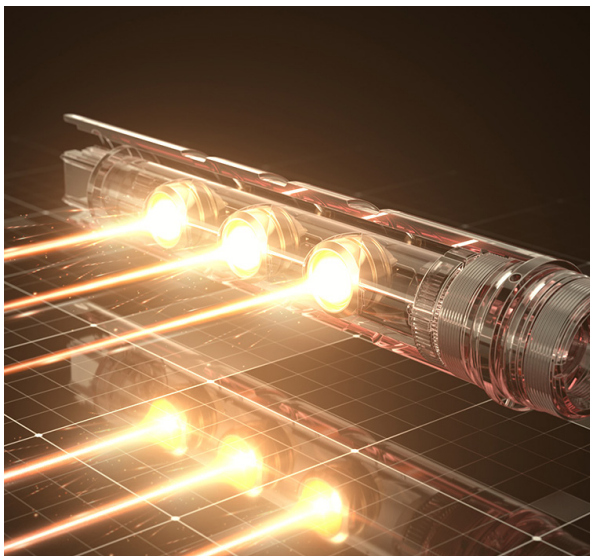
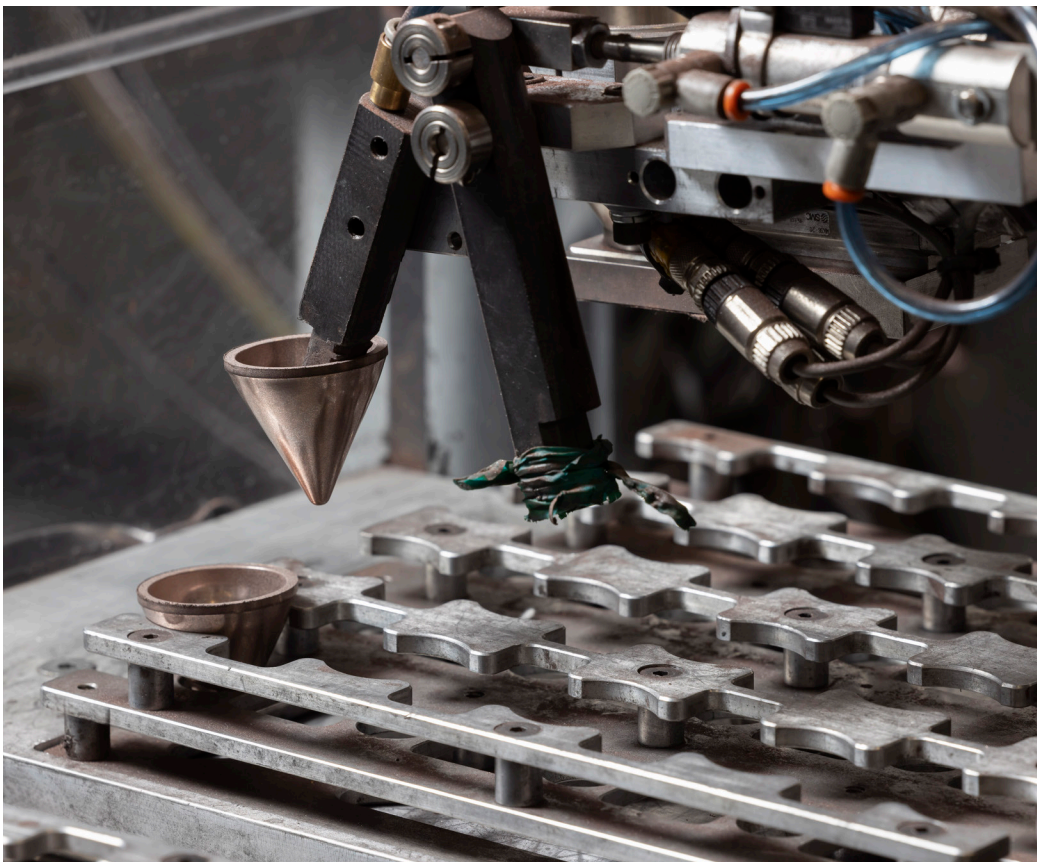
HALLIBURTON

Charge performance data

Perforating catalog





API and QC tested charge performane data

The charge performance data within this document are based on API and QC testing. It is recommended to perform HPTK simulations to see the effect of downhole conditions. If necessary additional testing can be performed at the JRC flow lab to better replicate perforating at the actual downhole conditions. Please contact your local Halliburton expert for all possible configurations.

Halliburton perforating tool kit (HPTK)

The industry has embraced perforating charge modeling technology. It is best understood as an engineered job design tool—one that integrates the use of perforating charges to see how a charge would perform in downhole conditions. This method of predicting the results of perforation was based on the leading calculation/technology of the time. With the development of the Halliburton Perforating Tool Kit (HPTK) model, this is no longer the only method. By utilizing more than 500 flow lab tests, actual dynamic pressure response, overburden stress, varieties of rock matrixes, and multiple perforating environments, the HPTK model provides advanced perforation performance correlations that will be utilized in post-job perforating efficacy analysis and prejob design to enhance future exploitation of your assets. The HPTK software was born from knowledge gained from the Halliburton state-of-the-art Advanced Perforating Flow Lab at the Halliburton Jet Research Center. Our continued studies of in-situ perforating of rock mechanics and flow regimes in hundreds of unique perforation conditions, including high pressure, high temperature, different rock matrixes, and perforation environments, the information is used and incorporated in the calculation within the HPTK algorithms. The HPTK has the enhanced ability to derive in-situ effective perforation tunnel performance, thus improving the predictability of the productivity or injectivity of a well perforated with a Halliburton perforation solution.

Advanced perforating flow lab (APFL)

The Advanced Perforating Flow Laboratory at Jet Research Center (JRC) is an industry leader in perforating system research, development and test programs. Since 2000, we have conducted tests tailored specifically for our clients' needs to help them better understand actual downhole conditions and perforating system performance.

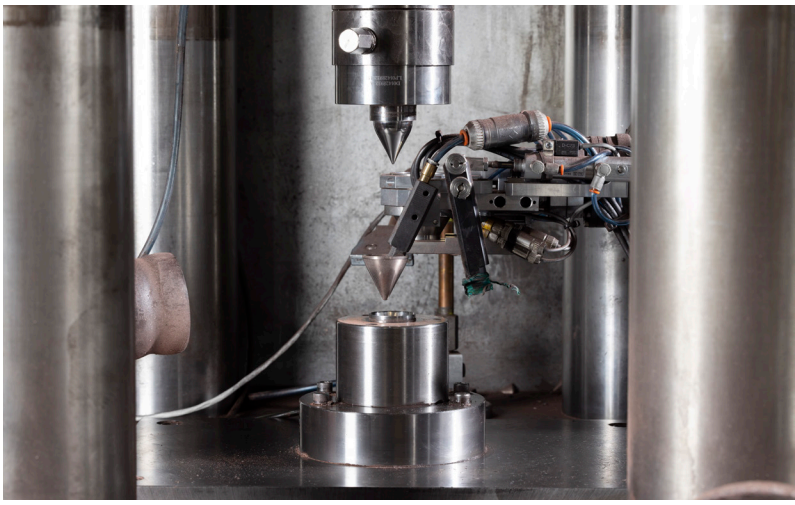
To meet our customers' developing challenges, Jet Research Center expanded the Advanced Perforating Flow Lab with leading-edge vessels and technologies. These vessels provide our customers with the most accurate information possible regarding the effects of perforations in different formations and in different environments. This facility gets you as close to the real world as you can get in a laboratory setting.

