Drilling motors and tools
SOKOL

AGS-SOKOL

ADJUSTABLE GAUGE STABILIZER

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AGS-SOKOL ACTING AS THE FIRST STRING STABILIZER — ROTARY BHA

Installation of AGS-SOKOL as first string stabilizer provides build up in the closed position (retracted) and slight drop off in the open position (extended).

AGS-SOKOL installed 1.5-4.6 m above the full gage near-bit stabilizer helps to change inclination in rotary drilling from 1.5°/30 m (build up) to — 0.6°/30 m (drop off). So directional driller is able to control the well trajectory without wasting time for round trip to change the string stabilizer.

Build up/drop off rate depends on the distance between the near-bit stabilizer and AGS-SOKOL. Aggressive rates may be reached by decreasing this distance.

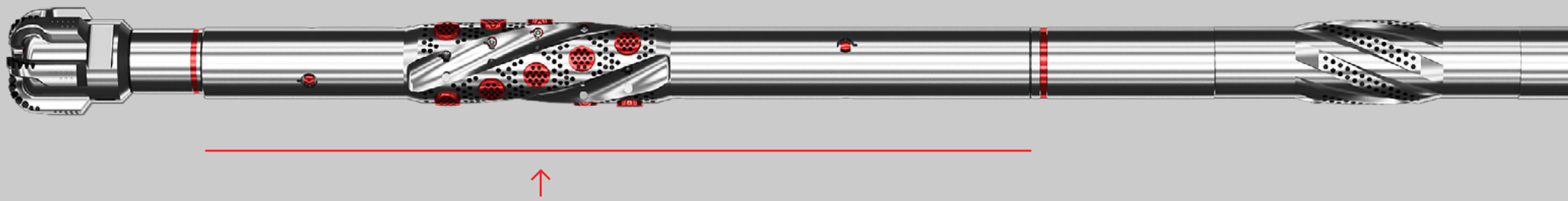
Behaviour of BHA with AGS-SOKOL in any mode is the same as regular, which allows to combine two BHA types in one. As a result, we get smoother build up trajectory and cost reduction by decreasing number of round trips.

AGS-SOKOL ACTING AS THE FIRST STRING STABILIZER — ROTARY BHA

Bottomhole assembly	Build up rate (°/30 m), in the following modes: "closed" (non-zero)/ "open" (zero)									
	152.4 mm		215.9 mm			311.1 mm			444.5 mm	
AGS-SOKOL = first string stabilizer	142.9	152.4	196.8	203.2	215.9	292.1	298.4	311.1	425.4	444.5
Bit-Full-gage stab-DC 1.5 m — AGS-SOKOL(AGS-SKL)-MWD-Full-gage stab	+1.30	-0.40	+1.50	+1.00	-0.40	+1.50	+1.00	-0.40	+1.00	-0.40
Bit-Full-gage stab-DC 3 m-AGS-SKL-MWD-Full-gage stab	+1.00	-0.20	+0.75	+0.50	-0.20	+1.25	+0.50	-0.20	+0.50	-0.20
Bit-Full-gage stab-DC 4.6 m-AGS-SKL-MWD-Full-gage stab	+1.25	+0.20	+0.60	+0.20	-0.40	+0.60	+0.20	-0.40	+0.40	-0.60

Example: Drilling of 311.1 section with 298.4 — 311.1 mm AGS-SOKOL. AGS-SOKOL *is 3 m above the full gage near-bit stabilizer. Drop off rate — 0.20°/30 m in "open" mode (extended), build up rate +0.5°/30 m "closed" mode (retracted). Field test results of the tool are given in the table above. These data can be used as initial metrics for calculation of BHA geometry. It is requested to provide data about your already drilled wells to get more qualified advice. Do not exceed the distance of 4.6 m between* AGS-SOKOL *and the near-bit stabilizer.*

AGS-SOKOL ACTING AS NEAR-BIT STABILIZER — ROTARY BHA



Apart from correction of straight section trajectory AGS-SOKOL is often used to drill the drop off section. This assembly provides locking up or build up in "open" mode (extended) and aggressive drop off rates in "closed" mode (retracted). AGS-SOKOL is placed right above the bit, distance to the first string stabilizer — 3 m.

Choice of the first string stabilizer has significant impact on behaviour of BHA with AGS-SOKOL. Smaller size — higher build up rate in "open" mode (extended).

DRILLING OF HORIZONTAL WELLS

Build up leads to increase of aggressivity and steerability of the BHA. For example AGS-SOKOL with range of diameters 203.2 — 215.9 placed 3 m below an undersized first string stabilizer (203.2 mm) provides build up rate +1,2°/30 m in "open" mode (extended) and drop off rate — 2,0°/30 m in "closed" mode (retracted).

AGS-SOKOL ACTING AS NEAR-BIT STABILIZER — ROTARY BHA

In this case AGS-SOKOL improves borehole cleaning by mixing mud settled on the lower wall of the hole. Besides there is a possibility to place MWD and LWD sensors in close proximity to the bit and to send data to the surface on a real time basis. This provides more accurate trajectory corrections in accordance with technical specifications during drilling of horizontal sections in thin formations.

