
BAUERBERG KLEIN
TRAINING & CONSULTING

BAUERBERG KLEIN
TRAINING & CONSULTING

Module 3

EXPLOSIVES AND CHARGES

CONTENT

- *The perforating process*
- *Type of explosives, uses and functions*
- *Common type of charges*
- *Propellants*

THE PERFORATING PROCESS

It can be divided into four (4) main steps

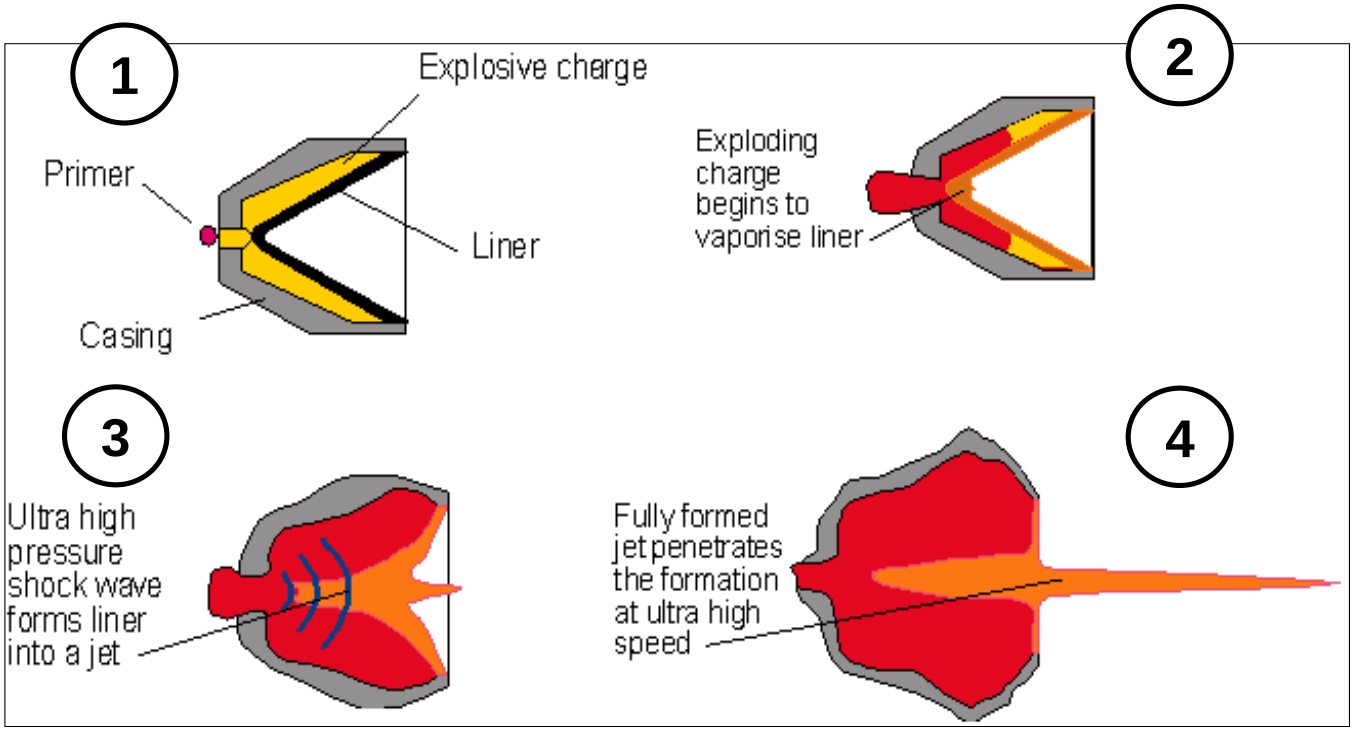
1. ***Deployment and positioning*** – Gun needs to be lowered to the required depth, this needs to be verified

2. ***Activating the gun*** – Depending on the method of deployment, either Mechanical, hydraulic or electric ignition of the primer and charge will occur

3. ***Fluidizing of the liner*** – Fluidization of the liner into a “jet” will occur as a result of the high pressures and temperatures generated by the ignition of the charges

4. ***Expelling of the jet*** – a high pressure/temperature fluidized liner is expelled at very high speed to penetrate the casing/cement and into the reservoir rock

