

Weatherford®

Completion Engineering Data Handbook

for

Completions, Remedial Stimulation, Workovers, & Fishing

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TUBULAR DIMENSIONAL DATA AS PER A.P.I. SPECIFICATION 5CT

Nominal O.D. Size (in)	Nominal Weight (lb/ft)	Nominal I.D. (in)	Maximum O.D. (in)	Minimum O.D. (in)	Maximum Wall (in)	Minimum Wall (in)	Maximum I.D. (in)	Minimum I.D. (in)	Drift Dia. (in)
1.050	1.20	.824	1.081	1.019	.113	.099	.882	.793	.730
1.315	1.80	1.049	1.346	1.284	.133	.117	1.112	1.018	.955
1.660	2.40	1.380	1.691	1.629	.140	.123	1.445	1.349	1.286
1.900	2.90	1.610	1.931	1.869	.145	.128	1.676	1.579	1.516
2-3/8	4.70	1.995	2.406	2.344	.190	.167	2.072	1.964	1.901
	5.95	1.867	2.406	2.344	.254	.224	1.959	1.836	1.773
2-7/8	6.50	2.441	2.906	2.844	.217	.191	2.524	2.410	2.345
	8.70	2.259	2.906	2.844	.308	.271	2.364	2.228	2.165
3-1/2	9.30	2.992	3.531	3.469	.254	.224	3.084	2.961	2.867
	12.95	2.750	3.531	3.469	.375	.330	2.871	2.719	2.625
4	11.00	3.476	4.031	3.969	.262	.231	3.570	3.445	3.351
4-1/2	9.50	4.090	4.545	4.478	.205	.180	4.184	4.068	3.965
	10.50	4.052	4.545	4.478	.224	.197	4.151	4.030	3.927
	11.60	4.000	4.545	4.478	.250	.220	4.105	3.978	3.875
	13.50	3.920	4.545	4.478	.290	.255	4.035	3.898	3.795
5	11.50	4.560	5.050	4.975	.220	.194	4.663	4.535	4.435
	13.00	4.494	5.050	4.975	.253	.223	4.605	4.469	4.369
	15.00	4.408	5.050	4.975	.296	.260	4.529	4.383	4.283
	18.00	4.276	5.050	4.975	.362	.319	4.413	4.251	4.151
	21.40	4.126	5.050	4.975	.437	.385	4.281	4.101	4.001
	23.20	4.044	5.050	4.975	.478	.421	4.209	4.019	3.919
	24.10	4.000	5.050	4.975	.500	.440	4.170	3.975	3.875
5-1/2	14.00	5.012	5.555	5.473	.244	.215	5.126	4.985	4.887
	15.50	4.950	5.555	5.473	.275	.242	5.071	4.923	4.825
	17.00	4.892	5.555	5.473	.304	.268	5.020	4.865	4.767
	20.00	4.778	5.555	5.473	.361	.318	4.920	4.751	4.653
	23.00	4.670	5.555	5.473	.415	.365	4.825	4.643	4.545
6-5/8	20.00	6.049	6.691	6.592	.288	.253	6.184	6.016	5.924
	24.00	5.921	6.691	6.592	.352	.310	6.072	5.888	5.796
	28.00	5.791	6.691	6.592	.417	.367	5.957	5.758	5.666
	32.00	5.675	6.691	6.592	.475	.418	5.855	5.642	5.550
7	17.00	6.538	7.070	6.965	.231	.203	6.663	6.503	6.413
	20.00	6.456	7.070	6.965	.272	.239	6.591	6.421	6.331
	23.00	6.366	7.070	6.965	.317	.279	6.512	6.331	6.241
	26.00	6.276	7.070	6.965	.362	.319	6.433	6.241	6.151
	29.00	6.184	7.070	6.965	.408	.359	6.352	6.149	6.059
	32.00	6.094	7.070	6.965	.453	.399	6.273	6.059	5.969
	35.00	6.004	7.070	6.965	.498	.438	6.194	5.969	5.879
	38.00	5.920	7.070	6.965	.540	.475	6.120	5.885	5.795
7-5/8	24.00	7.025	7.701	7.587	.300	.264	7.173	6.987	6.900
	26.40	6.969	7.701	7.587	.328	.289	7.124	6.931	6.844
	29.70	6.875	7.701	7.587	.375	.330	7.041	6.837	6.750
	33.70	6.765	7.701	7.587	.430	.378	6.944	6.727	6.640
	39.00	6.625	7.701	7.587	.500	.440	6.821	6.587	6.500
	42.80	6.501	7.701	7.587	.562	.495	6.712	6.463	6.376
	45.30	6.435	7.701	7.587	.595	.524	6.654	6.397	6.310
	47.10	6.375	7.701	7.587	.625	.550	6.601	6.337	6.250

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TUBULAR DIMENSIONAL DATA AS PER A.P.I. SPECIFICATION 5CT

Nominal O.D. Size (in)	Nominal Weight (lb/ft)	Nominal I.D. (in)	Maximum O.D. (in)	Minimum O.D. (in)	Maximum Wall (in)	Minimum Wall (in)	Maximum I.D. (in)	Minimum I.D. (in)	Drift Dia. (in)
8-5/8	24.00	8.097	8.711	8.582	.264	.232	8.247	8.054	7.941
	28.00	8.017	8.711	8.582	.304	.268	8.176	7.974	7.892
	32.00	7.921	8.711	8.582	.352	.310	8.092	7.878	7.796
	36.00	7.825	8.711	8.582	.400	.352	8.007	7.782	7.700
	40.00	7.725	8.711	8.582	.450	.396	7.919	7.682	7.600
	44.00	7.625	8.711	8.582	.500	.440	7.831	7.582	7.500
	49.00	7.511	8.711	8.582	.557	.490	7.731	7.468	7.386
9-5/8	32.30	9.001	9.721	9.577	.312	.275	9.172	8.953	8.845
	36.00	8.921	9.721	9.577	.352	.310	9.102	8.873	8.765
	40.00	8.835	9.721	9.577	.395	.348	9.026	8.787	8.679
	43.50	8.755	9.721	9.577	.435	.383	8.956	8.707	8.599
	47.00	8.681	9.721	9.577	.472	.415	8.891	8.633	8.525
	53.50	8.535	9.721	9.577	.545	.480	8.762	8.487	8.379
	59.40	8.407	9.721	9.577	.609	.536	8.649	8.359	8.251
	64.90	8.281	9.721	9.577	.672	.591	8.539	8.233	8.125
	70.30	8.157	9.721	9.577	.734	.646	8.429	8.109	8.001
	75.60	8.031	9.721	9.577	.797	.701	8.319	7.983	7.875
10-3/4	32.75	10.192	10.858	10.696	.279	.246	10.366	10.138	10.036
	40.50	10.050	10.858	10.696	.350	.308	10.242	9.996	9.894
	45.50	9.950	10.858	10.696	.400	.352	10.154	9.896	9.794
	51.00	9.850	10.858	10.696	.450	.396	10.066	9.796	9.694
	55.50	9.780	10.858	10.696	.495	.436	9.986	9.706	9.604
	60.70	9.660	10.858	10.696	.545	.480	9.898	9.606	9.504
	65.70	9.560	10.858	10.696	.595	.524	9.810	9.506	9.404
	73.20	9.406	10.858	10.696	.672	.591	9.675	9.352	9.250
	79.20	9.282	10.858	10.696	.734	.646	9.566	9.228	9.126
	85.30	9.156	10.858	10.696	.797	.701	9.455	9.102	9.000
11-3/4	42.00	11.084	11.868	11.691	.333	.293	11.281	11.025	10.928
	47.00	11.000	11.868	11.691	.375	.330	11.208	10.941	10.844
	54.00	10.880	11.868	11.691	.435	.383	11.102	10.821	10.724
	60.00	10.772	11.868	11.691	.489	.430	11.007	10.713	10.616
	65.00	10.682	11.868	11.691	.534	.470	10.928	10.623	10.526
13-3/8	48.00	12.715	13.509	13.308	.330	.290	12.928	12.648	12.559
	54.50	12.615	13.509	13.308	.380	.334	12.840	12.548	12.459
	61.00	12.515	13.509	13.308	.430	.378	12.752	12.448	12.359
	68.00	12.415	13.509	13.308	.480	.422	12.664	12.348	12.259
	72.00	12.347	13.509	13.308	.514	.452	12.604	12.280	12.191
16	65.00	15.250	16.160	15.920	.375	.330	15.500	15.170	15.062
	75.00	15.124	16.160	15.920	.438	.385	15.389	15.044	14.936
	84.00	15.010	16.160	15.920	.495	.436	15.289	14.930	14.822
18-5/8	87.50	17.755	18.811	18.532	.435	.383	18.046	17.662	17.567
20	94.00	19.124	20.200	19.900	.438	.385	19.429	19.024	18.936
	106.50	19.000	20.200	19.900	.500	.440	19.320	18.900	18.812
	133.00	18.730	20.200	19.900	.635	.559	19.082	18.630	18.542

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DIMENSIONAL & MINIMUM PERFORMANCE DATA - API TUBING

OD (in.) (mm)	Nominal Weight			Wall Thickness (in)	ID Nom. (in.) (mm)	Drift Dia. (in.) (mm)	ID Area ($in.^2$) (mm^2)	OD Area ($in.^2$) (mm^2)	Cross-Sectional Area ($in.^2$)	Moment of Inertia, I ($in.^4$)	OD ID Ratio R	Coupling or Box OD				Grade	Collapse Resistance (psi)	Internal Yield Pressure (psi)	Joint Yield Strength		
	T&C Non-Upset (lb/ft)	T&C Upset (lb/ft)	Integral Joint (lb/ft)									Non Upset (in.) (mm)	Upset Reg. (in.) (mm)	Upset Spec. Cl. (in.) (mm)	Integral Joint (in.) (mm)				T&C Non-Upset (lb.)	T&C Upset (lb.)	Integral Joint (lb.)
1,050 26,67	1.14	1.20		.113	.824 20,93	.730 18,54	.5333 34,40	.8659 55,87	.3326	.0370	1.274	1.313 33,35	1.660 44,16			H-40 J-55 C-75 N-80	7,680 10,560 14,410 15,370	7,530 10,360 14,120 15,070	6,360 8,740 11,920 12,710	13,310 18,290 24,950 26,610	
1,315 33,40	1.70	1.80	1.72	.133	1.049 26,64	.955 24,26	.8643 55,76	1.3581 87,62	.4939	.0873	1.254	1.660 42,16	1.900 48,26		1.550 39,37	H-40 J-55 C-75 N-80	7,270 10,000 13,640 14,550	7,080 9,730 13,270 14,160	10,960 15,060 20,540 21,910	19,760 27,160 37,040 39,510	15,970 21,960 29,940 31,940
1,660 42,16			2.10	.125	1.410 35,81		1.5614 100,74	2.1642 139,63	.6028	.1787	1.177				1.880 47,75	H-40 J-55	5,570 7,660	5,270 7,250			22,180 30,500
	2.30	2.40	2.33	.140	1.380 35,05	1.286 32,66	1.4957 96,503	2.1642 139,63	.6685	.1947	1.203	2.054 52,17	2.200 55,88		1.880 47,75	H-40 J-55 C-75 N-80	6,180 8,490 11,580 12,360	5,900 8,120 11,070 11,810	15,530 21,360 29,120 31,060	26,740 36,770 50,140 53,480	22,180 30,500 41,600 44,370
1,900 48,26			2.40	.125	1.650 41,91		2.1382 137,95	2.8353 182,91	.6970	.2759	1.152				2.110 53,59	H-40 J-55	4,920 6,640	4,610 6,330			26,890 36,970
	2.75	2.90	2.76	.145	1.610 40,89	1.516 38,51	2.0358 131,35	2.8353 182,91	.7995	.3099	1.180	2.200 55,88	2.500 63,50		2.110 53,59	H-40 J-55 C-75 N-80	5,640 7,750 10,570 11,280	5,340 7,350 10,020 10,680	19,090 26,250 35,800 38,180	31,980 43,970 59,960 63,960	26,890 36,970 50,420 53,780
2-1/16 52,40			3.25	.156	1.751 44,48		2.4080 155,36	3.3426 215,66	.9346	.4277	1.178				2.325 59,05	H-40 J-55 C-75 N-80	5,590 7,690 10,480 11,180	5,290 7,280 8,920 10,590			35,690 49,070 66,910 71,370
2-3/8 60,33	4.00			.167	2.041 51,84	1.947 49,45	3.2717 211,09	4.4301 285,83	1.1584	.710	1.164	2.875 73,03				H-40 J-55 C-75 N-80	5,230 7,190 9,520 9,980	4,920 6,770 9,230 9,840	30,130 41,430 56,500 60,260		
	4.60	4.70		.190	1.995 50,67	1.901 48,29	3.1259 201,68	4.4301 285,83	1.3042	.7842	1.191	2.875 73,03	3.063 77,80	2.910 73,91		H-40 J-55 C-75 N-80 P-105	5,890 8,100 11,040 11,780 15,460	5,600 7,700 10,500 11,200 14,700	35,960 49,450 67,430 71,930 94,410	52,170 71,730 97,820 104,340 136,940	
	5.80	5.95		.254	1.867 47,42	1.773 45,03	2.7377 176,63	4.4301 285,83	1.6925	.9654	1.272	2.875 73,03	3.063 77,80	2.910 73,91		C-75 N-80 P-105	14,330 15,280 20,060	14,040 14,970 19,650	96,560 102,990 135,180	126,940 135,400 177,710	
2-7/8 73,00	6.40	6.50		.217	2.441 62,00	2.347 59,61	4.6798 301,94	6.4918 418,85	1.8120	1.6109	1.178	3.500 88,90	3.668 93,17	3.460 87,88		H-40 J-55 C-75 N-80 P-105	5,580 7,680 10,470 11,160 14,010	5,280 7,260 9,910 10,570 13,870	52,780 72,580 98,970 105,570 138,560	72,480 99,660 135,900 144,960 190,260	

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DIMENSIONAL & MINIMUM PERFORMANCE DATA – API TUBING

OD (in.) (mm)	Nominal Weight T&C Non-Upset (lb/ft)	Nominal Weight T&C Upset (lb/ft)	Nominal Weight Integral Joint (lb/ft)	Wall Thickness (in)	ID Nom. (in.) (mm)	Drift Dia. (in.) (mm)	ID Area (in^2) (mm^2)	OD Area (in^2) (mm^2)	Cross-Sectional Area (in^2)	Moment of Inertia, I (in^4)	OD ID Ratio R	Coupling or Box OD Non Upset (in) (mm)	Coupling or Box OD Upset Reg. (in) (mm)	Coupling or Box OD Upset Spec. Cl. (in) (mm)	Coupling or Box OD Integral Joint (in) (mm)	Grade	Collapse Resistance (psi)	Internal Yield Pressure (psi)	Joint Yield Strength T&C Non-Upset (lb)	Joint Yield Strength T&C Upset (lb)	Joint Yield Strength Integral Joint (lb)
2-7/8 73,00	7.80	7.90		.276	2,323 59,00	2.229 56,62	4.2383 273,46	6.4918 418,85	2.2535	1.9242	1.238	3.500 88,90	3.668 93,17	3.460 87,88		C-75 N-80 C-90 P-105	13,020 13,890 15,620 18,220	12,600 13,440 15,120 17,640	132,100 140,900 158,500 184,900	169,000 180,300 202,800 236,600	
	8.60	8.70		.308	2.259 57,38	2.165 54,99	4.0079 258,59	6.4918 418,85	2.4839	2.0754	1.273	3.500 88,90	3.668 93,17	3.460 87,88		C-75 N-80 P-105	14,350 15,300 20,090	14,060 15,000 19,690	149,360 159,310 209,100	186,290 198,710 260,810	
3-1/2 88,90	7.70			.216	3.068 77,93	2.943 74,75	7.3972 476,98	9.6211 620,75	2.2285	3.0172	1.141	4.250 107,95				H-40 J-55 C-75 N-80	4,630 5,970 7,540 7,870	4,320 5,940 8,100 8,640	65,070 89,470 122,010 130,140		
	9.20	9.30		.254	2.992 75,99	2.867 72,82	7.0309 453,63	9.6211 620,75	2.5902	3.4323	1.170	4.250 107,95	4.500 114,30	4.180 106,70		H-40 J-55 C-75 N-80 P-105	5,380 7,400 10,040 10,530 13,050	5,080 6,980 9,520 10,160 13,340	79,540 109,370 149,140 159,090 208,800	103,610 142,460 194,260 202,220 271,970	
	10.20			.289	2.922 74,22	2.797 71,04	6.7058 432,66	9.6211 620,75	2.9153	3.7878	1.198	4.250 107,95				H-40 J-55 C-75 N-80	6,060 8,330 11,360 12,120	5,780 7,950 10,840 11,560	92,550 127,250 173,530 185,100		
	12.70	12.95		.375	2.75 69,85	2.625 66,68	5.9396 383,22	9.6211 620,75	3.6816	4.5588	1.273	4.250 107,95	4.500 114,30	4.180 106,70		C-75 N-80 P-105	14,350 15,310 20,090	14,090 15,000 19,690	230,990 246,390 323,390	276,120 294,530 386,570	
4 101,60	9.50			.226	3.548 90,12	3.423 86,94	9.8868 637,89	12.5664 810,78	2.6795	4.7877	1.127	4.750 120,65				H-40 J-55 C-75 N-80	4,060 5,110 6,350 6,590	3,960 5,440 7,420 7,910	72,000 99,010 135,010 144,010		
		11.00		.262	3.476 88,29	3.351 85,12	9.4896 612,27	12.5664 810,78	3.0767	5.4002	1.151		5.000 127,00			H-40 J-55 C-75 N-80	4,900 6,590 8,410 8,800	4,590 6,300 8,600 9,170		123,070 169,220 230,750 246,140	
4-1/2 114,30	12.60	12.75		.271	3.958 100,53	3.833 97,36	12.3039 793,85	15.9043 1026,15	3.6005	8.0821	1.137	5.200 132,08	5.563 141,30			H-40 J-55 C-75 N-80	4,500 5,720 7,200 7,500	4,220 5,800 7,900 8,430	104,360 143,500 195,680 208,730	144,020 198,030 270,040 288,040	

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TUBING SIZES AND CAPACITIES

OD (in)	Weight (lb/ft)	ID (in)	Barrels per Lin. Ft	Lin. Ft per Barrel	Cu Ft per Lin. Ft	Lin. Ft per Cu Ft	Gallons per Lin. Ft	Lin. Ft per Gallon
1.050	1.14/1.20	.824	.00066	1516.11	.00370	270.039	.028	36.098
1.315	1.70/1.80	1.049	.00107	935.48	.00600	166.621	.045	22.274
1.660	2.30/2.40	1.410	.00193	517.78	.01084	92.224	.081	12.328
	2.33	1.380	.00185	540.54	.01039	96.277	.078	12.870
1.900	2.40	1.650	.00264	378.11	.01485	67.346	.111	9.003
	2.75/2.90	1.610	.00252	397.13	.01414	70.734	.106	9.456
2-1/16	3.25	1.751	.00298	335.75	.01672	59.801	.125	7.994
2-3/8	4.00	2.041	.00405	247.11	.02272	44.014	.170	5.884
	4.60/4.70	1.995	.00387	258.64	.02171	46.068	.162	6.158
	5.80/5.95	1.867	.00339	295.32	.01901	52.601	.142	7.032
2-7/8	6.40/6.50	2.441	.00579	172.76	.03250	30.771	.243	4.113
	8.60/8.70	2.259	.00496	201.72	.02783	35.929	.208	4.803
3-1/2	7.70	3.068	.00914	109.36	.05134	19.479	.384	2.604
	9.20/9.30	2.992	.00870	114.99	.04882	20.481	.365	2.738
	10.20	2.922	.00829	120.57	.04657	21.474	.348	2.871
	12.70/12.95	2.750	.00735	136.12	.04125	24.245	.309	3.241
4	9.50	3.548	.01223	81.77	.06866	14.565	.514	1.947
	11.00	3.476	.01174	85.20	.06590	15.175	.493	2.029
4-1/2	12.60/12.75	3.958	.01522	65.71	.08544	11.704	.639	1.565

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
1.050	1.13	1.20	.113	.824	.730	GST Streamline		1.310	
						Hydril CS	.687	1.327	1.300
						VAM	.807	1.299	
	1.47	1.50	.154	.742	.648	Hydril CS	.687	1.327	
						VAM	.728	1.339	
1.315	1.68	1.80	.133	1.049	.955	Atlas Bradford DS-HT		1.551	
						Atlas Bradford DSS-HT & IJ-3SS	.985	1.562	
						Atlas Bradford IJ-3S	.985	1.551	
						GST Streamline		1.550	
						Hydril CS	.970	1.552	1.525
						VAM	1.004	1.555	
	2.17	2.25	.179	.957	.848	Atlas Bradford DSS-HT	.849	1.600	
						Hydril CS	.864	1.600	
						VAM	.906	1.614	
1.660	2.27	2.40	.140	1.380	1.286	Atlas Bradford DS-HT		1.889	
						Atlas Bradford DSS-HT & IJ-3SS	1.301	1.893	
						Atlas Bradford IJ-3S	1.301	1.889	
						GST Streamline		1.880	
						Hydril A-95	1.300	1.898	1.858
						Hydril CS	1.300	1.883	1.858
						VAM	1.307	1.913	
	2.99	3.02	.191	1.278	1.184	Hydril CS	1.218	1.927	
						VAM	1.209	1.976	
	3.09	3.24	.198	1.264	1.170	Hydril CS	1.200	1.927	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
1.900	2.75	2.90	.145	1.610	1.516	Atlas Bradford DS-HT		2.125	
						Atlas Bradford DSS-HT & IJ-3SS	1.531	2.123	
						Atlas Bradford IJ-3S	1.531	2.125	
						GST Streamline		2.110	
						Hydril A-95	1.530	2.134	2.094
						Hydril CS	1.530	2.113	2.094
						Mannesmann Omega	1.594	2.039	
						VAM	1.535	2.142	
	3.63	3.64	.200	1.500	1.406	Hydril CS	1.440	2.162	
						VAM	1.429	2.220	
	3.93	4.19	.219	1.462	1.368	Hydril CS	1.390	2.179	
2	3.23	3.40	.165	1.670	1.576	National Buttress		2.500	2.300
						Pittsburgh 8 Acme		2.500	2.300
2-1/16	3.18	3.40	.156	1.750	1.656	Atlas Bradford DS-HT		2.320	
						Atlas Bradford DSS-HT & IJ-3SS	1.685	2.340	
						Atlas Bradford IJ-3S	1.685	2.320	
						GST Streamline		2.310	
		3.25				Hydril A-95	1.700	2.325	2.300
						Hydril CS	1.700	2.330	2.300
						VAM	1.677	2.331	
	4.41	4.50	.225	1.613	1.519	Hydril CS	1.550	2.375	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
2-3/8	4.43	4.470	.190	1.995	1.901	Atlas Bradford DS-HT		2.700	
		4.70				Atlas Bradford DSS-HT & IJ-3SS	1.930	2.710	
						Atlas Bradford IJ-3S	1.935	2.700	
						Atlas Bradford IJ-4S	1.945	2.750	
						Atlas Bradford TC-4S		2.875	2.750
						Atlas Bradford FL-3S & FL-4S	1.926	2.375	
						Armco Nu-Lock & Seal Lock	1.950	2.875	2.700
						Extreme Line	1.935	3. 00	
						GST Streamline		2.700	
						Hydril A-95 & CS	1.945	2.700	2.630
						Hydril CFJ-P	1.945	2.525	
		4.60	.218	1.939	1.845	Hydril Super FJ	1.945	2.437	
						Mannesmann Omega	1.988	2.551	
						Mannesmann TDS		2.875	
						Buttress & 8TPI Acme		2.875	2.700
						VAM	1.929	2.697	2.618
	5.01	5.30				Atlas Bradford DSS-HT & IJ-3SS	1.875	2.710	
						Atlas Bradford IJ-4S	1.840	2.750	
						Atlas Bradford TC-4S		2.875	2.750
		5.1				VAM	1.929	2.697	2.618

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
2-3/8	5.75	5.95	.254	1.867	1.773	Atlas Bradford DSS-HT & IJ-3SS	1.805	2.910	2.800
						Atlas Bradford IJ-4S	1.820	2.800	
						Atlas Bradford TC-4S		2.875	
						Atlas Bradford FL-3S & FL-4S	1.823	2.375	
		5.80				Armco Seal Lock	1.450	2.875	
		5.95				Extreme Line	1.807	3. 00	
						Hydril PH-6	1.805	2.906	
		5.80				Mannesmann Omega	1.870	2.614	
						Mannesmann TDS	1.867	2.875	
						VAM	1.867	2.776	2.697
	5.89	6.20	.261	1.850	1.759	Atlas Bradford DSS-HT & IJ-3SS	1.791	2.910	
						Atlas Bradford IJ-4S	1.806	2.800	
						Atlas Bradford TC-4S		2.875	2.800
						Hydril PH-6	1.795	2.937	
	6.26	6.65	.280	1.815	1.721	Atlas Bradford FL-3S & FL-4S	1.771		
		6.30				VAM	1.866	2.856	
	7.30	7.70	.336	1.703	1.609	Atlas Bradford DSS-HT & IJ-3SS	1.641	3.135	
						Atlas Bradford IJ-4S	1.656	2.900	
						Atlas Bradford TC-4S		3. 00	2.400
						Hydril PH-6	1.645	3.125	
		7.30				VAM	1.866	2.856	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft) Plain End	Weight (lb/ft) Nominal - Depends on Joint	Tubular Wall Thickness (in.)	Tubular ID (in.)	Tubular Drift Dia. (in.)	Type of Joint	Joint ID * (in.)	Joint Regular Coupling OD (in.)	Joint Special Cl. Cplg OD (in.)
2-7/8	6.16	6.50	.217	2.441	2.347	Atlas Bradford DS-HT		3.218	
						Atlas Bradford DSS-HT & IJ-3SS	2.379	3.230	
						Atlas Bradford IJ-3S	2.379	3.218	
						Atlas Bradford IJ-4S	2.394	3.250	
						Atlas Bradford TC-4S		3.500	3.250
						Atlas Bradford FL-3S & FL-4S	2.372	2.875	
						Armco Nu-Lock	2.396	3.500	3.220
		6.40				Armco Seal Lock	2.396	3.500	3.220
		6.50				Extreme Line	2.381	3.500	
						GST Streamline		3.220	
						Hydril A-95		3.220	3.155
						Hydril CS	2.375	3.220	3.155
						Hydril CFJ-P	2.375	3. 00	
		6.40				Hydril Super FJ	2.375	2.968	
						Mannesmann Omega		3.079	
						Mannesmann TDS		3.500	
						National Buttress		3.500	3.220
						Pittsburgh 8TPI Acme		3.500	3.220
						VAM	2.375	3.197	3.150
	6.48	7.90	.276	2.323	2.229	Atlas Bradford DSS-HT & IJ-3SS	2.261	3.385	
						Atlas Bradford IJ-4S	2.276	3.375	
						Atlas Bradford TC-4S		3.500	3.375
						Atlas Bradford FL-3S & FL-4S	2.279	2.875	
						Hydril PH-6	2.265	3.437	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
2-7/8	6.48	7.70	.276	2.323	2.229	VAM	2.323	3.327	3.264
	8.44	8.70	.308	2.259	2.165	Atlas Bradford DSS-HT & IJ-3SS	2.197	3.510	
						Atlas Bradford IJ-4S	2.212	3.375	
						Atlas Bradford TC-4S		3.500	
						Atlas Bradford FL-3S & FL-4S	2.215	2.875	3.375
		8.60				Armco Seal Lock	2.396	3.500	
		8.70				Extreme Line	2.199	3.625	
						Hydril PH-6	2.200	3.500	
		8.60				Mannesmann Omega		3.154	
						Mannesmann TDS		3.500	
						VAM	2.260	3.327	3.264
	9.78	9.50	.340	2.195	2.101	Atlas Bradford DSS-HT & IJ-3SS	2.133	3.635	
						Atlas Bradford IJ-4S	2.148	3.450	
						Atlas Bradford TC-4S		3.500	3.450
						Hydril PH-6	2.130	3.625	
	9.69	10.40	.362	2.151	2.057	Atlas Bradford FL-3S & FL-4S	2.107	2.875	
		9.70				VAM	2.260	3.453	
	10.39	10.70	.392	2.091	1.997	Hydril PH-6	2.030	3.687	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
2-7/8	10.66	11. 0	.405	2.065	1.972	Atlas Bradford DSS-HT & IJ-3SS	2.003	3.760	3.500
						Atlas Bradford IJ-4S	2.018	3.500	
						Atlas Bradford TC-4S		3.625	
						Hydril PH-4	2.000	3.750	
						Hydril PH-6	2.000	3.750	
		10.70				VAM	2.205	3.453	
	11.44	11.65	.440	1.995	1.901	Atlas Bradford DSS-HT & IJ-3SS	1.933	3.760	3.550
						Atlas Bradford IJ-4S	1.948	3.550	
						Atlas Bradford TC-4S		3.625	
						Hydril PH-4	1.945	3.750	
3-1/2	7.57	7.70	.216	3.068	2.943	Atlas Bradford FL-3S & FL-4S	2.968	3.500	
						Mannesmann Omega	3.067	3.701	
						VAM	2.972	3.803	
	8.81	9.30	.254	2.992	2.867	Atlas Bradford DSS-HT		3.875	3.950
						Atlas Bradford DSS-HT & IJ-3SS	2.417	3.875	
						Atlas Bradford IJ-3S	2.417	3.875	
						Atlas Bradford IJ-4S	2.932	3.950	
						Atlas Bradford TC-4S		4.250	
						Atlas Bradford FL-3S & FL-4S	2.917	3.500	
						Armco Nu-Lock	2.947	4.250	3.865
		9.20				Armco Seal Lock	2.927	4.250	3.865

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
3-1/2	8.81	9.30	.254	2.992	2.867	Extreme Line	2.907	4.250	
						GST Streamline		3.865	
						Hydril A-95 & CS	2.920	3.905	3.805
						Hydril CFJ-P	2.920	3.609	
		9.20				Hydril Super FJ	2.930	3.594	
						Mannesmann Omega	2.992	4.250	
						Mannesmann TDS	2.992		
						National Buttress		4.250	3.865
						Pittsburgh 8TPI Acme		4.250	3.865
						VAM	2.972	3.862	3.793
	9.91	10.30	.289	2.922	2.797	Atlas Bradford DSS-HT & IJ-3SS	2.847	3.947	
						Atlas Bradford IJ-4S	2.862	3.950	3.950
						Atlas Bradford TC-4S		4.250	
						Atlas Bradford FL-3S & FL-4S	2.847	3.500	
						Hydril CS	2.878	3.955	
						Hydril CFJ-P	2.878	3.609	
		10.20				Hydril Super FJ	2.860	3.594	
						Mannesmann Omega	2.921		
						Mannesmann TDS	2.921	4.250	
						VAM	2.925	3.917	3.862
	12.31	12.70	.368	2.764	2.639	Atlas Bradford FL-3S & FL-4S	2.689	3.500	
		12.80				Hydril Super FJ	2.700	3.594	
						Hydril PH-6	2.700	4.312	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
3-1/2	12.52	12.95	.375	2.750	2.625	Atlas Bradford DSS-HT & IJ-3SS	2.675	4.260	4.100
						Atlas Bradford IJ-4S	2.690	4.100	
						Atlas Bradford TC-4S		4.250	
						Atlas Bradford FL-3S & FL-4S	2.675	3.500	
		12.70				Armco Seal Lock	2.927	4.250	
		12.95				Extreme Line			
						Hydril PH-6	2.687	4.312	
		12.70				Mannesmann Omega	2.752		
						Mannesmann TDS	2.752	4.250	
						VAM	2.925	4.035	3.957
	13.60	13.70	.413	2.673	2.548	VAM	2.835	4.138	4.026
	14.62	15.50	.449	2.602	2.477	Atlas Bradford FL-3S & FL-4S	2.527	3.500	
						Hydril Super FJ	2.540	3.594	
		14.70				VAM	2.756	4.138	4.026
	15.37	15.80	.476	2.548	2.423	Atlas Bradford DSS-HT	2.470	4.385	4.200
						Atlas Bradford IJ-4S	2.488	4.200	
						Atlas Bradford TC-4S		4.375	
						Hydril PH-6	2.485	4.500	
	15.68	15.80	.488	2.524	2.399	VAM	2.756	4.252	4.128
	16.28	16.70	.510	2.480	2.355	Atlas Bradford DSS-HT	2.391	4.525	4.250
						Atlas Bradford IJ-4S	2.420	4.250	
						Atlas Bradford TC-4S		4.375	
						Hydril PH-4	2.406	4.562	
						Hydril PH-6	2.406	4.562	
	16.81	17.05	.530	2.440	2.315	Extreme Line	2.398	4.374	
						Hydril PH-4	2.375	4.562	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
4	9.11	9.50	.226	3.548	3.423	Atlas Bradford FL-3S & FL-4S	3.448	4.000	
						Mannesmann Omega	3.547	4.209	
						VAM	3.480	4.325	
	10.46	11.00	.262	3.476	3.351	Atlas Bradford DS-HT		4.412	
						Atlas Bradford DSS-HT & IJ-3SS	3.401	4.385	
						Atlas Bradford IJ-3S	3.401	4.412	
						Atlas Bradford IJ-4S	3.416	4.450	
						Atlas Bradford TC-4S		4.500	4.450
						Atlas Bradford FL-3S & FL-4S	3.401	4.000	
						Hydril A-95 & CS	3.395	4.405	4.315
						Hydril CFJ-P	3.395	4.100	
						Hydril Super FJ	3.395	4.094	
						Mannesmann Omega	3.476	4.236	
						Mannesmann TDS	3.476	4.748	
		10.90				Pittsburgh 8TPI Acme		4.750	4.400
						National Buttress		4.750	4.400
						VAM	3.457	4.366	4.315
	11.34	11.60	.286	3.428	3.303	Atlas Bradford FL-3S & FL-4S	3.353	4.000	
						Hydril Super FJ	3.350	4.094	
	12.93	13.40	.330	3.340	3.215	Atlas Bradford DSS-HT & IJ-3SS	3.265	4.572	
						Atlas Bradford IJ-4S	3.280	4.525	
						Atlas Bradford TC-4S		4.625	4.525
		14.00				Atlas Bradford FL-3S & FL-4S	3.265	4.000	
		13.40				Hydril Super FJ	3.260	4.094	
						Hydril PH-6	3.275	4.625	
		13.00				VAM	3.457	4.468	4.356

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft) Plain End	Weight (lb/ft) Nominal - Depends on Joint	Tubular Wall Thickness (in.)	Tubular ID (in.)	Tubular Drift Dia. (in.)	Type of Joint	Joint ID * (in.)	Joint Regular Coupling OD (in.)	Joint Special Cl. Cplg OD (in.)
4	14.66	14.80	.380	3.240	3.115	VAM	3.346	4.614	
	16.36	16.50	.430	3.140	3.015	VAM	3.346	4.614	
	18.69	19.00	.5 0	3.000	2.875	Hydril PH-4	2.920	5.000	
	22.08	22.80	.610	2.780	2.655	Atlas Bradford DSS-HT	2.705	4.885	
						Atlas Bradford IJ-4S	2.720	4.850	
						Atlas Bradford TC-4S		5.000	4.850
		22.50				Hydril PH-4	2.700	5.187	
4-1/2	9.40	9.50	.205	4.090	3.965	Atlas Bradford FL-3S & FL-4S	3.990	4.500	
	10.23	10.50	.224	4.052	3.927	Atlas Bradford FL-3S & FL-4S	3.952	4.500	
	11.35	11.60	.250	4.000	3.875	Atlas Bradford FL-3S & FL-4S	3.925	4.500	
	12.24	12.75	.271	3.958	3.833	Atlas Bradford DS-HT		4.880	
						Atlas Bradford DSS-HT & IJ-3SS	3.883	4.940	
						Atlas Bradford IJ-4S	3.898	4.960	
						Atlas Bradford TC-4S		5.000	4.960
		12.60				Atlas Bradford FL-3S & FL-4S	3.883	4.500	
		12.75				Hydril A-95 & CS	3.865	4.910	4.825
						Hydril CFJ-P	3.865	4.609	
		12.60				Hydril Super FJ	3.880	4.594	
						Mannesmann Omega	3.957	4.744	
						Mannesmann TDS	3.957	5.201	
						National Buttress		5.200	4.920
						Pittsburgh 8TPI Acme		5.200	4.920
						VAM	3.933	4.862	

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft) Plain End	Weight (lb/ft) Nominal - Depends on Joint	Tubular Wall Thickness (in.)	Tubular ID (in.)	Tubular Drift Dia. (in.)	Type of Joint	Joint ID * (in.)	Joint Regular Coupling OD (in.)	Joint Special Cl. Cplg OD (in.)
4-1/2	13.04	13.50	.290	3.920	3.795	Atlas Bradford DSS-HT	3.845	4.940	4.960
						Atlas Bradford IJ-4S	3.860	4.960	
						Atlas Bradford TC-4S		5.000	
						Atlas Bradford FL-3S & FL-4S	3.845	4.500	
						Hydril CS	3.840	4.935	
						Hydril Super FJ	3.840	4.594	
						Mannesmann TDS	3.921	5.201	
	14.98	15.50	.337	3.826	3.701	Atlas Bradford DSS-HT & IJ-3SS	3.751	5.060	5.200
						Atlas Bradford IJ-4S	3.766	5.200	
						Atlas Bradford TC-4S		5.250	
		15.10				Atlas Bradford FL-3S & FL-4S	3.751	4.500	
		15.50				Hydril PH-6	3.765	5.125	
		15.10				Mannesmann TDS	3.827	5.201	
	16.44	16.90	.373	3.754	3.679	Atlas Bradford DSS-HT	3.679	5.150	5.200
						Atlas Bradford IJ-4S	3.680	5.200	
						Atlas Bradford TC-4S		5.250	
						Atlas Bradford FL-3S & FL-4S	3.679	4.500	
	18.69	19.20	.430	3.640	3.515	Atlas Bradford DSS-HT & IJ-3SS	3.565	5.260	5.200
						Atlas Bradford IJ-4S	3.580	5.200	
						Atlas Bradford TC-4S		5.250	
						Rucker Atlas Bradford	3.565	4.500	
						Hydril PH-6	3.560	5.312	

* Joint ID listed only when bored, otherwise ID same as tubular ID

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DIMENSIONAL DATA NON-API TUBING

OD (in)	Weight (lb/ft)		Tubular			Type of Joint	Joint		
	Plain End	Nominal - Depends on Joint	Wall Thickness (in.)	ID (in.)	Drift Dia. (in.)		ID * (in.)	Regular Coupling OD (in.)	Special Cl. Cplg OD (in.)
4-1/2	21.36	21.60	.500	3.500	3.375	Atlas Bradford DSS-HT	3.425	5.375	5.300
						Atlas Bradford IJ-4S	3.425	5.375	
						Atlas Bradford TC-4S		5.375	
						Atlas Bradford FL-3S & FL-4S	3.425	4.500	
						Hydril PH-4	3.420	5.500	
	23.56	24.60	.560	3.380	3.255	Hydril PH-4	3.300	5.562	
	26.04	26.50	.630	3.240	3.115	Hydril PH-4	3.160	5.687	

* Joint ID listed only when bored, otherwise ID same as tubular ID

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NON-UPSET RECOMMENDED MAKE-UP TORQUE

