

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**

ボールガイドの寿命試験特性データシート
Data Sheet on Rolling Fatigue Life test of Ball Guide

Project of Meiji University Academic Frontier

2010年4月27日（火）

Ball Guide LIFE TEST RIG

Machine type	Crank driven 8-Roller Guide life test rig
Motor	ϕ 3-8p-3.7kw
Frequency	0~80Hz

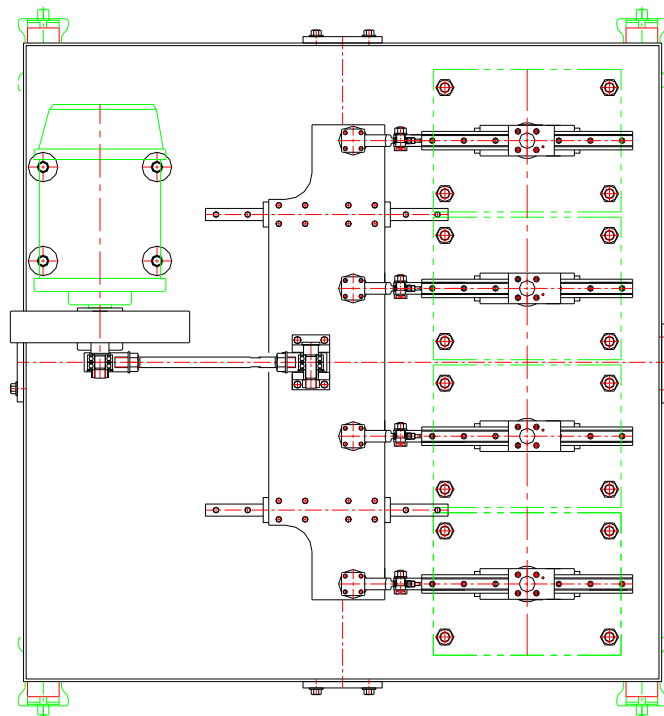
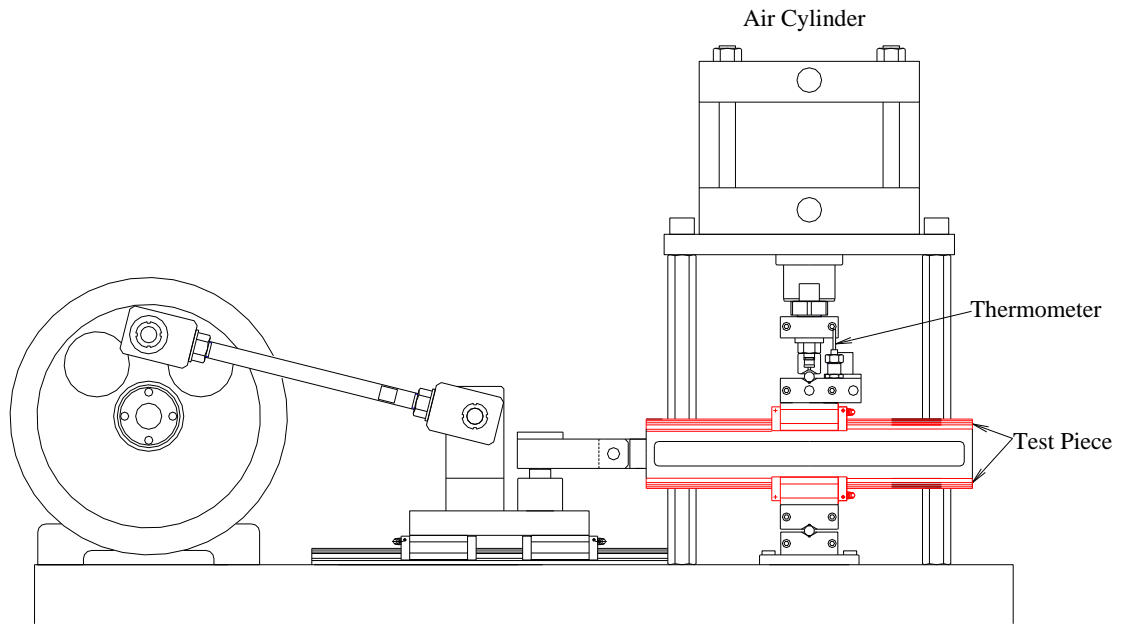


