Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 1

Even Semester: 2018-19 | **Date**: 06 March 2019

Course Code: PET 223 | **Time**: 1 Hour

Course Name: Fundamentals of Drilling Engineering | **Max Marks**: 40

Programme & Sem: B.Tech (PET) & IV Sem | **Weightage**: 20%

Instructions:

(i) ***All questions are compulsory***

(ii) ***API Charts are included as appendix for reference***

Part A

Answer **all** the Questions. **Each** question carries **one** mark. (5Qx1M=5)

1. Which component of the drill string ensures that the bit movement is centralized?
2. Why does the Kelly have a square or hexagonal profile and not a round one?
3. Which is the point of entry of drilling mud into the drill string?
4. What is the use of Kelly cock?
5. What is the primary application of the swivel?

Part B

Answer **all** the Questions. **Each** question carries **four** marks. (5Qx4M=20)

6. Briefly explain the different types of loads on drill pipe.
7. Describe the utility and functions of the Rotary table.
8. Why are Pins in drill collars longer and more tapered than those in drill pipes?
9. Why are Drill collars used to keep the drill pipe in tension?
10. Why is K-Monel used to manufacture certain drill collars?

Part C

Answer the Question. Question carries **fifteen** marks. (1Qx15M=15)

11. a. A well uses 16,000' of 5", 16.25ppf, X-95 new drill pipe. If the hole annulus is filled with 70 pcf mud and the drill pipe is 50% empty and 50% filled with 75pcf mud

    i. Calculate the collapse load.

    ii. Is the drill pipe safe to use under these conditions? (consider only collapse load)

    iii. Find whether the drill pipe can be used after the thickness has been reduced to 55%.

    b. What is yield strength of a drill pipe? A well uses 600' of $(7\frac{1}{4})$"x2" Drill collar and the rest is $5\frac{1}{2}$", 19.20 ppf, G-105 new drill pipe. Mud weight being used is 12ppg. If the tensile safety factor is given to be 1.5, calculate:

    i. Margin of Overpull

    ii. Total depth of hole.

APPENDIX

TABLE 2.2(b) New drillpipe collapse and internal pressure data (Courtesy of API[4])

1	2	3	4	5	6	7	8	9	10
Size OD (in)	*Nominal weight thds and couplings (lb)*	*Collapse pressure based on minimum values (psi)*				*Internal pressure at minimum yield strength (psi)*			
		E	*X95*	*G105*	*S135*	*E*	*X95*	*G105*	*S135*
$2\frac{3}{8}$	4.85	11 040	13 980	15 460	19 070	10 500	13 300	14 700	18 900
	6.65	15 600	19 760	21 840	28 080	15 470	19 600	21 660	27 850
$2\frac{7}{8}$	6.85	10 470	12 930	14 010	17 060	9910	12 550	13 870	17 830
	10.40	16 510	20 910	23 110	29 720	16 530	20 930	23 140	29 750
$3\frac{1}{2}$	9.50	10 040	12 060	13 050	15 780	9520	12 070	13 340	17 150
	13.30	14 110	17 880	19 760	25 400	13 800	17 480	19 320	24 840
	15.50	16 770	21 250	23 480	30 190	16 840	21 330	23 570	30 310
4	11.85	8410	9960	10 700	12 650	8600	10 890	12 040	15 480
	14.00	11 350	14 380	15 900	20 170	10 830	13 720	15 160	19 490
	15.70	12 900	16 340	18 050	23 210	12 470	15 790	17 460	22 440
$4\frac{1}{2}$	13.75	7200	8400	8950	10 310	7900	10 010	11 070	14 230
	16.60	10 390	12 750	13 820	16 800	9830	12 450	13 760	17 690
	20.00	12 960	16 420	18 150	23 330	12 540	15 890	17 560	22 580
	22.82	14 810	18 770	20 740	26 670	14 580	18 470	20 420	26 250
5	16.25	6970	8090	8610	9860	7770	9840	10 880	13 990
	19.50	10 000	12 010	12 990	15 700	9500	12 040	13 300	17 110
	25.60	13 500	17 100	18 900	24 300	13 120	16 620	18 380	23 620
$5\frac{1}{2}$	19.20	6070	6930	7300	8120	7250	9190	10 160	13 060
	21.90	8440	10 000	10 740	12 710	8610	10 910	12 060	15 510
	24.70	10 460	12 920	14 000	17 050	9900	12 540	13 860	17 830
$6\frac{5}{8}$	25.20	4810	5310	5490	6040	6540	8280	9150	11 770