OD (in.)	Tubing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
1.050	1.14	H-40	110	140	180
		J-55	140	180	230
		C-75	170	230	290
		N-80	190	250	310
1.315	1.70	H-40	160	210	260
		J-55	200	270	340
		C-75	270	360	450
		N-80	290	380	480
1.660	2.30	H-40	200	270	340
		J-55	260	350	440
		C-75	350	460	580
		N-80	370	490	610
1.900	2.75	H-40	240	320	400
		J-55	310	410	500
		C-75	410	540	680
		N-80	430	570	700
2-3/8	4.00	H-40	350	470	590
		J-55	460	610	760
		C-75	600	800	1,000
		N-80	640	850	1,060
	4.60	H-40	420	560	700
		J-55	550	730	910
		C-75	720	960	1,200
		N-80	770	1,020	1,280
		P-105	960	1,280	1,600
	5.80	C-75	1,040	1,380	1,730
		N-80	1,100	1,460	1,830
		P-105	1,380	1,840	2,300
2-7/8	6.40	H-40	600	800	1,000
		J-55	790	1,050	1,310
		C-75	1,040	1,380	1,730
		N-80	1,100	1,470	1,840
		P-105	1,390	1,850	2,310
	8.60	C-75	1,570	2,090	2,600
		N-80	1,660	2,210	2,760
		P-105	2,090	2,790	3,490

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NON-UPSET RECOMMENDED MAKE-UP TORQUE

OD (in.)	Tubing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
3-1/2	7.70	H-40	690	920	1,150
		J-55	910	1,210	1,510
		C-75	1,200	1,600	2,000
		N-80	1,280	1,700	2,130
	9.20	H-40	840	1,210	1,400
		J-55	1,110	1,480	1,850
		C-75	1,460	1,950	2,440
		N-80	1,550	2,070	2,590
		P-105	1,970	2,620	3,280
	10.20	H-40	980	1,310	1,640
		J-55	1,290	1,720	2,150
		C-75	1,700	2,270	2,840
		N-80	1,810	2,410	3,010
	12.70	C-75	2,270	3,030	3,790
		N-80	2,410	3,210	4,010
		P-105	3,050	4,060	5,080
4	9.50	H-40	710	940	1,180
		J-55	930	1,240	1,550
		C-75	1,230	1,640	2,050
		N-80	1,310	1,740	2,180
4-1/2	12.60	H-40	990	1,320	1,650
		J-55	1,310	1,740	2,180
		C-75	1,730	2,300	2,880
		N-80	1,830	2,440	3,050

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EXTERNAL UPSET RECOMMENDED MAKE-UP TORQUE

OD (in.)	Tubing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
1.050	1.20	H-40	350	460	580
		J-55	450	600	750
		C-75	590	780	980
		N-80	620	830	1,040
1.315	1.80	H-40	330	440	550
		J-55	430	570	710
		C-75	560	740	930
		N-80	590	790	990
1.660	2.40	H-40	400	530	660
		J-55	520	690	860
		C-75	680	910	1,140
		N-80	720	960	1,200
1.900	2.90	H-40	500	670	840
		J-55	660	880	1,100
		C-75	860	1,150	1,440
		N-80	920	1,220	1,530
2-3/8	4.70	H-40	740	990	1,240
		J-55	970	1,290	1,610
		C-75	1,280	1,700	2,130
		N-80	1,350	1,800	2,250
		P-105	1,700	2,270	2,840
	5.95	C-75	1,590	2,120	2,650
		N-80	1,680	2,240	2,800
		P-105	2,120	2,830	3,540
2-7/8	6.50	H-40	940	1,250	1,560
		J-55	1,240	1,650	2,060
		C-75	1,630	2,170	2,710
		N-80	1,730	2,300	2,880
		P-105	2,180	2,910	3,640
	8.70	C-75	2,140	2,850	3,560
		N-80	2,270	3,020	3,780
		P-105	2,860	3,810	4,760
3-1/2	9.30	H-40	1,300	1,730	2,160
		J-55	1,710	2,280	2,850
		C-75	2,260	3,010	3,760
		N-80	2,400	3,200	4,000
		P-105	3,040	4,050	5,060
	12.95	C-75	3,030	4,040	5,050
		N-80	3,220	4,290	5,360
		P-105	4,070	5,430	6,790
4	11.00	H-40	1,460	1,940	2,430
		J-55	1,920	2,560	3,200
		C-75	2,540	3,390	4,240
		N-80	3,420	4,560	5,700
4-1/2	12.75	H-40	1,620	2,160	2,700
		J-55	2,150	2,860	3,180
		C-75	2,840	3,780	4,730
		N-80	3,020	4,020	5,030

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INTEGRAL JOINT RECOMMENDED MAKE-UP TORQUE

OD (in.)	Tubing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
1.315	1.72	H-40	230	310	390
		J-55	300	400	500
		C-75	390	520	650
		N-80	410	550	690
1.660	2.10 & 2.33	H-40	280	380	480
		J-55	380	500	630
	2.33	C-75	490	650	810
		N-80	520	690	860
1.900	2.40 & 2.76	H-40	340	450	560
		J-55	440	580	730
	2.76	C-75	570	760	950
		N-80	610	810	1,010
2-1/16	3.25	H-40	430	570	710
		J-55	560	740	920
		C-75	730	970	1210
		N-80	770	1,030	1,290

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CASING AREAS

OD (in)	Tubing Weight (lb/ft)	ID (in)	ID Area (in^2)	OD Area (in^2)	Cross-Sectional Area (in^2)
4-1/2	9.50	4.090	13.1382	15.9044	2.7661
	10.50	4.052	12.8953	15.9044	3.0091
	11.60	4.000	12.5664	15.9044	3.3380
	12.60	3.958	12.3039	15.9044	3.6005
	13.50	3.920	12.0688	15.9044	3.8356
	15.10	3.826	11.4969	15.9044	4.4074
	16.60	3.754	11.0683	15.9044	4.8361
	16.90	3.714	10.8336	15.9044	5.0707
	17.70	3.696	10.7289	15.9044	5.1755
	18.80	3.670	10.5785	15.9044	5.3259
	21.60	3.500	9.6212	15.9044	6.2832
	24.60	3.380	8.9727	15.9044	6.9316
	26.50	3.240	8.2448	15.9044	7.6595
5	11.50	4.560	16.3313	19.6350	3.3037
	13.00	4.494	15.8620	19.6350	3.7730
	15.00	4.408	15.2607	19.6350	4.3743
	18.00	4.276	14.3604	19.6350	5.2746
	20.30	4.184	13.7491	19.6350	5.8859
	20.80	4.156	13.5657	19.6350	6.0693
	23.20	4.044	12.8444	19.6350	6.7906
	24.20	4.000	12.5664	19.6350	7.0686
5-1/2	14.00	5.012	19.7294	23.7584	4.0290
	15.50	4.950	19.2443	23.7584	4.5141
	17.00	4.892	18.7959	23.7584	4.9624
	20.00	4.778	17.9301	23.7584	5.8282
	23.00	4.670	17.1287	23.7584	6.6296
	26.00	4.548	16.2455	23.7584	7.5129
	28.40	4.490	15.8337	23.7584	7.9246
	32.30	4.276	14.3604	23.7584	9.3980
	36.40	4.090	13.1382	23.7584	10.6201
6	18.00	5.424	23.1063	28.2744	5.1681
	20.00	5.352	22.4969	28.2744	5.7775
	23.00	5.240	21.5652	28.2744	6.7092
	26.00	5.132	20.6854	28.2744	7.5890
6-5/8	20.00	6.049	28.7381	34.4717	5.7336
	24.00	5.921	27.5347	34.4717	6.9370
	28.00	5.791	26.3389	34.4717	8.1328
	32.00	5.675	25.2943	34.4717	9.1774

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CASING AREAS

OD (in)	Tubing Weight (lb/ft)	ID (in)	ID Area (in^2)	OD Area (in^2)	Cross-Sectional Area (in^2)
7	17.00	6.538	33.5723	38.4846	4.9123
	20.00	6.456	32.7354	38.4846	5.7492
	23.00	6.366	31.8291	38.4846	6.6555
	26.00	6.276	30.9355	38.4846	7.5491
	29.00	6.184	30.0352	38.4846	8.4494
	32.00	6.094	29.1673	38.4846	9.3173
	35.00	6.004	28.3121	38.4846	10.1725
	38.00	5.920	27.5254	38.4846	10.9592
	41.00	5.820	26.6034	38.4846	11.8812
	44.00	5.720	25.6970	38.4846	12.7876
	49.50	5.540	24.1052	38.4846	14.3794
7-5/8	24.00	7.025	38.7600	45.6636	6.9037
	26.40	6.969	38.1445	45.6636	7.5192
	29.70	6.875	37.1224	45.6636	8.5412
	33.70	6.765	35.9440	45.6636	9.7196
	39.00	6.625	34.4717	45.6636	11.1920
	45.30	6.435	32.5228	45.6636	13.1408
8-5/8	24.00	8.097	51.4919	58.4264	6.9345
	28.00	8.017	50.4795	58.4264	7.9469
	32.00	7.921	49.2778	58.4264	9.1486
	36.00	7.825	48.0905	58.4264	10.3359
	40.00	7.725	46.8692	58.4264	11.5572
	44.00	7.625	45.6636	58.4264	12.7628
	49.00	7.511	44.3084	58.4264	14.1180
	52.00	7.435	43.4163	58.4264	15.0101
9-5/8	32.60	9.001	63.6315	72.7599	9.1284
	36.00	8.921	62.5055	72.7599	10.2545
	40.00	8.835	61.3061	72.7599	11.4538
	43.50	8.755	60.2009	72.7599	12.5590
	47.00	8.681	59.1876	72.7599	13.5724
	53.50	8.535	57.2134	72.7599	15.5465
	58.40	8.435	55.8806	72.7599	16.8793
	61.10	8.375	55.0884	72.7599	17.6715
	71.80	8.125	51.8487	72.7599	20.9113
9-7/8	62.80	8.625	58.4264	76.5888	18.1624

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CASING AREAS

OD (in)	Tubing Weight (lb/ft)	ID (in)	ID Area (in^2)	OD Area (in^2)	Cross-Sectional Area (in^2)
10-3/4	32.75	10.192	81.585	90.7628	9.1779
	40.50	10.050	79.327	90.7628	11.4354
	45.50	9.950	77.757	90.7628	13.0062
	51.00	9.850	76.201	90.7628	14.5613
	55.50	9.760	74.815	90.7628	15.9475
	60.70	9.660	73.290	90.7628	17.4727
	65.70	9.560	71.781	90.7628	18.9823
	71.10	9.450	70.138	90.7628	20.6246
	76.00	9.350	68.662	90.7628	22.1012
	81.00	9.250	67.201	90.7628	23.5620
11-3/4	42.00	11.084	96.490	108.4343	11.9439
	47.00	11.000	95.033	108.4343	13.4009
	54.00	10.880	92.971	108.4343	15.4630
	60.00	10.772	91.135	108.4343	17.2996
	65.00	10.682	89.618	108.4343	18.8161
	71.00	10.586	88.015	108.4343	20.4197
13-3/8	48.00	12.715	126.977	140.5007	13.5241
	54.50	12.615	124.987	140.5007	15.5135
	61.00	12.515	123.013	140.5007	17.4872
	68.00	12.415	121.055	140.5007	19.4452
	72.00	12.347	119.733	140.5007	20.7677
	77.00	12.275	118.341	140.5007	22.1601
	80.70	12.215	117.187	140.5007	23.3141
	85.00	12.159	116.115	140.5007	24.3862
	98.00	11.937	111.913	140.5007	28.5875
13-5/8	88.20	12.375	120.277	145.8021	25.5255
16	55.00	15.376	185.685	201.0624	15.3771
	65.00	15.250	182.655	201.0624	18.4078
	75.00	15.124	179.649	201.0624	21.4136
	84.00	15.010	176.951	201.0624	24.1117
	109.00	14.688	169.440	201.0624	31.6223
18-5/8	87.50	17.755	247.590	272.4479	24.8584
	94.50	17.689	245.752	272.4479	26.6957
	106.00	17.563	242.264	272.4479	30.1842
	117.50	17.439	238.855	272.4479	33.5931
20	94.00	19.124	287.242	314.1600	26.9177
	106.50	19.000	283.529	314.1600	30.6306
	133.00	18.730	275.528	314.1600	38.6315
	169.00	18.376	265.212	314.1600	48.9482

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
4-1/2 114,3	9,50	,205 5,21	4,090 103,9	3,965 100,7	5,000 127,00	H-40	2,770	3,190	3,190			111	77		
						J-55	3,310	4,380	4,380			152	101		
						K-55	3,310	4,380	4,380			152	112		
	10.50	,224 5,69	4,052 102,9	3.927 99,75	5.000 127,00	J-55	4,010	4,790	4,790		4,790	165	132		203
						K-55	4,010	4,790	4,790		4,790	165	146		249
	11.60	.250 6,35	4.000 101,6	3.875 98,43	5.000 127,00	J-55	4,960	5,350	5,350	5,350	5,350	184	154	162	225
						K-55	4,960	5,350	5,350	5,350	5,350	184	170	180	277
						C-75	6,130	7,290		7,290	7,290	250		212	288
						N-80	6,350	7,780		7,780	7,780	267		223	304
						L-80	6,350	7,780		7,780	7,780	267		212	291
						C-95	7,010	9,240		9,240	9,240	317		234	325
						P-110	7,560	10,690		10,690	10,690	367		279	385
						Q-125	15,840	16,380		16,380	15,300	551		438	420
	12.60	.271 6,88	3.958 100,5	3.833 97,36	5.000 127,00	K-55	5,720	5,790				199			
						C-75	7,200	7,900				271			
						N-80	7,500	8,440				289			
						C-95	8,400	10,010				343			
	13.50	.290 7,37	3.920 99,57	3.795 96,39	5.000 127,00	K-55	6,420	6,200		8,460	8,460	211			
						C-75	8,170	8,460		9,020	9,020	288		257	331
						N-80	8,540	9,020		9,020	9,020	307		270	349
						L-80	8,540	9,020		9,020	9,020	307		257	334
						C-95	9,650	10,710		10,710	10,710	364		284	374
						P-110	10,670	12,410		12,410	12,410	422		338	443
						V-150	12,880	16,920				576			
	15.10	.337 8,56	3.826 97,18	3.701 94,00	5.000 127,00	K-55	7,620	7,210				242			
						C-75	10,390	9,830				331			
						L-80	11,080	10,480		10,480	10,480	353		308	384
						S-95	12330	12,450		12,450	11,630	419		357	446
						P-110	14,320	14,420		14,420	13,460	485		406	509
						Q-125	15,840	16,380		16,380	15,300	551		438	554
						V-150	18,110	19,660		19,660	18,360	661		519	658
	16,60 16,80 17,10	,373 9,47	3,754 95,35	3,629 92,17	5,000 127,00	K-55	8,360	7,980				266			
						C-75	11,400	10,880				363		299(8)	
						N-80	12,160	11,600				387		314(8)	
						C-95	14,440	13,780				459		330(8)	
						P-110	16,720	15,960				532		330(8)	
						V-150	22,110	21,760				725			
	16,90	.380 9,65	3.740 94,99	3.615 91,82		C-95	14,690	14,040				467			
						P-110	17,010	16,260				541			
						V-150	22,890	22,170				738			
	17,70	,402 10,21	3,696 93,87	3,571 90,70		C-95	15,450	14,810				492			
						P-110	17,890	17,140				569			
						V-150	24,390	23,380				776			

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
	18.80	.430	3.640	3.515		C-75	12,960	12,540				412			
	20.00	10,92	92,46	89,28		N-80	13,830	13,380				440			
						C-95	16,420	15,890				522			
						P-110	19,010	18,390				605			
						V-150	25,930	25,080				825			
	21.60	.500	3.500	3.375		C-75	14,810	14,580				471			
		12,70	88,90	85,73		N-80	15,800	15,560				503			
4-1/2 114,3						P-110	21,730	21,390				691			
						V-150	29,630	29,170				942			
	24.60	.560	3.380	3.255		N-80	17,430	17,420				554			
		14,22	85,85	82,68		P-110	23,970	23,960				762			
						V-150	32,690	32,670				1.040			
	26.50	.630	3.240	3.115		N-80	19,260	19,600				613			
		16,00	82,29	79,12		P-110	26,490	26,950				842			
						V-150	36,120	36,750				1.040			
	11.50	.220	4.560	4.435	5.563	J-55	3,060	4,240	4,240			182	133		
		5,59	115,82	112,65	141,30	K-55	3,060	4,240	4,240			182	147		
	13.00	.253	4.494	4.369	5.563	J-55	4,140	4,870	4,870	4,870	4,870	208	169	182	252
		6,43	114,14	110,97	141,30	K-55	4,140	4,870	4,870	4,870	4,870	208	186	201	309
						C-75	4,990	6,640				283			
						N-80	5,140	7,090				302			
	15.00	.296	4.408	4.283	5.563	J-55	5,550	5,700	5,700	5,700	5,700	241	207	223	293
		7,52	111,96	108,79	141,30	K-55	5,550	5,700	5,700	5,700	5,700	241	228	246	359
						N-80	7,250	8,290		8,290	8,290	350		311	396
						L-80	7,250	8,290		8,290	8,290	350		295	379
						C-95	8,090	9,840		9,840	9,840	416		326	424
						S-95	9,380	9,840		9,840	9,840	416		342	441
						P-110	8,830	11,400		11,400	11,400	481		388	503
5 127,0						V-150	10,260	15,540		15,540	15,540	656		497	651
	18.00	.362	4.276	4,151	5,563	N-80	10,490	10,140		10,140	9,910	422		396	477
		9,19	108,61	105,44	141,30	L-80	10,490	10,140		10,140	9,910	422		377	457
						C-95	12,010	12,040		12,040	11,770	501		416	512
						P-110	13,450	13,940		13,940	13,620	580		495	606
						Q-125	14,830	15,840		15,840	15,480	659		535	661
						V-150	16,860	19,010		19,010	18,580	791		634	785
	20.30	.408	4.184	4.059	5.563	C-75	11,240	10,710				441			
		10,36	106,27	103,09	141,30	N-80	11,990	11,420				471			
						P-100	16,490	15,710				647			
						V-150	21,470	21,420				883			
	20.80	.422	4.156	4.031	5.563	C-75	11,590	11,080				455			
		10,72	105,56	102,39	141,30	N-80	12,360	11,820				486			
						P-110	17,000	16,250				668			
						V-150	22,870	22,160				910		755	847

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
5 127,0	21.40	.437	4.126	4.001	5.563	N-80	12,760	12,240		10,810	9,910	501		490	537
		11,10	104,80	101,63	141,30	L-80	12,760	12,240		10,810	9,910	501		466	510
						C-95	15,150	14,530		12,840	11,770	595		515	563
						P-110	17,000	16,820		14,870	13,620	689		613	671
						Q-125	19,940	19,120		16,900	15,480	783		662	724
	23.20	.478	4.044	3.919	5.563	N-80	13,830	13,380		10,810	9,910	543		540	537
		12,14	102,72	99,54	141,30	L-80	13,830	13,380		10,810	9,910	543		513	510
						C-95	16,430	15,890		12,840	11,770	645		567	563
						P-110	19,020	18,400		14,780	13,626	747		675	671
						Q-125	21,620	20,910		16,900	15,480	849		729	724
	24.10	.500	4.000	3.875	5.563	N-80	14,400	14,000		10,810	9,910	566		558	537
		12,70	101,60	98,43	141,30	L-80	14,400	14,000		10,810	9,910	566		538	510
						C-95	17,100	16,630		12,840	11,770	672		595	563
						P-110	19,800	19,250		14,870	13,620	778		708	671
						Q-125	22,500	21,880		16,900	15,480	884		765	724
						V-150	27,000	26,250		20,280	18,580	1,060		907	858
5-1/2 139,7	14.00	.244	5,012	4,887	6,050	H-40	2,630	3,110	3,110			161	130		
		6,20	127,30	124,13	153,67	J-55	3,120	4,270	4,270			222	172		
						K-55	3,120	4,270	4,270			222	189		
	15.50	.275	4.950	4.825	6.050	J-55	4,040	4,810	4,810	4,810	4,810	248	202	217	300
		6,99	125,73	122,56	153,67	K-55	4,040	4,810	4,810	4,810	4,810	248	222	239	366
						N-80	4,990	7,000				362			
						P-110	5,620	9,620				497			
	17.00	.304	4.892	4.767	6.050	J-55	4,910	5,320	5,320	5,320	5,320	273	229	247	329
		7,72	124,26	121,08	153,67	K-55	4,910	5,320	5,320	5,320	5,320	273	252	272	402
						N-80	6,280	7,740		7,740	7,740	397		348	446
						L-80	6,280	7,740		7,740	7,740	397		338	428
						C-95	6,930	9,190		9,190	9,190	471		374	480
						P-110	7,460	10,640		10,640	10,640	546		445	568
						Q-125	7,980	12,090		12,090	12,090	620		481	620
	20.00	.361	4.778	4,653	6.050	N-80	8,820	9,190		9,190	8,990	466		428	524
		9,17	121,36	118,19	153,67	L-80	8,820	9,190		9,190	8,990	466		416	503
						C-95	10,000	10,910		10,910	10,680	554		460	563
						P-110	11,080	12,630		12,630	12,360	641		548	667
						Q-125	12,080	14,360		14,360	14,050	729		592	728
						V-150	13,480	17,230		17230	16860	874		701	865
	23,00	.415	4,670	4,545	6,050	N-80	11,160	10,560		9880	8990	530		502	579
		10,54	118,62	115,44	153,67	L-80	11,160	10,560		9,880	8,990	530		489	550
						C-95	12,920	12,540		11,730	10,680	630		540	608
						P-110	14,520	14,520		13,580	12,360	729		643	724
						Q-125	16,060	16,510		15,430	14,050	829		694	782
						V-150	18,390	19,810		18,520	16,860	994		823	927

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
5-1/2 139,7	26.00	.476 12,09	4.548 115,52	4.423 112,34	6.05 153,70	K-55	8,700	8,330				413			
						N-80	12,650	12,120				601			
						C-95	15,020	14,390		11,730	10,680	714		628	608
						P-110	17,390	16,660		13,580	12,360	826		748	724
						Q-125	19,770	18,930		15,430	14,050	939		808	782
						V-150	23,720	22,720		18,520	16,860	1,127		957	927
	28,40	.530 13,46	4,440 112,78	4,315 109,60		C-75	13,060	12,650				621			
						N-80	13,930	13,490				662			
						P-110	19,160	18,550				910			
	32.30	.612 15,55	4.276 108,61	4,151 105,44		N-80	15,820	15,580				752			
						P-110	21,760	21,420				1,034			
						V-150	29,670	29,210				1,410			
	36,40	.705 17,91	4,090 103,89	3,965 100,71		N-80	17,880	17,950				850			
						P-110	24,590	24,680				1,168			
						V-150	33,530	33,650				1,593			
6 152,4	18.00	.288 7,32	5.424 137,77	5.299 134,59	6.625 168,28	H-40	2,780	3,360	3,360			206	179		
						J-55	3,620	4,620	4,620			283	239	279	
						N-80	4,740	6,720		6,720		412		323	
	20,00	.324 8,23	5,352 135,94	5,227 132,80	6.625 168,28	N-80	5,690			7,560		461		366	
	23,00	.380 9,65	5,240 133,09	5,115 129,92	6,625 168,28	N-80	7,180			8,870		737		432	
						P-110	10,380			12,190		536		565	
	26.00	.434 11,02	5,132 130,35	5.007 127,18	6.625 168,28	P-110	12,380			13,920		833		646	
6-5/8 168,3	20.00	.288 7,32	6.049 153,65	5.924 150,47	7.390 187,70	H-40	2,520	3,040	3,040			229	184		
						J-55	2,970	4,180	4,180	4,180	4,180	315	245	266	374
						K-55	2,970	4,180	4,180	4,180	4,180	315	267	290	453
						N-80	3,480	6,090				459			
						C-95	3,830	7,230				545			
	24.00	.352 8,94	5.921 150,39	5.796 147,22	7.390 187,70	J-55	4,560	5,110	5,110	5,110	5,110	382	314	340	453
						K-55	4,560	5,110	5,110	5,110	5,110	382	342	372	548
						N-80	5,760	7,440		7,440	7,440	555		481	615
						L-80	5,760	7,440		7,440	7,440	555		473	592
						C-95	6,290	8,830		8,830	8,830	659		546	665
						P-110	6,710	10,230		10,230	10,230	763		641	786
						V-150	7,350	13,960				1,041			
	28.00	.417 10,59	5.791 147,09	5.666 143,92	7.390 187,70	K-55	6,170	6,060				447			
						N-80	8,170	8,810		8,810	8,810	651		586	721
						L-80	8,170	8,810		8,810	8,810	651		576	693
						C-95	9,200	10,460		10,460	10,460	773		665	780
						P-110	10,140	12,120		12,120	12,120	895		781	922
						V-150	12,130	16,510				1,220			

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD	Weight per foot w/ Coupling	Wall Thickness	ID	Drift Dia.	Coupling or Joint OD Round or Buttress	Grade	Collapse Resistance	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
(in.)	(lb/ft)	(in.)	(in.)	(in.)	(in.)		(psi)*		Short	Long			Short	Long	
(mm)		(mm)	(mm)	(mm)	(mm)										
	32,00	.475	5,675	5,550	7.390	K-55	7,320	6,900				504			
		12,07	144,15	140,97	187,70	N-80	10,320	10,040		10,040	9,820	734		677	814
6-5/8						L-80	10,320	10,040		10,040	9,820	734		666	783
168,3						C-95	11,800	11,920		11,920	11,660	872		769	880
						P-110	13,200	13,800		13,800	13,500	1,009		904	1,040
						Q-125	14,530	15,680		15,680	15,340	1,147		989	1,138
	17,00	.231	6,538	6,413	7.656	H-40	1,450	2,310	2,310			196	122		
		5,87	166,07	162,89	194,46										
	20,00	.272	6,456	6,331	7.656	H-40	1,980	2,720	2,720			230	176		
		6,91	163,98	160,81	194,46	J-55	2,270	3,740	3,740	3,740	3,740	316	234	257	373
						K-55	2,270	3,740	3,740	3,740	3,740	316	254	281	451
						N-80	3,830	6,340		6,340	6,340	532		442	508
	23,00	.317	6.366	6.241	7.656	J-55	3,270	4,360	4,360	4,360	4,360	366	264	313	432
		8,05	161,69	158,52	194,46	K-55	3,270	4,360	4,360	4,360	4,360	366	309	341	522
						N-80	3,830	6,340		6,340	6,340	532		442	588
						L-80	3,830	6,340		6,340	6,340	532		435	565
						C-95	4,150	7,530		7,530	7,530	632		505	636
	26,00	.362	6,276	6,151	7,656	J-55	4,320	4,980	4,980	4,980	4,980	415	334	367	490
		9,19	159,41	156,26	194,46	K-55	4,320	4,980	4,980	4,980	4,980	415	364	401	592
						N-80	5,410	7,240		7,240	7,240	604		519	667
						L-80	5,410	7,240		7,240	7,240	604		511	641
						C-95	5,870	8,600		8,600	8,600	717		593	722
						P-110	6,210	9,960		9,960	9,960	830		693	853
7						V-150	6,890	13,580				1,132			
177,8	29,00	.408	6,184	6,059	7,656	N-80	7,020	8,160		8,160	8,160	676		597	746
		10,36	157,07	153,89	194,46	L-80	7,020	8,160		8,160	8,160	676		587	718
						C-95	7,820	9,690		9,690	9,690	803		683	808
						P-110	8,510	11,220		11,220	11,220	929		797	955
						Q-125	9,100	12,750		12,750	12,750	1,056		885	1,045
						V-150	9,800	15,300		15,300	15,300	1,267		1,049	1,243
	32,00	.453	6,094	5,969	7.856	N-80	8,600	9,060		9,060	8,460	745		672	823
		11,51	154,79	151,61	194,46	L-80	8,600	9,060		9,060	8,460	745		661	791
						C-95	9,730	10,760		10,760	10,050	885		768	891
						P-110	10,760	12,460		12,460	11,640	1,025		897	1,053
						Q-125	11,720	14,160		14,160	13,220	1,165		996	1,152
						V-150	13,020	16,980		16,980	15,870	1,397		1,180	1,370
	35,00	.498	6.004	5.879	7.656	N-80	10,180	9,960		9,240	8,460	814		746	876
		12,65	152,50	149,33	194,46	L-80	10,180	9,960		9,240	8,460	814		734	833
						C-95	11,640	11,830		10,970	10,050	966		853	920
						P-110	13,010	13,700		12,700	11,640	1,119		996	1,096
						Q-125	14,310	15,560		14,430	13,220	1,272		1,106	1,183
						V-150	16,230	18,680		17,320	15,870	1,526		1,311	1,402

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DIMENSIONAL DATA & MINIMUM PERFORMANCE PROPERTIES - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
7 177,8	38.00	.540 13,72	5.920 150,37	5.795 147,19	7.656 194,46	N-80	11,390	10,800		9,240	8,460	877		814	876
						L-80	11,390	10,800		9,240	8,460	877		801	832
						C-95	13,420	12,820		10,790	10,050	1,041		931	920
						P-110	15,110	14,850		12,700	11,640	1,205		1,087	1,096
						Q-125	16,750	16,880		14,430	13,220	1,370		1,207	1,183
						V-150	19,240	20,240		17,320	15,870	1,644		1,430	1,402
	41.00	.590 14,99	5.820 147,83	5.695 144,65		P-110	16,990	16,220		12,700	11,640	1,307		1,111	1,096
						Q-125	19,300	18,440		14,430	13,220	1,485		1,244	1,183
						V-150	22,820	22,130		17,320	15,870	1,782		1,488	1,402
	44.00	.640 16,26	5.720 145,29	5.595 142,11		C-95	15,780	15,200				1,215			
						P-110	18,820	17,600				1,407			
						V-150	24,920	24,000				1,918			
	49,50	.730 18,54	5,540 140,72	5,415 137,54		P-110	20,550	20,080				1,582			
						V-150	28,020	27,380				2,157			
7-5/8 193,7	24.00	.300 7,62	7.025 178,44	6.900 175,26	8.500 215,9	H-40	2,040	2,750	2,750			276	212		
	26.40	.328 8,33	6.969 177,01	6.844 173,84	8.500 215,9	J-55	2,890	4,140	4,140	4,140	4,140	414	315	346	483
						K-55	2,890	4,140	4,140	4,140	4,140	414	342	377	581
						N-80	3,400	6,020		6,020	6,020	602		490	659
						L-80	3,400	6,020		6,020	6,020	602		482	635
						C-95	3,710	7,150		7,150	7,150	714		560	716
						P-110	3,930	8,280		8,280	8,280	827		654	845
						V-150	4,080	11,290				1,128			
	29.70	.375 9,53	6.875 174,62	6.750 171,45	8.500 215,9	N-80	4,790	6,890		6,890	6,890	683		575	749
						L-80	4,790	6,890		6,890	6,890	683		566	721
						C-95	5,120	8,180		8,180	8,180	811		659	813
						P-110	5,340	9,470		9,470	9,470	940		769	960
						V-150	6,060	12,910				1,281			
	33,70	.430 10,92	6,765 171,83	6,640 168,66	8,500 215,9	N-80	6,560	7,900		7,900	7,900	778		674	852
						L-80	6,560	7,900		7,900	7,900	778		664	820
						C-95	7,260	9,380		9,380	9,380	923		772	925
						P-110	7,850	10,860		10,860	10,860	1,069		901	1,093
						Q-125	8,350	12,340		12,340	12,340	1,215		1,009	1,197
						V-150	8,860	14,800		14,800	14,800	1,458		1,207	1,424
	39,00	.500 12,70	6,625 168,28	6,500 165,10	8,500 215,9	N-80	8,810	9,180		9,180	9,180	895		798	981
						L-80	8,810	9,180		9,180	9,180	895		786	945
						C-95	9,980	10,900		10,900	10,900	1,063		914	1,065
						P-110	11,060	12,620		12,620	12,620	1,231		1,066	1,258
						Q-125	12,060	14,340		14,340	14,340	1,399		1,194	1,379
						V-150	13,450	17,220		17,220	17,220	1,679		1,428	1,640

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD	Weight per foot w/ Coupling	Wall Thickness	ID	Drift Dia.	Coupling or Joint OD Round or Buttress	Grade	Collapse Resistance	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
(in.)	(lb/ft)	(in.)	(in.)	(in.)	(in.)		(psi)*		Short	Long			Short	Long	
(mm)		(mm)	(mm)	(mm)	(mm)										
	42.80	.562	6.501	6.376	8.500	N-80	10,790	10,320		10,320	9,790	998		905	1,093
		14,27	165,13	161,95	215,9	L-80	10,790	10,320		10,320	9,790	998		891	1,053
						C-95	12,410	12,250		12,250	11,620	1,185		1,037	1,187
						P-110	13,920	14,190		14,190	13,460	1,372		1,210	1,402
7-5⁄8						Q-125	15,350	16,120		16,120	15,290	1,559		1,355	1,536
193,7	45,30	.595	6.435	6,310	8,500	N-80	11,510	10,920		10,490	9,790	1,051		962	1,152
		15,11	163,45	160,27	215,9	L-80	11,510	10,920		10,490	9,790	1,051		947	1,109
						C-95	13,660	12,970		12,460	11,620	1,248		1,101	1,251
						P-110	15,420	15,020		14,430	13,460	1,446		1,285	1,477
						Q-125	17,090	17,070		16,400	15,290	1,643		1,439	1,619
	46,10	.595	6.560	6,500	8,500	L-80	11,340	10,750		10,490	9,790	1,070		841	1,001
7-3⁄4		15,11	166,62	165,10	215,9	C-95	13,320	12,760		12,460	11,620	1,271		978	1,129
196,9						P-110	14,980	14,780		14,430	13,460	1,471		1,142	1,334
						Q-125	16,580	16,790		16,400	15,290	1,672		1,279	1,462
	24,00	.264	8,097	7,972	9,625	J-55	1,370	2,950	2,950			381	244		
		6,71	205,56	202,49	244,48	K-55	1,370	2,950	2,950			381	263		
	28,00	.304	8,017	7,892	9,625	H-40	1,640	2,470	2,470			318	233		
		7,72	203,63	200,46	244,48	K-55	1,880	3,390				437			
	32,00	.652	7,921	7,796	9,625	H-40	2,210	2,860	2,860			366	279		
		8,94	201,19	198,02	244,48	J-55	2,530	3,930	3,930	3,930	3,930	503	372	417	579
						K-55	2,530	3,930	3,930	3,930	3,930	503	402	452	690
						N-80	3,050	5,710				732			
						L-80	3,050	5,710				732			
						P-110	3,430	7,860				1,006			
	36.00	.400	7.825	7.700	9.625	J-55	3,450	4,460	4,460	4,460	4,460	568	434	486	654
		10,16	198,76	195,58	244,46	K-55	3,450	4,460	4,460	4,460	4,460	568	468	526	780
						N-80	4,100	6,490		6,490	6,490	827		688	895
8-5⁄8						L-80	4,100	6,490		6,490	6,490	827		678	864
219,1						C-95	4,360	7,710		7,710	7,710	982		789	
						P-110	4,700	8,930				1,137			
	40.00	.450	7.725	7.600	9.625	K-55	4,400	5,020				636			
		11,43	196,22	193,04	244,46	N-80	5,520	7,300		7,300	7,300	925		788	1,001
						L-80	5,520	7,300		7,300	7,300	925		776	966
						C-95	6,010	8,670		8,670	8,670	1,098		904	1,092
						P-110	6,380	10,040		10,040	10,040	1,271		1,055	1,228
						V-150	7,040	13,700				1,734			
	44,00	.500	7.625	7,500	9,625	K-55	5,350	5,580				702			
		12,70	193,68	190,50	244,46	N-80	6,950	8,120		8,120	8,120	1,021		887	1,105
						L-80	6,950	8,120		8,120	8,120	1,021		874	1,066
						C-95	7,730	9,640		9,640	9,640	1,212		1,017	1,206
						P-110	8,400	11,160		11,160	11,160	1,404		1,186	1,423
						Q-125	8,980	12,680		12,680	12,680	1,595		1,330	1,562

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
	49.00	.557	7.511	7.386	9.625	N-80	8,570	9,040		9,040	9,040	1,129		997	1,222
		14,15	190,78	187,60	244,46	L-80	8,570	9,040		9,040	9,040	1,129		983	1,180
						C-95	9,690	10,740		10,740	10,740	1,341		1,144	1,334
						P-100	10,720	12,430		12,430	12,430	1,553		1,335	1,574
8-5/8						Q-125	11,650	14,130		14,130	14,130	1,765		1,496	1,728
219,1						V-150	12,950	16,940		16,940	16,940	2,118		1,789	2,056
	52.00	.595	7.435	7.310		K-55	7,060	6,640				826			
		15,11	188,85	185,67		C-75	9,210	9,050				1,126			
						N-80	9,650	9,660				1,201			
						P-110	12,260	13,280				1,651			
						V-150	15,160	18,110				2,252			
8-3/4	49.70	.557	7.636	7.500	9.625	S-95	10,260	10,580		10,580	10,580	1,362		1,017	1,232
222,3		14,15	193,95	190,50	244,46	S-105	11,100	10,580		10,580	10,580	1,362		1,095	1,273
	32.30	.312	9.001	8.845	10.625	H-40	1,400	2,270	2,270			365	254		
		7,92	228,63	224,66	269,88										
	36.00	.352	8.921	8.765	10.625	H-40	1,740	2,560	2,560			410	294		
		8,94	226,59	222,63	269,88	J-55	2,020	3,520	3,520	3,520	3,520	564	394	453	639
						K-55	2,020	3,520	3,520	3,520	3,520	564	423	489	755
						C-75	2,320	4,800				769			
						N-80	2,370	5,120				820			
						P-110	2,470	7,040				1,128			
	40.00	.395	8.835	8.679	10.625	J-55	2,570	3,950	3,950	3,950	3,950	630	452	520	714
		10,03	224,40	220,45	269,88	K-55	2,570	3,950	3,950	3,950	3,950	630	486	561	843
						N-80	3,090	5,750		5,750	5,750	916		737	979
						L-80	3,090	5,750		5,750	5,750	916		727	947
9-5/8						C-95	3,330	6,820		6,820	6,820	1,088		847	1,074
244,5						P-110	3,480	7,900				1,260			
	43.50	.435	8.755	8.599	10.625	N-80	3,810	6,330		6,330	6,330	1,005		825	1,074
		11,05	222,38	218,41	269,88	L-80	3,810	6,330		6,330	6,330	1,005		813	1,038
						C-95	4,130	7,510		7,510	7,510	1,193		948	1,178
						P-110	4,430	8,700		8,700	8,700	1,381		1,106	1,388
						Q-125	4,620	9,890		9,890	9,890	1,570		1,240	1,527
						V-150	4,750	11,860				1,818			
	47.00	.472	8.681	8.525	10.625	N-80	4,750	6,870		6,870	6,870	1,086		905	1,161
		11,99	220,49	216,54	269,88	L-80	4,750	6,870		6,870	6,870	1,086		893	1,122
						C-95	5,080	8,150		8,150	8,150	1,289		1,040	1,273
						P-100	5,310	9,440		9,440	9,440	1,493		1,213	1,500
						Q-125	5,640	10,730		10,730	10,730	1,697		1,361	1,650
						V-150	6,020	12,870				2,036			

