AXE Tool

Rival's AXEial Anti-Shock & Vibration tool (the AXE TOOL™) absorbs axial shocks, vibrations, and excitation whereas traditional spring based shocks and thrusters redirect vibrations and excitation without removing them from the BHA.

- Placement is flexible based on BHA design
- Anti-Shock elements eliminate shocks & vibrations instead of reflect

Payoffs:

- Eliminate unplanned trips due to MWD & RSS failures
- Protect drill bits and sustain ROP for faster intervals
- Reduce cumulative shocks on equipment to reduce repair costs and extend component life

Size	5" AXE	6.5" AXE	8" AXE	9" AXE
Nominal OD	5.00 in (127.0 mm)	6.50 in (165.1 mm)	8.00 in (203.2 mm)	9.00 in (228.6 mm)
Recommended Hole Sizes	6-1/8 - 6-3/4 in (156 - 171 mm)	7-7/8 - 8-3/4 in (200 - 222 mm)	9-7/8 - 17-1/2 in (251 - 445 mm)	10 5/8" - 32" (270 – 813 mm)
Length	8.2 ft (2.5 m)	8.6 ft (2.6 m)	9.7 ft (2.9 m)	11.0 ft (3.4 m)
Inner Diameter	1.75 in (44.5 mm)	2.00 in (50.8 mm)	2.50 in (63.5 mm)	2.75 in (69.85)
Weight	500 lbs (230 kg)	725 lbs (330 kg)	1,175 lbs (530 kg)	1,785 lbs (810 kg)
WOB to Fully Compress	50,000 lbs (22,200 daN)	70,000 lbs (31,100 daN)	100,000 lbs (44,500 daN)	140,000 (62,300 daN)
Overpull to Fully Extend	50,000 lbs (22,200 daN)	70,000 lbs (31,100 daN)	100,000 lbs (44,500 daN)	140,000 (62,300 daN)
Max Stroke Up to Solid	3.0 in (76.2 mm)			
Max Stroke Down to Solid	3.0 in (76.2 mm)			
Max Overpull to Re-Run	90,000 lbs (40,000 daN)	200,000 lbs (89,000 daN)	325,000 lbs (145,000 daN)	400,000 lbs (1,779,290 daN)
Max Temperature	320°F (160°C) Standard 400°F (200°C) Hi-Temp			
Common Rig End Connections	3-1/2 IF XT-39	4-1/2 XH 4-1/2 IF	6-5/8 REG	6 5/8 Reg 7 5/8 Reg

AXE Tool Placement

- **Conventional**
  - AXE is placed as close to MWD
  - Can be placed above or below MWD. If BHA allows it, placing AXE below MWD system will further benefit the MWD.
- **Conventional RSS**
  - AXE is placed as close to MWD & RSS as possible
  - If MWD/RSS allows it, placing AXE below MWD system will further benefit the MWD
- **Motorized RSS**
  - Typical placement is directly below the motor, but it can be run above if directional tools don't enable running below.
  - Stabilizers can be place according to current client application's practices.
- **Packed hole BHA**
  - Flexible placement
  - If using MWD placed adjacent to MWD

Conventional BHA Placement	
1	Bit
2	Motor
3	RIVAL AXE
4	M/LWD
5	BHA/Pipe To Surface

Conventional RSS BHA Placement	
1	Bit
2	RSS
3	M/LWD
4	RIVAL AXE
5	BHA/Pipe To Surface

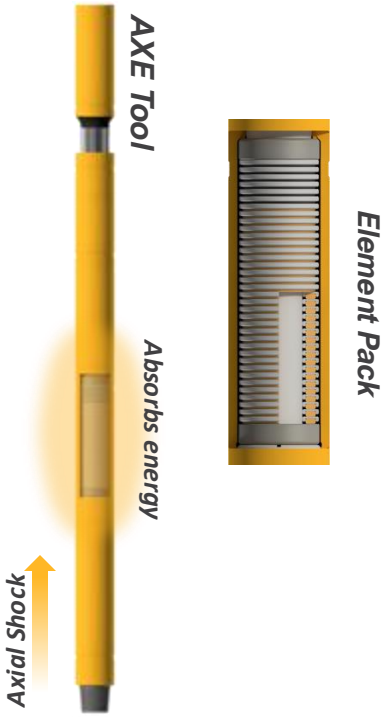
Motorized RSS BHA Placement	
1	Bit
2	RSS
3	MWD*
4	RIVAL AXE
5	PDM
6	BHA/Pipe To Surface

*Note: AXE can be shot-hopped to put MWD above AXE if DD company has short-hop capability.

AXE Tool | Comparison to a Shock Tool

AXE Tool elements absorb energy directly which is dissipated internally

- ✓ No Recoil
- ✓ Absorbs axial shocks internally to protect the BHA
- ✓ Bi-Directional dampening enables flexible placement
- ✓ Cushions WOB transfer to the drill bit to protect PDC drill bit cutters
- ✓ Compatible with Air-Hammers and Roller-Cone bits
- ✓ Proven to deliver longer intervals reducing directional tool failures and protecting bits for higher ROP



Shock Tools store energy in efficient springs stacks that reflect the inputted energy back to the source.

- ✓ Effective for managing bit-bounce in Roller Cone Applications
- ✓ Works with Agitators which use springs to create axial movement in the drill string
- X Does not dampen Axial Shock & Vibration; it isolates it below the shock tool reflecting to the source
- X Causes PDC drill bit damage when recoil sends energy back to bit