

**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**

JRレール用鋼両振り軸荷重  
疲労特性データシート

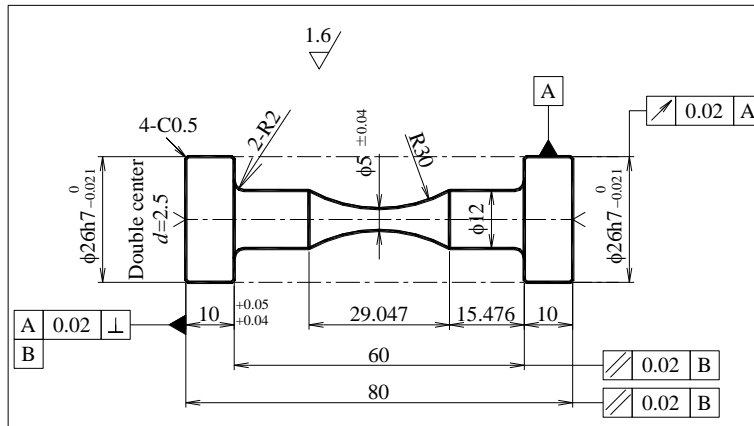
Data Sheet on Fatigue Properties of Rail Steel  
by Alternating Axial Loading Life Test

Project of Meiji University Academic Frontier

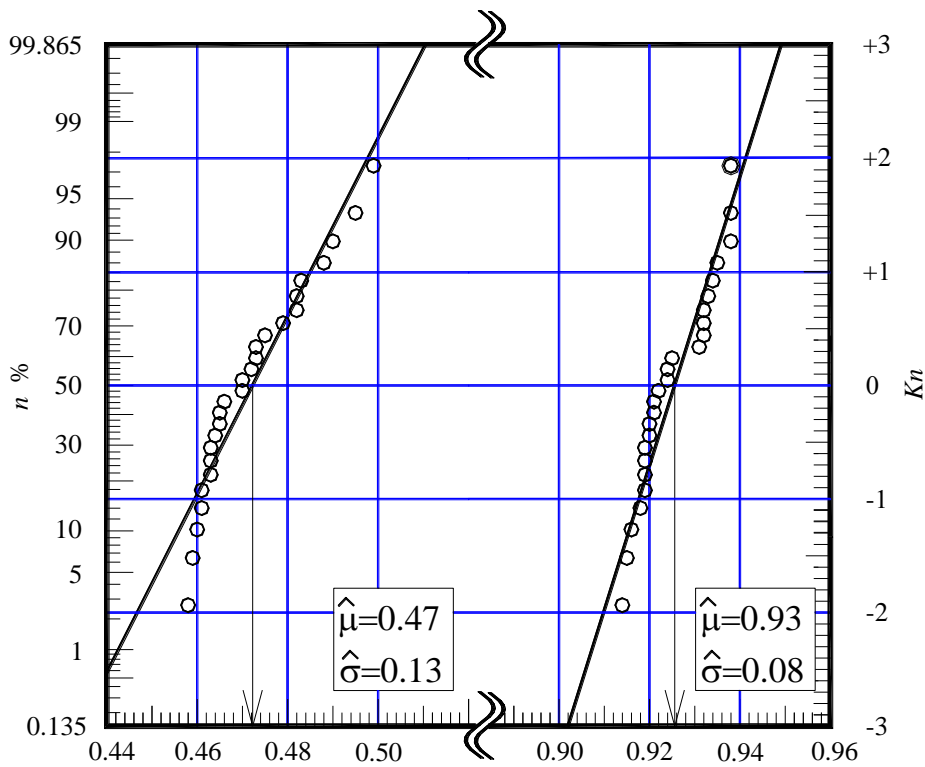
2010年4月27日（火）

**Table.1 Test machine properties**

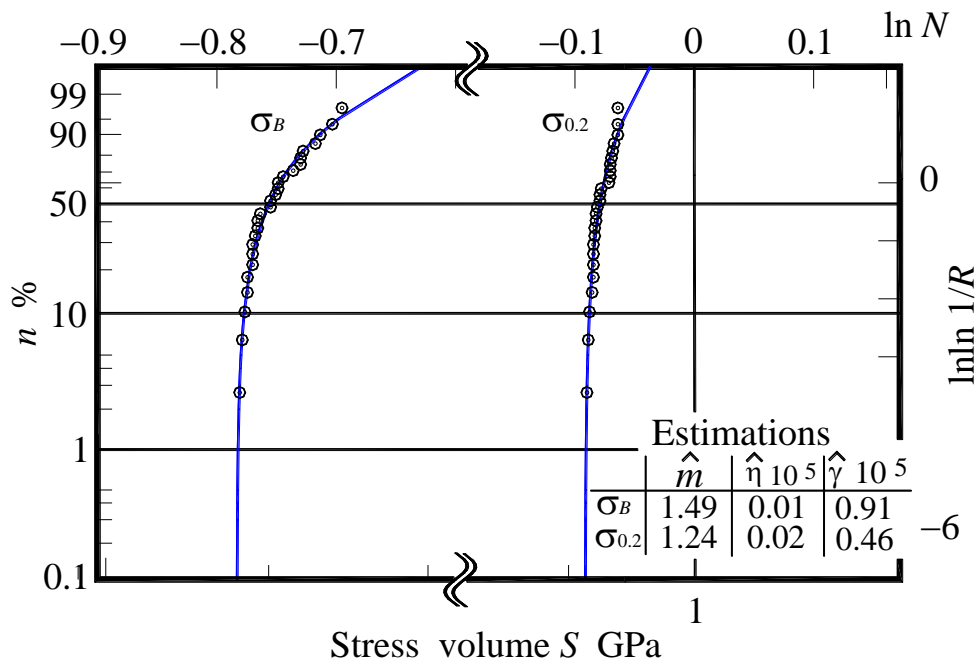