Bottomhole assembly	Build up rate (°/30 m), in the following modes: "closed" (non-zero)/ "open" (zero)									
	152.4 mm		215.9 mm			311.1 mm			444.5 mm	
AGS-SOKOL = near-bit stabilizer	142.9	152.4	196.8	203.2	215.9	292.1	298.4	311.1	425.4	444.5
Bit-AGS-SKL-DC 3.0 m-Full-gage stab-MWD-Full-gage stab	-1.25	-0.20	+1.30	-1.25	-0.40	-1.25	-1.25	-0.40	-1.00	-0.40
Bit-AGS-SKL-6.4 mm DC 3.0 m-Full-gage stab-MWD-Full-gage stab	-1.00	+0.20	-1.00	-1.00	+0.30	-1.20	-1.20	0	-1.20	0
Bit-AGS-SKL-3.0 mm DC 12.7 m-Full-gage stab-MWD-Full-gage stab	-0.60	+1.00	-1.60	-1.60	+0.60	-1.00	-1.00	+0.50	-1.20	+0.50

Example: Drilling of 215.9 section with 203.2 — 215.9 mm AGS-SOKOL. AGS-SOKOL *is 3 m above the undersized near-bit stabilizer (203.2 mm). Build up rate +0,80/30 m in "open" mode (extended), drop off rate — 1.6°/30 m "closed" mode (retracted). Field test results of the tool are given in the table above. These data can be used as initial metrics for calculation of BHA geometry.*

AGS-SOKOL ABOVE THE MOTOR

About one quarter of the BHA with AGS-SOKOL are BHA where AGS-SOKOL is placed above the motor. According to research results 90% of time for hold sections drilling in sliding mode is spent on correction of inclination.

DRILLING OF HOLD SECTIONS

Cost advantage of AGS-SOKOL installation above the motor is decreasing time for inclination correction. In this case changes of wellbore geometry are made by changing mode of operation of AGS-SOKOL during rotary drilling. This decreases sliding time. As a result we get faster ROP, cleaner hole and better wellbore quality as we eliminate violent geometry changes due to multiple orientations with motor.

DRILLING OF HORIZONTAL WELLS

Increase of inclination angle leads to increase of BHA aggressivity. In some cases AGS-SOKOL is enough to make the required inclination corrections, so installation of straight motor is possible.

AGS-SOKOL ABOVE THE MOTOR

Size of well, mm	AGS-SKL size range, mm	Distance from AGS-SKL to bearing section, m	Rate of inclination change, °/30m	
			"closed" mode (non-zero)	"open" mode (zero)
444.5	425.4 — 444.5	9.1 — 10.1	+0.30	-0.40
406.4	387.3 — 406.4	9.1 — 10.1	+0.30	-0.40
311.1	298.4 — 311.1	8.5 — 9.4	+0.30	-0.30
	292.1 — 311.1	7.9 — 8.8	+0.50	-0.50
215.9	203.2 — 215.9	7.9 — 8.8	+0.30	-0.20
	196.8 — 215.9	7.3 — 8.2	+0.40	-0.40
152.4	142.9 — 152.4	6.1 — 6.7	+0.30	-0.40

Example: Drilling of 215.9 section with 203.2 — 215.9 mm AGS-SOKOL. AGS-SOKOL is placed 7.9 m above the bearing section or 0.6 m above pin connection of the motor. Drop off rate — 0,20°/30 m in "open" mode (extended), build up rate +0,3°/30 m "closed" mode (retracted). Field test results of the tool are given in the table above. These data can be used as initial metrics for calculation of BHA geometry. The data given are applicable for BHA with bearing section 212.7 mm and bend angle 0.6° — 1.0°. It is requested to provide data about your already drilled wells to get more qualified advice.

AGS-SOKOL BELOW THE MOTOR

Recently AGS-SOKOL has been used as a rotating near-bit stabilizer right below the motor. Now this BHA is commonly used for horizontal wells with size 165.1 and smaller.

The tool is placed right above the bit and torqued to lower box of the motor. Full gage mode of the stabilizer is set to the size 3 mm less than wellbore (bit) diameter. Motor may be equipped with bearing section stabilizer. Third stabilizer is installed 4.9 — 6.1 m above in the drill string, this distance is defined by position of connection point of motors with twin power section.

Unplanned corrections of azimuth in horizontal wells are very rare. AGS-SOKOL allows to set a zero bend angle and achieve higher ROP with fast correction of inclination. Use of the tool below the motor provides build up rate up to +1,4°/30 m in open mode (extended) and drop off rate up to — 2,5°/30 m in "closed" mode (retracted).

AGS-SOKOL BELOW THE MOTOR

Sections with small radius of hole curvature are commonly drilled with bits with increased diameter to support drillability of the wellbore with rigid BHA components (e.g., to drill 155.6 and 165.1 mm sections of the well bits with diameters 165.1 and 171.4 mm accordingly). Field test data have proven that the stabilizer passes through the sections with curvature up to 22°/30 m.

Size of well, mm	AGS-SKL size range, mm	Size of bearing section, mm	Size of first string stabilizer, mm	Rate of inclination change, °/30m	
				"closed" mode (non-zero)	"open" mode (zero)
149.2	136.5 — 146.0	133.3	127.0	-2.50	+1.40
155.6	142.9 — 152.4	139.7	133.3	-2.50	+1.40
215.9	203.2 — 215.9	—	203.2	-1.00	+0.50
311.1	292.1 — 311.1	—	308.0	-1.20	+0.80

Example: Drilling of 155.6 mm section with 142.9 — 152.4 mm AGS-SOKOL. The tool is placed above 155.6 mm bit and below the motor with housing diameter 120.6 mm and stabilizer 139.7 mm. First string stabilizer 133.3 mm is placed above or between the power sections at the distance 4.9 — 6.1 m. Build up rate +1.40°/30 m in "open" mode (extended), drop off rate — 2,5°/30 m "closed" mode (retracted). Field test results of the tool are given in the table above. These data can be used as initial metrics for calculation of BHA geometry. Straight motors were run with AGS-SOKOL placed below the motor. If another bend angle is required, please consult with the motor manufacturer.

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