THE PERFORATING PROCESS (Continued)



TYPE OF EXPLOSIVES, USES AND FUNCTIONS

CHARACTERISTICS	TYPE	
	HIGH EXPLOSIVES	LOW EXPLOSIVES
Type	Primary & secondary	-
Method of initiation	Primary by ignition and secondary by detonator	By ignition
Time of conversion	Microseconds	Milliseconds
Velocity of flame front	2 – 10 Km/sec	0.5 – 1.6 Km/sec
Pressures generated	50000 – 4000000 psi	< 50000 psi
Common uses	Demolition, blasting, shaped charges	Propellant, blasting, bullet guns

TYPE OF EXPLOSIVES, USES AND FUNCTIONS (Continued)

Explosive specifications

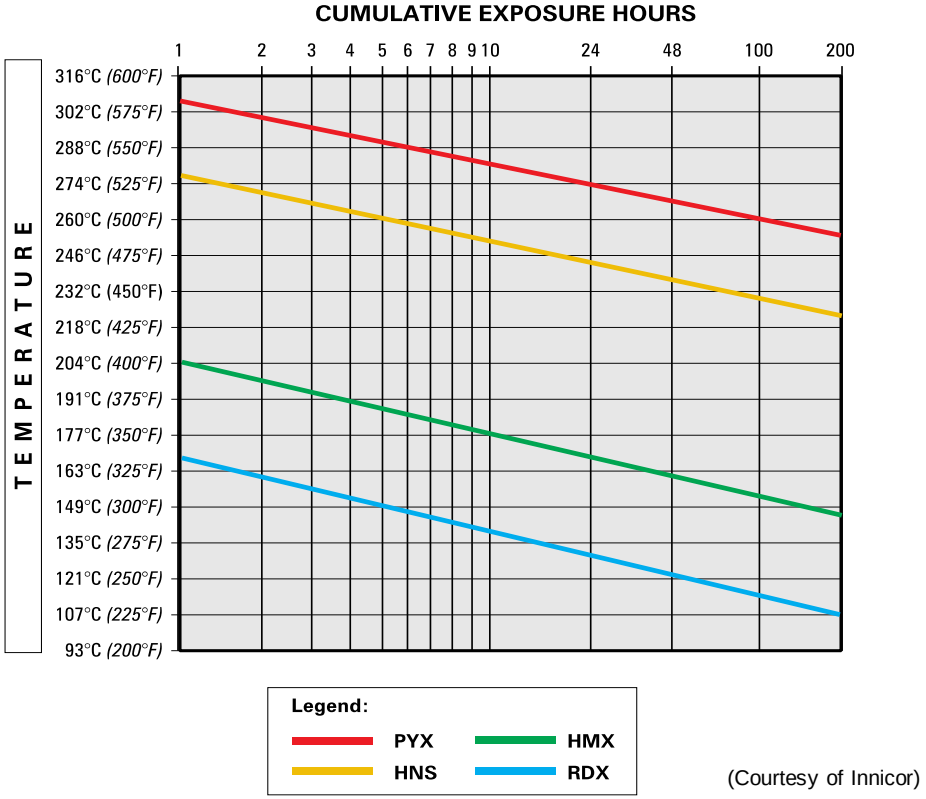
PROPERTY	TYPE					
	PRIMARY		SECONDARY			
Name	Lead Azide	Tacot	HNS	RDX	PSF	HMX
Chemical formulations	PbN_6	$C_{12}H_8O_{12}N_4$	$C_2H_2N_6O_{12}$	$C_6H_6N_6$	SN_6O_{14}	$C_4H_8N_8O_8$
Temperature limit [°C]	329	378	320	180	307	327
Density [kg/m^3]	-	-	1740	1820	-	1900
Detonation velocity [m/s]	-	-	7000	8400	-	9124
Remarks			For HT charges	Most common	For HT charges	>T than RDX

TYPE OF EXPLOSIVES, USES AND FUNCTIONS (Continued)

Explosives can degrade in time if exposed to temperatures above their limits

Choice of charge must consider operational time for the particular method selected

In some cases, guns are left in the wellbore without activating for many months.



