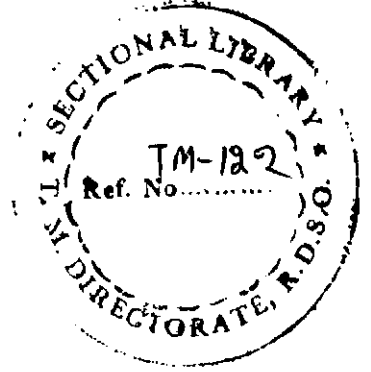


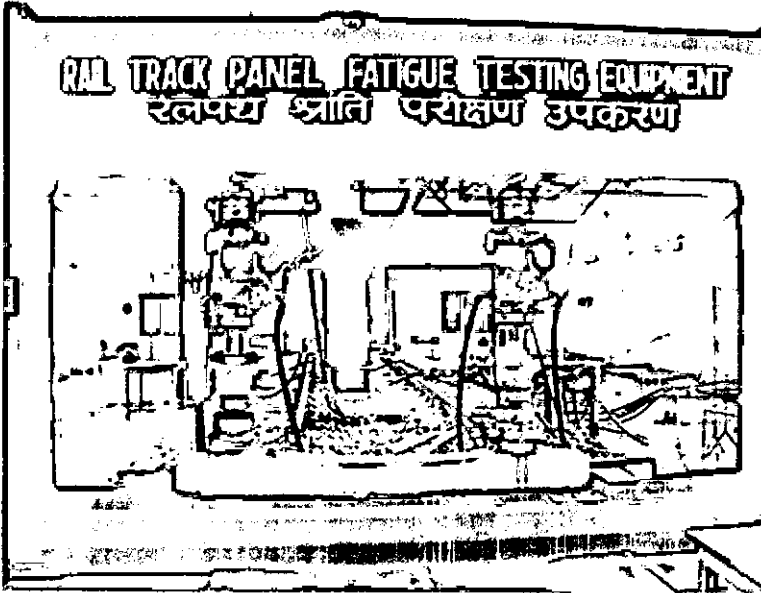
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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS



FATIGUE TESTING OF BG MONOBLOCK PRESTRESSED
CONCRETE SLEEPERS TO DRG. NO. EDO/T-2255 FOR
DEDICATED FREIGHT CORRIDOR (DFC)

REPORT NO. TM-122



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JULY 2008

TRACK MACHINE & MONITORING DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANISTAION
LUCKNOW

Forward

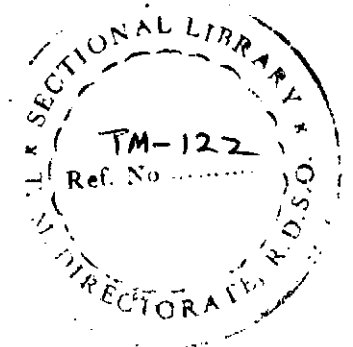
This report is based on tests conducted by the Track Machine & Monitoring Directorate of RDSO. Although every care has been taken in recording data accurately and in analysing it objectively, the views expressed in this report are subject to modification from time to time in the light of fresh data. Further, they do not necessarily represent the views of Ministry of Railways (Railway Board), Government of India.

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Vijay Sharma
Exe. Director/TM

P.K.Garg
Director/TM

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1.0 INTRODUCTION :

Track Design Directorate designed a monoblock BG pre-stressed concrete sleepers to drawing no. EDO/T-2255 for increasing its axle load carrying capacity to 32.5T.

Track Design developed a test scheme keeping in view of the limiting dynamic loading capacity of Rail Track Panel Fatigue Testing Equipment, which is 25T. As per the test scheme, rail seat of three full size sleeper are to be tested for static and dynamic loading on Rail Track Panel Fatigue Testing Equipment. Accordingly, the test set up was prepared and testing was carried out.

2.0 TESTING ARRANGEMENT AND TEST SCHEME:

Photograph of dynamic and static testing arrangement is annexed as Annexure- A and Annexure -B. The applied dynamic load range were 2.5T to 23T (-24.53KN to -225.63KN) for a test span of 680mm and frequency of 8.33 Hz. The sleeper were tested for 2 million cycle but the test cycles were extended up to 5 million cycles for third PSC sleeper, and the upper load range was also increased to 24.5T for the third sleeper after 4.5 million cycles.

The sleepers to be tested for fatigue strength were received in Track Lab. after development of initial crack of 15mm at Kanpur since the static loading facility for desired load were not available in the Track Lab.. However, this facility have now been developed. The rail seats of the sleepers after initial crack were to be subjected to dynamic loading upto two million cycles or failure, whichever is earlier. The growth of crack during dynamic testing was to be observed after every five lac cycles. If sleeper did not fail after completion of two million cycles the same was again subjected to gradually increasing static load till failure and corresponding failure load was to be recorded. The loads and the corresponding deflections of the sleeper were recorded.

The other rail seat i.e. cracked seat of the same sleeper was to be tested to gradually increased static load till the appearance of first crack. The load was then continued to be increased till failure of the sleeper. The load corresponding to initiation of crack and failure to be recorded.

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Later on, the test bed for static load testing capacity 100T has been developed in Track laboratory, therefore, static loading on one sleeper for appearing of fine crack upto 15 mm (approx.) height from the bottom of the sleeper below the rail seat was carried out at this test bed.

3.0 LOADING PARAMETER :

The load, corresponding span and other testing parameters adopted for dynamic testing are as under :

Dynamic Testing :

Sl. No.	Test Span (in mm)	Load Range	Nos. of rail seat to be tested	Frequency of loading	Total nos. of cycles
1.	680mm	2.5T-23T (24.53KN to 225.63KN)	3	8.33Hz	2.0 Million
2.	680mm	2.5T-24.5T (24.53KN to 240.34KN)	1	8.33Hz	2.0 Million

For Static Testing , the test span was kept as 560mm.

4.0 TEST RESULTS AND OBSERVATIONS :

4.1 SLEEPER NO. 1 (LAB. ID no. TL/07-4001)

Static loading of one rail seat for appearance of fine crack upto 15 mm (approx.) height from the bottom of the sleeper below the rail seat was carried out at Kanpur. This rail seat was tested for dynamic loading on Rail Track panel Fatigue Testing Equipment as per the scheme. The crack propagation details are given in Table 1-A below. The sleeper did not fracture upto two million cycles. Therefore, gradually increased static load was applied on this rail seat till failure. Similarly, second rail seat was also tested for gradually increased static load for achieving failure load. The details are given in Table 1-B below. The graph for Load Vs Deflection is enclosed as Graph 1 & 1A.

The static load testing for rail seat of sleeper no 1&2 (non tested rail seat) was done on a separate test frame in track lab. However, it was observed during the testing that the floor on which the frame was resting, settled gradually. Due to this, the max. deflection during testing for these rail seats is much more (26mm-40mm) as compared to other sleeper rail seat (in the range of 8-10mm).

Table 1-A

Crack propagation details below rail seat under dynamic Testing

No. of Cycles	Crack length (in mm)	
	Facing side	Back Side
After 5 Lacs	Not visible	Not visible
After 10 Lacs	30mm	30mm
After 15 Lacs	45mm	33mm
After 20 Lacs	50mm	35mm

Table 1-B

Static Load Testing(Failure Load)

Tested(Dynamic) rail seat		Untested rail seat	
Initial crack observed	Failure load	Initial crack observed	Failure load
30T	62T	-	62T

4.2 SLEEPER NO. 2 (LAB. ID no. TL/07-4002)

This sleeper was also subjected to similar testing loads as for sleeper no. 1. The details of crack propagation and static load testing are given in Table 2-A and Table 2-B respectively. The graph for Load Vs Deflection is enclosed as Graph 2 & 2A.