Our facilities include four unique testing vessels that do more than any other facility in the industry. They feature full perforating and flow capabilites:

- 50,000-psi vessel – Allows JRC to conduct tests at the highest pressures in the industry.
- 25,000-psi high-temperature vessels – these vessels can simulate wells at temperatures reaching 400°F (204°C), enabling us to test perforating capabilities in high temperatures and at high pressures.
- 10,000-psi vessel – Can rotate to 180 degrees, enabling JRC to perform gravity-related sanding studies to better understand the effects of perforating and fracturing in horizontal, vertical or deviated wells

Frac perforating shaped charges

Halliburton's portfolio of frac optimized shaped charges deliver superior consistent holes by providing reduced variance from shot to shot, regardless of fluid clearance and decentralization. Achieving consistent holes on both the upper and lower sides of the well ensures that the initial reservoir breakdown has the greatest chance of creating the most efficient, evenly distributed fractures.



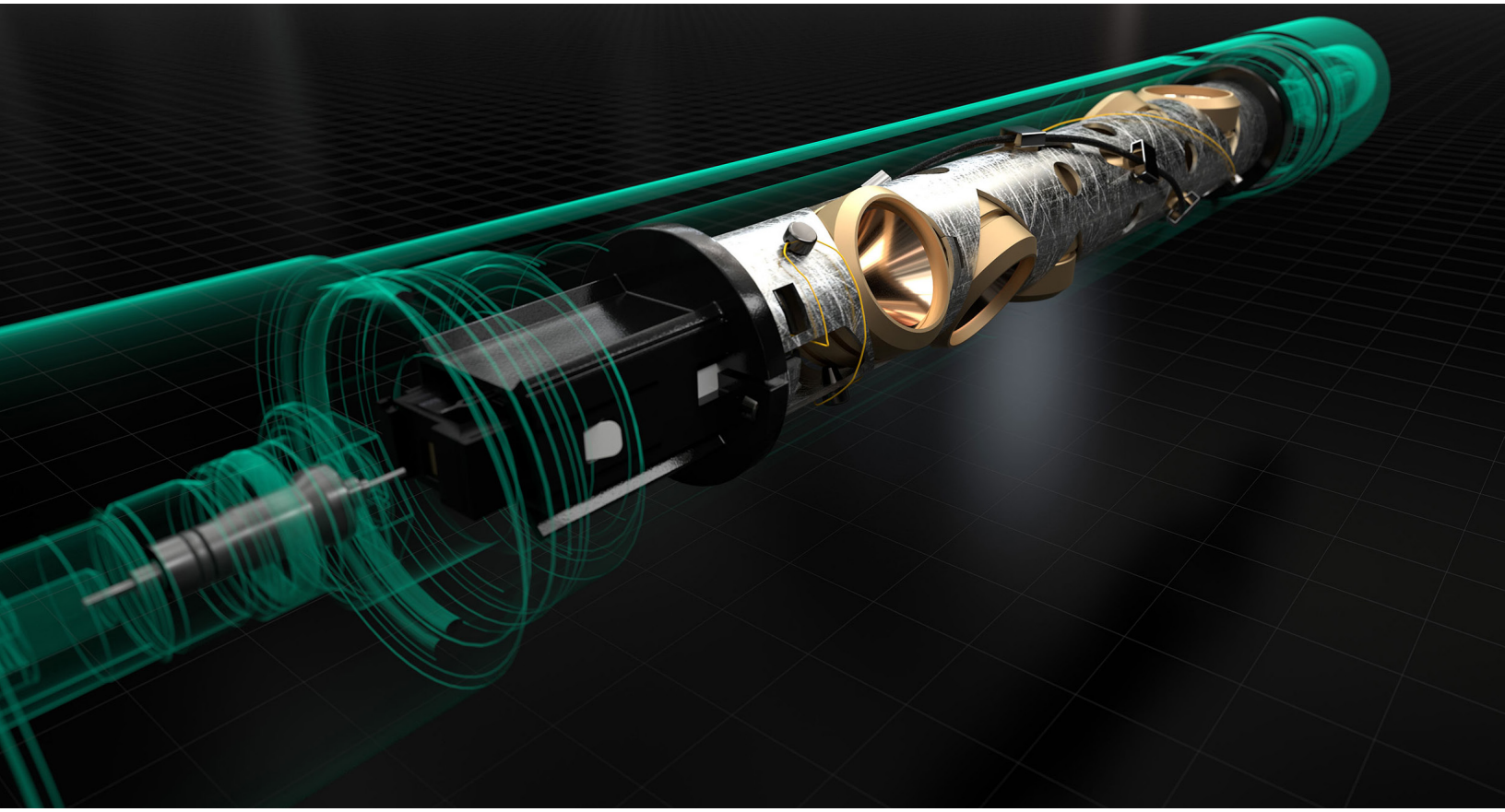
Frac perforating shaped charges

Gun Size (in.)	Target Casing	Avg. EHD (in.)	EHV (%)	QC Pen (in.)	Charge Name	Part Number	Explosive Load	Explosive Type
2.75	4.5-in. 11.6 lb	0.37	7.80%	22.5	150 MaxForce® Frac	102745134	15g	RDX
	4.5-in. 12.6 lb	0.35	3.50%	22.5	150 MaxForce Frac	102745134	15g	RDX
	4.5-in. 13.5 lb	0.35	2.40	22.5	150 MaxForce Frac	102745134	15g	RDX
		0.35	2.40	23.7	150 MaxForce Frac	102740045	15g	HMX
3.125	4.5-in. 11.6 lb	0.46	4.70	14.4	210 MaxForce Frac	102045430	21g	RDX
		0.49	5.80	17.8	210 MaxForce Frac	102127122	21g	HMX
	4.5-in. 13.5 lb	0.32	2.80	22.6	2101 FracJet	103097018	21g	RDX
		0.44	9.90	17.8	210 MaxForce Frac	102127122	21g	HMX
		0.41	2.30	31.6	230 MaxForce Frac	102736069	23g	RDX
		0.42	3.00	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.47	4.00	17.8	2105 FracJet	102771488	21g	PETN
	4.5-in. 15.1 lb	0.43	9.20	23.5	2103 FracJet	103002358	21g	RDX
		0.42	2.83	23.5	2104 FracJet	103002357	21g	HMX
	5-in 18 lb	0.32	6.70	21.3	1801 FracJet	103092925	18g	RDX
		0.34	4.70	22.6	2101 FracJet	103097018	21g	RDX
		0.34	3.10	24.8	2102 FracJet	103097742	21g	RDX
		0.36	5.80	23.5	2103 FracJet	103002358	21g	RDX
		0.38	4.80	31.6	230 MaxForce Frac	102736069	23g	RDX
		0.41	7.30	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.43	8.90	14.4	210 MaxForce Frac	102045430	21g	RDX
		0.44	11.70	17.8	210 MaxForce Frac	102127122	21g	HMX
	5.5-in. 20 lb	0.32	3.50	22.6	2101 FracJet	103097018	21g	RDX
		0.34	4.40	21.3	1801 FracJet	103092925	18g	RDX
		0.35	2.55	23.5	2103 FracJet	103002358	21g	RDX
		0.35	3.30	25.5	2104 FracJet	103002357	21g	HMX
		0.39	8.90	31.6	230 MaxForce Frac	102736069	23g	RDX
		0.4	14.20	14.4	210 MaxForce Frac	102045430	21g	RDX
		0.42	11.24	17.8	2105 FracJet	102771488	21g	PETN
		0.4	7.10	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.42	13.20	17.8	210 MaxForce Frac	102127122	21g	HMX
	5.5-in. 23 lb	0.32	6.30	22.6	2101 FracJet	103097018	21g	RDX
		0.35	3.37	23.5	2103 FracJet	103002358	21g	RDX
		0.36	5.30	25.5	2104 FracJet	103002357	21g	HMX
		0.39	10.80	17.8	2105 FracJet	102771488	21g	PETN
		0.4	5.90	31.6	230 MaxForce Frac	102736069	23g	RDX
		0.42	3.80	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.43	11.70	14.4	210 MaxForce Frac	102045430	21g	RDX
		0.45	13.80	17.8	210 MaxForce Frac	102127122	21g	HMX
		0.49	9.70	6.6	2302 FracJet	103180743	23g	RDX
		0.59	7.10	5.4	2301 FracJet	103135709	23g	RDX
	5.5-in 26 lb	0.42	8.42	17.8	210 MaxForce Frac	102127122	21g	HMX
	6-in. 25 lb	0.36	17.40	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.53	12.30	5.4	2301 FracJet	103135709	23g	RDX