(Courtesy of Innicor)

API 19B TEST RECOMMENDATIONS

EQUIPMENT/ CONDITION	API RECOMMENDATION
Perforating system	Standard field gun with charges of particular phasing, shot density, continuously loaded
Charge selection	RDX or PETN samples from a minimum of 1000 units run
	A minimum run of 300 charges for HT explosives
Charge storage	Conventional manufacturer's package, a minimum of 4 weeks aging prior to testing, selected from closed containers
Multi directional guns	A continuously loaded gun to provide a minimum 12 shots or 1 foot
Uni-directional guns (0° phasing)	Must be tested in two positions, all shots fired with maximum and minimum gun clearance. A minimum of 8 shots ofr each position
Test fluid	Water
Test QA/QC	For a test to be valid it is required that the average depth of penetration does not reaches within 3 inches from the outer steel vessel
	Shots that are 12" from the top or 6" from bottom of the target are not to be counted for penetration results computation
Data Acquisition	Three parameters are measured, Total depth of penetration, entry hole diameter and burr height
Reporting results	Use API Form 19B section 1

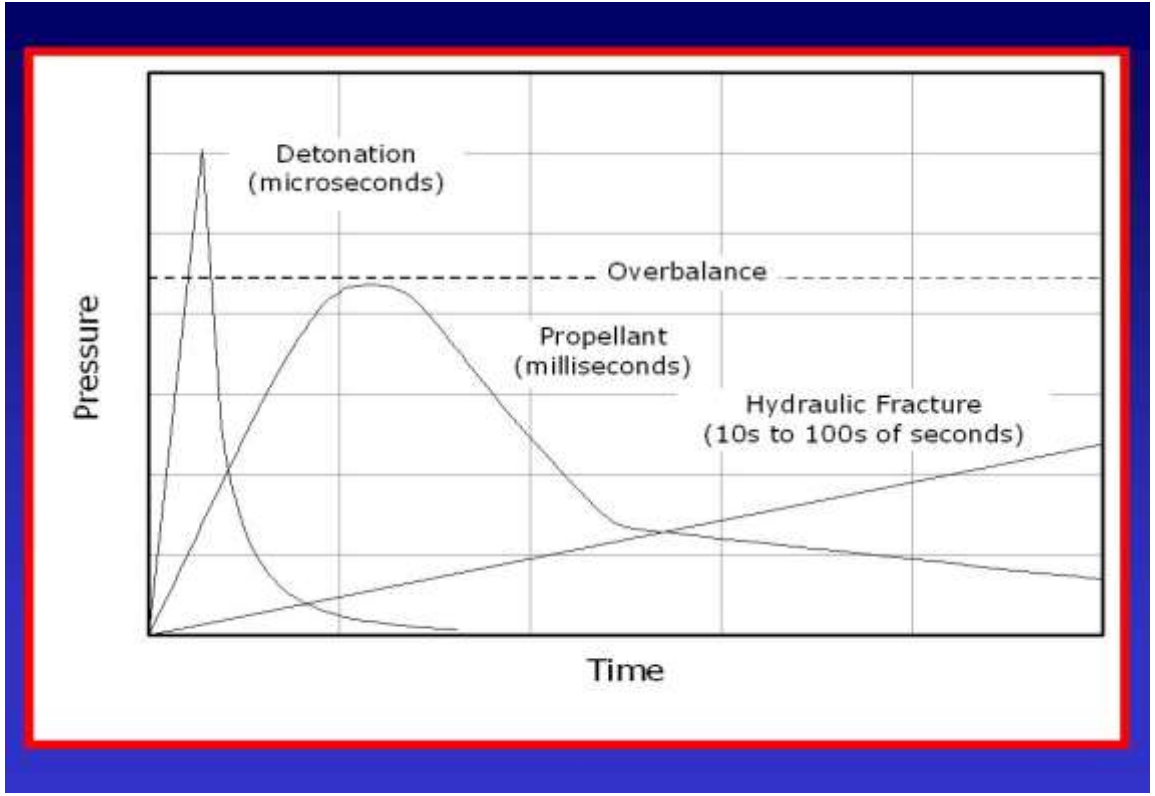
PROPELLANTS

This method relays on the placement of a propellant sleeve outside a conventional gun's carrier.