Table 2-A

Crack propagation details below rail seat under dynamic Testing

No. of Cycles	Crack length (in mm)	
	Facing side	Back Side
After 5 Lacs	Not visible	Not visible
After 10 Lacs	26mm	45mm
After 15 Lacs	38mm	60mm
After 20 Lacs	42mm	85mm

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4.4 SLEEPER NO. 4 (LAB. ID no. TL/07-4004)

Static loading of one rail seat for appearing of fine crack upto 15 mm (approx.) height from the bottom of the sleeper below the rail seat was carried out on test set up arranged in Track Lab./TMM Dte. Crack observed at 31T load. This sleeper was also subjected to similar testing loads as for sleeper no. 1. The details of crack propagation and static load testing are given in Table 4-A and 4-B respectively. The graph for Load Vs Deflection is enclosed as Graph 4 & 4A.

Table 4-A

Crack propagation details below rail seat under dynamic Testing

No. of Cycles	Crack length (in mm)	
	Facing side	Back Side
After 5 Lacs	Not visible	Not visible
After 10 Lacs	Not visible	Not visible
After 15 Lacs	40mm	30mm
After 20 Lacs	48mm	40mm

Table 4-B

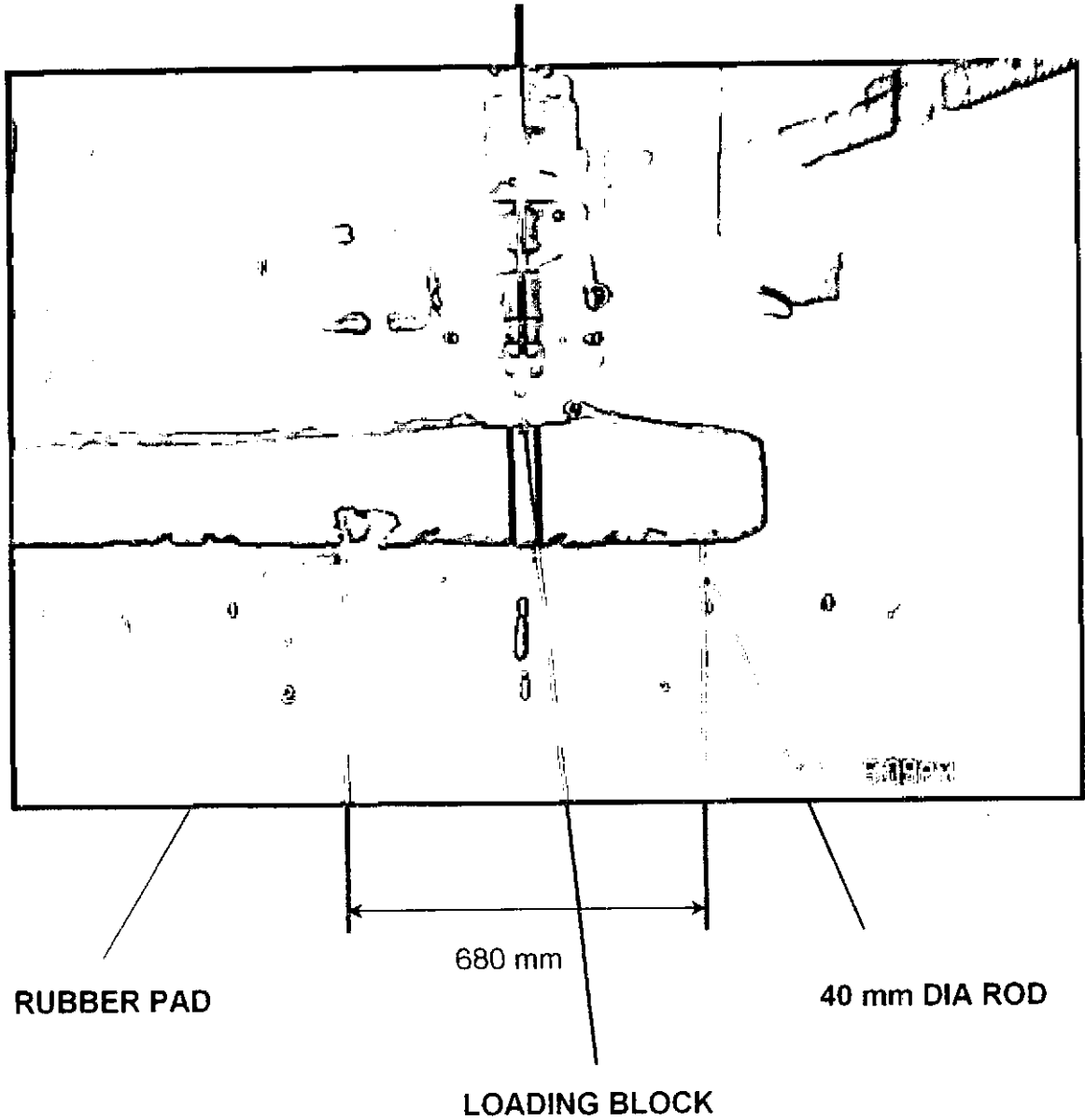
Static Load Testing(Failure Load)

Tested(Dynamic) rail seat		Untested rail seat*	
Initial crack observed	Failure load	Initial crack observed	Failure load
26T	48T	24T	60T

* The rail seat of sleeper, which was not tested dynamically but tested statically till appearance of a fine crack upto height of 15mm (approx.) from the bottom of the sleeper below the rail seat has mentioned as Untested rail seat.

