GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

# REPORT ON

# PERFORMANCE OF TUNGSTEN CARBIDE TIP TAMPING TOOLS AND ORDINARY TAMPING TOOLS

**TECHNICAL REPORT NO. TM-16**

March,99

**Track Machines & Monitoring Directorate**



RESEARCH DESIGNS & STANDARDS ORGANISATION
Manak Nagar, LUCKNOW-226011.

# P_R_E_F_A_C_E

The life of ordinary tamping tools is very low, ranging from 10 to 15 kms of tamping and as a result, these have to be replaced very frequently in the field. Carbide tip tamping tools had been in use on some of the railway system abroad and their life is to be about 6,00,000 insertions (approximately 750 kms tamping in case of 32-tool bank ). However, the cost of these tools is also very high and some railways could not adopt them in place of ordinary tools. Also the railways were not sure of the actual performance of these under the prevailing conditions in the field and as such it was decided by the Railway Board to conduct field trials with the Carbide tip tamping tools and ordinary tamping tools for comparative study of their performance. These trials have been conducted in the association with Northern Railway in the similar field conditions. The results of the above trials have been brought out in this report.

It is hoped that the railways will find this report helpful in deciding the adoption of Carbide tip tamping tools, particularly for their cost benefit analysis. It has not been possible to quantify the other benefits like improved tamping quality and longer life of tamping bank with adoption of Carbide tip tools.

March 10, 1999.

Dharm Singh
Executive Director (TMM)
R.D.S.O. Lucknow-226011.

# I_N_D_E_X


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# PERFORMANCE STUDY OF TUNGSTEN CARBIDE TIP TAMPING TOOLS AND ORDINARY TAMPING TOOLS

## 1. INTRODUCTION

Tamping Tools are important part of tamping assembly of Tie Tamping Machines and quality of tamping is affected to a great extent on account of their condition and wear. During the course of tamping, tools are subjected to abrasion from ballast, which results in their wear and tear and worn out tools have to be replaced with new/reconditioned tools for proper tamping. Frequent replacement of worn-out tools is a costly proposition as the same does involve the cost of the new tools and their frequent replacement not only lowers the productivity but also the quality of output of the machine. Therefore, it has always been an endeavor to have wear resistant tamping tools.

M/s Ballast Tools International (BTI) USA, approached the Railway Board and offered to supply one set (32 nos.) of Tungsten Carbide Tip tamping tools for trial purpose vide their letter no. KI/R-III/97 dated 11-3-97. Thereupon, Railway Board asked RDSO to conduct field trials of these tools in association with Northern Railway vide their letter no.96/Track-III/TK/13 dated 12-2-97. (Copy placed at Annexure-I), and ascertain their life under track conditions prevalent on Indian Railways. The scope of the study was further extended to conduct similar trials on Ordinary Tools for making comparison.

## 2.0 METHODOLOGY

### 2.1 Criteria for Tool Condemnation

The shoe area of the tamping tools determines their life and when this area falls below certain limit the tool need to be replaced. This limit is recommended by the Original Equipment Manufacturer (OEM) as 80% of the original area. However in actual practice, the Zonal Railway allows tools with relatively lesser area i.e. upto 70% also. For the purpose of this study, the limiting value of 70% of original area has been adopted for determining the tool life. In actual practices tools are being allowed for even lesser percentage but the additional life so achieved has not been taken into consideration for the study.



It will be seen from the observations that many times tools were not replaced even after reaching the condemnation limit. It is clarified that track tamped up-to the day of condemnation of a particular tool and not the actual replacement, was considered as its performance.

### 2.2 Measurements

During the trials, the observations were recorded as below: -

i) Date of inspection

ii) Tamping machine No.
iii) Type of ballast
iv) Total track kilometres tamped
v) Number of insertions
vi) Measurement of width and height of shoe of the all tamping tools.

Whenever any tool was replaced during the trials, the following details were recorded for further study to determine their average life: -

i) Date of replacement
ii) Total no. of insertions
iii) Measurement of the shoe of tamping tool
iv) Reasons for replacement

## 3.0 FIELD TRIALS

### 3.1 Tungsten Carbide Tip Tools

One complete set of 32 tools was fitted on Continuous Tamping Machine, CSM -09-32 (No.912) of Northern Railway. The tools were fixed in the machine as per arrangements shown in Annexure –II. During the trials, the machine worked in day as well as night time on Delhi-Meerut-Saharanpur, Delhi-Ambala, New Delhi-Tughlakabad and Jalandhar-Amritsar sections of Northern Railway

Initially, joint measurements were taken on fortnightly basis by RDSO staff, machine staff and the representative of M/s Khemka Instruments (Indian agent of M/s BTI) at site. During initial two months, observations were taken fortnightly but very little wear on tools was observed and as such it was decided to record subsequent measurements on monthly basis. The sheets showing joint measurements are placed in the report as Annexure-VIII to XVII. During the trials, the replacement of condemned Carbide Tip tool, whenever needed was done with ordinary tool

The trials was conducted from 16-3-98 to 14-10-98. During this period, 20 out of total 32 tools were already replaced and condition of the remaining tools also warranted replacement by the end of the trials.



### 3.2 Ordinary Tools

For comparative study, another new set of ordinary tools (32 nos.) was fitted on Continuous Action Tamping Machine CSM 09-32 (no. 901) of Northern Railway. This machine had been working near Shahabad Markanda station on Delhi-Ambala section. The wear of these tools is usually very fast as compared to Tungsten Carbide tip tools. Therefore, measurements were recorded on daily basis. The trials started on 12-1-99 and continued till 17-1-99. By this time, most of the tools were worn out and the shoe area had reduced to less than 70% of the original. Observations of these trials are placed in the report as Annexure XVIII to XXIV.

## 4.0. DISCUSSION

### 4.1 Tungsten Carbide Tip Tools:

The trials with Tungsten Carbide Tip tamping tools started on 16-3-98 and wear details were recorded on 31-3-98 by taking measurement of width and height of tool shoes. These measurements show that the wear of the tool shoe had been mostly less than 2 mm after 21656 insertions (26.7 km. of tamping). However, there was chipping of tools at location nos.1, 2, 5, 6, 7, 13, 15, 17, 19, 27 and 30. Next measurements were taken on 16-4-98 after 34106 insertions (42.86 kms. of tamping). A close look at this and all subsequent observations indicate that there had been very little wear of the tools due to abrasion with ballast. However, there had been damage to tools due to chipping off of the carbide strips of the shoes. This might have happened due to hitting of the tools with sleepers due to uneven sleeper spacing, particularly during night working. Once the carbide strip had gone, fast wear of steel material below was recorded. The damaged tools (no. 9 and 10) had extensive wear due to chipping of the carbide strips after 96912 insertions (125.86 kms of tamping) and these tools had to be replaced with local made tools on 16-6-98. By this time, other tools had also worn out by 4 to 5 mm, both in height and width. However, the tools with damaged carbide strips showed very high wear (tool no. 1, 2, 3, 5, 6, 7 & 11).

On 18-6-98, the right hand tamping bank of the machine (holding tool no. 17 to 32) had gone defective and was replaced. All the tools were removed and fitted on the new tamping bank in the same order as in the old tamping bank.

Further during the period from 16-6-98 to 15-7-98, two tools (no.5 and 6) were badly damaged due to chipping of carbide strips at bottom corner which resulted in heavy wear of the steel. The shoe height and width of these tools got reduced by 10 to 15 mm, and as such they were also replaced. These tools had undergone 151020 insertions (196.13 kms of tamping).

During the 5 months period between 16-3-98 and 18-8-98, 222.73 kms of track had been tamped and total 11 tools out of 32 had been replaced by local made tools. The last measurements of the carbide tip tools were made on 14-10-98 when total track tamped by the tools was recorded as 325.83 kms. Majority of the tools (twenty nos.) had already been replaced with locally made tools and dimensions of the remaining 12 tools had diminished to less than 70% of the original area. Therefore, further measurements were discontinued and it was decided to remove the remaining tools also.



The summary sheet of all the joint measurements has been prepared and is placed as Annexure - IV. It indicates the tool wear, date of their replacement, no. Of insertions and total kilometers tamped for all the tools. As noted in the observations, the ballast during the trials was hard stone, a mix of granite and sandstone. The Performance of the tungsten carbide tools is summarised below:

i) After tamping about 90 kms of track (70381 insertions) having granite and sand stone ballast, wear of the order of 1 - 5 mm in the width and 8-10 mm in the height was recorded.

ii) The tools had problem of chipping of corners and edges. Carbide strips broke from almost every side, chipping being in the order of 3 to 8 mm. The reason for this may be both the brittle nature of the material and hitting of tools against sleeper due to uneven spacing and incorrect tamping depth particularly during night time.

iii) Tools fitted at position 1, 2, 5, 6, 7, 9, 10 and 11 gave minimum life and tamped only 125.86 kms (96912 insertions) of track. The tools at position no.16, 17, 21, 29 and 32 recorded best performance and tamped 325.83 kms ( 250890 insertions ) of track. Rest of the tools lasted for 196.0 to 290.0 kms ( 151020 to 222400 insertions ).

The performance V/s cumulative percentage of the tools has been shown in Annexure -VI, both in tabular and graphical form. It also gives both average tool life as well as life 75 percentile value.

4.2 Ordinary Tools

Tool No. 5, 6, 13, 14; tool No. 1, 2, 3, 4, 7, 8, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 and tool no.9 were fixed on 11-1-99, 12-1-99 and 13-1-99 respectively. As recorded in the measurements taken on 12-11-98, the initial dimensions of the tools differed significantly from the standard dimensions shown in the drawing (Annexure-III). The joint measurements were taken on daily basis during the trials and the same are placed as Annexure-XVIII to XXIV.

On 13-1-99 after tamping 2.77 kms of track (2136 insertions), shoe wear upto 8 mm in height and 3 mm in width was recorded. Subsequently, the measurements were taken between 14-1-99 to 17-1-99. Seven tamping tools (nos. 5, 6, 9, 10, 23, 24, 27 and 28) got worn first and had to be replaced on 16-1-99. These tools underwent only 7.41 kms of tamping (5709 insertions) except tool no. 5 and 6, which tamped 10.53 kms of track (8101 insertions). Last joint measurements of the total wear recorded on 17-1-99. By this time, the shoe area had reduced to less than 70% of the original area except for tool no. 12, 15, 16 and 29. The number of insertions and total track tamped for these four tools have been worked out in the summary sheet by extrapolating the last two measurements of the shoe area. The summary sheet placed at Annexure-V shows tool-wise dimensions of the shoe, and kilometers tamped

The performance of the tools varied from 7.41 km. to 12.93 kms. (5709 to 9936 insertions) except for tool no. 9 and 10 having exceptionally low tamping life of 4.64 kms and 5.50 kms respectively. No problem of chipping of the ordinary tools was observed and the tool wear was primarily on account of abrasion with ballast.

The cumulatative performance of the tools indicating their average life and 75 percentile life is shown in Annexure -VII.