Table 1 Dimensions of ball guide

Catalogue No.	SHS25R
Carriage raceway length, mm	$l_t = 71$
Number of ball circulation	$j = 4$
Number of effective ball lines	$i_t = 2$
Initial contact angle	$\alpha = 45^\circ$
Ball diameter, mm	$D_w = 3.969$
Ball pitch, mm	$t_w = 4.271$
Conformity factor	$f = 0.52$

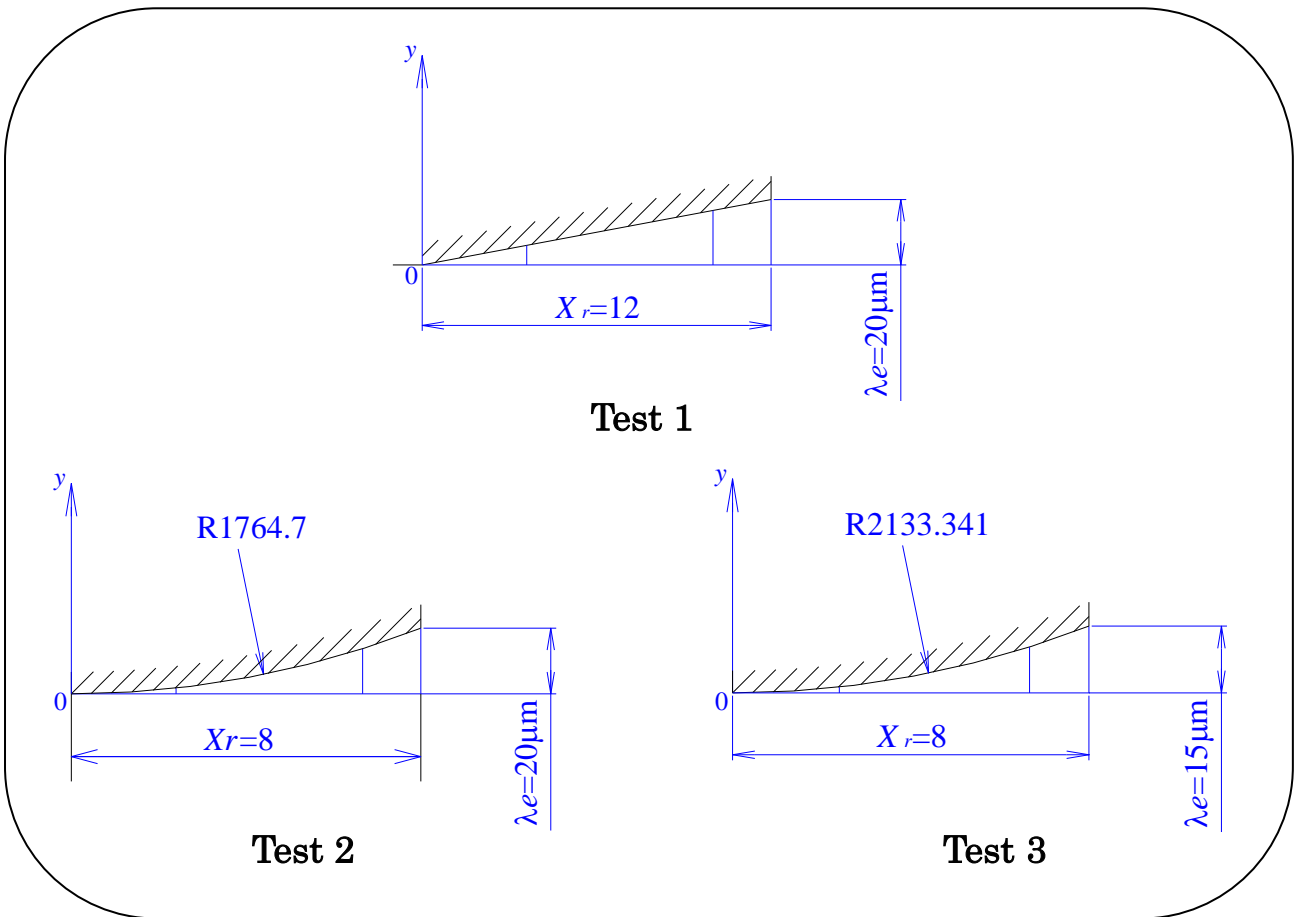


Fig. 1 Change of crowning

Table 3 Test condition

Test load , kN	11.0	
Test speed, m/min	48.0(Max)	15.0 (Mean)
Stroke, mm	200	
Total Number of balls	39	
Grease	AFB-LF Grease	

Table 4 Parameters by log-normal distribution function (L-N)

	Test 1	Test 2	Test 3
μ	5.29	6.51	7.65
σ	0.74	1.96	0.69
σ/μ	0.14	0.30	0.090

Table 5 Parameters by two-parameter Weibull distribution function (2PW)

	Test 1	Test 2	Test 3
m	1.67	1.79	3.19
η	2.73	9.11	17.3

