A program for drillstring improvement

The author says operators should heed the teachings of drillpipe pioneers Lubinski and Rollins and the recommendations of the "IADC Drilling Manual". Use of larger-than-normal drillpipe is also now a proven technique offering improved strength and superior hydraulics.

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AT THE 1991 IADC Annual Meeting in Dallas, Texas, then-IADC Chairman **Alain Roger**, President of **Sedco Forex**, announced in his speech to the general session that "Dudman had solved their drillstring problems…. Turning the drillstring upside down would solve all of the contractors' problems, including putting all the stacked rigs back to work." This comment drew several looks of disbelief, since the industry was at a standstill.

In the ensuing 11 years, no failures have been reported utilizing larger-than-standard drillstrings in relatively small hole sizes. At the same time, significant increases in rates of penetration (ROP) due to more effective bit weights and superior hydraulics have been repeatedly documented. This, coupled with successful control of hole deviation problems, should remove any disbelief that applying the work of **Arthur Lubinski** to the design of drillstrings is not only sound engineering, but good economics, as costs have been substantially lowered and failures eliminated.

12 years of consulting on drillstring problems in Africa, Europe, Southeast Asia, Latin America and North America has determined that most failures are operator inflicted. The operators are consistently abusing the drilling contractor's drillstring by overlooking the basic teachings of Arthur Lubinski and **Moak Rollins**.

Crooked holes are the main cause of the accumulation of fatigue that develops into fatigue cracks, tool joint wear and casing wear. The only recommended BHA (bottom hole assembly) shown in the "IADC Drilling Manual" and all other publications consists of 3 zones of stabilization utilizing large, stiff drill collars in the first 45 ft-50 ft above the bit. The operators are not following these recommendations; they are locating stabilizers randomly in limber drill collars, which frequently makes the BHA a kick assembly instead of the desired straight-hole assembly. These randomly placed stabilizers, between limber drill collars, effectively create a crankshaft downhole causing drill collar whirl and bit whirl.

In 12 ¼-in. hole size, it is not practical to use 11-in. OD drill collars, and it is not necessary except under the most severe crooked hole/rough drilling conditions. Sufficient 9 ½-in. OD drill collars for desired bit weight plus a 15% safety margin has proven to eliminate connection failures and provide superior deviation control and weight concentration directly above the bit. 2 and 3 stabilizers are recommended in zone 1 directly above the bit in severe crooked hole country. Additional stabilizers in zone 1 are cheap insurance for drilling a straight hole free of doglegs, ledges and spirals which promotes the running of casing without bends that cause casing wear and drill pipe wear. Operators are not incorporating this recommendation into their drilling programs, resulting in difficult and very time consuming efforts to try and remove doglegs and ledges by reaming and/or back reaming.

The 8-in. OD drill collars with 6 ⅝-in. regular connections have

Conventional vs PinUp drillpipe design

(5-1/2-in. HT drillpipe. Both configurations use 3-3/4-in. ID)

Conventional

(7-1/8-in. BoxUp x 7-1/8-in. OD PinDown)

Tool Joint OD (in.)	MUT (ft-lb)	Status
7-1/8	55,800	Full
7	53,000	Reduced
6-7/8 *	48,500	Reduced
6-3/4 *	44,000	Reduced
6-1/2 *	Replacement Required	

PinUp

(7-1/8-in. BoxUp x 7-1/2-in. OD BoxDown)

Tool Joint OD (in.)	MUT (ft-lb)	Status
7-1/2	55,800	Full
7-3/8	55,800	Full
7-1/4	55,800	Full
7-1/8	55,800	Full
7	53,000	Reduced
6-7/8	48,500	Reduced
6-3/4	44,000	Reduced
6-1/2	Replacement Required	

*** Under 6-15/16-in. OD minimum premium**

Conventional BoxUp configuration requires replacement at or below 6-3/4-in. OD.

When 6-3/4-in. OD (3/8-in. wear) is reached conventionally, PinUp design is at least 7-1/8-in. OD, which allows another 3/8-in. wear: double the wear life.

PinUp design provides the full MUT rating when conventional MUT must be reduced.

not been API for over 40 years and are frequently used in 12 ¼-in. and larger hole sizes—guaranteeing failures and a crooked hole. 8-in. OD drill collars are recommended for 8 ¾-in. hole sections for maximum weight and stiffness to control hole deviation. In the 12 ¼-in. and larger hole sizes, only one stand of 8-in. OD or preferably API 8 ¼-in. OD drill collars should be run in the destructive transition zone in tension between the 9 ½-in. OD drill collars and the heavy wall drill pipe. Long (5-ft) bottle-neck crossover subs are required between the collars and between the collars and heavy wall drill pipe.