TABLE 2.4(b) Used drillpipe collapse and internal pressure data API Class 2. (Courtesy of API[4])

1	2	3	4	5	6	7	8	9	10
Size OD (in)	*Nominal weight thds and couplings (lb/ft)*	*Collapse pressure based on minimum values (psi)**				*Internal pressure at minimum yield strength (psi)**			
		E	*X95*	*G105*	*S135*	*E*	*X95*	*G105*	*S135*
$2\frac{3}{8}$	4.85	6020	6870	7240	8030	7800	9880	10 920	14 040
	6.65	11 480	14 540	16 080	20 630	11 490	14 560	16 090	20 690
$2\frac{7}{8}$	6.85	5270	5900	6150	6610	7360	9320	10 300	13 250
	10.40	12 250	15 520	17 160	22 060	12 280	15 550	17 190	22 100
$3\frac{1}{2}$	9.50	4790	5270	5450	6010	7080	8960	9910	12 740
	13.30	10 250	12 420	13 450	16 310	10 250	12 990	14 350	18 450
	15.50	12 480	15 810	17 480	22 470	12 510	15 840	17 510	22 510
4	11.85	3620	4020	4210	4550	6390	8090	8940	11 500
	14.00	6440	7410	7850	8840	8040	10 190	11 260	14 480
	15.70	8560	10 150	10 910	12 930	9260	11 730	12 970	16 670
$4\frac{1}{2}$	13.75	2960	3290	3400	3480	5870	7440	8220	10 570
	16.60	5170	5770	6010	6490	7300	9250	10 220	13 140
	20.00	8660	10 280	11 050	13 120	9320	11 800	13 040	16 770
	22.82	10 830	13 720	14 950	18 320	10 830	13 720	15 170	19 500
5	16.25	2850	3150	3240	3300	5770	7310	8080	10 390
	19.50	4760	5230	5410	5970	7060	8940	9880	12 710
	25.60	9420	11 270	12 160	14 590	9750	12 350	13 650	17 550
$5\frac{1}{2}$	19.20	2440	2610	2650	2650	5390	6830	7540	9700
	21.90	3640	4040	4230	4580	6400	8110	8960	11 520
	24.70	5260	5890	6140	6610	7360	9320	10 300	13 250
$6\frac{5}{8}$	25.20	1870	1900	1900	1900	...	...	...	...

TABLE 2.5(b) Used drillpipe collapse and pressure data API Class 3. (Courtesy of API[4])

1	2	3	4	5	6	7	8	9	10
Size OD (in)	*Nominal weight thds and couplings (lb/ft)*	*Collapse pressure based on minimum values (psi)**				*Internal pressure at minimum yield strength (psi)**			
		E	*X95*	*G105*	*S135*	*E*	*X95*	*G105*	*S135*
$2\frac{3}{8}$	4.85	4260	4590	4810	5350	6600	8360	9240	11 880
	6.65	10 030	12 050	13 040	15 760	9730	12 320	13 620	17 510
$2\frac{7}{8}$	6.85	3600	4010	4190	4530	6230	7890	8720	11 210
	10.40	10 800	13 680	14 880	18 230	10 390	13 160	14 540	18 700
$3\frac{1}{2}$	9.50	3230	3650	3790	4000	5990	7580	8380	10 780
	13.30	8040	9480	10 160	11 930	8670	10 990	12 140	15 610
	15.50	11 010	13 950	15 410	18 960	10 580	13 410	14 820	19 050
4	11.85	2570	2790	2840	2850	5400	6840	7560	9720
	14.00	4630	5070	5230	5810	6810	8620	9530	12 250
	15.70	6490	7480	7920	8940	7840	9930	10 970	14 110
$4\frac{1}{2}$	13.75	2090	2170	2170	2170	4970	6290	6960	8940
	16.60	3520	3930	4110	4420	6180	7830	8650	11 120
	20.00	6580	7590	8040	9100	7880	9990	11 040	14 190
	22.82	9140	10 900	11 750	14 040	9170	11 610	12 830	16 500
5	16.25	1990	2050	2050	2050	4880	6190	6840	8790
	19.50	3210	3630	3770	3960	5970	7570	8360	10 750
	25.60	7250	8460	9020	10 410	8250	10 450	11 550	14 850
$5\frac{1}{2}$	19.20	1640	1640	1640	1640	5100	6460	7140	9180
	21.90	2580	2810	2860	2870	5420	6860	7580	9750
	24.70	3600	4000	4190	4520	6230	7890	8720	11 210
$6\frac{5}{8}$	25.20	1170	1170	1170	1170	4110	5210	5750	7400