Table 6 Parameters by two-point estimation (TPE)

	Test 1	Test 2	Test 3
m	10/9	10/9	10/9
η	1.99	5.89	8.36
γ	0.45	1.96	7.89

Table 7 Travel distance to failure of ball Guide

No	Test 1	Test 2	Test 3
1	54.32	196.9	870.6
2	66.95	240.6	880.4
3	74.18	280.2	899.6
4	83.23	302.8	916.0
5	97.37	361.8	1007.7
6	103.0	403.9	1030.5
7	133.0	449.2	1168.0
8	151.2	459.9	1178.9
9	171.7	474.3	1178.9
10	215.2	474.3	1203.5
11	222.4	484.2	1217.6
12	231.4	501.9	1243.3
13	241.4	535.2	1257.7
14	261.4	586.7	1312.7
15	308.0	613.8	1397.4
16	313.0	625.9	1494.8
17	324.8	625.9	1509.1
18	355.1	662.8	1524.1
19	392.5	756.1	1616.0
20	484.5	779.7	1619.8
21	508.1	911.4	1630.6
22	524.6	1023.6	1674.2
23		1127.6	1730.3
24		1191.5	1792.8
25		1201.9	2020.8
26		1293.0	2142.7
27		1472.3	2242.0
28		1826.9	2308.2
29		2123.3	2665.7
30		2651.8	3721.1