As shown in the "IADC Drilling Manual", the most effective size of drill collar to control hole deviation in a 10 5/8-in. hole is 9 ½-in. OD, 9 7/8-in. hole size is 9-in. OD, 8 ¾-in. hole size is 8-in. OD, 7 7/8-in. hole size is 7-in. OD 6 ¾-in. hole size is 6-in. OD and 6 1/8-in. hole size is 5 ½-in. OD. Additionally, in 5 ¾-in.-5 7/8-in. hole sizes, 5-in. OD drill collars are recommended, while 4 ¼-in. OD drill collars are recommended for the 4 ¾-in.-4 7/8-in. hole section. 3-5 large stiff drill collars have proven to be adequate in the 8 ¾-in. and smaller hole sizes when combined with heavy wall drill pipe for additional bit weight when desired. Turning the drillstring upside down permits reducing the drill collar diameter below the pin for a fishing neck and reducing the drill pipe pin tool joint likewise for fishability. Box OD and Pin ID are the dimensions controlling torsional strength in a connection, thus permitting the reduction at the pin for fishability. The larger OD box not only increases connection strength, but extends connection life.

Larger-than-normal drill pipe for increased strength and hydraulics has been accepted by the industry with significant increases in ROP and decreases in fatigue failures resulting. The use of fishable box OD tool joints with an API, double shoulder or wedge type thread connections provides a very limited wear life and an operational life of decreasing torsional strengths and decreasing make up torques. Larger box OD tool joints increase wear life, maintain torsional strength longer and retain higher make up torque values for greater periods of time.

Fishable box tool joints for larger-than-normal drill pipe compromises joint strength, make up torque and wear life. Fishable pins up and larger boxes down maintains joint strength, maintains make up torque and prolongs wear life. For example, box weak drill pipe connections are significantly improved with larger boxes as follows:

• 5 ½-in. drill pipe for 8 ½-in. hole size, with a fishable 7-in. OD connection has a minimal premium class diameter of 6 15/16-in. OD allowing only 1/16-in. wear. A 7 ½-in. OD box with a 7-in. OD fishable pin provides 9/16-in. wear. With a 3 ¾-in. bore in the connection, this configuration remains box strong and maintains joint strength and make up torque values until worn to 7-in. OD;

• 4-in. drill pipe for 6 1/8-in. hole size, with a fishable 5-in. OD connection has a minimum premium class diameter of 4 13/16-in. OD allowing only 3/16-in. wear. A 5 ½-in. OD box with a 5-in. OD fishable pin provides 11/16-in. OD wear. With a 2 13/16-in. bore in the connection, this configuration remains box strong and maintains joint strength and make up torque values until worn to 5-in. OD;

• 3 ½-in. drill pipe for 5 ¾-in. hole size, with a fishable 4 5/8-in. OD connection has a minimum premium class diameter of 4 ½-in. OD allowing only 1/8-in. wear. A 5-in. OD box with a fishable 4 5/8-in. OD pin provides ½-in. OD wear. With a 2 9/16-in. bore in the connection, this configuration remains box strong and maintains joint strength and make up torque until worn to 4 ¾-in. OD.

2 7/8-in. or 3 ½-in. Slim Hole drill pipe for 4 ¾-in. hole size, with a fishable 3 13/16-in. OD connection has a minimum premium class diameter of 3 13/16-in. allowing no wear. A 4 ¼-in. OD box with a 3 13/16-in. OD fishable pin provides 7/16-in. OD wear. With a 2 1/8-in. bore in the connection, this configuration remains box strong and maintains joint strength and make up torque values until worn to 4-in. OD.

These strengths and make up torque values apply to API and High Torque connections. The chart for 5 ½-in. drill pipe details the compromise of using a conventional fishable box versus the extended torsional strength, make up torque and wear life of using a fishable pin with a larger box.

Drillstring improvements have been made and are readily available to the industry. Contractors, knowledgeable of these improvements can encourage the operators to use good drilling practices to drill straight useful holes whether near vertical, extended reach or horizontal as shown in the IADC drilling manual. This, in addition to larger-than-normal drill pipe which is stronger and hydraulically superior, will help the industry drill faster and more economically without constantly abusing the drilling contractors drillstring. Let's all be reminded that steel does not accumulate fatigue unless abused. 11 years and over 800 wells with no connection or tube failures while drilling faster and cheaper is solid proof that drillstring improvements are available to the industry.