- The actual firing of the gun ignites the sleeve
- Pressure generated can reach 30000 psi in intervals of 1 to 10000 microseconds
- High-pressure waves follows the gun's shot and creates fractures in the rock Propellants are low power explosives
- Various service providers supply the technology

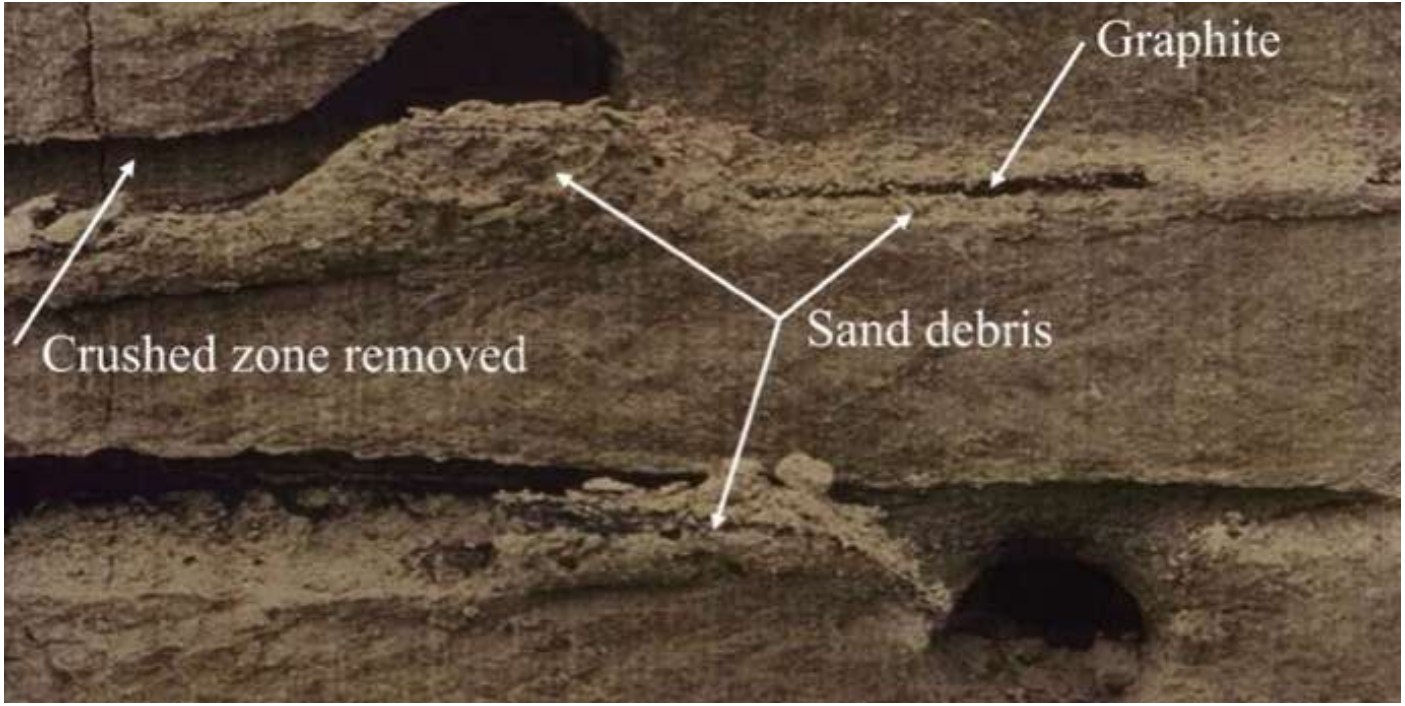
(StimGun Courtesy of Owen Oil Tools)

PROPELLANTS (Continued)



(Courtesy of Slide Player)

RESULTING PERFORATIONS (Test samples)



(Courtesy of Schlumberger)

MODULE 3 – SUMMARY

Four (4) typical steps can be used to represent the perforating process: Deployment/positioning, gun activation, liner's fluidizing and expelling

Two (2) main type of explosives are utilised in perforating; low and high explosives, some used as igniters and some used as charges

RDX, HMX and HNS are the most common type of explosive charges, the main difference is the temperature rating

API RP 19b is a reference for the development of procedures and specifications for testing charges

Propellants are also use along with perforating guns for enhanced well performance, an sleeve (Propellant) is placed around the perforating gun


BAUERBERG KLEIN
TRAINING & CONSULTING