<b>Machine type</b>	Multi-type Fatigue Testing Machine in Axial Loading
<b>Number of test axes</b>	4
<b>Loading capacity</b>	±10kN
<b>Frequency</b>	80Hz



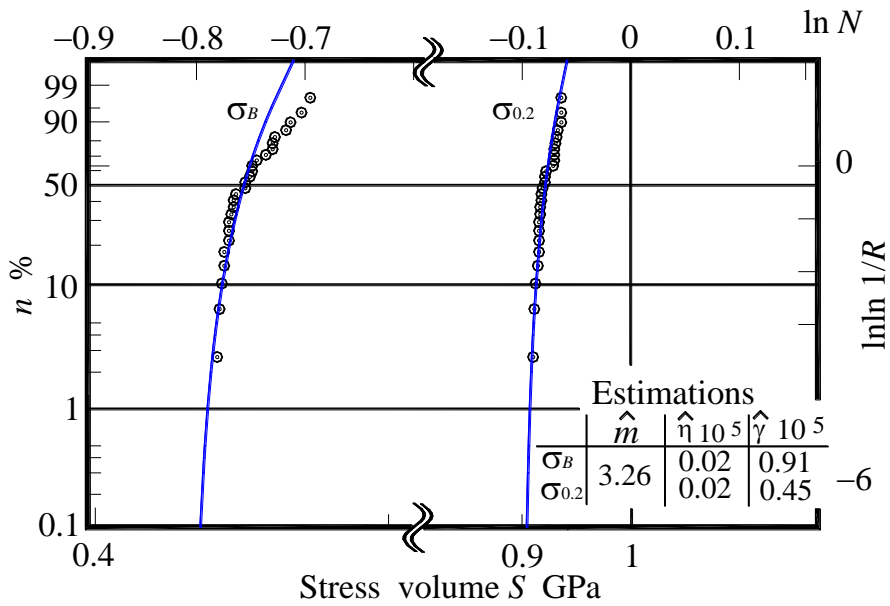
**Fig.1 Test piece**



**Fig.2 Distribution for tensile strength  $\sigma_B$  and 0.2% proof strength  $\sigma_{0.2}$  based on the normal distribution**