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
9-5/8 244,5	53.50	.545 13,84	8.535 216,79	8.379 212,83	10.625 269,88	N-80	6,620	7,930		7,930	7,930	1,244		1,062	1,329
						L-80	6,620	7,930		7,930	7,930	1,244		1,047	1,286
						C-95	7,330	9,410		9,410	9,410	1,477		1,220	1,458
						P-110	7,930	10,900		10,900	10,900	1,710		1,442	1,718
						Q-125	8,440	12,390		12,390	12,390	1,943		1,595	1,890
						V-150	8,970	14,860		14,860	14,860	2,332		1,909	2,251
	58.40	.595 15,11	8.435 214,25	8.279 210,29	10.625 269,88	N-80	7,890	8,650		8,650	8,650	1,350		1,167	1,443
						L-80	7,890	8,650				1,350		1,151	1,396
						C-95	8,880	10,280		10,280	10,280	1,604		1,341	1,583
						P-110	9,750	11,900		11,900	11,900	1,857		1,564	1,865
						Q-125	10,530	13,520		13,520	13,520	2,110		1,754	2,052
						V-150	11,570	16,230		16,230	16,230	2,530		2,098	2,519
	61.10	.625 15,88	8.375 212,73	8.219 208,76	10.625 269,88	C-95	9,800	10,800				1,680			
						S-95	10,500	10,800		10,800	10,490	1,679		1,430	
						P-110	10,840	12,500				1,944			
						V-150	13,130	17,050		17,050	17,050	2,650		2,211	2,638
	71,80	.750 19,05	8.125 206,38	7,969 202,41	10,625 269,88	P-110	15,810	15,000				2,300			
						V-150	19,640	20,450		18,060	16,560	3,137		2,672	2,692
9-3/4 247,7	59.20	.595 15,11	8.560 217,42	8.500 215,90	10.625 269,88	S-95	9,750	10,150		10,150	10,150	1,626		1,204	1,469
						S-105	10,470	10,150		10,150	10,150	1,626		1,297	1,524
9-7/8 250,8	62.80	.625 15,88	8.625 219,08	8.500 215,90	10.625 269,88	S-95	10,180	10,520		10,520	10,490	1,725		1,123	1,385
						S-105	11,010	10,520		10,520	10,490	1,725		1,210	1,437
10-3/4 273,1	32.75	.279 7,09	10,192 258,88	10.036 254,91	11.750 298,45	H-40	880	1,820	1,820			367	205		
	40,50	.350 8,89	10,050 255,27	9,894 251,31	11,750 298,45	H-40	1,390	2,280	2,280			457	314		
						J-55	1,580	3,130	3,130		3,130	629	420		700
						K-55	1,580	3,130	3,130		3,130	629	450		819
						N-80	1,720	4,560	4,560		4,560	915	597		964
	45,50	.400 10,16	9.950 252,73	9,794 248,77	11.750 298,45	J-55	2,090	3,580	3,580		3,580	715	493		796
						K-55	2,090	3,580	3,580		3,580	715	528		931
						N-80	2,480	5,210	5,210		5,210	1,041	701		1,097
						P-110	2,610	7,160				1,430			
	51,00	.450 11,43	9,850 250,19	9,694 246,23	11,750 298,45	J-55	2,700	4,030	4,030		4,030	801	565		891
						K-55	2,700	4,030	4,030		4,030	801	606		1,043
						N-80	3,220	5,860	5,860		5,860	1,165	804		1,228
						L-80	3,220	5,860	5,860		5,860	1,165	794		1,190
						C-95	3,490	6,960	6,960		6,960	1,383	927		1,354
						P-110	3,670	8,060	8,060		8,060	1,602	1,080		1,594
						Q-125	3,740	9,160	9,160		9,160	1,820	1,213		1,758

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD	Weight per foot w/ Coupling	Wall Thickness	ID	Drift Dia.	Coupling or Joint OD Round or Buttress	Grade	Collapse Resistance	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
(in.)	(lb/ft)	(in.)	(in.)	(in.)	(in.)		(psi)*								
(mm)		(mm)	(mm)	(mm)	(mm)										
	55.50	.495	9.760	9.604	11.750	N-80	4,020	6,450	6,450		6,450	1,276	895		1,345
		12,57	247,90	243,94	298,45	L-80	4,020	6,450	6,450		6,450	1,276	884		1,303
						C-95	4,300	7,660	7,660		7,660	1,515	1,032		1,483
						P-110	4,630	8,860	8,860		8,860	1,754	1,203		1,745
						Q-125	4,850	10,070	10,070		10,070	1,993	1,351		1,925
						V-150	5,040	12,090				2,392			
	60.70	.545	9.660	9.504	11.750	N-80	5,160	7,100	7,100		7,100	1,398	996		1,473
		13,84	245,36	241,40	298,45	L-80	5,160	7,100	7,100		7,100	1,398	983		1,428
						C-95	5,570	8,430	8,430		8,430	1,660	1,148		1,625
						P-110	5,860	9,760	9,760		9,760	1,922	1,338		1,912
						Q-125	6,070	11,090	11,090		11,090	2,184	1,503		2,109
						V-150	6,560	13,310				2,620			
	65.70	.595	9.560	9.404	11.750	N-80	6,300	7,750	7,750		7,750	1,519	1,096		1,600
10-3/4		15,11	242,82	238,86	298,45	L-80	6,300	7,750	7,750		7,750	1,519	1,082		1,551
273,1						C-95	6,950	9,200	9,200		9,200	1,803	1,263		1,765
						P-110	7,490	10,650	10,650		10,650	2,088	1,472		2,077
						Q-125	7,920	12,110	12,110		12,110	2,373	1,653		2,291
						V-150	8,330	14,530	14,530		14,530	2,847	1,978		2,730
	71.10	.650	9.450	9.294	11.750	S-95	9,600	10,050	9,710		9,480	1,959	1,403		1,971
		16,51	240,03	236,07	298,45	P-110	9,280	11,640	11,240		10,980	2,269	1,618		2,257
						Q-125	9,990	13,230	12,780		12,480	2,578	1,817		2,489
						V-150	10,890	15,870	15,330		14,970	3,094	2,174		2,966
	76.00	.700	9.350	9.194		C-95	9,850	10,830				2,100			
		17,78	237,49	233,53		P-110	10,900	12,530				2,431			
						V-150	13,220	17,090				3,315			
	81,00	.750	9,250	9,094	12,750	P-110	12,530	13,430				2,592			
		19,05	234,95	230,99	323,85	V-150	15,550	18,310				3,534			
	42.00	.333	11.084	10,928	12.750	H-40	1,070	1,980	1,980		1,980	478	307		554
		8,46	281,53	277,57	323,85										
	47.00	.375	11,000	10,844	12,750	J-55	1,510	3,070	3,070		3,070	737	477		807
		9,53	279,40	275,44	323,85	K-55	1,510	3,070	3,070		3,070	737	509		935
	54,00	.435	10,880	10,724	12,750	J-55	2,070	3,560	3,560		3,560	850	568		931
		11,05	276,35	272,39	323,85	K-55	2,070	3,560	3,560		3,560	850	606		1,079
						N-80	2,440	5,180				1,237			
11-3/4	60.00	.489	10.772	10.616	12.750	J-55	2,660	4,010	4,010		4,010	952	649		1,042
298,5		12,42	273,61	269,65	323,85	K-55	2,660	4,010	4,010		4,010	952	693		1,208
						N-80	3,180	5,830	5,830		5,830	1,384	924		1,440
						L-80	3,180	5,830	5,830		5,830	1,384	913		1,399
						C-95	3,440	6,920	6,920		6,920	1,644	1,066		1,596
						P-110	3,610	8,010	8,010		8,010	1,903	1,242		1,877
						Q-125	3,680	9,100	9,100		9,100	2,163	1,396		2,074

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
11-3/4 298,5	65,00	.534 13,56	10,682 271,32	10,526 267,36	12,750 323,85	N-80	3,870	6,360	6,360		6,360	1,505	1,019		1,566
						L-80	3,870	6,360	6,360		6,360	1,505	1,007		1,521
						S-95	5,740	7,560	7,560		7,560	1,788	1,189		1,781
						P-110	4,490	8,750	8,750		8,750	2,070	1,371		2,041
						Q-125	4,690	9,940	9,940		9,940	2,352	1,540		2,256
	71.00	.582 14,78	10.586 268,88	10,430 264,92	12.750 323,85	S-95	7,280	8,230	8,230		8,230	1,940	1,306		1,933
						P-110	5,470	9,530	9,530		9,530	2,246	1,506		2,215
						Q-125	5,760	10,840	10,840		10,840	2,552	1,693		2,448
11-7/8 301,6	71.80	.582 14,78	10.711 272,06	10.625 269,88	12.750 323,85	S-95	7,190	8,150	8,150		8,150	1,962	1,153		1,735
						P-110	5,290	9,430	9,430		9,430	2,271	1,329		1,988
						Q-125	5,630	10,720	10,720		10,720	2,581	1,494		2,198
13-3/8 339,7	48.00	.330 8,38	12.715 322,96	12.559 318,99	14.375 365,13	H-40	770	1,730	1,730		1,730	541	322		607
	54,50	.380 9,65	12.615 320,42	12.459 316,46	14.375 365,13	J-55	1,130	2,730	2,730		2,730	853	514		909
						K-55	1,130	2,730	2,730		2,730	853	547		1,038
						N-80	1,130	3,980				1,241			
	61.00	.430 10,92	12.515 317,88	12.359 313,92	14.375 365,13	J-55	1,540	3,090	3,090		3,090	962	595		1,025
						K-55	1,540	3,090	3,090		3,090	962	633		1,169
						N-80	1,670	4,500				1,400			
	68.00	.480 12,19	12.415 315,34	12.259 311,38	14.375 365,13	J-55	1,950	3,450	3,450		3,450	1,069	675		1,140
						K-55	1,950	3,450	3,450		3,450	1,069	718		1,300
						N-80	2,270	5,020	5,020		5,020	1,556	963		1,585
						L-80	2,270	5,020	5,020		5,020	1,556	952		1,545
						C-95	2,330	5,970	5,970		5,970	1,847	1,114		1,772
						P-110	2,340	6,910	6,910		6,910	2,139	1,297		2,079
	72.00	.514 13,06	12.347 313,61	12.191 309,65	14.375 365,13	N-80	2,670	5,380	5,380		5,380	1,661	1,040		1,693
						L-80	2,670	5,380	5,380		5,380	1,661	1,029		1,650
						C-95	2,820	6,390	6,390		6,390	1,973	1,204		1,893
						P-110	2,880	7,400	7,400		7,400	2,284	1,402		2,221
						Q-125	2,820	8,410	8,410		8,410	2,596	1,577		2,463
						V-150	2,880	10,090	10,090		10,090	3,115	1,887		2,939
	80.70	.580 14,72	12.215 310,25	12.059 306,28	14.375 365,12	S-95	4,990	7,210			7,210	2,215			2,173
						P-110	4,000	8,350			8,350	2,565			2,493
						Q-125	4,140	9,490			9,490	2,914			2,765
	85,00	.608 15,44	12.159 308,84	12.003 304,88	14.375 365,13	N-80	3,870	6,360	6,360		6,360	1,951	1,252		2,364
						P-110	4,490	8,750				2,682			
	86,00	.625 15,88	12.125 307,98	11,969 304,01	14.375 365,13	S-95	6,240	7,770	7,770		7,750	2,378	1,507		2,333
						P-110	4,780	9,000			8,980	2,754			2,677
						Q-125	5,030	10,220			10,200	3,129			2,969
	92.00	.672 17,07	12.031 305,59	11.875 301,63	14.375 365,13	N-80	5,050	7,030				2,145			
						P-110	5,700	9,670	9,190		8,980	2,950	1,878		2,868

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DIMENSIONAL DATA & MINIMUM PERFORMANCE - CASING

OD (in.) (mm)	Weight per foot w/ Coupling (lb/ft)	Wall Thickness (in.) (mm)	ID (in.) (mm)	Drift Dia. (in.) (mm)	Coupling or Joint OD Round or Buttress (in.) (mm)	Grade	Collapse Resistance (psi)*	Internal Yield Pressure (psi)*				Body Yield Strength (1000 lb)*	Joint Strength (1000 lbs) * Threaded & Coupled Joint		
								Plain End or Extreme Line	Round Thread		Buttress Thread		Round Thread		Buttress Thread
									Short	Long			Short	Long	
13-3/8	98.00	.719	11.937	11.781	14.375	N-80	5,910	7,530	6,680		6,530	2,287	1,498		2,400
339,7		18,26	303,19	299,24	365,13	P-110	6,930	10,350				3,145			
13-1/2	81.40	.580	12.340	12.250	14.375	S-95	4,860	7,140	7,140		7,140	2,236	1,225		1,948
342,9		14,73	313,44	311,15	365,13	P-110	3,910	8,270			8,270	2,590			2,235
						Q-125	4,030	9,400			9,400	2,943			2,479
13.625	88.20	.625	12.375	12.250	14.375	S-95	5,930	7,630	7,630		7,630	2,425	1,178		1,885
346,1		15,88	314,33	311,15	365,13	P-110	4,570	8,830			8,830	2,807			2,163
						Q-125	4,800	10,030			10,030	3,191			2,399
	65.00	.375	15.250	15.062	17.000	H-40	670	1,640	1,640		1,640	736	439		781
		9,53	292,74	382,57	431,80										
	75.00	.438	15.124	14.936	17.000	J-55	1,020	2,630	2,630		2,630	1,178	710		1,200
		11,13	384,15	379,37	431,80	K-55	1,020	2,630	2,630		2,630	1,178	752		1,331
	84.00	.495	15.010	14.822	17.000	J-55	1,410	2,980	2,980		2,980	1,326	817		1,351
		12,57	381,25	376,48	431,80	K-55	1,410	2,980	2,980		2,980	1,326	865		1,499
16						N-80	1,480	4,330	4,330		4,330	1,929	1,167		1,898
406,4						P-110	1,480	5,960	5,960		5,960	2,652	1,575		2,518
						Q-125	1,480	6,770	6,770		6,770	3,014	1,773		2,809
	109.00	.656	14.688	14.500	17.000	J-55	2,560	3,950	3,950		3,950	1,739	1,116		1,772
		16,66	373,08	368,30	431,80	K-55	2,560	3,950	3,950		3,950	1,739	1,181		1,965
						L-80	3,080	5,740	5,740		5,740	2,530	1,578		2,441
						P-110	3,470	7,890	7,890		7,890	3,478	2,151		3,302
	87.50	.435	17.755	17.567	19.625	H-40	630	1,630	1,630			994	559		
18-5/8		11,05	450,98	446,20	498,48	J-55	630	2,250	2,250		2,250	1,367	754		1,329
473,1						K-55	630	2,250	2,250		2,250	1,367	794		1,427
						N-80	630	3,270	3,270		3,270	1,990	1,079		1,887
	94.00	.438	19.124	18.936	21.000	H-40	520	1,530	1,530			1,077	581		1,041
		11,13	485,75	480,97	533,40	J-55	520	2,110	2,110	2,110	2,110	1,480	784	907	1,402
						K-55	520	2,110	2,110	2,110	2,110	1,480	824	955	1,479
	106,50	0,500	19,000	18,812	21,000	J-55	770	2,410	2,410	2,410	2,410	1,685	913	1,057	1,595
		12,50	482,60	477,82	533,40	K-55	770	2,410	2,410	2,410	2,410	1,685	960	1,113	1,683
20						N-80	770	3,500	3,500	3,500	3,500	2,450	1,307	1,514	2,281
508,0	133.00	.635	18.730	18.542	21.000	K-55	1,500	3,060	3,060	3,060	3,060	2,125	1,253	1,453	2,123
		16,13	475,74	470,97	533,40	N-80	1,600	4,450	4,450	4,450	4,450	3,091	1,707	1,976	2,877
						L-80	1,600	4,450	4,450	4,450	4,450	3,091	1,692	1,958	2,849
	169.00	.812	18,376	18,188	21,000	K-55	2,500	3,910	3,230	3,430	3,380	2,692	1,402	1,732	2,689
		20,63	466,75	461,98	533,40	N-80	3,020	5,680	4,690	4,990	4,920	3,916	2,221	2,573	3,645
						L-80	3,020	5,680	4,690	4,990	4,920	3,916	2,202	2,549	3,610

* Collapse Resistance, Internal Yield Pressure and Joint Yield Strengths are minimum values with no safety factor, reproduced from API Bulletin 5C2, Bulletin on Performance Properties of Casing and Tubing, and from published literature of manufacturers of premium threads and tubular goods.

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CASING SIZES AND CAPACITIES

OD (in)	Weight (lb/ft)	ID (in)	Barrels per Lin. Ft	Lin. Ft per Barrel	Cu Ft per Lin. Ft	Lin. Ft per Cu Ft	Gallons per Lin. Ft	Lin. Ft per Gallon
4-1/2	9.50	4.090	.01625	61.54	.09124	10.961	.683	1.465
	10.50	4.052	.01595	62.70	.08955	11.167	.670	1.493
	11.60	4.000	.01554	64.34	.08726	11.459	.653	1.532
	12.60	3.958	.01522	65.71	.08544	11.704	.639	1.565
	13.50	3.920	.01493	66.99	.08381	11.932	.627	1.595
	15.10	3.826	.01422	70.32	.07984	12.525	.597	1.674
	16.60	3.754	.01369	73.05	.07686	13.010	.575	1.739
	17.70	3.740	.01359	73.59	.07629	13.108	.571	1.752
	18.80	3.696	.01327	75.36	.07450	13.422	.557	1.794
	21.60	3.640	.01287	77.69	.07226	13.838	.541	1.850
	24.60	3.500	.01190	84.03	.06681	14.967	.500	2.001
	26.50	3.380	.01110	90.11	.06231	16.049	.466	2.145
5	11.50	4.560	.02020	49.51	.11341	8.818	.848	1.179
	13.00	4.494	.01962	50.97	.11015	9.079	.824	1.214
	15.00	4.408	.01887	52.98	.10597	9.436	.793	1.261
	18.00	4.276	.01776	56.30	.09972	10.028	.746	1.341
	20.30	4.184	.01701	58.80	.09548	10.474	.714	1.400
	20.80	4.156	.01678	59.60	.09420	10.615	.705	1.419
	23.20	4.044	.01589	62.95	.08919	11.211	.667	1.499
	24.20	4.000	.01554	64.34	.08726	11.459	.653	1.532
5-1/2	14.00	5.012	.02440	40.98	.13701	7.299	1.025	.976
	15.50	4.950	.02380	42.01	.13364	7.483	1.000	1.000
	17.00	4.892	.02325	43.01	.13052	7.661	.976	1.024
	20.00	4.778	.02218	45.09	.12451	8.031	.931	1.074
	23.00	4.670	.02119	47.20	.11895	8.407	.890	1.124
	26.00	4.548	.02009	49.77	.11281	8.864	.844	1.185
	28.40	4.490	.01958	51.06	.10995	9.095	.823	1.216
	32.30	4.276	.01776	56.30	.09972	10.028	.746	1.341
	36.40	4.090	.01625	61.54	.09124	10.961	.683	1.465
6	18.00	5.424	.02858	34.99	.16046	6.232	1.200	.833
	20.00	5.352	.02782	35.94	.15622	6.401	1.169	.856
	23.00	5.240	.02667	37.49	.14975	6.678	1.120	.893
	26.00	5.132	.02558	39.09	.14364	6.962	1.075	.931
6-5/8	18.00	6.049	.03554	28.13	.19956	5.011	1.493	.670
	24.00	5.921	.03406	29.36	.19121	5.230	1.430	.699
	28.00	5.791	.03258	30.70	.18290	5.467	1.368	.731
	32.00	5.675	.03128	31.96	.17565	5.693	1.314	.761

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CASING SIZES AND CAPACITIES

OD (in)	Weight (lb/ft)	ID (in)	Barrels per Lin. Ft	Lin. Ft per Barrel	Cu Ft per Lin. Ft	Lin. Ft per Cu Ft	Gallons per Lin. Ft	Lin. Ft per Gallon
7	17.00	6.538	.04152	24.08	.23313	4.289	1.744	.573
	20.00	6.456	.04049	24.70	.22732	4.399	1.701	.588
	23.00	6.366	.03937	25.40	.22103	4.524	1.653	.605
	26.00	6.276	.03826	26.13	.21482	4.655	1.607	.622
	29.00	6.184	.03715	26.92	.20857	4.794	1.560	.641
	32.00	6.094	.03607	27.72	.20254	4.937	1.515	.660
	35.00	6.004	.03502	28.56	.19661	5.086	1.471	.680
	38.00	5.920	.03404	29.37	.19114	5.232	1.430	.699
	41.00	5.820	.03290	30.39	.18474	5.413	1.382	.724
	44.00	5.720	.03178	31.46	.17845	5.604	1.335	.749
	49.50	5.540	.02981	33.54	.16739	5.974	1.252	.799
7-5/8	24.00	7.025	.04794	20.86	.26916	3.715	2.014	.497
	26.40	6.969	.04718	21.20	.26488	3.775	1.982	.505
	29.70	6.875	.04591	21.78	.25779	3.879	1.928	.519
	33.70	6.765	.04446	22.49	.24960	4.006	1.867	.536
	39.00	6.625	.04264	23.45	.23938	4.177	1.791	.558
	45.30	6.435	.04022	24.86	.22585	4.428	1.689	.592
8-5/8	24.00	8.097	.06369	15.70	.35757	2.797	2.675	.374
	28.00	8.017	.06243	16.02	.35054	2.853	2.622	.381
	32.00	7.921	.06095	16.41	.34220	2.922	2.560	.391
	36.00	7.825	.05948	16.81	.33395	2.994	2.498	.400
	40.00	7.725	.05797	17.25	.32547	3.072	2.435	.411
	44.00	7.625	.05648	17.71	.31710	3.154	2.372	.422
	49.00	7.511	.05480	18.25	.30769	3.250	2.302	.434
	52.00	7.435	.05370	18.62	.30149	3.317	2.255	.443
9-5/8	32.60	9.001	.07870	12.71	.44187	2.263	3.306	.303
	36.00	8.921	.07731	12.93	.43405	2.304	3.247	.308
	40.00	8.835	.07582	13.19	.42572	2.349	3.185	.314
	43.50	8.755	.07446	13.43	.41805	2.392	3.127	.320
	47.00	8.681	.07320	13.66	.41101	2.433	3.075	.325
	53.50	8.535	.07076	14.13	.39730	2.517	2.972	.336
	58.40	8.435	.06911	14.47	.38805	2.577	2.903	.344
	61.10	8.375	.06813	14.68	.38255	2.614	2.862	.349
	71.80	8.125	.06413	15.59	.36005	2.777	2.693	.371
9-7/8	62.80	8.625	.07226	13.84	.40573	2.465	3.035	.329

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CASING SIZES AND CAPACITIES

OD (in)	Weight (lb/ft)	ID (in)	Barrels per Lin. Ft	Lin. Ft per Barrel	Cu Ft per Lin. Ft	Lin. Ft per Cu Ft	Gallons per Lin. Ft	Lin. Ft per Gallon
10-3/4	32.75	10.192	.10091	9.91	.56654	1.765	4.238	.236
	40.50	10.050	.09811	10.19	.55087	1.815	4.121	.243
	45.50	9.950	.09617	10.40	.53996	1.852	4.039	.248
	51.00	9.850	.09425	10.61	.52916	1.890	3.959	.253
	55.50	9.760	.09253	10.81	.51953	1.925	3.887	.257
	60.70	9.660	.09065	11.03	.50894	1.965	3.807	.263
	65.70	9.560	.08878	11.26	.49846	2.006	3.729	.268
	71.10	9.450	.08675	11.53	.48706	2.053	3.644	.274
	76.00	9.350	.08492	11.78	.47680	2.097	3.567	.280
	81.00	9.250	.08312	12.03	.46666	2.143	3.491	.286
11-3/4	42.00	11.084	.11934	8.38	.67005	1.492	5.012	.200
	47.00	11.000	.11754	8.51	.65993	1.515	4.937	.203
	54.00	10.880	.11499	8.70	.64561	1.549	4.830	.207
	60.00	10.772	.11272	8.87	.63286	1.580	4.734	.211
	35.00	10.682	.11084	9.02	.62233	1.607	4.655	.215
	71.00	10.586	.10886	9.19	.61119	1.636	4.572	.219
13-3/8	48.00	12.715	.15705	6.37	.88175	1.134	6.596	.152
	54.50	12.615	.15459	6.47	.86794	1.152	6.493	.154
	51.00	12.515	.15215	6.57	.85423	1.171	6.390	.156
	68.00	12.415	.14972	6.68	.84064	1.190	6.289	.159
	72.00	12.347	.14809	6.75	.83145	1.203	6.220	.161
	77.00	12.275	.14637	6.83	.82178	1.217	6.148	.163
	80.70	12.215	.14494	6.90	.81377	1.229	6.088	.164
	85.00	12.159	.14361	6.96	.80633	1.240	6.032	.166
	86.00	12.125	.14281	7.00	.80182	1.247	5.998	.167
	92.00	12.031	.14061	7.11	.78944	1.267	5.906	.169
	98.00	11.937	.13842	7.22	.77715	1.287	5.814	.172
13-5/8	88.20	12.375	.14876	6.72	.83523	1.197	6.248	.160
16	65.00	15.250	.22591	4.43	1.26840	0.788	9.489	.105
	75.00	15.124	.22219	4.50	1.24752	0.802	9.332	.107
	84.00	15.010	.21886	4.57	1.22879	0.814	9.192	.109
	109.00	14.688	.20957	4.77	1.17663	0.850	8.802	.114
18-5/8	87.50	17.755	.30622	3.27	1.71932	0.582	12.862	.078
20	94.00	19.124	.35527	2.81	1.99468	0.501	14.922	.067
	106.50	19.000	.35068	2.85	1.96889	0.508	14.729	.068
	133.00	18.730	.34078	2.93	1.91333	0.523	14.313	.070
	169.00	18.376	.32802	3.05	1.84169	0.543	13.777	.073

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SHORT THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
4-1/2	9.50	H-40	580	770	960
		J-55	760	1,010	1,260
		K-55	840	1,120	1,400
	10.50	J-55	990	1,320	1,650
		K-55	1,100	1,460	1,830
	11.60	J-55	1,160	1,540	1,930
		K-55	1,280	1,700	2,130
5	11.50	J-55	1,000	1,330	1,660
		K-55	1,100	1,470	1,840
	13.00	J-55	1,270	1,690	2,110
		K-55	1,400	1,860	2,330
	15.00	J-55	1,550	2,070	2,590
		K-55	1,710	2,280	2,850
5-1/2	14.00	H-40	980	1,300	1,630
		J-55	1,290	1,720	2,150
		K-55	1,420	1,890	2,360
	15.50	J-55	1,520	2,020	2,530
		K-55	1,670	2,220	2,780
	17.00	J-55	1,720	2,290	2,860
		K-55	1,890	2,520	3,150
6-5/8	20.00	H-40	1,380	1,840	2,300
		J-55	1,840	2,450	3,060
		K-55	2,000	2,670	3,340
	24.00	J-55	2,360	3,140	3,930
		K-55	2,570	3,420	4,230
7	17.00	H-40	920	1,220	1,530
	20.00	H-40	1,320	1,760	2,200
		J-55	1,760	2,340	2,930
		K-55	1,910	2,540	3,180
	23.00	J-55	2,130	2,840	3,550
		K-55	2,320	3,090	3,860
	26.00	J-55	2,510	3,340	4,180
		K-55	2,730	3,640	4,550
7-5/8	24.00	H-40	1,590	2,120	2,650
	26.40	J-55	2,360	3,150	3,940
		K-55	2,570	3,420	4,280

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SHORT THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
8-5/8	24.00	J-55	1,830	2,440	3,050
		K-55	1,970	2,630	3,290
	28.00	H-40	1,750	2,330	2,910
	32.00	H-40	2,090	2,790	3,490
		J-55	2,790	3,720	4,650
		K-55	3,020	4,020	5,030
	36.00	J-55	3,260	4,340	5,430
		K-55	3,510	4,680	5,850
9-5/8	32.30	H-40	1,910	2,540	3,180
	36.00	H-40	2,210	2,940	3,680
		J-55	2,960	3,940	4,930
		K-55	3,170	4,230	5,290
	40.00	J-55	3,390	4,520	5,650
		K-55	3,650	4,860	6,080
10-3/4	32.75	H-40	1,540	2,050	2,560
	40.50	H-40	2,360	3,140	3,930
		J-55	3,150	4,200	5,250
		K-55	3,380	4,500	5,630
	45.50	J-55	3,700	4,930	6,160
		K-55	3,960	5,280	6,600
	51.00	J-55	4,240	5,650	7,060
		K-55	4,550	6,060	7,580
		C-75	5,670	7,560	9,450
		N-80	6,030	8,040	10,050
		C-95	6,950	9,270	11,590
		P-110	8,100	10,800	13,500
	55.50	C-75	6,320	8,430	10,540
		N-80	6,710	8,950	11,190
		C-95	7,740	10,320	12,900
		P-110	9,020	12,030	15,040
	60.70	P-110	10,040	13,380	16,730
	65.70	P-110	11,040	14,720	18,400

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SHORT THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
11-3/4	42.00	H-40	2,300	3,070	3,840
	47.00	J-55	3,580	4,770	5,960
		K-55	3,850	5,090	6,360
	54.00	J-55	4,260	5,680	7,100
		K-55	4,550	6,060	7,580
	60.00	J-55	4,870	6,490	8,110
		K-55	5,200	6,930	8,660
		C-75	6,520	8,690	10,860
		N-80	6,930	9,240	11,550
		C-95	8,000	10,660	13,330
13-3/8	48.00	H-40	2,420	3,220	4,030
	54.50	J-55	3,860	5,140	6,430
		K-55	4,100	5,470	6,840
	61.00	J-55	4,460	5,950	7,440
		K-55	4,750	6,330	7,910
	68.00	J-55	5,060	6,750	8,440
		K-55	5,390	7,180	8,980
	72.00	C-75	7,340	9,780	12,230
		N-80	7,800	10,400	13,000
		C-95	9,030	12,040	15,050
16	65.00	H-40	3,290	4,390	5,490
	75.00	J-55	5,330	7,100	8,880
		K-55	5,640	7,520	9,400
	84.00	J-55	6,130	8,170	10,210
		K-55	6,490	8,650	10,810
18-5/8	87.50	H-40	4,190	5,590	6,990
		J-55	5,660	7,540	9,430
		K-55	5,960	7,940	9,930
20	94.00	H-40	4,360	5,810	7,260
		J-55	5,880	7,840	9,800
		K-55	6,180	8,240	10,300
	106.50	J-55	6,850	9,130	11,410
		K-55	7,200	9,600	12,000
	133.00	J-55	8,940	11,920	14,900
		K-55	9,400	12,530	15,660

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LONG THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
4-1/2	11.60	J-55	1,220	1,620	2,030
		K-55	1,350	1,800	2,250
		C-75	1,610	2,150	2,690
		N-80	1,710	2,280	2,850
		C-95	1,940	2,580	3,230
		P-110	2,270	3,020	3,780
	13.50	C-75	1,950	2,600	3,250
		N-80	2,070	2,760	3,450
		C-95	2,350	3,130	3,910
		P-110	2,750	3,660	4,580
	15.10	P-110	3,300	4,400	5,500
5	13.00	J-55	1,370	1,820	2,280
		K-55	1,510	2,010	2,510
	15.00	J-55	1,670	2,230	2,790
		K-55	1,850	2,460	3,080
		C-75	2,220	2,960	3,700
		N-80	2,360	3,140	3,930
		C-95	2,670	3,560	4,450
		P-110	3,130	4,170	5,210
	18.00	C-75	2,830	3,770	4,710
		N-80	3,000	4,000	5,000
		C-95	3,410	4,550	5,690
		P-110	3,980	5,310	6,640
5-1/2	15.50	J-55	1,630	2,170	2,710
		K-55	1,790	2,390	2,990
	17.00	J-55	1,850	2,470	3,090
		K-55	2,040	2,720	3,400
		C-75	2,450	3,270	4,090
		N-80	2,610	3,480	4,350
		C-95	2,970	3,960	4,950
		P-110	3,470	4,620	5,780
	20.00	C-75	3,020	4,030	5,040
		N-80	3,210	4,280	5,350
		C-95	3,650	4,870	6,090
		P-110	4,270	5,690	7,110
	23.00	C-75	3,550	4,730	5,910
		N-80	3,770	5,020	6,280
		C-95	4,290	5,720	7,150
		P-110	5,010	6,680	8,350

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LONG THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
6-5/8	20.00	J-55	2,000	2,660	3,330
		K-55	2,180	2,900	3,630
	24.00	J-55	2,550	3,400	4,250
		K-55	2,790	3,720	4,650
		C-75	3,400	4,530	5,660
		N-80	3,610	4,810	6,010
		C-95	4,120	5,490	6,860
		P-110	4,810	6,410	8,010
	28.00	C-75	4,140	5,520	6,900
		N-80	4,400	5,860	7,330
		C-95	5,020	6,690	8,360
		P-110	5,860	7,810	9,760
	32.00	C-75	4,790	6,380	7,980
		N-80	5,080	6,770	8,460
		C-95	5,810	7,740	9,680
		P-110	6,780	9,040	11,300
7	23.00	J-55	2,350	3,130	3,910
		K-55	2,560	3,410	4,260
		C-75	3,120	4,160	5,200
		N-80	3,320	4,420	5,530
		C-95	3,790	5,050	6,310
	26.00	J-55	2,750	3,670	4,590
		K-55	3,010	4,010	5,010
		C-75	3,670	4,890	6,110
		N-80	3,890	5,190	6,490
		C-95	4,450	5,930	7,410
		P-110	5,200	6,930	8,660
	29.00	C-75	4,220	5,620	7,030
		N-80	4,480	5,970	7,460
		C-95	5,120	6,830	8,540
		P-110	5,980	7,970	9,960
	32.00	C-75	4,750	6,330	7,910
		N-80	5,040	6,720	8,400
		C-95	5,760	7,680	9,600
		P-110	6,730	8,970	11,210

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LONG THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
7	35.00	C-75	5,270	7,030	8,790
		N-80	5,600	7,460	9,330
		C-95	6,400	8,530	10,660
		P-110	7,470	9,960	12,450
	38.00	C-75	5,270	7,670	9,590
		N-80	6,110	8,140	10,180
		C-95	6,980	9,310	11,640
		P-110	8,150	10,870	13,590
7 5/8	26.40	J-55	2,600	3,460	4,330
		K-55	2,830	3,770	4,710
		C-75	3,460	4,610	5,760
		N-80	3,680	4,900	6,130
		C-95	4,200	5,600	7,000
	29.70	C-75	4,070	5,420	6,780
		N-80	4,310	5,750	7,190
		C-95	4,940	6,590	8,240
		P-110	5,770	7,690	9,610
	33.70	C-75	4,760	6,350	7,940
		N-80	5,060	6,740	8,430
		C-95	5,790	7,720	9,650
		P-110	6,760	9,010	11,260
	39.00	C-75	5,630	7,510	9,390
		N-80	5,980	7,980	9,980
		C-95	6,860	9,140	11,430
		P-110	8,000	10,660	13,330
8-5/8	32.00	J-55	3,130	4,170	5,210
		K-55	3,390	4,520	5,650
	36.00	J-55	3,650	4,860	6,080
		K-55	3,950	5,260	6,580
		C-75	4,860	6,480	8,100
		N-80	5,160	6,880	8,600
		C-95	5,920	7,890	9,860
	40.00	C-75	5,570	7,420	9,280
		N-80	5,910	7,880	9,850
		C-95	6,780	9,040	11,300
		P-110	7,910	10,550	13,190

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LONG THREAD CASING RECOMMENDED MAKE-UP TORQUE

OD (in.)	Casing Weight (lb/ft)	Grade	Torque (ft-lb)		
			Minimum	Optimum	Maximum
8-5/8	44.00	C-75	6,260	8,340	10,430
		N-80	6,650	8,870	11,090
		C-95	7,630	10,170	12,710
		P-110	8,900	11,860	14,830
	49.00	C-75	7,040	9,390	11,740
		N-80	7,480	9,970	12,460
		C-95	8,580	11,440	14,300
		P-110	10,010	13,350	16,690
9-5/8	36.00	J-55	3,400	4,530	5,660
		K-55	3,670	4,890	6,110
	40.00	J-55	3,900	5,200	6,500
		K-55	4,210	5,610	7,010
		C-75	5,210	6,940	8,680
		N-80	5,530	7,370	9,210
		C-95	6,350	8,470	10,590
	43.50	C-75	5,820	7,760	9,700
		N-80	6,190	8,250	10,310
		C-95	7,110	9,480	11,850
		P-110	8,300	11,060	13,830
	47.00	C-75	6,390	8,520	10,650
		N-80	6,790	9,050	11,310
		C-95	7,800	10,400	13,000
		P-110	9,100	12,130	15,160
	53.50	C-75	7,490	9,990	12,490
		N-80	7,970	10,620	13,280
		C-95	9,150	12,200	15,250
		P-110	10,670	14,220	17,780
20	94.00	J-55	6,800	9,070	11,340
		K-55	7,160	9,550	11,940
	106.50	J-55	7,930	10,570	13,110
		K-55	8,350	11,130	13,410
	133.00	J-55	10,350	13,800	17,250
		K-55	10,900	14,530	18,160

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DIMENSIONAL DATA AND PERFORMANCE PROPERTIES OF API INTERNAL UPSET DRILL PIPE

Nominal O.D. (in)	Weight per Foot with Coupling (lb/ft)	Nominal I.D. (in)	Nominal Wall (in)	Collapse Pressure				Internal Yield/Burst Pressure				Tensile Strength			
				Premium Class Pipe Grade				Premium Class Pipe Grade				Premium Class Pipe Grade			
				E	X	G	S	E	X	G	S	E	X	G	S
2-3/8	4.85 6.65	1.995 1.815	.190 .280	8522 13378	10161 16945	10912 18729	12891 24080	9600 14147	12160 17920	13440 19806	17280 25465	76893 107616	97398 136313	107650 150662	138407 193709
2-7/8	6.85 10.40	2.441 2.151	.217 .362	7640 14223	9017 18016	9633 19912	11186 25602	9057 15110	11473 19139	12680 21153	16303 27197	106946 166535	135465 210945	149725 233149	192503 299764
3-1/2	9.50 13.30 15.50	2.992 2.764 2.602	.254 .368 .449	7074 12015 14472	8284 15218 18331	8813 16820 20260	10093 21626 26049	8709 12617 15394	11031 15982 19499	12192 17664 21552	15675 22711 27710	152979 212150 250620	193774 268723 317452	214171 297010 350868	275363 381870 451115
4	11.85 14.00 15.70	3.476 3.340 3.240	.262 .330 .380	5704 9012 10914	6508 10795 13825	6827 11622 15190	7445 13836 18593	7860 9900 11400	9956 12540 14440	11004 13860 15960	14148 17820 20520	182016 224182 253851	230554 283963 321544	254823 313854 355391	327630 403527 456931
4-1/2	13.75 16.60 20.00 22.82	3.958 3.826 3.640 3.500	.271 .337 .430 .500	4686 7525 10975 12655	5190 8868 13901 16030	5352 9467 15350 17718	5908 10964 18806 22780	7227 8987 11467 13333	9154 11383 14524 16889	10117 12581 16053 18667	13008 16176 20640 24000	213258 260165 322916 367566	270127 329542 409026 465584	298561 364231 452082 514593	383864 468297 581248 661620
5	16.25 19.50 25.60	4.408 4.276 4.000	.296 .362 .500	4490 7041 11458	4935 8241 14514	5067 8765 16042	5661 10029 20510	7104 8688 12000	8998 11005 15200	9946 12163 16800	12787 15638 21600	259155 311535 414690	328263 394612 525274	362817 436150 580566	466479 560764 746443
5-1/2	19.20 21.90 24.70	4.892 4.778 4.670	.304 .361 .415	3736 5730 7635	4130 6542 9011	4336 6865 9626	4714 7496 11177	6633 7876 9055	8401 9977 11469	9286 11027 12676	11939 14177 16298	294260 244780 391285	372730 436721 495627	411965 482692 547799	529669 620604 704313
6-5/8	25.20 27.70	5.965 5.901	.330 .362	2931 3535	3252 4048	3353 4235	3429 4611	5977 6557	7571 8305	8368 9179	10759 11802	387466 422418	490790 535063	542452 591385	697438 760352

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TOOL JOINT - INTERCHANGEABILITY CHARTS

Size (in)	Joint OD (in)	Joint ID (in)	Interchangeable With
API Regular			
2-3/8	3.125	1.000	-----
2-7/8	3.750	1.250	-----
3-1/2	4.250	1.500	-----
4-1/2	5.500	2.250	-----
5-1/2	6.750	2.750	5" Union Tool Regular
6-5/8	7.750	3.500	5" Union Tool F.H. 6" Union Tool Regular
7-5/8	8.875	4.000	-----
8-5/8	10.000	4.750	-----
Union Tool Regular			
3	4.250	1.500	-----
4	5.750	2.250	-----
5	6.750	2.750	5-1/2" API Regular
6	7.750	3.500	6-5/8" API Regular
API Full Hole			
2-7/8	4.250	2.125	-----
3-1/2	4.625	2.438	-----
4	5.250	2.813	4-1/2" Reed Double Streamline
4-1/2	5.750	3.000	-----
5-1/2	7.000	4.000	-----
6-5/8	8.000	5.000	-----
Union Tool Full Hole			
4-1/2	6.000	3.000	-----
5-1/2	7.250	3.500	6-5/8" API Regular
6-5/8	8.375	4.938	-----
API Internal Flush, Hughes and Reed I.F.			
2-3/8	3.375	1.750	2-7/8" Slim Hole
2-7/8	4.125	2.125	3-1/2" Slim Hole
3-1/2	4.750	2.688	3-1/2" Reed Wide Open 4-1/2" Slim Hole
4	5.750	3.250	4" Reed Wide Open 4-1/2" Hughes Xtra Hole 4 1/2" Reed Xtra Hole 5" Reed Double Streamline
4-1/2	6.125	3.750	4-1/2" Reed Wide Open 5" Hughes Xtra Hole 5-1/2" Reed Double Streamline
5-1/2	7.375	4.813	-----

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TOOL JOINT - INTERCHANGEABILITY CHARTS

Size (in)	Joint OD (in)	Joint ID (in)	Interchangeable With
Hughes Acme Regular			
2-3/8	3.125	1.000	-----
2-7/8	3.750	1.250	-----
3-1/2	4.250	1.875	-----
4-1/2	5.500	2.500	-----
5-1/2	6.750	3.000	-----
6-5/8	7.750	3.500	-----
Hughes Acme Streamline, Reed Acme Full Hole			
2-3/8	3.375	1.438	-----
2-7/8	4.000	1.563	-----
3-1/2	4.625	2.438	-----
4-1/2	5.750	3.000	-----
5-1/2	7.000	4.000	-----
Hughes Xtra Hole			
2-7/8	4.250	1.875	2-7/8" Reed Xtra Hole 3-1/2" Reed Double Streamline 3-1/2" Hughes Double Streamline
3-1/2	4.750	2.438	3-1/2" Reed Xtra Hole 4" Hughes Slim Hole 4-1/2" Hughes External Flush 4-1/2" F.H. Reed External Flush
4-1/2	6.000	3.250	4" API I.F. 4-1/2" Reed Xtra Hole 5-1/2" Reed Double Streamline
5	6.250	3.750	4-1/2" API I.F. 5" Reed Xtra Hole 5-1/2" Reed Double Streamline
Hughes External Flush			
2-3/8	2.500	1.000	2-3/8" Homco External Flush
2-7/8	3.000	1.063	-----
3-1/2	3.625	1.500	3-1/2" F.H. Reed External Flush
4-1/2	4.688	2.188	3-1/2" Reed Xtra Hole 3-1/2" Hughes Xtra Hole 4" Hughes Slim Hole 4-1/2" F.H. Reed External Flush
Hughes Slim Hole, Reed Slim Hole			
2-3/8	2.875	1.250	-----
2-7/8	3.375	1.750	2-3/8" API I.F.
3-1/2	4.000	2.125	2-7/8" API I.F.
4	4.500	2.563	3-1/2" Hughes Xtra Hole 3-1/2" Reed Xtra Hole 4-1/2" Reed External Flush 4-1/2" F.H. Reed External Flush
4-1/2	5.000	2.688	3-1/2" API I.F.