## 5.0 CONCLUSIONS

On the basis of the discussion in aforesaid paragraph, following conclusions are drawn: -

5.1 The life of tungsten carbide tip tamping tools ranges from 125 to 325 kms of tamping and 75% of the tools tamped 196.13 kms of track ( 151020 insertions) or above. Against this the ordinary tamping tools lasted for 12.93 kms ( 9936 insertions) and 75% of these tools gave tamping life of 9.21 kms ( 7085 insertions) or above. The average life of carbide tip tools works out to be 216.64 kms ( 166821 insertions) against 9.51 kms ( 7320 insertions) of ordinary tools as show in Annexure-IV and V respectively. All the above three performance indices i.e. maximum, average and 75% cumulative performance show that the life of carbide tip tamping tools is 21-25 times that of the ordinary tools.

5.2 Carbide tip tamping tools are brittle in nature and there is problem of chipping of the Tungsten Carbide Strip due to impact from ballast and hitting against the sleepers. Otherwise the wear due to abrasion is very nominal.

5.3 The replacement of tools, can be substantially reduced with adoption of carbide tip tamping tools. Only 2-3 replacements will be required for each machine in a year. This will save the efforts being put in for allied works like the transport of tools to the site and their fixing etc.

5.4 Due to reduced wear of tool, the quality of packing by the machine will also improve with the adoption of the carbide tip tools.

5.5 The damage to tamping units and its seal's etc. will be reduced due to fewer replacements of tools at a large interval contrary to that of ordinary tools

Annexure-I

**GOVERNMENT OF INDIA**
**MINISTRY OF RAILWAYS**
**( RAILWAY BOARD )**

No. 96/Track-III/TK/13 New Delhi, dt.12-2-97.

M/s Khemka Instruments Pvt. Ltd.,
613-614, Som Dutt Chambers-II,
9, Bhikaiji Cama Place,
New Delhi-110066.

Dear Sirs,

Reg: Trial and Testing of Tamping Tools of
M/s Ballast Tools International, U.S.A.
Ref: Your letter No.KI/R-III/96 dt.28-1-97.

Please refer to your letter under reference advising about supply of 16 Nos. Tamping Tools for trials free of cost.

In this connection you are advised to request your Principal to forward at least 32 Tools and not 16 as has been proposed by you. The tools may be consigned to JDTM-II, RDSO, Lucknow for testing and trial purpose. The details of the dispatch instructions etc. may also be advised to this office for record. The arrangement may be tied up with RDSO that the consignment is received without any procedural delays.

Yours faithfully,

Sd/-
(Harjinder Singh )
Director Track (MC)
Railway Board.

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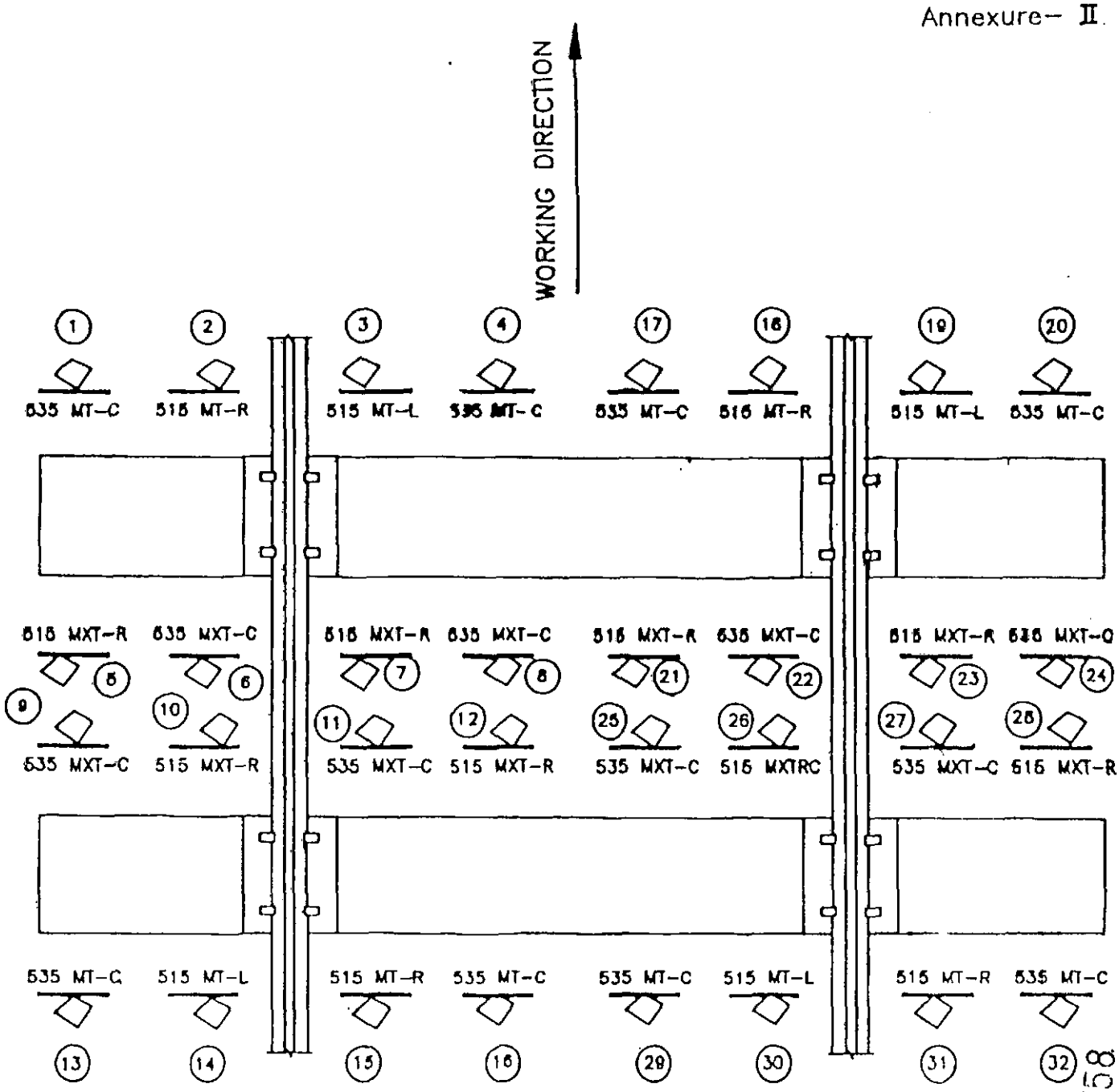
Copy to:

JDTM-II, R D.S.O., Lucknow for information and necessary action.




MACHINE : CSM 09–32(S.No. 912)

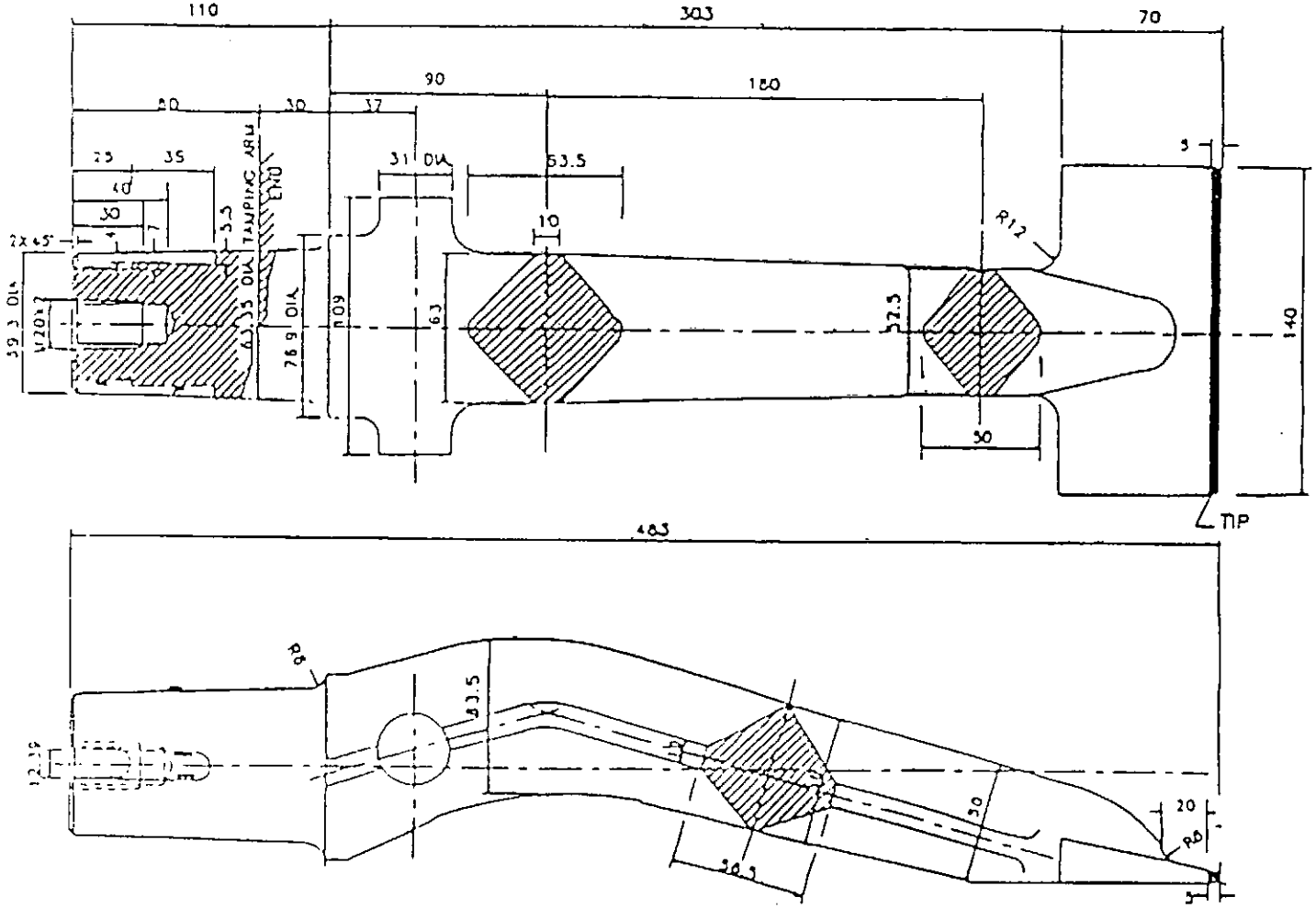
## TAMPING TOOLS

ALL TOOLS SLANT–TOP, CARBIDE BACKED CENTER TOOLS

TOOL LENGTH : 480 mm.

FULL SET (32 Nos.) :
- 535 MT–C (8 Nos.)
- 535 MXT–C (8 Nos.)
- 515 MT–R (4 Nos.)
- 515 MXT–R (8 Nos.)
- 515 MT–L (4 Nos.)

## LAYOUT ARRANGEMENT OF TAMPING TOOLS




7. FORGING TO BE SAND-BLASTED.
6. HEAT TREATMENT CYCLE: AFTER THE FORMATION OF THE TIP OF THE TOOL THE COMPONENT SHALL BE NORMALIZED AND THEN HARDENED AND TEMPERED AS PER APPENDIX-B OF IS: 6517-1978.
5. TIP OF TOOL (UPTO 5 mm DEPTH) TO BE PRE-HEATED TO 200°-250°C AND PRESSED/SQUEEZED WITH AN ARMER PLATE BY A SLOW DOWNWARD STROKE.
4. MATERIAL: Gr.40 Mn Cr4 Mo2 TO IS:2517-1978.
3. PROCESS OF MANUFACTURE: CLOSE DIE FORGING.
2. ROUNDING OFF TO BE DONE TO 3 mm RADII WHEREVER NOT SPECIFIED.
1. ALL DIMENSIONS ARE IN MILLIMETRES.

