

明治大学学術フロンティア
信頼性データバンク疲労データシート

**Meiji University Academic Frontier
Reliability Data Bank Fatigue Data Sheet**

ボールブッシュの寿命試験特性データシート
Data Sheet on Rolling Fatigue Life test of Ball Bush

Project of Meiji University Academic Frontier

2010年4月27日(火)

Table .1 Test piece properties

l_t	Carriage raceway length, mm	38
S_t	Stroke, mm	100
D_a	Ball diameter, mm	3.969
J	Number of ball circulations	6
Z_t	Number of effective balls	10
C_b	Hertz constant, $N/mm^{\frac{3}{2}}$	7.54×10^4

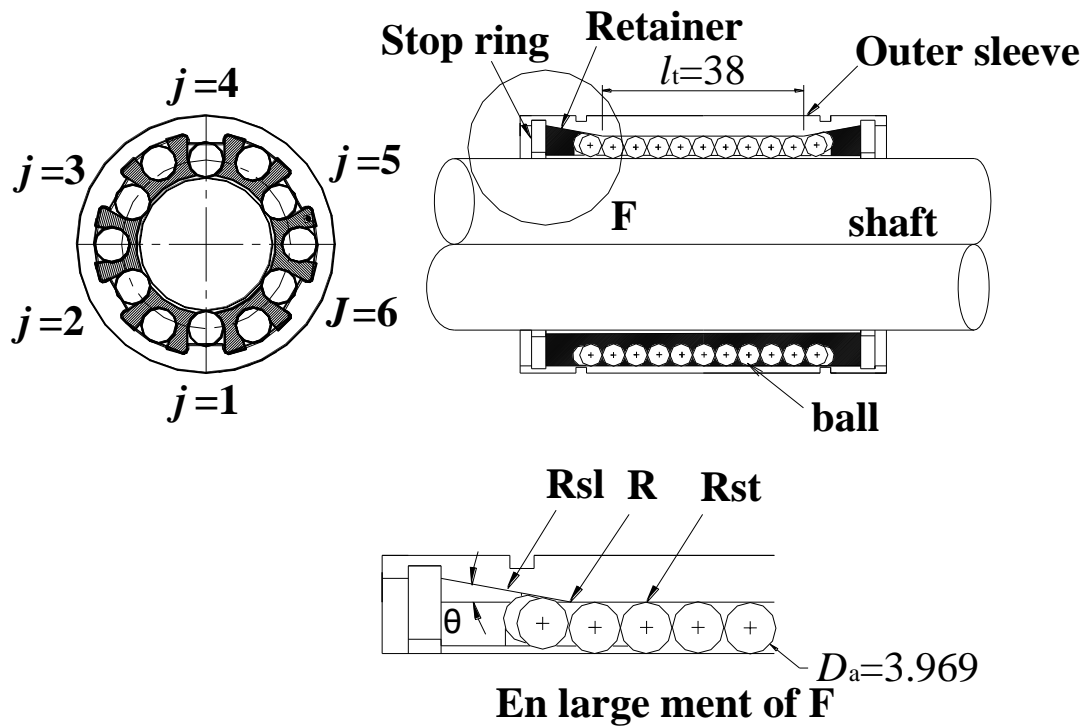


Fig.1 Shape of outer sleeve

Table.2 Test condition

Stroke, mm	100
Test speed, km/h	1.8(2.4)
Test load, kN	2.3
Lubricant	Li-base Grease