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TOOL JOINT - INTERCHANGEABILITY CHARTS

Size (in)	Joint OD (in)	Joint ID (in)	Interchangeable With
Hughes Double Streamline			
3-1/2	3.875	1.813	2-7/8" Hughes Xtra Hole 3-1/2" Reed Double Streamline
4 4-1/2	4.500 5.000	2.375 2.688	4" Reed Double Streamline 4-1/2" Reed Double Streamline
Reed External Flush			
2-3/8 Reg 2-3/8 FH 2-7/8 FH 3-1/2 FH	2.375 2.500 3.000 3.625	.875 1.000 1.250 1.500	----- ----- ----- 3-1/2" Hughes External Flush
4-1/2 FH	4.688	2.188	3-1/2" Hughes Xtra Hole 3-1/2" Reed Xtra Hole 4" Hughes Slim Hole 4-1/2" Hughes External Flush
Reed Double Streamline			
2-7/8	3.250	1.250	-----
3-1/2	3.875	1.813	2-7/8" Hughes Xtra Hole 2-7/8" Reed Xtra Hole 3-1/2" Hughes Double Streamline
4 4-1/2	4.500 5.000	2.375 2.688	4" Hughes Double Streamline 4-1/2" Hughes Double Streamline
5	5.563	3.375	4" API I.F. 4-1/2" Hughes Xtra Hole
5	5.563	3.375	4-1/2" Reed Xtra Hole
5-1/2	6.125	3.750	4-1/2" API I.F. 5" Hughes Xtra Hole 5" Reed Xtra Hole
Reed Full Hole			
2-3/8 2-7/8	3.375 4.000	1.438 1.875	----- -----
Reed Xtra Hole (Semi-Internal Flush)			
2-7/8	4.250	1.875	3-1/2" Reed Double Streamline
3-1/2	4.750	2.438	3-1/2" Hughes Xtra Hole 3-1/2" Hughes Xtra Hole Hughes Slim Hole 4-1/2" Hughes External Flush 4-1/2" F.H. Reed External Flush
4-1/2	6.000	3.250	4-1/2" F.H. Reed External Flush API I.F. 4-1/2" Hughes Xtra Hole 5" Reed Double Streamline
5	6.375	3.750	4-1/2" API I.F. 5" Hughes Xtra Hole 5-1/2" Reed Double Streamline

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TOOL JOINT - INTERCHANGEABILITY CHARTS

Size (in)	Joint OD (in)	Joint ID (in)	Interchangeable With
Reed Open Hole, Reed Full Opening			
2-3/8	3.125	2.000	2-3/8" American Open Hole
2-7/8	3.750	2.438	2-7/8" American Open Hole
3-1/2	3.625	3.000	3-1/2" American Open Hole
4	5.250	3.469	4" American Open Hole
4-1/2	5.750	3.969	-----
Reed Wide Open (W.O.)			
2-3/8	3.375	2.000	-----
2-7/8	4.125	2.438	-----
3-1/2	4.750	3.000	3-1/2" API I.F. 4-1/2" Slim Hole
4	5.750	3.438	4" API I.F. 4-1/2" Reed Xtra Hole 4-1/2" Hughes Xtra Hole 5" Reed Double Streamline
4-1/2	6.125	3.875	4-1/2" API I.F. 5" Reed Xtra Hole 5" Hughes Xtra Hole 5-1/2" Reed Double Streamline
American P.A.C.			
2-3/8	2.875	1.375	-----
2-7/8	3.125	1.500	-----
3-1/2	3.750	2.000	-----
American Open Hole			
2-3/8	3.250	1.813	2-3/8" Reed Open Hole (F.O.)
2-7/8	3.875	2.151	2-7/8" Reed Open Hole (F.O.)
3-1/2	4.750	2.688	3-1/2" Reed Open Hole (F.O.)
4	5.500	3.250	4" Reed Open Hole (F.O.)

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DRILL PIPE SIZES AND CAPACITIES

OD (in)	Weight (lb/ft)	ID (in)	Barrels per Lin. Ft	Lin. Ft per Barrel	Cu Ft per Lin. Ft	Lin. Ft per Cu Ft	Gallons per Lin. Ft	Lin. Ft per Gallon
2-3/8	4.80	2.000	.00389	257.35	.02182	45.838	.163	6.128
	6.65	1.185	.00136	733.07	.00766	130.570	.057	17.454
2-7/8	6.45	2.469	.00592	168.87	.03325	30.077	.249	4.021
	8.35	2.323	.00524	190.76	.02943	33.977	.220	4.542
	10.40	2.151	.00449	222.49	.02523	39.628	.189	5.297
3-1/2	8.50	3.063	.00911	109.72	.05117	19.543	.383	2.612
	11.20	2.900	.00817	122.40	.04587	21.801	.343	2.914
	13.30	2.764	.00742	134.74	.04167	24.000	.312	3.208
	15.50	2.602	.00658	152.04	.03693	27.081	.276	3.620
4	14.00	3.340	.01084	92.28	.06084	16.436	.455	2.197
	15.70	3.240	.01020	98.06	.05725	17.466	.428	2.335
4-1/2	12.75	4.000	.01554	64.34	.08726	11.459	.653	1.532
	13.75	3.958	.01522	65.71	.08544	11.704	.639	1.565
	16.60	3.826	.01422	70.32	.07984	12.525	.597	1.674
	20.00	3.640	.01287	77.69	.07226	13.838	.541	1.850
5	19.50	4.276	.01776	56.30	.09972	10.028	.746	1.341
5-1/2	21.90	4.778	.02218	45.09	.12451	8.031	.931	1.074
	24.70	4.670	.02119	47.20	.11895	8.407	.890	1.124
5-9/16	19.00	4.975	.02404	41.59	.13499	7.408	1.010	.990
	22.20	4.859	.02293	43.60	.12877	7.766	.963	1.038
	25.25	4.733	.02176	45.95	.12218	8.185	.914	1.094
6-5/8	22.20	6.065	.03573	27.98	.20062	4.984	1.501	.666
	25.20	5.965	.03456	28.93	.19406	5.153	1.452	.689
	31.90	5.761	.03224	31.02	.18101	5.524	1.354	.738

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DRILL PIPE STRETCH TABLE

OD (in)	Tubing Weight (lb/ft)	ID (in)	Stretch Constant (in./1000 lb /1000 ft)	Free Point Constant
2-3/8	4.85	1.995	.30675	3260.0
	6.65	1.815	.21704	4607.5
2-7/8	6.85	2.441	.22075	4530.0
	10.40	2.151	.13996	7145.0
3-1/2	9.50	2.992	.15444	6475.0
	13.30	2.764	.11047	9052.5
	15.50	2.602	.09294	10,760.0
4	11.85	3.476	.13000	7692.5
	14.00	3.340	.10512	9512.5
4-1/2	13.75	3.958	.11111	9000.0
	16.60	3.826	.09076	11,017.5
	18.10	3.754	.08271	12,090.0
	20.00	3.640	.07275	13,745.0
5	16.25	4.408	.09145	10,935.0
	19.50	4.276	.07583	13,187.5
5-1/2	21.90	4.778	.06863	14,570.0
	24.70	4.670	.06033	16,575.0
6-5/8	25.20	5.965	.06129	16,315.0

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TUBING, DRILL PIPE & CASING STRETCH DATA

$$\Delta L = \frac{F \times L \times 12}{E \times A_s}$$

General Stretch Formula

Where:

ΔL = Stretch (in)

F = Pull/Tension force (lb)

L = Length of the string (ft)

A_s = Cross-sectional area of the tubular (in^2)

E = Modulus of elasticity, 30 x 10^6 psi for carbon steels

Stretch

$$\Delta L = F \times L \times SC$$

Where:

ΔL = Stretch (in)

F = Pull/Tension force, in thousands of pounds (for example: for 50,000 lb, F = 50)

L = Length of the string (ft)

SC = Stretch Constant (in. of stretch/thousands of pounds/thousand feet of length)

$$SC = \frac{0.4}{A_s}$$

Calculating Stretch Constants

Where:

SC = Stretch Constant (in/1000 lb/1000 ft)

A_s = Cross-sectional area of the tubular (in^2)

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Determining Free Point

$$L = \frac{\Delta L \times F\,PC}{F}$$

Where:

L	=	* Minimum length of the free pipe, or length being stretched (ft)
ΔL	=	Stretch (in)
F	=	Pull/Tension force (1000 lb)
FPC	=	Charted Free Point Constant

** Since there will be friction forces present, which cannot be easily determined, the length of free pipe may be longer than calculated. This formula, therefore, assumes that there are no friction forces.*

Calculating Free Point Constants

$$FPC = 2500 \times A_s$$

Where:

FPC	=	Charted Free Point Constant
A_s	=	Cross-sectional area of the tubular (in^2)

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TUBING STRETCH TABLE

OD (in)	Tubing Weight (lb/ft)	ID (in)	Stretch Constant (in./1000 lb /1000 ft)	Free Point Constant
1.050	1.14	.824	1.20120	832.5
	1.20	.824	1.20120	832.5
1.315	1.30	1.125	1.09890	910.0
	1.43	1.097	.96852	1,032.5
	1.63	1.065	.85653	1,167.5
	1.70	1.049	.80972	1,235.0
	1.72	1.049	.80972	1,235.0
	1.80	1.049	.80972	1,235.0
1.660	2.10	1.410	.66335	1,507.5
	2.30	1.380	.59791	1,672.5
	2.33	1.380	.59791	1,672.5
	2.40	1.380	.59791	1,672.5
1.900	2.40	1.650	.57389	1,742.5
	2.60	1.610	.50063	1,997.5
	2.72	1.610	.50063	1,997.5
	2.75	1.610	.50063	1,997.5
	2.76	1.610	.50063	1,997.5
	2.90	1.610	.50063	1,997.5
2-1/16	2.66	1.813	.52562	1,902.5
	3.25	1.751	.42781	2,337.5
	3.30	1.751	.42781	2,337.5
	3.40	1.751	.42781	2,337.5
2-3/8	3.10	2.125	.45249	2,210.0
	3.32	2.107	.42418	2,357.5
	4.00	2.041	.34542	2,895.0
	4.60	1.995	.30675	3,260.0
	4.70	1.995	.30675	3,260.0
	5.30	1.939	.27082	3,692.5
	5.80	1.867	.23641	4,230.0
	5.95	1.867	.23641	4,230.0
	6.20	1.853	.23081	4,332.5
	7.70	1.703	.18587	5,380.0
	4.36	2.579	.31546	3,170.0
	4.64	2.563	.30008	3,332.5
2-7/8	6.40	2.441	.22075	4,530.0
	6.50	2.441	.22075	4,530.0
	7.90	2.323	.17746	5,635.0
	8.60	2.259	.16103	6,210.0
	8.70	2.259	.16103	6,210.0
	8.90	2.243	.15748	6,350.0
	9.50	2.195	.14771	6,770.0
	10.40	2.151	.13996	7,145.0
	11.00	2.065	.12727	7,857.5
	11.65	1.995	.11884	8,415.0

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TUBING STRETCH TABLE

OD (in)	Tubing Weight (lb/ft)	ID (in)	Stretch Constant (in./1000 lb /1000 ft)	Free Point Constant
3-1/2	5.63	3.188	.24405	4097.5
	5.75	3.188	.24405	4097.5
	7.70	3.068	.17953	5570.0
	9.20	2.992	.15444	6475.0
	9.30	2.992	.15444	6475.0
	10.20	2.922	.13722	7287.5
	10.30	2.922	.13722	7287.5
	12.80	2.764	.11047	9052.5
	12.95	2.750	.10864	9205.0
	13.70	2.673	.09975	10025.0
	14.70	2.601	.09289	10770.0
	15.10	2.602	.09294	10760.0
	15.80	2.524	.08662	11545.0
	17.05	2.440	.08089	12362.5
4	9.40	3.548	.14925	6700.0
	9.50	3.548	.14925	6700.0
	10.80	3.476	.13000	7692.5
	10.90	3.476	.13000	7692.5
	11.00	3.476	.13000	7692.5
	11.60	3.428	.11987	8342.5
	13.40	3.340	.10512	9512.5
4-1/2	12.60	3.928	.11111	9000.0
	12.75	3.928	.11111	9000.0
	15.10	3.826	.09076	11017.5
	15.50	3.826	.09076	11017.5
	16.90	3.754	.08271	12090.0
	19.00	3.640	.07275	13745.0

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CASING STRETCH TABLE

OD (in)	Tubing Weight (lb/ft)	ID (in)	Stretch Constant (in./1000 lb /1000 ft)	Free Point Constant
4-1/2	9.50	4.090	.14461	6,915.0
	10.50	4.052	.13293	7,522.5
	11.60	4.000	.11983	8,345.0
	13.50	3.920	.10428	9,590.0
	15.10	3.826	.09076	11,017.5
	16.90	3.740	.08133	12,295.0
5	11.50	4.560	.12107	8,260.0
	13.00	4.494	.10602	9,432.5
	15.00	4.408	.09145	10,935.0
	18.00	4.276	.07583	13,187.5
	20.80	4.156	.06591	15,172.5
5-1/2	14.00	5.012	.09928	10,072.5
	15.50	4.950	.08861	11,285.0
	17.00	4.892	.08061	12,405.0
	20.00	4.778	.06863	14,570.0
	23.00	4.670	.06033	16,575.0
6-5/8	20.00	6.049	.06976	14,335.0
	24.00	5.921	.05766	17,342.5
	28.00	5.791	.04918	20,332.5
	32.00	5.675	.04359	22,942.5
7	17.00	6.538	.08143	12,280.0
	20.00	6.456	.06958	14,372.5
	23.00	6.366	.06010	16,640.0
	26.00	6.276	.05299	18,872.5
	29.00	6.184	.04734	21,122.5
	32.00	6.094	.04293	23,292.5
	35.00	6.004	.03932	25,430.0
	38.00	5.920	.03650	27,397.5
7-5/8	24.00	7.025	.05794	17,260.0
	26.40	6.969	.05320	18,797.5
	29.70	6.875	.04683	21,352.5
	33.70	6.765	.04115	24,300.0
	39.00	6.625	.03574	27,980.0
8-5/8	24.00	8.097	.05769	17,335.0
	28.00	8.017	.05033	19,867.5
	32.00	7.921	.04372	22,872.5
	36.00	7.825	.03870	25,840.0
	40.00	7.725	.03461	28,892.5
	44.00	7.625	.03156	31,682.5
	49.00	7.511	.02833	35,295.0

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CASING STRETCH TABLE

OD (in)	Tubing Weight (lb/ft)	ID (in)	Stretch Constant (in./1000 lb /1000 ft)	Free Point Constant
9-5/8	32.30	9.001	.04382	22,820.0
	36.00	8.921	.03901	25,635.0
	40.00	8.835	.03492	28,635.0
	43.50	8.755	.03185	31,397.5
	47.00	8.681	.02947	33,930.0
	53.50	8.535	.02573	38,865.0
10-3/4	32.75	10.192	.04358	22,945.0
	40.50	10.050	.03498	28,587.5
	45.50	9.950	.03076	32,515.0
	51.00	9.850	.02747	36,402.5
	55.50	9.760	.02508	39,867.5
	60.70	9.660	.02289	43,682.5
	65.70	9.560	.02107	47,455.0
11-3/4	42.00	11.084	.03349	29,860.0
	47.00	11.000	.02985	33,502.5
	54.00	10.880	.02587	38,657.5
	60.00	10.772	.02312	43,250.0
13-3/4	48.00	12.715	.02958	33,810.0
	54.50	12.615	.02578	38,785.0
	61.00	12.515	.02287	43,717.5
	68.00	12.415	.02057	48,612.5
	72.00	12.347	.01926	51,920.0
16	65.00	15.250	.02173	46,020.0
	75.00	15.124	.01868	53,535.0
	84.00	15.010	.01659	60,280.0
20	94.00	19.124	.01486	67,295.0

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MECHANICALLY APPLIED EFFECT FORMULAE

Length Change due to Slack-off Force

$$\Delta L_s = \frac{L \times F_s}{E \times A_s} + \frac{r^2 \times F_s^2}{8 \times E \times I \times (W_s + W_i - W_o)}$$

Where:

ΔL_s = Length change due to slack-off force (in)

r = Radial clearance between the tubing and the casing (in)
r = [(Casing ID - Tubing OD) ÷ 2]

A_s = Cross-sectional area of the tubing (in^2)

F_s = Slack-off force (lbf)

E = Modulus of elasticity, 30 x 10^6 psi for carbon steels

I = Moment of inertia of the tubing (in^4)
I = [(Tubing OD)^4 - (Tubing ID)^4] x π ÷ 64

W_s = Weight of the tubing (lb/in)

W_i = Weight of the final fluid displaced in the tubing per unit length (lb/in)
W_i = (Tubing ID)^2 x .0034 x Final Tbg. Fluid Wt.(lb/gal)

W_o = Weight of the final fluid displaced in the annulus per unit length (lb/in)
W_o =(Tubing OD)^2 x .0034 x Final Ann. Fluid Wt.(lb/gal)

Length Change due to Tension Force

$$\Delta L_t = \frac{F_t \times L}{E \times A_s}$$

Where:

ΔL_t = Length change due to tension force (in)

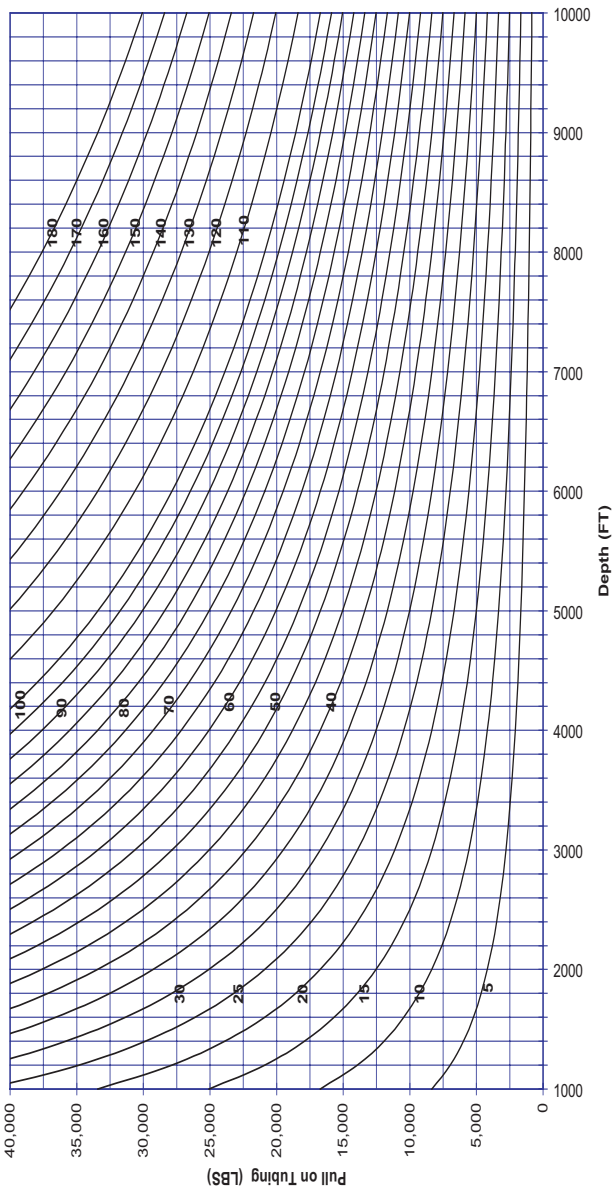
A_s = Cross-sectional area of the tubing (in^2)

F_t = Tension force (lbf)

E = Modulus of elasticity, 30 x 10^6 psi for carbon steels

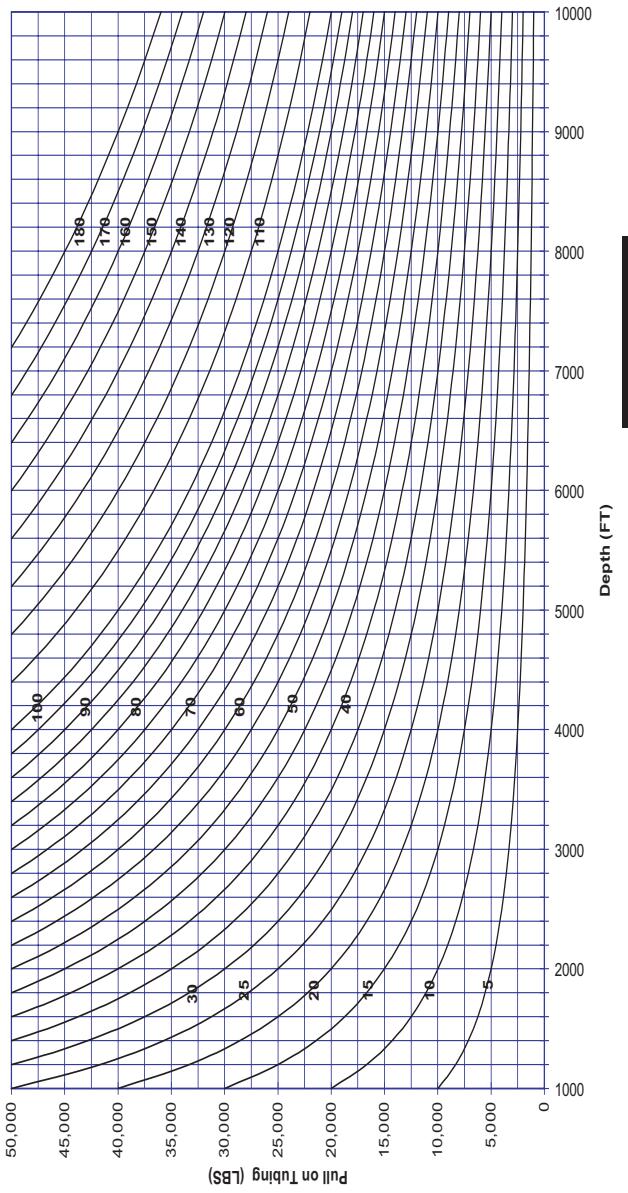
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Tubing Stretch - 1.660" O.D. API Tubing



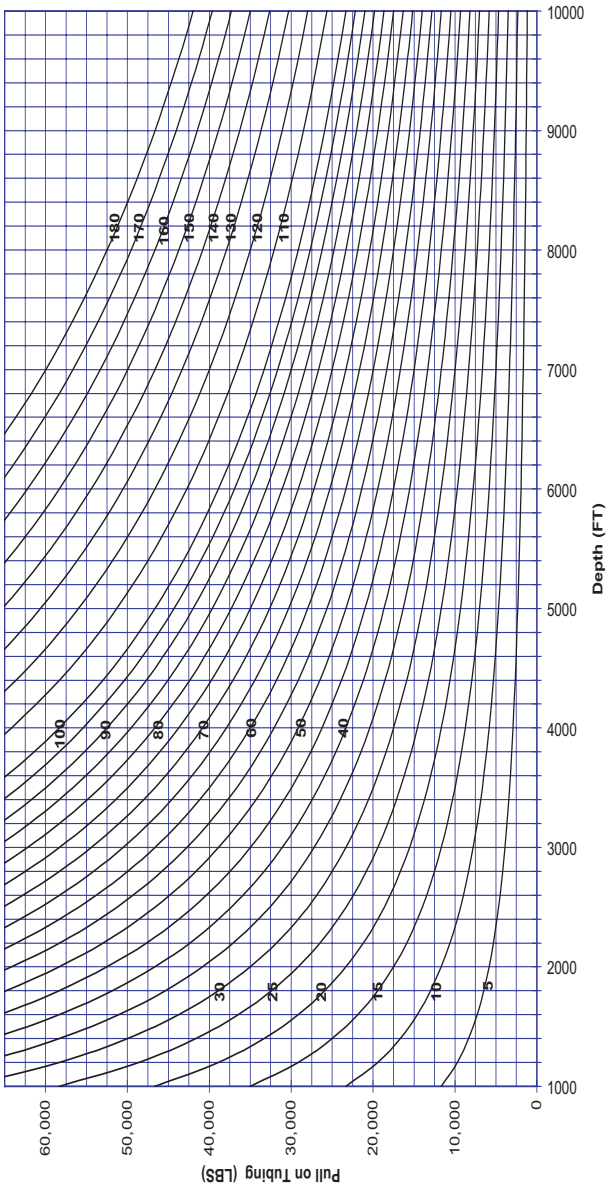
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Tubing Stretch - 1.900" O.D. API Tubing



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Tubing Stretch - 2 1/16" O.D. API Tubing

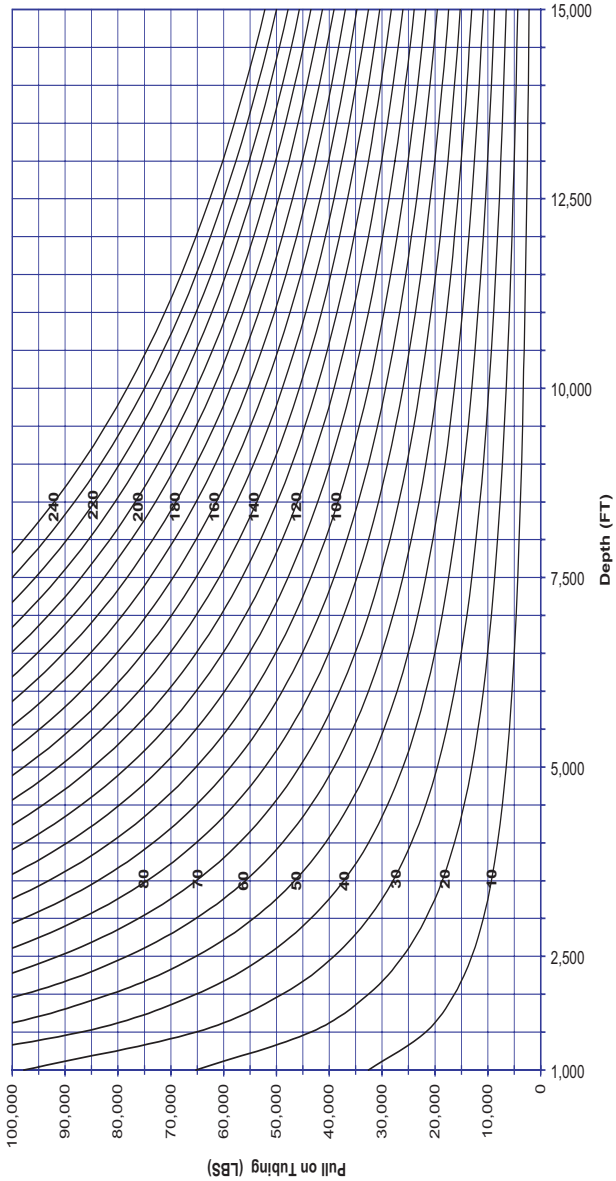


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Tubing Stretch 2-3/8" O.D. API Tubing

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Tubing Stretch 2-3/8" O.D. API Tubing

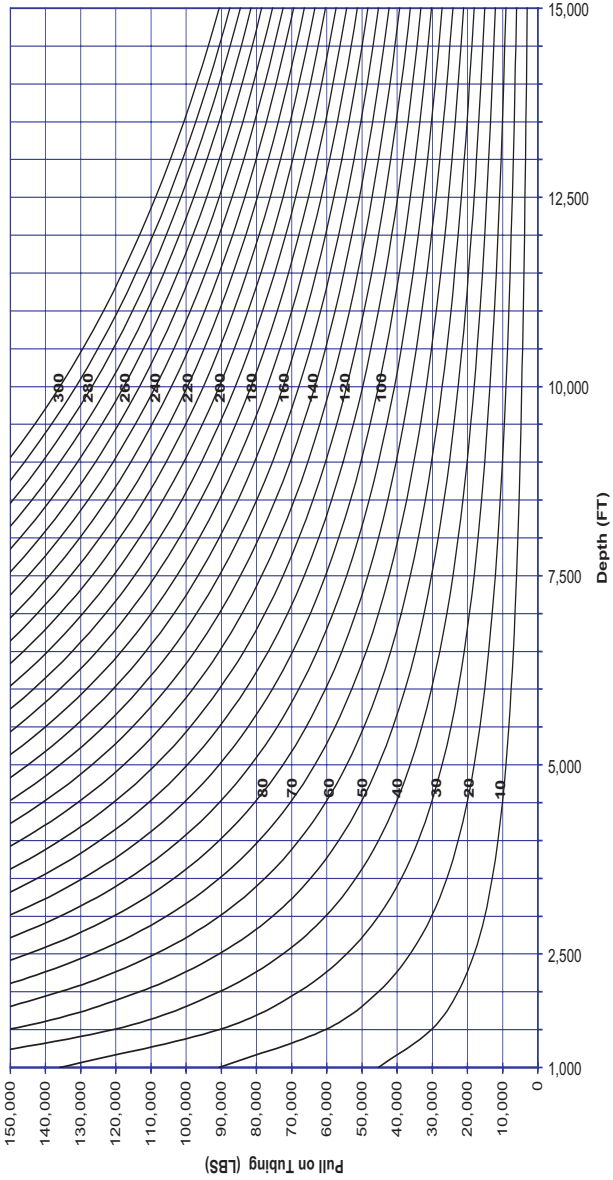


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Tubing Stretch 2-7/8" O.D. API Tubing

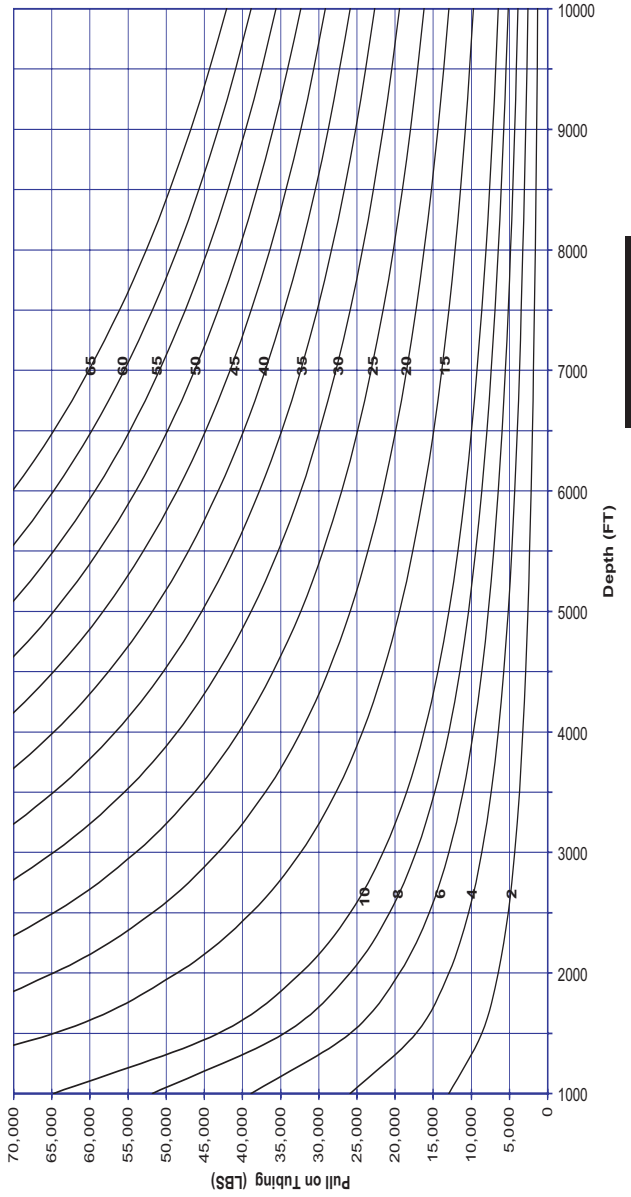
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Tubing Stretch 2-7/8" O.D. API Tubing



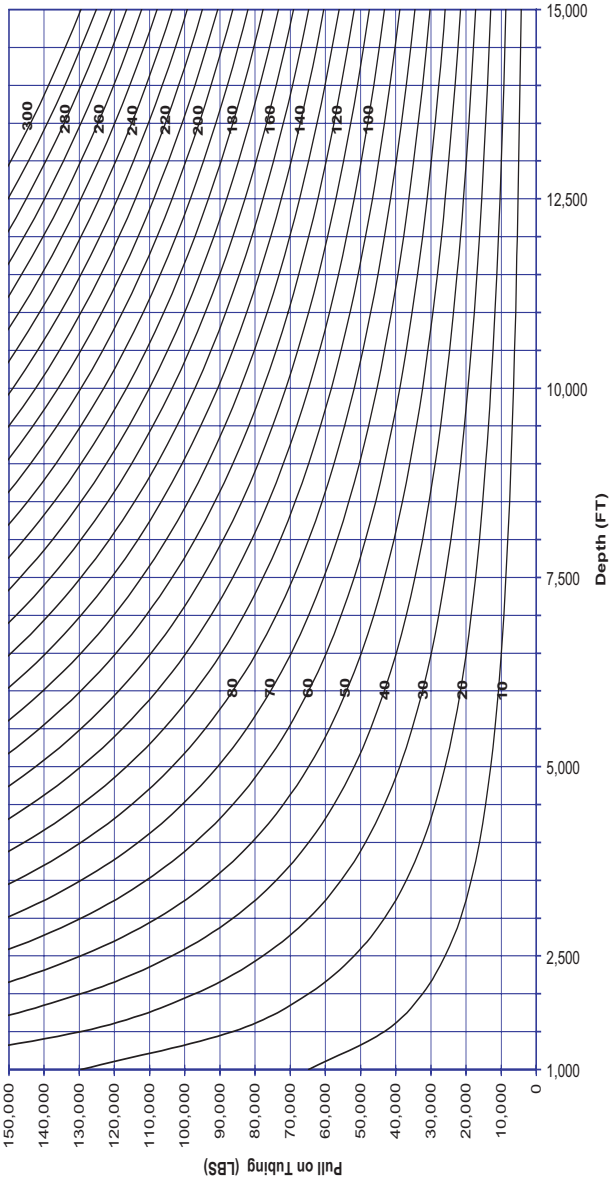
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Tubing Stretch 3-1/2" O.D. API Tubing



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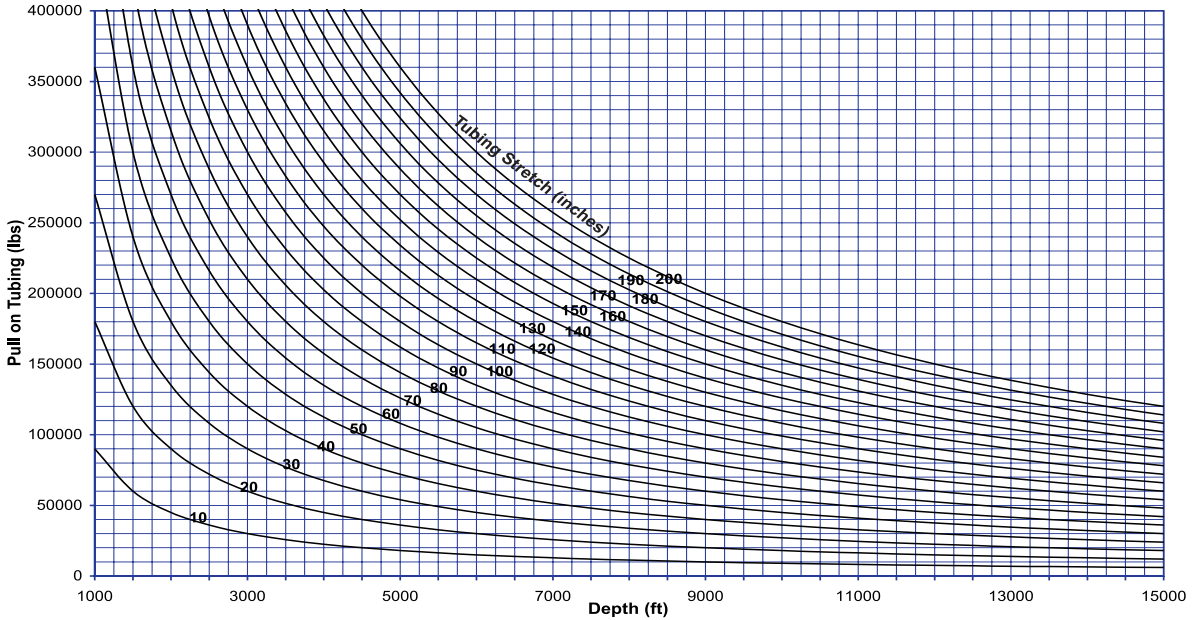
Tubing Stretch 3-1/2" O.D. API Tubing

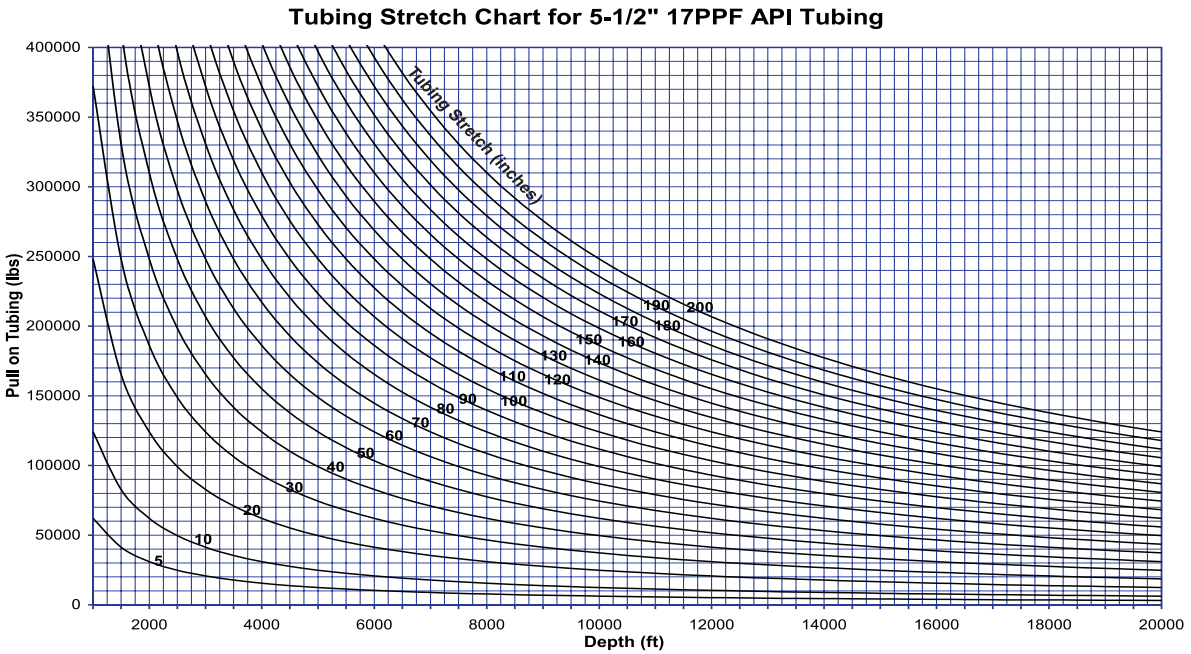


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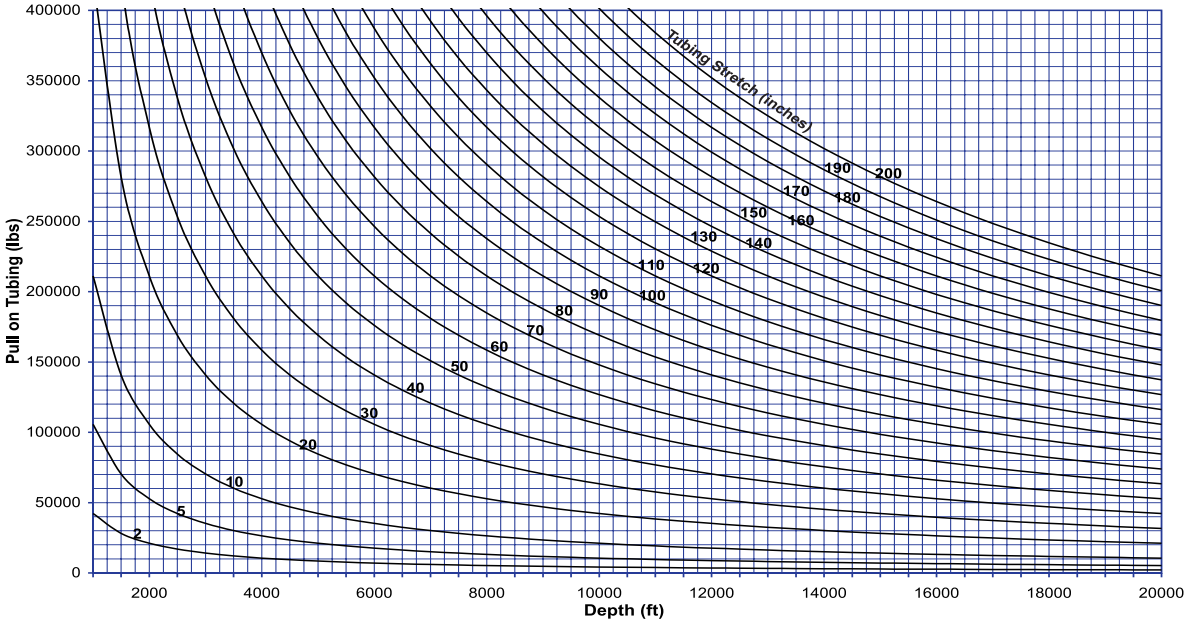
Tubing Stretch Chart for 4-1/2" 12.6/12.75PPF API Tubing





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Tubing Stretch Chart for 7" 29PPF API Tubing



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LENGTH CHANGE DUE TO TUBING SLACK-OFF CHARTS

There may be times when you are required to operate a tool without a benefit of a weight indicator, or the indictor available is not functioning properly. Slack-off charts give the amount of tubing to slack off to get a pre-determined weight set down on the tool or seal assembly.

