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[] Hansford Lubinski

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[] RP7G

[] Howard .

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Lubinski

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[] Hansford

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[] Miller .

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(LCF HCF)

ASTM

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([] Tipton .

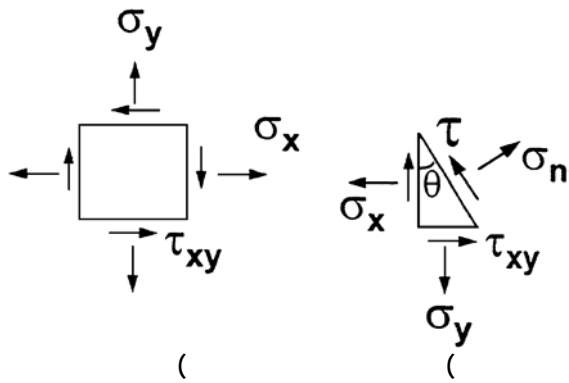
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[] Socie

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Smith-Watson-Topper)

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[] Bannatin

[] Smith-Watson-Topper

$$\epsilon_a \sigma_{\max} = \frac{\sigma_f'^2}{E} (2N_f)^{2b} + \sigma_f' \epsilon_f' (2N_f)^{b+c} \quad ()$$

[] Fatemi and Socie

$$\gamma_a \left(1 + k \frac{\sigma_{\max}}{\sigma_Y} \right) = \frac{\tau_f'}{G} (2N_f)^{b_0} + \gamma_f' (2N_f)^{c_0} \quad ()$$

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$$K_f^2 \epsilon_a \sigma_{\max} = \frac{\sigma_f'^2}{E} (2N_f)^{2b} + \sigma_f' \epsilon_f' (2N_f)^{b+c} \quad ()$$

(())

$$K_f \gamma_a \left(1 + k \frac{K_f \sigma_{\max}}{\sigma_Y} \right) = \frac{\tau_f'}{G} (2N_f)^{b_0} + \gamma_f' (2N_f)^{c_0} \quad ()$$

$$\sigma_{xm} = \frac{T}{A}$$

()

[] Johancsick

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()

K_f

)

$$T_1 = P_h A_1 + \text{WOB}$$

()

$$\sigma_{xa} = E c_p r_o$$

()

$$c_p = c_w \text{BSMF}$$

()

[] (BSMF)

(σ_{ya})

$$\sigma_{ym} = \frac{\Delta P \bar{r}}{h}$$

()

$$\bar{r} = \frac{(\text{OD}_{TJ} + \text{OD}_{DP})}{4}$$

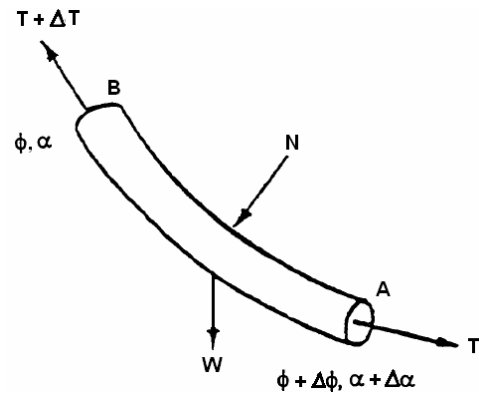
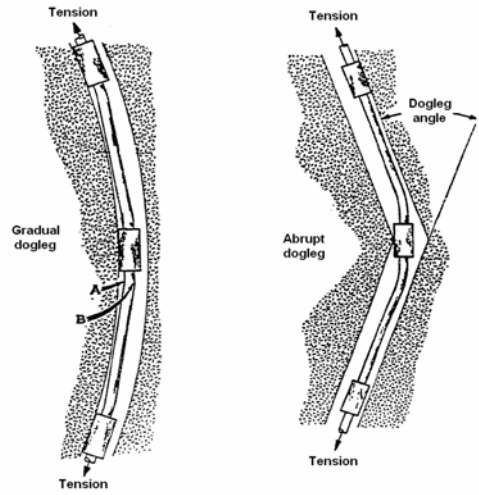
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$\tau_{xya})_d$

$$\tau_{xym})_d = \frac{T_q}{J} r_o$$

()



$$N = \left[(T \Delta \phi \sin \bar{\alpha})^2 + (T \Delta \alpha + w \sin \bar{\alpha})^2 \right]^{\frac{1}{2}}$$

