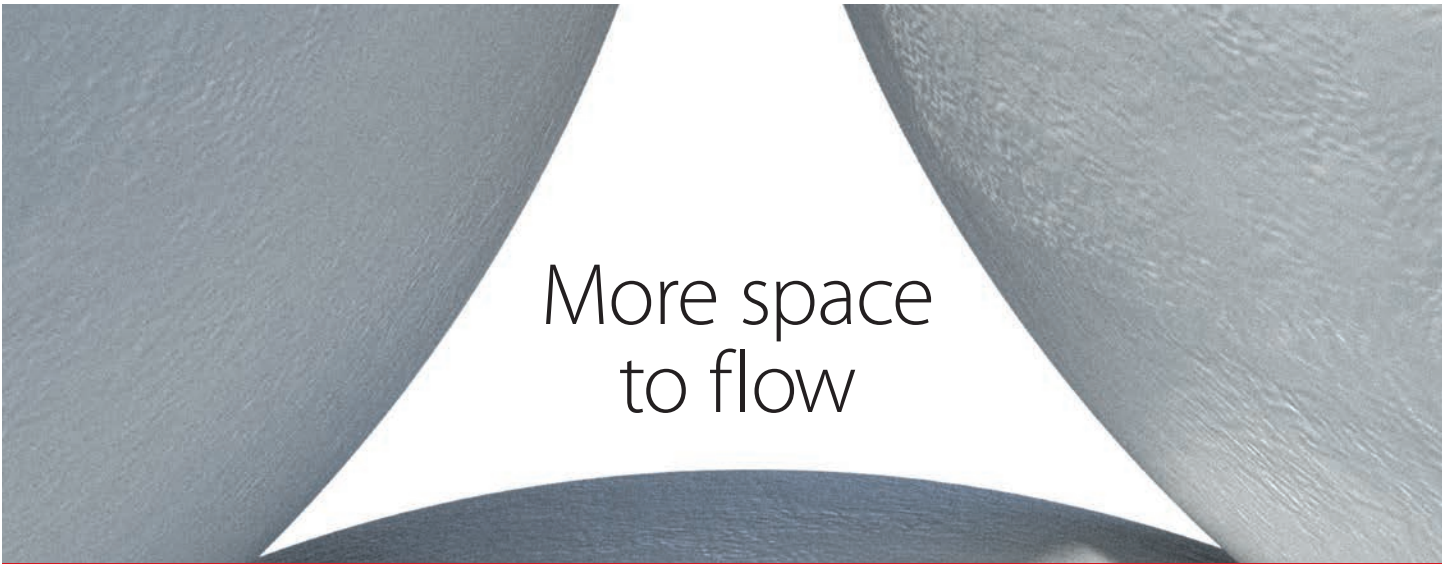


KRYPTOSPHERE LD

Ultra-conductive, low-density ceramic proppant



More space
to flow

Lower F&D costs, increased recovery

KRYPTOSPHERE® LD ultra-conductive, low-density ceramic proppant technology significantly exceeds the conductivity, compressive strength and durability of existing low-density products.

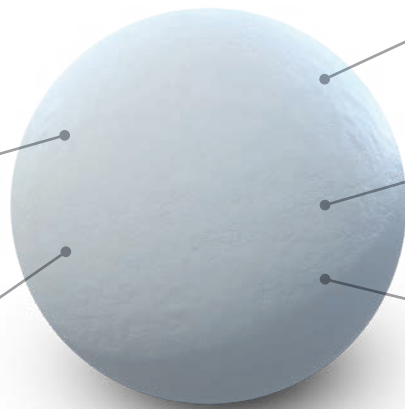
In addition, KRYPTOSPHERE LD technology provides comparable and, in many cases, higher conductivity than intermediate-density and bauxite ceramics while delivering improved proppant transport and increased propped fracture volume.

The higher flow rates and larger propped volume increases recovery and return on investment, thereby lowering finding and development costs per barrel of oil equivalent.

