HALLIBURTON

DEEP-STAR™ PERFORATING SYSTEM

Increase Your Production with Deeper Charge Penetration

Maximum Charge Penetration is the Key to Maximum Production. Deep-Star™ Penetrates Deeper than Other Systems in the Industry.

By combining innovative charge technology with reliable detonating and delivery system components, Halliburton's Explosive Products Center has created the most advanced through-tubing capsule perforating system in the industry: **The Deep-Star™ Perforating System.**

Halliburton has always been the leader in perforating technology. We originated and introduced jet perforating to the energy industry, forever changing the way oil and gas are produced. Now, Halliburton introduces another breakthrough in perforating technology. One that combines new technology with proven reliability to bring the most value to your well operation. In fact, all of the parameters necessary for successful perforating—penetration, entrance hole diameter, shot density, debris control—have been optimized to bring the most value possible in a through-tubing perforating gun *and* help achieve the main goals of any perforating job: Maximum production from your well, faster return on your investment.

Features of the Deep-Star Perforating System include the following.

✔ **Elimination of charge interference** Optimum firing time between detonations has been precisely calculated during the design phase, so that the detonation of each charge does not interfere with subsequent detonations, even at 6 shots-per-foot in the 2⅛ inch gun and 8 shots-per-foot in the 1 11/16 inch gun.

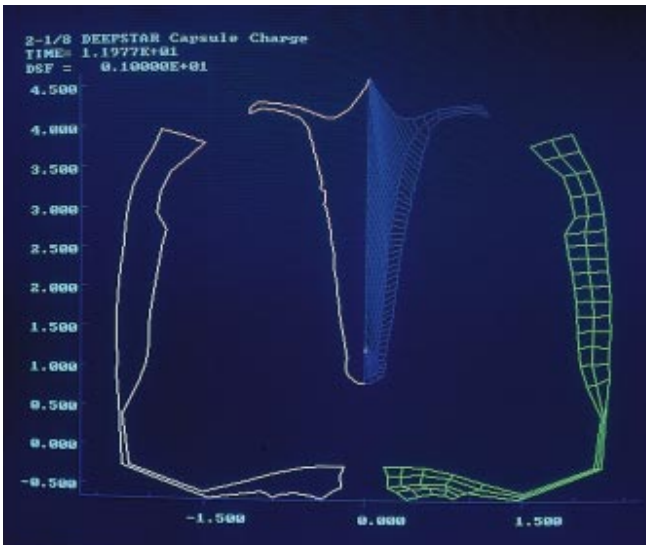
✔ **Versatile** Various phasing options are available, including 0°, 90° downside, 90° spiral, and Triphase™ (0°, +45°, and -45°).

✔ **Improved charge orientation** Center-of-gravity effects were considered during strip geometry design, allowing the gun system to naturally orient itself properly.

✔ **Complete interval coverage** A new gull-wing-design tandem connector* allows placing a charge across the connector. This permits uninterrupted shot densities along the entire gun length.

*Patent Pending

Halliburton integrates both hydrocode and in-flow technologies to optimize the charge design process. Hydrocode technology provides extensive analysis of the explosive process. The new software mathematically and graphically simulates a model of the firing and penetration process from the instant of detonation until all explosive energy is expended. The design engineer is able to observe this process, record and analyze data, and modify charge design parameters. In-flow analysis is utilized to help design the gun system and help optimize production for a given set of reservoir conditions.