**Fig.3 Distribution for tensile strength  $\sigma_B$  and 0.2% proof strength  $\sigma_{0.2}$  based on the three parameter Weibull distribution (Non-linear regression)**



**Fig.4 Distribution for tensile strength  $\sigma_B$  and 0.2% proof strength  $\sigma_{0.2}$  based on the three parameter Weibull distribution ( $m=3.26$ )**

**Table.2 Mechanical properties for test piece JIS 50kgN**

<b>Tensile strength [GPa]</b>	N(0.93, 0.08)
<b>0.2% proof strength</b>	N(0.47,0.13)

**Table.3 Chemical compositions of material (mass%)**

C	Si	Mn	P	S
0.72	0.3	0.74	0.014	0.006

**Table.4 Number of stress cycles to failures of alternating axial loading fatigue life test data for rail steel**

No.	0.40	0.38	0.35	0.33	0.32	0.30
1	2.10E+04	2.81E+04	7.73E+04	1.79E+05	5.30E+05	5.34E+05
2	2.22E+04	3.61E+04	8.78E+04	2.32E+05	6.38E+05	5.86E+05
3	2.68E+04	3.65E+04	9.40E+04	2.82E+05	7.54E+05	8.64E+05
4	2.75E+04	3.75E+04	9.44E+04	2.89E+05	8.47E+05	1.64E+06
5	2.84E+04	3.96E+04	1.05E+05	3.10E+05	8.56E+05	1.18E+07
6	3.70E+04	4.17E+04	1.06E+05	3.16E+05	9.08E+05	2.08E+07
7	3.84E+04	4.22E+04	1.07E+05	3.23E+05	9.53E+05	2.19E+07
8	4.66E+04	4.26E+04	1.16E+05	3.42E+05	1.02E+06	2.69E+08
9		4.45E+04	1.16E+05	3.43E+05	1.20E+06	
10		4.53E+04	1.26E+05	3.44E+05	1.34E+06	
11		4.79E+04	1.41E+05	3.53E+05	1.45E+06	
12		5.07E+04	1.43E+05	3.53E+05	1.55E+06	
13		5.16E+04	1.44E+05	4.21E+05	1.56E+06	
14		5.40E+04	1.44E+05	4.23E+05	1.77E+06	
15		5.45E+04	1.47E+05	4.36E+05	2.06E+06	
16		5.47E+04	1.56E+05	4.79E+05	2.55E+06	
17		5.48E+04	1.76E+05	4.89E+05	2.91E+06	
18		6.32E+04	1.84E+05	5.12E+05	3.18E+06	
19		6.59E+04	1.97E+05	7.99E+05	3.31E+06	
20		6.76E+04	2.01E+05	1.16E+06	1.86E+07	
21		7.12E+04	3.00E+05	5.35E+07	1.89E+08	
22					2.99E+08	
Suspension						

Note: This life test will be continued until finish for the data of six stress amplitudes.

**Table.5 Estimation parameters by the log-normal distribution function**

Stress $S$ [GPa]	0.40	0.38	0.35	0.33	0.32
$\mu$	10.31	10.77	11.80	12.90	14.28
$\sigma$	0.32	0.25	0.35	0.50	0.71
$\sigma/\mu$	0.031	0.023	0.030	0.039	0.050