KRYPTOSPHERE LD technology:
Precision-engineered, strong, durable, round, single-mesh-sized and smooth proppant grains

Significantly less erosive on pumping equipment due its excellent shape and smoothness

Round and smooth. Reduces flow path tortuosity to reduce non-Darcy impacts and improve overall conductivity



Extraordinary strength and durability. Maintains higher conductivity and flow for the life of the well

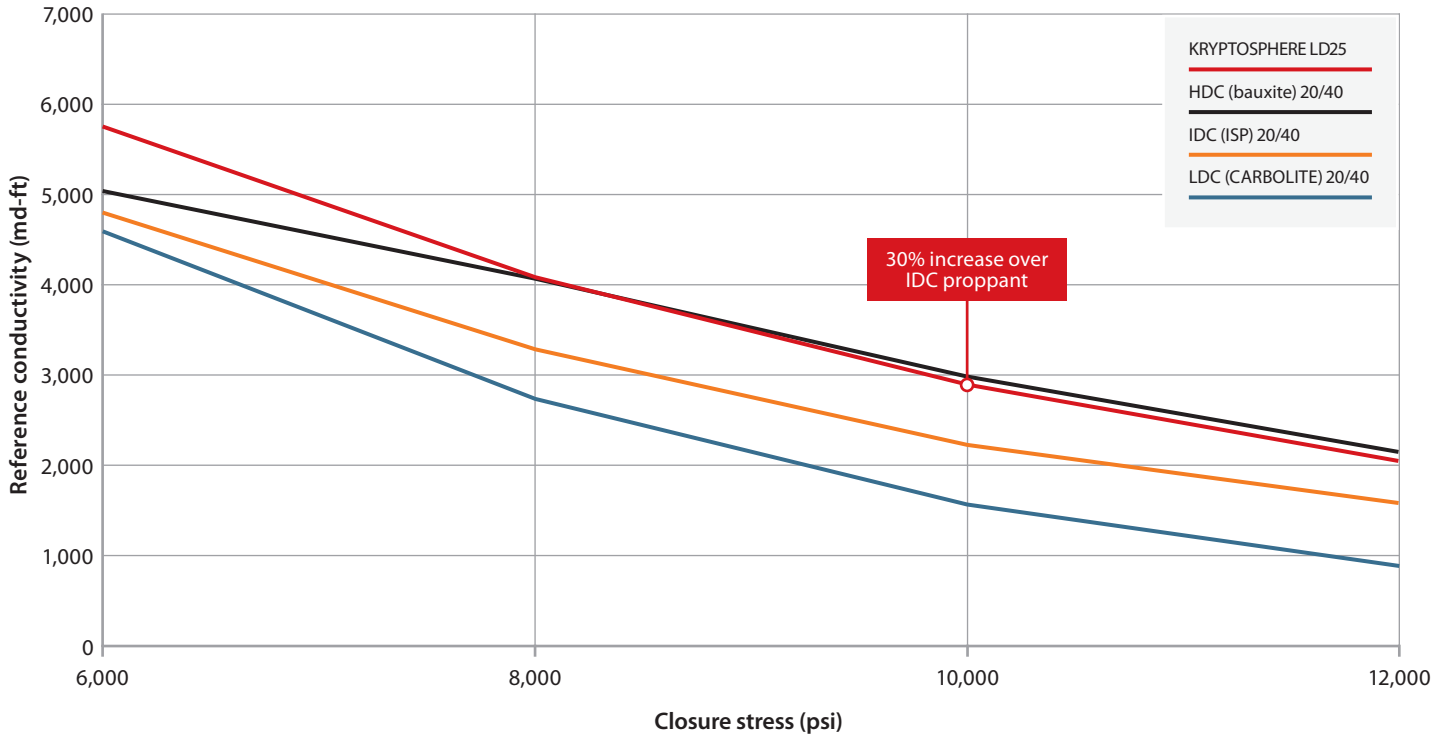
Improved proppant transport and higher propped volume compared to intermediate-density proppant

Uniform size and shape for optimal proppant packing. Creates a frac with more space for hydrocarbon flow

