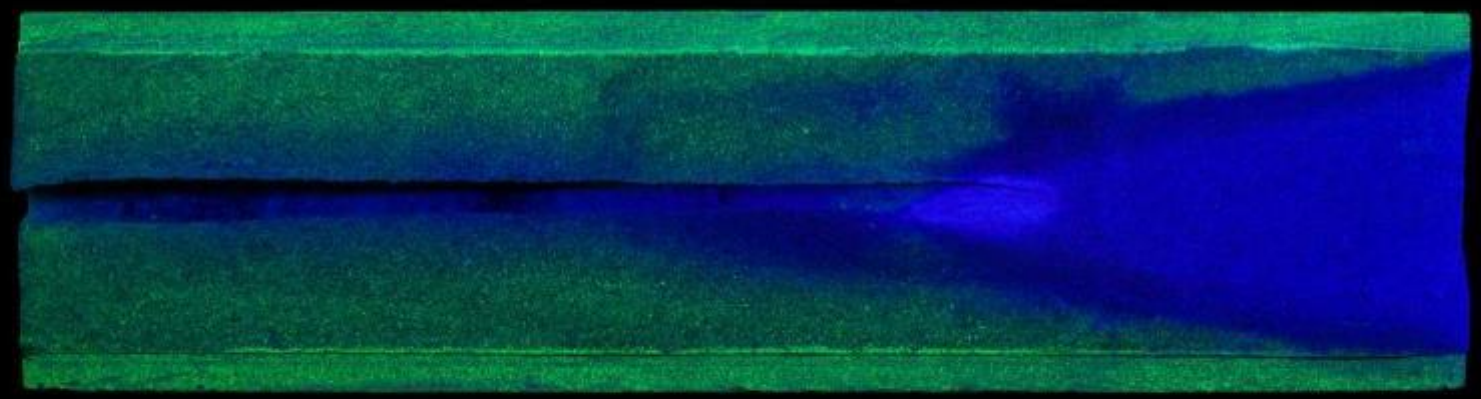


26g DPEX – Bunt Sandstone (11400 PSI)