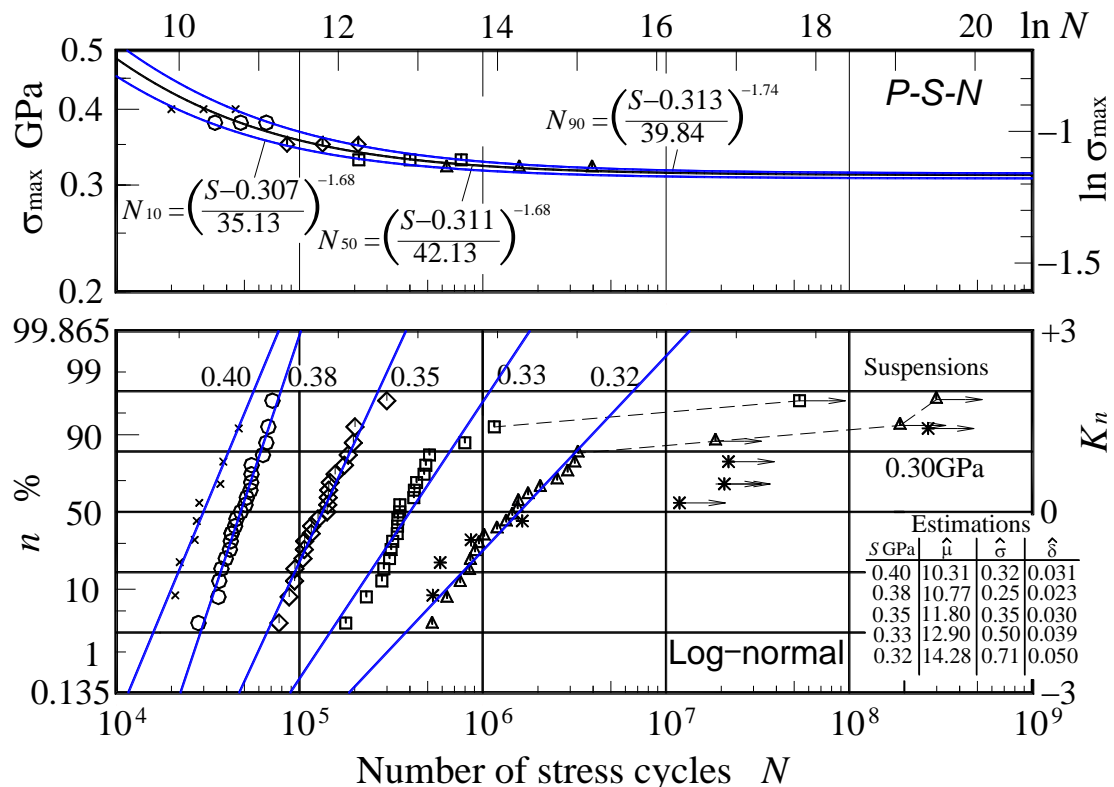
**Table.6 Estimation parameters for the two-parameter Weibull distribution function**

Stress $S$ [GPa]	0.40	0.38	0.35	0.33	0.32
$m$	3.74	4.86	3.40	2.47	1.86
$\eta \times 10^5$	0.34	0.54	1.57	4.96	20.47

