

## BLACK MAMBA STRING DESIGN GUIDELINES

Black Mamba Rod Lift provides an industry first – Complete, Predictable, End-to-End Rod Control. Rod lift systems can be pumped more aggressively than past recommendations as bending moments and the side-effects of compression in the rod string are eliminated through Black Mamba’s constant helical stabilization of the rod string during negative loading.

Standard procedures and mentality for Black Mamba string designs are as follows:

1. In lieu of Sinker Bars, run Black Mamba Complete Rod Control Sinker Rod (1" Rod Body w/ 3/4" Pin – Guided 7 per for Complete Rod Control)
  - a. Design from pump upward to neutral point (when Top Minimum Stress becomes positive)

Rod string design					Rod string stress analysis (service factor: 1)				
Diameter (in)	Rod Grade	Length (ft)	Min. Ten. Str. (psi)	Fric. Coeff	Stress Load %	Top Maximum Stress (psi)	Top Minimum Stress (psi)	Bot. Minimum Stress (psi)	# Guides/Rod
+ 1.23	Superod	4000	N/A	0.2	88.8%	26024	4096	2342	0
0.875	BM-HAS-7PER	2000	140000	0.06	79.0%	42675	6235	226	7
+ 1	BMHASNK-PK-134	2250	78000	0.06	86.2%	24100	173	-4074	7

- b. The RodStar user shall validate a variety of pumping conditions to ensure compression is not predicted to creep up into the next taper. Gas interference mode at approximately 60 – 80% under various speeds will likely increase the number of Sinker Rods needed.
- c. **Black Mamba typically adds an additional 10% of Sinker Rod taper length as a safety factor if there is not Complete Rod Control above the sinker rod taper.**
- d. Black Mamba’s CRC Sinker Rod is approximately \$10 per foot.  
Sinker Bar + Stabilizer Bars combined are approximately \$20 per foot.

2. When designing a pure Complete Rod Control rod string, use of a deviation survey is not required. Each rod is buckle-proof as molded. Rod string velocity can approach 2,000 inches per minute (Stroke Length x Strokes per Minute) without hesitation. Pumping Units and free-fall velocity are computed based on Lufkin guidelines below.

**Maximum Strokes per Minute** (based on the free fall speed of the rod)

**Formula:**

Conventional Units:      Air Balanced Units:      Mark II Units:

**Example:** Assumes a C-320D-256-100 Conventional Unit.

$$SPM = .7 \sqrt{\frac{60000}{L}} \quad SPM = .63 \sqrt{\frac{60000}{L}} \quad SPM = .56 \sqrt{\frac{60000}{L}}$$

$$SPM = .7 \sqrt{\frac{60000}{100}} = 17.15 \text{ SPM Maximum}$$

Lufkin. *Artificial Lift Nomenclature and Application Formulas.*

3. Black Mamba’s 7 per configuration is recommended in applications where side-load per rod increases beyond 200 lbf. Minimum taper length of Complete Rod Control sections shall be 400 feet.