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Issue Article

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ACCRUAL OF CONTINGENT DEPRECIATION AND CLASSIFICATION DRILL PIPES

Abstract: *the article analyzes the accrual of wear and classification of drill pipes, as well as calculations of the amount of conditional wear to be accrued taking into account the increase in pipe wear as the depth of the well increases. For the calculation of conditional depreciation, the norms of conditional depreciation given in the "Handbook of Enlarged Estimated Norms" were used, and the depreciation rates were used in the "Price List of district prices for the construction of oil and gas wells".*

Partial control of drill pipes on the drilling rig is effective in eliminating most of the potential sources of accidents from the drill string. If the share of accidents occurring in the controlled area is small, then partial control will not have a noticeable effect. After the elimination of seizures or accidents, it is necessary to conduct an extraordinary inspection of the drill string.

This work can be used to perform the tasks set when drilling wells and to avoid accidents and complications associated with drill pipes in order to successfully drill to the design depth in extremely difficult mining and geological conditions at abnormally high reservoir pressures.

Key words: *drilling coefficient, flaw detection, defect, wear, cavities, tightening, vibration, marking, class, thread, drill string, curvature, hole.*

Language: *English*

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Introduction

The acquisition of drill, weighted drill and lead pipes according to standard sizes with the registration of separate passport logs on them and their operation during the wiring of certain specific wells make it possible to keep accurate records of work, as well as to keep records after the write–off of all pipes of the value of the complete development of each set.

During the operation of a set of drill pipes by a drilling foreman, detailed information about the operation of a set of pipes is regularly noted in the passport journal [1].

Information about accidents with a set of pipes (in accordance with the accident acts) is entered into a special form jointly by representatives of the drilling company and the pipe division. Marks on the types of preventive maintenance and repair of a set of pipes in a pipe division are also made in special forms by a representative of the pipe division.

The forms for recording work, accidents, prevention and repair of a set of drill pipes provided for in the set's passport journal are given in the guidance document. There are also passport forms, and the corresponding forms of accounting for work, prevention and repair of the leading pipe.

For timely and high-quality provision of drilling enterprises with pipes of the required standard sizes, as well as for the purpose of planning the work of the pipe division, the latter keeps records of: receipt, availability and consumption of drill pipes and locks;

movement of drill pipe sets; types and volumes of preventive and repair work with drill pipes.

For the purpose of monthly accounting of costs from the rental of drill pipes under the article "Costs of tool operation during well wiring", conditional depreciation in manats is accrued on drill, weighted drill, lead pipes and locks, depending on the volume of penetration in meters. The amount of conditional wear to be accrued on all pipes of this set is calculated taking into account the coefficient of increase in pipe wear as well depths increase [2, 3], determined for each depth interval after 500 m, and other factors of well wiring.

Conditional wear in kilograms and manats is calculated for pipes involved in drilling wells, determined based on the number of meters drilled in this well [4, 13].

The amount of conditional depreciation to be accrued on all pipes of this set is calculated from the following expression:

$$S = \alpha c \delta (l_1 k_1 n_1 + l_2 k_2 n_2 .... + l_n k_n n_n) \quad (1)$$

where *a* is the specific rate of metal consumption of pipes for 1 m of conditional penetration (kg / m) with coefficients *k, c, δ, n* equal to one;

k, c, δ, *n, c* is the coefficient of drillability for a given drilling area;

k_1, k_2, ..., k_n are coefficients that take into account the increase in pipe wear as the depth of the well increases; determined by the formula

$$k = 1 + 0{,}001 H_s \quad (2)$$

N_s - the depth of the sole of this interval, m;

l_1, l_2, ..., l_n — penetration in the interval 1, 2....... p (500 m long), m;

δ is a coefficient that takes into account the influence of the drilling method and the inclination of the borehole on the wear of pipes (for the turbine method of drilling vertical wells δ=1; for inclined δ = 1.35; for rotary δ= 1.65);

n_1, n_2, ...,n_n — the number of pipe sections with a length of 500 m involved in drilling intervals respectively 1, 2, ..., n.

Indexes *1, 2, ... n* denote the sequence numbers of the trunk intervals of 500 m, counting from the wellhead.

The norms of conditional depreciation are given in the "Handbook of Enlarged estimated Norms", and the depreciation rates are in the "Price List of district prices for the construction of oil and gas wells".

Depreciation in manats for a set stops when its total amount reaches 70% of the original cost of pipes and 90% of the cost of locks screwed on these pipes [5, 6].

Depending on the amount of conditional wear of the pipe can be divided into three classes:

Class......................................	I	II	III
Conditional wear, % of the weight of the set	<50	51-85	86-100

The classification of drill pipes in operation and their marking are carried out on the pipe base based on the results of flaw detection of the planted ends of pipes, including sections of pipe threads.

The pipes of the first three classes are suitable for operation.