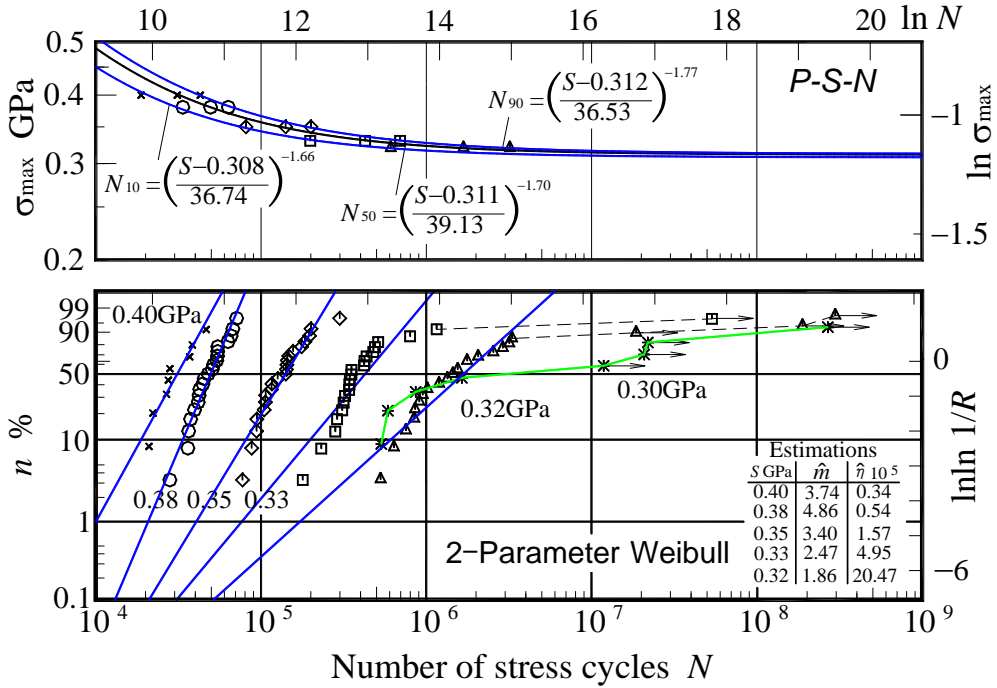
**Table.7 Estimation parameters for three-parameter Weibull distribution function**

Stress $S$ [GPa]	0.40	0.38	0.35	0.33	0.32
$m$	1.47	1.54	1.49	1.42	1.48
$\eta \times 10^5$	0.15	0.20	0.80	2.40	15.04
$\gamma \times 10^5$	0.17	0.31	0.70	1.94	3.22

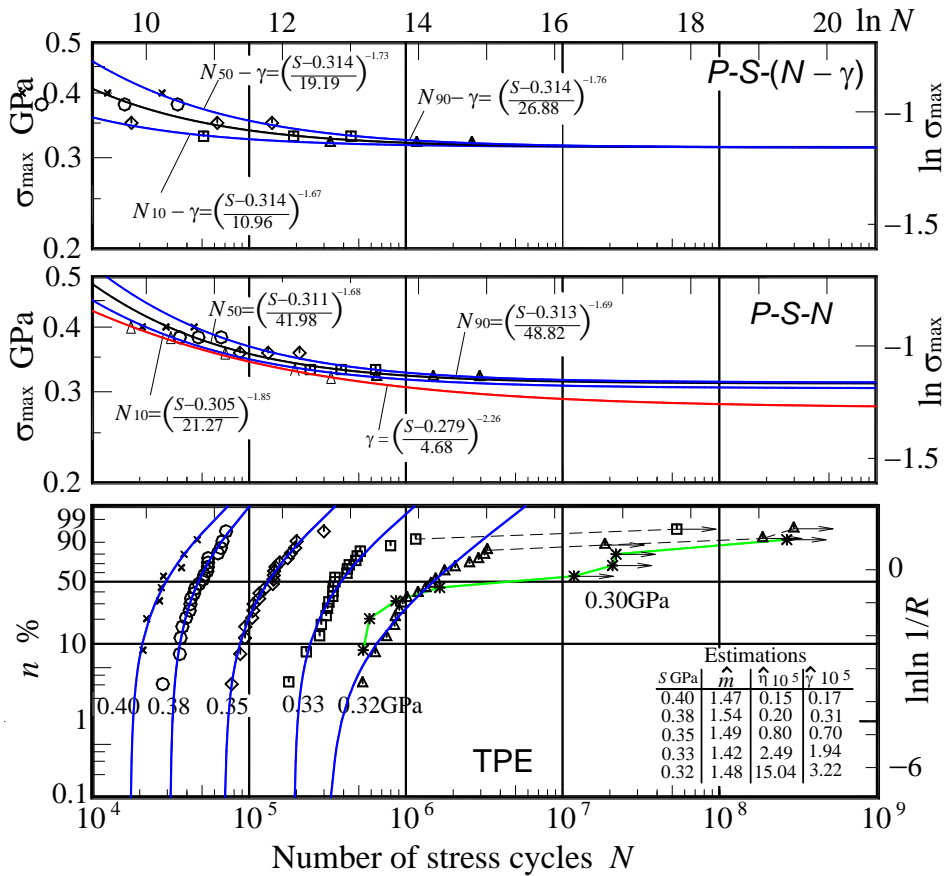
**Table.8 Estimation parameters for all test results**



