



OPERATION MANUAL ROCK BITS

1. BITS STORAGE

- 1.1 Bits should be kept in conditions preventing immediate contact of the package and the product in it with any moisture sources, including atmosphere precipitation. If bits are kept indoors, control of relative air humidity and temperature is required.
- 1.2 It is not recommended to keep sealed bearing bits at low temperatures. You should also avoid sudden changes in temperature as it can affect seal life.
- 1.3 Drill bits must be stored and transported in factory package strictly observing correct vertical orientation of the package (bits should be kept with their pins upwards). Stowing and fastening of goods as well as loading and unloading should ensure safety of the package during transportation and relocation.
- 1.4 On the drill rigs, drill bits must be stored in factory packaging. If kept without original package, bits should be kept with their pins upwards in line with measures to ensure mechanical protection of the thread and protection of bits against humidity and atmosphere precipitation.

2. DRILL BITS PREPARATION

- 2.1 Before a new bit run, you should analyze previous bit run (wear, ROP, drilling modes, meters drilled etc.).
- 2.2 Check the condition and configuration of a bit: security of mounting, correct operation of backpressure valve, availability and diameter of the nozzles, thread condition. Make sure that the thread of a drilling rod (sub, centralizer etc.) is in order, fault free and matches the bit thread.
- 2.3 Check the drill rods condition. Prevent using deformed drill rods, as well as those with worn threads. In addition, using drill rods from different manufacturers in one drilling assembly is not recommended.
- 2.4 Check the centering bushing of the drilling table. The clearance between the drill rod and the centering bushing should not be more than 16 mm.
- 2.5 Check compressor operation, also check air hoses and air ducts for leakage. It should be noted that air leakage in the pressure pipe would adversely affect cuttings removal speed and bit cooling.
- 2.6 Check lifting jacks for normal operation. Prevent loss of leveling of the drill rig during the drilling.
- 2.7 Do not make unauthorized modifications of the bit design by welding additional parts, removing back pressure valve and/or nozzles.

3. MAKING UP BITS

- 3.1 Flush the drilling assembly with air before making up a bit.
- 3.2 You should clean and grease the pin of the bit and the box connection of the drill rod.
- 3.3 You must make up the bit using special device (bit breaker) or pipe tongs. It is prohibited to use hammer tool or hold the bit with hands.
- 3.4 Avoid impacts or mismatch when making up the bit.

4. RUN IN HOLE OPERATION

- 4.1 Do not run a new bit in an old non-penetrating well. It will inevitably result in chipped shirrtails and cutters on the gauge, locked cones.
- 4.2 Tripping and borehole reaming are prohibited, if a drilling assembly is not rotating or a compressor is switched off.
- 4.3 During run in hole operation, you should avoid hitting a bit against the edges when passing through the centering bushing of the drill rig, as well as hitting against the walls of the hole. During running a bit in hole, the speed should be minimized when reaching the bottom-hole. Hitting a bit against the bottom-hole is prohibited.

5. BREAKING IN A NEW BIT

- 5.1 Break in a new bit during 15-20 min at 35-50 rpm or less and 10-15% of the WOB applied to this type and size of bits by your company.
- 5.2 Gradually increase WOB (within the ranges specified by the manufacturer) until you get the maximum ROP without vibrations.
- 5.3 It is not recommended to break in new bits when drilling wells in the first row of the drilled block or when drilling directional wells.

6. DRILLING

- 6.1 Bit record (Appendix 1) should be filled in by the drilling operators every shift.
- 6.2 Volume of water injected in the hole should be minimum and only enough for dust control. At the same time, when drilling the initial 3-6 m or when drilling through intensely fractured disintegrated formations, you should increase water supply for troweling well walls to prevent their constant collapse.
- 6.3 Drilling modes should be selected based on achieving optimum performance within the range of parameters given in the table below:

№	IADC Code	Axial load (kg) per mm of bit diameter		Recommended RPM
		MIN	MAX	
1	Code 4XX	15,24	76,86	50 - 150
2	Code 5XX	46,06	99,89	50-120
3	Code 6XX	61,29	107,34	50-100
4	Code 7XX	61,29	122,92	50-90
5	Code 8XX	92,10	138,15	40-80

- 6.4 A drilling mode is considered to be efficient, if it provides highest bit durability, ROP and drill rig capacity for the specific mining and geological applications.
- 6.5 Drill only with switched on compressor.
- 6.6 Do not apply WOB when the bit does not rotate.
- 6.7 If the drilling assembly starts vibrating while drilling, you should either reduce only WOB or both WOB and RPM at the same time to the level where vibrations stop.
- 6.8 Do not drill if air passages (nozzles) are blocked.

- 6.9 It is prohibited to apply WOB and after that switch on the drill pipe spinner, as it may cause damage of the drill bit, TCI, drill rods and joints.
- 6.10 Do not use new or test bits for cleaning out collapsed wells. For this purpose, use only worn bits.
- 6.11 In case of a long shut down (emergency, repair, power cut etc.), lift the bit up to 2-3 meters above the bottom-hole. Leaving the bit on bottom-hole is prohibited as it will result in plugged bearings and locked cones. Before you resume drilling, you should switch on the compressor and flush the bit for 40 - 60 seconds to confirm cuttings removal and stable air pressure.
- 6.12 It is prohibited to drill in case there is a metal object on bottom-hole.
- 6.13 A bit must be thoroughly examined by a drill rig operator at least 4 times per shift (checking bit cutting structure, easy rotation of the cones, play of the cones, intensity of temperature of each cone, wear of the leg backs).

7. BIT WEAR SYMPTOMS

- Locked bearing in at least one cone.
- Significant play resulting in cones jamming or interference.
- Rollers or balls falling out of at least one cone.
- 90 % worn cutting structure.
- Bit failure (broken journal, cracked welding seam, cracked cone).
- Sudden increase of torque when drilling.

8. SELECTION AND REPLACEMENT OF NOZZLES

- 8.1 To keep a bit bearing clean (open bearing bits), it is necessary to ensure that enough pressed air passes through them, this is achieved by correct selection of nozzles diameter. It should be understood that the minimum recommended air pressure **in the bit** should be at least 2,4 bar (35 psi), which can be measured using a manometer. At the same time, it should be noted that 0,13 to 0,7 bar (2-10 psi) accounts for pressure drop in the air pipe leading to the bit.
- 8.2 To replace a nozzle you have to remove the pin (using pliers), remove the nozzle, insert a new nozzle, and fix the nozzle with the pin (using hammer).