08759

NOTES

RDSO's SPECIFICATION No. TM/DIM/6/26

SPECIFICATIONS | SCALE 1:1 | ALT | DESCRIPTION | AUTH

R. D. S. O.

TAMPING TOOL (SQUARE ARMED) FOR CONTINUOUS TAMPING MACHINE

(PROVISIONAL)

CANCELD./SUPSED.

REVISED

DRG.No. TM/9702

ANNEXURE - III

8

# Summary of Measurements of Tungsten Carbide Tip Tamping Tool

| Tool No. | Original Area | Percent worn out tool area on different dates | | | | | | Date of Condem-nation | Total Number of Insertions | Total Tamping (kms.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 16-5-98 | 16-6-98 | 17-7-98 | 18-8-98 | 18-9-98 | 14-10-98 | | | |
| 1 | 11124 | 84.07 | 56.05 | | | | | 16/6/98 | 96912 | 125.86 |
| 2 | 9432.5 | 84.65 | 51.15 | | | | | 16/6/98 | 96912 | 125.86 |
| 3 | 9508.8 | 88.46 | 72.53 | 52.2 | | | | 17/7/98 | 151020 | 196.13 |
| 4 | 11072.3 | 89.73 | 89.3 | 57.82 | | | | 17/7/98 | 151020 | 196.13 |
| 5 | 9520.1 | 82.01 | 57.34 | | | | | 16/6/98 | 96912 | 125.86 |
| 6 | 10891.5 | 85.9 | 53.6 | | | | | 16/6/98 | 96912 | 125.86 |
| 7 | 9511.3 | 86.76 | 65 | 37.34 | | | | 16/6/98 | 96912 | 125.86 |
| 8 | 11067.5 | 92.01 | 86.13 | 67.23 | | | | 17/7/98 | 151020 | 196.13 |
| 9 | 11048 | 86.66 | 55.6 | | | | | 16/6/98 | 96912 | 125.86 |
| 10 | 9647.4 | 73.37 | 56.58 | | | | | 16/6/98 | 96912 | 125.86 |
| 11 | 11203 | 90.52 | 68 | 53.12 | | | | 16/6/98 | 96912 | 125.86 |
| 12 | 9523 | 90.94 | 84.03 | 55.37 | | | | 17/7/98 | 151020 | 196.13 |
| 13 | 11056.4 | 93.09 | 89.62 | 66.27 | | | | 17/7/98 | 151020 | 196.13 |
| 14 | 9562.5 | 93.05 | 91 | 63.08 | | | | 17/7/98 | 151020 | 196.13 |
| 15 | 9520.1 | 93.03 | 90.98 | 66.55 | | | | 17/7/98 | 151020 | 196.13 |
| 16 | 11046 | 94.14 | 91.56 | 71.6 | 71.3 | 70.3 | 68.16 | 14/10/98 | 250890 | 325.83 |
| 17 | 11036.5 | 93.86 | 90.75 | 81.29 | 76.21 | 70.29 | 55.84 | 14/10/98 | 250890 | 325.83 |
| 18 | 9421.23 | 91.42 | 89.36 | 81.42 | 72.77 | | | 18/9/98 | 222400 | 288.83 |
| 19 | 9576.72 | 90.88 | 87.07 | 63.44 | | | | 17/7/98 | 151020 | 196.13 |
| 20 | 11106 | 91.36 | 85.93 | 74.5 | 58.44 | | | 18/8/98 | 171580 | 222.73 |
| 21 | 9534 | 94.35 | 91.96 | 87.64 | 80.75 | 72.69 | 57.39 | 14/10/98 | 250890 | 325.83 |
| 22 | 10937.3 | 95.66 | 95.24 | 85.12 | 72.89 | 48.98 | | 18/9/98 | 222400 | 288.83 |
| 23 | 9496.96 | 90 | 83.89 | 54.98 | | | | 17/7/98 | 151020 | 196.13 |
| 24 | 10986.2 | 92.64 | 89.04 | 75.09 | | | | 18/8/98 | 171580 | 222.73 |
| 25 | 11067.6 | 94.47 | 94.01 | 85.2 | 78.26 | 44.02 | | 18/9/98 | 222400 | 288.83 |
| 26 | 9800.94 | 92.95 | 91.3 | 82.69 | 76.06 | | | 18/9/98 | 222400 | 288.83 |
| 27 | 11144.5 | 89.84 | 87.11 | 65.68 | | | | 17/7/98 | 151020 | 196.13 |
| 28 | 9602.19 | 90.33 | 89.47 | 75.92 | 66.79 | | | 18/8/98 | 171580 | 222.73 |
| 29 | 11086.4 | 94.28 | 93.56 | 78.64 | 77.37 | 76.49 | 65.96 | 14/10/98 | 250890 | 325.83 |
| 30 | 9516.69 | 94.11 | 93.24 | 73.37 | 67.32 | | | 18/8/98 | 171580 | 222.73 |
| 31 | 9379.92 | 96.06 | 90.67 | 83.85 | 79.11 | 64.42 | | 18/9/98 | 222400 | 288.83 |
| 32 | 11234.7 | 95.07 | 93.13 | 86.74 | 84.43 | 73.32 | 65.14 | 14/10/98 | 250890 | 325.83 |

Note: Date of condemnation denotes the day on which the measurement shows the measured shoe area less than 70% of the original.

Annexure - V

## Summary of Measurements of Ordinary Tamping Tool

| Tool No. | Original Area | Percent worn out tool area on different dates | | | | Date of Condem-nation | Total Number of Insertions | Total Tamping (kms.) |
|---|---|---|---|---|---|---|---|---|
| | | 15-1-99 | 16-1-99 | 17-1-99 before day's work | 17/1/99* after day's work | | | |
| 1 | 9022.1 | 82.3 | 80.99 | 69.79 | | 17/1/99 | 7544 | 9.81 |
| 2 | 7381.8 | 78.97 | 77.31 | 65.24 | | 17/1/99 | 7544 | 9.81 |
| 3 | 8610.9 | 87.58 | 84.86 | 81.4 | 68.77 | 17/1/99* | 8425 | 10.95 |
| 4 | 10095.11 | 90.9 | 88.42 | 79.82 | 67.81 | 17/1/99* | 8425 | 10.95 |
| 5 | 8121.96 | 75.39 | 66.32 | | | 16/1/99 | 8101 | 10.53 |
| 6 | 8101.17 | 73.82 | 66.73 | | | 16/1/99 | 8101 | 10.53 |
| 7 | 9215.48 | 75.01 | 68.86 | | | 16/1/99 | 5709 | 7.41 |
| 8 | 10104.78 | 77.65 | 69.88 | | | 16/1/99 | 5709 | 7.41 |
| 9 | 8219.13 | 80.95 | 78.49 | | | 16/1/99 | 3573 | 4.64 |
| 10 | 6633.78 | 67.78 | | | | 15/1/99 | 4286 | 5.56 |
| 11 | 10163.18 | 85.95 | 77.51 | 68.87 | | 17/1/99 | 7544 | 9.81 |
| 12 | 10485.25 | 90.21 | 87.34 | 79.97 | 70.77 | | 8499 | 11.04 |
| 13 | 8488.72 | 86.76 | 83.87 | 69.16 | | 17/1/99 | 9936 | 12.93 |
| 14 | 6608.91 | 72.87 | 72.57 | 68.6 | | 17/1/99 | 9936 | 12.93 |
| 15 | 8689.99 | 89.86 | 87.67 | 79.72 | 74.18 | | 9090 | 11.81 |
| 16 | 9851.18 | 90.76 | 82.94 | 78.33 | 73.32 | | 9009 | 11.7 |
| 17 | 10555.96 | 84.7 | 80.66 | 75.82 | 66.6 | 17/1/99* | 8425 | 10.95 |
| 18 | 8637.91 | 86.81 | 81.99 | 73.15 | 64.08 | 17/1/99* | 8425 | 10.95 |
| 19 | 8661.7 | 75.04 | 71.1 | 66.11 | | 17/1/99 | 7544 | 9.81 |
| 20 | 9905.87 | 82.17 | 74.08 | 70.39 | 64.15 | 17/1/99* | 8425 | 10.95 |
| 21 | 10073.38 | 80.51 | 79.63 | 66.68 | | 17/1/99 | 7544 | 9.81 |
| 22 | 10036.22 | 83.39 | 68.7 | | | 16/1/99 | 5709 | 7.41 |
| 23 | 8406.94 | 59.69 | | | | 15/1/99 | 4286 | 5.56 |
| 24 | 10178.67 | 61.64 | | | | 15/1/99 | 4286 | 5.56 |
| 25 | 9709.91 | 76.47 | 74.87 | 65.02 | | 17/1/99 | 7544 | 9.81 |
| 26 | 8615.33 | 82.12 | 78.71 | 63.24 | | 17/1/99 | 7544 | 9.81 |
| 27 | 10089.08 | 61.18 | | | | 15/1/99 | 4286 | 5.56 |
| 28 | 10473.23 | 76.97 | 63.58 | | | 16/1/99 | 5709 | 7.41 |
| 29 | 9794.21 | 90.98 | 83.68 | 75.7 | 71.35 | | 8698 | 11.3 |
| 30 | 8625.61 | 88.56 | 82.66 | 72.36 | 68.81 | 17/1/99* | 8425 | 10.95 |
| 31 | 8723.34 | 79.66 | 79.3 | 74.41 | 69.27 | 17/1/99* | 8425 | 10.95 |
| 32 | 10448.24 | 81.06 | 71.72 | 66.86 | | 17/1/99 | 7544 | 9.81 |

Note: 1. Date of condemnation denotes the day on which the measurement shows the measured shoe area less than 70% of the original.

2. Life of tools at position no. 12,15,16 and 29 have been worked out by extrapolation of the last two measurement values.

3. The measurements shown on dates 12 to 16-1-99 had been taken before beginning day's work. On 17-1-99, two measurements, one before and the other after day's work were recorded.