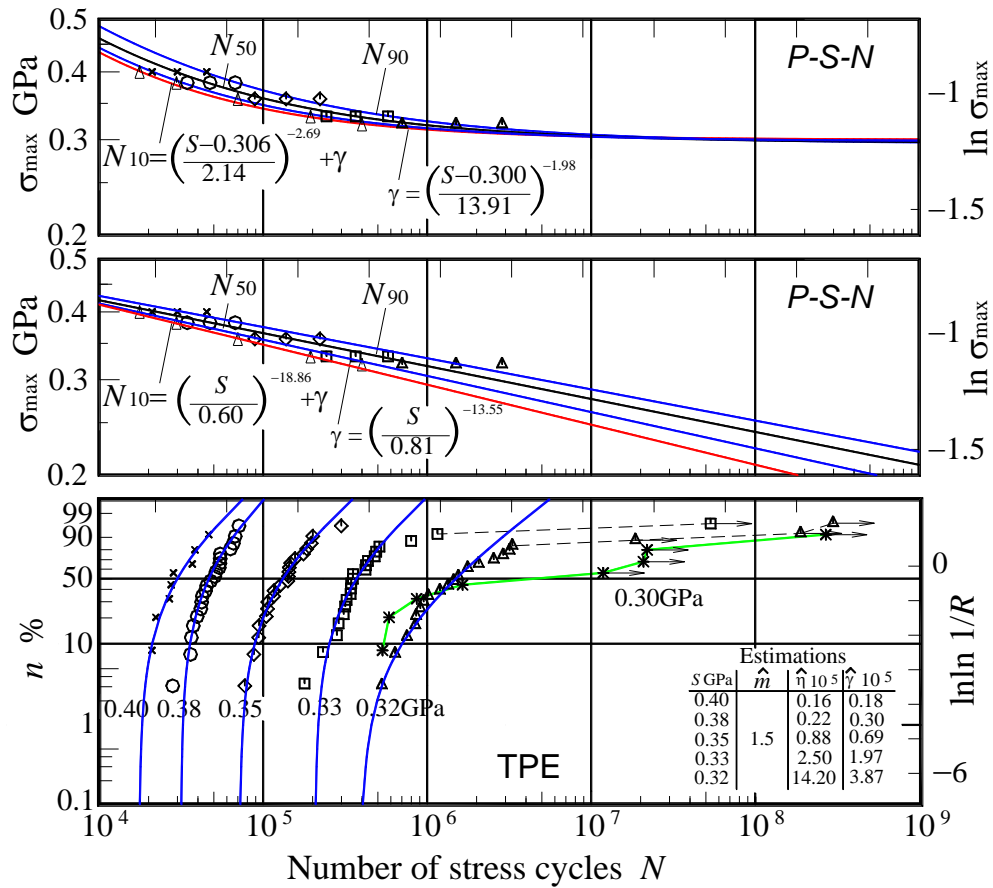
**Fig.3 Life distribution and P-S-N curve for alternating axial stress life test, based on the log-normal distribution function**



**Fig.4 Life distribution and P-S-N curve for alternating axial stress life test based on the two-parameter Weibull distribution function**



**Fig.5 Life distribution and P-S-N curve for alternating axial stress life test based on the three-parameter Weibull distribution function**



**Fig.6 Life distribution and P-S-N curve for alternating axial stress life test based on the three-parameter Weibull distribution function ( $m=1.5$ )**

Continued to be 02.28.2012