**TEST SET UP FOR FATIGUE TESTING(DYNAMIC) OF PSC SLEEPER ON
RAIL TRACK PANEL FATIGUE TESTING EQUIPMENT**

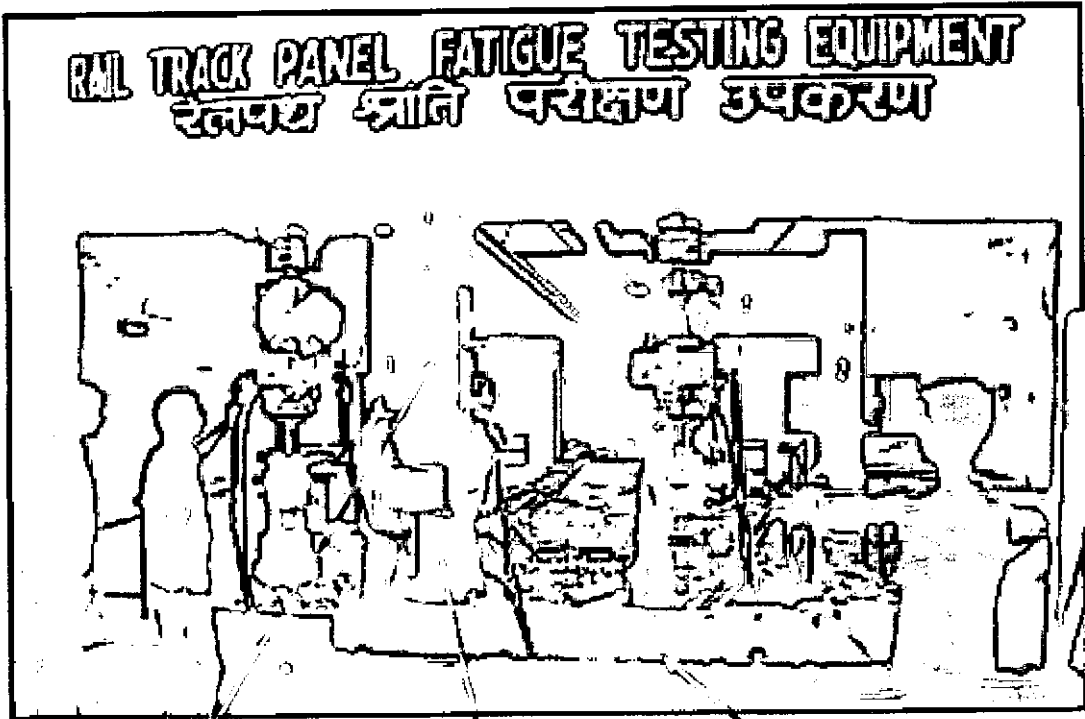
LOADING BY ACTUATOR



Photograph: 1

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TEST SET UP FOR STATIC LOAD TESTING OF PSC SLEEPER ON RAIL TRACK PANEL FATIGUE TESTING EQUIPMENT