The classification system for drill pipes of prefabricated construction with diameters of 114 and 140 mm is shown in Table 1.

Table 1.

Pipe class (marking)	Type and size of the defect
I (one white stripe)	No defects found
II (two white stripes)	Small metallurgical defects (shells, pores, non-metallic inclusions, etc.) were not detected in the threaded and (or) smooth part of the planted end; clamps in the smooth part (outside the thread) with a depth of less than 3 mm
III (three white stripes)	Fatigue cracks or suppers in the thread area with a depth of up to 2 mm; suppers in the smooth part of the planted end with a depth of up to 5 mm
IV (one white and one red stripe)	Fatigue cracks or clamps in the threaded part up to 4 mm deep
V (one red stripe)	Fatigue cracks or suppressions in the threaded part with a depth of more than 4 mm; s clamps in the smooth part with a depth of more than 5 mm. There is no end pulse on an arc more than ¼ of the circumference of the pipe

Intermediate is the IV class of pipes. Pipes of this class are transferred to Class III after re-cutting the thread or into marriage if the remaining length of the planted part of the pipe is insufficient for re-cutting.

If during repeated flaw detection (after thread re-cutting) it is determined that the crack depth does not exceed the values set for Class III pipes, then the pipe is transferred to class III; otherwise, the pipes are rejected. Pipes with unacceptable defects are classified as class V - defective.

Classification and marking are not carried out on the drilling rig. When checking on the drilling rig, pipes having a lower class than those of which the drill string consists are rejected. For example, if the drill string consists of Class I pipes, the pipes corresponding to Class II, III, IV and V are withdrawn; if the string consists of Class I and II pipes, the pipes of class III, IV and V are withdrawn [7,14].

Class I pipes are used without restriction in accordance with their strength category and standard size.

Class II pipes are not recommended for use in deep wells with a bottom hole of more than 4000 m, as well as in highly complicated conditions (for example, in the presence of cavities or intense curvature of the borehole during rotary drilling). It is recommended to use Class III pipes when drilling to a depth of no more than 2500 m and their development should be carried out in a fixed trunk, checking monthly by means of flaw detection.

In drill pipes with welded locks (DPWL) pipes, transverse and volumetric defects are detected in the weld zone and in the section of the tunnel junction to the coupling. In light alloy drill pipes, operational defects (mainly fatigue cracks) are detected in sections of pipe threads. In addition, the light alloy drill pipes body is controlled, as well as the rest of the drill pipes [8, 15].

Used pipes made of D16T alloy assembled with locks, manufactured according to TU 1-2-85-72, are classified according to the wear values of the pipe wall (Table 2).

The maximum permissible loads on the hook for pipes with various degrees of wear are calculated from the yield strength, taking into account the safety factor of 1.3.

Table 2

Diameter, mm		Smallest wall thickness, mm	Smallest cross-sectional area, cm^2	Permissible stretching load, MN	Permissible rotating moment, N m
Nominal (wall thickness)	The smallest external				
Class I pipes (one strip)					
147 (13; 11; 9)	145,5	11,8; 10; 8	54,7; 47; 39	1,45; 1,24; 0,99	66 700
					52 900
					46 900
129 (11; 9)	127,5	10,8; 8	40,8; 33,9	1,34; 1,12	36 900
					34 900
114 (10)	112,8	9,0	32,6	0,86	24 500
93 (9)	92,0	8,1	23,7	0,62	14,300
73 (9)	72,0	8,1	18,1	0,48	8 100
Class II pipes (two lanes)					
147 (13; 11; 9)	142,0	10,5; 8,5; 7,5	42,4; 36,2; 32	1,18; 0,91; 0,82	64 300
					50 700
					43 100
129 (11; 9)	124,0	8,5; 7,5	31,4; 27,8	0,76; 0,70	34 200
					32 300
114 (10)	109,5	8,4	25,1	0,58	20 500
93 (9)	90,0	7,5	19,4	0,48	10 400
73 (9)	70,5	7,5	15,9	0,40	5 200
Class III pipes (three lanes)					
147 (13; 11; 9)	139	8,5; 7,7; 7,0	34,5; 29,7; 26,2	0,82; 0,70; 0,56	60 200
					45 500
					39 200
129 (11; 9)	122	8,0; 7,0;	25,8; 22,9	0,5; 0,25	28 100
					20 300
114 (10)	108	7,0	20,6	0,5	16 400
93 (9)	89	7,0	16,0	0,4	7 100
73 (9)	69	7,0	12,5	0,31	3 200
Pipes of class IV (four lanes) - defect					
147 (13; 11; 9)	139	<8,5; 7; 7			
129 (11; 9)	122	<7			
114 (10)	108				
93 (9)	89				
73 (9)	69				

The frequency of inspections of drill pipes on the drilling rig depends on the conditions of their operation: the depth of the well, the category of rocks, the drilling method, the degree of curvature of the borehole, the corrosive properties of the medium, the size and pipe strength groups, pipe quality, etc

Table 3 shows the data of inspections of drill pipes on the drilling rig.