Table.3 Travel distance to failure of Ball bush

No.	Life,km	
	Without processing ($N_s=52$)	With processing ($N_s=67$)
1	26.81	118.62
2	43.89	166.58
3	55.27	170.83
4	66.13	233.74
5	99.01	256.84
6	99.92	275.12
7	129.20	303.38
8	129.38	312.11
9	129.39	312.12
10	136.12	339.19
11	139.82	341.90
12	213.77	343.99
13	230.17	372.61
14	238.89	428.80
15	269.49	429.60
16	301.03	439.02
17	302.42	562.03
18	339.80	598.27
19	361.15	633.95
20	369.60	635.80
21	389.23	637.13
22	401.43	660.25
23	408.75	662.02
24	428.40	703.88
25	439.95	717.65
26	502.62	718.32
27	518.21	751.41
28	602.03	815.59
29	648.26	817.44
30	734.69	876.94
31	848.92	933.34
32	880.75	952.77
33	914.18	1078.47
34	939.04	1083.89
35	987.03	1114.06
36	1021.25	1168.67
37	1031.86	1200.06
38	1031.86	1416.78
39	1122.60	1475.07
40	1140.87	1539.74
41	1160.51	1541.15
42	1186.32	1633.39
43	1263.98	1640.53
44	1264.67	1675.32
45	1374.39	1733.01
46	1479.60	1801.78
47	1740.97	1805.98
48	1858.41	1867.25
49	1894.10	1943.86
50	1918.56	1991.04
51	2582.26	2054.68
52	2583.71	2151.36
53	-	2176.87
54	-	2236.98
55	-	2307.08
56	-	2503.40
57	-	2575.09
58	-	2654.46
59	-	2729.48
60	-	2791.11
61	-	2811.15
62	-	2909.34
63	-	2915.10
64	-	2929.77
65	-	3069.47
66	-	3366.79
67	-	3467.17