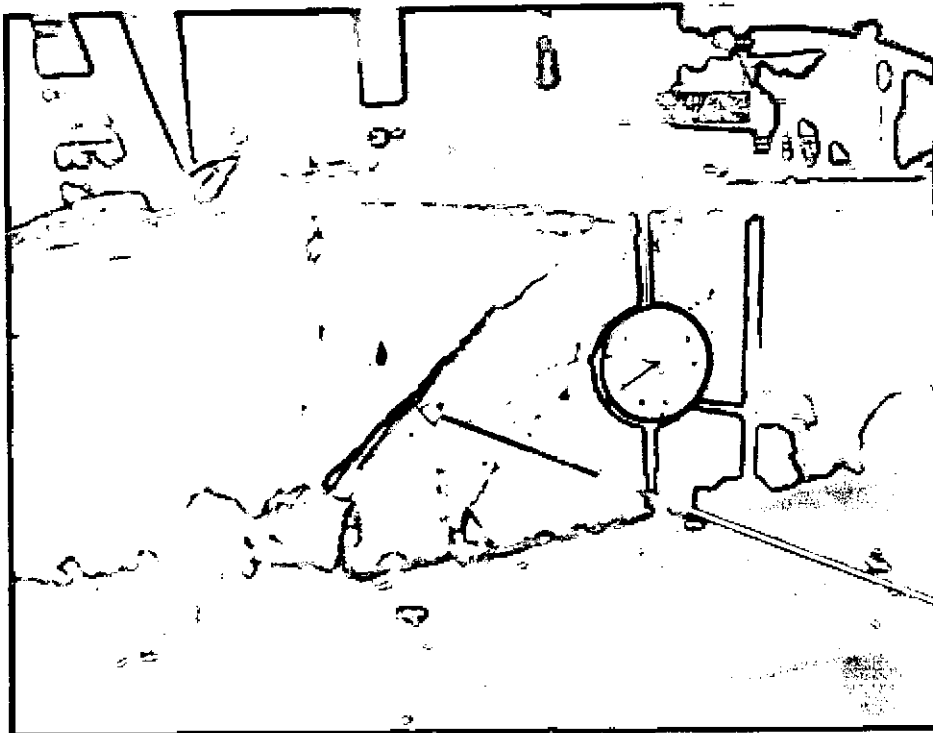
Static Load Frame

Hydraulic Jack

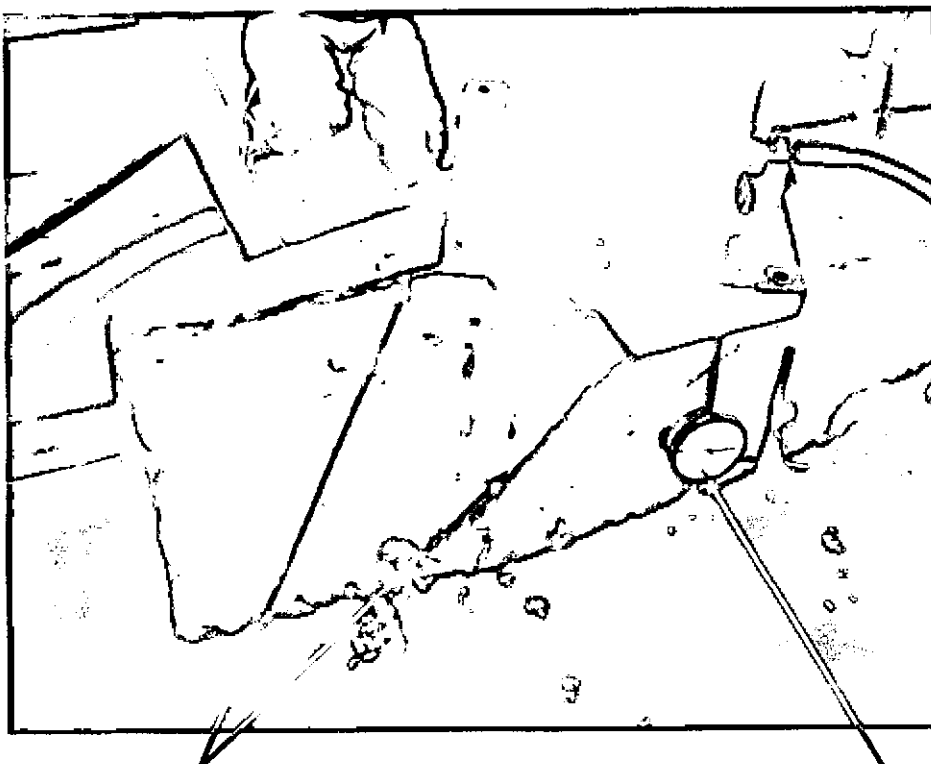
PSC Sleeper

Photograph: 2

STATIC LOADING FOR DETERMINATION OF FAILURE LOAD OF DYNAMIC TESTED AND UNTESTED RAIL SEAT OF PSC SLEEPER



CRACK GROWTH



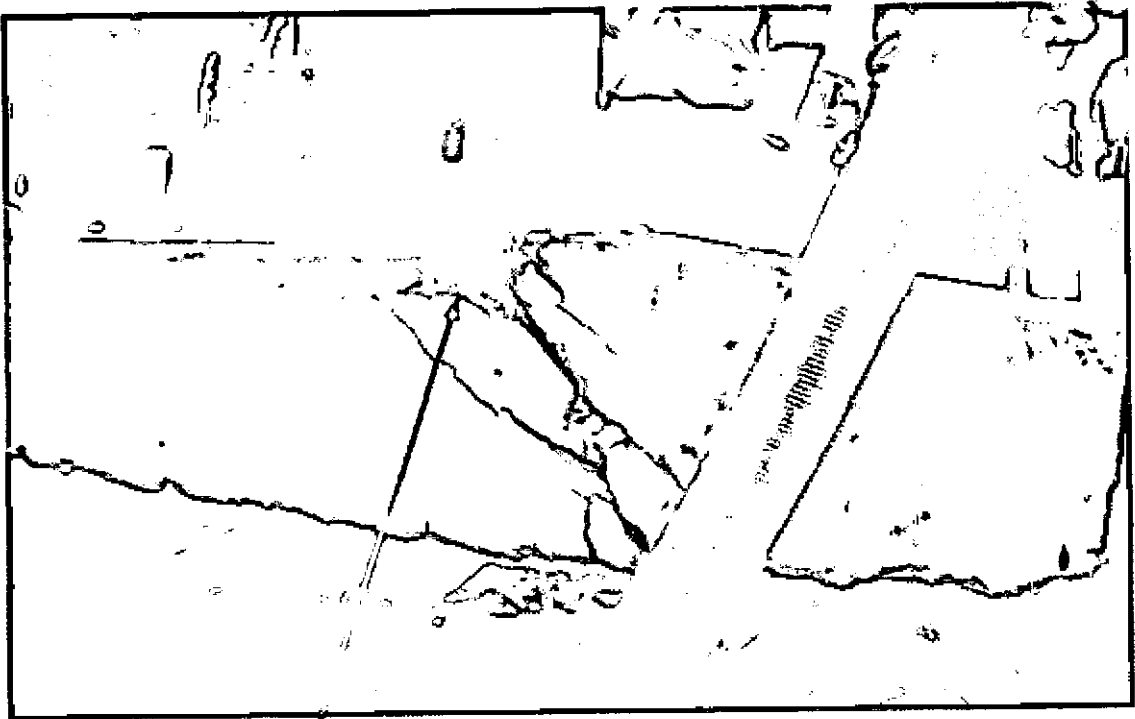
CRACK GROWTH

DEFLECTION DIAL GAUGE

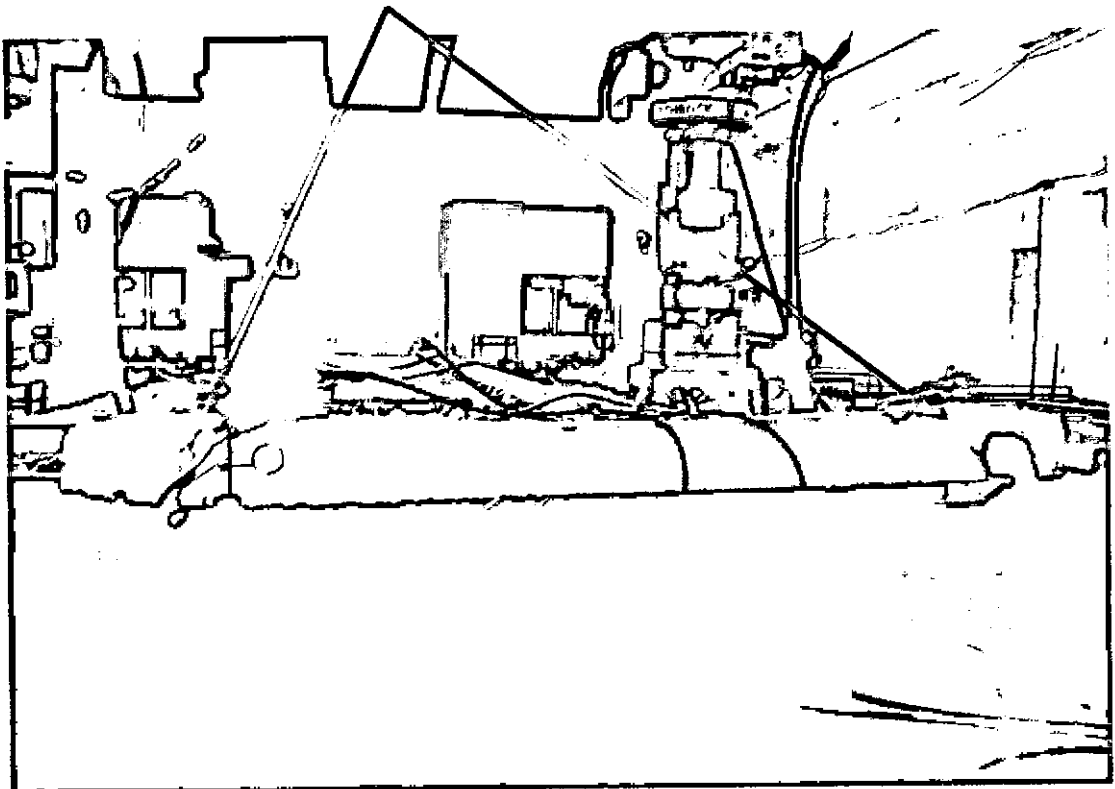
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Photograph : 3