TABLE 2.2(a) New drillpipe torsional and tensile data. (Courtesy of API[4])

1	2	3	4	5	6	7	8	9	10
Size OD (in)	*Nominal weight thds and couplings (lb)*	*Torsional data torsional yield strength (ft-lb)**				*Tensile data based on minimum values load at the minimum yield strength (lb)*			
		E	*X95*	*G105*	*S135*	*E*	*X95*	*G105*	*S135*
$2\frac{3}{8}$	4.85	4760	6030	6670	8570	97 820	123 900	136 940	176 070
	6.65	6250	7920	8750	11 250	138 220	175 080	193 500	248 790
$2\frac{7}{8}$	6.85	8080	10 240	11 320	14 550	135 900	172 140	190 260	244 620
	10.40	11 550	14 640	16 180	20 800	214 340	271 500	300 080	385 820
$3\frac{1}{2}$	9.50	14 150	17 920	19 800	25 460	194 270	246 070	271 970	349 680
	13.30	18 550	23 500	25 970	33 390	271 570	343 990	380 190	488 820
	15.50	21 090	26 710	29 520	37 950	322 780	408 850	451 890	581 000
4	11.85	19 470	24 670	27 260	35 050	230 750	292 290	323 050	415 350
	14.00	23 290	29 500	32 600	41 920	285 360	361 460	399 500	513 650
	15.70	25 810	32 690	36 130	46 460	324 120	410 550	453 770	583 420
$4\frac{1}{2}$	13.75	25 910	32 820	36 270	46 630	270 030	342 040	378 040	486 050
	16.60	30 810	39 020	43 130	55 450	330 560	418 700	462 780	595 000
	20.00	36 900	46 740	51 660	66 420	412 360	522 320	577 300	742 240
	22.82	40 910	51 820	57 280	73 640	471 240	596 900	659 740	848 230
5	16.25	35 040	44 390	49 060	63 080	328 070	415 560	459 300	590 530
	19.50	41 170	52 140	57 600	74 100	395 600	501 090	553 830	712 070
	25.60	52 260	66 190	73 160	94 060	530 150	671 520	742 200	954 260
$5\frac{1}{2}$	19.20	44 070	55 830	61 700	79 330	372 180	471 430	521 050	669 920
	21.90	50 710	64 230	70 990	91 280	437 120	553 680	611 960	786 810
	24.70	56 570	71 660	79 200	101 830	497 220	629 810	696 110	895 000
$6\frac{5}{8}$	25.20	70 580	89 400	98 810	127 050	489 470	619 990	685 250	881 040

Drill collar OD (in)	Drill collar ID (in)												
	1	1¼	1½	1¾	2	2¼	2½	2 13/16	3	3¼	3½	3¾	4
2⅞	19	18	16										
3	21	20	18										
3⅛	22	22	20										
3¼	26	24	22										
3½	30	29	27										
3¾	35	33	32										
4	40	39	37	35	32	29							
4⅛	43	41	39	37	35	32							
4¼	46	44	42	40	38	35							
4½	51	50	48	46	43	41							
4¾			54	52	50	47	44						
5			61	59	56	53	50						
5¼			68	65	63	60	57						
5½			75	73	70	67	64	60					
5¾			82	80	78	75	72	67	64	60			
6			90	88	85	83	79	75	72	68			
6¼			98	96	94	91	88	83	80	76	72		
6½			107	105	102	99	96	91	89	85	80		
6¾			116	114	111	108	105	100	98	93	89		
7			125	123	120	117	114	110	107	103	98	93	84
7¼			134	132	130	127	124	119	116	112	108	103	93
7½			144	142	139	137	133	129	126	122	117	113	102
7¾			154	152	150	147	144	139	136	132	128	123	112
8			165	163	160	157	154	150	147	143	138	133	122
8¼			176	174	171	168	165	160	158	154	149	144	133
8½			187	185	182	179	176	172	169	165	160	155	150
9			210	208	206	203	200	195	192	188	184	179	174
9½			234	232	230	227	224	220	216	212	209	206	198
9¾			248	245	243	240	237	232	229	225	221	216	211
10			261	259	257	254	251	246	243	239	235	230	225
11			317	315	313	310	307	302	299	295	291	286	281
12			379	377	374	371	368	364	361	357	352	347	342