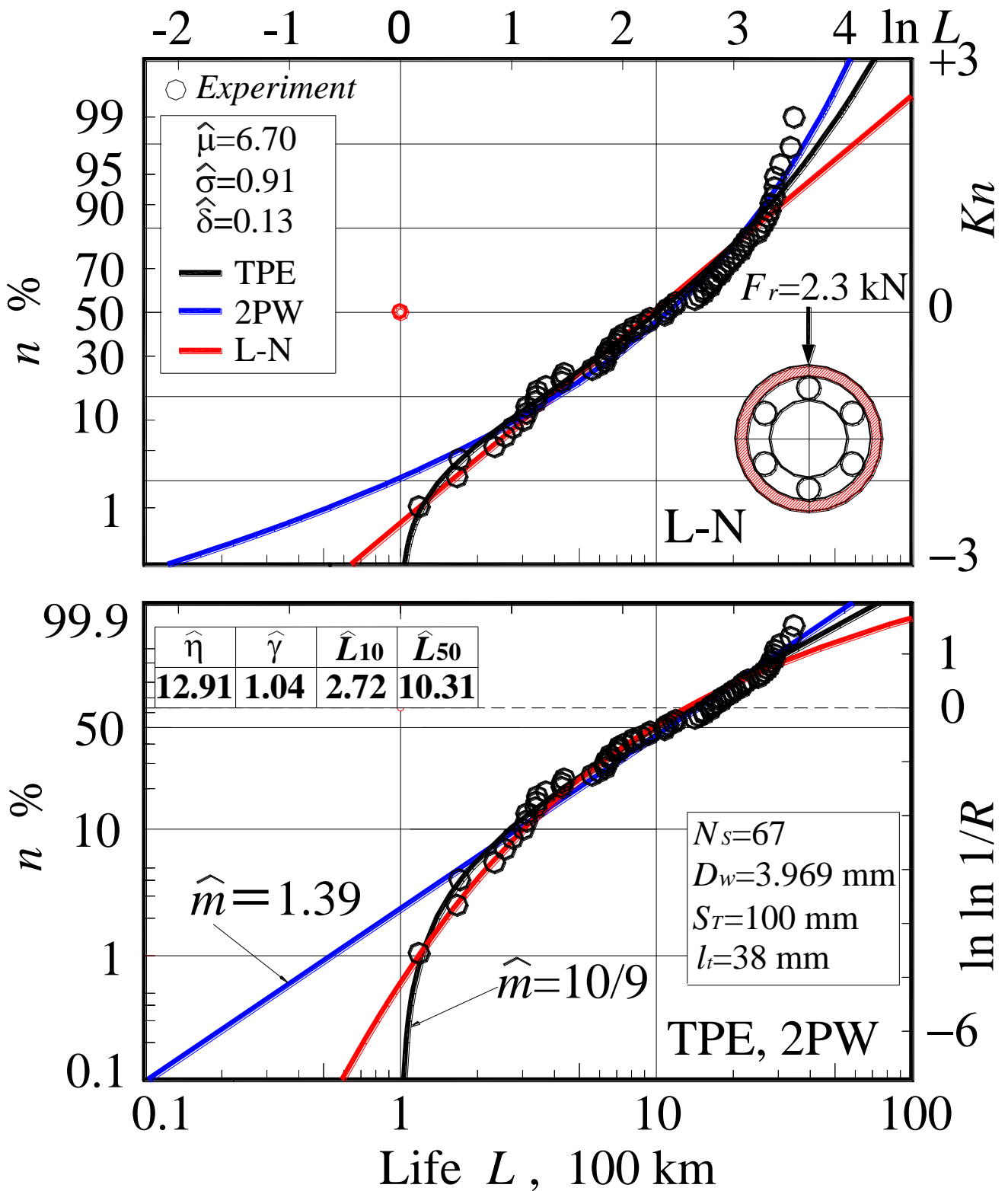


Fig.2 Weibull and log-normal plot for ball bush fatigue life data without processing $N_s=52$

$$\text{TPE: } C_{ex} = (L_{10} - \gamma)^{1/3} \times F = 2229 \text{ N}$$

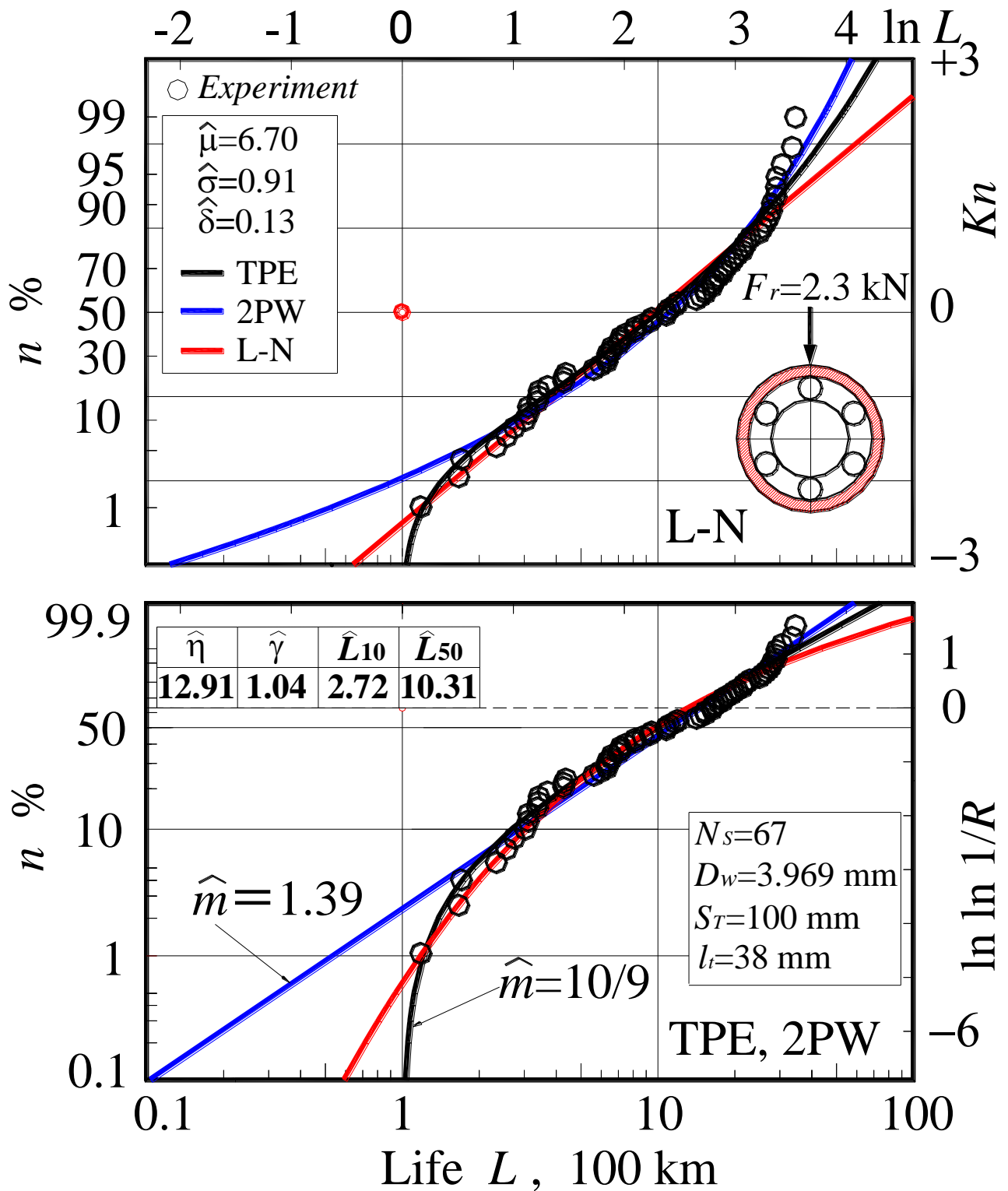


Fig.3 Weibull and log-normal plot for ball bush fatigue life data with processing $N_s=67$