Table 3

Drilling method	Well depth, m	Frequency of inspection of drill pipes (type of inspection - flaw detection), day.	
		Sections of pipe threads of steel drill pipes of prefabricated construction	Zones of welded seam of pipes of type DPWL
The rotor	<2500 2500 – 3500 3500 - 5000 > 5000	60 45 30 20	60 60 45 45
Downhole engines	<2500 2500 – 3500 > 3500	90 65 45	120 120 90

When drilling in complicated conditions (cavities, puffs, vibrations caused by drilling hard rocks with large-pitch chisels, trunk bends with a deviation of more than 3° per 100 m of penetration), as well as when drilling ultra-deep wells, the frequency of monitoring may be 1.5-2 times less than indicated in Table 3.

In many cases, it is advisable, without shortening the intervals between inspections of the entire column, to more often monitor sections of the drill string operating in highly complicated intervals of the borehole, as well as drill pipes located above the drill collar. In such cases, individual sections of the column can be monitored once every 10 or more days [9, 10, 16].

Pipes of class III are recommended to be checked by means of flaw detection monthly (prefabricated construction).

After the elimination of seizures or accidents, it is necessary to conduct an extraordinary inspection of the drill string. Partial control of drill pipes on a drilling rig is effective when most of the potential sources of accidents from the drill string are eliminated. If the share of accidents occurring in the controlled area is small, then partial control will not have a noticeable effect [11, 12, 17]. Therefore, recommendations are not given for monitoring on the drilling site of pipe threads LDP (light alloy drill pipes) and pipes of the type DPIE (drill pipes planted inside with ends) and DPOE (drill pipes planted outside with ends).

Drill pipes are written off according to their actual condition based on the results of inspection, flaw detection and instrumental measurements given in Table 4.

Table 4. Classification of drill pipes

Type of defect	Pipe class	
	2	3
Uniform wear of the pipe on the outer surface:		
wall thickness after wear, %, not less	80	65
Eccentric wear on the outer surface:		
wall thickness after wear, %, not less	65	55
Dents, % of the outer diameter, no more	3	5
Crumpling, outer diameter, no more	3	5
Neck, % of the outer diameter, no more	3	5
Residual narrowing:		
reduction of the outer diameter, %, no more	3	5
Residual expansion:		

increase in outer diameter, %, no more	3	5
Longitudinal incisions, notches:		
remaining wall thickness, %, not less	80	65
Transverse incisions:		
remaining wall thickness, %, not less	90	80
incision length, % of the circumference of the pipe,	10	10
no more		
Pitting corrosion, erosion:		
wall thickness at the site of the deepest corrosion, % from nominal, not less than	80	65

Depending on the actual wear during operation and changes in the geometric dimensions of the pipe are transferred to II and III classes.

Table 5 shows the degree of wear and the magnitude of defects, upon reaching which the pipes are transferred to the next class. Based on the data in Table 5, the strength characteristics of pipes of II and III classes are compiled.

The degree of wear of the lock thread is determined either by reducing the distance between the thrust ledge of the nipple and the thrust end of the coupling, or by reducing the number of revolutions required for complete screwing of the drill lock.

For a thread with a pitch of 6.35 mm (4nX”) and a taper of 1/6, the distance between the ledge and the end of the locking parts is equal to 25 mm, for a thread with a pitch of 5.08 (5nXl”) and a taper of ¼ -14.5 mm.

The maximum wear values of drill locks on the outer surface are given in Table 5. The first class corresponds to the nominal diameter of the lock, the second and third are determined by the amount of wear. If the diameter values are less than those specified for Class III, the locks are rejected.

The write-off of drill pipes is made out by an appropriate act drawn up by the employees of the drilling company with the participation of a representative of the pipe division and approved by the management of the drilling company.

Table 5. Wear of drill locks

Lock size	Outer diameter of the lock, mm			
	with uniform wear		**with uneven wear**	
	by class		**by class**	
	II	III	II	III
ZN -80	77,6	75	78,8	77,0
ZN -95	92,0	89	93,5	92,0
ZN -108	104,7	102	106.4	106,0
ZN -140	135,8	133	137,9	136,5
ZN -172	166,8	164	169,4	168.0
ZN -197	191,0	188	194,0	192,5
ZSH -108, ZSHK -108	104,7	100-	106,4	104.0
ZSH -118, ZSHK -118, ЗУК-120	114,5	109	111,3	113,5
ZSH -133, ZUK -133	129,0	125	131,0	129,0
ZSH -146, ZUK -146	141,6	136	143,8	141,0
ZSH -178, ZUK -178	172,6	167	175,3	172,5
ZSH -203	197,0	191	200,0	197

ZU -155, ZUK -155 ZU -185	150,3 179,4	148 177	152,6 182,2	151,5 181,0

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