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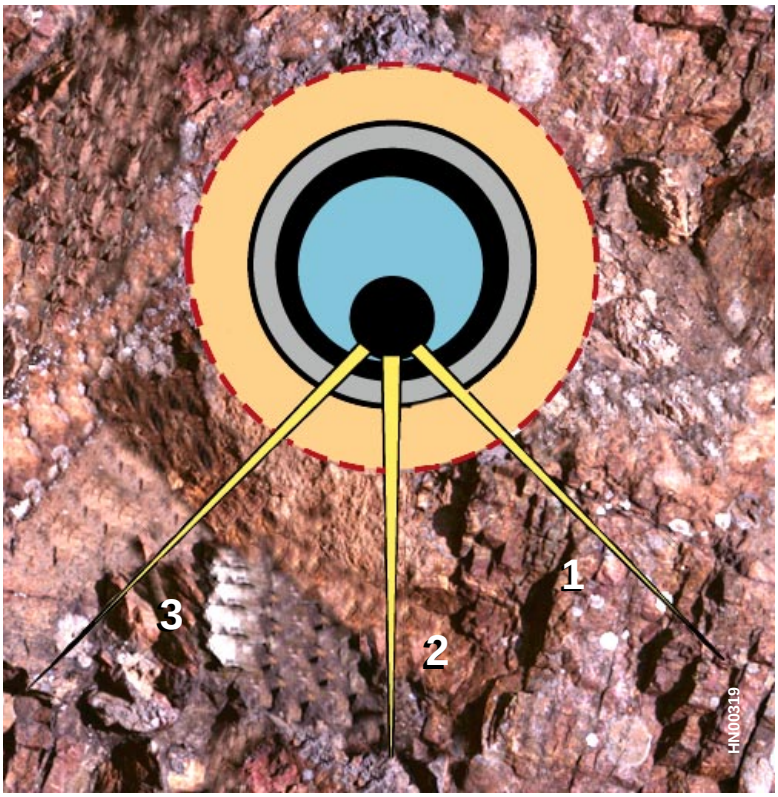

Gun Description:
Halliburton
2-1/8″ Deep Star
995.53005
Powder: 14 gm RDX
Phasing: 45 deg
Test = 6 spf
Run = 6 spf

Well Config:

Csg OD (in)	Csg Wt (lbm/ft)	Grade
4.500	10.50	J-55

Bore Hole = 6.250 in
Sandstone = 1323 psi
Damage = 4.000 in

Downhole Performance

Perf	Rock Pen in	Str #1 Dia. in
1	29.72	0.289
2	30.06	0.303
3	29.72	0.289
Avg:	29.83	0.294

Halliburton's Deep-Star perforating system solves the major problem that occurs when utilizing high-shot density guns: charge interference. If this is not considered in the design process, the high-energy waves produced by the detonation interact with adjacent charges, resulting in decreased charge performance.

Halliburton's design software allows the engineer to ensure that the firing time between detonations is adequate to eliminate charge-to-charge interference. In fact, Halliburton has test data for the $1^{11}/_{16}$ inch, 8-shot-per-foot perforating system on file with the American Petroleum Institute, confirming the test results.

0° Phasing 90° Phasing 90° Spiral

Deep-Star Carrier Specifications

	2⅛ in. Carrier	1¹¹⁄₁₆ in. Carrier
Nominal gun OD	2.125 in. (5.39 cm)	1.687 in. (4.28 cm)
Minimum allowable restriction	2.188 in. (5.55 cm)	1.718 in. (4.36 cm)
Carrier type	Expendable, retrievable	
Maximum gun length	Unlimited*	
Maximum operating temperature		
(with RDX charge)	325°F (162°C)	
(with HMX charge)	375°F (191°C)	
Pressure rating**	15,000 psi (103 400 kPa)	
Wellbore conditions	Dry gas or fluid	
Shot density	1-6 spf (3-20 spm)	1-8 spf (3-26 spm)
Phasing	0°, Triphase	0°
	90° Downside	Triphase
	90° Spiral	114° Downside
Selective fire capability	Two gun sections	

*Restricted only by lubricator height and rig height
**Higher pressure ratings available

Deep-Star Charge Performance

API RP-43 Fifth Edition Test Results

Section I Concrete Test, 0° phase

	Entrance Hole Diameter	Penetration	SPF	Casing Type	Concrete Compressive Strength
1¹¹⁄₁₆ in. RDX	0.24 in.	15.84 in.	8	4½ in.,11.6 lb/ ft, L80	7,200 psi
1¹¹⁄₁₆ in. HMX	0.25 in.	16.36 in.	8	¼ in. steel plate	QC concrete target
2⅛ in. RDX	0.31 in.	22.23 in.	6	5½ in., 17 lb/ft, L80	5,571 psi
2⅛ in. HMX	0.29 in.	21.06 in.	6	5½ in., 17 lb/ft, L80	7,867 psi

Halliburton provides the best through-tubing, expendable perforating system available in the industry today. To see how the Deep-Star Perforating System can help get maximum production from your well, call your local Halliburton representative – your Solution Connection℠.

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