$$\text{TPE: } C_{ex} = (L_{10} - \gamma)^{1/3} \times F = 2734 \text{ N}$$

Table.5 Estimation from experimental data

		Without processing ($N_S=52$)	With processing ($N_S=67$)
LN	σ	1.17	0.91
	μ	6.15	6.7
	$\delta=\sigma/\mu$	0.19	0.13
2PW	m	1.06	1.39
	η	7.83	14.74
	L_{10}	0.99	2.94
	L_{50}	5.59	10.31
3PW	m	1.11	1.11
	η	7.02	12.91
	L_{10}	1.03	2.72
	L_{50}	5.14	10.31
	γ	0.12	1.04

Table.6 Basic dynamic load ratings

Basic dynamic load rating	Without processing ($N_S=52$)	With processing ($N_S=67$)
C_{ISO} [N]	2580	2580
C_{ex} (2 parameter) [N]	2292	3295
C_{ex} (3 parameter) [N]	2229	2734
$\lambda b_{m ISO}$ (2 parameter)	0.89	1.28
$\lambda b_{m ISO}$ (3 parameter)	0.86	1.06

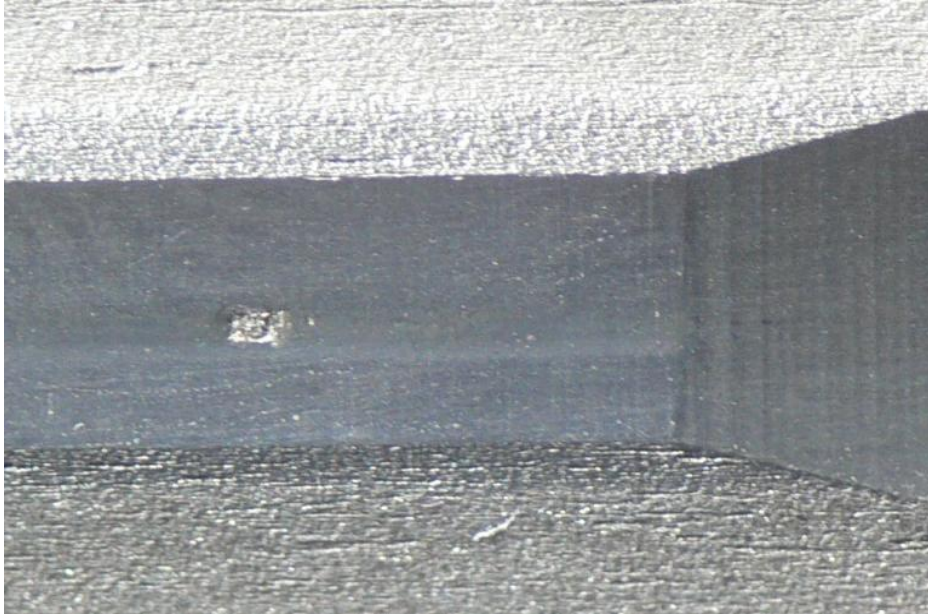


Fig. 4 Flaking of outer sleeve raceway surface without processing (straight)