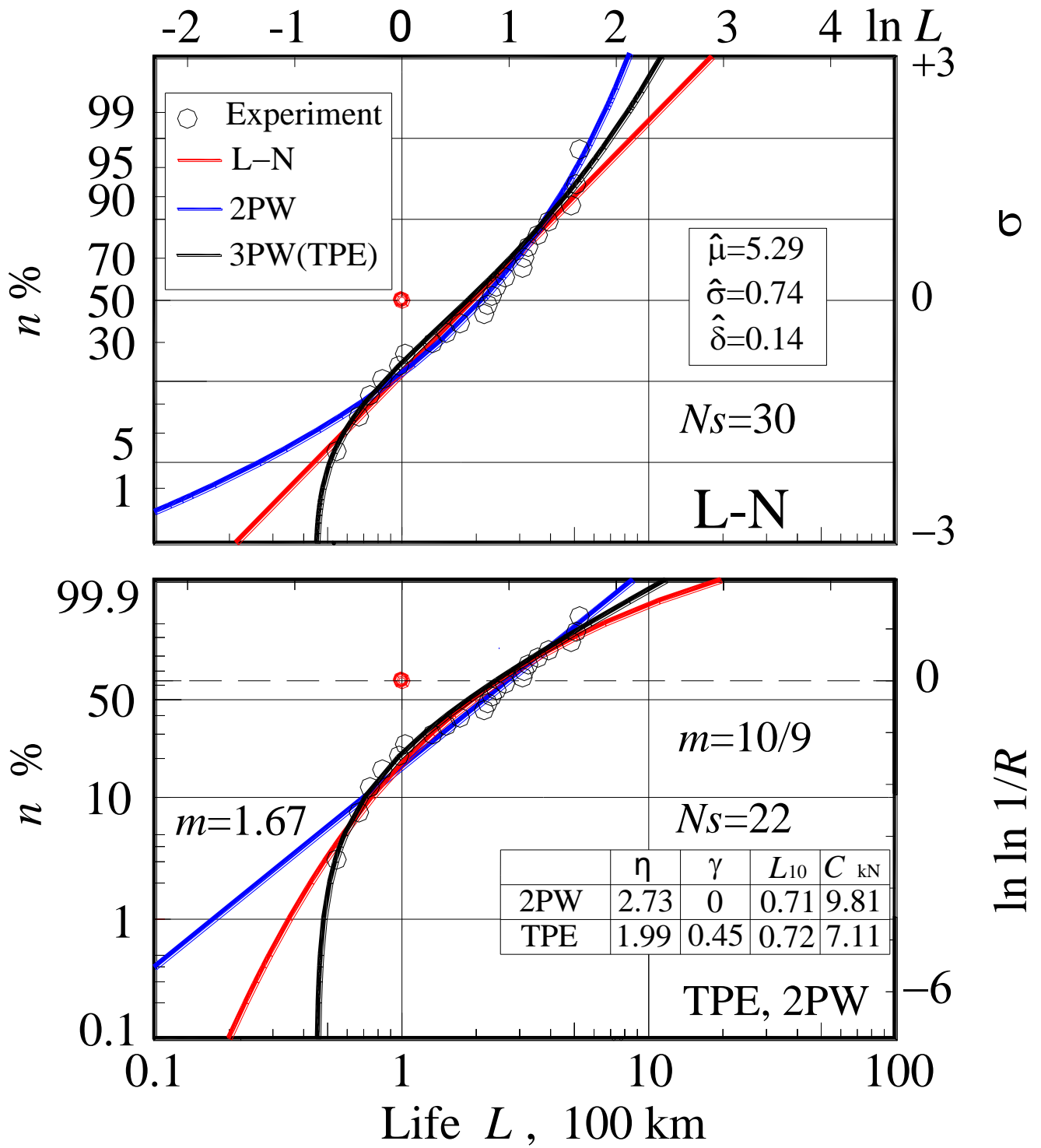


Fig. 2 Weibull and log-normal plot for LMRG component life data by method of two point estimation (Test 1 , $N_s=22$)