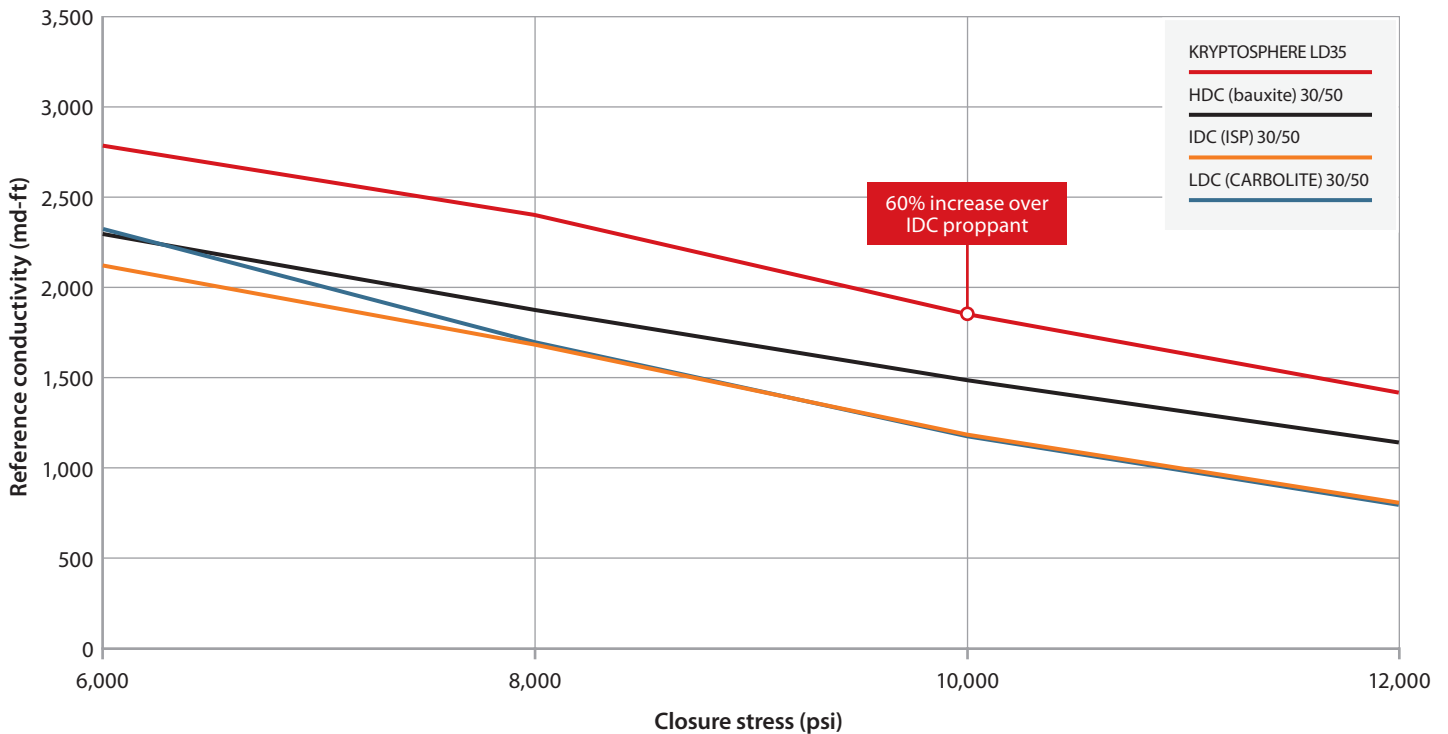
A step-change in performance

KRYPTOSPHERE LD technology creates more space for hydrocarbon flow which results in the highest levels of production and recovery across the entire range of low and high stress conditions. The significantly higher baseline conductivity compared to typical intermediate- and low-density ceramic proppant maintains the highest flow rates and extends the productive life of the frac.