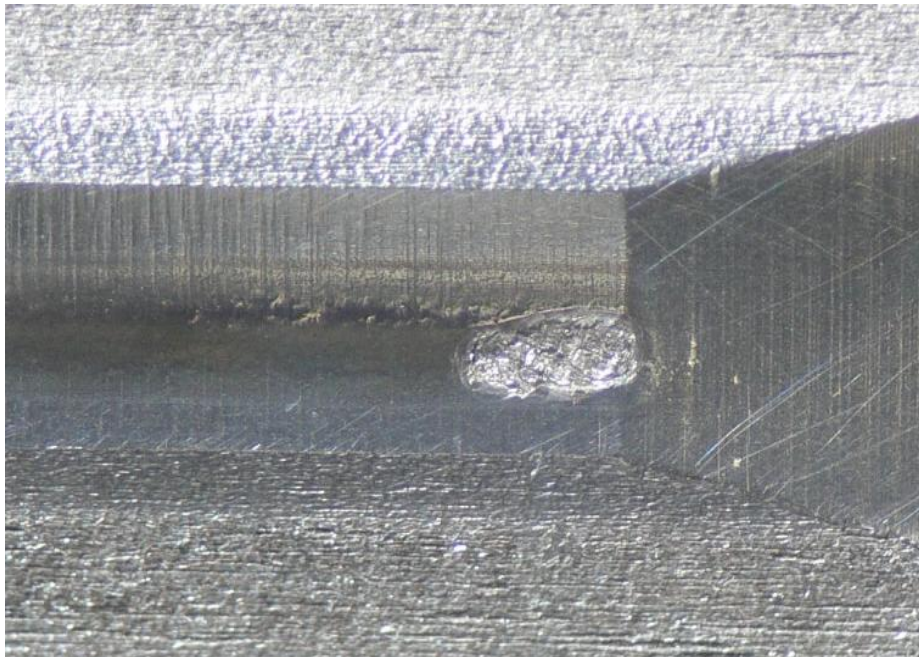


Fig. 5 Flaking of outer sleeve raceway surface without processing (edge)

Table .1 Test piece properties of linear bush with ball retainer

l_t	Carriage raceway length, mm	40.9
S_t	Stroke, mm	100
D_a	Ball diameter, mm	3.969
J	Number of ball circulations	6
Z_t	Number of effective balls	10
C_b	Hertz constant, $N/mm^{\frac{3}{2}}$	7.54×10^4