()

$$\Delta T = w \cos \bar{\alpha} \pm \mu N$$

()

$$\Delta T_q = \mu N R$$

()

$$T_{i+1} = T_i + \Delta T$$

()

$$Tq_{i+1} = Tq_i + \Delta Tq$$

()

Peterson

[]

$$\tau_{xym})_c = \frac{T_{qm}/2}{J} r_o$$

()

$$k_f = 1 + \left(k_t - 1 / \left(1 + \frac{a}{r} \right) \right)$$

()

$$\tau_{xya})_c = \frac{T_{qa}/2}{J} r_o$$

()

[] Ohira Ikawa

(() ())

$$k_t = 1 + 2\sqrt{t/r}$$

()

a

(-)

[] Peterson

(σ_u)

$$a = 35.047 \left(\frac{1}{\sigma_u} \right)^{1.8}$$

$$\sigma_{max} = (\sigma_{xa} + \sigma_{xm}) \cos^2 \theta + (\sigma_{ya} + \sigma_{ym}) \sin^2 \theta + 2(\tau_{xya} + \tau_{xym}) \sin \theta \cos \theta$$

()

()

$$\sigma_n = \sigma_{xa} \cos^2 \theta + \sigma_{ya} \sin^2 \theta + 2\tau_{xya} \sin \theta \cos \theta$$

()

(σ_u)

a

$$\tau = (\sigma_{ya} - \sigma_{xa}) \sin \theta \cos \theta + \tau_{xya} (\cos^2 \theta - \sin^2 \theta)$$

()

[]

Tulsa

(ϵ_a, γ_a) θ

$$\gamma_a = \frac{\tau}{G} = \frac{2(1+\nu)\tau}{E}$$

()

[]

() ()

ANSYS

ANSYS

()

:

	[MPa]	[MPa]	
()	240.965	274.335	1.14
()	241.316	273.977	1.14
()	154.808	159.779	1.03
()	48.780	49.401	1.01

() ()

Miner

:

()

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()

()

() ()

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()

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() ()

:

	()	[m]	[m]	[m]	[m]	[N/m]
()	D	137.16	0.06985	0.17145	0.17145	1581.98
	D	137.16	0.0762	0.127	0.1651	729.69
	E	4114.8	0.127	0.127	0.161925	284.58

[] Tulsa

. () (Survey) :

	Build and hold
KOP(Kick-off point)	914.4 m
(Build up)	7 deg/30.48 m
	30 deg
	5334 m

. () :

	11.751 N/L
	0.020 Pa.s
	957.605 N/m ²
	1324.89 Lpm
	3 * 0.00873125 m
	133446.6 N
	1828.8 m
	0.3
	0.25
	0.220472 m
	0.2159 m
	100 rpm
	3.048 m/hr
	3253.962 N.m
	9.144 m

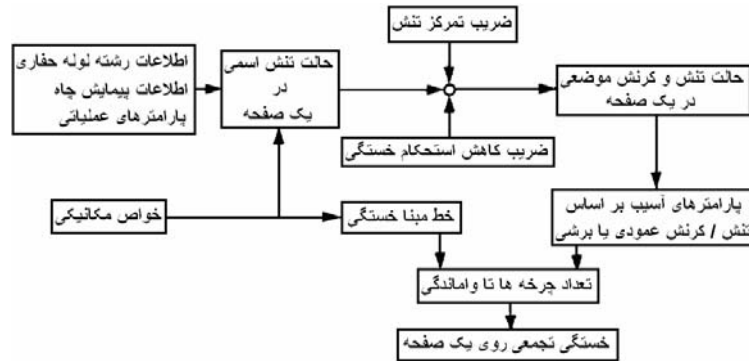
. () :

$\sigma_Y, 0.2\%$	703.265 MPa
$\sigma_u,$	803.929 MPa
$E,$	209104.190 MPa
$\sigma'_f,$	941.134 MPa
$b,$	-0.0616
$\varepsilon'_f,$	6.2937
$c,$	-0.8317
$k,$	0.6
$t, ()$	0.093218 mm
$r, ()$	0.237236 mm
$k_t,$	1.14
$k_t,$	1.14
	1.03
	1.01

[]

()

()



:

. [] Tulsa

:

	[MPa]	[MPa]	[MPa]	[MPa]		:
1	190.295	14.479	0	0	1032662	
2 ()	142.721	25.511	0	0	1429244	
3 ()	188.916	12.411	0	0	804668	
4 ()	190.295	25.511	0	0	288240	
5 ()	190.295	25.511	0	0	531178	
6	766.697	53.090	0	0	10102	
7	601.912	53.090	0	0	121222	
8 ()	0	0	434.37	434.37	13654	
9 ()	0	0	434.37	434.37	10120	
10 ()	0	0	434.37	434.37	28500	
11 ()	0	0	434.37	434.37	26480	
12 ()	0	0	434.37	434.37	29908	
13 ()	0	0	364.043	364.043	27354	
14 ()	190.295	25.511	0	0	847348	

ASTM-A-370

NC-31

E

:

	EU	NC-31 2 7/8 IF
<i>OD</i>	0.073025 [m]	0.104775 [m]
<i>ID</i>	0.05461 [m]	0.053975 [m]
<i>W</i>	141 [N/m]	-
<i>E</i>	2.09104 [GPa]	2.03367 [GPa]
σ_Y	703.265 [MPa]	910.108 [MPa]
σ_u	803.929 [MPa]	1027.319 [MPa]
	8.74% (in 1 Centimeter)	3.54% (in 1 Centimeter)
	69.2%	59.0%

ASTM E-606

E

:

	(95% Confidence band per ASTM E-739)		(95% Confidence band per ASTM E-739)
σ'_f	918.382 [MPa]	941.134 [MPa]	962.508 [MPa]
<i>b</i>	-0.0633	-0.0616	-0.0600
ϵ'_f	4.3674	6.2937	8.9812
<i>c</i>	-0.8432	-0.8317	-0.8205
<i>k'</i>	810.823 [MPa]	798.482 [MPa]	785.658 [MPa]
<i>n'</i>	0.0694	0.0712	0.0731

:

<i>r</i>	0.74422	0.07112	0.2286	0.09906	0.2413	0.96266
[mm]						
<i>t</i>	0.12446	0.0381	0.10414	0.07112	0.08128	0.1397
[mm]						
<i>K_f</i>	1.69	1.49	1.84	1.70	1.73	1.67
[] ()						
<i>K_f</i>	1.96	2.14	1.77	1.85	1.76	1.70

()

(N = N)

()