4. The date of Condemnation marked (*) denotes measurement taken after that day's work

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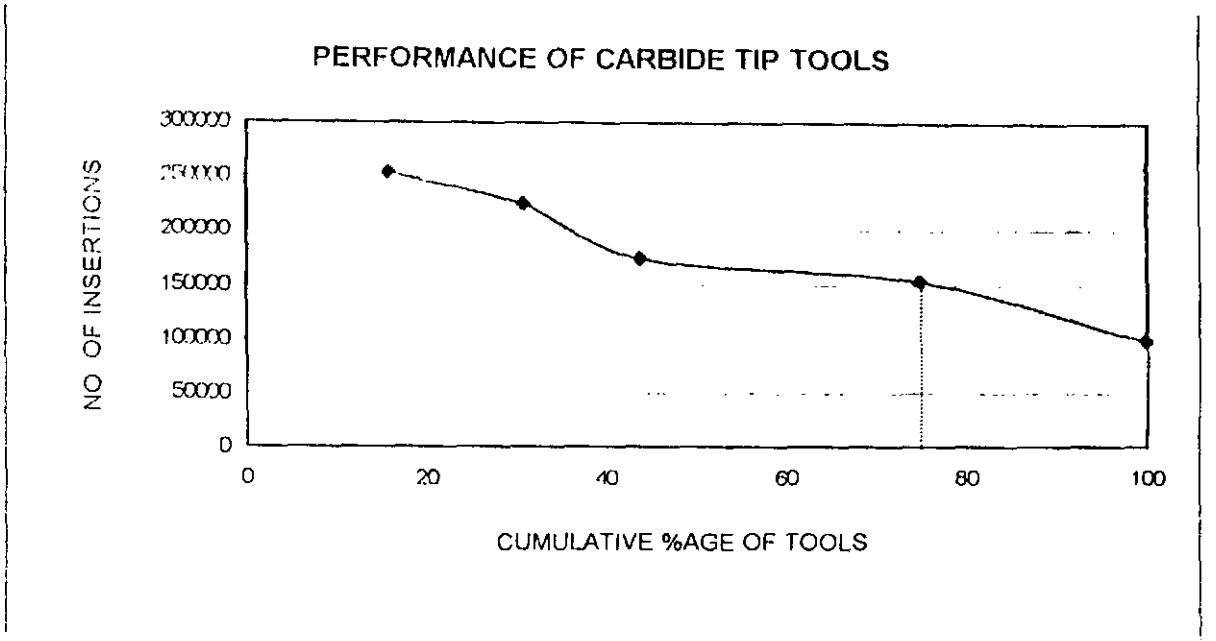
Annexure-VI

## Performance V/S Cumulative Percentage of Carbide Tip Tools

| S.No. | Performance (No. of Insertions) | No. of Tool | Cumulative No. of Tool | Cumulative %age of Tool | Average Performance (No. of Insertions) |
|---|---|---|---|---|---|
| 1 | 250890(325.83 kms) | 5 | 5 | 16 | 166821 (216.64 kms) |
| 2 | 222400(288.83 kms) | 5 | 10 | 31 | |
| 3 | 171580(222.73 kms) | 4 | 14 | 44 | |
| 4 | 151020(196.13 kms) | 10 | 24 | 75 | |
| 5 | 96912(125.86 kms) | 8 | 32 | 100 | |

Note:-

Figures in brackets above indicate equivalent kilometres of track tamped.

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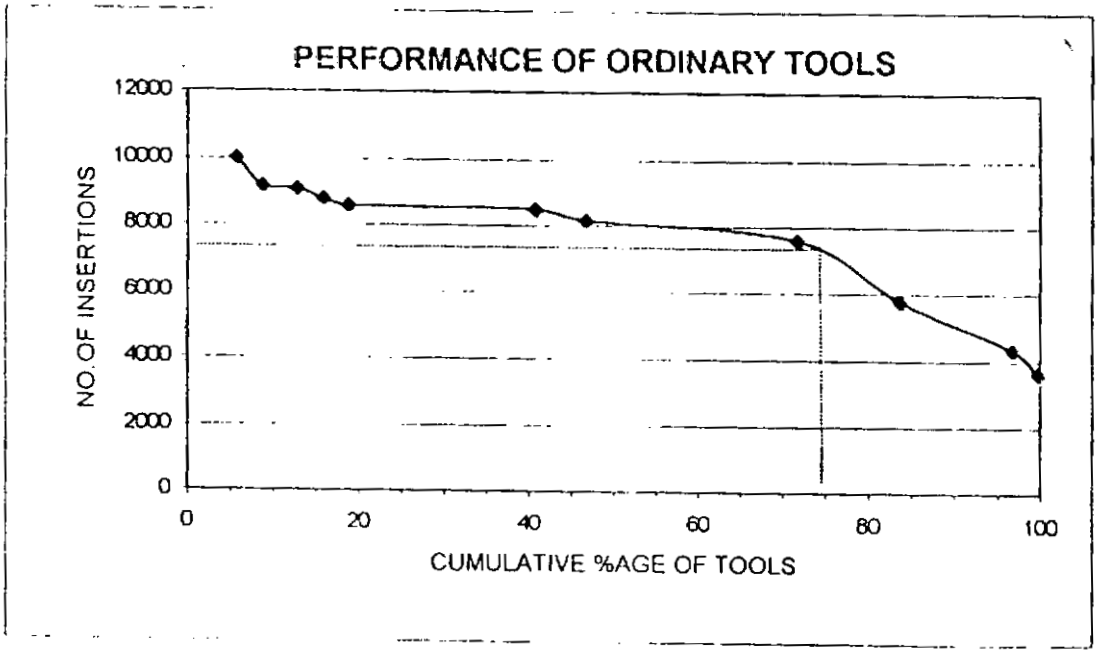
## Performance V/S Cumulative Percentage of Ordinary Tools

| S.No. | Performance (No. of Insertions) | No. of Tool | Cumulative No. of Tool | Cumulative %age of Tool | Average Performance (No. of Insertions) |
|---|---|---|---|---|---|
| 1 | 9936 (12.93 kms) | 2 | 2 | 6 | 7320 ( 9.51 kms ) |
| 2 | 9090 (11.81 kms) | 1 | 3 | 9 | |
| 3 | 9009 (11.7 kms) | 1 | 4 | 13 | |
| 4 | 8698(11.30 kms) | 1 | 5 | 16 | |
| 5 | 8499 (11.04 kms) | 1 | 6 | 19 | |
| 6 | 8425 (10.95 kms) | 7 | 13 | 41 | |
| 7 | 8101 (10.53 kms) | 2 | 15 | 47 | |
| 8 | 7544 (9.81 kms) | 8 | 23 | 72 | |
| 9 | 5709 (7.41 kms) | 4 | 27 | 84 | |
| 10 | 4286 (5.56 kms) | 4 | 31 | 97 | |
| 11 | 3573 (4.64 kms) | 1 | 32 | 100 | |

Note:-

Figuers in brackets above indicate equivalent kilometres of track tamped.



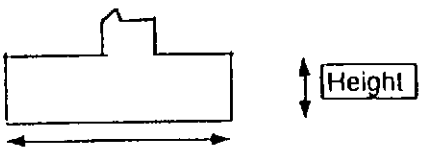

By linear interpolation performance of tool against 75% cumulative percentage, works out to be 7085 insertions ( 9.21 kms tamping )

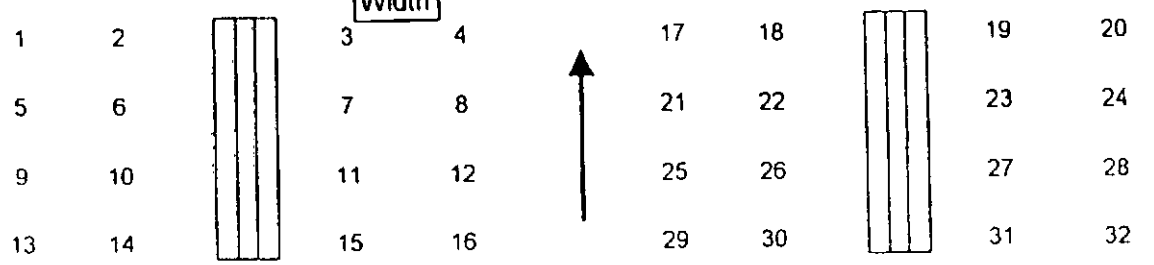
08763

# REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/1998
Type of Tamping Machine: CSM 09-32
No. of Insertions: 0
Kms Tamped: 0
Type of Ballast: Hard Stone

Inspection Date: 16/3/1998
Machine No.: 912
Railway: Northern Railway
Station: Deoband




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 131.8 | 84 4 | |
| 2 | 113.1 | 83.4 | |
| 3 | 113.2 | 84 | |
| 4 | 131.5 | 84 2 | |
| 5 | 113.2 | 84.1 | |
| 6 | 132.5 | 82 2 | |
| 7 | 113.5 | 83 8 | |
| 8 | 131.6 | 84 1 | |
| 9 | 130.9 | 84.4 | |
| 10 | 113.1 | 85 3 | |
| 11 | 131.8 | 85 | |
| 12 | 113.1 | 84.2 | |
| 13 | 131 | 84 4 | |
| 14 | 113.3 | 84 4 | |
| 15 | 113.2 | 84 1 | |
| 16 | 131.5 | 84 | |

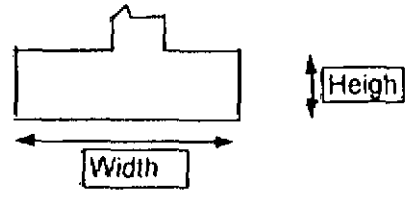
| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 131 7 | 83 8 | |
| 18 | 113.1 | 83 3 | |
| 19 | 113.2 | 84.6 | |
| 20 | 131.9 | 84 2 | |
| 21 | 113.5 | 84 | |
| 22 | 131.3 | 83.3 | |
| 23 | 113 6 | 83 6 | |
| 24 | 131 1 | 83 8 | |
| 25 | 131.6 | 84.1 | |
| 26 | 113.7 | 86.2 | |
| 27 | 132 2 | 84 3 | |
| 28 | 113 1 | 84 9 | |
| 29 | 131 2 | 84 5 | |
| 30 | 113.7 | 83 7 | |
| 31 | 112.2 | 83 6 | |
| 32 | 131 4 | 85 5 | |

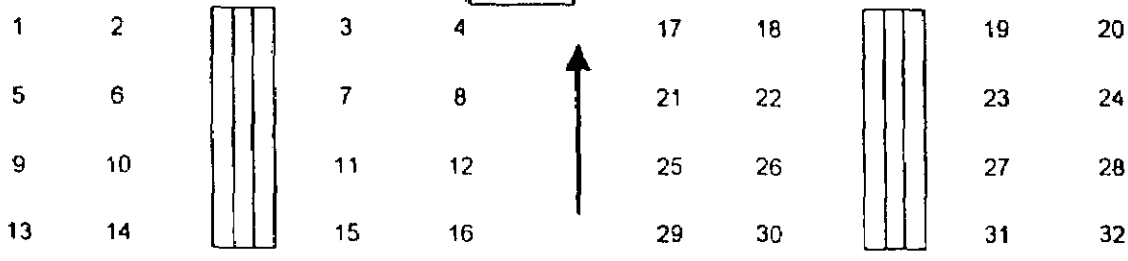
08764

Annexure-IX

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 16/3/1998 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 31/3/1998 |
| No. of Insertions: | 21656 | Machine No.: | 912 |
| Kms Tamped: | 26.7 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Deoband |




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 130.95 | 82.41 | * |
| 2 | 111.86 | 80.56 | * |
| 3 | 112.4 | 81.67 | |
| 4 | 130.56 | 83.45 | |
| 5 | 111.24 | 80.57 | * |
| 6 | 130.7 | 81.27 | * |
| 7 | 112.28 | 82.7 | * |
| 8 | 130.77 | 82.9 | |
| 9 | 130.36 | 82.84 | |
| 10 | 111.21 | 82.88 | |
| 11 | 130.4 | 83.4 | |
| 12 | 112.56 | 83.9 | |
| 13 | 130.79 | 83.64 | * |
| 14 | 112.25 | 82.91 | |
| 15 | 112.22 | 82.9 | * |
| 16 | 130.4 | 82.88 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 130.77 | 82.83 | * |
| 18 | 111.84 | 82.66 | |
| 19 | 111.81 | 82.9 | * |
| 20 | 130.45 | 82.03 | |
| 21 | 112.86 | 82.94 | |
| 22 | 131.12 | 82.37 | |
| 23 | 111.91 | 81.87 | |
| 24 | 130.18 | 82.06 | |
| 25 | 130.75 | 82.29 | |
| 26 | 112.99 | 84.34 | |
| 27 | 131.07 | 82.98 | * |
| 28 | 111.98 | 83.4 | |
| 29 | 131.15 | 83.05 | |
| 30 | 112.55 | 82.77 | * |
| 31 | 111.82 | 82.18 | |
| 32 | 130.95 | 82.94 | |