Evaluation Results

Sander Schilf Sandstein: (UCS 6200psi) , 26g DP HMX/St

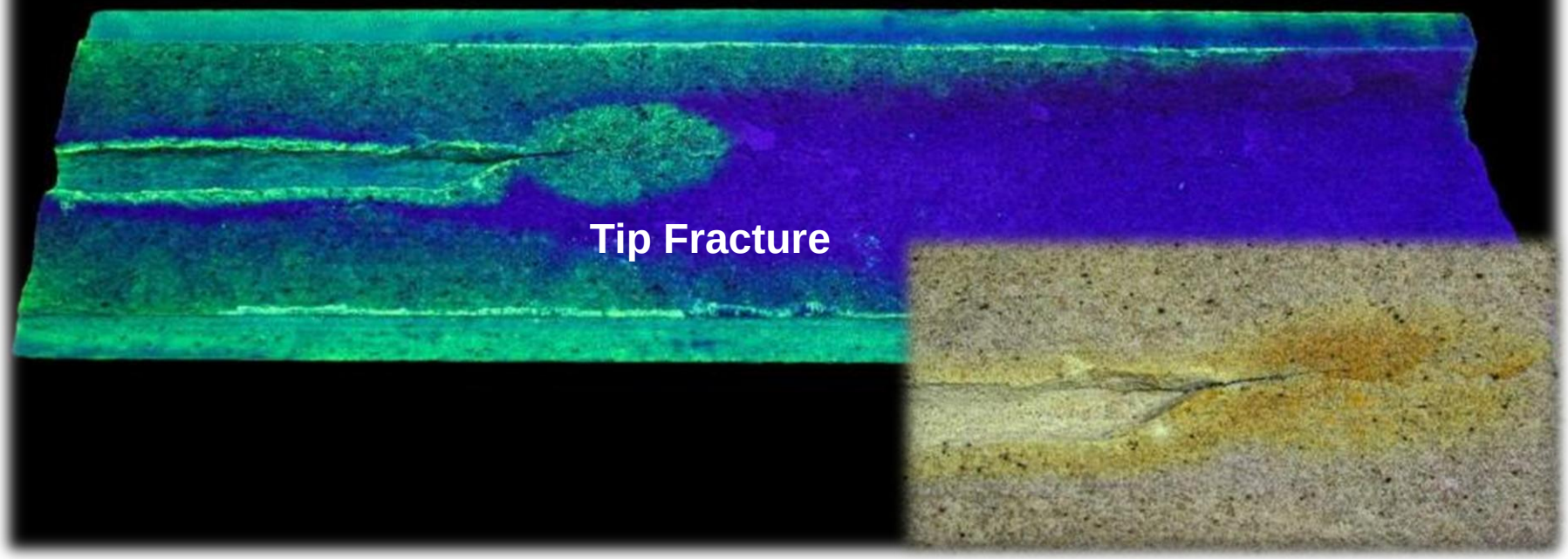


Fluorescent dye indicates path of fluid flow

Evaluation Results

Bunt Sandstone: (UCS 11300psi), 26g DPEX HMX/St

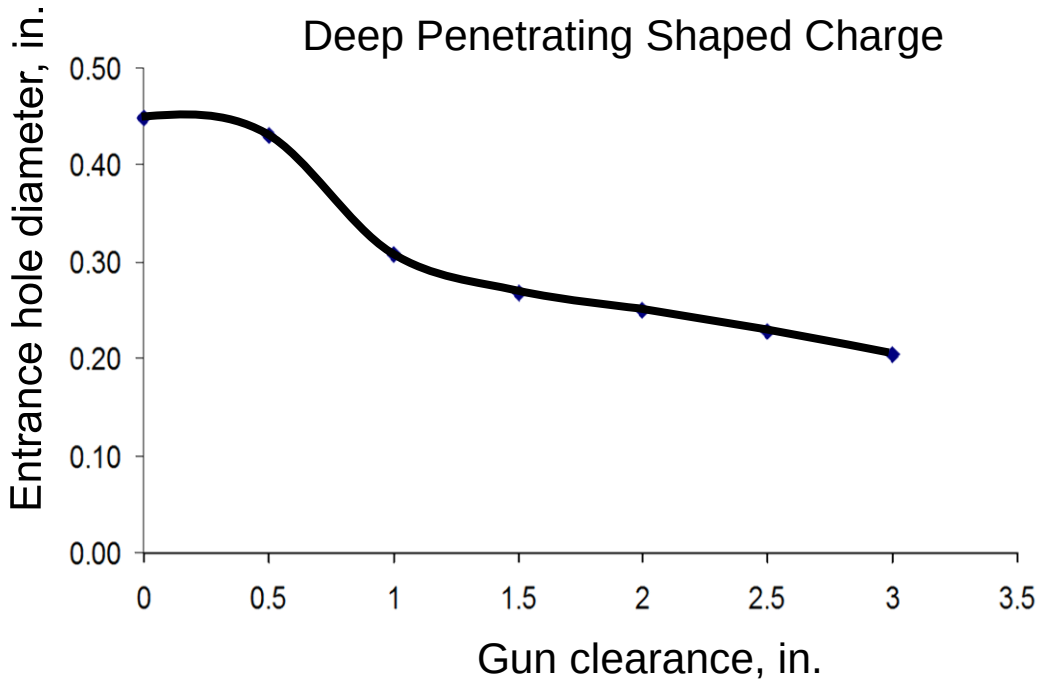
Fluorescent dye indicates path of fluid flow