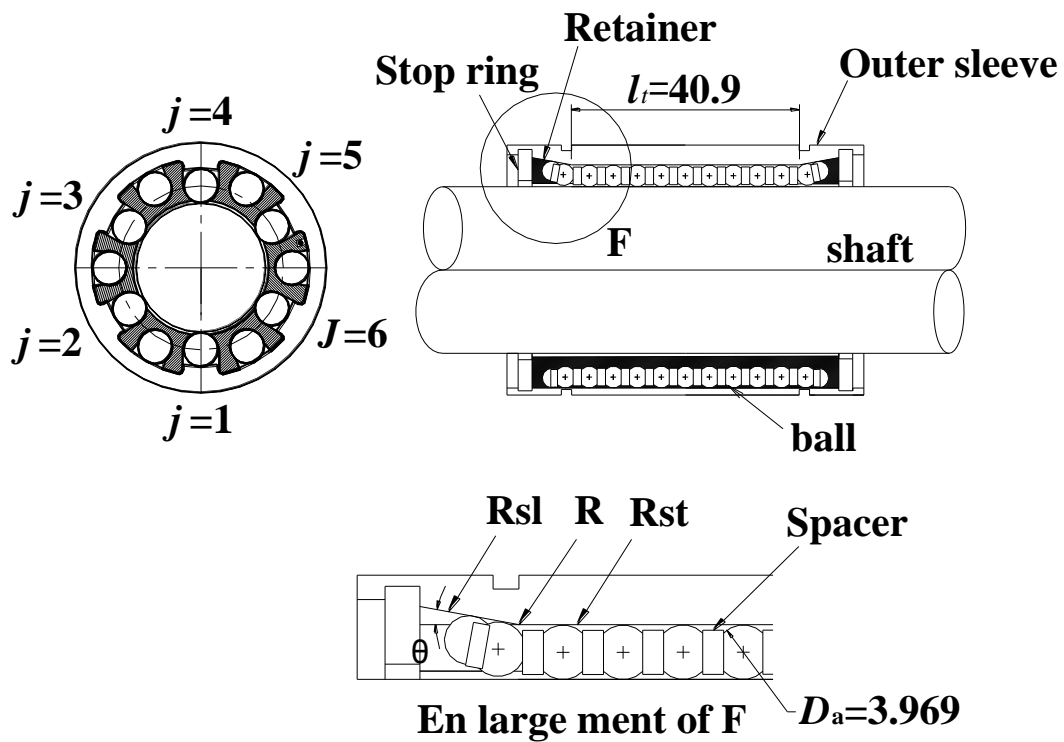


Fig. 1 Internal structure of linear bush with ball retainer

Table.2 Test condition of linear bush with ball retainer

Stroke, mm	100
Test speed, km/h	3.0
Test load, kN	2.3
Lubricant	Li-base Grease

Table.3 Travel distance to failure of linear bush with ball retainer N=30

N	Life, km
	Ball retainer
1	103.13
2	117.50
3	136.67
4	187.47
5	188.95
6	192.73
7	210.05
8	226.31
9	332.66
10	347.62
11	369.05
12	412.29
13	441.70
14	452.44
15	496.81
16	512.74
17	517.99
18	561.05
19	624.44
20	672.70
21	683.69
22	699.97
23	722.29
24	743.27
25	750.24
26	823.02
27	867.57
28	1066.88
29	1491.12
30	1897.26

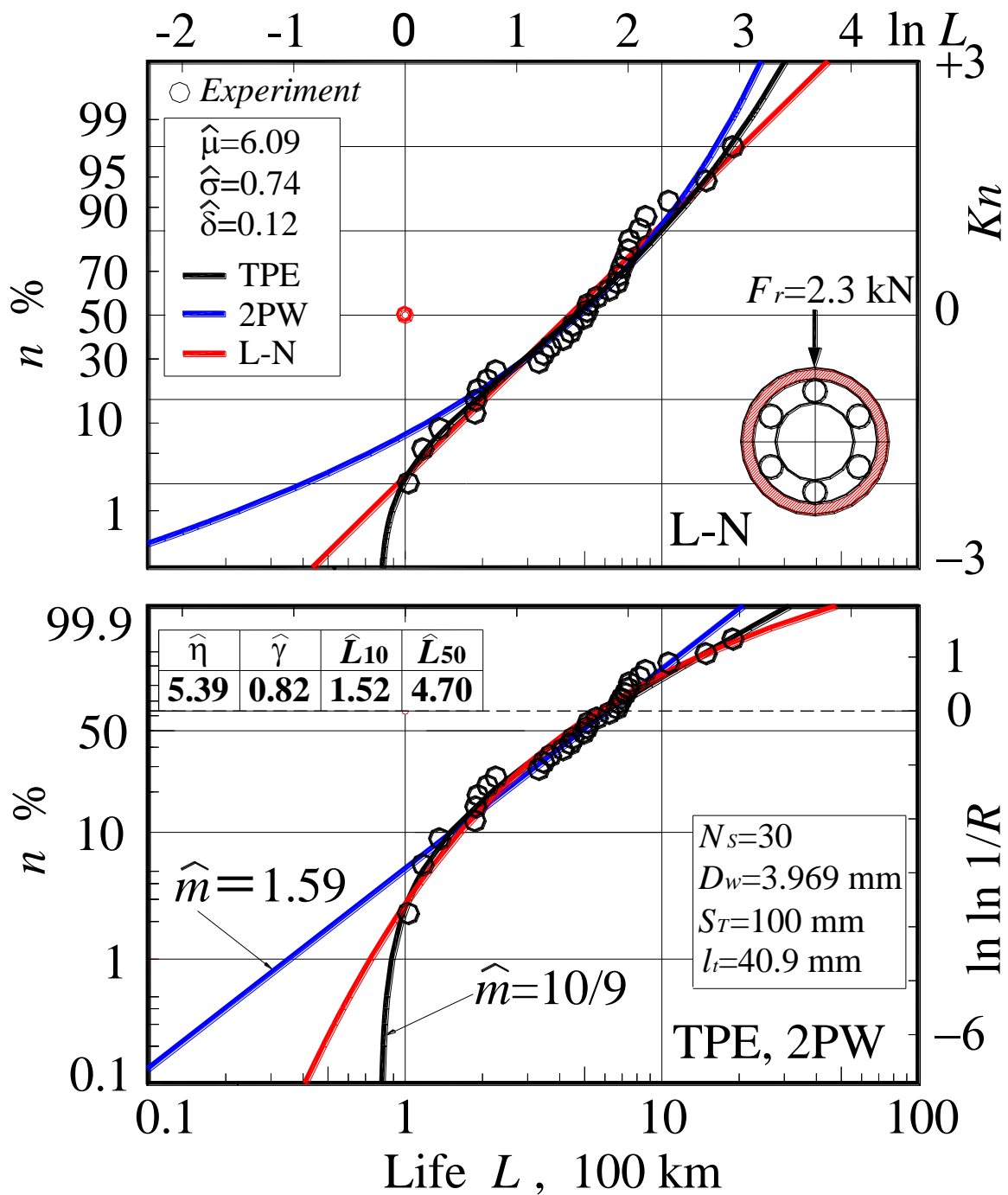


Fig.2 Weibull and log-normal plot for linear bush with ball retainer fatigue life data