**STATIC LOADING SHOWING FAILURE OF PSC SLEEPER AFTER
DYNAMIC TESTED AND UNTESTED RAIL SEAT**



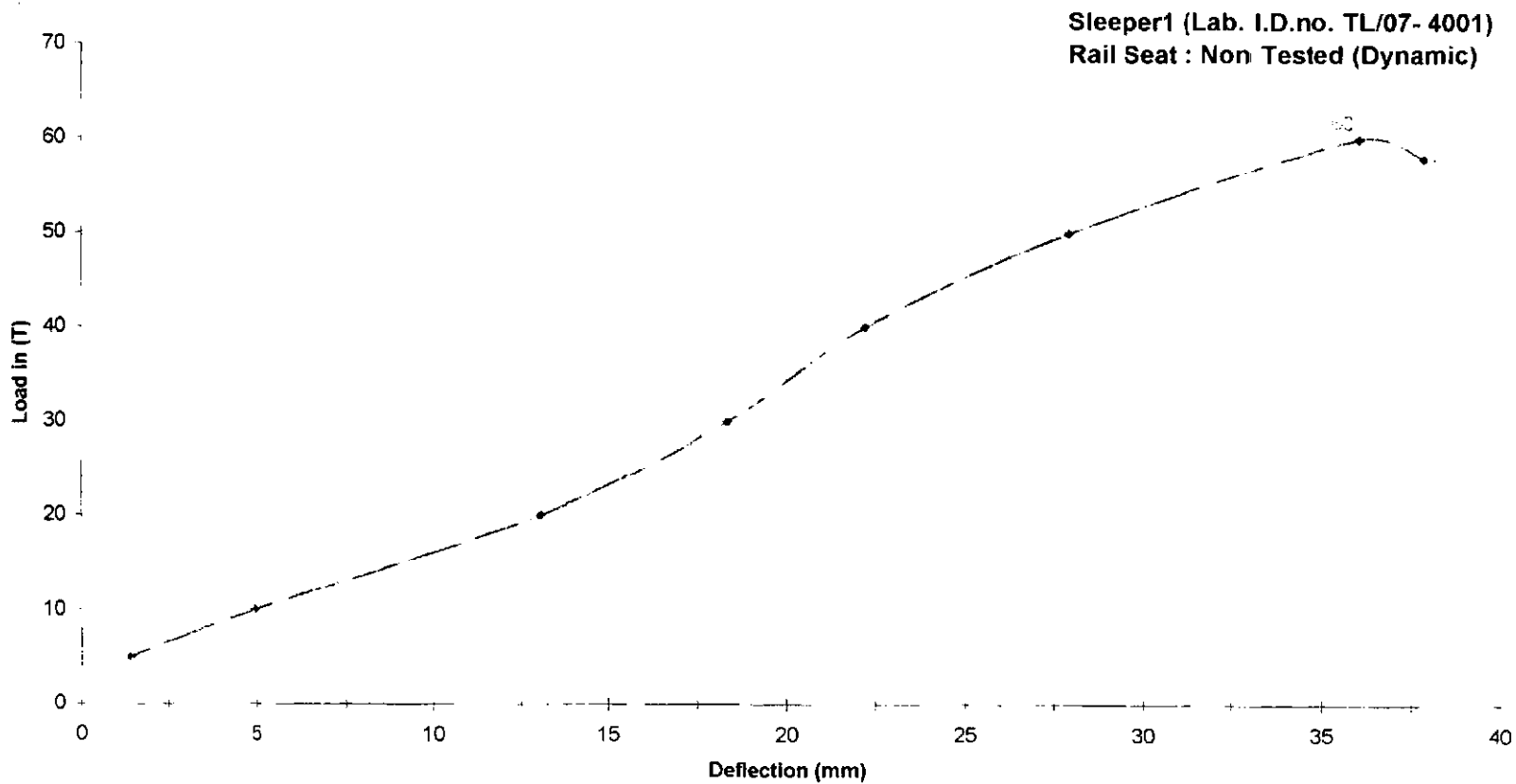
BROKEN SLEEPER RAIL SEAT



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Photograph :4

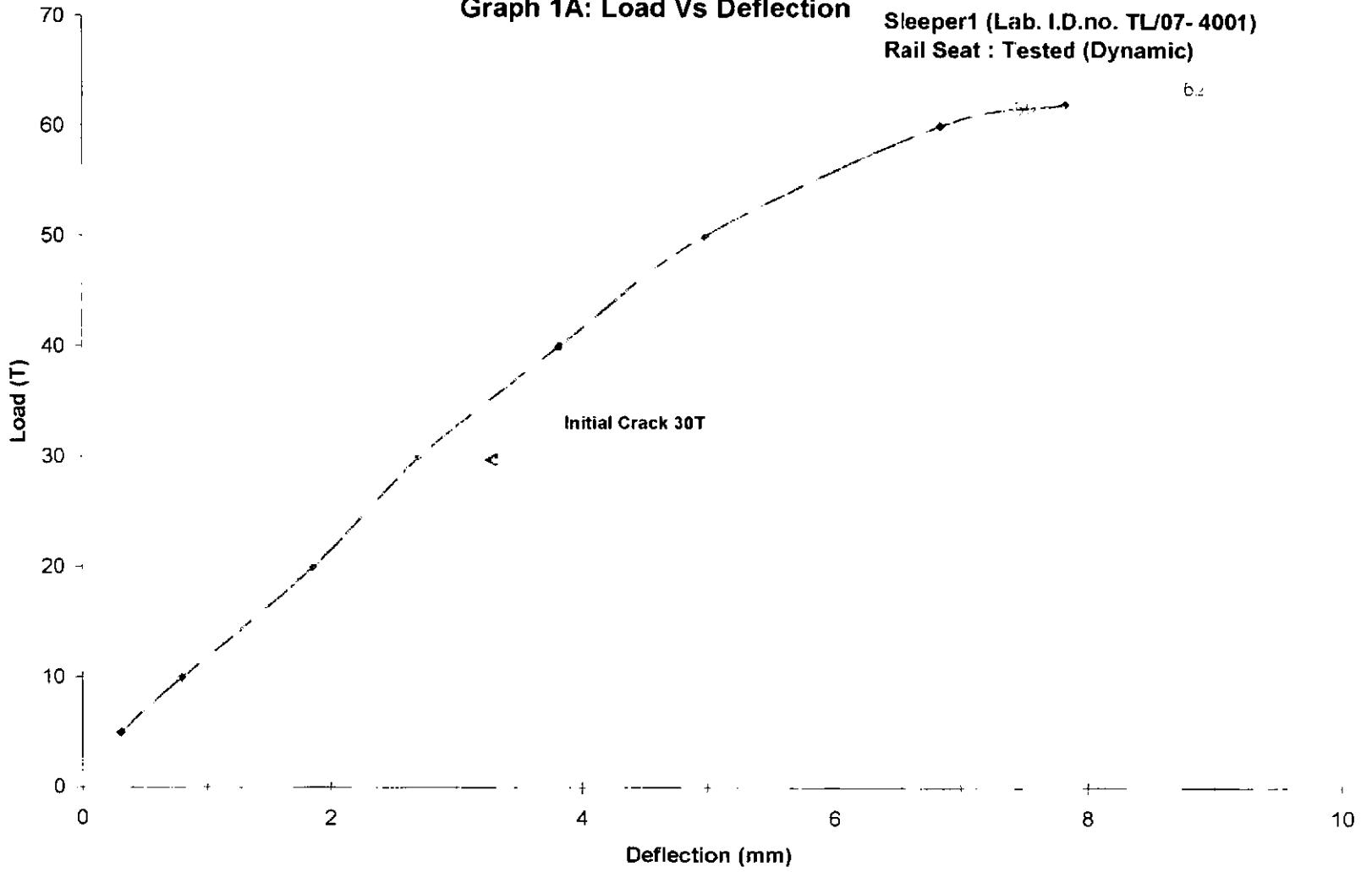
Graph 1: Load Vs Deflection



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Graph 1A: Load Vs Deflection