Conductivity comparison, 25 Mesh vs comparable mesh products



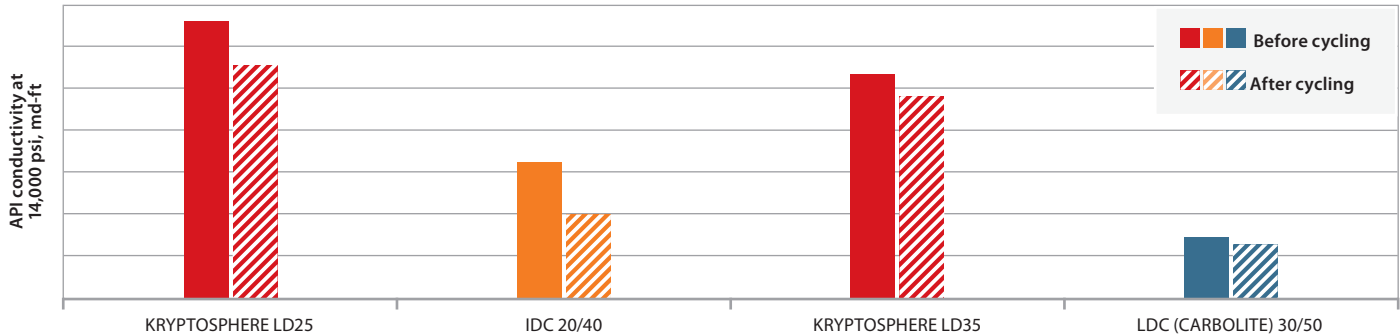
Conductivity comparison, 35 Mesh vs comparable mesh products



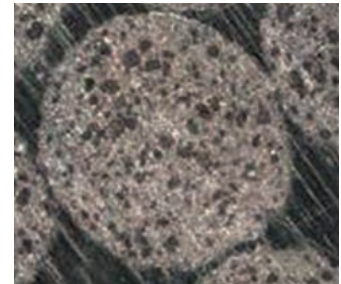
Sustains conductivity after stress-cycling

KRYPTOSPHERE LD technology has a high crush-resistance and withstands stress-cycling to ensure that fracture conductivity, integrity and connectivity are sustained long-term to optimize production.

Conductivity before and after 5 stress cycles (Cycle: 14,000 psi - 6,000 psi - 14,000 psi)



Exceptional microstructure for increased strength and durability



KRYPTOSPHERE LD

KRYPTOSPHERE LD technology has an exceptionally low and uniformly distributed internal porosity which creates a proppant with extraordinary compressive strength and durability.

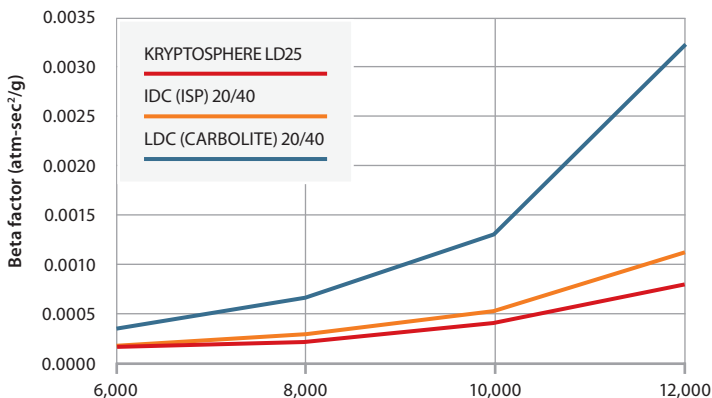
Standard low-density ceramic proppant

High internal porosity with irregular distribution dramatically reduces strength leading to the creation of fines that rapidly reduce conductivity and production.

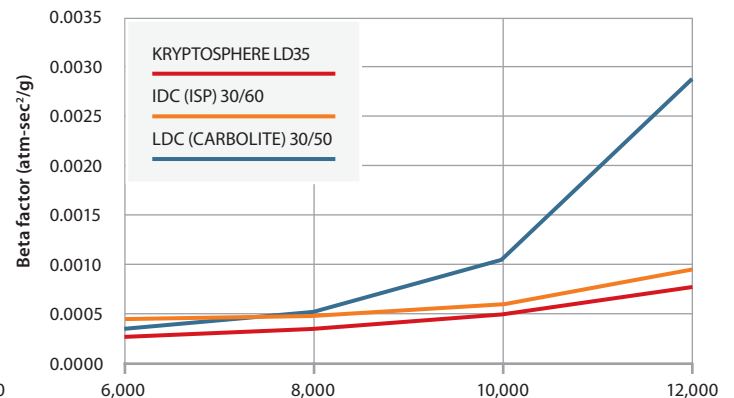
Lower beta factor and pressure drop

The spherical, smooth and uniform size characteristics of KRYPTOSPHERE LD technology creates a frac with more uniform flow paths. The reduced flow path tortuosity minimizes the pressure drop due to non-Darcy flow effects across the fracture which further enhances overall conductivity, flow rates and ultimate recovery.