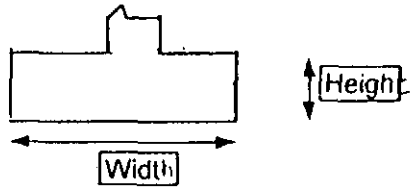
09765 09780

Note:-(*) under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

Annexure-X

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 16/3/1998 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 16/4/1998 |
| No. of Insertions | 34106 | Machine No.: | 912 |
| Kms Tamped: | 42.86 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Shahabad Markanda |




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | | 3 | 4 | 17 | 18 | | 19 | 20 |
| 5 | 6 | | 7 | 8 | 21 | 22 | | 23 | 24 |
| 9 | 10 | | 11 | 12 | 25 | 26 | | 27 | 28 |
| 13 | 14 | | 15 | 16 | 29 | 30 | | 31 | 32 |

WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 130 48 | 80.19 | * |
| 2 | 111 23 | 79.19 | * |
| 3 | 111 71 | 80.27 | |
| 4 | 130 23 | 82.18 | |
| 5 | 111 18 | 79.92 | * |
| 6 | 130 47 | 81.11 | * |
| 7 | 111 5 | 81.29 | * |
| 8 | 130 63 | 82.01 | |
| 9 | 130 21 | 80.44 | |
| 10 | 111 1 | 79.87 | |
| 11 | 130 34 | 83.03 | * |
| 12 | 112 27 | 82 | |
| 13 | 130 69 | 82.09 | * |
| 14 | 112 19 | 82.55 | |
| 15 | 112 03 | 81.07 | * |
| 16 | 130 3 | 81.38 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 130.7 | 80.51 | * |
| 18 | 111 8 | 79.32 | |
| 19 | 111 77 | 81.53 | * |
| 20 | 130.36 | 81.35 | |
| 21 | 112 66 | 82.34 | |
| 22 | 131.02 | 82.09 | |
| 23 | 111 64 | 80.42 | |
| 24 | 130.07 | 81.89 | |
| 25 | 130 54 | 82.2 | |
| 26 | 112 26 | 84.3 | |
| 27 | 130.82 | 81.39 | * |
| 28 | 111 9 | 82.35 | |
| 29 | 131 11 | 83 | |
| 30 | 112 05 | 82.67 | * |
| 31 | 111 79 | 82.09 | |
| 32 | 130 6 | 82 8 | |

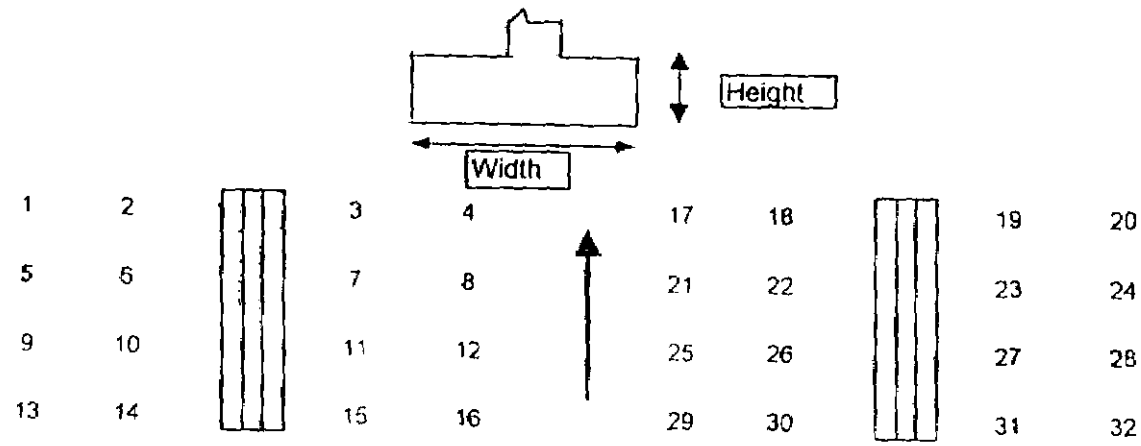
Note:- (*) under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

08766

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/1998
Type of Tamping Machine: CSM 09-32
No. of Insertions: 39635
Kms Tamped: 54.61
Type of Ballast: Hard Stone

Inspection Date: 1/5/98
Machine No.: 912
Railway: Northern Railway
Station: Muzzaffarnagar




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No | Width | Height | Remarks |
| 1 | 129.12 | 78.41 | * |
| 2 | 108.73 | 77.32 | * |
| 3 | 111.54 | 79.8 | |
| 4 | 129.04 | 79.32 | |
| 5 | 110.8 | 77.36 | * |
| 6 | 129.35 | 78.4 | * |
| 7 | 111.07 | 77.17 | * |
| 8 | 129.74 | 80.53 | |
| 9 | 129.17 | 79.23 | * |
| 10 | 107.74 | 75.47 | * |
| 11 | 128.71 | 79.83 | * |
| 12 | 111.86 | 80.61 | |
| 13 | 129.02 | 81.12 | * |
| 14 | 111.61 | 81.45 | |
| 15 | 111.43 | 79.6 | * |
| 16 | 130.04 | 80.5 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No | Width | Height | Remarks |
| 17 | 129.59 | 80.1 | * |
| 18 | 111.57 | 78.87 | * |
| 19 | 110.95 | 80.93 | * |
| 20 | 129.28 | 80.31 | |
| 21 | 112.37 | 81.63 | |
| 22 | 130.82 | 81.59 | |
| 23 | 111.61 | 79.83 | * |
| 24 | 129.56 | 79.99 | |
| 25 | 130.27 | 81.72 | * |
| 26 | 111.86 | 83.74 | |
| 27 | 129.65 | 80.82 | * |
| 28 | 111.27 | 80.47 | |
| 29 | 129.8 | 82.48 | |
| 30 | 111.29 | 82.34 | * |
| 31 | 111.32 | 81.47 | |
| 32 | 129.81 | 82.49 | |

08767

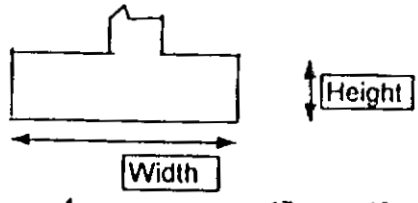
Note:-(*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping

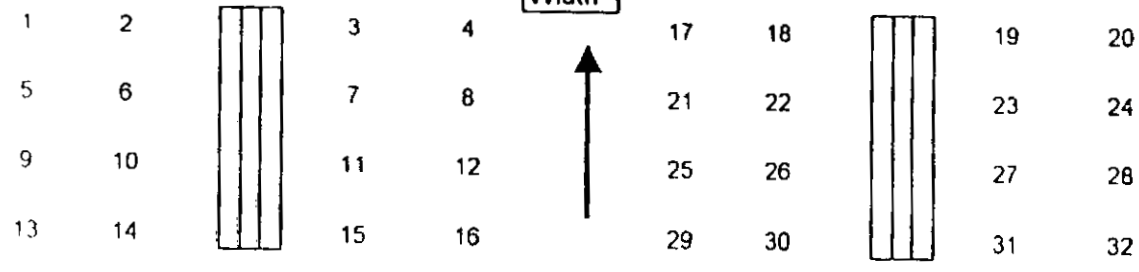
Annexure-XII

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/1998
Type of Tamping Machine: CSM 09-32
No. of Insertions: 70381
Kms Tamped: 89.71
Type of Ballast: Hard Stone

Inspection Date: 16/5/1998
Machine No.: 912
Railway: Northern Railway
Station: Muzzaffarnagar




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No | Width | Height | Remarks |
| 1 | 128.07 | 73.03 | * |
| 2 | 108.7 | 73.46 | * |
| 3 | 110.31 | 76.26 | |
| 4 | 128.9 | 77.08 | |
| 5 | 109.26 | 71.46 | * |
| 6 | 127.44 | 73.42 | * |
| 7 | 109.38 | 75.45 | * |
| 8 | 129 33 | 78 74 | |
| 9 | 128 02 | 74.79 | * |
| 10 | 105 59 | 67.04 | * |
| 11 | 128.65 | 78.83 | * |
| 12 | 111.28 | 77.83 | |
| 13 | 129 | 79.79 | * |
| 14 | 111 2 | 80.02 | |
| 15 | 111 34 | 79 55 | * |
| 16 | 129.8 | 80.09 | |

| RIGHHAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 129.49 | 80 | * |
| 18 | 110.92 | 77.65 | * |
| 19 | 110.8 | 78.55 | * |
| 20 | 129.2 | 78.34 | |
| 21 | 112.24 | 80.14 | |
| 22 | 130.75 | 80.02 | |
| 23 | 110.92 | 77.06 | * |
| 24 | 129.5 | 78.59 | |
| 25 | 130.2 | 80.3 | * |
| 26 | 111.09 | 82.01 | |
| 27 | 129.55 | 77.29 | * |
| 28 | 111.2 | 78 | |
| 29 | 129 07 | 80.98 | |
| 30 | 111.08 | 80.63 | * |
| 31 | 110.92 | 81.23 | |
| 32 | 129.65 | 82.38 | |

08768

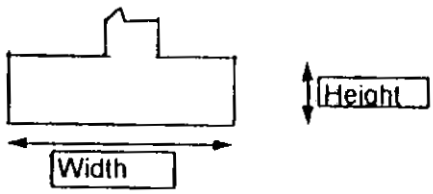
Note -(*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

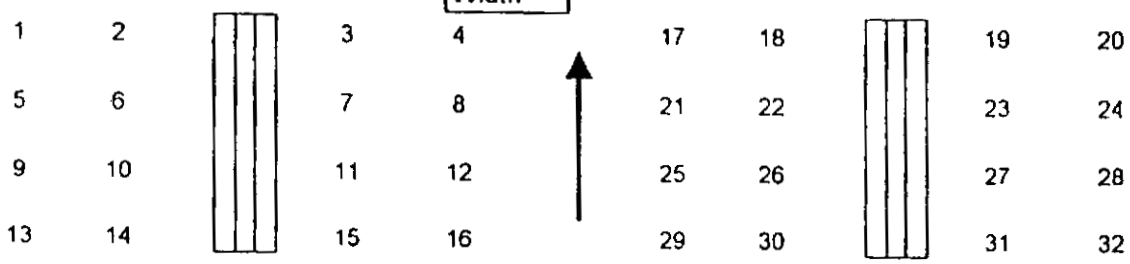
Annexure-XIII

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/98
Type of Tamping Machine: CSM 09-32
No. of Insertions: 96912
Kms Tamped: 125.86
Type of Ballast: Hard Stone

Inspection Date: 16/6/1998
Machine No.: 912
Railway: Northern Railway
Station: Hazarat Nizamuddin