**Sleeper1 (Lab. I.D.no. TL/07- 4001)
Rail Seat : Tested (Dynamic)**

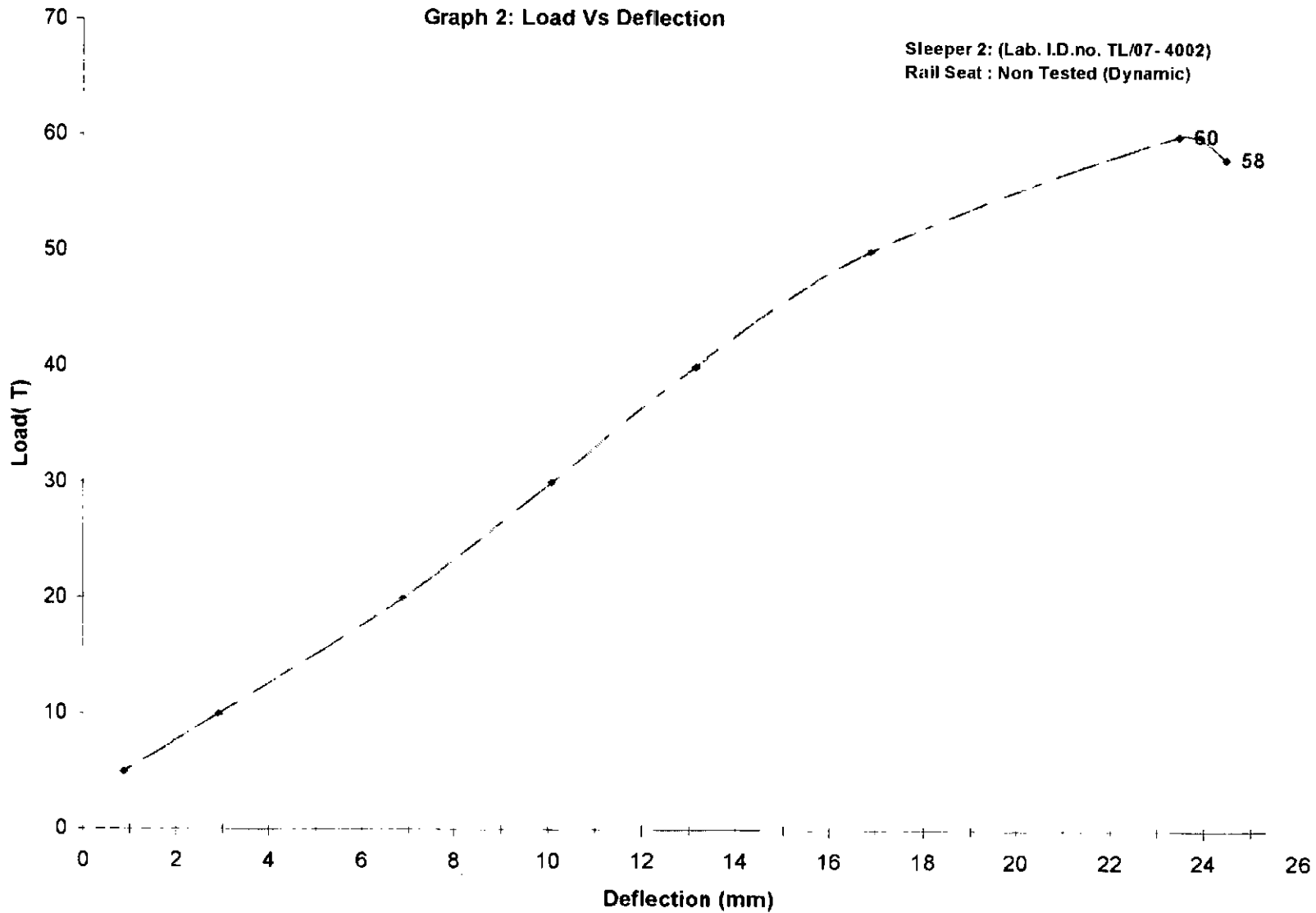


6.2

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Graph 2: Load Vs Deflection

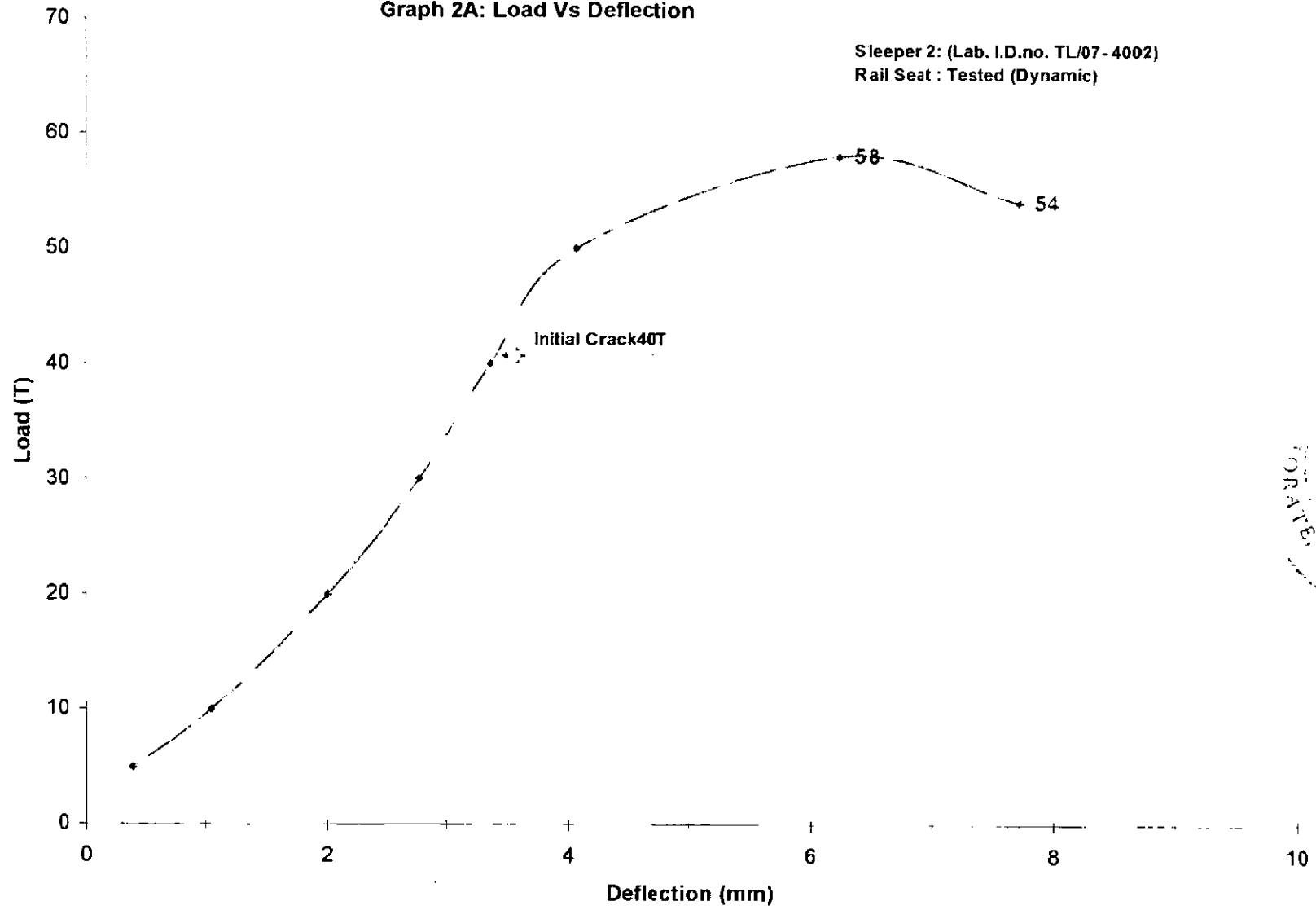
**Sleeper 2: (Lab. I.D.no. TL/07- 4002)
Rail Seat : Non Tested (Dynamic)**



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Graph 2A: Load Vs Deflection

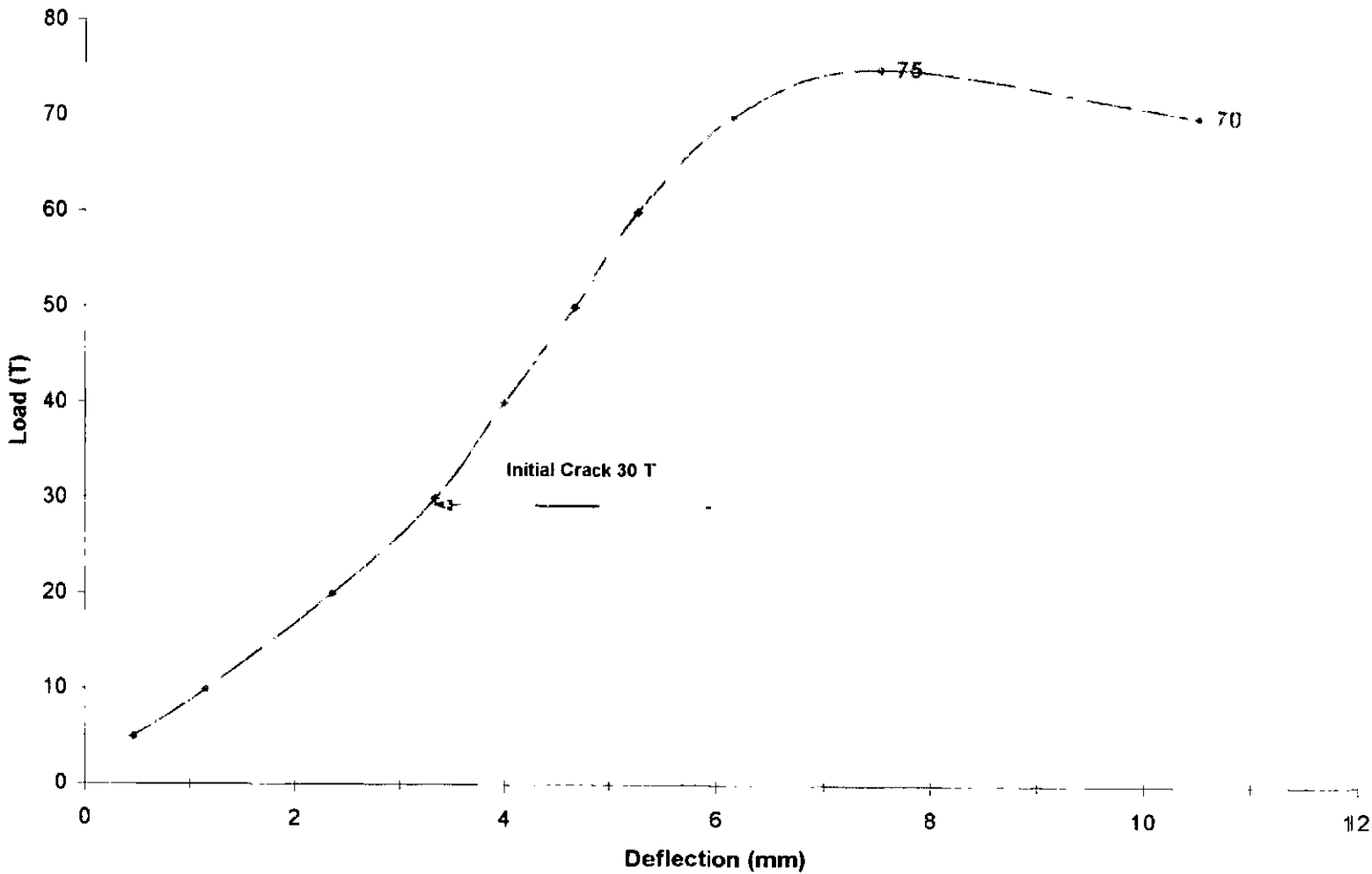
Sleeper 2: (Lab. I.D.no. TL/07-4002)
Rail Seat : Tested (Dynamic)