Tulsa

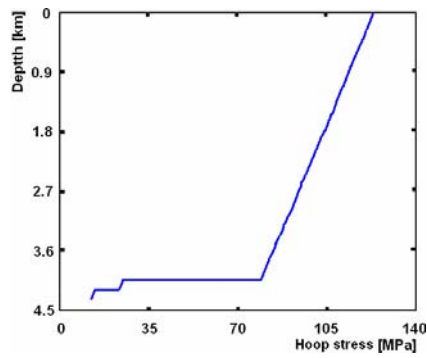
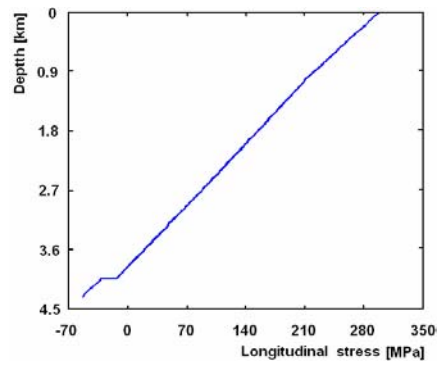
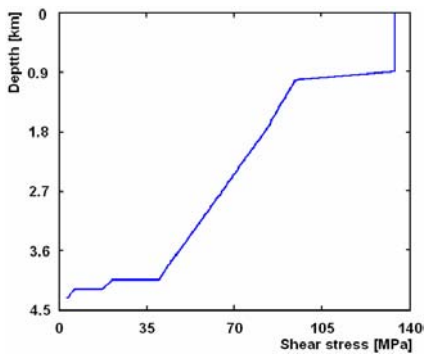
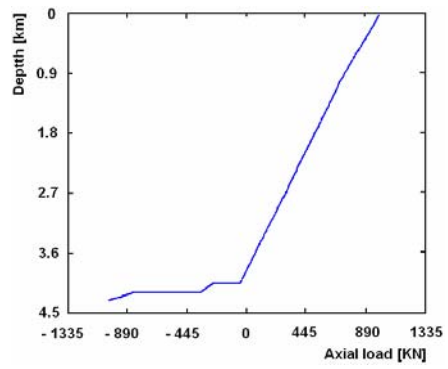
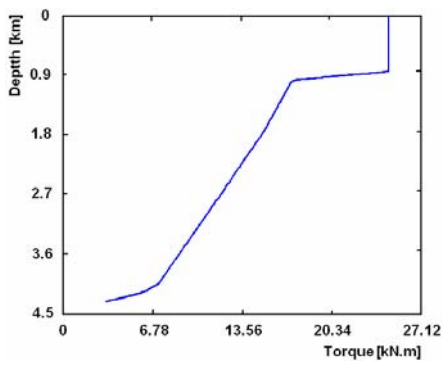
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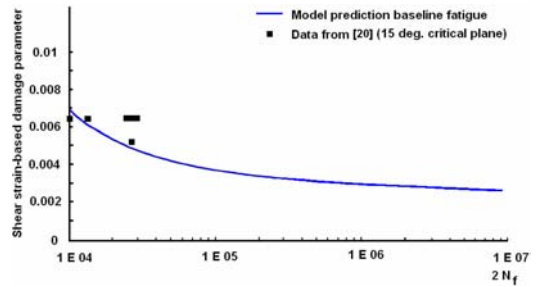
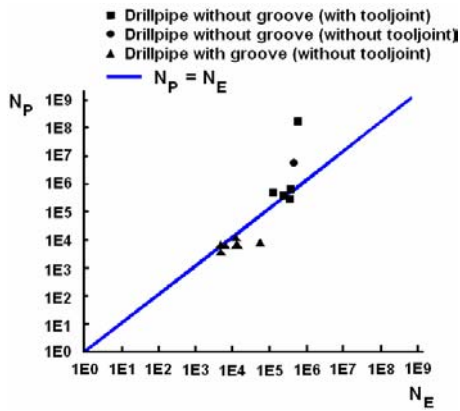
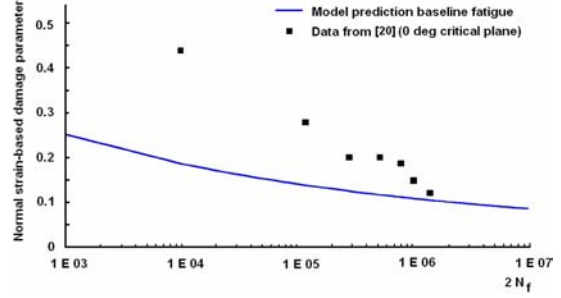
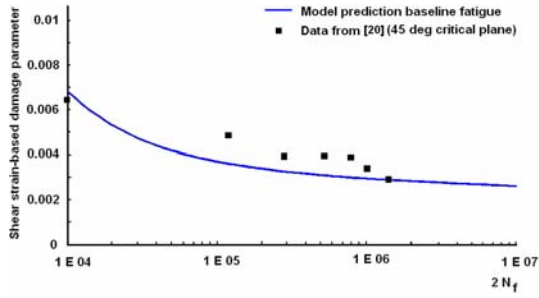
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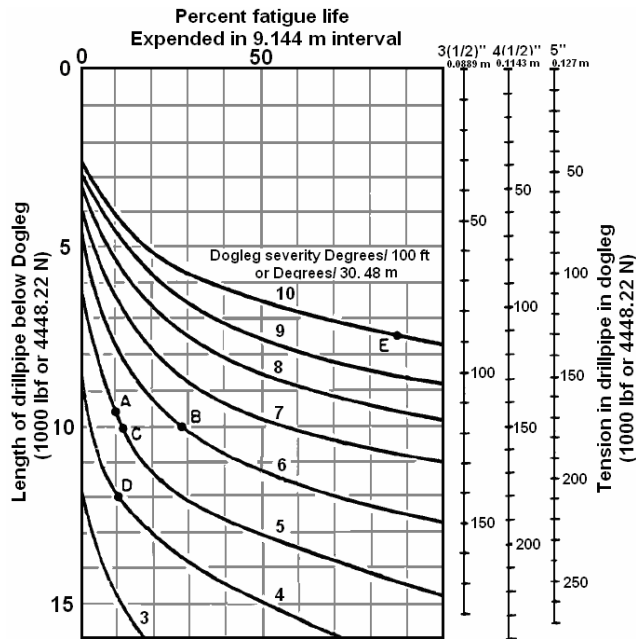
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N_E