3.375	5.5-in. 17 lb	0.43	13.10	14.4	210 MaxForce Frac	102045430	21g	RDX
		0.45	11.70	17.8	210 MaxForce Frac	102127122	21g	HMX
	5.5-in. 23 lb	0.4	3.50	31.6	230 MaxForce Frac	102736069	23g	RDX
		0.4	4.30	36.2	230 MaxForce Frac	102732983	23g	HMX
		0.42	11.24	17.8	2103 FracJet	102771488	21g	PETN

Note: All performance data are taken with cement backed unless otherwise stated.
Please contact a Halliburton expert for other custom designs and configurations.

Velocity Revolve shaped charges

Gun Size (in.)	Target Casing	Avg. EHD 0 deg (in.)	EHV (%)	QC Pen (in.)	Charge Name	Part Number	Explosive Load	Explosive Type
3.125-in.	4.5-in 11.6 ib	0.53	1.80	6.6	2302-S FracJet	103157902	23g	RDX
	5.5-in. 23 lb	0.34	1.00	17	1901-S FracJet	103286712	19g	RDX
		0.35	4.90	26.2	2103-S FracJet	103108333	21g	RDX
		0.31	2.30	32.7	2300-S FracJet	103228015	23g	RDX
		0.35	6.40	27.3	2300-S FracJet	102986369	23g	HMX
		0.36	1.10	20	2100-S FracJet	103110311	21g	RDX
		0.4	1.00	6.6	2302-S FracJet	103157902	23g	RDX

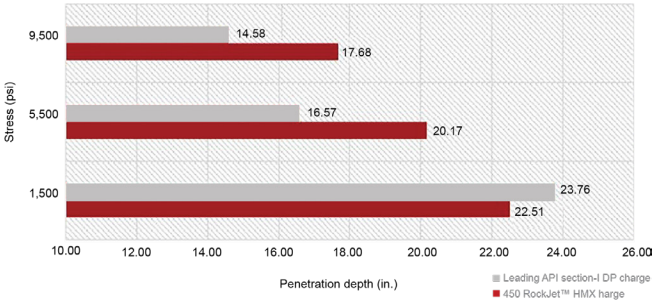


Rock optimized charges

RockJet® shaped perforating charges provide the deepest penetration in actual downhole stressed rock and maximize casing hole size to deliver the greatest possible well performance. Traditional surface tests performed in concrete targets are not a reliable indicator of actual downhole charge performance. Inflow modeling demonstrates that maximizing reservoir contact through deep and clean perforating tunnels extending past the damage zone is critical to maximizing both the productivity and injectivity of natural completion wells. The 450 and 175 RockJet perforating charges were developed using stressed rock cores for optimized performance in real-world downhole conditions, using the exclusive capabilities of the Advanced Perforating Flow Laboratory at the Jet Research Center. These charges were developed for optimized performance in actual downhole well conditions. The 450 RockJet charge performance was confirmed using the industry's first fully transparent witnessed test program under APIs new test protocol, RP19B Section 2. HPTK modeling plus testing can be used to determine performance at other specific downhole conditions of interest.

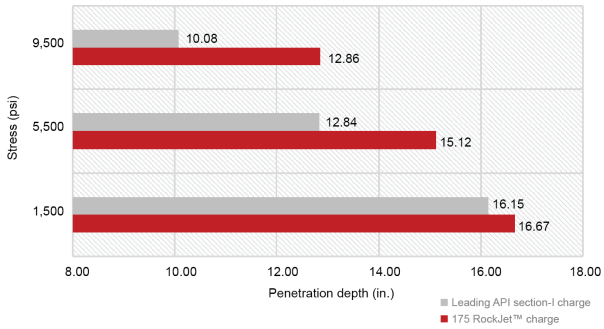
450 RockJet® HMX perforating charge results

Penetration performance



175 RockJet® HMX perforating charge results

Penetration performance



Rock optimized charges

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Core Penetration 1,500 psi in. (mm)	Core Penetration 5,500 psi in. (mm)	Through 9,500 psi in. (mm)	Through Hole in. (mm)	Explosive Load (gram)	Case Material
2 7/8	6 (20)	60	103254898	175 RockJet® HMX	16.67 (423.4)	15.12 (384.0)	12.86 (326.6)	0.30 (7.6)	17.5	Steel
3 1/8	6 (20)	60	103254898	175 RockJet HMX	16.67 (423.4)	15.12 (384.0)	12.86 (326.6)	0.30 (7.6)	17.5	Steel
4 1/2	12 (39)	150/30	103254898	175 RockJet HMX	16.67 (423.4)	15.12 (384.0)	12.86 (326.6)	0.30 (7.6)	17.5	Steel
4 5/8	12 (39)	150/30	103254898	175 RockJet HMX	16.67 (423.4)	15.12 (384.0)	12.86 (326.6)	0.30 (7.6)	17.5	Steel
4 1/2	5 (16)	72	103093779	450 RockJet HMX	22.51 (571.7)	20.17 (512.3)	17.68 (449.1)	0.46 (11.7)	45	Steel
4 5/8	5 (16)	72	103093779	450 RockJet HMX	22.51 (571.7)	20.17 (512.3)	17.68 (449.1)	0.46 (11.7)	45	Steel
7	12 (39)	135/45	103093779	450 RockJet HMX	22.51 (571.7)	20.17 (512.3)	17.68 (449.1)	0.46 (11.7)	45	Steel

Note: The charges have been tested under the Section 2 standard* protocol, involving 12 shots into Berea sandstone at multiple stress levels, following stringent API guidelines, in the presence of an API witness.