Drill Collar Weight (ppf)

Roll No.											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 2

Even Semester: 2018-19 **Date**: 16 April 2019

Course Code: PET 223 **Time**: 1 Hour

Course Name: Fundamentals of Drilling Engineering **Max Marks**: 40

Program & Sem: B. Tech & IV Sem **Weightage**: 20%

Instructions:

(i) ***Answer all questions***

Part A

Answer **all** the Questions. **Each** question carries **two** marks. (5Qx2M=10)

1. What is the difference between Lang's Lay and ordinary lay?
2. If a drilling line has the configuration of 9x6/6/1, what information can be inferred from it?
3. "During drilling the speed of fast line is much faster than that of the travelling block." Why does this happen?
4. What is Journal angle? How does it vary depending on the type of formation being drilled?
5. If the velocity of fast line is 600 feet/min and the velocity of travelling block is 60 feet/min, how many sheaves does the crown block have?

Part B

Answer **all** the Questions. **Each** question carries **four** marks. (4Qx4M=16)

6. If the travelling block has 3 sheaves, calculate the efficiency factor of the hoisting system. Assume k=0.9615
7. Explain the direct method of evaluation of the fracture gradient.
8. Write briefly about polycrystalline diamond compact bits.
9. The following options are available for bit selection for a new well to be drilled.

	A	B	C
Bit Cost ($)	27,000	25,000	26,000
Rotational Time (h)	48	46	45
Rig Cost ($/h)	3500	3200	3200
Round trip time (h)	14	10	12
Footage/Bit (feet)	6000	5400	5500

Choose the best option and justify your answer.

Part C

Answer the Question. Question carries **fourteen** marks. (1Qx14M=14)

10. Find the depths of casing seats for an oil well to be drilled using the following data. (Assume Poisson's ratio = 0.4):

Depth (feet)	Pore Pressure (Psi)
3000	1300
3400	2000
4000	2500
4500	3200
8000	6000
8500	6900
10000	8400
12000	10,700

Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Even Semester: 2018-19 | **Date**: 23 May 2019

Course Code: PET 223 | **Time**: 3 Hours

Course Name: Fundamentals of Drilling Engineering | **Max Marks**: 80

Program & Sem: B.Tech & IV Sem | **Weightage**: 40%

Instructions:

(i) ***Attempt all questions***

(ii) ***API Charts are included as appendix***

Part A

Answer the Questions. **Each** question carries **ten** marks. (2Qx10M=20)

1. Fill in the blanks with the appropriate answer.
   i. The equipment used to hold the drill string in place above the rotary table while tripping in or out is ______________.
   ii. ______________ are placed above the drill bits to absorb shocks when the bit bounces off hard formations
   iii. Ratio of the moment of inertia to the OD of the pipe is called ____________.
   iv. Drill collars are not provided with tool joints instead of which ____________ are cut from pipe body.
   v. While tripping in or out the Kelly complex rests in a specially dug hole called ____________.
   vi. Class 2 drill pipes have thickness reduced to __________ of original thickness.
   vii. Special types of casings which are not cemented to the surface are called ____________.
   viii. ____________ prevents rotary motion of Kelly to be transferred to the draw works.
   ix. On being subjected to continuous loading, casing deformation is permanent after load exceeds the _____________.
   x. ____________ drill collars can be used to counter differential sticking.

2. Choose the correct option
   i. Which of the following is not part of the bottom hole assembly?
      a. HWDP b. Drill Collar
      c. Drill Pipe d. Bit

   ii. Which of the following order is correct?
      a. Casing Diameter>Drill Pipe Diameter>Bit Diameter
      b. Bit Diameter>Casing Diameter> Drill Pipe Diameter
      c. Drill Pipe Diameter>Bit Diameter>Casing Diameter
      d. Casing Diameter>Bit Diameter>Drill Pipe diameter

iii. In areas of low tectonic activity, overburden stress gradient is

a. 1psi/ft
b. 0.465 psi/ft
c. 0.8 psi/ft
d. 0.052 psi/ft

iv. Which of the following is not a drill pipe grade?

a. X-95
b. D-405
c. G-105
d. E

v. Which type of rock strength is important in context of fracture gradient?

a. Tensile
b. Compressive
c. Shear
d. Impact

vi. Drill collars are lost in hole mainly due to

a. Corrosion
b. Worn & poorly shaped pins or boxes
c. Stuck pipe
d. Tensile loading

vii. Which of the following is not a well kill method?