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 93.01 | 67.04 | * |
| 2 | 74.08 | 65.13 | * |
| 3 | 91.94 | 75.02 | * |
| 4 | 128.55 | 76.91 | |
| 5 | 87.9 | 62.11 | * |
| 6 | 92.46 | 63.24 | * |
| 7 | 85.29 | 72.48 | * |
| 8 | 127.16 | 74.95 | |
| 9 | | | Replaced on 16/6/98 |
| 10 | | | Replaced on 16/6/98 |
| 11 | 100.78 | 75.59 | * |
| 12 | 108.95 | 73.45 | |
| 13 | 127.75 | 77.57 | * |
| 14 | 110.28 | 78.91 | |
| 15 | 111.14 | 77.94 | * |
| 16 | 129.55 | 78.07 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 128.77 | 77.78 | * |
| 18 | 110.57 | 76.14 | * |
| 19 | 108.79 | 76.65 | * |
| 20 | 127.52 | 74.84 | |
| 21 | 111.57 | 78.58 | |
| 22 | 130.58 | 79.77 | |
| 23 | 107.56 | 74.07 | * |
| 24 | 129.28 | 75.67 | |
| 25 | 129.85 | 80.13 | * |
| 26 | 111.13 | 80.52 | |
| 27 | 128.99 | 75.26 | * |
| 28 | 110.99 | 77.4 | |
| 29 | 128.64 | 80.63 | |
| 30 | 110.59 | 80.24 | * |
| 31 | 110.34 | 77.08 | |
| 32 | 129.09 | 81.05 | |

69780

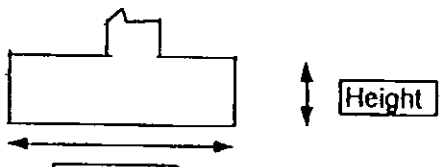
Note:- (*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

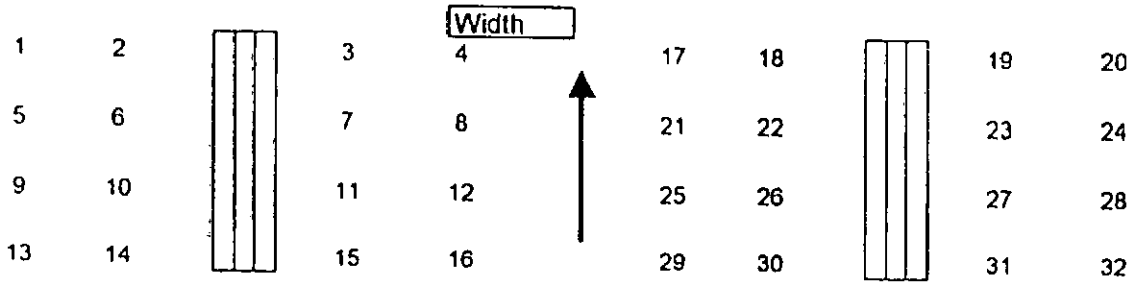
Annexure-XIV

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/1998
Type of Tamping Machine: CSM 09-32
No. of Insertions: 151020
Kms Tamped: 196.13
Type of Ballast: Hard Stone

Inspection Date: 17/7/1998
Machine No.: 912
Railway: Northern Railway
Station: Hazarat Nizamuddin




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 92.86 | 56 83 | * |
| 2 | 72.67 | 54.18 | * |
| 3 | 86.46 | 57.41 | * |
| 4 | 115.86 | 55.26 | |
| 5 | | | Replaced on 15-7-98 |
| 6 | | | Replaced on 15-7-98 |
| 7 | 63.81 | 55 67 | * |
| 8 | 115.88 | 64.21 | |
| 9 | | | Replaced on 16-6-98 |
| 10 | - | | Replaced on 16-6-98 |
| 11 | 97.65 | 60.95 | * |
| 12 | 95.69 | 55.11 | |
| 13 | 114.05 | 64.25 | * |
| 14 | 95.78 | 62.98 | |
| 15 | 94.89 | 66.77 | * |
| 16 | 117.38 | 67 4 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 127.11 | 70.58 | * |
| 18 | 106.19 | 72.24 | * |
| 19 | 93.12 | 65.24 | * |
| 20 | 122.85 | 67.35 | |
| 21 | 110.25 | 75.79 | |
| 22 | 122.8 | 75.81 | |
| 23 | 79.58 | 65.61 | * |
| 24 | 124.02 | 66.52 | |
| 25 | 128.85 | 73.18 | * |
| 26 | 107.15 | 75..64 | |
| 27 | 110.17 | 66.44 | * |
| 28 | 106.04 | 68.75 | |
| 29 | 127.64 | 68.3 | |
| 30 | 99.13 | 70.4 | * |
| 31 | 108.01 | 72.82 | |
| 32 | 126.45 | 77.07 | |

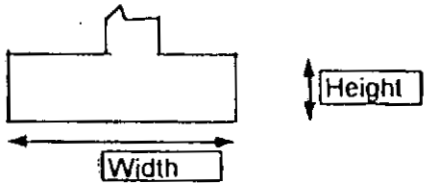
0770

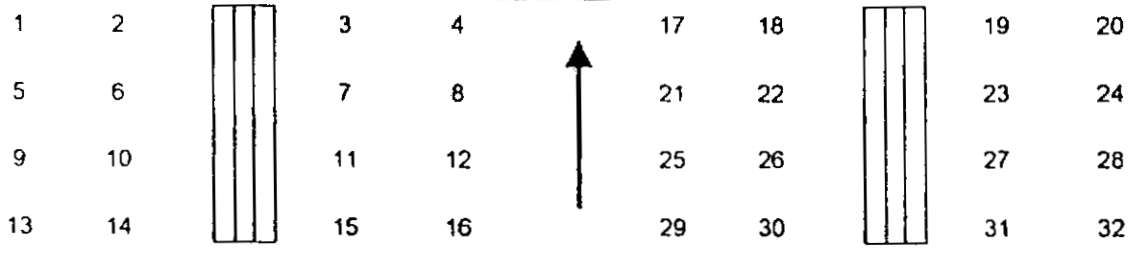
Note:- (*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

Annexure-XV

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 16/3/1998 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 18/8/1998 |
| No. of Insertions: | 171580 | Machine No.: | 912 |
| Kms Tamped: | 222.73 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Sahibabad |




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | | | Replaced on 16-8-98 |
| 2 | | | Replaced on 16-8-98 |
| 3 | 68.69 | 57.2 | * |
| 4 | 109.78 | 54.63 | |
| 5 | | | Replaced on 15-7-98 |
| 6 | | | Replaced on 15-7-98 |
| 7 | | | Replaced on 27/7/98 |
| 8 | 103.63 | 63.12 | |
| 9 | | | Replaced on 16-6-98 |
| 10 | | | Replaced on 16-6-98 |
| 11 | | | Replaced on 27/7/98 |
| 12 | 48.64 | 55.06 | |
| 13 | 102.7 | 63.85 | * |
| 14 | 94.84 | 62.18 | |
| 15 | 73.82 | 66.19 | * |
| 16 | 117.08 | 67.27 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Widrh | Height | Remarks |
| 17 | 125.33 | 67.11 | * |
| 18 | 99.63 | 68.81 | * |
| 19 | 88 | 61.96 | * |
| 20 | 112.82 | 57.53 | |
| 21 | 105.69 | 72.84 | |
| 22 | 113.85 | 70.02 | |
| 23 | | | Replaced on 27/7/98 |
| 24 | | | Replaced on 16/8/98 |
| 25 | 126.44 | 68.5 | * |
| 26 | 103 | 72.37 | |
| 27 | | | Replaced on 16/8/98 |
| 28 | 101.14 | 63.41 | |
| 29 | 126.29 | 74.05 | |
| 30 | 95.62 | 67 | * |
| 31 | 107.5 | 69.03 | |
| 32 | 125.27 | 75.72 | |

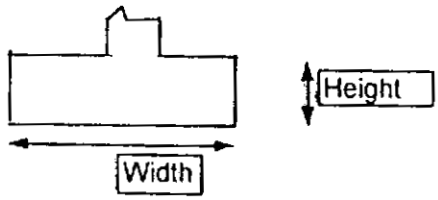
Note:- (*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

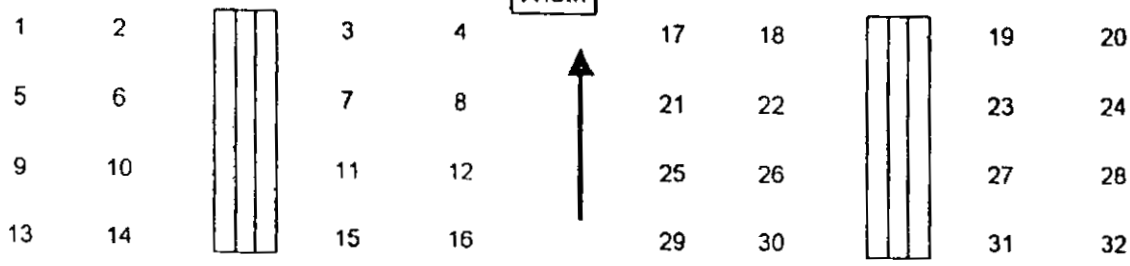
Annexure - XVI

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

Date of fitment: 16/3/1998
Type of Tamping Machine: CSM 09-32
No. of Insertions: 222400
Kms Tamped: 288.83
Type of Ballast: Hard Stone

Inspection Date: 18/9/1998
Machine No.: 912
Railway: Northern Railway
Station: Tarraori




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | | | Replaced on 16/8/98 |
| 2 | | | Replaced on 16/8/98 |
| 3 | | | Replaced on 22/8/98 |
| 4 | 107.68 | 54.54 | |
| 5 | | | Replaced on 15/7/98 |
| 6 | | | Replaced on 15/7/98 |
| 7 | | | Replaced on 27/7/98 |
| 8 | | | Replaced on 26/8/98 |
| 9 | | | Replaced on 16/6/98 |
| 10 | | | Replaced on 16/6/98 |
| 11 | | | Replaced on 27/7/98 |
| 12 | | | Replaced on 28/8/98 |
| 13 | 97.88 | 62.31 | * |
| 14 | 86.88 | 61.91 | |
| 15 | 72.32 | 66.01 | * |
| 16 | 115.65 | 67.15 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 115.59 | 67.11 | * |
| 18 | | | Replaced on 1/9/98 |
| 19 | | | Replaced on 2/9/98 |
| 20 | | | Replaced on 22/8/98 |
| 21 | 101.26 | 68.44 | |
| 22 | 85.57 | 62.61 | |
| 23 | | | Replaced on 27/7/98 |
| 24 | | | Replaced on 16/8/98 |
| 25 | 80.35 | 60.63 | * |
| 26 | | | Replaced on 14/9/98 |
| 27 | | | Replaced on 16/8/98 |
| 28 | | | Replaced on 26/8/98 |
| 29 | 125.84 | 67.39 | |
| 30 | 95.48 | 66.25 | * |
| 31 | 99.33 | 60.83 | |
| 32 | 113.99 | 72.26 | |