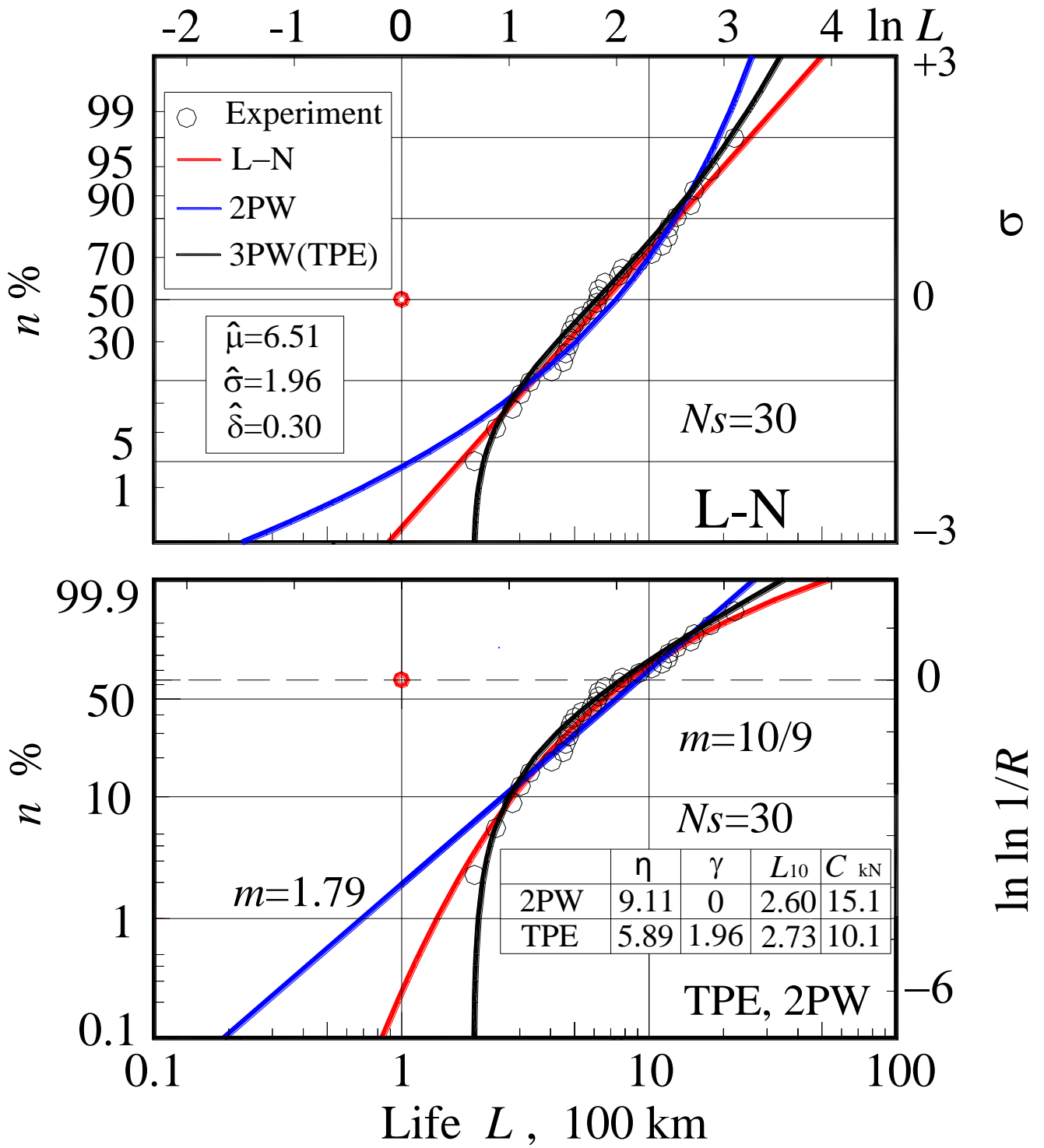


Fig. 3 Weibull and log-normal plot for LMRG component life data by method of two point estimation (Test 2 , $N_s = 30$)