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Confinement Pressure (psi)	Core Penetration in. (mm)	Through Hole in. (mm)	Explosive Load (gram)	Case Material
3 1/2	6 (20)	60	103269259	270 RockJet® HNS	Utilize HPTK or test at client specific parameters			27	Steel
4	5 (16)	60	103273625	350 RockJet HNS	Utilize HPTK or test at client specific parameters			35	Steel
4 5/8	5 (16)	72	103143245	390 RockJet HNS	Utilize HPTK or test at client specific parameters			39	Steel
4 3/4	12 (39)	135/45	102964094	265 RockJet HMX	Utilize HPTK or test at client specific parameters			26.5	Zinc
7	12 (39)	135/45	103143245	390 RockJet HNS	Utilize HPTK or test at client specific parameters			39	Steel

Note: The systems are released and have been developed and tested at specific downhole conditions using section 2 protocols.

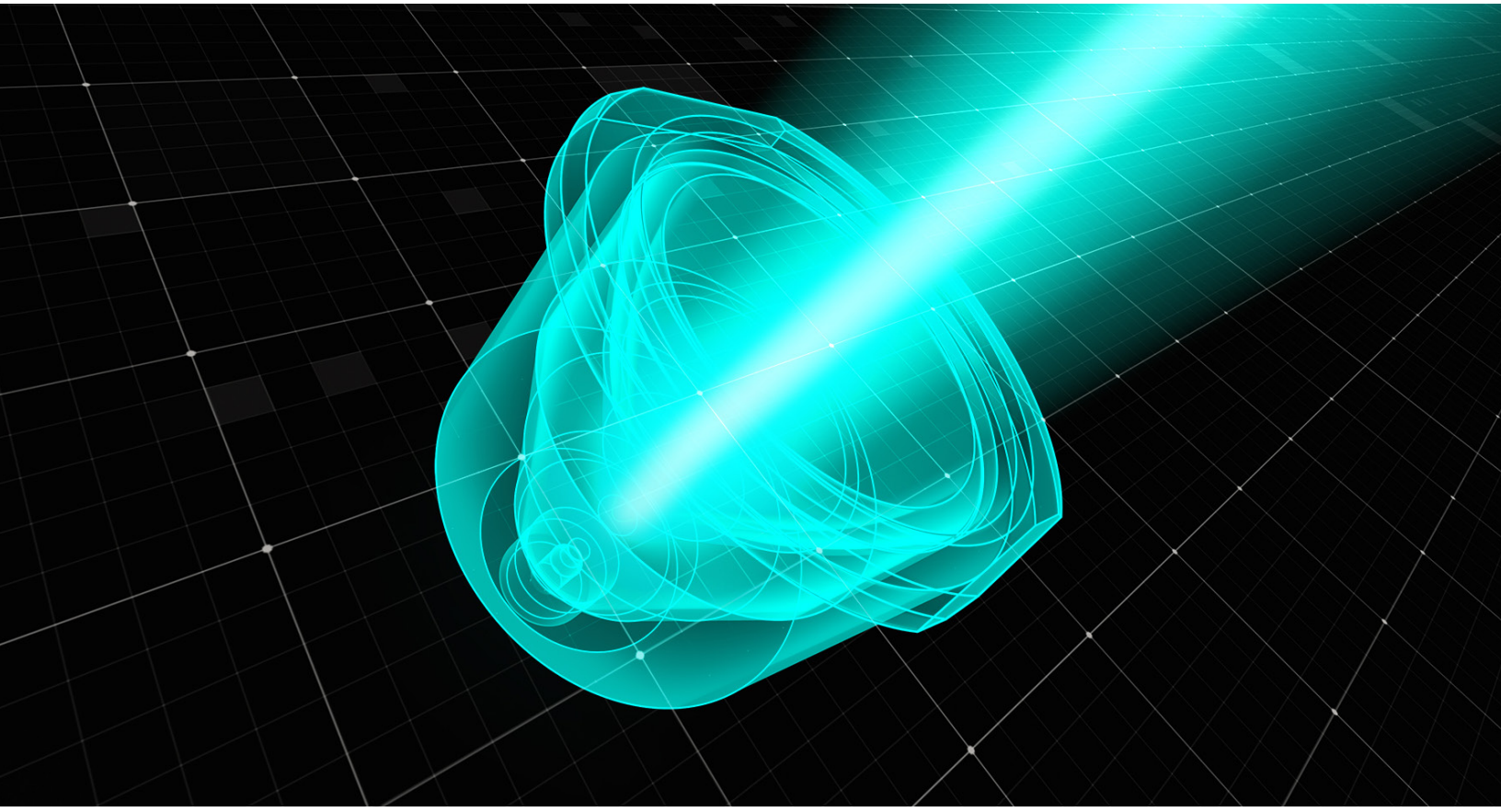
Deep penetrating shaped charges

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Penetration in. (mm)	Entrance Hole in. (mm)	Casing Size in. (mm)	Target Strength (psi)	Explosive Load (gram)	Case Material	Data Type
Capsule guns											
1 11/16	4 (13)	0	100005450	1 11/16-in. Dyna-Star®, RDX	10.5 (266.7)	0.39 (9.9)	4 1/2	5149	13.4	Steel	19B
1 11/16	8 (26)	0	101521848	080 MaxForce®, Deep Star™, HMX	19.9 (505.5)	0.26 (6.6)	4 1/2	7170	8	Steel	19B
2 1/8	8 (26)	0	101210198	2 1/8-in. Millennium™ Deep Star, HMX	30.7 (779.8)	0.35 (8.9)	5 1/2	5189	15.9	Steel	RP43
2 1/8	8 (26)	0/45/90	101210198	2 1/8-in. Millennium Deep Star, HMX	20.6 (523.2)	0.30 (7.6)	5 1/2	6740	15.9	Steel	19B
2 1/8	6 (20)	0	100005448	2 1/8-in. Dyna-Star, RDX	16.6 (421.9)	0.42 (10.7)	5 1/2	5538	15.5	Steel	RP43
2 1/8	4 (13)	0	100005448	2 1/8-in. Dyna-Star, RDX	15.5 (393.7)	0.35 (8.9)	5 1/2	5292	15.5	Steel	19B
Ported guns											
4	4 (13)	90	101288857	4-in. Millennium Express GSC RDX	27.18 (690.4)	0.51 (13)	5 1/2	5600	19.5	Steel	QC
Slickwall guns											
3 1/8	6 (20)	60	101618994	3 1/8-in. Millennium Express IS SDP RDX	37.9 (962.6)	0.38 (9.7)	4 1/2	5745	21	Steel	QC
3 1/8	6 (20)	60	101366678	3 1/8-in. Millennium IS HMX	38.3 (972.8)	0.40 (10.2)	4 1/2	6200	21	Steel	QC
3 1/8	4 (13)	90	101204537	4-in. Basic Millennium Express RDX	16.7 (422.9)	0.50 (12.7)	5 1/2	6277	19.5	Steel	QC
4	4 (13)	90	101204537	4-in. Basic Millennium Express RDX	24.9 (633.5)	0.50 (12.7)	5 1/2	6277	19.5	Steel	QC
3 1/8	4 (13)	90	101310802	4-in. Twisted Strip Millennium Express RDX w/ twist lock 1/2 rubber jacket	16.7 (422.9)	0.50 (12.7)	5 1/2	6277	19.5	Steel	QC
4	4 (13)	90	101310802	4-in. Twisted Strip Millennium Express RDX w/ twist lock 1/2 rubber jacket	24.9 (633.5)	0.50 (12.7)	5 1/2	6277	19.5	Steel	QC