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Graph 3: Load Vs Deflection

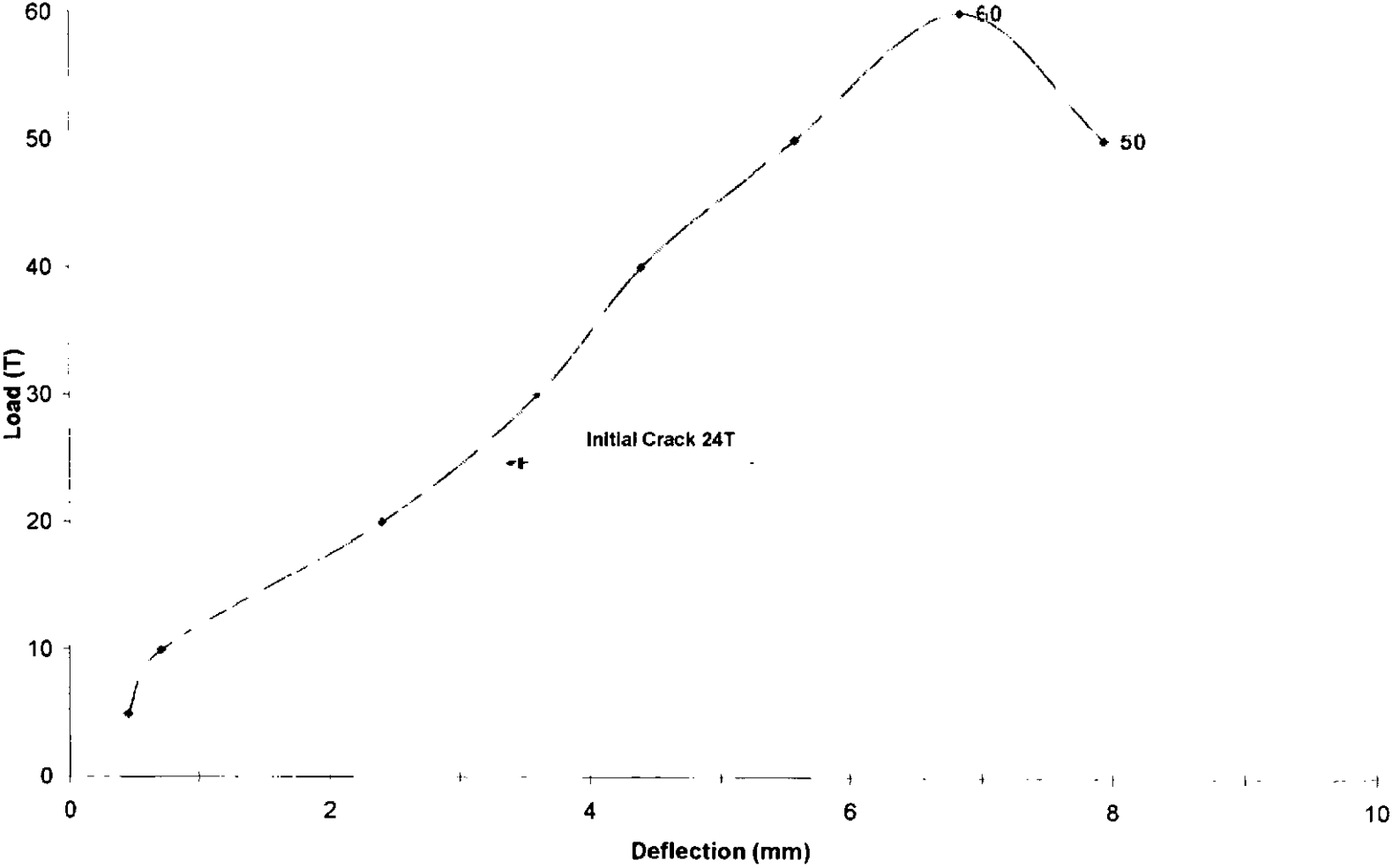
Sleeper 3: (Lab. I.D.no. TL/07- 4003)
Rail Seat : Non Tested (Dynamic)



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Graph 3A: Load Vs Deflection