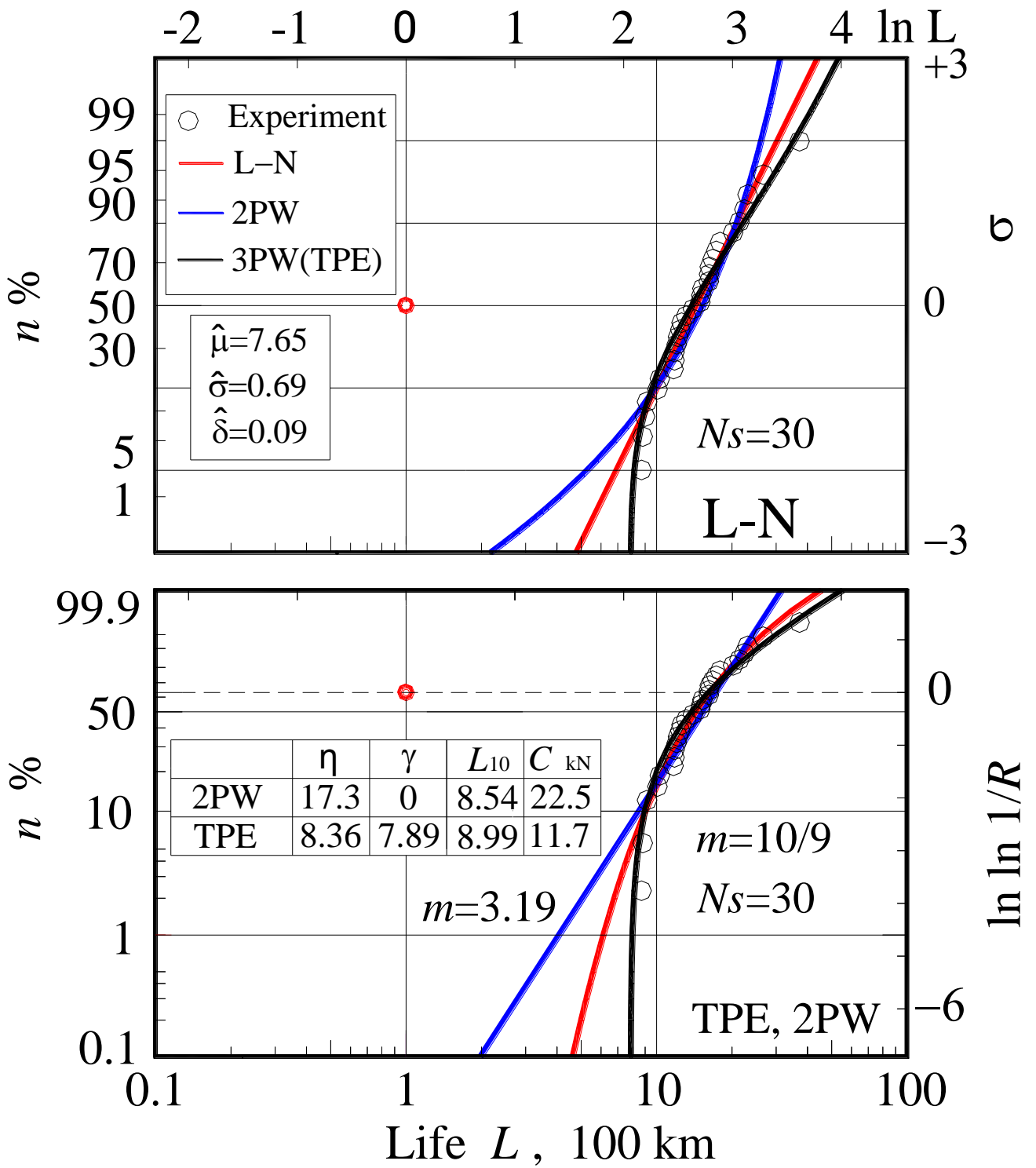


Fig. 4 Weibull and log-normal plot for LMRG component life data by method of two point estimation (Test 3 , $N_s = 30$)

**Table 8 Estimation of C from life distribution
(Test 1)**

	TPE	2PW	Log-normal
$C_{ex(\gamma)}$ kN	7.11	—	—
$C_{ex(\gamma=0)}$ kN	9.85	9.81	10.04
C_{th} kN	14.18	14.18	14.18
$C_{ex(\gamma)} / C_{th}$	0.50	—	—
$C_{ex(\gamma=0)} / C_{th}$	0.69	0.69	0.7

**Table 9 Estimation of C from life distribution
(Test 2)**

	TPE	2PW	L-N
$C_{ex(\gamma)}$ kN	10.08	—	—
$C_{ex(\gamma=0)}$ kN	15.37	15.11	15.55
C_{th} kN	17.54	17.54	17.54
$C_{ex(\gamma)} / C_{th}$	0.575	—	—
$C_{ex(\gamma=0)} / C_{th}$	0.876	0.861	0.887

**Table 10 Estimation of C from life distribution
(Test 3)**

	TPE	2PW	L-N
$C_{ex(\gamma)}$ kN	11.69	—	—
$C_{ex(\gamma=0)}$ kN	22.87	22.49	22.92
C_{th} kN	18.09	18.09	18.09
$C_{ex(\gamma)} / C_{th}$	0.646	—	—
$C_{ex(\gamma=0)} / C_{th}$	1.26	1.24	1.27