Scalloped guns											
1 9/16	4 (13)	0	100157028	1 9/16-in. Millennium, HMX, IS	11.3 (288.0)	0.21 (5.3)	4 1/2	5967	3.4	Steel	RP43
1 9/16	6 (20)	60	100157028	1 9/16-in. Millennium, HMX, IS	8.3 (210.8)	0.23 (5.8)	2 7/8	6949	3.4	Steel	19B
2	6 (20)	60	101208224	2-in. Millennium, HMX, IS	18.3 (464.8)	0.22 (5.6)	2 7/8	6019	6.8	Steel	19B
2	6 (20)	60	101603801	070 MaxForce, HMX, IS	20.3 (515.6)	0.24 (6.1)	2 7/8	5697	7	Steel	19B
2 1/2	6 (20)	60	101418095	2 1/2-in. Millennium II, HMX, IS	24.5 (622.3)	0.32 (8.1)	3 1/2	5996	11.1	Steel	19B
2 3/4	6 (20)	60	101233817	2 3/4-in. Millennium, HMX	26.0 (660.4)	0.30 (7.6)	4 1/2	6394	15	Steel	19B
2 7/8	6 (20)	60	101826652	175 MaxForce, HMX	38.6 (980.4)	0.37 (9.4)	4 1/2	5405	17.5	Steel	19B
2 7/8	6 (20)	60	103022473	175 MaxForce RD, HMX	38.6 (980.4)	0.37 (9.4)	4 1/2	5405	17.5	Steel	19B
2 7/8 (HW)	6 (20)	60	101233817	2 3/4-in. Millennium, HMX	30.0 (762.0)	0.35 (8.9)	4 1/2	5124	15	Steel	19B
2 7/8	6 (20)	60	101388406	2 7/8-in. Millennium, HMX	26.6 (676.4)	0.38 (9.7)	4 1/2	6522	17.5	Steel	QC
3 1/8	6 (20)	60	101366678	3 1/8-in. Millennium, HMX, IS	33.9 (861.1)	0.34 (8.7)	4 1/2	5598	21	Steel	19B
3 1/8	6 (20)	60	101618994	3 1/8-in. Millennium Express, RDX, IS	40.1 (1018.5)	0.38 (9.7)	4 1/2	5460	21	Steel	QC
3 3/8	6 (20)	60	101233819	3 3/8-in. Millennium, HMX	37.5 (952.5)	0.45 (11.4)	4 1/2	5754	25	Steel	19B
3 3/8	6 (20)	60	102621295	3 3/8-in. Millennium, HMX	45.5 (1155.7)	0.43 (10.9)	4 1/2	5028	26	Steel	19B
4	4 (13)	90	101210636	4-in. Millennium, HMX	43.4 (1102.4)	0.38 (9.7)	5 1/2	6365	39	Steel	19B
4 1/2	5 (16)	60	102827901	Millennium II, SDP, RDX	51.6 (1308.1)	0.48 (12.2)	7	5101	39	Steel	QC
4 1/2	5 (16)	60	101210636	4-in. Millennium, HMX	39.6 (1005.8)	0.37 (9.4)	7	6775	39	Steel	19B
4 1/2	12 (39)	150/30	101210674	4 1/2-in. Millennium, HMX	26.8 (680.7)	0.38 (9.7)	7	8484	22.7	Steel	RP43
4 5/8	5 (16)	72	102054947	390 MaxForce, HMX	61.6 (1564.6)	0.33 (8.4)	7	5513	39	Steel	19B
4 5/8	5 (16)	72	102624465	4 5/8-in. Millennium II, HMX	53.3 (1353.8)	0.43 (10.9)	7	5420	39	Steel	19B
4 5/8	5 (16)	60	101210636	4-in. Millennium, HMX	43.6 (1107.4)	0.35 (8.9)	7	5518	39	Steel	19B
4 5/8	5 (16)	72	102827901	Millennium II, SDP, RDX	51.6 (1308.1)	0.48 (12.2)	7	5101	39	Steel	QC
4 5/8	12 (39)	150/30	101826652	175 MaxForce, HMX	36.5 (927.1)	0.38 (9.6)	7	5937	17.5	Steel	19B
4 5/8	12 (39)	150/30	101210674	4 1/2-in. Millennium, HMX	24.4 (619.8)	0.38 (9.7)	7	6322	22.7	Steel	19B
6 3/4	18 (59)	60/120	102703250	330 MaxForce , HMX	29.9 (759.5)	0.42 (10.7)	9 5/8	5101	33	Zinc	QC
6 3/4	18 (59)	60/120	101972806	330 MaxForce, HMX	37.4 (950.0)	0.40 (10.2)	9 5/8	5241	33	Steel	19B