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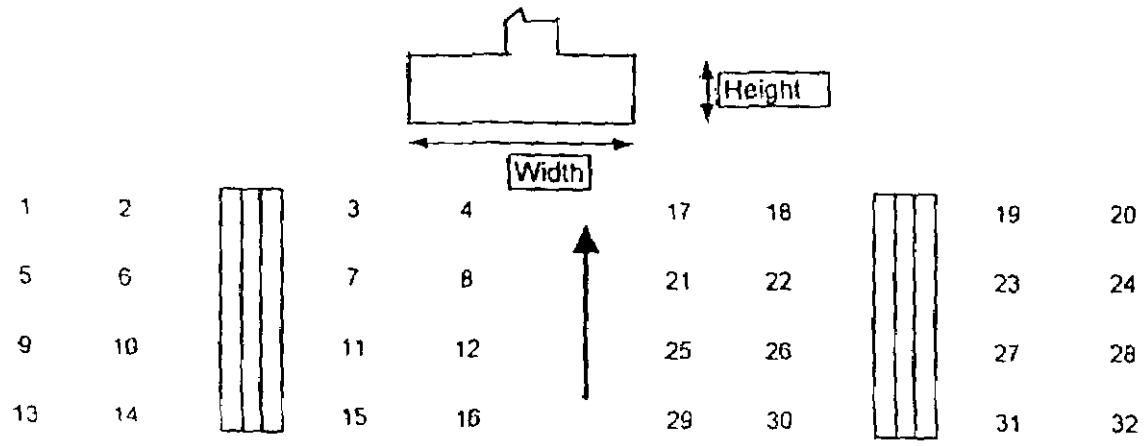
Note:- (*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

## REPORT ON THE PERFORMANCE OF CARBIDE TIP TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 16/3/1998 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 14/10/1998 |
| No. of Insertions: | Meter Defective(250690) | Machine No.: | 912 |
| Kms Tamped: | 325.83 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Jandiala |




**WORKING DIRECTION**

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | | | Replaced on 16/8/98 |
| 2 | | | Replaced on 16/8/98 |
| 3 | | | Replaced on 22/8/98 |
| 4 | 89.17 | 53.97 | |
| 5 | | | Replaced on 15/7/98 |
| 6 | | | Replaced on 15/7/98 |
| 7 | | | Replaced on 27/7/98 |
| 8 | | | Replaced on 26/8/98 |
| 9 | | | Replaced on 16/6/98 |
| 10 | | | Replaced on 16/6/98 |
| 11 | | | Replaced on 27/7/98 |
| 12 | | | Replaced on 26/8/98 |
| 13 | 88.43 | 58.71 | * |
| 14 | 85.78 | 60.43 | |
| 15 | 64.18 | 63.74 | * |
| 16 | 114.12 | 65.98 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 95.52 | 64.52 | * |
| 18 | | | Replaced on 1/9/98 |
| 19 | | | Replaced on 2/9/98 |
| 20 | | | Replaced on 22/8/98 |
| 21 | 90 | 60.79 | |
| 22 | 72.6 | 61.83 | |
| 23 | | | Replaced on 27/7/98 |
| 24 | | | Replaced on 16/6/98 |
| 25 | | | Replaced on 10/10/98 |
| 26 | | | Replaced on 14/9/98 |
| 27 | | | Replaced on 16/8/98 |
| 28 | | | Replaced on 26/8/98 |
| 29 | 123.22 | 59.35 | |
| 30 | 90.63 | 60.81 | * |
| 31 | 94.18 | 59.6 | |
| 32 | 112.96 | 64.79 | |

Note:- (*)under remarks column indicates that the carbide strips of the tool got chipped off during tamping.

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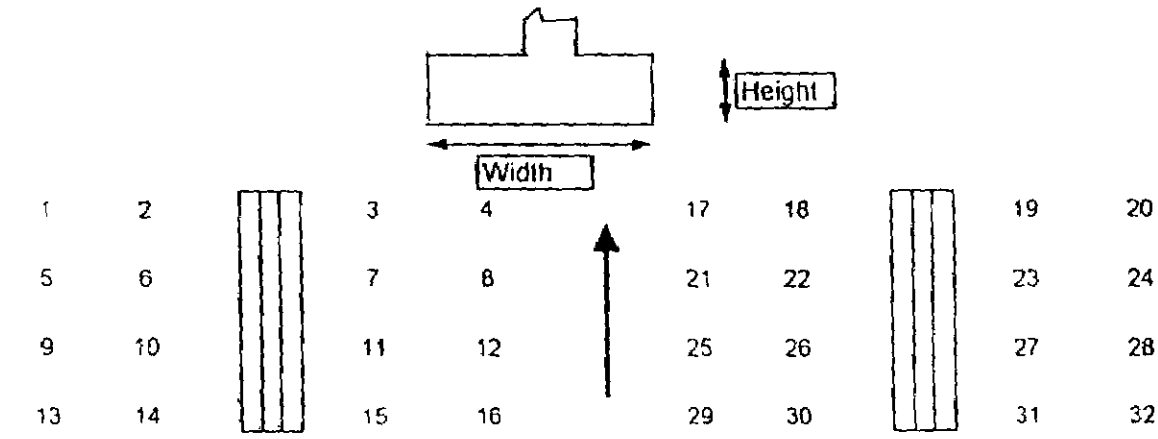
## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 12/1/99 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 12/1/99 |
| No. of Insertions: | 0 | Machine No.: | 901 |
| Kms Tamped: | 0 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Shahabad Markanda |




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 141.39 | 63.81 | |
| 2 | 117.19 | 62.99 | |
| 3 | 121.64 | 70.79 | |
| 4 | 140.62 | 71.79 | |
| 5 | 138.6* | 58.6* | |
| 6 | 138.6* | 58.45* | |
| 7 | 126.97 | 72.58 | |
| 8 | 141.01 | 71.66 | |
| 9 | ** | ** | |
| 10 | 120.68 | 54.97 | |
| 11 | 141.45 | 71.85 | |
| 12 | 141.75 | 73.97 | |
| 13 | 139.64* | 60.79* | |
| 14 | 101.1* | 65.37* | |
| 15 | 121.25 | 71.67 | |
| 16 | 139.2 | 70.77 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 140.54 | 75.11 | |
| 18 | 121.03 | 71.37 | |
| 19 | 121.79 | 71.12 | |
| 20 | 140.27 | 70.62 | |
| 21 | 138.58 | 72.69 | |
| 22 | 140.8 | 71.28 | |
| 23 | 115.48 | 72.8 | |
| 24 | 140.57 | 72.41 | |
| 25 | 140.54 | 69.09 | |
| 26 | 118.44 | 72.74 | |
| 27 | 140.36 | 71.88 | |
| 28 | 141.32 | 74.11 | |
| 29 | 139.34 | 70.29 | |
| 30 | 119.27 | 72.32 | |
| 31 | 122.45 | 71.24 | |
| 32 | 141.46 | 73.86 | |

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Note: 1 ( * ) Tool no. 5,6,13 and 14 were fitted on 11.1.99 and had already tamped 3.12 kms of track on 12.1.99 when measurements were taken.

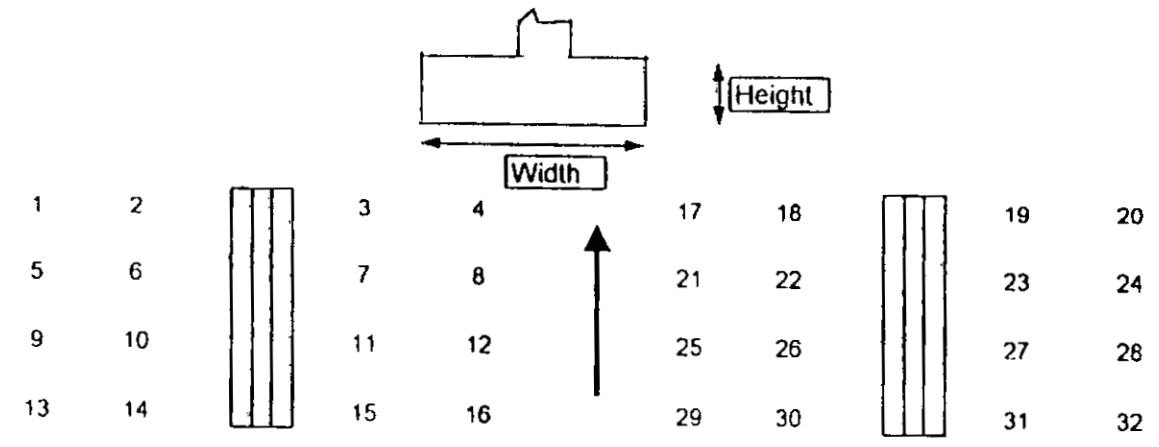
2 ( ** ) New tool at position no 9 was fixed on 13.1.99 Therefore no measurements are shown here

Annexure - XIX

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

Date of fitment: 12/1/99
Type of Tamping Machine: CSM 09-32
No. of Insertions: 2136
Kms Tamped: 2 77
Type of Ballast: Hard Stone

Inspection Date: 13/1/1999
Machine No.: 901
Railway: Northern Railway
Station: Shahabad Markanda




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 141.38 | 63.44 | |
| 2 | 116.73 | 58.27 | |
| 3 | 121.52 | 68.51 | |
| 4 | 137.62 | 70.67 | |
| 5 | 138.07 | 58.34 | |
| 6 | 138.27 | 54.89 | |
| 7 | 126.77 | 68.15 | |
| 8 | 138.78 | 66.59 | |
| 9 | 140.57 | 58.47 | Tool fitted ondate. |
| 10 | 120.61 | 54.11 | |
| 11 | 141.26 | 70.09 | |
| 12 | 141.6 | 72.69 | |
| 13 | 138.77 | 57.94 | |
| 14 | 100.34 | 63.73 | |
| 15 | 120.46 | 70.43 | |
| 16 | 138.71 | 70.5 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 139.01 | 70.9 | |
| 18 | 119.11 | 66.21 | |
| 19 | 120.64 | 65.56 | |
| 20 | 139.51 | 67.82 | |
| 21 | 136.63 | 67.25 | |
| 22 | 139.16 | 67.26 | |
| 23 | 115.1 | 66.19 | |
| 24 | 139.83 | 64.8 | |
| 25 | 136.65 | 64.51 | |
| 26 | 115.65 | 68.24 | |
| 27 | 140.28 | 63.25 | |
| 28 | 140.67 | 70.15 | |
| 29 | 138.03 | 67.34 | |
| 30 | 118.45 | 69.3 | |
| 31 | 121.13 | 66.38 | |
| 32 | 140.64 | 71.41 | |

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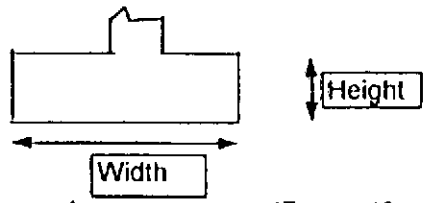
Annexure-XX

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 12/1/99 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 14/1/1999 |
| No of Insertions: | 2773 | Machine No.: | 901 |
| Kms Tamped: | 3 6 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Shahabad Markanda |




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | | 3 | 4 | 17 | 18 | | 19 | 20 |
| 5 | 6 | | 7 | 8 | 21 | 22 | | 23 | 24 |
| 9 | 10 | | 11 | 12 | 25 | 26 | | 27 | 28 |
| 13 | 14 | | 15 | 16 | 29 | 30 | | 31 | 32 |