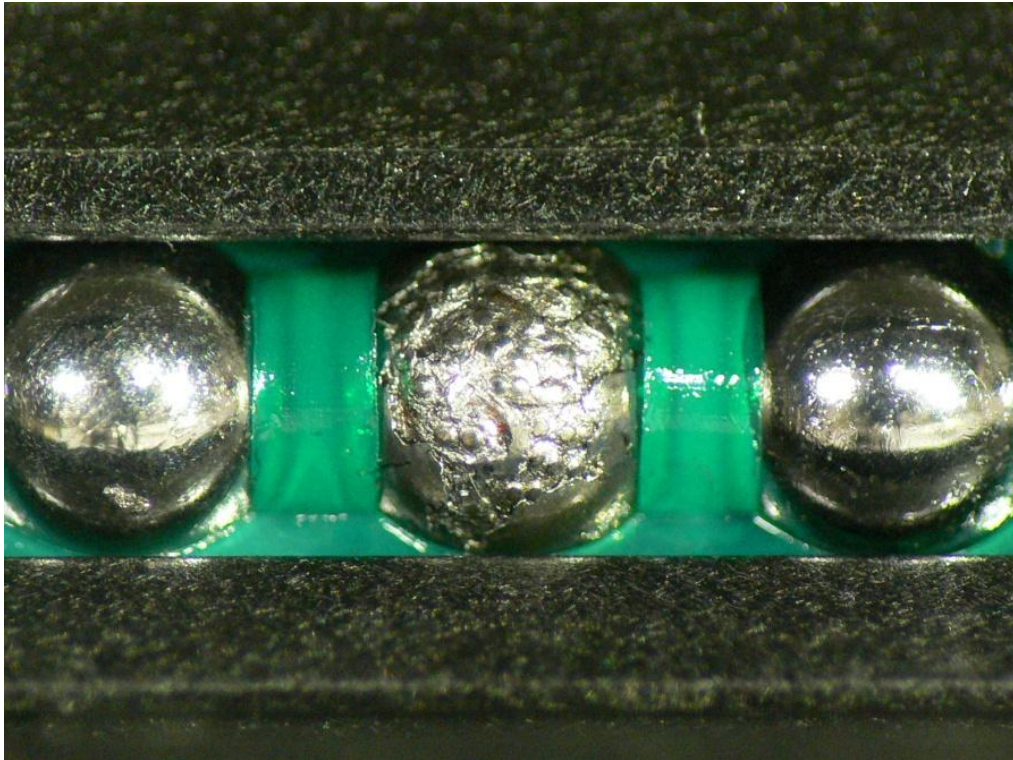


Fig.4 Spalling of ball
(Test 2 , $L = 1127.6$ km)