Deep penetrating shaped charges

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Penetration in. (mm)	Entrance Hole in. (mm)	Casing Size in. (mm)	Target Strength (psi)	Explosive Load (gram)	Case Material	Data Type
Scalloped guns											
7	12 (39)	135/45	102054947	390 MaxForce, HMX	55.7 (1414.8)	0.32 (8.1)	9 5/8	5760	39	Steel	19B
7	12 (39)	135/45	101207997	7-in. Millennium, HMX	43.3 (1099.8)	0.36 (9.1)	9 5/8	7006	39	Steel	RP43
7	12 (39)	135/45	101702911	4 5/8-in. Millennium II, HMX	47.1 (1196.2)	0.43 (10.9)	9 5/8	5982	39	Steel	19B
7	12 (39)	135/45	101207997	7-in. Millennium, HMX	38.7 (983)	0.42 (10.7)	9 5/8	6397	39	Steel	19B
HNS high temperature scalloped guns											
2	6 (20)	0	100157018	2-in. Sidewinder II™, HNS, IS	11.8 (299.7)	0.23 (5.8)	4 1/2	5960	6.9	Steel	QC
2 3/4	6 (20)	60	101318485	2 3/4-in. Millennium, HNS	27.5 (699.8)	0.30 (7.6)	4 1/2	5694	15.1	Steel	QC
2 7/8	6 (20)	60	102322181	2 7/8-in. G-Force®, HNS	14.4 (365.8)	0.25 (6.4)	5	5101	10.5	Steel	QC
2 7/8	6 (20)	60	101388407	2 7/8-in. Millennium, HNS	22.8 (579.1)	0.28 (7.1)	4 1/2	6859	18.5	Steel	19B
3 3/8	6 (20)	60	102326523	250 Dominator, HNS	23.4 (594.4)	0.29 (7.4)	4 1/2	5101	25	Steel	QC
3 3/8	6 (20)	60	101365876	3 3/8-in. Millennium, HNS	22.1 (561.3)	0.31 (7.9)	4 1/2	6578	25	Steel	19B
4 1/2	6	60	102326523	250 Dominator, HNS	23.4 (594.4)	0.29 (7.4)	7	5101	25	Steel	QC
4 5/8	4 (13)	180	101287306	4-in. SUPER DP, HNS	30.2 (767.1)	0.29 (7.4)	7 5/8	6349	39	Steel	19B
4 5/8	5 (16)	72	101287306	4-in. SUPER DP, HNS	31.2 (792.5)	0.33 (8.4)	7	7559	39	Steel	19B
4 5/8	6 (20)	60	102326523	250 Dominator, HNS	23.4 (594.4)	0.29 (7.4)	7	5101	25	Steel	QC
4 3/4	5 (16)	72	102736073	390 Dominator, HNS	28.4 (721.4)	0.35 (8.9)	7	5101	39	Steel	QC

Note: All performance data are taken with concrete target - from eith API Section 1 tests, or single-shot QC tests. These API / QC figures are not representative of downhole performance. See page 2 related to modeling or testing at down hole conditions.