Slacking off the tubing, into a well, has three resultant effects on the string:

1. Steel compression
2. Buckling inside casing
3. Friction between tubing & casing

Steel Compression

Steel compresses at the same rate as it stretches. Assuming that steel is perfectly elastic throughout the range of compression or stretch, if 20,000# stretches a simple six inches, 20,000# down will also compress the same sample six inches. While this simple principle is involved in the slack-off charts, it does not completely describe the mechanics of slack-off.

Buckling

Slacking-off weight on drill pipe, or tubing, has a tendency to buckle the string. If there is space between the tubing and casing, the tubing will buckle outward until it contacts the wall of the casing. While slacking-off, you lose inches due to steel compression, and you also lose inches due to the sideways movement of tubing buckling. When tubing buckles inside casing, its buckled shape follows the contour of the casing forming a corkscrew shape, or helix.

As you can see, the number of inches to slack-off to account for buckling will be dependent on the tubing OD, the casing ID, and the annular space available to accommodate buckling. From the charts, you will see that 3-1/2" tubing in 7" casing accommodates little buckling, while 2-3/8" tubing in 9-5/8" casing allows for considerably more buckling.

The following ten charts show the number of inches to slack-off to account for steel compression and buckling; friction is not taken into account.

When you have calculated how many inches to slack-off, you still don't know how much of this weight will be transferred to bottom. The number of inches to slack-off tells how much weight has been transferred from the elevators to some point within the well. However, it will not tell you how much of this weight went into friction, and how much went to bottom.

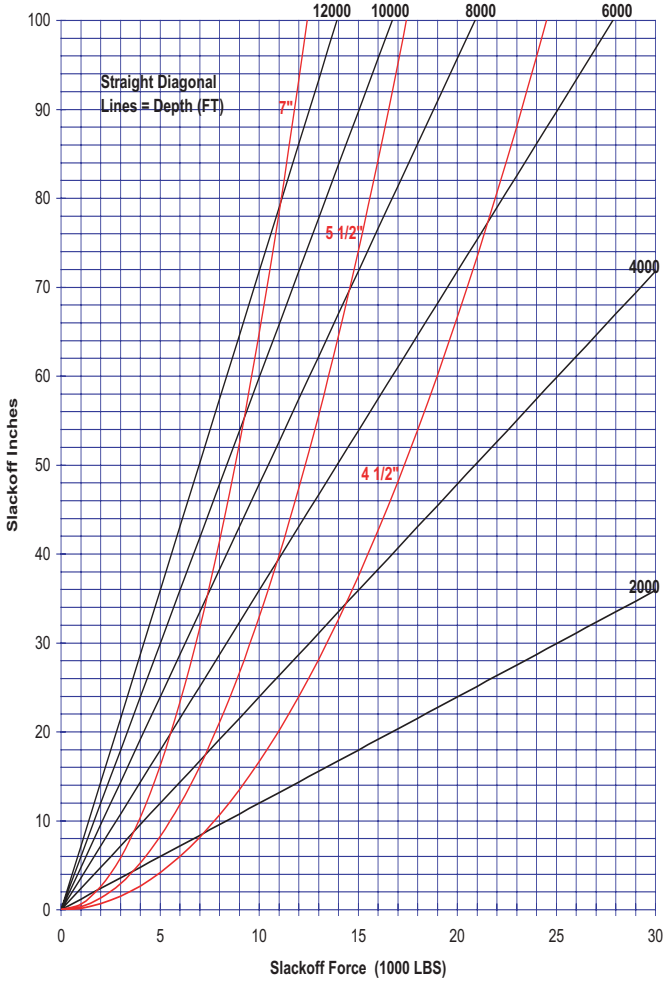
Example:
Refer to the 2-7/8" Slack-off chart for an example of these calculations.

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1.660" O.D. 2.4# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

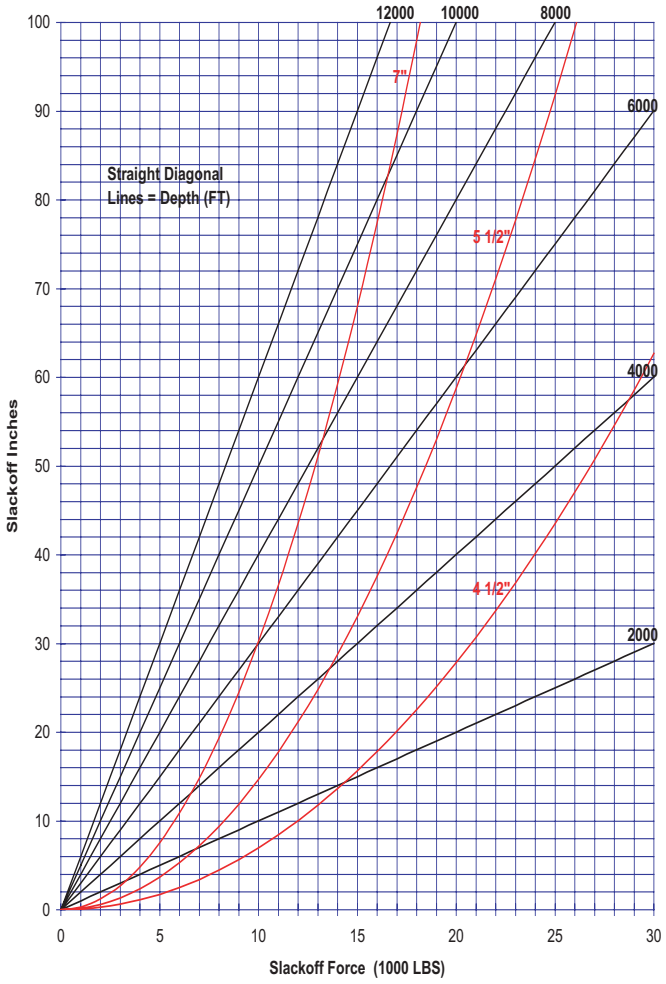


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1.900" O.D. 2.9# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

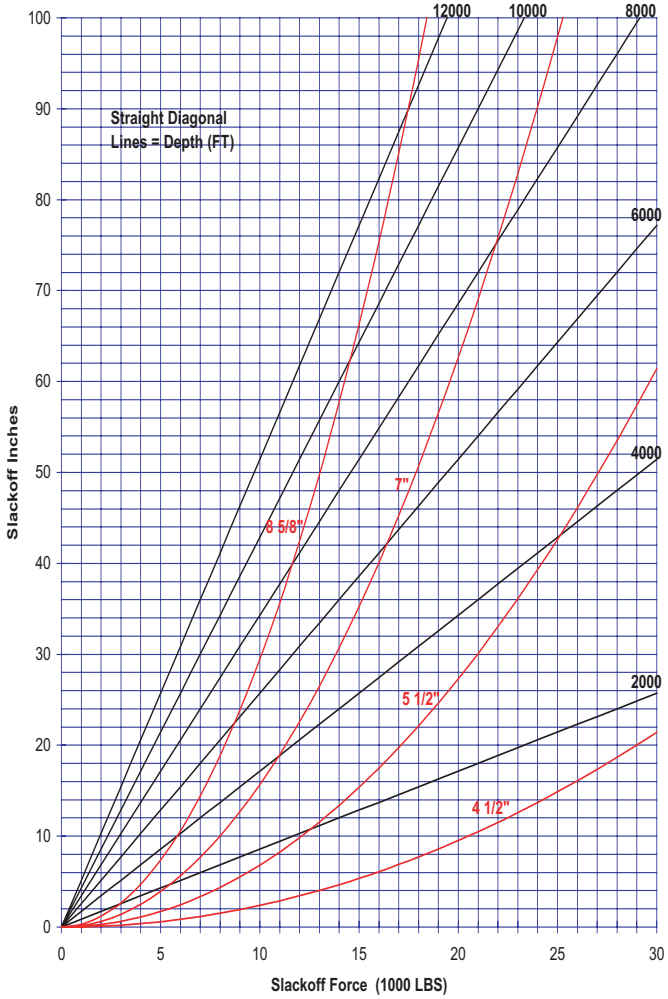


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2 1/16" O.D. 3.25# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

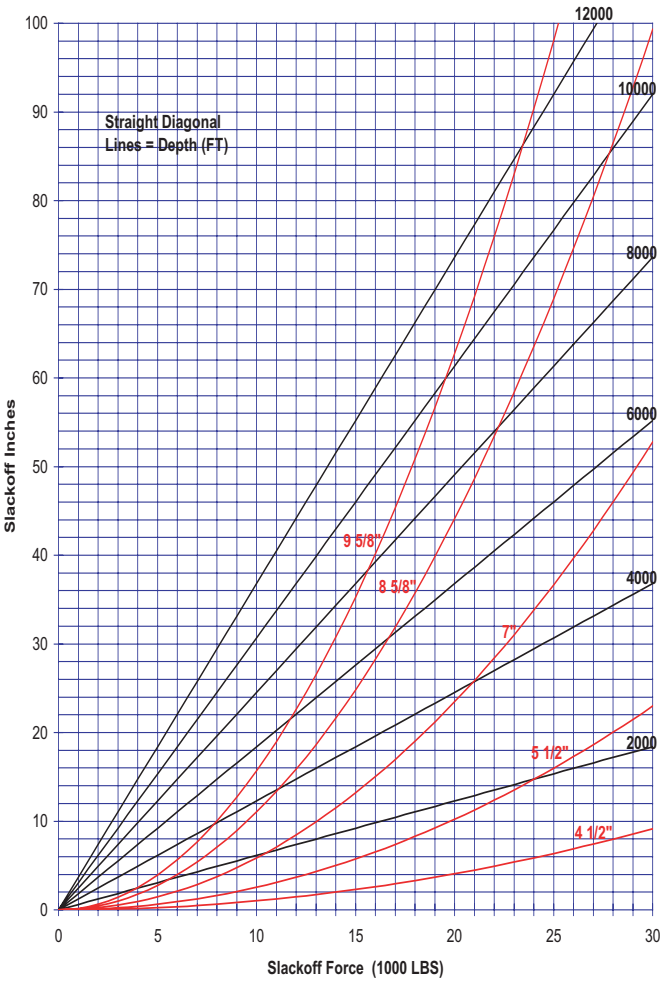


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2 3/8" O.D. 4.7# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

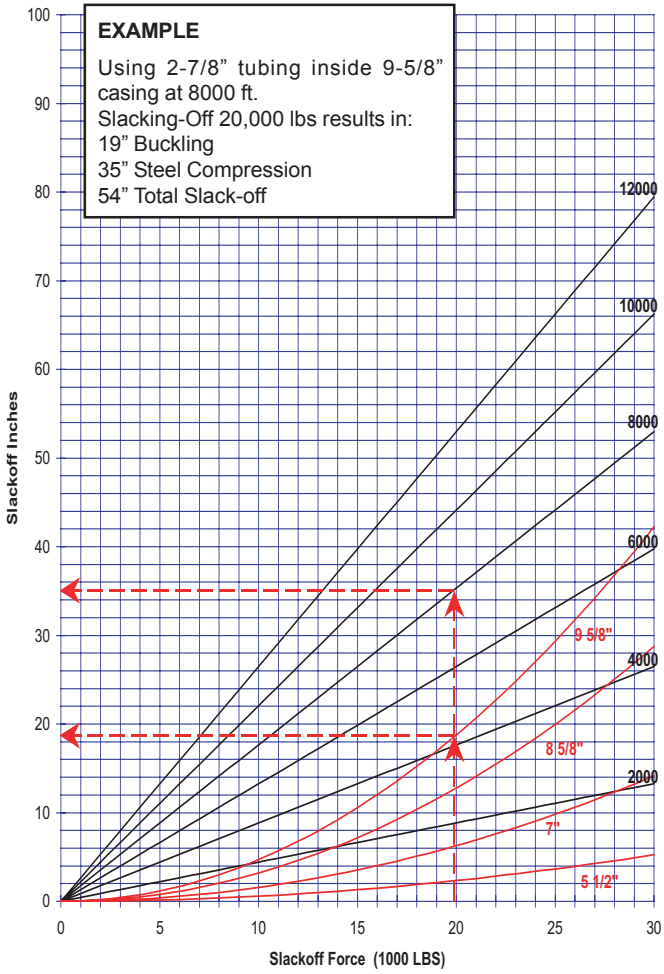


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2 7/8" O.D. 6.5# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

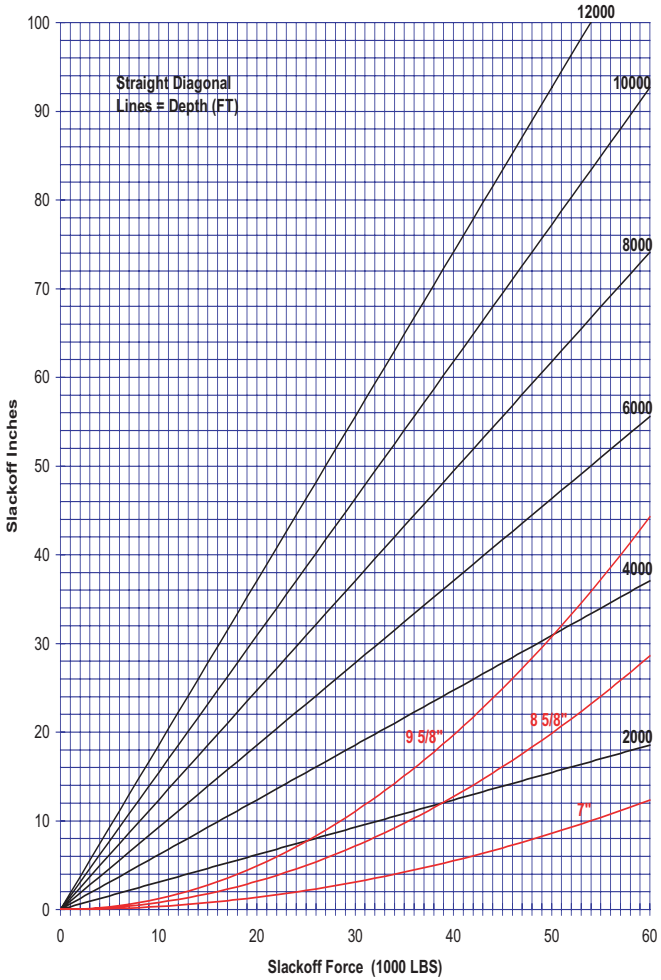


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3 1/2" O.D. 9.3# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

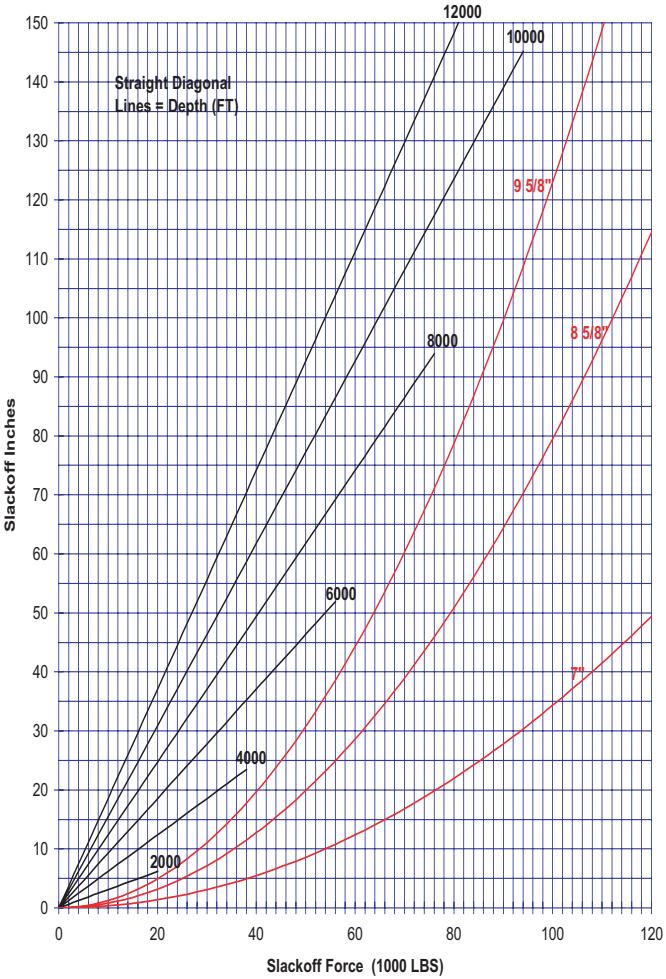


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3 1/2" O.D. 9.3# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

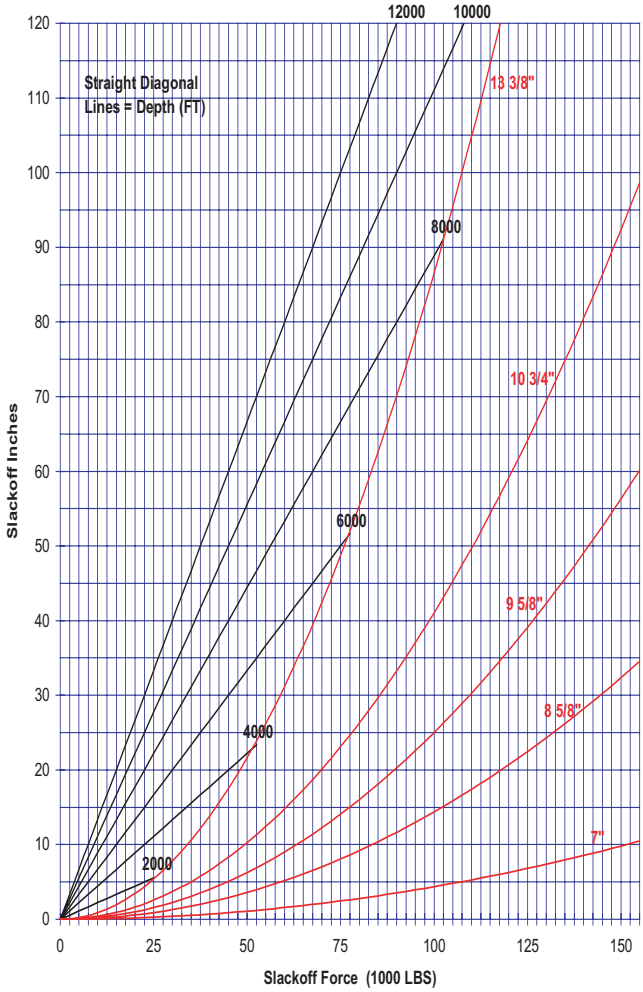


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4 1/2" O.D. 12.75# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

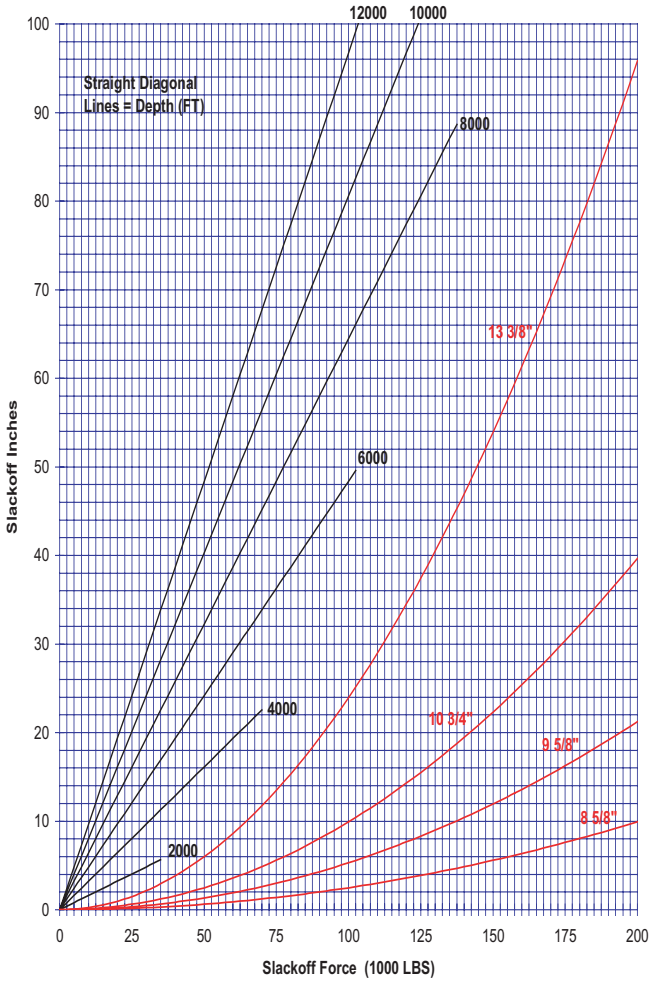


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5 1/2" O.D. 17# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings

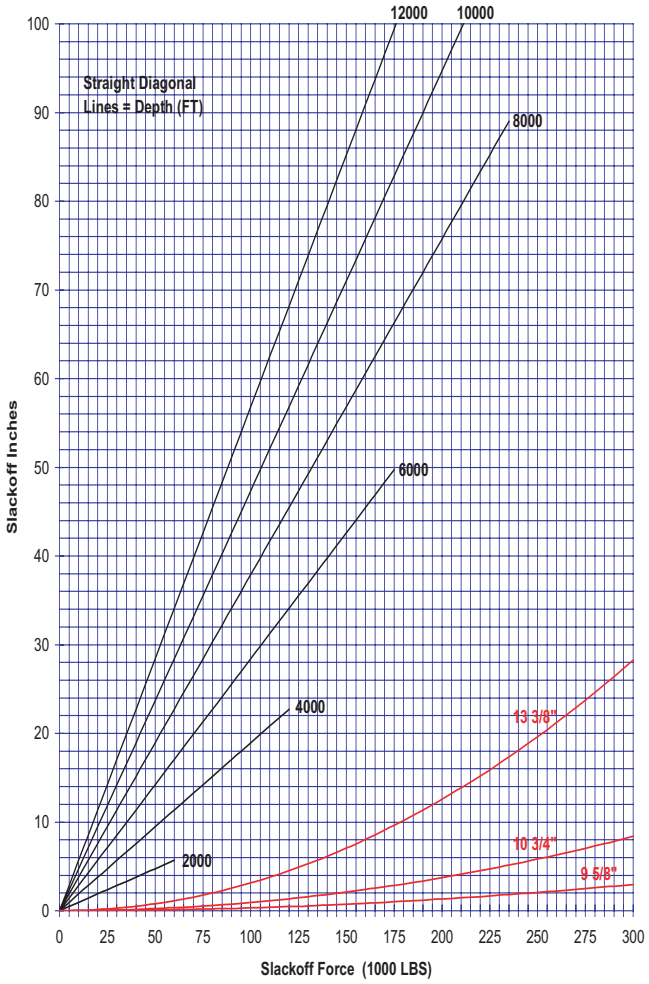


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7" O.D. 29# API Tubing

Calculated In Fresh Water

No Allowances Made for Couplings



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SLACK-OFF WEIGHT ON PACKER CHARTS
Slack-Off Weight Actually Reaching Bottom

Whether you intend to slack off weight using inches, or by the weight indicator, you have the problem of estimating how much of this weight actually gets down to the tool. Once the tubing has been buckled into contact with the casing wall, a portion of the additional slack-off is lost due to friction between the tubing and casing. As more and more of the tubing comes in contact with the casing wall, you will reach a point where the friction force is enough to support the weight of the rest of the string. At this point, you will not be able to get any more weight to bottom. The smaller the tubing, for a given casing size, the more it can buckle and the greater the friction force.

The following charts estimate how much force will get to bottom for a tubing/casing configuration. It should be understood that to calculate how much weight will get to bottom, a coefficient of friction must be assumed. Values obtained should be considered estimated, however, they have been found to be reasonably accurate. All charts assume that the weight, to be used, is available for slack-off.

It should be noticed that after slacking off so much weight, additional slack-off transfers very little additional weight to bottom. This implies that the tubing has buckled into a helix. The friction has become so great between the tubing and casing that it will not allow any more weight to pass to bottom. This frictional force will eventually be capable of supporting more weight than can be applied by the string.

The amount of weight necessary to set a packer, as published in the technical insert, is the weight required at the tool, **not** at the surface. Slacking off this amount of weight, at surface, does not mean that the weight is available at the tool. There are a number of options available at this point, depending on the type and operating characteristics of the particular tool involved. Please consult the Weatherford Packer technical insert for options.

These slack-off charts were not put in this calculation handbook to be used as absolute numbers. The effects of friction are highly dependent upon the fluid in the casing, the condition of the casing ID, the condition of the tubing OD, and a number of other variables.

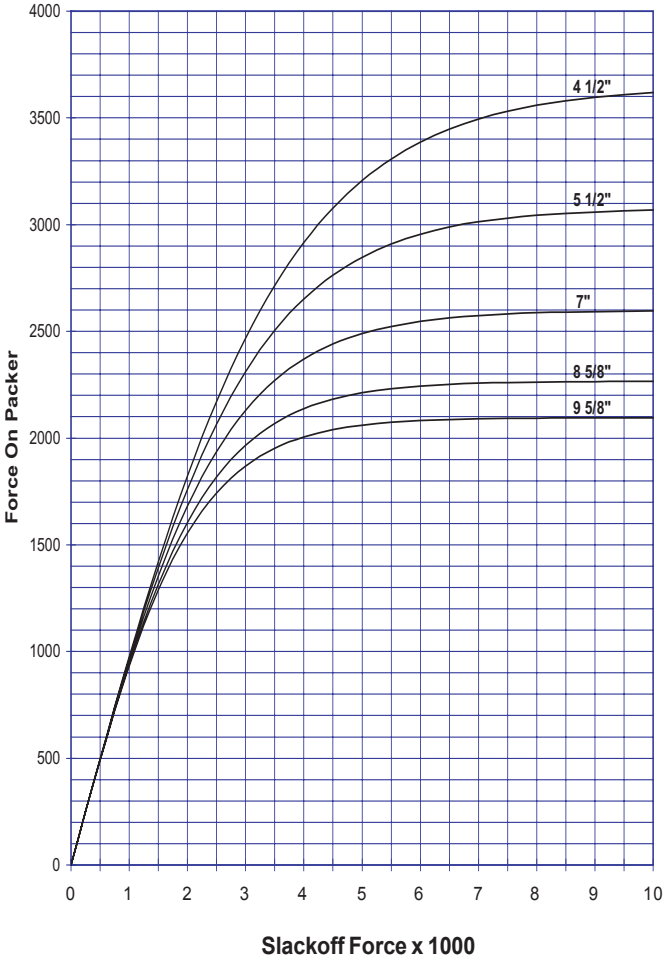
When running the second string of a dual string of tubing, treat it as if it were the first string. The logic is that even though you don't have the same radial clearance for buckling, there is the added friction of the primary string. This added friction offsets the benefit of reduced annular clearance.

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1.660" O.D. 2.4# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

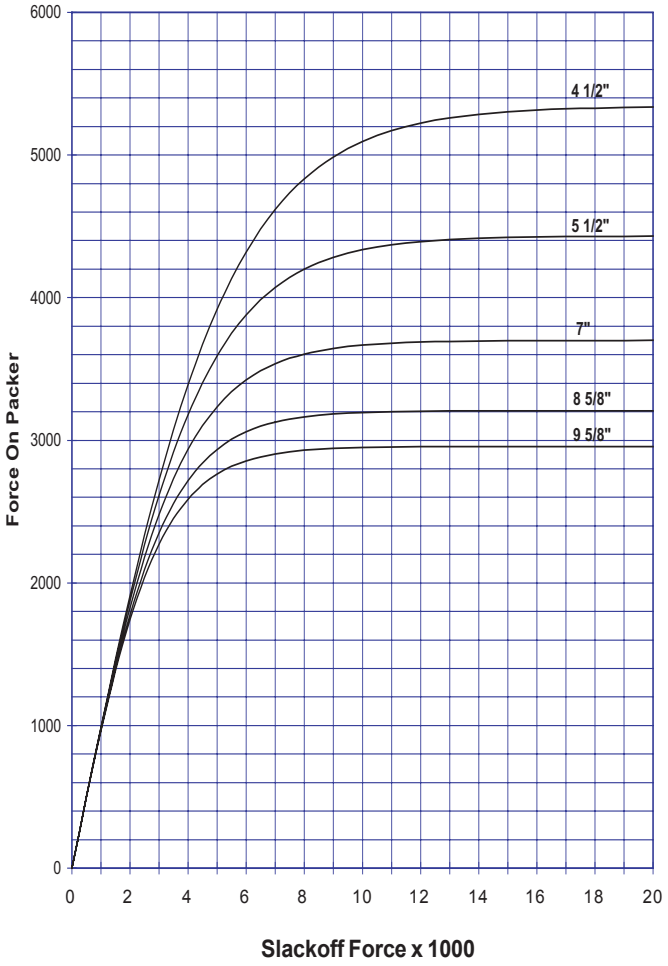


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1.900" O.D. 2.9# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

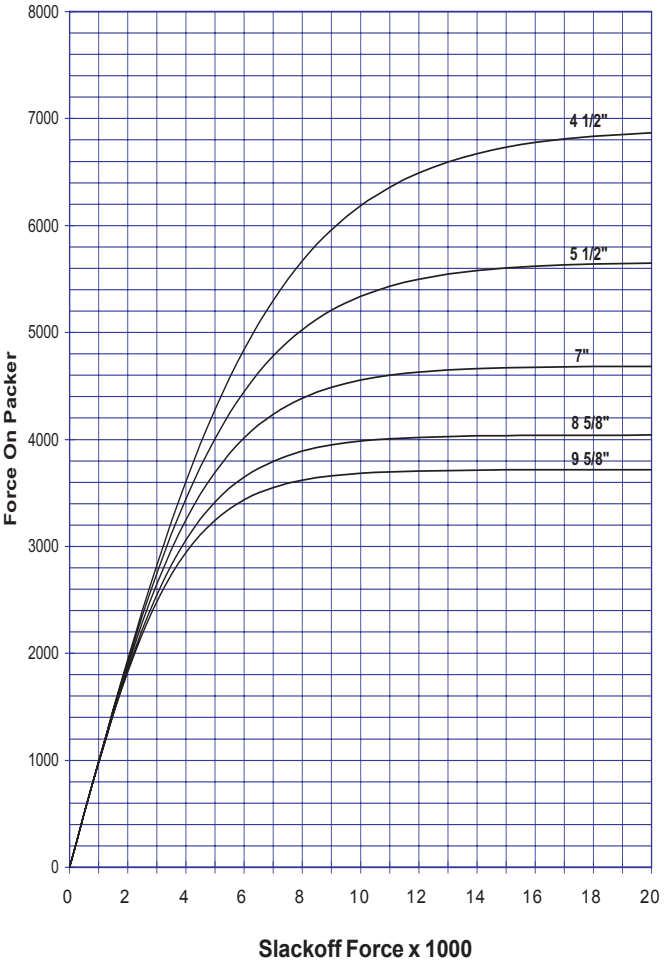


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2 1/16" O.D. 3.25# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

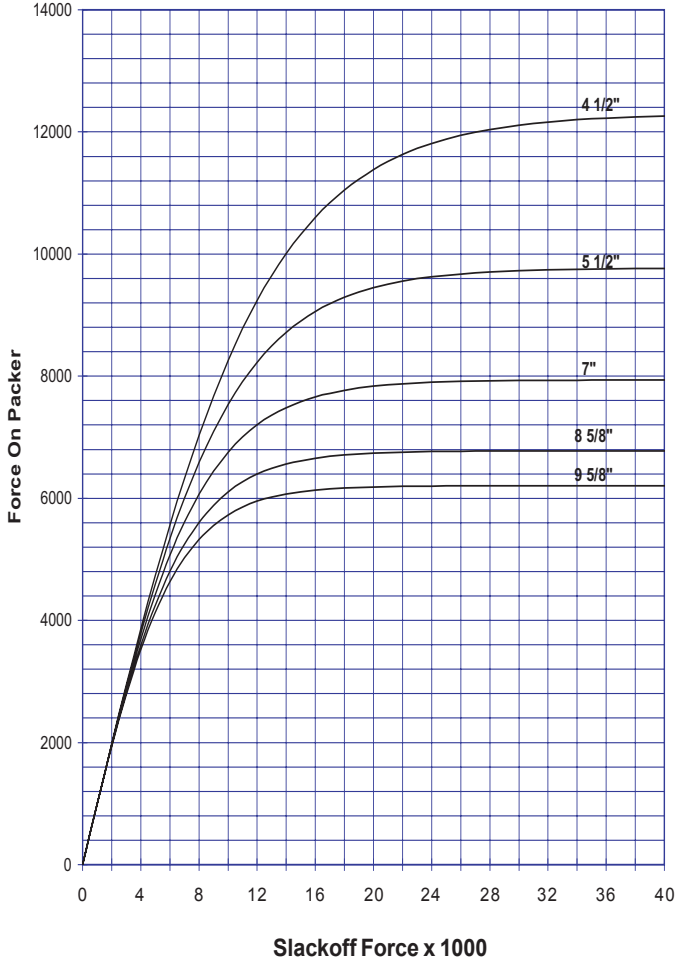


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2 3/8" O.D. 4.7# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