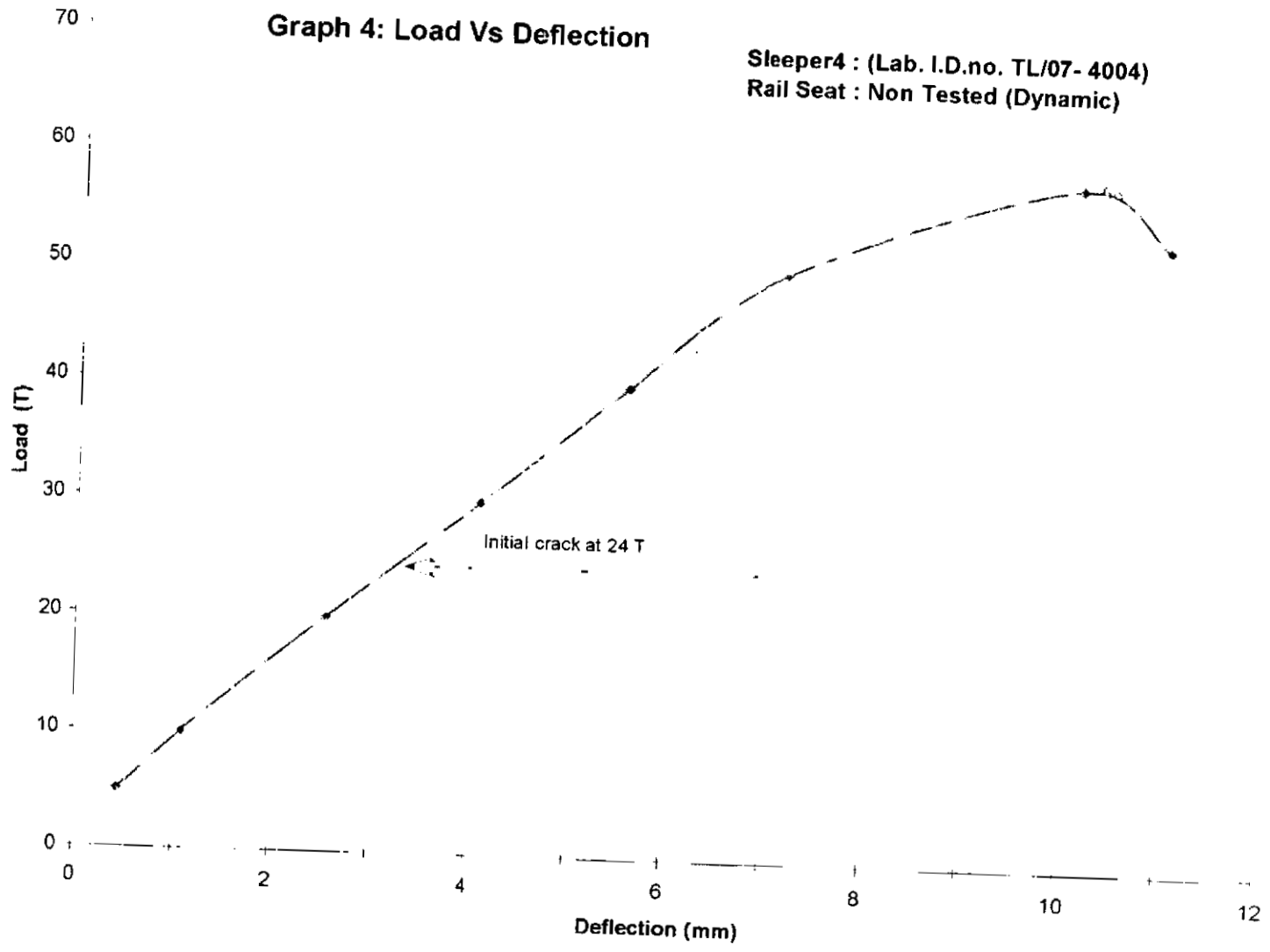
Sleeper 3: (Lab. I.D.no. TL/07- 4003)
Rail Seat : Tested (Dynamic)



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Graph 4: Load Vs Deflection

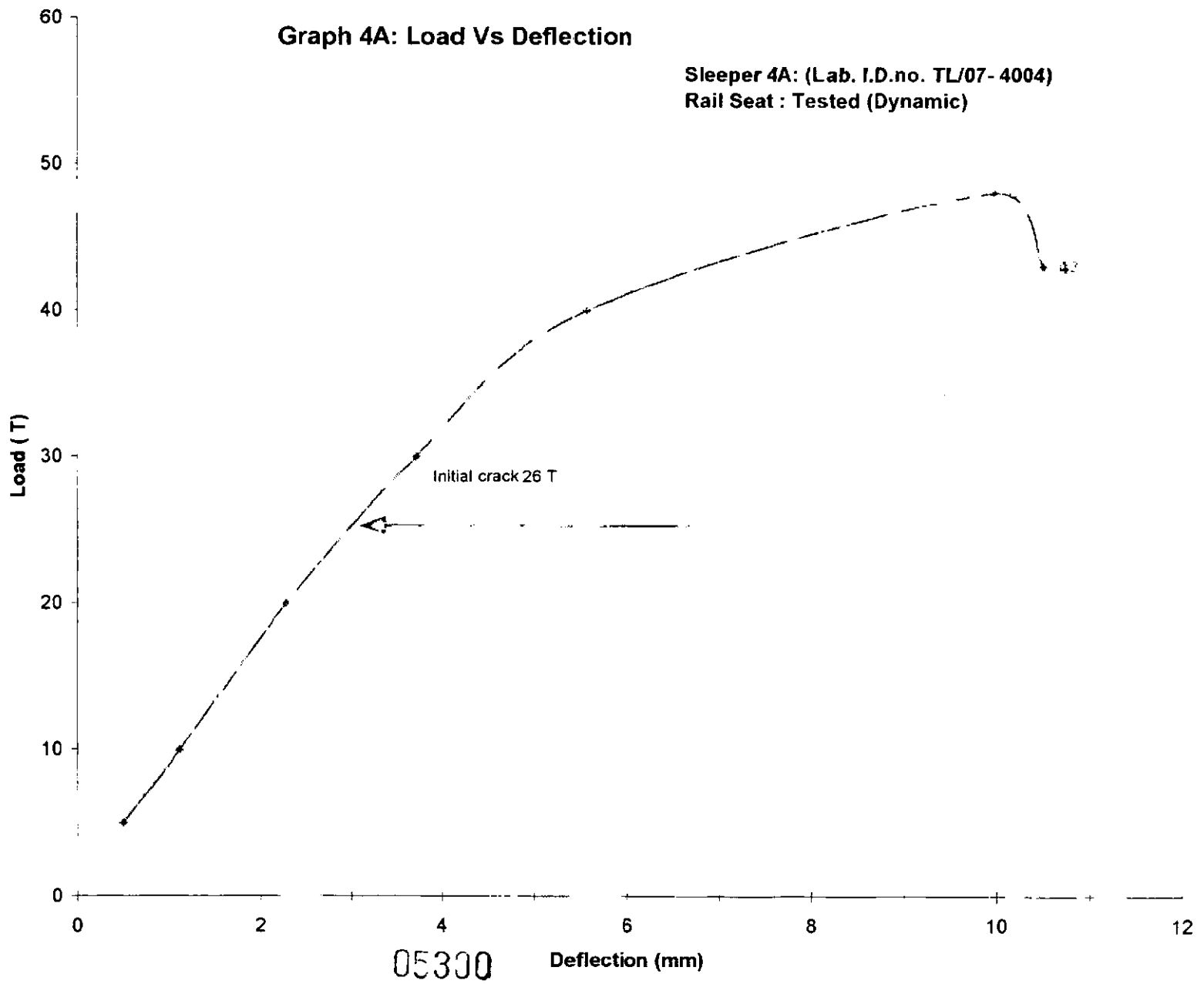
Sleeper4 : (Lab. I.D.no. TL/07- 4004)
Rail Seat : Non Tested (Dynamic)



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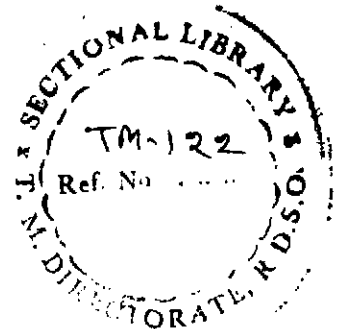
Graph 4A: Load Vs Deflection

Sleeper 4A: (Lab. I.D.no. TL/07-4004)
Rail Seat : Tested (Dynamic)



This report is based on the tests conducted on Rail Track Panel Fatigue Testing Equipment in Track lab./RDSO by a team consisting of following officer/ staff under the guidance of Sri P.K. Garg Director/TM-III

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| 9. Sri S.P.Srivastava | - | TG-I |
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| 11. Sri Gayadeen | - | TG-III |
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