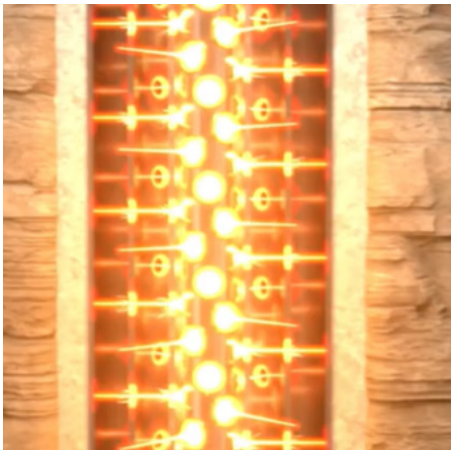
Big hole shaped charges

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Penetration in. (mm)	Entrance Hole in. (mm)	Casing Size in.	Target Strength (psi)	Explosive Load (gram)	Case Material	Data Type
Scalloped guns											
2 3/4	6 (20)	60	101206793	2 3/4-in. BH, RDX	5.5 (139.7)	0.67 (17.0)	4 1/2	6109	14.7	Steel	RP43
3 1/8	10 (33)	135/45	102327840	140 MaxForce® Flow™ HMX	4.4 (111.8)	0.66 (16.8)	5	5076	14	Zinc	19B
3 1/8	10 (33)	135/45	101351605	3 1/8-in. Mirage®, HMX, LD	3.8 (96.5)	0.64 (16.3)	5	6100	14	Zinc	QC
3 1/8	6 (20)	60	102036926	220 MaxForce Flow, HMX	6.1 (154.9)	0.82 (20.8)	5	5000	22	Steel	QC
3 1/8	6 (20)	60	102185516	220 MaxForce Flow, HMX, ZINC	5.6 (142.2)	0.77 (19.6)	5	5000	22	Zinc	QC
3 3/8	12 (39)	135/45	101351605	3 1/8-in. Mirage, HMX, LD	4.1 (105.4)	0.63 (16.0)	5 1/2	6100	14	Zinc	QC
4 5/8	12 (39)	150/30	100005326	4 5/8-in. BH OMNI™, RDX, LD	5.5 (140.0)	0.65 (16.5)	7	7346	22.7	Zinc	RP43
4 5/8	12 (39)	150/30	100157006	4 5/8-in. BH, HMX	7.0 (178.3)	0.75 (19.1)	7	5723	25	Steel	QC
4 5/8	12 (39)	150/30	100005311	4 5/8-in. SUPER BH, RDX	6.3 (160.0)	0.93 (23.6)	7	6982	28	Steel	RP43
4 5/8	12 (39)	150/30	100156995	4 5/8-in. SUPER HOLE, HMX	5.0 (127.3)	0.96 (24.4)	7	5016	28	Steel	RP43
4 5/8	12 (39)	150/30	101233690	4 5/8-in. SUPER HOLE, HMX, LD	5.3 (134.6)	0.85 (21.6)	7	5622	28	Zinc	RP43
4 5/8	12 (39)	26/129	101228756	4.625-in.,12 SPF, SH, RDX, ZINC, 28G	5.7 (144.8)	0.91 (23.1)	7	5101	28	Zinc	QC
4 5/8	12 (39)	150/30	100156995	4 5/8-in. SUPER HOLE, HMX	6.0 (152.4)	0.90 (22.8)	7	6009	28	Steel	19B
4 5/8	14 (46)	26/129	100156995	4 5/8-in. SUPER HOLE, HMX	6.0 (152.4)	0.90 (22.8)	7	6009	28	Steel	19B
4 5/8	16 (52)	135/45	103163887	260 MaxForce Flow LD, HMX	5.6 (142.2)	0.79 (20.1)	7 5/8 in 47.1 ppf	5101	26	Zinc	QC Barrel
4 5/8	16 (52)	135/45	103163887	260 MaxForce Flow LD, HMX	5.6 (142.2)	0.76 (19.3)	7 5/8 in 29.7 ppf	5101	26	Zinc	QC Barrel
4 5/8	16 (52)	135/45	103163887	260 MaxForce Flow LD, HMX	5.6 (142.2)	0.77 (19.6)	7 5/8 in 39 ppf	5101	26	Zinc	QC Barrel
4 5/8	16 (52)	135/45	103163887	260 MaxForce Flow LD, HMX	5.6 (142.2)	0.78 (19.81)	7 in 29 ppf	5101	26	Zinc	QC Barrel
4 5/8	16 (52)	135/45	103168807	260 MaxForce Flow, HMX	5.5 (139.7)	0.84 (21.34)	7 5/8 in 47.1 ppf	5101	26	Steel	QC Barrel
4 5/8	16 (52)	135/45	103168807	260 MaxForce Flow, HMX	5.5 (139.7)	0.83 (21.08)	7 3/4 in 46.1 ppf	5101	26	Steel	QC Barrel
4 3/4	16 (52)	135/45	103163887	260 MaxForce Flow LD, HMX	5.6 (142.2)	0.67 (17.02)	7 3/4 in 46.1 ppf	5101	26	Zinc	QC Barrel
4 3/4	16 (52)	135/45	103168807	260 MaxForce Flow, HMX	5.5 (139.7)	0.8 (20.32)	7 3/4 in 46.1 ppf	5101	26	Steel	QC Barrel
4 3/4	12 (39)	135/45	102964094	265 HMX BH LD	8.5 (215.9)	0.7 (17.8)	7 5/8 in 47.1 ppf	5101	26.5	Zinc	QC
5	12 (39)	150/30	100005311	4 5/8-in. SUPER HOLE, RDX	6.9 (175.3)	0.91 (23.1)	7	5192	28	Steel	RP43
5	12 (39)	150/30	100156995	4 5/8-in. SUPER HOLE, HMX	6.0 (152.4)	1.00 (25.4)	7	6487	28	Steel	QC
5	12 (39)	150/30	100005311	4 5/8-in. SUPER HOLE, RDX	6.6 (168.9)	0.83 (21.1)	7 5/8	7877	28	Steel	RP43
5	12 (39)	135	101307494	5-in. Mirage, RDX, LD	6.0 (152.4)	0.90 (22.9)	7 5/8	6551	32	Zinc	19B
5	18 (59)	60/120	101269719	5 in, 18 SPF, BH, RDX, 28 grams	6.4 (162.6)	0.93 (23.6)	7	5101	28	Steel	QC
5 1/8	12 (39)	135	101307494	5-in. Mirage, RDX, LD	6.6 (167.6)	0.88 (22.4)	7 5/8	5576	32	Zinc	19B
5 3/4	18 (59)	60/120	101688614	5 3/4-in. Mirage, RDX, LD	6.5 (165.1)	0.94 (23.9)	8 5/8	6050	28	Zinc	QC
6 1/2	12/14 (39/46)	135/45/138	101304878	6 1/2-in. Mirage, RDX, LD	5.6 (142.2)	1.07 (27.2)	8 5/8	7043	47	Zinc	19B
6 1/2	12/14 (39/46)	135/45/138	101304878	6 1/2-in. Mirage, RDX, LD	6.8 (172.7)	0.91 (23.1)	9 5/8	5088	47	Zinc	19B
6 1/2	12/14 (39/46)	135/45/138	101304878	6 1/2-in. Mirage, RDX, LD	6.8 (172.7)	0.90 (22.8)	9 7/8	6949	47	Zinc	19B
6 1/2	14 (46)	135	101304878	6 1/2-in. Mirage, RDX, LD	6.6 (167.6)	0.72 (19.3)	10 1/8	6471	47	Zinc	19B
6 3/4	18 (59)	60/120	102505344	390 MaxForce Flow UltraKleen, HMX	5.4 (137.2)	1.00 (25.4)	9 5/8	6350	39	Steel	19B
6 3/4	18 (59)	60/120	102505344	390 MaxForce Flow UltraKleen, HMX	5.2 (133.8)	0.97 (24.6)	9 7/8	6683	39	Steel	19B
6 3/4	18 (59)	60/120	102505344	390 MaxForce Flow UltraKleen, HMX	5.8 (147.3)	0.77 (19.6)	10 1/8	6009	39	Steel	19B
6 3/4	18 (59)	60/120	102896189	490 MaxForce Flow UltraKleen, HMX	8.8 (223.5)	1.02 (25.9)	9 7/8	5101	49	Steel	QC
6 3/4	18 (59)	60/120	102428572	390 MaxForce Flow, HMX	5.5 (139.7)	1.02 (25.9)	9 5/8	7131	39	Steel	19B
6 3/4	18 (59)	60/120	102528007	390 MaxForce Flow, HMX	6.1 (155.0)	0.82 (20.8)	9 7/8	6671	39	Zinc	19B
7	12/14 (39/46)	138	101329124 (1.1D) 103200704 (1.4D)	6 1/2-in. Mirage, HMX, LD	6.9 (175.3)	1.00 (25.4)	9 5/8	5740	47	Zinc	19B
7	12/14 (39/46)	135/45/138	101304878 (1.1D) 103200705 (1.4D)	6 1/2-in. Mirage, RDX, LD	6.1 (154.9)	1.07 (27.2)	9 5/8	6178	47	Zinc	19B
7	12/14 (39/46)	135/45/138	101213474 (1.1D) 103200706 (1.4D)	7-in. SUPER HOLE, RDX	5.8 (147.3)	1.29 (32.8)	9 5/8	5975	56.5	Steel	19B
7	12/14 (39/46)	135/45/138	101228037	7-in. Mirage SUPER HOLE, RDX, LD	4.7 (119.4)	1.03 (26.2)	9 5/8	5746	39	Zinc	19B
7	15 (49)	60/120	102876673 (1.1D) 103200459 (1.4D)	565 MaxForce Flow, HMX	8 (203.2)	1.41 (35.8)	9 5/8	5101	56.5	Steel	QC Barrel
7	15 (49)	60/120	102876673 (1.1D) 103200459 (1.4D)	565 MaxForce Flow, HMX	8 (203.2)	1.4 (35.6)	9 7/8	5101	56.5	Steel	QC Barrel
7	17 (55)	60/120	102876673 (1.1D) 103200459 (1.4D)	565 MaxForce Flow, HMX	8 (203.2)	1.42 (36.1)	9 5/8	5101	56.5	Steel	QC Barrel
7	18 (59)	60/120	101711688	7-in. Mirage, HMX, LD	7.6 (194.1)	1.12 (28.4)	9 7/8	5950	39	Zinc	QC
7	18 (59)	60/120	102599833	7-in. Mirage, RDX, LD	6.1 (155.0)	1.06 (26.9)	9 5/8	5950	39	Zinc	QC
7	18 (59)	60/120	101833421	7-in. Mirage, HMX, LD	6.5 (165.1)	1.09 (27.7)	9 5/8	6446	40	Zinc	19B
7	18 (59)	60/120	102351458	7-in. HMX BH	6.4 (162.6)	1.08 (27.4)	9 5/8	6474	39	Steel	19B
9 5/8	17 (55)	60/120	102428572	390 MaxForce Flow, HMX	5.5 (139.7)	0.92 (23.4)	13 3/8	5101	39	Steel	QC

Note: These API / QC figures are not representative of downhole performance. See page 2 related to modeling or testing at down hole condtions.