Beta factor comparison, 25 Mesh vs comparable mesh products



Beta factor comparison, 35 Mesh vs comparable mesh products



Physical and chemical properties

Typical sieve analysis [weight % retained]

U.S. Mesh [mesh]	Microns	LD20	LD25	LD35
-18+20 mesh	-1000+850	100	0	0
-20+25 mesh	-850+710	0	100	0
-30+35 mesh	-600+500	0	0	100
Mean particle diameter [microns]		960	810	575
API/ISO crush test				
% by weight fines generated @ 12,500 psi		10	8	5

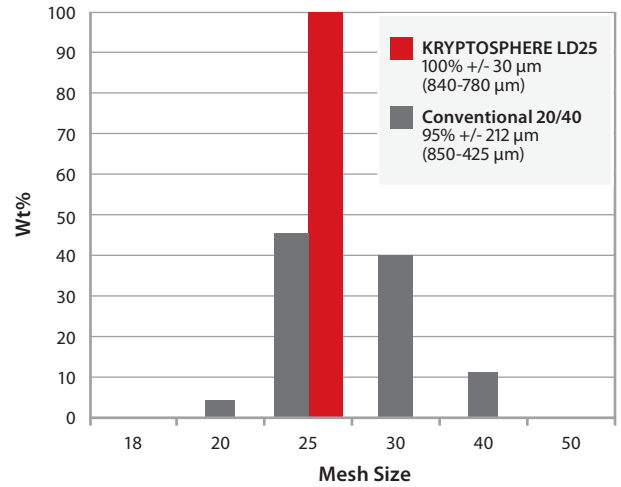
Sizing requirements:

These specifications meet the recommended practices as detailed in ISO 13503-2.

Typical additional properties

Roundness	0.9	Apparent specific gravity	2.83
Sphericity	0.9	Absolute volume [gal/lb]	0.042
Bulk density [lb/ft ³]	104	Solubility in 12/3 HCl/HF acid [% weight loss]	<2
	1.67 [g/cm ³]		
Chemistry	>50% Alumina		

Single mesh size technology



KRYPTOSPHERE LD technology is a single-mesh-sized product that can be manufactured at the optimal size for your fracture design and reservoir conditions.

Long-term conductivity

Closure stress Reference conductivity*, md-ft

[psi]	20 Mesh	25 Mesh	35 Mesh	45 Mesh
2,000	9,095	8,490	3,490	2,188
4,000	8,155	7,225	3,200	2,100
6,000	6,820	5,750	2,790	1,950
8,000	5,095	4,075	2,400	1,770
10,000	3,500	2,890	1,860	1,463
12,000	2,450	2,050	1,420	1,015
14,000	1,700	1,440	1,025	671
16,000	1,100	975	700	425

Closure stress Beta Factor, atm-sec²/gram

[psi]	20 Mesh	25 Mesh	35 Mesh
2,000	0.000099	0.000097	0.000228
4,000	0.000114	0.000120	0.000254
6,000	0.000143	0.000162	0.000302
8,000	0.000210	0.000254	0.000366
10,000	0.000349	0.000403	0.000500
12,000	0.000562	0.000626	0.000697
14,000	0.000919	0.001010	0.001043
16,000	0.001648	0.001688	0.001043

Closure stress Reference permeability*, Darcies

[psi]	20 Mesh	25 Mesh	35 Mesh	45 Mesh
2,000	512	469	204	130
4,000	464	405	188	126
6,000	395	327	165	118
8,000	301	237	143	108
10,000	211	170	113	90
12,000	151	124	88	64
14,000	107	88	65	43
16,000	71	61	45	28

* Reference conductivity and permeability are measured with a single phase fluid under laminar flow conditions in accordance with ISO 13503-5. In an actual fracture, the effective conductivity will be much lower due to non-Darcy and multiphase flow effects. For more information, please refer to SPE Paper #106301.

Talk to CARBO to find out how we can help you enhance your production.

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