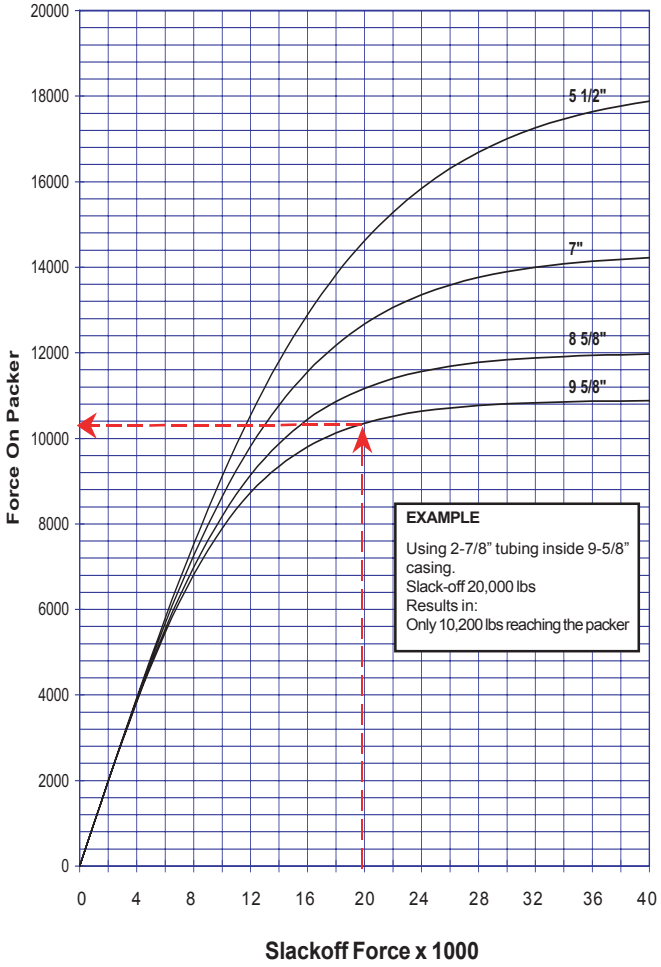


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2 7/8" O.D. 6.5# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

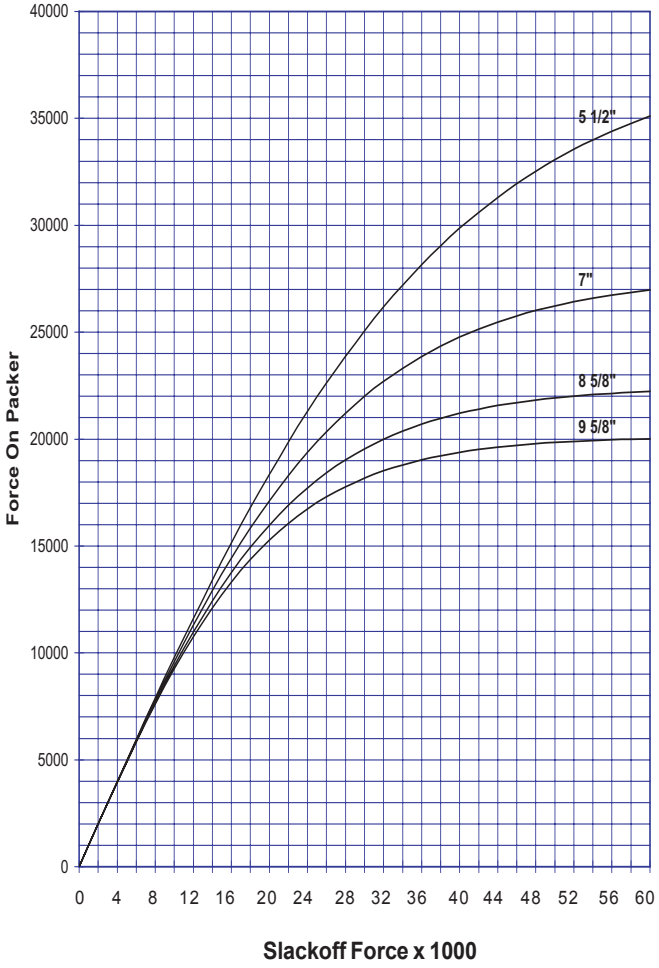


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3 1/2" O.D. 9.3# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

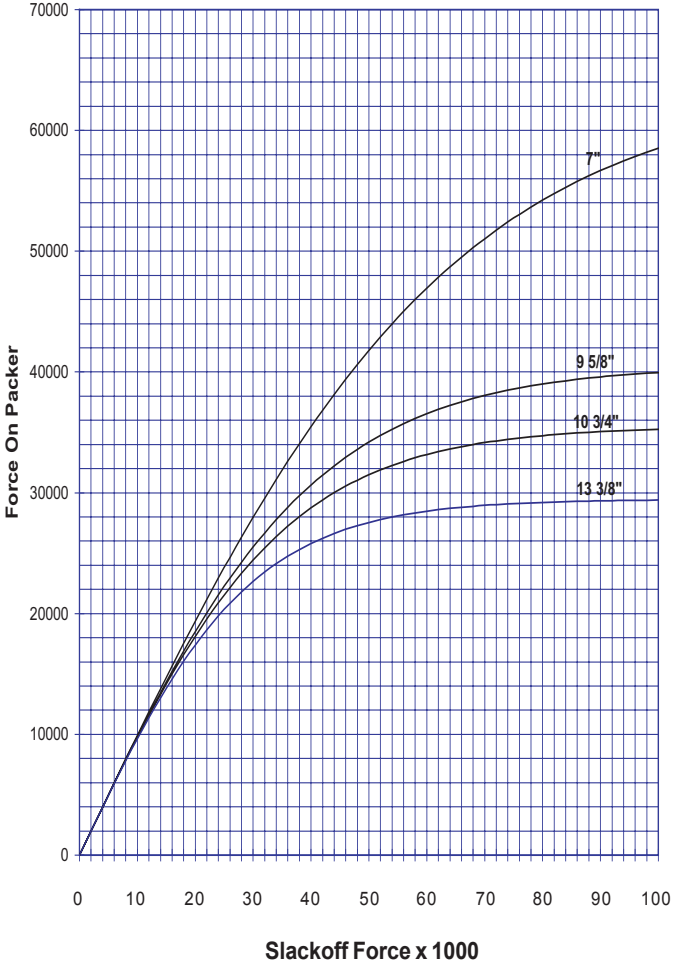


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4 1/2" O.D. 12.75# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

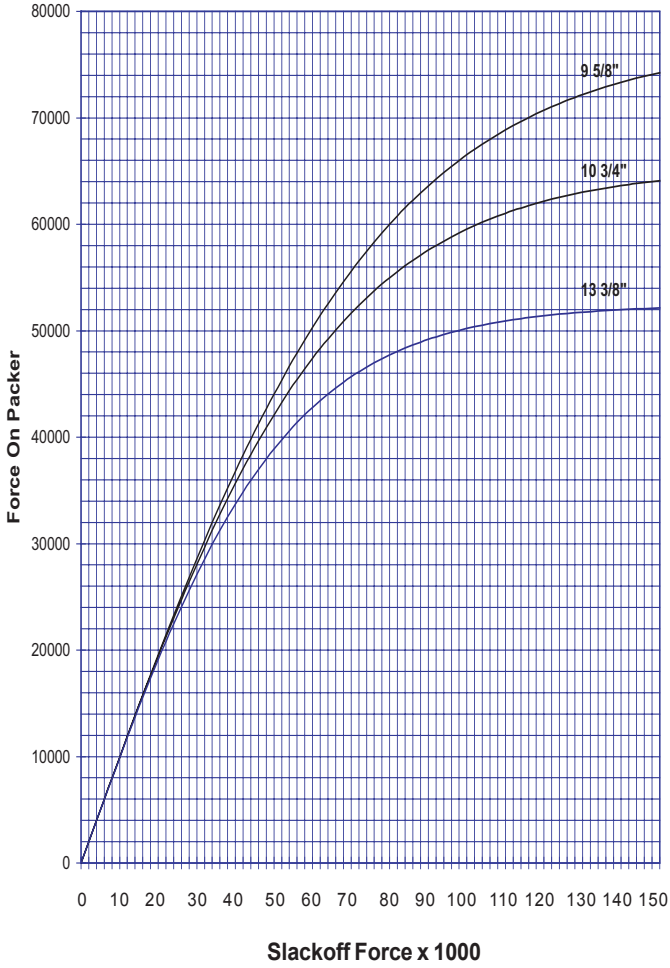


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5 1/2" O.D. 17# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511

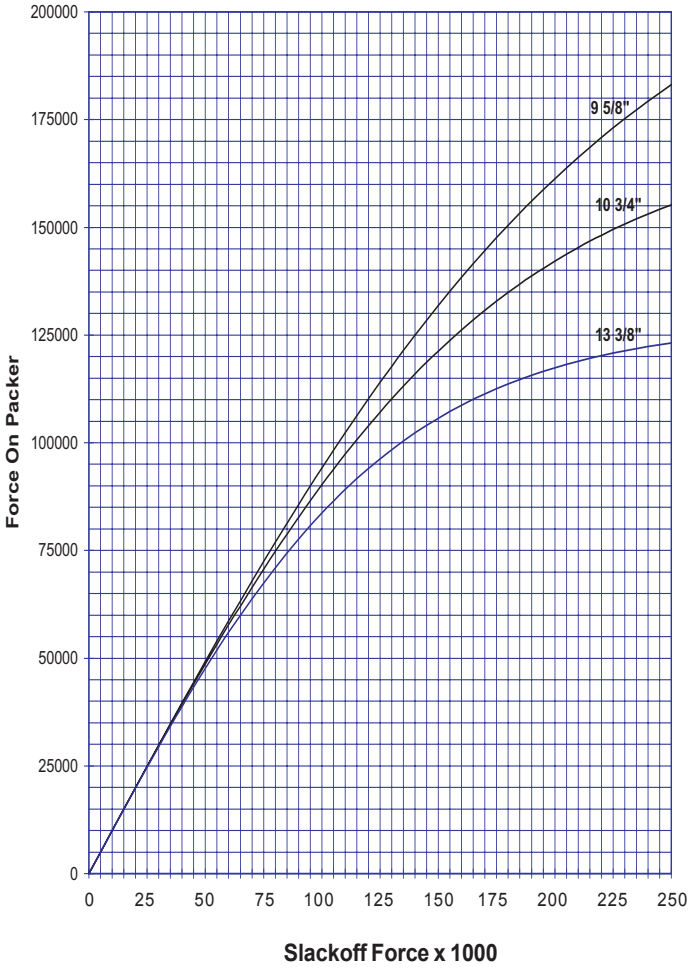


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7" O.D. 17# API Tubing

No Allowances Made for Couplings or Friction

Reference SPE 26511



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TUBING WEIGHT FACTORS w_s, w_i and w_o

Tubing OD	Tubing Weight		w_i & w_o	7	8	9	10	11	12	13	14	15	16	17	18	lb/gal Fluid
(in)	(lb/ft)	(lb/in)	(lb/in)	52.3	59.8	67.3	74.8	82.3	89.8	97.2	104.7	112.2	119.7	127.2	134.6	lb/cu ft Weight
1.660	2.400	w_s = .200	w_i	.045	.052	.058	.065	.071	.078	.084	.091	.097	.104	.110	.116	
			w_o	.065	.075	.084	.094	.103	.112	.122	.131	.140	.150	.159	.169	
1.900	2.900	w_s = .242	w_i	.062	.070	.079	.088	.097	.106	.115	.123	.132	.141	.150	.159	
			w_o	.086	.098	.110	.123	.135	.147	.159	.172	.184	.193	.209	.221	
2-1/16	3.250	w_s = .271	w_i	.073	.083	.094	.104	.114	.125	.135	.146	.156	.167	.177	.187	
			w_o	.101	.116	.130	.145	.159	.174	.188	.202	.217	.231	.246	.260	
2-3/8	4.700	w_s = .392	w_i	.095	.108	.122	.135	.149	.162	.176	.189	.203	.217	.230	.243	
			w_o	.134	.153	.172	.192	.211	.230	.249	.268	.288	.307	.326	.345	
2-7/8	6.500	w_s = .542	w_i	.142	.162	.182	.203	.223	.243	.263	.284	.304	.324	.344	.364	
			w_o	.196	.225	.253	.281	.309	.337	.365	.393	.421	.450	.478	.506	
3-1/2	9.200	w_s = .767	w_i	.213	.243	.274	.304	.335	.365	.395	.426	.456	.487	.517	.548	
			w_o	.291	.333	.365	.416	.458	.500	.541	.583	.625	.666	.708	.749	
4-1/2	12.750	w_s = 1.063	w_i	.373	.426	.479	.533	.586	.639	.692	.746	.799	.852	.906	.959	
			w_o	.482	.551	.620	.689	.757	.826	.895	.964	1.033	1.102	1.170	1.239	

NOTE: For w_i use weight of fluid in tubing. For w_o, use weight of fluid in annulus

W_i = (Tubing ID)^2 x .0034 x Tubing Fluid Weight

W_i = (Tubing OD)^2 x .0034 x Annulus Fluid Weight

PISTON EFFECT FORMULAE

PISTON FORCE

$$F_1 = \Delta P_o(A_p - A_o) - \Delta P_i(A_p - A_i)$$

Where:

F_1	=	Piston Effect Force change (lbf)
A_p	=	Packer valve area (in^2)
A_o	=	Area of the tubing O.D. (in^2)
A_i	=	Area of the tubing I.D. (in^2)
ΔP_o	=	Change in total annular pressure at packer (psi)
ΔP_i	=	Change in total tubing pressure at packer (psi)

$$\Delta L_1 = \frac{F_1 \times L}{E \times A_s}$$

LENGTH CHANGE

Where:

ΔL_1	=	Change in length of the tubing string (in)
L	=	Length of the tubing (in)
F_1	=	Piston Effect Force change (lbf)
E	=	Modulus of elasticity, 30 x 10^6 psi (for carbon steels)
A_s	=	Cross-sectional area of the tubing (in^2)

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BUCKLING EFFECT FORMULAE
LENGTH CHANGE

$$\Delta L_2 = \frac{r^2 \times A_p^2 \times (\Delta P_i - \Delta P_o)^2}{-8 \times E \times I \times (W_s + W_i - W_o)}$$

Where:

ΔL_2 = Length change due to buckling (in)

r = Radial clearance between the tubing and the casing (in)
r = [(Casing ID -Tubing OD) ÷ 2]

A_p = Packer valve area (in^2)

ΔP_i = Change in the total tubing pressure at the packer (psi)
$\Delta P_i = (P_{i\,final} - P_{i\,initial})$

ΔP_o = Change in the total annulus pressure at the packer (psi)
$\Delta P_o = (P_{o\,final} - P_{o\,initial})$

E = Modulus of elasticity, 30 x 10^6 psi for carbon steels

I = Moment of inertia of the tubing (in^4)
I = [(Tubing OD)^4 - (Tubing ID)^4] x π ÷ 64

W_s = Weight of the tubing (lb/in)

W_i = Weight of the final fluid displaced in the tubing per unit length (lb/in)
W_i = (Tubing ID)^2 x .0034 x Final Tbg. Fluid Wt.(lb/gal)

W_o = Weight of the final fluid displaced in the annulus per unit length (lb/in)
W_o =(Tubing OD)^2 x .0034 x Final Ann. Fluid Wt.(lb/gal)

LENGTH FROM THE PACKER TO THE NEUTRAL POINT

$$n = \frac{A_p \times [P_{i\,final} - P_{o\,final}]}{(W_s + W_i - W_o)}$$

Where:

n = The distance from the packer to the neutral point (in).
This distance may also be referred to as the length of buckled tubing.

A_p = Packer valve area (in^2)

$P_{i\,final}$ = Total tubing pressure at the packer that will exist for the given condition(psi)

$P_{o\,final}$ = Total annulus pressure at the packer that will exist for the given condition(psi)

W_s = Weight of the tubing (lb/in)

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W_i = Weight of the final fluid displaced in the tubing per unit length (lb/in)
$W_i = (\text{Tubing ID})^2 \times .0034 \times \text{Final Tbg. Fluid Wt.(lb/gal)}$

W_o = Weight of the final fluid displaced in the annulus per unit length (lb/in)
$W_o = (\text{Tubing OD})^2 \times .0034 \times \text{Final Ann. Fluid Wt.(lb/gal)}$

CORRECTED LENGTH CHANGE DUE TO BUCKLING

$$\Delta L'_2 = \Delta L_2 \times \frac{L}{n} \times [2 - (\frac{L}{n})]$$

Where:

$\Delta L'_2$ = Length change due to buckling when neutral point is above wellhead (in)

ΔL_2 = Length change due to buckling (in)

L = Length of the tubing string (in)

n = The distance from the packer to the neutral point (in)
This distance may also be referred to as the length of buckled tubing.

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BALLOONING EFFECT CALCULATIONS

Ballooning Force

$$\Delta F_3 = .6(\Delta P_{oa} A_o - \Delta P_{ia} A_i)$$

Where:

F_3 = Ballooning Effect Force change (lbf)

ΔP_{oa} = Change in average annulus pressure (psi)

A_o = Area of the tubing O.D. (in^2)

ΔP_{ia} = Change in average annulus pressure (psi)

A_i = Area of the tubing I.D. (in^2)

Length Change

$$\Delta L_3 = \frac{2 \times L \times \gamma}{E} \times \frac{(R^2 \times \Delta P_{oa}) - \Delta P_{ia}}{(R^2 - 1)}$$

Where:

ΔL_3 = Change in length (in)

L = Length of the tubing string (in)

γ = Poissons ratio, .3 for steel

E = Modulus of elasticity, 30 x 10^6 psi for carbon steel

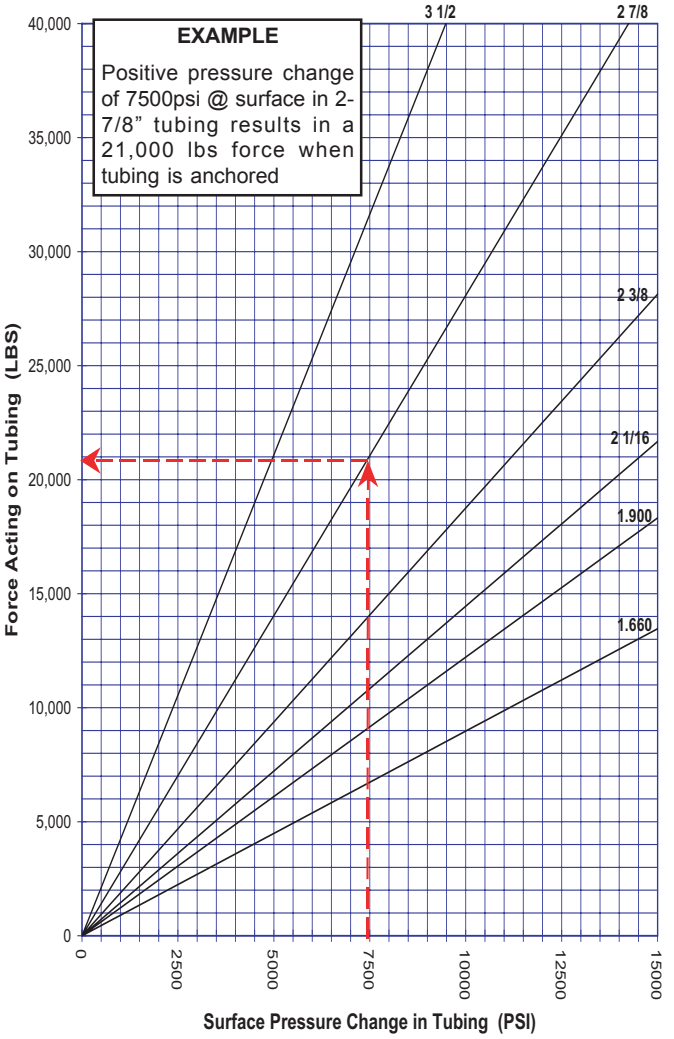
ΔP_{ia} = Change in average tubing pressure (psi)

ΔP_{oa} = Change in average annulus pressure (psi)

R^2 = Ratio of the tubing O.D. to the tubing I.D., squared [where $R^2 = (OD \div ID)^2$]

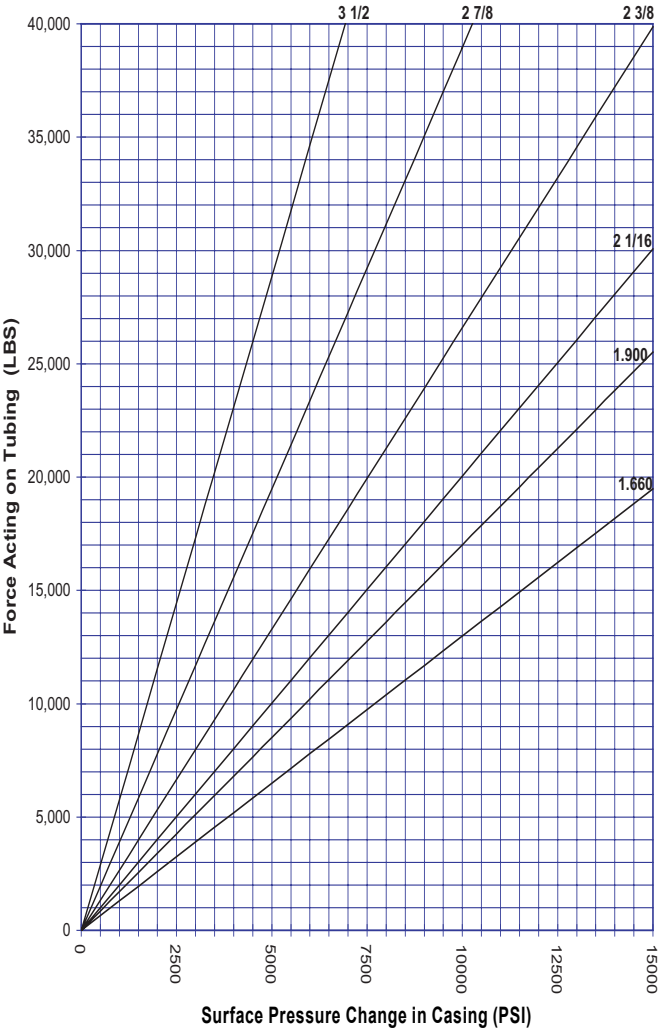
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Ballooning Effect



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Reverse Ballooning Effect



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TEMPERATURE EFFECT

Temperature Effects on Tubing Length Due to Injecting Cold Fluids

Heated metal expands and cooled metal contracts. In a long string of tubing with a temperature change over it's entire length, this expansion or contraction can be considerable and run to several feet.

When a well is completed the tubing takes on the temperature gradient of the surrounding geology, and settles down to an average length.

The main areas where temperature effects are prevalent are:

Production

When the hotter fluids from the formation are produced up the tubing string the average temperature of the tubing will increase. The amount of temperature increase will be dependent upon the reservoir temperature and the rate of flow. This will cause the tubing to expand and so lengthen if free to move. If the lower end of the tubing is anchored to the packer, then a compressive force is applied to the packer and the tubing may begin to buckle. The type and extent of buckling will be dependent upon the OD of the tubing and the ID of the production casing.

Steam Injection

As with production the injection of steam will increase the average temperature of the tubing and the same effects will be apparent. The main difference with steam injection over production is that the effects will take place in a much shorter period of time and tend to be more extreme.

Fluid Injection

The most common situation for the service tool hand is the injecting of cold fluids (as encountered during stimulation operations, hydraulic fracturing treatments and sand-control completions) which are almost always colder than the well temperature and tend to shorten the string.

This shortening can pick up a tubing expansion device (PBR, TSR, locator seal assembly, etc.) or rob set down weight from a compression set packer. In extreme cases the tensile strength of the tubing may be exceeded and the tubing may part.

When determining the effects of temperature, there are a number of important points that have to be taken into consideration:

- If the well is on production, or fluid is being injected, the temperature of the tubing is assumed to be the same as the fluid inside it. If the well is static, or shut-in, the tubing temperature is assumed to be the same as the surrounding fluid.
- The temperature of any unheated injection fluid is assumed to be the same as the ambient air temperature at the well site, unless it is heated by some method.
- During production or remedial operations (fluid injection), assume that the entire length of the tubing will heat up, or cool down, to the temperature of the produced, or injected, fluids. This may not always be the case depending on the duration but making the assumption will allow for calculation of the worst case scenario.
- Temperature effects are not always felt immediately at the packer, as it can take from several minutes to several hours for the tubing string to completely heat up or cool down. It is generally assumed that the temperature effect will occur immediately, so that it can be considered to act at the same time as all of the other effects, again this will give the worst case scenario.
- The temperature of injection fluids will vary with the ambient temperature of the injected fluids. In extreme cases, mainly during the winter, this effect can be extremely severe.

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Example:

7000 ft depth
210°F BHT
60°F Fluid
2-7/8" Tubing
Water in annulus

Injection rate of 2 BPM (barrels/minute) for 1 hour brings the temperature at the bottom of the string down to 83°F

Injecting at 4 BPM for 1 hour would yield 72°F

Injecting at 6 BPM for 1 hour would yield 68°F

Injecting at 2 BPM for 6 hours would yield 62°F

At these rates and times, temperature of the bottom of the string is brought down close to the temperature of the injected fluid.

Example:

10,000 feet depth
270°F BHT
60°F Injection Fluid
2-7/8" Tubing

Injection rate of 2 BPM for 1 hour would bring the temperature of the bottom of the string down to 102°F

Injecting at 4BPM for 1 hour would yield 83°F

Injecting at 6BPM for 1 hour would yield 76°F

Injecting at 2BPM for 6 hours would yield 64°F

In the preceding examples, even at the lowest rate and the shortest time, the bottom of the string is cooled 168°F. In the 6-hour test, the bottom of the string was cooled to within 4°F of the injection fluid temperature. Injection for long periods, such as waterfloods, will cool the string down to the temperature of the injected fluid.

For a hydraulic fracturing or acid treatment, it is accepted practice to make calculations based on the string being cooled to the injection fluid temperature. This assumption results in maximum tubing movement.

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TEMPERATURE EFFECT CALCULATIONS

$$\Delta F_4 = 207 \times A_s \times \Delta T$$

Temperature Force

Where:

F_4 = Temperature Effect Force change (lbf)

A_s = Tubing cross sectional area (in^2)

ΔT = Change in average tubing temperature (°F)
ΔT = Final Avg. Tbg. Temp. - Init. Avg. Tbg. Temp.

$$\Delta L_4 = L \times \beta \times \Delta T$$

Length Change

Where:

ΔL_4 = Length change due to the temperature effect (in)

L = Length of the tubing string (in)

β = Coefficient of thermal expansion for steel, .0000069 in/in/°F

ΔT = Change in average tubing temperature (°F)
ΔT = Final Avg. Tbg. Temp. - Init. Avg. Tbg. Temp.

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Charts

The following charts are calculated based on the ambient conditions referenced. The output of the charts is in units of force (lbs); should length be required, please consult the stretch charts.

Elongation of Tubing Due to Temperature when Running in the Hole

Tubing will elongate due to temperature when run in the hole. To calculate this elongation, you can use the simple Lubinski formula for tubing movement due to temperature:

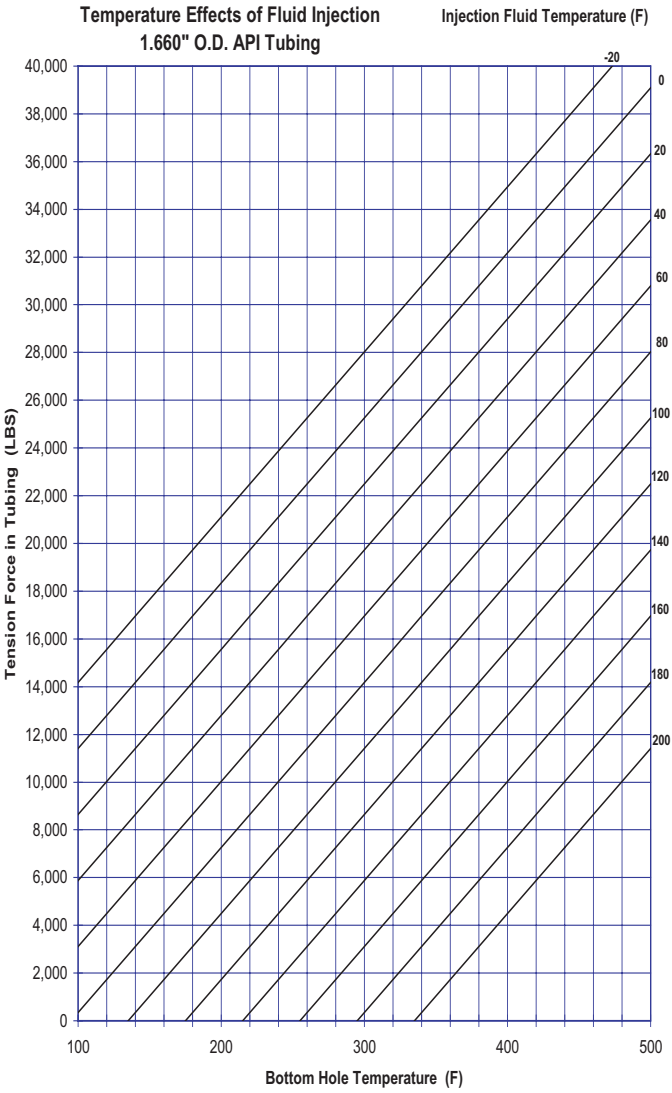
$$\Delta L = L \times \beta \times \Delta T \times 12$$

Where:

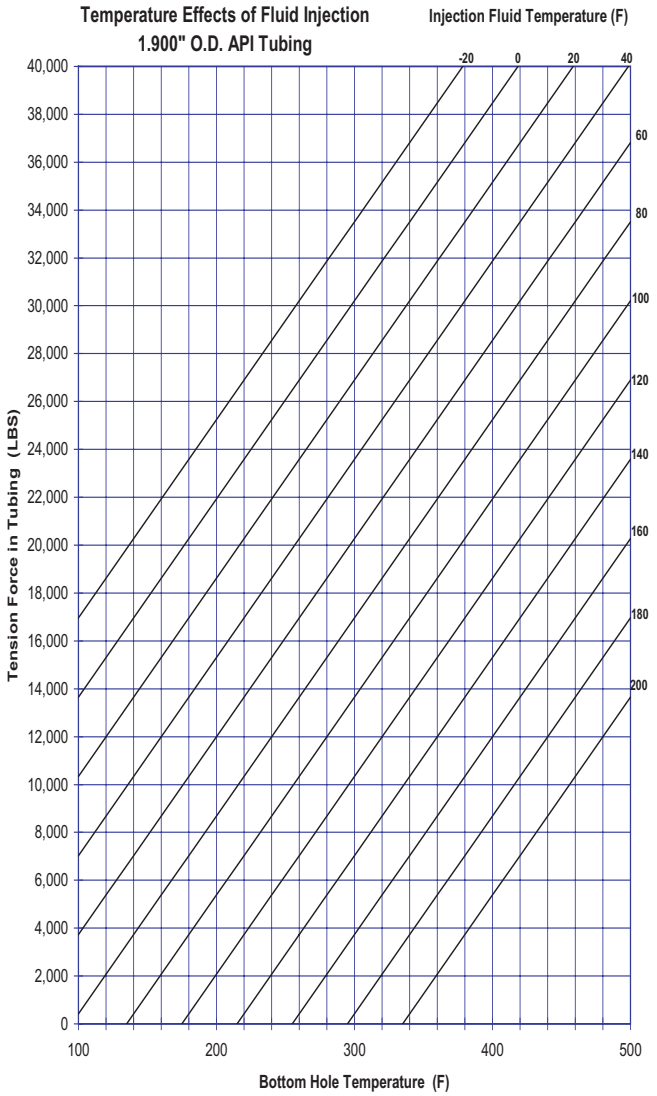
ΔL	=	Length change (in)
L	=	Length of tubing string (ft)
β	=	Coefficient of Thermal Expansion (0.0000069 in/in/°F for steel)
ΔT	=	Change in average tubing temperature (°F)

The average temperature of the string before running is assumed to be the ambient air temperature. The average temperature of the string in the well is taken to be the mean yearly temperature (70°F) averaged with the BHT.

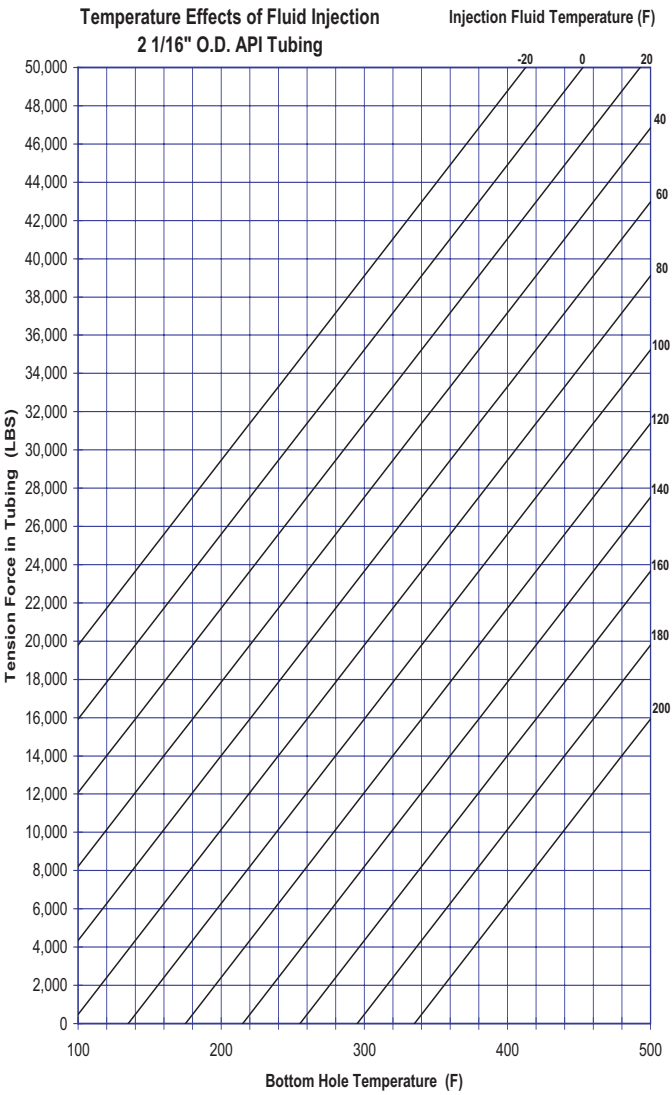
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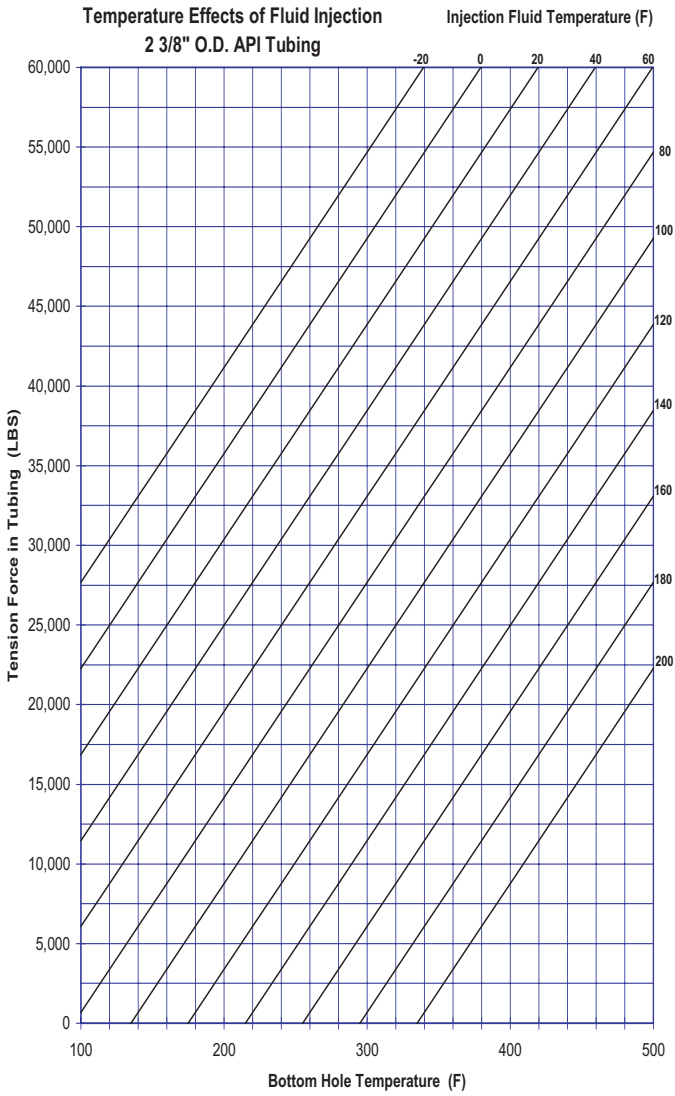
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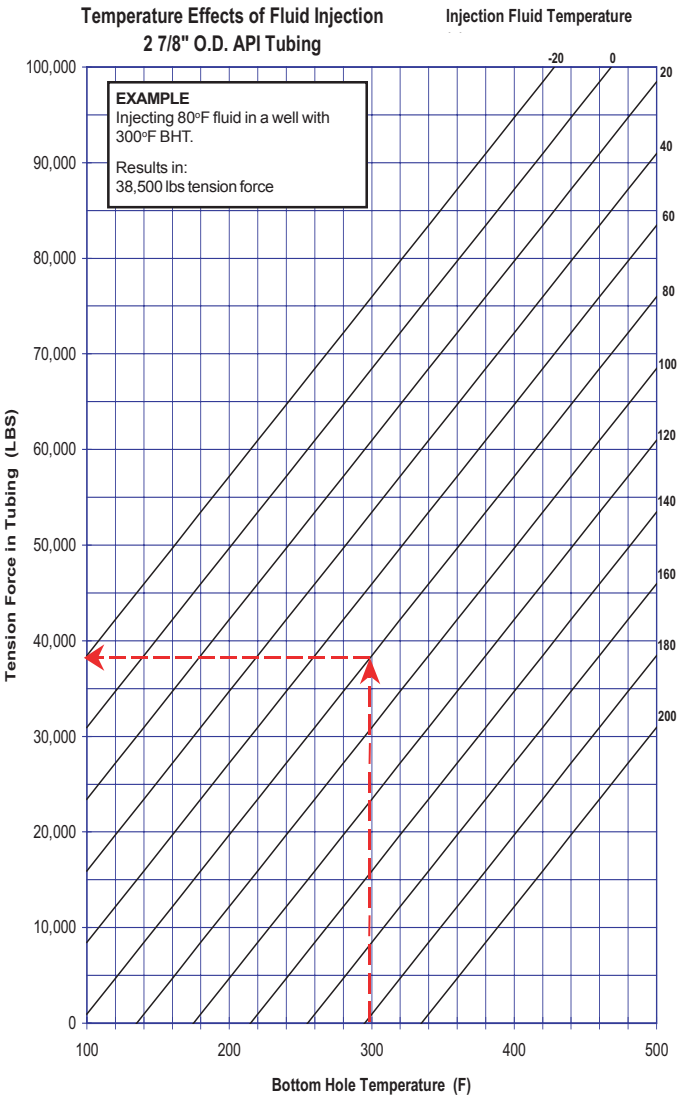


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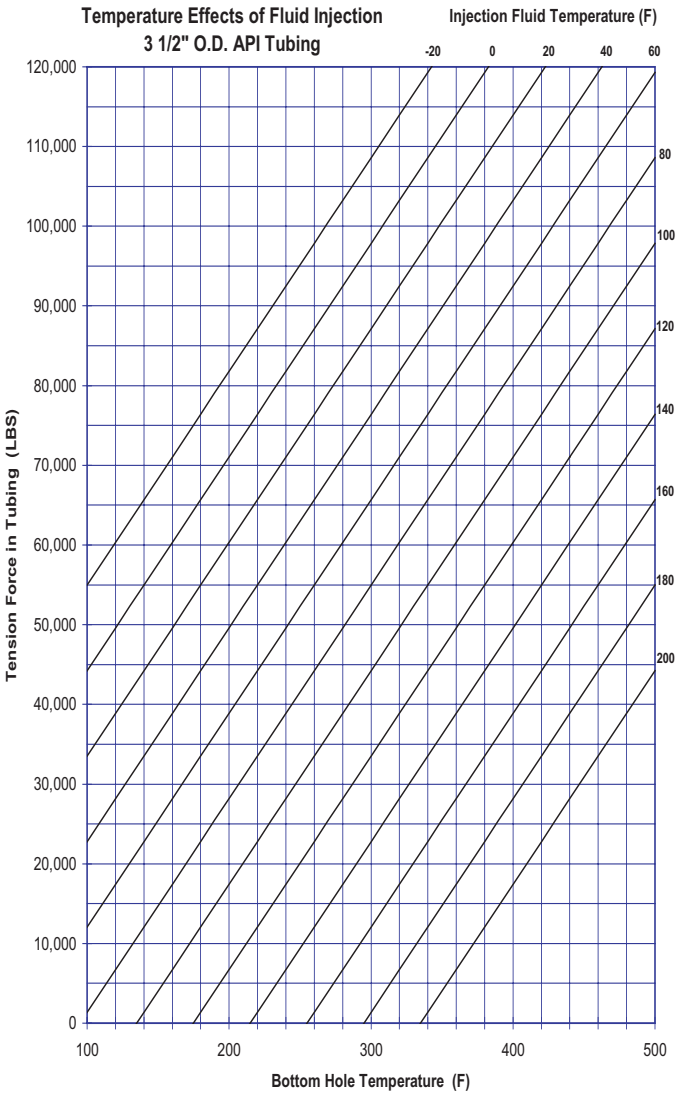