Targeted Anulus Perforating (TAP) systems

Because of the various well configurations and types, a unique or more tailored engineering approach is necessary to meet plug and abandonment governmental requirements, as well as operator-specific objectives for well designs. Through extensive models, tests, and development of both tool technology and shaped-charge design, the Targeted Annular Perforating (TAP) approach provides a custom perforating solution for unique plug and abandonment (P&A) projects. The TAP approach is reliable and efficient to provide flexibility in operational capabilities for well abandonment to squeeze off zones, provide targeted casing penetration, and allow annular cement squeeze operations for remedial work. The TAP charge is specifically designed to perforate an inner casing but not a secondary outer casing.



TAP systems

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Inner Casing (in.)	Through Hole Inner Casing in. (mm)	Coverage Degree (°)	Outer Casing (in.)	Penetration	Explosive Load (gram)	Case Material	Data Type
Scalloped guns												
7	12 (39)	135/45	103210728 (1.1D) 103233836 (1.4D)	TAP, RDX, steel, 51G	9-5/8-in. 47 ppf L80	0.76 (19.3)	360	13-3/8-in. 72 ppf L80	0	51	Steel	QC Barrel
7	12 (39)	135/45	103210728 (1.1D) 103233836 (1.4D)	TAP, RDX, steel, 51G	9-5/8-in. 47 ppf L80	0.79 (20.1)	270	11-3/4-in. 65 ppf P110	0	51	Steel	QC Barrel
7	12 (39)	135/45	103210728 (1.1D) 103233836 (1.4D)	TAP, RDX, steel, 51G	9-5/8-in. 53.3 ppf P110	0.74 (18.8)	360	13-3/8-in. 72 ppf L80	0	51	Steel	QC Barrel
7	12 (39)	135/45	103210728 (1.1D) 103233836 (1.4D)	TAP, RDX, steel, 51G	9-7/8-in. 62.8 ppf Q125	0.73 (18.5)	240	13-3/8-in. 72 ppf L80	0	51	Steel	QC Barrel
7	12 (39)	135/45	103255015	TAP, RDX, steel, 31G	9-5/8-in. 47 ppf L80	0.61 (15.5)	360	13-3/8-in. 72 ppf L80	0	34	Steel	QC Barrel
7	18 (59)	60/120	103238892	TAP, RDX, steel, 34G	9-5/8-in. 47 ppf L80	0.5 (12.7)	360	13-3/8-in. 72 ppf L80	0	31	Steel	QC Barrel

Maxim® shaped charges opimized for multiple casing string applications

Gun Size (in.)	Shot Density SPF (SPM)	Phasing	Part Number	Charge Name	Inner Casing	Through Hole Inner Casing in. (mm)	Outer Casing	Through Hole Outer Casing in. (mm)	Penetration* in. (mm)	Explosive Load (gram)	Case Material	Data Type
4 5/8	5 (16)	45/135	101357518 (1.1D) 103200702 (1.4D)	5 3/4-in. Maxim® RDX	7 3/4-in. 46-lb C-110	0.73 (18.5)	9 7/8-in. 68.1-lb C-110	0.66 (16.7)	7.95 (201.9)	56.5	Steel	QC
4 5/8	5 (16)	45/135	102184167 (1.1D) 103200703 (1.4D)	5 3/4-in. Maxim RDX	7 3/4-in. 46-lb C-110	0.69 (17.5)	9 7/8-in. 68.1-lb C-110	0.68 (17.3)	7.13 (181.1)	56.5	Zinc	QC
5	8 (26)	135	101350449	5-in. Maxim RDX	7 5/8-in. 47.1-lb P-110	0.75 (19.1)	9 5/8-in. 47-lb P-110	0.66 (16.8)	6.00 (152.4)	47	Steel	QC
5	8 (26)	135	101350449	5-in. Maxim RDX	7 3/4-in. 45.7-lb Q-125	0.64 (16.3)	10-in. 68-lb C-110	0.66 (16.8)	Not Measured	47	Steel	Barrel
5	8 (26)	135	101350449	5-in. Maxim RDX	4 5/8-in. 47.1-lb P-110	0.83 (21.1)	11 3/4-in. 65-lb Q-125	0.30 (7.6)	4.21 (106.9)	47	Steel	QC
5 3/4	10 (33)	45/135	101357518 (1.1D) 103200702 (1.4D)	5 3/4-in. Maxim RDX	8 5/8-in. 60.8-lb P-110	0.83 (21.1)	11 3/4-in. 65-lb P-110	0.71 (18.0)	9.2 (233.7)	56.5	Steel	QC
5 3/4	10 (33)	45/135	101357518 (1.1D) 103200702 (1.4D)	5 3/4-in. Maxim RDX	9 7/8-in. 68-lb C-110	0.79 (20.1)	13 5/8-in. 88.2-lb Q-125	0.57 (14.5)	6.10 (154.9)	56.5	Steel	QC
5 3/4	10 (33)	45/135	102184167 (1.1D) 103200703 (1.4D)	5 3/4-in. Maxim RDX	8 5/8-in. 60.8-lb P-110	0.82 (20.8)	11 3/4-in. 65-lb P-110	0.71 (18.0)	9.19 (233.4)	56.5	Zinc	QC
5 3/4	10 (33)	45/135	103114501 (1.1D) 103200701 (1.4D)	5 3/4-in. Maxim HMX	8 5/8-in. 60.7-lb P-110	0.94 (23.9)	11 3/4-in. 65-lb P-110	0.73 (18.5)	8.8 (223.5)	56.5	Steel	QC
6 3/4	14 (46)	138	101357518 (1.1D) 103200702 (1.4D)	5 3/4-in. Maxim RDX	System released for multi casing testing					56.5	Steel	QC
6 3/4	14 (46)	138	102184167 (1.1D) 103200703 (1.4D)	5 3/4-in. Maxim RDX	9 5/8-in. 65.1-lb Q-125	0.76 (19.3)	Single Casing Test Only		9.83 (249.7)	56.5	Zinc	QC
6 3/4	14 (46)	138	103114501 (1.1D) 103200701 (1.4D)	5 3/4-in. Maxim HMX	9 7/8-in. 68-lb Q125	0.73 (18.5)	11 7/8-in 71.8-lb Q125	0.54 (13.7)	Not Measured	56.5	Steel	Barrel
7	14 (46)	138	101357518 (1.1D) 103200702 (1.4D)	5 3/4-in. Maxim RDX	9 5/8-in. 47-lb L-80	0.61 (15.5)	13 3/8-in. 72-lb P-110	0.68 (17.3)	8.77 (222.7)	56.5	Steel	QC
7	14 (46)	138	102184167 (1.1D) 103200703 (1.4D)	5 3/4-in. Maxim RDX	System released for multi casing testing					56.5	Zinc	QC
7	14 (46)	138	103114501 (1.1D) 103200701 (1.4D)	5 3/4-in. Maxim HMX	System released for multi casing testing					56.5	Steel	QC

Notes:

- 1.4D can go by airfreight
- Multi casing charges need specific test set-ups for evaluation prior to use
  - Centralized casing, decentralized casings, cement, fluid etc.
- See page 2 related to modeling or testing at down hole condtions.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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