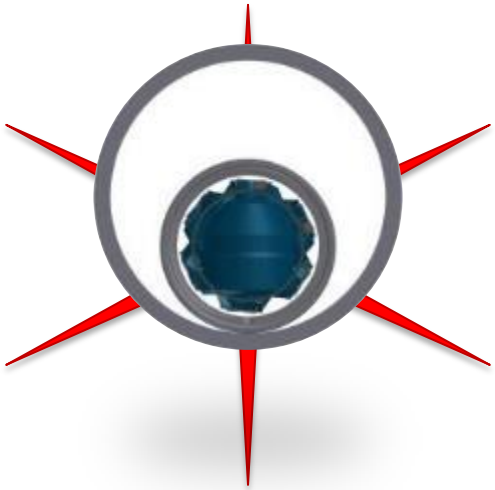


Evaluation Results

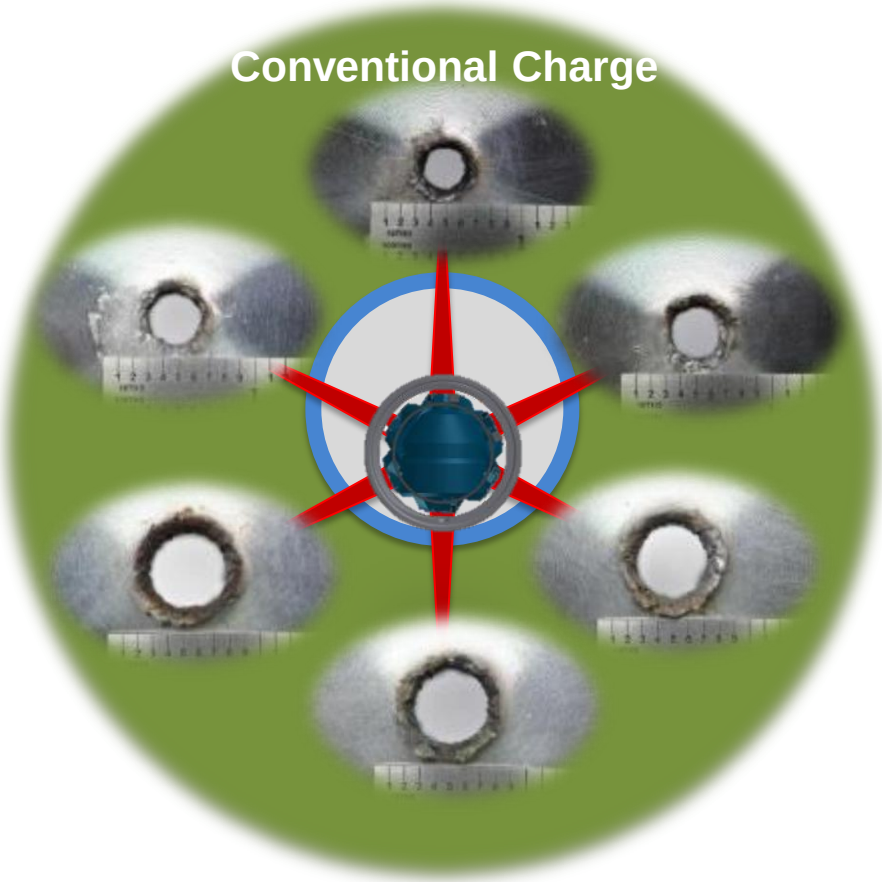
- A good perforation is desirable, but the highest penetration, especially if it is in cement, does not necessarily mean the highest production rate.
- The highest production rate can be evaluated through the use of formation specific perforating systems that can be evaluated using next generation evaluation options.

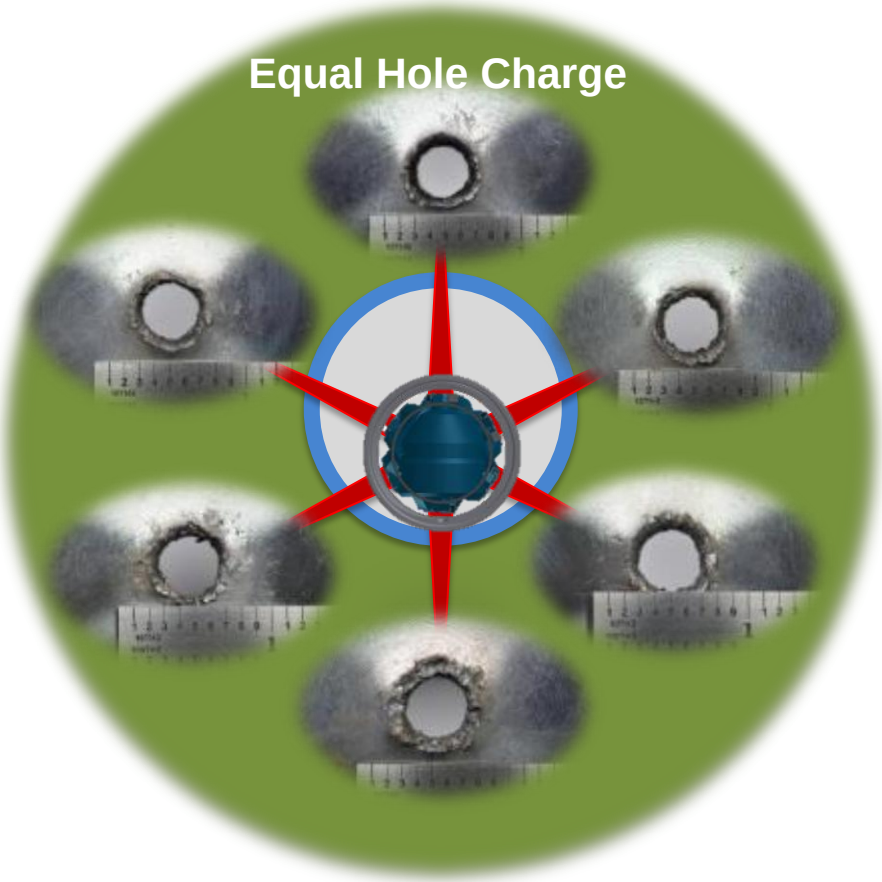
Evaluation Results





Evaluation Results





Evaluation Results

- The greatest depth of penetration according to API RP 19B Section I or SS-05 does not necessarily result in the highest productivity ratio of a well.
- The average values of API RP Section I tests will give an indication on the system performance homogenity but does not necessarity give an indication on the down hole performance.
- The success of a perforation and the productivity of a well can be greatly influenced by the right choice of perforating charge. The decision on the right perforating charge can be made using API RP Section II and Section IV test results.

Thank you!

Questions?