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Temperature Effects of Fluid Injection
2 7/8" O.D. API Tubing

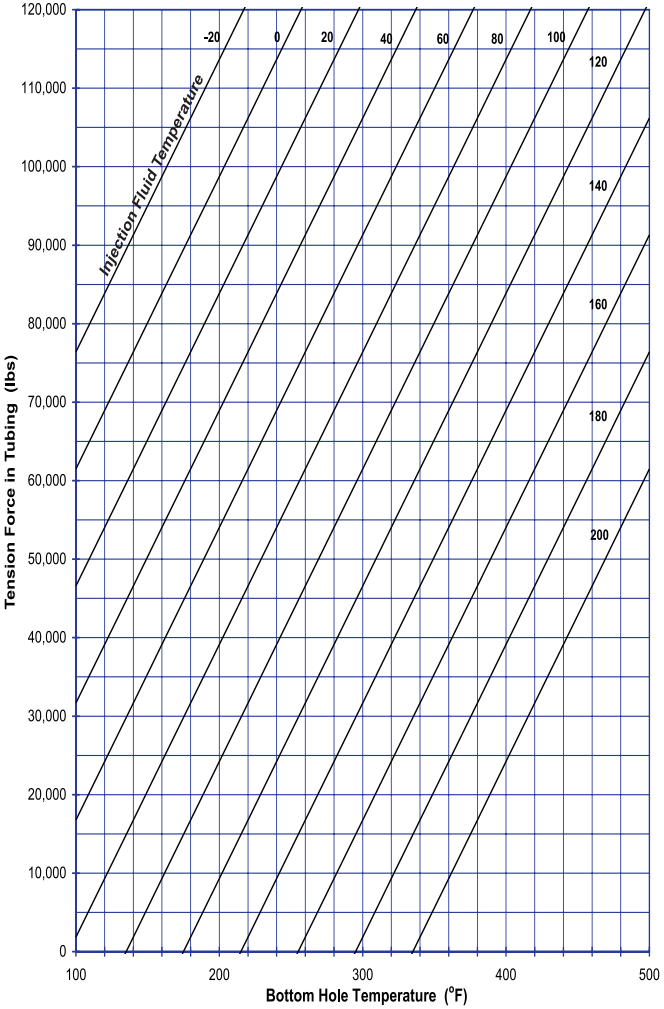


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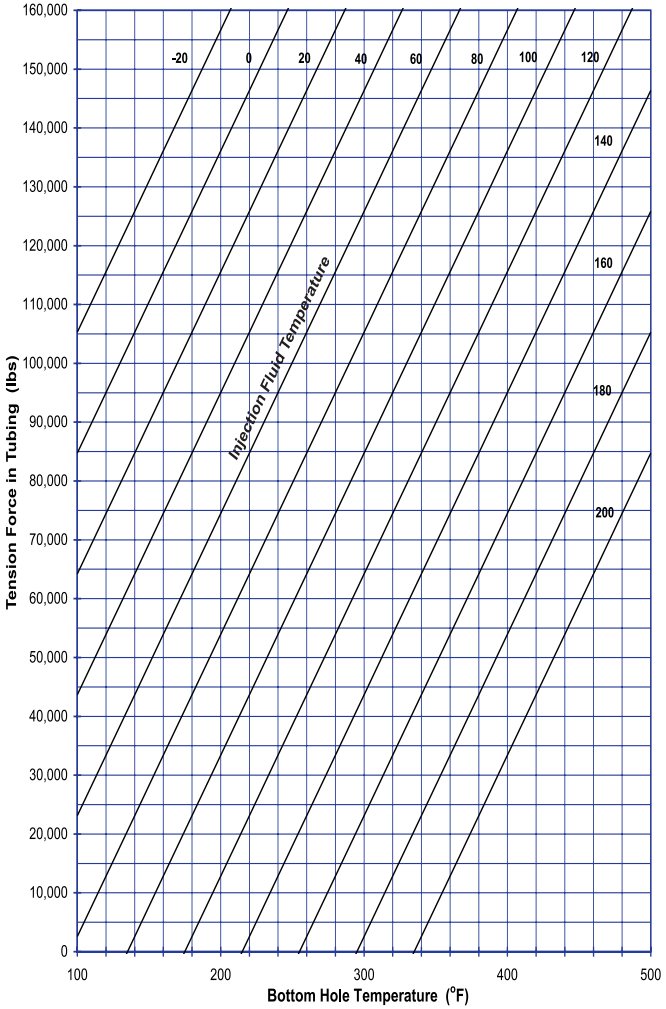
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Temperature Effects of Fluid Injection
4-1/2" O.D. 12.6/12.75# API Tubing



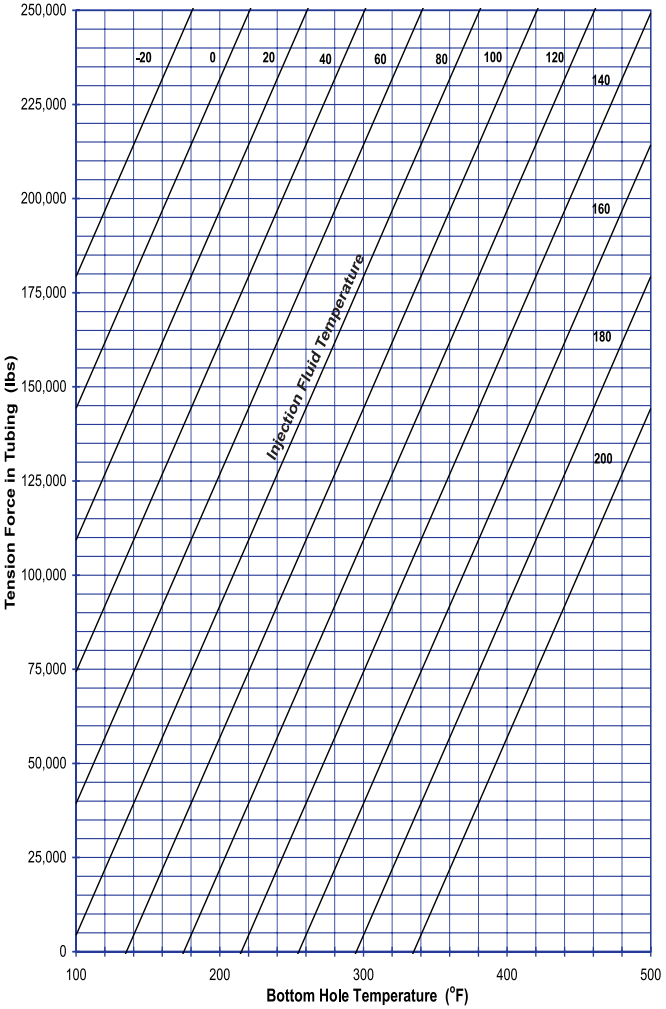
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Temperature Effects of Fluid Injection
5-1/2" O.D. 17# API Tubing



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Temperature Effects of Fluid Injection
7" O.D. 29# API Tubing



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FLUID DENSITY AND PRESSURE 14

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FLUID GRADIENT & PRESSURE FORMULAE

FLUID GRADIENT VS. SLURRY DENSITY (HYDROSTATIC PRESSURE EXERTED BY FLUID/SAND MIXTURES)

On occasion you may be required to operate a tool in the presence of a sand laden slurry. To properly operate that tool, you will need to know the hydrostatic pressure exerted by a column of this slurry. The following chart will provide fluid gradient factors needed in making this calculation, based on the true density of the sand being 22.144 lb/gallon.

Densities of Sand/Fluid Slurries:

#/Gal Slurry = (MW + PSA)÷ [(.0456 x PSA) + 1]

where:

MW = #/gal of fluid
PSA = pounds of sand added per gallon of fluid

Example of Calculation:

The customer tells you he is going to pump 500 bbls of 9.2 #/gal gelled brine adding 2 pounds of sand per gallon of fluid.

#/Gal Slurry = (9.2 + 2) ÷ [(.0456 x 2) + 1]
= 10.264 #/Gal Slurry

Note: This is the fluid density used to calculate hydrostatic pressure.

Calculate fluid gradient = 10.264 x 0.052
= 0.534 psi/ft

NOTE: The chart on the next page depicts the graphical solution to this example.

Use the calculation procedure from the preceding chapter to determine pressures at the tool.

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LIQUID GRADIENTS

Liquid gradient (psi/ft) = MW x .052

where,

MW = Fluid Weight (lb/gal)

Liquid gradient (psi/ft) = MW x .007

where,

MW = Fluid Weight (lb/ft^3)

Liquid gradient (psi/ft) = SG x .433

where,

SG = Specific Gravity of Fluid

$$\text{Liquid gradient (psi/ft)} = \frac{61.27}{(131.5 + {}^{\circ}\text{API})}$$

where,

°API = API scale of Specific Gravity for Oil

SLURRY GRADIENTS

$$\text{Slurry Gradient (psi/ft)} = \left(\frac{[\text{MW} + (\text{lbs of sand added per gal})]}{1 + [(.0456\ \text{gal/lb}) \times (\text{lbs of sand added per gal})]}\right) \times .052$$

where,

MW = Fluid Weight (lb/gal)

HYDROSTATIC PRESSURE

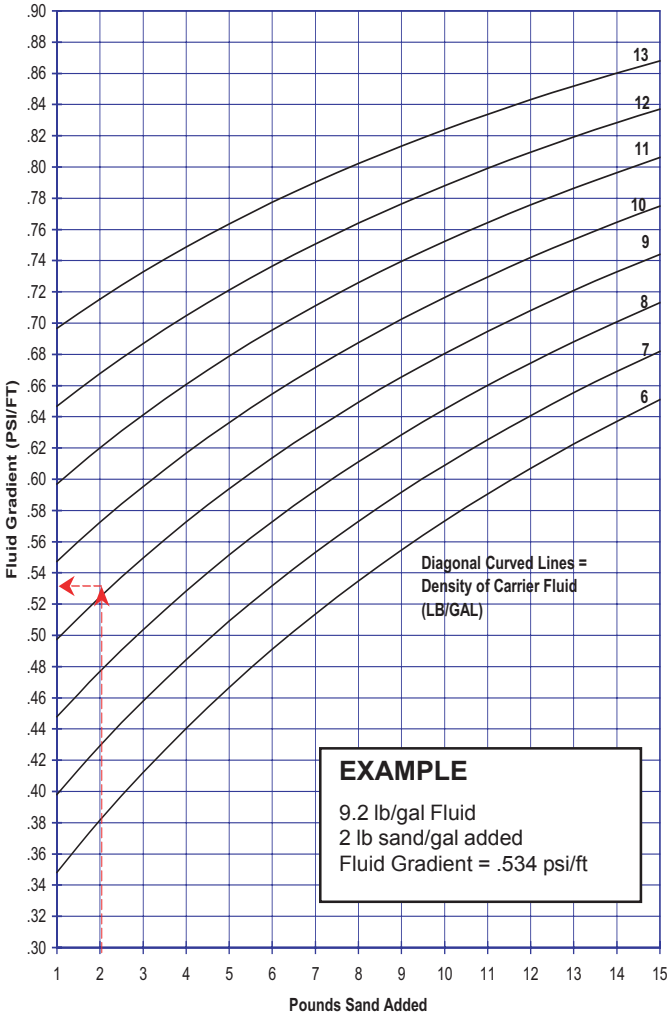
Hydrostatic Pressure (psi) = LG x L

where,

LG = Liquid gradient (psi/ft)
L = Vertical Depth (ft)

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Slurry Density - Fluid Gradient



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Fluid Gradient Table

Weight (#/GAL)	Fluid Gradient (PSI/FT)	Density API Gravity
6.160	0.3200	60
6.325	0.3286	55
6.499	0.3376	50
6.572	0.3414	48
6.646	0.3452	46
6.721	0.3491	44
6.760	0.3512	43
6.799	0.3532	42
6.838	0.3552	41
6.878	0.3573	40
6.918	0.3594	39
6.959	0.3615	38
7.001	0.3637	37
7.042	0.3658	36
7.085	0.3681	35
7.128	0.3703	34
7.171	0.3725	33
7.215	0.3748	32
7.259	0.3771	31
7.304	0.3794	30
7.396	0.3842	28
7.490	0.3891	26
7.586	0.3941	24
7.685	0.3992	22
7.786	0.4045	20
7.890	0.4099	18
8.052	0.4183	15
8.220	0.4270	12
8.337	0.4331	10
Weight (#/GAL)	**Fluid Gradient (PSI/FT)**	**Weight (#/cu ft)**
8.337	0.4331	62.37
8.400	0.4364	62.84
8.600	0.4468	64.33
8.800	0.4571	65.83
9.000	0.4675	67.32
9.200	0.4779	68.82
9.400	0.4883	70.32
9.600	0.4987	71.81
9.800	0.5091	73.31
10.000	0.5195	74.81
10.200	0.5299	76.30
10.400	0.5403	77.80
10.600	0.5506	79.29
10.800	0.5610	80.79
11.000	0.5714	82.29

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Fluid Gradient Table

Weight (#/GAL)	Fluid Gradient (PSI/FT)	Weight (#/cu ft)
11.200	0.5818	83.78
11.400	0.5922	85.28
11.600	0.6026	86.77
11.800	0.6130	88.27
12.000	0.6234	89.77
12.200	0.6338	91.26
12.400	0.6442	92.76
12.600	0.6545	94.25
12.800	0.6649	95.75
13.000	0.6753	97.25
13.200	0.6857	98.74
13.400	0.6961	100.24
13.600	0.7065	101.74
13.800	0.7169	103.23
14.000	0.7273	104.73
14.200	0.7377	106.22
14.400	0.7481	107.72
14.600	0.7584	109.22
14.800	0.7688	110.71
15.000	0.7792	112.21
15.200	0.7896	113.70
15.400	0.8000	115.20
15.600	0.8104	116.70
15.800	0.8208	118.19
16.000	0.8312	119.69
16.200	0.8416	121.18
16.400	0.8519	122.68
16.600	0.8623	124.18
16.800	0.8727	125.67
17.000	0.8831	127.17
17.200	0.8935	128.66
17.400	0.9039	130.16
17.600	0.9143	131.66
17.800	0.9247	133.15
18.000	0.9351	134.65
18.200	0.9455	136.15
18.400	0.9558	137.64
18.600	0.9662	139.14
18.800	0.9766	140.63
19.000	0.9870	142.13
19.200	0.9974	143.63
19.400	1.0078	145.12
19.600	1.0182	146.62
19.800	1.0286	148.11
20.000	1.0390	149.61

Steel = 65 PPG

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GAS PRESSURE AT SURFACE VS. BOTTOM HOLE PRESSURE

Bottom Hole Pressure for a Column of Nitrogen

It is often necessary to calculate the bottom hole pressure for a well displaced with nitrogen gas. Being a gas, its weight changes with temperature and pressure according to the "Perfect Gas Law"

$$PV = nRT$$

This formula is presented for your information only to show the linear relationship between pressure, volume, and temperature. It is **not** to be used to calculate bottom hole pressure.

The density, and hence the weight, increases with an increase in pressure and decreases with an increase in temperature.

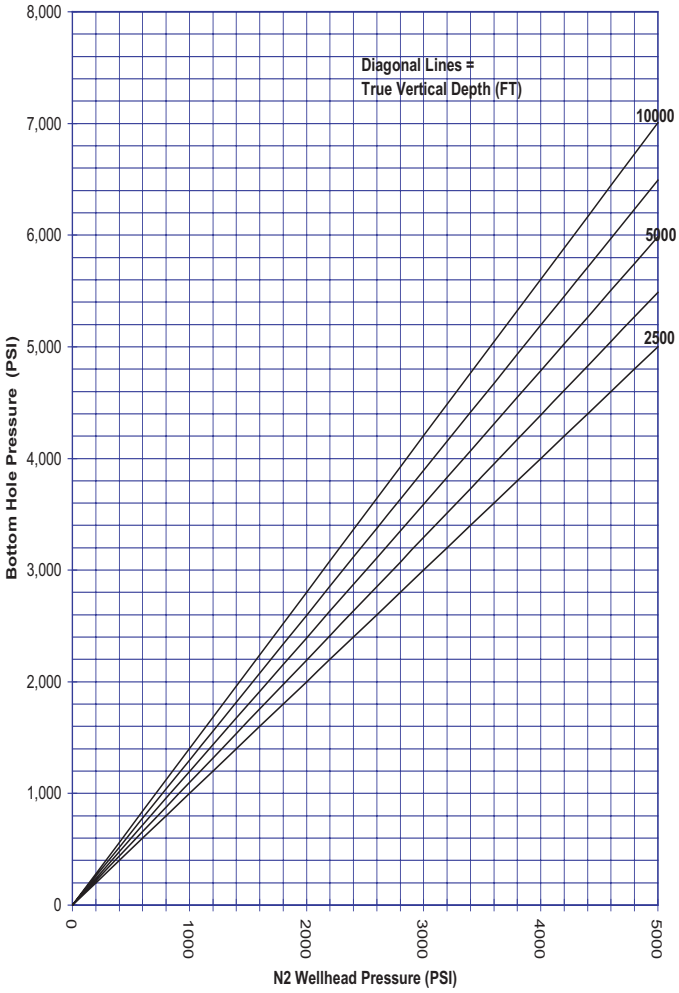
To present a simplified graph of bottom hole pressure and hydrostatic pressure with different wellhead pressures, we must assume a surface temperature and temperature gradient. It is well known that temperatures are not the same in all wells at a specific depth, but an average temperature is assumed for this graph. This average will be 70°F at surface with a 0.016°F per foot geothermal temperature gradient. On a 10,000 foot deep vertical well, this would equate to 230°F BHT.

The primary purpose of calculating the bottom hole pressure of a column of nitrogen is to balance fluids across a packer. To use the chart on the following page, calculate the bottom hole pressure at the tool (hydrostatic of the column of fluid), read across to the well depth, then down to get nitrogen pressure at the wellhead. The difference between bottom hole pressure and the nitrogen pressure at the wellhead is the hydrostatic head of the column of nitrogen gas.

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Nitrogen Wellhead Pressure vs Bottom Hole Pressure

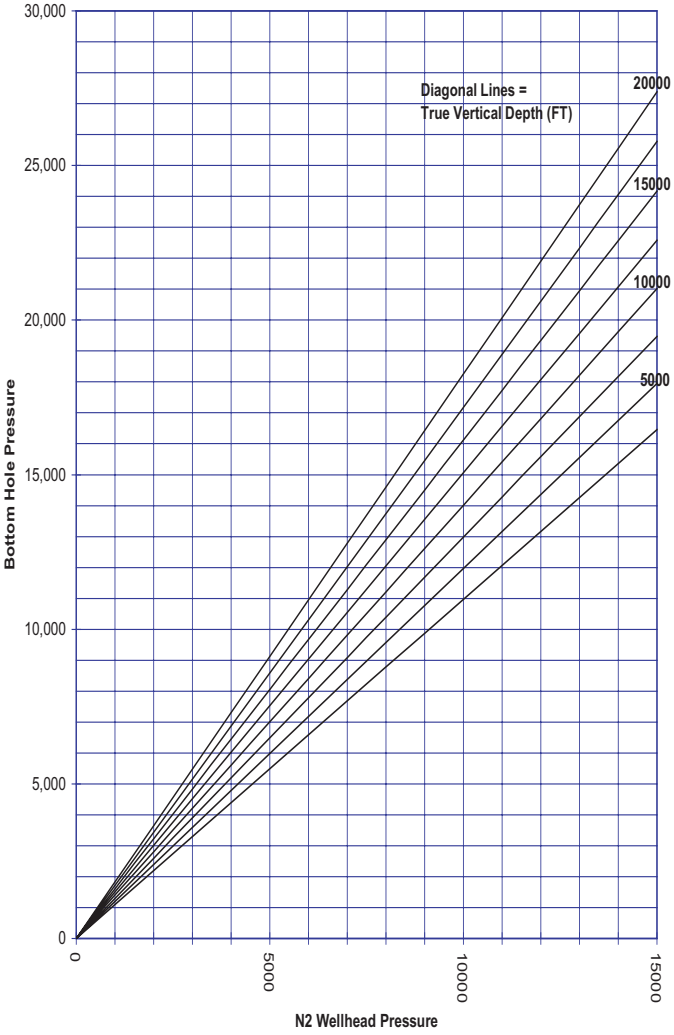
Calculated Using Temperature Compensation for Depth and Gas Gravity of .96685 with Respect to Air



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Nitrogen Wellhead Pressure vs Bottom Hole Pressure

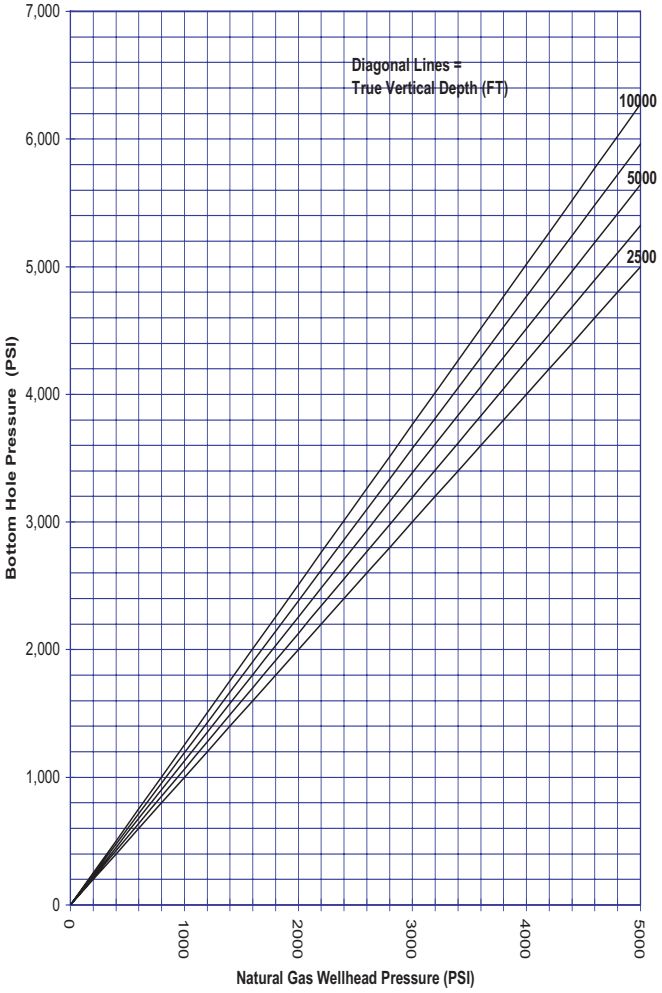
Calculated Using Temperature Compensation for Depth and Gas Gravity of .96685 with Respect to Air



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Natural Gas Wellhead Pressure vs Bottom Hole Pressure

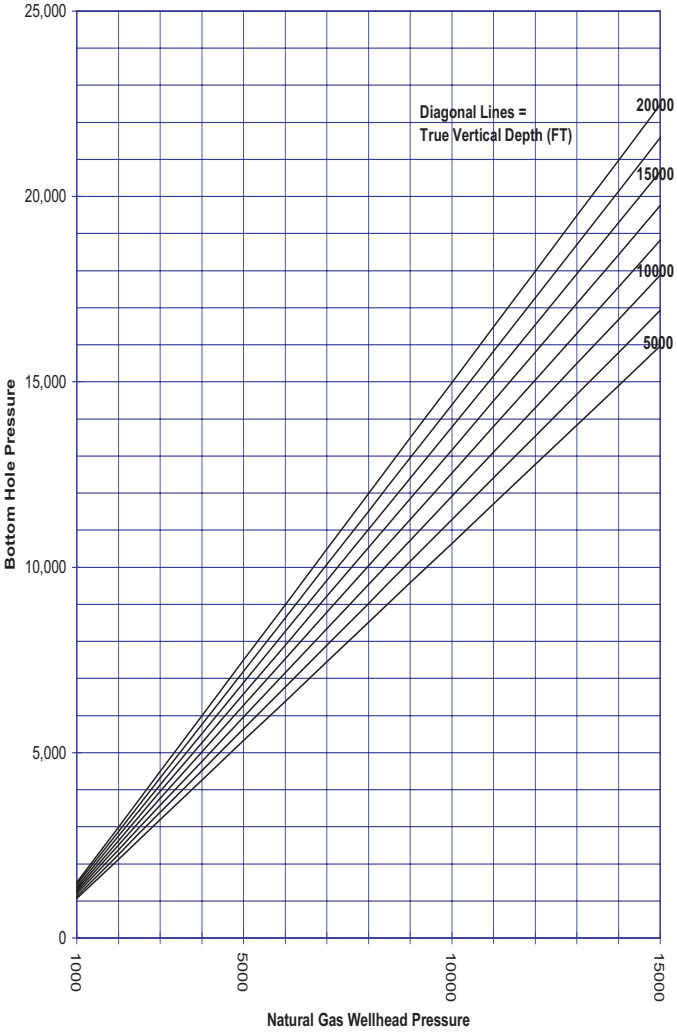
Calculated Using Temperature Compensation for Depth and Gas Gravity of .650 with Respect to Air



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Natural Gas Wellhead Pressure vs Bottom Hole Pressure

Calculated Using Temperature Compensation for Depth and Gas Gravity of .650 with Respect to Air



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Gas Fluid Density

Assumed Gas Gradient for Varied Pressures

(For Dry Gas Specific Gravity 0.6 with respect to air)

Pressure	Gradient	LBS/GAL
0	0.000	0.00
200	0.005	0.10
400	0.009	0.17
600	0.013	0.25
800	0.018	0.35
1,000	0.022	0.42
1,200	0.026	0.50
1,400	0.031	0.60
1,600	0.035	0.67
1,800	0.039	0.75
2,000	0.044	0.85
2,200	0.048	0.92
2,400	0.052	1.00
2,600	0.057	1.10
2,800	0.061	1.17
3,000	0.065	1.25
3,200	0.070	1.35
3,400	0.074	1.42
3,600	0.078	1.50
3,800	0.083	1.60
4,000	0.087	1.67
4,200	0.091	1.75
4,400	0.096	1.85
4,600	0.100	1.93
4,800	0.105	2.02
5,000	0.109	2.10
5,200	0.113	2.18
5,400	0.118	2.27
5,600	0.122	2.35
5,800	0.126	2.43
6,000	0.131	2.52
6,200	0.135	2.60
6,400	0.139	2.68
6,600	0.144	2.77
6,800	0.148	2.85
7,000	0.152	2.93
7,200	0.157	3.02
7,400	0.161	3.10

Pressure	Gradient	LBS/GAL
7,600	0.165	3.18
7,800	0.170	3.27
8,000	0.174	3.35
8,200	0.178	3.43
8,400	0.183	3.52
8,600	0.187	3.60
8,800	0.191	3.68
9,000	0.196	3.77
9,200	0.200	3.85
9,400	0.204	3.93
9,600	0.209	4.02
9,800	0.213	4.10
10,000	0.217	4.18
10,200	0.222	4.27
10,400	0.226	4.35
10,600	0.230	4.43
10,800	0.235	4.52
11,000	0.239	4.60
11,200	0.243	4.68
11,400	0.248	4.77
11,600	0.252	4.85
11,800	0.256	4.93
12,000	0.261	5.02
12,200	0.265	5.10
12,400	0.269	5.18
12,600	0.274	5.27
12,800	0.278	5.35
13,000	0.282	5.43
13,200	0.287	5.52
13,400	0.291	5.60
13,600	0.295	5.68
13,800	0.300	5.78
14,000	0.304	5.85
14,200	0.309	5.95
14,400	0.313	6.03
14,600	0.317	6.10
14,800	0.322	6.20
15,000	0.326	6.28

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Fluid Density and Pressure

(At 60 degrees F)

		Density			Fluid Head		
Degrees API	Specific Gravity	lb/gal	lb/cu ft	g/cc	psi/ft	kg/sq cm/m	Buoyancy Factor
60	0.738	6.160	46.08	0.738	0.320	0.0738	0.905
55	0.758	6.325	47.31	0.758	0.328	0.0758	0.903
50	0.779	6.499	48.62	0.779	0.336	0.0779	0.900
45	0.801	6.683	49.99	0.801	0.347	0.0801	0.897
40	0.825	6.878	51.45	0.825	0.357	0.0825	0.894
35	0.849	7.085	53.00	0.849	0.368	0.0849	0.891
30	0.876	7.304	54.64	0.876	0.379	0.0876	0.888
25	0.904	7.537	56.38	0.904	0.391	0.0904	0.884
20	0.933	7.786	58.24	0.933	0.404	0.0933	0.880
15	0.965	8.052	60.23	0.965	0.418	0.0965	0.876
10	1.000	8.337	62.36	1.000	0.433	0.1000	0.872
	1.007	8.400	62.83	1.007	0.436	0.1007	0.871
	1.031	8.600	64.33	1.031	0.446	0.1031	0.868
	1.055	8.800	65.82	1.055	0.457	0.1055	0.865
	1.079	9.000	67.32	1.079	0.467	0.1079	0.862
	1.103	9.200	68.82	1.103	0.477	0.1103	0.859
	1.127	9.400	70.31	1.127	0.488	0.1127	0.856
	1.151	9.600	71.81	1.151	0.498	0.1151	0.852
	1.175	9.800	73.30	1.175	0.509	0.1175	0.849

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Fluid Density and Pressure

(At 60 degrees F)

		Density			Fluid Head		
Degrees API	Specific Gravity	lb/gal	lb/cu ft	g/cc	psi/ft	kg/sq cm/m	Buoyancy Factor
	1.199	10.000	74.80	1.199	0.519	0.1199	0.846
	1.223	10.200	76.30	1.223	0.529	0.1223	0.843
	1.247	10.400	77.79	1.247	0.540	0.1247	0.840
	1.271	10.600	79.29	1.271	0.550	0.1271	0.837
	1.295	10.800	80.78	1.295	0.561	0.1295	0.834
	1.319	11.000	82.28	1.319	0.571	0.1319	0.831
	1.343	11.200	83.78	1.343	0.581	0.1343	0.828
	1.367	11.400	85.27	1.367	0.592	0.1367	0.825
	1.391	11.600	86.77	1.391	0.602	0.1391	0.822
	1.415	11.800	88.27	1.415	0.612	0.1415	0.819
	1.439	12.000	89.76	1.439	0.623	0.1439	0.816
	1.463	12.200	91.26	1.463	0.633	0.1463	0.813
	1.487	12.400	92.75	1.487	0.644	0.1487	0.810
	1.511	12.600	94.25	1.511	0.654	0.1511	0.806
	1.535	12.800	95.75	1.535	0.664	0.1535	0.803
	1.569	13.000	97.24	1.559	0.675	0.1559	0.800
	1.583	13.200	98.74	1.583	0.685	0.1583	0.797
	1.607	13.400	100.23	1.607	0.696	0.1607	0.794

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Fluid Density and Pressure

(At 60 degrees F)

		Density			Fluid Head		
Degrees API	Specific Gravity	lb/gal	lb/cu ft	g/cc	psi/ft	kg/sq cm/m	Buoyancy Factor
	1.631	13.600	101.73	1.631	0.706	0.1631	0.791
	1.655	13.800	103.23	1.655	0.716	0.1655	0.788
	1.679	14.000	104.72	1.679	0.727	0.1679	0.785
	1.703	14.200	106.22	1.703	0.737	0.1703	0.782
	1.727	14.399	107.71	1.727	0.748	0.1727	0.779
	1.751	14.600	109.21	1.751	0.758	0.1751	0.776
	1.775	14.800	110.71	1.775	0.768	0.1775	0.773
	1.799	15.000	112.20	1.799	0.779	0.1799	0.770
	1.823	15.200	113.70	1.823	0.789	0.1823	0.767
	1.847	15.400	115.20	1.847	0.799	0.1847	0.764
	1.871	15.600	116.69	1.871	0.810	0.1871	0.761
	1.895	15.800	118.19	1.895	0.820	0.1895	0.757
	1.919	16.000	119.68	1.919	0.831	0.1919	0.754
	1.943	16.200	121.18	1.943	0.841	0.1943	0.751
	1.967	16.400	122.69	1.967	0.851	0.1967	0.748
	1.991	16.600	124.17	1.991	0.862	0.1991	0.745
	2.015	16.800	125.67	2.015	0.872	0.2015	0.742
	2.039	17.000	127.16	2.039	0.883	0.2039	0.739

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Fluid Density and Pressure

(At 60 degrees F)

		Density			Fluid Head		
Degrees API	Specific Gravity	lb/gal	lb/cu ft	g/cc	psi/ft	kg/sq cm/m	Buoyancy Factor
	2.063	17.200	128.66	2.063	0.893	0.2063	0.736
	2.087	17.400	130.16	2.087	0.903	0.2087	0.733
	2.111	17.600	131.65	2.111	0.914	0.2111	0.730
	2.135	17.800	133.15	2.135	0.924	0.2135	0.727
	2.159	18.000	134.64	2.159	0.935	0.2159	0.724
	2.183	18.200	136.14	2.183	0.945	0.2183	0.721
	2.207	18.400	137.64	2.207	0.955	0.2207	0.718
	2.231	18.600	139.13	2.231	0.966	0.2231	0.715
	2.255	18.800	140.63	2.255	0.976	0.2255	0.712
	2.278	19.000	142.12	2.278	0.987	0.2278	0.708
	2.302	19.200	143.62	2.302	0.997	0.2302	0.705
	2.326	19.400	145.12	2.326	1.007	0.2326	0.702
	2.350	19.600	146.61	2.350	1.018	0.2350	0.699
	2.374	19.800	148.11	2.374	1.028	0.2374	0.696
	2.398	20.000	149.61	2.398	1.038	0.2398	0.693

Buoyancy factor is used to compensate for loss of weight when steel tubulars are immersed in fluid.
Applicable only when tubing or casing is completely filled with fluid.
Actual hook load = length of string (ft) x weight of string (lb/ft) x Buoyancy Factor.

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SECTION 5 - TUBING ANCHORS

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Tension Force Tables - 3-1/2” Tubing 6
SHEAR PIN SELECTION TABLE 7

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Tubing Anchor Example Calculations:

Shear Release
Tubing Anchors are furnished with an adjustable shear release. This release is a secondary or safety release and is not used unless the anchor cannot be released normally. It is usual practice to run anchors with a high shear value to insure against accidental or pre-mature releasing. If too high a shear value is used, it may be impossible to use the shear release without damaging the tubing.

If the rods, pump, and standing valve are pulled from the well and the anchor must be sheared to release, you would be required to pull the weight of the string plus the shear value of the tool.

In the previous case:
Force to shear release tubing anchor = Tubing WT. + Shear Value
= 18,800 + 50,000
= 68,800 #
Caution: We are now within 5% of the joint yield strength of the tubing.

In the unlikely event that the sucker rods are pulled, but the tubing remains full of trapped fluid, you must now pull the weight of the tubing plus the shear value of the tool, *plus* the weight of the column of fluid.

Force to shear release tubing anchor = Tubing Wt. + Shear + Fluid Wt.
= 18,800 + 50,000 + 6000
= 74,800 #

We now risk tubing damage by pulling over the joint strength. For this application, it is suggested a lighter shear value be used, as the required tension is considerably less than the shear value.

Assuming the worst case, where the rods and pump cannot be pulled and the tubing is trapped full of fluid. We must now add the weight of the rod string to the answer directly above.

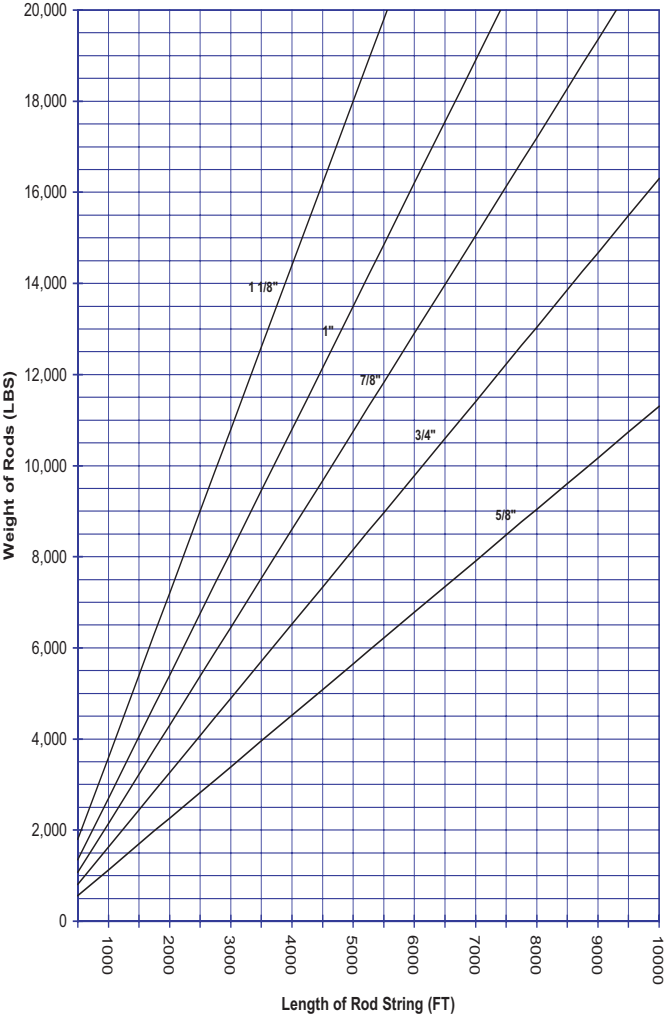
Force to shear release tubing anchor = 74,800 + 8000
= 82,800 #

Tubing damage is now certain with this configuration. Our options include a lighter shear value or a stronger tubing string.

Minimum Shear Values
Tubing Anchors are shipped with all shear screws installed (maximum shear value). In the preceding example, the shear value should have been reduced to allow for *all* operational contingencies. If too low a value is used, you run the risk of pre-mature release. The following table lists *minimum* recommended shear values. The table does not take into account, the type of donut or tubing hanger used, as some types require tension higher than FT to install.

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Weight of Rod Strings



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NOTE: The total tension required to offset piston, bouyancy, and temperature effects is obtained by Ft (total tension)= F1+F2-F3.

TUBING ANCHORS Tension Force Charts – 2-3/8" Tubing O.D.