$N_s = 30$

TPE: $C_{ex} = (L_{10}^{-\gamma})^{1/3} \times F = 2042$ N

Table.4 Estimation from experimental data

		Ball retainer ($N_s=30$)
LN	σ	0.74
	μ	6.09
	$\delta=\sigma/\mu$	0.12
2PW	m	1.59
	η	6.25
	L_{10}	1.54
	L_{50}	4.98
3PW	m	1.11
	η	5.39
	L_{10}	1.52
	L_{50}	4.7
	γ	0.82

Table.5 Basic dynamic load ratings

Basic dynamic load rating	Ball retainer ($N_s=30$)
C_{ISO} [N]	2586
C_{ex} (2 parameter) [N]	2656
C_{ex} (3 parameter) [N]	2042
$\lambda_{bm ISO}$ (2 parameter)	1.03
$\lambda_{bm ISO}$ (3 parameter)	0.79

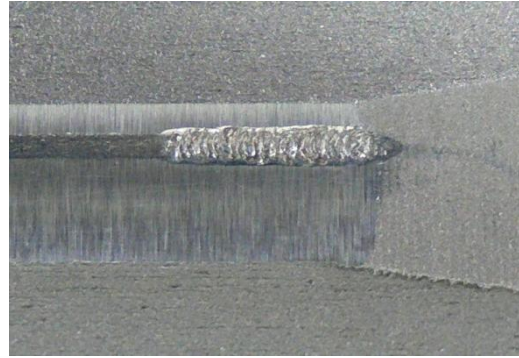
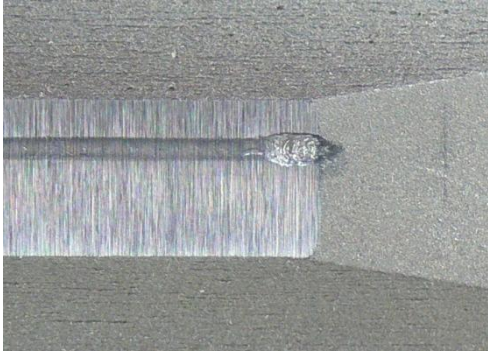


Fig.3 Flaking of outer sleeve raceway surface of linear bush with ball retainer (edge)

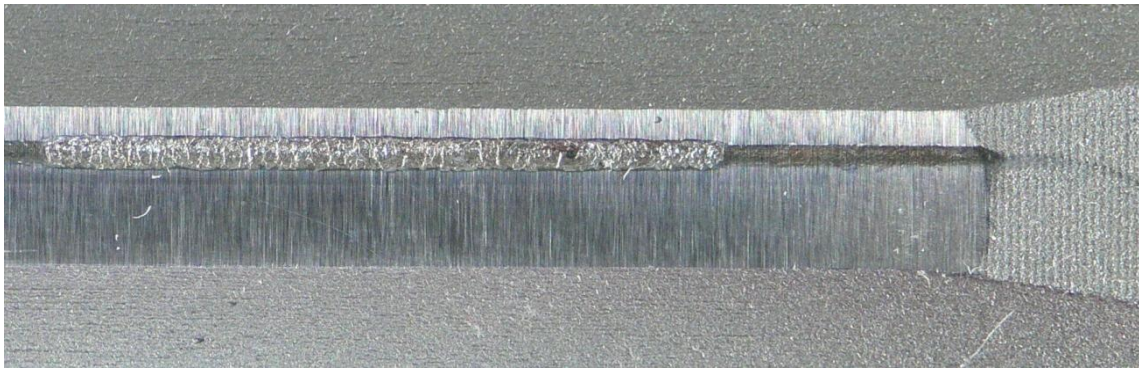


Fig.4 Flaking of outer sleeve raceway surface of linear bush with ball retainer (straight)