a. Engineer's method
b. Eaton's method
c. Concurrent method
d. Bull heading

viii. ____________ is used to stabilize well bore and prevent it's caving.

a. Tubing
b. Centralizer
c. Wellhead
d. Casing

ix. The process of drilling without returns is called

a. Underbalanced drilling
b. Lost Circulation
c. Leak off
d. Blind drilling

x. Optimum journal angle for hard formation is

a. 33°
b. 36°
c. 45°
d. 35°

Part B

Answer the Questions. **Each** question carries **ten** marks. (3Qx10M=30)

3. Explain the four types of well kill methods.
4. What are the different ways to prevent lost circulation? Why should the lost circulation materials vary in size?
5. What is a BOP? Write briefly about it's different types. How does the accumulator unit function in the BOP control system?

Part C

Answer **both** the Questions. **Each** question carries **fifteen** marks. (2Qx15M=30)

6. The following data refers to a 1.5" block line with 10 lines of extra improved plough steel wire rope strung to the travelling block.
   Hole depth= 10000 feet
   Drill Pipe= 5" OD/ 19.5 ppf
   Drill Collar= 500 feet, 8" x $2\frac{13}{16}$", 150 ppf
   Mud Weight= 75 pcf
   Line and Sheave efficiency coefficient, K=0.9615
   Velocity of fast line= 10 ft/sec
   Weight of travelling block = 23,500 lbs
   Calculate:
   i. Efficiency factor of hoisting system
   ii. Weight of drill string in mud
   iii. Hook load
   iv. Dynamic crown load
   v. Design factor
   vi. Draw works power

7. An exploration and production company is planning to drill a wild cat well. For this the drilling, casing and mud programme are as follows:

0-300'	26" Hole	20" Casing	50 pcf
300'-4500'	17 ½" hole	13 3/8" Casing	65 pcf
4500'-7500'	12 ¼" hole	9 5/8" Casing	78 pcf
7500'-10000'	8 ½" hole	7" Casing	88 pcf

Pressure gradient for different formations are given below:

0-4500'	0.465 psi/ft
4500-7500'	0.48 psi/ft
7500-10000'	0.57 psi/ft

The mud gradient in the casing-formation annulus is equal to that of formation brine till 4500' below which it increases to 0.5 psi/feet. Also, formation fluid invasion is in the form of saline water till 4500' below which a gas kick of 0.1psi/feet is encountered. Find out the Collapse pressure and Burst Pressure at surface and at shoe for each Casing string.

APPENDIX

6 × 19 classification wirerope, bright (uncoated) or drawn-galvanized wire, independent wirerope core. (Courtesy of API[7])

1	2	3	4	5	6	7	8	9	10
Nominal diameter		*Approximate mass*		*Nominal strength*					
				Improved plough steel			*Extra improved plough steel*		
in	*mm*	*lb/ft*	*kg/m*	*lb*	*kN*		*lb*	*kN*	
$\frac{1}{2}$	13	0.46	0.68	23 000	102		26 600	118	
$\frac{9}{16}$	14.5	0.59	0.88	29 000	129		33 600	149	
$\frac{5}{8}$	16	0.72	1.07	35 800	159		41 200	183	
$\frac{3}{4}$	19	1.04	1.55	51 200	228		58 800	262	
$\frac{7}{8}$	22	1.42	2.11	69 200	308		79 600	354	
1	26	1.85	2.75	89 800	399		103 400	460	
$1\frac{1}{8}$	29	2.34	3.48	113 000	503		130 000	578	
$1\frac{1}{4}$	32	2.89	4.30	138 800	617		159 800	711	
$1\frac{3}{8}$	35	3.50	5.21	167 000	743		192 000	854	
$1\frac{1}{2}$	38	4.16	6.19	197 800	880		228 000	1010	
$1\frac{5}{8}$	42	4.88	7.26	230 000	1020		264 000	1170	
$1\frac{3}{4}$	45	5.67	8.44	266 000	1180		306 000	1360	
$1\frac{7}{8}$	48	6.50	9.67	304 000	1350		348 000	1550	
2	51	7.39	11.0	344 000	1530		396 000	1760	

New drillpipe torsional and tensile data. (Courtesy of API[4])