Table #1 F_1 – OPERATING FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH (Feet)	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
1000	610	1550													
2000	520	1220	2080	3100											
3000	500	1110	1830	2660	3590	4640									
4000	480	1060	1700	2430	3250	4140	5130	6300							
5000	470	1020	1630	2300	3040	3840	4730	5670	6670	7750					
6000	470	1000	1580	2210	2900	3650	4450	5310	7220	7200	8210	9300			
7000	460	980	1540	2150	2800	3500	4260	5060	5900	6800	7740	8730	9760	10,850	
8000	460	970	1520	2100	2730	3400	4120	4870	5660	6510	7380	8300	9260	10,270	11,310
9000	460	960	1500	2060	2670	3310	4010	4720	5470	6270	7100	7970	8870	9820	10,790
10,000	460	960	1480	2040	2630	3520	3910	4600	5320	6090	6870	7700	8550	9450	10,370

OPERATING FLUID LEVEL (feet)

Table #2 F_2 - TEMPERATURE INCREASE FACTOR

ΔF	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
F_2	1350	2700	4050	5400	6750	8100	9450	10,800	12,150	13,500	14,850	16,200	17,550	10,850	20,200

To obtain F_2: Subtract the mean yearly temperature for the area in which the well is located from the temperature of the well fluid at surface.
Locate your answer in the ΔF row. Read F_2 immediately below.

Table #3 F_3 – INITIAL WELL FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH (Feet)	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
1000	180	460													
2000	150	360	610	910											
3000	150	330	540	780	1060	1370									
4000	140	310	500	720	960	1220	1510	1820							
5000	140	300	480	680	890	1130	1390	1670	1960	2290					
6000	140	290	460	650	850	1070	1310	1560	1830	2130	2430	2740			
7000	140	290	450	630	820	1030	1250	1490	1740	2010	2290	2580	2880	3200	
8000	140	280	450	620	800	1000	1210	1430	1670	1920	2180	2450	2730	3030	3340
9000	140	280	440	610	780	980	1170	1390	1610	1850	2100	2350	2620	2900	3180
10,000	130	280	430	600	770	960	1150	1350	1570	1800	2030	2270	2530	2790	3060

FLUID LEVEL WHEN ANCHOR IS SET (feet)

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TUBING ANCHORS Tension Force Charts – 2-7/8" Tubing O.D.

Table #1 F_1 – OPERATING FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH (Feet)	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
1000	890	2180													
2000	770	1790	3040	4540											
3000	730	1630	2670	3890	5270	6800									
4000	710	1540	2490	3560	4760	6070	7520	9090							
5000	700	1500	2380	3370	4460	5630	6930	8310	9770	11,300					
6000	690	1460	2310	3240	4250	5340	6530	7790	9110	10,530	12,040	13,630			
7000	680	1440	2250	3150	4110	5130	6240	7410	8640	9960	11,340	12,790	14,320	15,890	
8000	680	1420	2210	3080	4000	4980	6030	7130	8300	9520	10,810	12,160	13,580	15,040	16,560
9000	680	1410	2180	3020	3920	4850	5870	6920	8020	9180	10,400	11,680	13,000	14,370	15,800
10,000	670	1400	2160	2980	3850	4760	5630	6740	7800	8910	10,080	11,290	12,550	13,800	15,190

OPERATING FLUID LEVEL (feet)

Table #2 F_2 - TEMPERATURE INCREASE FACTOR

°F	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
F_2	1880	3750	5630	7500	9370	11,250	13,100	15,000	16,900	18,800	20,600	22,500	24,400	26,100	28,100

To obtain F_2: Subtract the mean yearly temperature for the area in which the well is located from the temperature of the well fluid at surface.
Locate your answer in the °F row. Read F_2 immediately below.

Table #3 F_3 – INITIAL WELL FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH (Feet)	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
1000	250	630													
2000	210	500	850	1260											
3000	200	450	740	1080	1470	1910									
4000	200	430	690	990	1330	1700	2100	2540							
5000	190	410	660	940	1240	1580	1940	2320	2730	3170					
6000	190	410	640	900	1180	1500	1830	2170	2550	2940	3360	3800			
7000	190	400	630	880	1140	1440	1750	2070	2420	2780	3160	3570	3990	4440	
8000	190	390	620	860	1110	1400	1690	1990	2320	2660	3020	3390	3790	4210	4630
9000	190	390	610	840	1090	1360	1640	1930	2240	2560	2900	3260	3630	4020	4420
10,000	190	390	600	830	1070	1330	1600	1880	2180	2490	2810	3150	3500	3870	4250

FLUID LEVEL WHEN ANCHOR IS SET (feet)

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TUBING ANCHORS Tension Force Charts – 3-1/2" Tubing O.D.

Table #1 F_1 – OPERATING FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000
1000	1323	3367																
2000	1142	2645	4509	6733														
3000	1082	2405	3968	5772	7815	10100												
4000	1052	2285	3697	5291	7064	9018	11152	13467										
5000	1034	2212	3535	5002	6613	8369	10268	12313	14501	16834								
6000	1022	2164	3427	4809	6312	7936	9679	11543	13527	15631	17855	20201						
7000	1013	2130	3349	4672	6098	7626	9258	10993	12831	14772	16816	18963	21213	23567				
8000	1007	2104	3292	4569	5937	7395	8943	10581	12310	14123	16037	18036	20125	22304	24574	26934		
9000	1002	2084	3246	4489	5811	7214	8697	10260	11904	13627	15431	17314	19278	21322	23446	25650	27935	30300
10000	998	2068	3210	4425	5711	7070	8501	10004	11579	13226	14946	16737	18601	20537	22545	24625	26777	29002

OPERATING FLUID LEVEL (feet)

Table #2 F_2 - TEMPERATURE INCREASE FACTOR

ΔT	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
F_2	2680	5362	8043	10724	13405	16086	18767	21448	24129	26810	24491	32171	34852	37533	40214	42895	45576	48257	50938	53619

To obtain F_2: Subtract the mean yearly temperature for the area in which the well is located from the temperature of the well fluid at surface.
Locate your answer in the ΔF row. Read F_2 immediately below.

Table #3 F_3 – INITIAL WELL FLUID LEVEL FACTOR

PUMP AND TUBING ANCHOR DEPTH (Feet)	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000
1000	356	906																
2000	307	712	1214	1813														
3000	291	642	1068	1554	2104	2719												
4000	283	615	995	1424	1901	2427	3002	3625										
5000	278	596	952	1346	1780	2253	2754	3314	3903	4531								
6000	275	583	922	1295	1699	2136	2605	3107	3641	4208	4806	5438						
7000	273	573	902	1258	1641	5053	2492	2959	3454	3976	4527	5105	5710	6344				
8000	271	566	886	1230	1598	1991	2407	2848	3313	3803	4317	4855	5417	6004	6615	7250		
9000	270	561	874	1208	1564	1942	2341	2762	3204	3668	4154	4661	5189	5739	6311	6905	7520	8156
10000	269	557	864	1191	1537	1903	2288	2693	3117	3560	4023	4505	5007	5528	6069	6529	7208	7807

FLUID LEVEL WHEN ANCHOR IS SET (feet)

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SHEAR PIN SELECTION TABLE FOR ANCHOR CATCHER, TUBING & REDUCED SHEAR-OUT VALVES	
F_T (Prestrain Tension)	Minimum Shear Value (Including Safety Factor)
0 - 10,000 lbs	25,000 lbs
10,000 - 20,000 lbs	30,000 lbs
20,000 - 30,000 lbs	40,000 lbs
30,000 - 40,000 lbs	50,000 lbs

Important Note:

Total tension required to offset
Piston, Buoyancy and Temperature Effects
is obtained by:

$$F_t = F_1 + F_2 + F_3$$

F_t = total tension

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COMMON FORMULAS AND CONVERSION FACTORS

Multiply	By	To Obtain
Acres	43,560	Square feet
Acres	4,047	Square metres
Acres	160	Square rods
Acres	5,645.4	Square varas (Texas)
Acres	0.4047	Hectares
Acre feet	7,758	Barrels
Acre feet	1,233.5	Cubic metres
Atmospheres	33.94	Feet of water
Atmospheres	29.92	Inches of mercury
Atmospheres	760	Millimetres of mercury
Atmospheres (at sea level)	14.7	Pounds per square inch
Barrels	5.6146	Cubic feet
Barrels (oil)	0.15899	Cubic metres
Barrels (US liquid)	0.11924	Cubic metres
Barrels (oil)	42.0	Gallons
Barrels (US liquid)	31.5	Gallons
Barrels	158.9	Litres
Barrels of cement (dry weight)	376.0	Pounds of cement
Barrels per hour	0.0936	Cubic feet per minute
Barrels per hour	0.700	Gallons per minute
Barrels per hour	2.695	Cubic inches per second
Barrels per day	0.02917	Gallons per minute
Bars	0.9869	Atmosphere
British thermal unit	0.2928	Watt hours
BTU	1,055.06	Joules
BTU's per minute	0.02356	Horsepower
BTU's per second	1,054.4	Watts
Centigrade heat units	1.8	BTU
Centimetres	1×10^{8}	Angstrom units
Centimetres	0.01	Metres
Centimetres	0.03281	Feet
Centimetres	0.3937	Inches
Centimetres	10,000.0	Microns
Centimetres of mercury	0.1934	Pounds per square inch
Chains	66	Feet
Chains	4	Rods
Cubic centimetres	0.06102	Cubic inches
Cubic centimetres	2.6417×10^{-4}	Gallons
Cubic centimetres	0.0010567	Quarts (US fluid)
Cubic centimetres	0.03381	Ounces (US fluid)
Cubic feet	28,317.0	Cubic centimetres
Cubic feet	0.1781	Barrels
Cubic feet	7.481	Gallons (US)
Cubic feet	28.316	Litres
Cubic feet of steel	489.6	Pounds of steel

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Multiply	By	To Obtain
Cubic feet	1728	Cubic inches
Cubic feet	0.028317	Cubic metres
Cubic feet	0.03704	Cubic yards
Cubic feet / atmosphere	2,116.3	Foot / pounds
Cubic feet per minute	10.686	Barrels per hour
Cubic feet per minute	28.8	Cubic inches per second
Cubic feet per minute	7.481	Gallons per minute
Cubic feet per minute	0.1247	Gallons per second
Cubic feet per minute	472.0	Cubic centimetres per second
Cubic feet per second	7.48	Gallons per second
Cubic feet per second	0.64632	Million gallons per day
Cubic inches	16.387	Millilitres
Cubic inches	16.387	Cubic centimetres
Cubic inches	0.00058	Cubic feet
Cubic inches	0.00433	Gallons
Cubic inches	0.0164	Litres
Cubic metres	6.2897	Barrels
Cubic metres	35.314	Cubic feet
Cubic metres	1.308	Cubic yards
Cubic yards	4.8089	Barrels
Cubic yards	27	Cubic feet
Cubic yards	46,656	Cubic inches
Cubic yards	0.76456	Cubic metres
Fathoms	6.0	Feet
Fathoms	1.829	Metres
Feet	30.48	Centimetres
Feet	0.3048	Metres
Feet	0.3600	Varas (Texas)
Feet of water @ 60° F	0.4331	Pounds per square inch
Feet per minute	0.5080	Centimetres per second
Feet per second	0.68182	Miles per hour
Foot / pounds	0.0012856	BTU
Foot / pounds	3.766×10^{-7}	Kilowatt / hours
Foot / pounds per second	0.0013558	Kilowatts
Foot / pounds	5.051×10^{-7}	Horsepower / hours
Foot / pounds per second	0.0018182	Horsepower
Foot / pounds (force)	1.3558	Joules
Gallons (US liquid)	0.03175	Barrels (US liquid)
Gallons (US)	0.02381	Barrels
Gallons	0.003785	Cubic metres
Gallons (US)	3,785	Cubic centimetres
Gallons (US)	0.13368	Cubic feet
Gallons (US)	231	Cubic inches
Gallons (US)	3.785	Litres
Gallons (US)	0.8327	Gallons (imperial)
Gallons per minute	1.429	Barrels per hour

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Multiply	By	To Obtain
Gallons per minute	0.1337	Cubic feet per minute
Gallons per minute	0.002228	Cubic feet per second
Gallons per minute	34.286	Barrels per day
Grains (Avoirdupois)	0.0648	Grams
Grains per gallon	17.118	Parts per million
Grains per gallon	142.86	Pounds per million gallons
Grains per gallon	0.01714	Grams per litre
Grams	15.432	Grains
Grams	0.001	Kilograms
Grams	1,000	Milligrams
Grams	0.03527	Ounces
Grams	0.002205	Pounds
Grams per litre	58.418	Grains per gallon
Hectare	2.471	Acres
Hectare	0.010	Square kilometres
Horsepower (British)	2,545.0	BTU per hour
Horsepower (British)	42.42	BTU per minute
Horsepower	0.7457	Kilowatts
Horsepower (British)	745.7	Watts
Horsepower (British)	1.0139	Horsepower (metric)
Horsepower	33,000	Foot pounds per minute
Horsepower (metric)	542.47	Foot / pounds per second
Inches	0.0254	Metres
Inches	2.54	Centimetres
Inches	0.08333	Feet
Inches of mercury	1.134	Feet of water
Inches of mercury	0.4912	Pounds per square inch
Inches of water @ 60° F	0.0361	Pounds per square inch
Kilograms per square centimetres	14.223	Pounds per square inch
Kilograms	2.2046	Pounds
Kilograms	1,000	Grams
Kilometres	0.6214	Miles
Kilometres	3,281	Feet
Kilopascals	0.1451	PSI
Kilowatt / hours	3,414.0	BTU
Kilowatts	1.3410	Horsepower
Knots (international)	0.5144	Metres per second
Knots (nautical miles per hour)	1.1516	Miles per hour
Litres	1,000	Cubic centimetres
Litres	61.02	Cubic inches
Litres	0.26418	Gallons
Litres	1.0567	Quarts
Metres	100	Centimetres
Metres	3.281	Feet
Metres	39.37	Inches
Metres	1.094	Yards

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Multiply	By	To Obtain
Miles	5,280.0	Feet
Miles	1,609.3	Metres
Miles	1.609	Kilometres
Miles	1,900.8	Varas (Texas)
Miles (international nautical)	6,076.1033	Feet
Miles (international nautical)	1.1508	Miles (US statute)
Miles per hour	1.4667	Feet per second
Millimetres	0.001	Metres
Minutes (angle)	2.909×10^{-4}	Radians
Ounces	0.2835	Kilograms
Ounces (avoirdupois)	437.5	Grains
Ounces (avoirdupois)	28.3495	Grams
Ounces (US fluid)	29.57	Millilitres
Parts per million	0.05835	Grains per gallon
Parts per million	8.34	Pounds per million gallons
Pints (US liquid)	1.89	Litres
Pounds	7,000	Grains
Pounds	453.6	Grams
Pounds	0.45359	Kilograms
Pounds force	4.4482	Newtons
Pounds per gallon	0.1198	Grams per cubic centimetre
Pounds per gallon	0.052	Pounds/sq inch/feet of depth
Pounds per square inch	2.309	Feet of water at 60° F
Pounds per square inch	2.0353	Inches of mercury
Pounds per square inch	51.697	Millimetres of mercury
Pounds per square inch	0.0703	Kilograms per sq centimetre
Pounds per square inch	6.8947	Kilopascals
Pounds per million gallons	0.11982	Parts per million
Pounds C° units (PCU)	1.8	BTU
PSI	6.895	Kilopascals
PSI	0.0703	Kilograms/Sq centimetre
Quarts	0.946	Litres
Quarts	946.36	Millilitres
Quintal (Mexican)	101.467	Pounds
Radians	57.30	Degrees
Revolutions per minute	0.10472	Radians per second
Rods	16.5	Feet
Square centimetres	0.1550	Square inches
Square feet	929	Square centimetres
Square feet	0.0929	Square metres
Square inches	6.452	Square centimetres
Square kilometres	0.3861	Square miles
Square metres	10.76	Square feet
Square metres	1.196	Square yards
Square miles	640	Acres
Square miles	2.590	Square kilometres

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Multiply	By	To Obtain
Square miles	0.8361	Square metres
Tons (long)	1,016.0	Kilograms
Tons (long)	2,240.0	Pounds
Tons (metric)	6.297	Barrels of water @ 60° F
Tons (metric)	1,000.0	Kilograms
Tons (metric)	2,204.6	Pounds
Tons (metric)	1.102	Tons (short or net)
Tons (short or net)	0.9072	Tons (metric)
Tons (short or net)	907.18	Kilograms
Tons (short or net)	2,000.0	Pounds
Vara (Texas)	2.7778	Feet
Yards	0.9144	Metres

Note:
To convert the right column to the left column, divide by the conversion factor.

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Base Unit	A Metric Units	B English Units	C Factor	D Factor
Length	Millimeters (mm)	Inches (in)	.0393701	25.40
	Meters (m)	Feet (ft)	3.28084	.3048
		Yards (yd)	1.09361	.9144
	Kilometers (Km)	Statute Miles	.621373	1.609394
		Nautical Miles (UK)	.539613	1.85318
		Nautical Miles (Other)	.539957	1.852
Area	Square Centimeters (cm^2)	Square Inches (in^2)	.155	6.4516
	Square Meters(m^2)	Square Feet (ft^2)	10.7639	.0929
	Hectares	Acres	2.47105	.404686
	Square Kilometers (Km^20	Square Miles (mi^2)	.386102	2.58999
Volume & Capacity	Cubic Centimeters (cm^3)	Cubic Feet (ft^3)	.353147	28.3168
		Gallons [US](Gal)	.264178	3.78533
		Gallons [UK](Gal)	.219976	4.54596
	Cubic Meters (m^3)	Cubic Feet (ft^3)	35.3147	.0283168
		Barrels [US](bbl)	6.28994	.158984
Force	Grams (gf)	Grains (gr.f)	15.4324	.0647989
		Ounces (oz.f)	.0353147	28.3495
	Kilograms (kgf)	Pounds (lbf)	2.20462	.453592
	Newtons (N)		.224809	4.44822
	Ton	Short ton [US]	1.10231	.907185
		Long Ton	.984204	1.01605
Pressure	Atmospheres (atm)	Pounds Force per	14.6960	.0680459
	Bars (bar)	Square Inch (psi)	14.5038	.0689475
	Kilograms/Sq. Centimeter(kgf/cm^2)		14.2234	.0703069
	Kilograms/Sq. Millimeter (kgf/mm^2)	Short tons/Sq.Inch	.711167	1.40614
		Short tons/Sq. Foot	102.408	.00976486
	Pascals (Pa)	Pounds/Sq.Inch (PSI)	.000145	6894.757
Torque	Kilogram-meters	Foot Pounds (ft lb)	7.23301	.138255
	Newton-Meters (Nm)		.737562	1.35582
Energy, Work & Power	Joules (J)	British Thermal Units (BTU)	.000947813	1055.06
	Kilocalories (Kcal)		3.96707	.252075
	Kilocalories per Sq. Meter ($Kcal/m^2$)	British Thermal Units per Sq. Foot (BTU/ft^2)	.368553	2.71331
	Kilocalories per Kilogram (Kcal/kg)	British Thermal Units per Pound (BTU/lb)	1.79943	.55573
	Kilocalories per Cubic Meter ($Kcal/m^3$)	British Thermal Units per Cubic Foot (BTU/ft^3)	.112335	8.90196
	Watts (W)	Horsepower (HP)	.00134102	745.7
Flow	Liters per Minute (L/min)	Gallons [US] per Minute (gal/min)	.26420	3.785
	Cu Meters per Hour (m^3/hr)	Barrels per Day (bbl/day)	150.953	.0066245
	Metric Tons per Year [40° API Oil]	Barrels per Day (bbl/day) [40° API Oil]	.02091	47.83

GENERAL INFORMATION

English-To-Metric Unit Conversion
To convert from units in Col. “B” to unit in Col. “A”, multiply the number of Col. “B” units by the factor in Col. “D”

Metric-To-English Unit Conversion
To convert from units in Col. “A” to units in Col. “B”, multiply the number of Col. “A” units by the factor in Col. “C”

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	Metric	US
Length	cm x 0.3937 = inches m x 3.281 = feet	in x 2.54 = cm ft x 0.3048 = m
Area	cm^2 x 0.155 = in^2 m^2 x 10.76 = ft^2	in^2 x 6.452 = cm^2 ft^2 = 0.0929 = m^2
Volume	cm^3 (cc) x 0.06102 = in^3 m^3 x 35.3147 = ft^3 m^3 x 6.29 = bbl m^3 x 264.2 = gal	in^3 x 16.3871 = cm^3 ft^3 x 0.02832 = m^3 bbl x 0.159 = m^3 gal x 0.003755 = m^3 gal (US) x 0.83267 = gal (imp) ft^3 x 7.481 = gal bbl x 42 = gal bbl x 5.6146 = ft^3 ft^3 x 0.1781 = bbl ft^3 x 1728 = in^2
Pressure	kg/cm^2 x 14.2234 = psi bar x 14.50 = psi bar x 0.987 = atm KPa x 6.895 = psi bar x 1.02 = kg/cm^2	psi x 0.07031 = kg/cm^2 atm x 14.70 = psi atm x 1.013 = bar psi x 0.145 = KPa psi x 0.6804 = atm
Force	Newtons x 0.225 = lbf kgf x 9.81 = N kgf x 2.205 = lbf	lbf x 4.448 = N lbf x 0.454 = kgf
Weight / Mass	g x 0.03527 = oz kg x 2.205 = lb 1 short ton (2,000 lb) = 907 kgs 1 long ton (2,240 lb) = 1,016 kgs 1 tonne (metric) = 1,000 kgs	oz x 28.35 = g lb x 0.43536 = kg
Density	g/cm^3 x 62.4 = lb/ft^3 kg/m^3 x 0.001 = g/cm^3	lb/ft x 0.01602 = g/cm^3 lb/ft x 16.02 = kg/m^3 lb/gal x 0.1199 = g/cm^3 gal/ft x 7.49 = lb/ft^3
Gradient	kg cm^2/m x 0.231 = psi/ft	ft of water x 0.0295 = atm ft of water x 0.433 = psi psi/ft x 4.33 = kg cm^2/m
Temperature	(°C + 17.78) x 1.8 = °F C + 273 = °K	(°F - 32) x 0.5555 = °C

GENERAL INFORMATION

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TUBING MOVEMENT FORMULAE

Changes in temperature and pressure can cause expansion or contraction of a tubing string, as detailed in the Weatherford "Fundamental Completion Training Manual". For easy reference, the formulae used for calculating the forces developed by this expansion/ contraction are shown below:

Piston Effect Force $F_1 = \Delta P_o(A_p - A_o) - \Delta P_i(A_p - A_i)$

Buckling Effect Force F_2 = usually neglible

Ballooning Effect Force $F_3 = .6(\Delta P_{oa} A_o - \Delta P_{ia} A_i)$

Temperature Effect Force $F_4 = 207 \times A_s \times \Delta T$

The forces calculated by the above formulae are in pounds (lbs), and the equivalent tubing movement (expansion or contraction) can be obtained from the stretch charts in other sections of this data handbook, or can be calculated using the following formula:

Stretch or Contraction

$$\Delta L = \frac{F \times L}{E \times A_s}$$

Force Change

$$\Delta F = \frac{\Delta L \times E \times A_s}{L}$$

Where:

- F = Force (lbs)
- L = Tubing string length (in)
- E = Modulus of elasticity, 30 x 10^6 psi (for carbon steels)
- A_s = Cross-sectional area of the tubing (in^2)
- A_p = Packer valve area (in^2)
- A_o = Area of the tubing O.D. (in^2)
- A_i = Area of the tubing I.D. (in^2)
- ΔP_o = Change in total annular pressure at packer (psi)
- ΔP_i = Change in total tubing pressure at packer (psi)
- ΔP_{oa} = Change in average annulus pressure (psi)
- ΔP_{ia} = Change in average annulus pressure (psi)
- ΔT = Change in average tubing temperature (^oF)
- ΔT = Final Avg. Tbg. Temp. - Init. Avg. Tbg. Temp.
- ΔL = Change in length (in)
- ΔF = Change in force (lbs)

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TOP JOINT TENSION FORMULA

Three forces are combined to determine the Top Joint Tension (TJT):

- Weight of Tubing String in Air (lbs)
- Tubing to Packer Force (lbs)
- End Area Force (lbs)

$$TJT = TW + (F_a) - (F_p)$$

Where:

Tubing Weight (TW) = String length (ft) x Pipe Weight (lbs/ft)

F_p = Packer to Tubing Force *(↑↓)*

F_a = Actual or End Area Force (lbs)

A_p = Packer sealbore or valve area (in^2)

A_o = Area of the tubing O.D. (in^2)

A_i = Area of the tubing I.D. (in^2)

$P_{o\ final}$ = Final annulus pressure at packer (psi)

$P_{i\ final}$ = Final tubing pressure at packer (psi)

$$F_a = [(A_p - A_o) \times P_{o\ final} - (A_p - A_i) \times P_{i\ final}]$$

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BASIC FORMULAS FOR MEASUREMENT

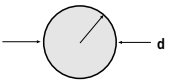
Area (A)



Square A = L x W



Rectangle A = L x W

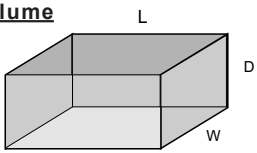


Circle A = πR^2

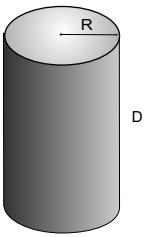
Diameter (D) = 2 x Radius (R)

pi (π) = 3.14 (and is constant)

Volume



Tank = L x W x D



Cylinder (tubing / casing) = πR^2 x D

Pressure — Force per unit area = $\frac{F}{A}$

Hydrostatic Pressure = Pressure created by a column of fluid
= Density x Vertical depth of column

Force = Pressure x Area

Impact Force = Mass x Acceleration

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LENGTH / AREA / VOLUME

Legends

A = Area
a = Altitude (height or depth)
r = Radius
D = Diameter

Formulas

Any Triangle $A = {}^{1}/_{2}\, a\, b$



Right Triangle
$a = \sqrt{c^2 - b^2}$
$b = \sqrt{c^2 - a^2}$
$c = \sqrt{a^2 + b^2}$



Circle
$A = \pi r^2$
$A = 0.7854\, D^2$
$C = \pi D$



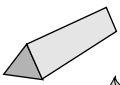
Rectangle/ Parallelogram $A = a\, b$



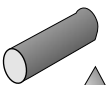
Trapezoid $A = {}^{1}/_{2}\, a\, (b_1 + b_2)$

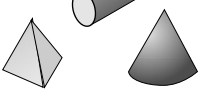


Cube $V = b^3$



Prism / Cylinder $V = a \times$ (Area of base)





Pyramid / Cone $V = {}^{1}/_{3}\, a \times$ (Area of base)



Sphere $V = {}^{4}/_{3}\, \pi r^3 = \frac{\pi D^3}{6}$ $\quad A = 4\ \pi r^2$

Constants

π	= 3.1416	π^2	= 9.8696
$\pi/^2$	= 1.5708	$^1/\pi^2$	= 0.1013
$\pi/^3$	= 1.0472	$\sqrt{\pi}$	= 1.7725
$2\pi/_3$	= 2.0944	$\sqrt[3]{\pi}$	= 1.4646
$^1/\pi$	= 0.3183		

Electrical

Ohm's Law Volts = Amps x Ohms
Watt's Law Watts = Amps x Volts
Kilowatt hour=1,000 Watt / hours
Amps $= \frac{\text{Watts}}{\text{Volts}}$

GENERAL INFORMATION

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RULES OF THUMB

Rules Of Thumb provides an approximate value for rapid field use and/or checking the magnitude of calculated values.

1. Rule of thumb for finding the fill up volume of any size pipe is the inside diameter squared equals barrels per 1,000 ft.
   ID^2 = bbls / 1,000 ft.

2. Approximate hydrostatic head = 0.052 x Wt / gal. x Depth in ft.

3. Hydrostatic head = Gradient x True vertical depth.

4. To convert specific gravity to API = 141.5 ÷ SG - 131.5 = °API.

5. To convert specific gravity to gradient : SG of fluid x 0.433 = Gradient of fluid.

6. Bottom hole pressure of gas column = Surface pressure x Gas correction factor.

7. Centigrade x 1.8 + 32° = °F.

8. Centigrade = Fahrenheit - 32° x 0.5555.

9. 1 Pascal = 1 Newton / square metre (using SI units).

10. Approximate hydrostatic head in KPa = kg / litre x Depth in meters x 9.81.

11. Partial pressure = psi x $\dfrac{\%\ H_2S / CO_2}{100}$

12. Specific gravity = $\dfrac{141.5}{API + 131.5}$

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FORCE AND IMPACT FORCE

2 types of Force are relevant to wireline operations:

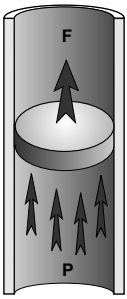
1. **Force** created by a pressure acting on an area.
   Whenever a pressure differential downhole acts on a cross-sectional area, the force created is directly proportional to the pressure and the area.

Force = Pressure x Area

Example The force of 3 $^{1}/_{2}$" x plug (2.750" packing bore) with a 5,000 psi pressure differential is:

$$\text{Area} = \pi R^2 = 3.14 \times \left(\frac{2.750}{2}\right)^2 = 5.94 \text{ in}^2$$

$$\text{Force} = \text{Pressure x Area} = 5{,}000 \times 5.94 = 29{,}700 \text{ lbf}$$



2. **Impact Force** created during downhole jarring action.
   This impact force is critical to achieve the desired movement and shearing action in downhole tools and equipment. The amount of force created is directly proportional to the mass of the stem, and the speed at the point where jars are fully opened or closed.

Impact Force = Mass x Acceleration

Downward Jar Action	Upward Jar Action
Acceleration due to gravity only.	More acceleration available from wireline unit speed on the surface.
Limited by - Fluid viscosity. - Hole deviation.	Stem can be accelerated through heavy fluid and in deviated holes by wireline from the surface.
Result Less impact available. Smaller shear pin diameters in shear down tools.	More impact available. Larger shear pin diameters in shear up tools.

Stem Weight Calculation (approximate)
Stem weight (lbs) = Stem OD (inches) x Length (ft).

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AREA FORMULAE

Surface Area, A (in^2) = $\pi \times D^2 \div 4$
= $.7854 \times D^2$

Cross-sectional Area, A_S (in^2) = $\pi \times (O.D.^2 - I.D.^2) \div 4$
= $.7854 \times (O.D.^2 - I.D.^2)$

End Area of Tubulars, A_S (in^2) = $.7854 \times (D_O^2 - D_i^2)$

VOLUME & HEIGHT FORMULAE

Volume(ft^3) = Area x Length = A (in^2) x L (in) ÷ 1728

Volume (ft^3 /lin. ft) = $(D^2 - d^2) \times .005454$

Volume (lin. ft /ft^3) = $\dfrac{183.35}{(D^2 - d^2)}$

Volume (gal /lin. ft) = $(D^2 - d^2) \times .0408$

Volume (lin. ft /gal) = $\dfrac{24.51}{(D^2 - d^2)}$

Volume (Bbl /lin. ft) = $(D^2 - d^2) \times .0009714$ or $\dfrac{(D^2 - d^2)}{1029.4}$

Volume (lin. ft /Bbl) = $\dfrac{1029.4}{(D^2 - d^2)}$

Where:

Between Tubing and Hole
D = Diameter of the hole (in)
d = Tubing OD (in)

Between Casing and Hole
D = Diameter of the hole (in)
d = Casing OD (in)

Between Tubing and Casing
D = Casing ID (in)
d = Tubing OD (in)

Between Casing and Casing
D = Outer Casing ID (in)
d = Inner Casing OD (in)

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NOTE:

In cases where multiple tubing strings are used, the formulae for the volume and height between multiple tubing strings, of the same size, and open hole/casing can be modified from the formulae above.

For example:

$$\text{Volume } (ft^3 / lin.ft) = [D^2 - (n \times d^2)] \times .005454$$

$$\text{Volume } (lin.ft / ft^3) = \frac{183 .35}{[D^2 (n \times d^2)] \times .005454}$$

Where:

n = number of tubing strings

SAND FILL-UP VOLUME vs. LINEAR HEIGHT FORMULA

Lbs Sand / Linear ft. = 14.3 x ((.7854 x D^2 x 12) / 231)

Linear ft. / 100 lbs sack of sand = .07 x (231/(.7854 x D^2 x12)) x 100

Assumes the use of 20-40 Mesh Sand

Bulk density of sand is 14.3 lbs / gal. (S.G. = 1.72)

Bulk Volume of sand is .07 gal / ft^3.

FORCE

F = m x a

Where:

F = force (lbs)
m = mass (lbs)
a = acceleration (32 ft/sec^2)

WEIGHT OF TUBING/CASING STRINGS IN AIR FORMULA

Weight (lbs) = String length (ft) x Pipe Weight (lbs/ft)

FORCE DUE TO BUOYANCY FORMULA

Buoyancy Force (lbs) = Pressure (psi) x area under pressure (in^2)

Buoyancy Factor = (MW ÷ 65.63) - 1

Where:

MW = mud weight (lbs/gal)

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CALCULATING STRESS DUE TO TUBING SLACK-OFF (BEFORE PRESSURE AND TEMPERATURE CHANGES OCCUR)

$$S_o = \frac{F_s}{A_s} + \frac{(\text{Tbg OD}) \times (r) \times (F_s)}{4 \times I}$$

Where:

S_o = Tubing Stress caused by slacking off tubing weight onto the packer (psi)

F_s = Slack-off force (lbs)

Tbg OD = O.D. of the tubing (in)

Casing ID = I.D. of the casing (in)

A_s = Tubing cross-sectional area (in^2)

r = Radial clearance between tubing and casing (in) where, r = (Casing ID - Tubing OD) ÷ 2

I = Moment of inertia of the tubing (in^4) where, $I = \pi \times (O.D.^4 - I.D.^4) \div 64$

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AVERAGE FLUID VELOCITIES PAST PACKERS (FT/SEC)

Open Ended Tubing

$$\text{Fluid Velocity (ft/sec)} = \frac{(A_{i\,csg} - A_{i\,tbg}) \times LS \times 9.96}{(A_{i\,csg} - A_{o\,packer})}$$

Where:

$A_{i\ tbg}$ = Tubing I.D. area (in^2)

LS = Lowering speed of the pipe (ft/sec)

$A_{o\,packer}$ = Packer area calculated on the gauge ring O.D. of the packer (in^2)

$A_{i\,csg}$ = Casing I.D. area (in^2)

Bull Plugged Tubing

$$\text{Fluid Velocity (ft/sec)} = \frac{(A_{i\,csg}) \times LS \times 9.96}{(A_{i\,csg} - A_{o\,packer})}$$

Where:

Fluid Velocity = Velocity past the packer when lowering the pipe (ft/sec)

$A_{i\,csg}$ = Casing I.D. area (in^2)

LS = Lowering speed of the pipe (ft/sec)

$A_{o\,packer}$ = Packer area calculated on the gauge ring O.D. of the packer (in^2)

AVERAGE EQUIVALENT FLOW RATES PAST PACKERS (BBL/MIN)

$$\text{FlowRate (bbl/min)} = (A_{i\,csg} - A_{o\,packer}) \times FV \times .07421$$

Where:

Flow Rate = Avg. equiv. flow rate past the packer when lowering the pipe (bbl/min)

$A_{i\,csg}$ = Casing I.D. area (in^2)

$A_{o\,packer}$ = Packer area calculated on the gauge ring O.D. of the packer (in^2)

FV = Fluid velocity past the packer when lowering the pipe (ft/sec)

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TEMPERATURE CONVERSIONS

$$^{o}F = (^{o}C \times 1.8) + 32$$

$$^{o}C = (^{o}F - 32) \div 1.8$$

$$^{o}K = ^{o}C + 273$$

$$^{o}R = ^{o}F + 460$$

Where:

^{o}F = degrees Fahrenheit

^{o}C = degrees Centigrade

^{o}K = degrees Kelvin

^{o}R = degrees Rankine

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CALCULATING GAS FLOW THROUGH A CHOKE

$$Q = \frac{C \times P_a}{\sqrt{SG \times T}}$$

Where:

Q = Gas Flow Rate, at 60°F & atmospheric pressure (MCF per day)

C = Choke Coefficient (see table for various choke sizes)

T = Absolute Gas Temperature, upstream of the choke (°R)

P_a = Absolute Pressure, upstream of the choke (gage reading + 15 psi) (psia)

SG = Gas Specific Gravity

°R = degrees Rankine (°F + 460)

Choke Coefficient Table	
Choke Size (in)	Coefficient C
1/8	6.25
3/16	14.44
1/4	26.51
5/16	43.64
3/8	61.21
7/16	85.13
1/2	112.72
5/8	179.74
3/4	260.99

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FORMULAE FOR CAPACITIES OF CYLINDRICAL & RECTANGULAR TANKS

Capacity of Vertical Cylindrical Tanks with Flat Ends

Capacity per foot of depth of liquid (Bbl)	=	$.1399 \times D^2$
Capacity per inch of depth of liquid (Bbl)	=	$.01165 \times D^2$
Capacity per foot of depth of liquid (gal)	=	$5.8752 \times D^2$
Capacity per inch of depth of liquid (gal)	=	$.4896 \times D^2$
Capacity per foot of depth of liquid (ft^3)	=	$.7854 \times D^2$
Capacity per inch of depth of liquid (ft^3)	=	$.06545 \times D^2$

Where:

D = diameter (ft)

Capacity of Rectangular Tanks with Flat Ends

Capacity per foot of depth of liquid (Bbl)	=	$.17808 \times L \times W$
Capacity per inch of depth of liquid (Bbl)	=	$.01484 \times L \times W$
Capacity per inch of depth of liquid (gal)	=	$.62340 \times L \times W$
Capacity per inch of depth of liquid (ft^3)	=	$.08333 \times L \times W$

Where:

L = length (ft)

W = width (ft)

CONTENTS OF PIPELINES

Contents per linear foot (Bbl)	=	$.0009714 \times D^2$
Contents per linear foot (gal)	=	$.0408 \times D^2$
Contents (lin. ft/Bbl)	=	$1029.4 \div D^2$
Contents (lin. ft/gal)	=	$24.51 \div D^2$

Where:

D = diameter (in)

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FORMULAE FOR CALCULATING HYDRAULIC HORSEPOWER

Hydraulic Horsepower	=	BPM x Pressure x .0245
Hydraulic Horsepower	=	BPH x Pressure x .000409
Hydraulic Horsepower	=	BPD x Pressure x .000017
Hydraulic Horsepower	=	GPM x Pressure x .000584

Where:

BPM	=	barrels per minute
BPH	=	barrels per hour
BPD	=	barrels per day
GPM	=	gallons per minute
Pressure	=	pressure (psi)

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DECIMAL EQUIVALENTS OF FRACTIONS OF ONE INCH

Fraction	Decimal	Millimeters	Fraction	Decimal	Millimeters
1/64	.01563	.39688	33/64	.51563	13.09688
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.04688	1.19063	35/64	.54688	13.89063
1/16	.06250	1.58750	9/16	.56250	14.28750
5/64	.07813	1.98438	37/64	.57813	14.68438
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.10938	2.77813	39/64	.60938	15.47813
1/8	.12500	3.17500	5/8	.62500	15.87500
9/64	.14063	3.57188	41/64	.64063	16.27188
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.17188	4.36563	43/64	.67188	17.06563
3/16	.18750	4.76250	11/16	.68750	17.46250
13/64	.20313	5.15938	45/64	.70313	17.85938
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.23438	5.95313	47/64	.73438	18.65313
1/4	.25000	6.35000	3/4	.75000	19.05000
17/64	.26563	6.74688	49/64	.76563	19.44688
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.29688	7.54063	51/64	.79688	20.24063
5/16	.31250	7.93750	13/16	.81250	20.63750
21/64	.32813	8.33438	53/64	.82813	21.03438
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.35938	9.12813	55/64	.85938	21.82813
3/8	.37500	9.52500	7/8	.87500	22.22500
25/64	.39063	9.92188	57/64	.89063	22.62188
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.42188	10.71563	59/64	.92188	23.41563
7/16	.43750	11.11250	15/16	.93750	23.81250
29/64	.45313	11.50938	61/64	.95313	24.20938
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.48438	12.30313	63/64	.98438	25.00313
1/2	.50000	12.70000	1	1.00000	25.40000

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