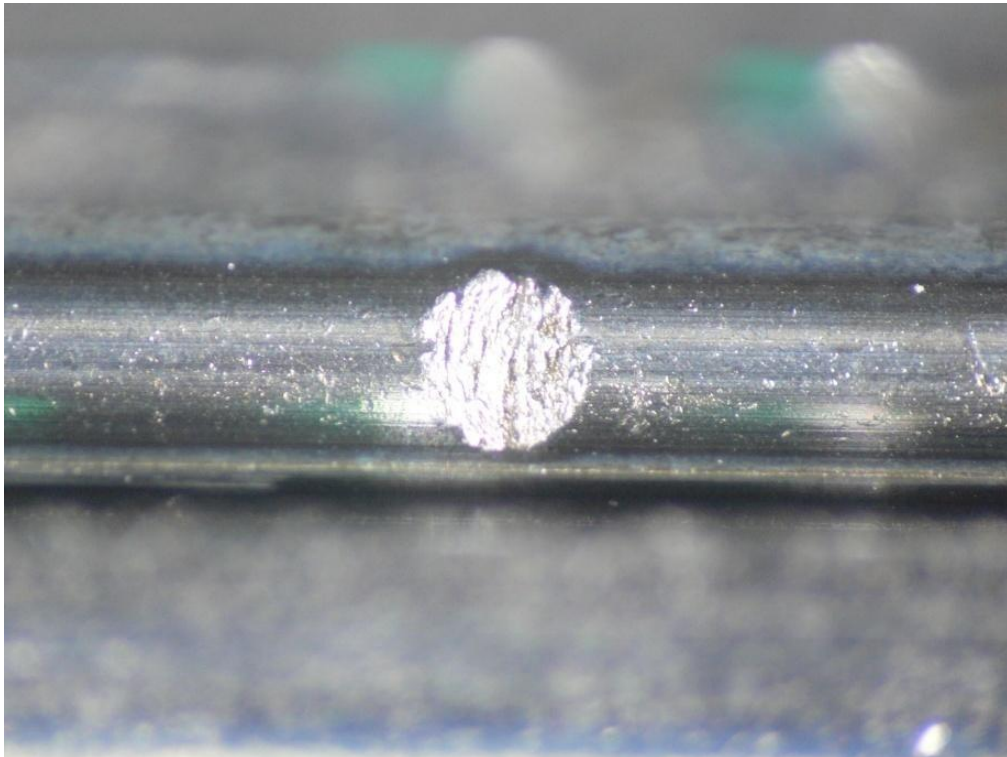
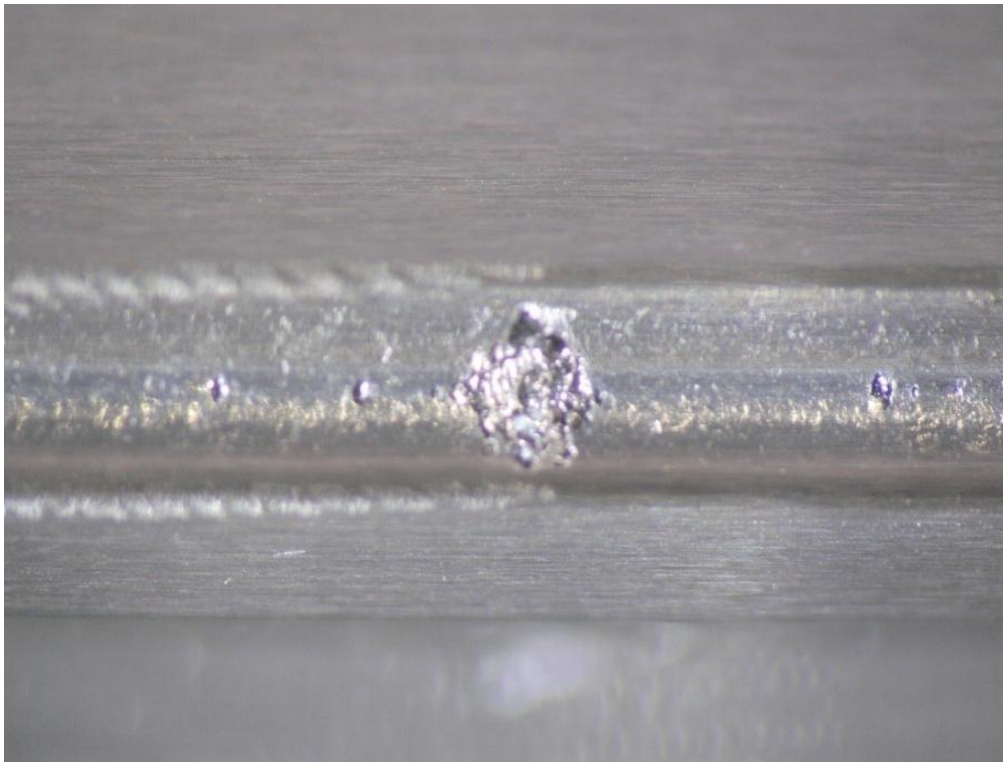


Fig.5 Spalling of carriage raceway surface
(Test 1 , $L = 215.2$ km)



**Fig.6 Spalling of rail
(Test 3 , $L = 2020.8$ km)**