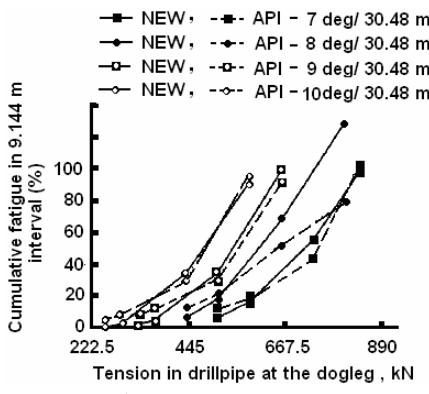
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N_p

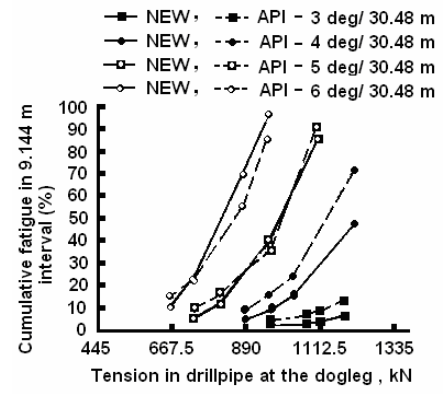


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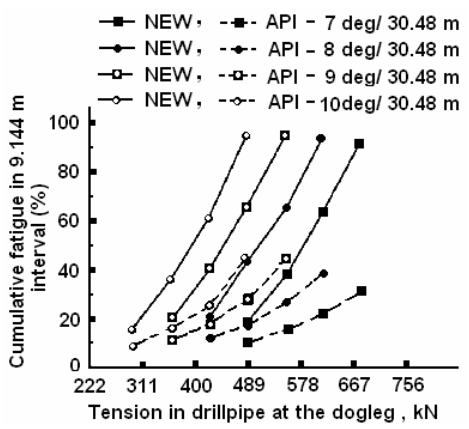
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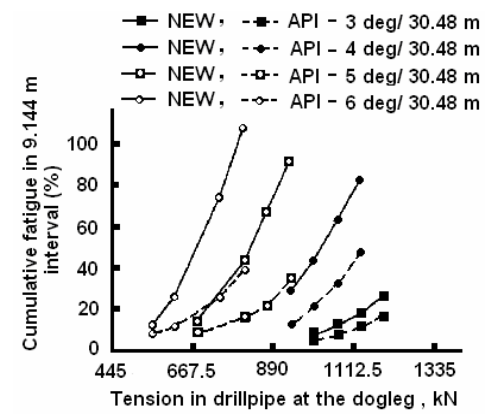
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 . Build and Hold



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	: A ₁	API
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	: c _p	S Build and hold
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	: G	API
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	() : r	
	: r ₀	
	: \bar{r}	
	: R	-
	: T ₁	-
	: T	
i	: T _i	-
i + 1	: T _{i+1}	
i	: Tq _i	-
i + 1	: Tq _{i+1}	-
	: Tq	API
	: h	
	: t	
	: σ _Y	

	: $\bar{\alpha}$: w
	: θ		: WOB
	: μ	θ	: ϵ_a
			: ϵ'_f
	: ν		: $\epsilon_a \sigma_{max}$
	: $\Delta\phi$: σ'_f
	: $\Delta\alpha$	θ	: σ_{max}
	: ΔP	θ	: σ_n
	: ΔT		: σ_x
	: ΔT_q		: σ_{xa}
	: $\tau_{xym} \Big)_d$: σ_{xm}
	: $\tau_{xym/a} \Big)_c$: σ_{ya}
			: σ_{ym}
	: τ_{xya}		: σ_y
	: τ_{xym}		: σ_u
θ	: τ		: $\gamma_a \left(1 + k \frac{\sigma_{max}}{\sigma_y} \right)$
	: τ_{xy}		: γ_a
	: τ_{max}	θ	: γ'_f
	: τ'_f		: ϕ
			: α

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|---|---------------------------|
| 1 - Monitoring | 2 - Upset fade-out zone |
| 3 - Corrosion pits | 4 - Slip marks |
| 5 - Interlocking | 6 - Soft element mode |
| 7 - Bending stress magnification factor | 8 - Micro discontinuities |
| 9 - Weight on bit | |