1	2	3	4	5	6	7	8	9	10
Size OD (in)	*Nominal weight thds and couplings (lb)*	*Torsional data torsional yield strength (ft-lb)**				*Tensile data based on minimum values load at the minimum yield strength (lb)*			
		E	*X95*	*G105*	*S135*	*E*	*X95*	*G105*	*S135*
$2\frac{3}{8}$	4.85	4760	6030	6670	8570	97 820	123 900	136 940	176 070
	6.65	6250	7920	8750	11 250	138 220	175 080	193 500	248 790
$2\frac{7}{8}$	6.85	8080	10 240	11 320	14 550	135 900	172 140	190 260	244 620
	10.40	11 550	14 640	16 180	20 800	214 340	271 500	300 080	385 820
$3\frac{1}{2}$	9.50	14 150	17 920	19 800	25 460	194 270	246 070	271 970	349 680
	13.30	18 550	23 500	25 970	33 390	271 570	343 990	380 190	488 820
	15.50	21 090	26 710	29 520	37 950	322 780	408 850	451 890	581 000
4	11.85	19 470	24 670	27 260	35 050	230 750	292 290	323 050	415 350
	14.00	23 290	29 500	32 600	41 920	285 360	361 460	399 500	513 650
	15.70	25 810	32 690	36 130	46 460	324 120	410 550	453 770	583 420
$4\frac{1}{2}$	13.75	25 910	32 820	36 270	46 630	270 030	342 040	378 040	486 050
	16.60	30 810	39 020	43 130	55 450	330 560	418 700	462 780	595 000
	20.00	36 900	46 740	51 660	66 420	412 360	522 320	577 300	742 240
	22.82	40 910	51 820	57 280	73 640	471 240	596 900	659 740	848 230
5	16.25	35 040	44 390	49 060	63 080	328 070	415 560	459 300	590 530
	19.50	41 170	52 140	57 600	74 100	395 600	501 090	553 830	712 070
	25.60	52 260	66 190	73 160	94 060	530 150	671 520	742 200	954 260
$5\frac{1}{2}$	19.20	44 070	55 830	61 700	79 330	372 180	471 430	521 050	669 920
	21.90	50 710	64 230	70 990	91 280	437 120	553 680	611 960	786 810
	24.70	56 570	71 660	79 200	101 830	497 220	629 810	696 110	895 000
$6\frac{5}{8}$	25.20	70 580	89 400	98 810	127 050	489 470	619 990	685 250	881 040

Drill collar OD (in)	Drill collar ID (in)												
	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{13}{16}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	4
$2\frac{7}{8}$	19	18	16										
3	21	20	18										
$3\frac{1}{8}$	22	22	20										
$3\frac{1}{4}$	26	24	22										
$3\frac{1}{2}$	30	29	27										
$3\frac{3}{4}$	35	33	32										
4	40	39	37	35	32	29							
$4\frac{1}{8}$	43	41	39	37	35	32							
$4\frac{1}{4}$	46	44	42	40	38	35							
$4\frac{1}{2}$	51	50	48	46	43	41							
$4\frac{3}{4}$			54	52	50	47	44						
5			61	59	56	53	50						
$5\frac{1}{4}$			68	65	63	60	57						
$5\frac{1}{2}$			75	73	70	67	64	60					
$5\frac{3}{4}$			82	80	78	75	72	67	64	60			
6			90	88	85	83	79	75	72	68			
$6\frac{1}{4}$			98	96	94	91	88	83	80	76	72		
$6\frac{1}{2}$			107	105	102	99	96	91	89	85	80		
$6\frac{3}{4}$			116	114	111	108	105	100	98	93	89		
7			125	123	120	117	114	110	107	103	98	93	84
$7\frac{1}{4}$			134	132	130	127	124	119	116	112	108	103	93
$7\frac{1}{2}$			144	142	139	137	133	129	126	122	117	113	102
$7\frac{3}{4}$			154	152	150	147	144	139	136	132	128	123	112
8			165	163	160	157	154	150	147	143	138	133	122
$8\frac{1}{4}$			176	174	171	168	165	160	158	154	149	144	133
$8\frac{1}{2}$			187	185	182	179	176	172	169	165	160	155	150
9			210	208	206	203	200	195	192	188	184	179	174
$9\frac{1}{2}$			234	232	230	227	224	220	216	212	209	206	198
$9\frac{3}{4}$			248	245	243	240	237	232	229	225	221	216	211
10			261	259	257	254	251	246	243	239	235	230	225
11			317	315	313	310	307	302	299	295	291	286	281
12			379	377	374	371	368	364	361	357	352	347	342

Weight of drill collars