**WORKING DIRECTION**

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No | Width | Height | Remarks |
| 1 | 137.67 | 59.06 | |
| 2 | 114.12 | 52.12 | |
| 3 | 117.84 | 66.2 | |
| 4 | 137.6 | 67.47 | |
| 5 | 133 98 | 52.56 | |
| 6 | 134.71 | 49 87 | |
| 7 | 126 34 | 62.22 | |
| 8 | 138.46 | 61 85 | |
| 9 | 137.2 | 54 36 | |
| 10 | 116 68 | 50.66 | |
| 11 | 138 98 | 65 29 | |
| 12 | 139 8 | 69 5 | |
| 13 | 135.07 | 55 69 | |
| 14 | 99 61 | 61 88 | |
| 15 | 120.42 | 65 9 | |
| 16 | 138 08 | 65 46 | |

| RIGHTHAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 138.69 | 69 38 | |
| 18 | 118.91 | 64 2 | |
| 19 | 120.06 | 61 84 | |
| 20 | 139.28 | 64 11 | |
| 21 | 136.62 | 65 52 | |
| 22 | 137.62 | 64 92 | |
| 23 | 114 65 | 62 45 | |
| 24 | 138.18 | 56 57 | |
| 25 | 135.57 | 62 81 | |
| 26 | 115.08 | 66 95 | |
| 27 | 139.27 | 55 37 | |
| 28 | 140.18 | 65 93 | |
| 29 | 136.81 | 66 34 | |
| 30 | 117.71 | 68 46 | |
| 31 | 118.91 | 64 79 | |
| 32 | 139 81 | 68 19 | |

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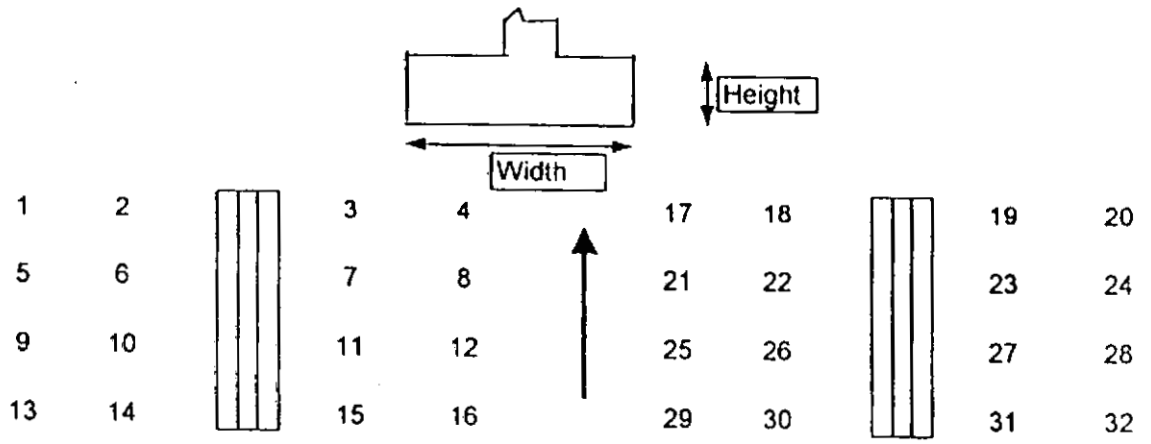
Annexure - XXI

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

Date of fitment: 12/1/99
Type of Tamping Machine: CSM 09-32
No. of Insertions: 4286
Kms Tamped: 5.56
Type of Ballast: Hard Stone

Inspection Date: 15/1/1999
Machine No.: 901
Railway: Northern Railway
Station: Shahabad Markanda




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 136.6 | 54.36 | |
| 2 | 114.1 | 51.09 | |
| 3 | 117.58 | 64.14 | |
| 4 | 137.58 | 66.7 | |
| 5 | 130.94 | 46.76 | |
| 6 | 134.12 | 44.59 | |
| 7 | 123.62 | 55.92 | |
| 8 | 137.41 | 57.1 | |
| 9 | 133.93 | 49.68 | |
| 10 | 110.31 | 40.76 | |
| 11 | 138.33 | 63.15 | |
| 12 | 138.63 | 68.23 | |
| 13 | 134.84 | 54.62 | |
| 14 | 98.85 | 48.72 | |
| 15 | 120.32 | 64.9 | |
| 16 | 137.89 | 64.84 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 137.11 | 65.21 | |
| 18 | 118.68 | 63.18 | |
| 19 | 119.35 | 54.46 | |
| 20 | 138.26 | 58.87 | |
| 21 | 131.04 | 61.89 | |
| 22 | 135.9 | 61.58 | |
| 23 | 114.56 | 43.8 | |
| 24 | 135.16 | 46.42 | |
| 25 | 135.17 | 54.93 | |
| 26 | 114.09 | 62.01 | |
| 27 | 136.26 | 45.3 | |
| 28 | 137.76 | 58.52 | |
| 29 | 135.79 | 65.62 | |
| 30 | 115.67 | 66.04 | |
| 31 | 118.85 | 58.47 | |
| 32 | 138.35 | 61.22 | |

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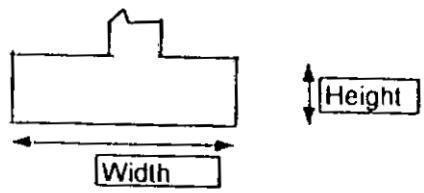
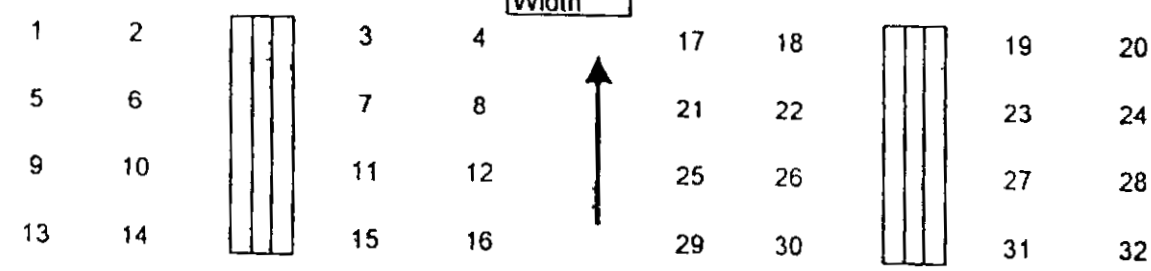
Annexure - XXII

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

Date of fitment: 12/1/99
Type of Tamping Machine: CSM 09-32
No. of Insertions: 5709
Kms Tamped 7.41
Type of Ballast Hard Stone

Inspection Date: 16/1/1999
Machine No : 901
Railway: Northern Railway
Station: Shahabad Markanda




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 135.56 | 53.9 | |
| 2 | 112 21 | 50.86 | |
| 3 | 117.24 | 62.33 | |
| 4 | 134.06 | 66.58 | |
| 5 | 130.74 | 41.2 | Replaced on 16/1/99 |
| 6 | 134 08 | 40.32 | Replaced on 16/1/99 |
| 7 | 120 21 | 52.79 | |
| 8 | 136 01 | 51.92 | |
| 9 | 130.54 | 49.42 | Replaced on 16/1/99 |
| 10 | 110 21 | 40.56 | Replaced on 16/1/99 |
| 11 | 136.78 | 57.59 | |
| 12 | 136 77 | 66.96 | |
| 13 | 134 64 | 52.88 | |
| 14 | 98 69 | 48.6 | |
| 15 | 117.75 | 64.7 | |
| 16 | 130 87 | 62.43 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 130 77 | 65.11 | |
| 18 | 114 64 | 61.78 | |
| 19 | 115 71 | 53.27 | |
| 20 | 134 43 | 54.59 | |
| 21 | 131 02 | 61.22 | |
| 22 | 131 43 | 52.46 | |
| 23 | 109 26 | 42.71 | Replaced on 16/1/99 |
| 24 | 133 93 | 44.29 | Replaced on 16/1/99 |
| 25 | 132 49 | 54.87 | |
| 26 | 110 84 | 61.18 | |
| 27 | 132 68 | 45.03 | Replaced on 16/1/99 |
| 28 | 137 66 | 48.37 | Replaced on 16/1/99 |
| 29 | 131 | 62.56 | |
| 30 | 111 13 | 64.16 | |
| 31 | 118 59 | 58.33 | |
| 32 | 135 68 | 55.23 | |

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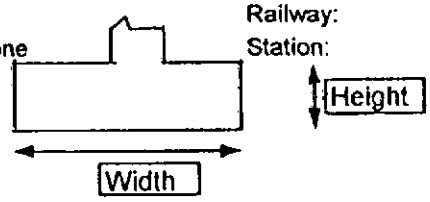
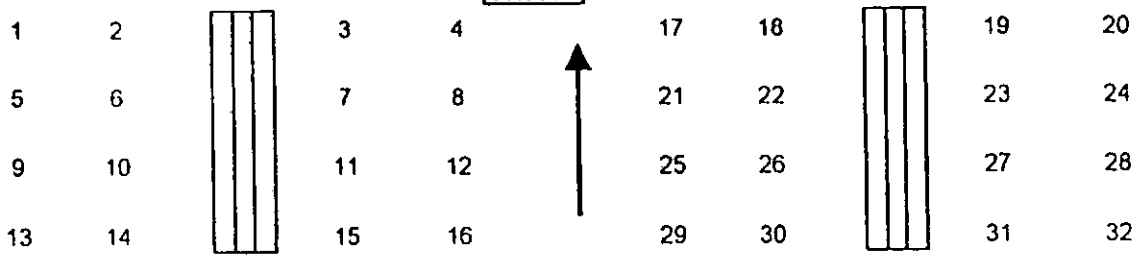
Annexure - XXIII

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 12/1/99 | Inspection Date: | 17/1/1999 ( before day's work) |
| Type of Tamping Machine: | CSM 09-32 | | |
| No. of Insertions: | 75.44 | Machine No.: | 901 |
| Kms Tamped: | 9.81 | Railway: | Northern Railway |
| Type of Ballast: | Hard Stone | Station: | Shahabad Markanda |




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 134.42 | 46.84 | |
| 2 | 111.38 | 43.24 | |
| 3 | 115.42 | 60.73 | |
| 4 | 129.9 | 62.03 | |
| 5 | | | Replaced on 16/1/99 |
| 6 | | | Replaced on 16/1/99 |
| 7 | 119 55 | 45.89 | |
| 8 | 128 69 | 40.63 | |
| 9 | | | Replaced on 161/99 |
| 10 | | | Replaced on 16/1/99 |
| 11 | 134 65 | 51.98 | |
| 12 | 135.25 | 62 | |
| 13 | 129 23 | 45.43 | |
| 14 | 93.69 | 48.39 | |
| 15 | 112.05 | 61.83 | |
| 16 | 128 26 | 60.16 | |

| RIGHT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 128.04 | 62.51 | |
| 18 | 112.92 | 55.96 | |
| 19 | 114.28 | 50.11 | |
| 20 | 133.43 | 52.26 | |
| 21 | 128.61 | 52.23 | |
| 22 | 127.84 | 48.72 | |
| 23 | | | Replaced on 16/1/99 |
| 24 | | | Replaced on 16/1/99 |
| 25 | 130.85 | 48.25 | |
| 26 | 107 | 50.92 | |
| 27 | | | Replaced on 16/1/99 |
| 28 | | | Replaced on 16/1/99 |
| 29 | 130.7 | 56.73 | |
| 30 | 110.55 | 56.46 | |
| 31 | 117.29 | 55.34 | |
| 32 | 129.78 | 53.83 | |

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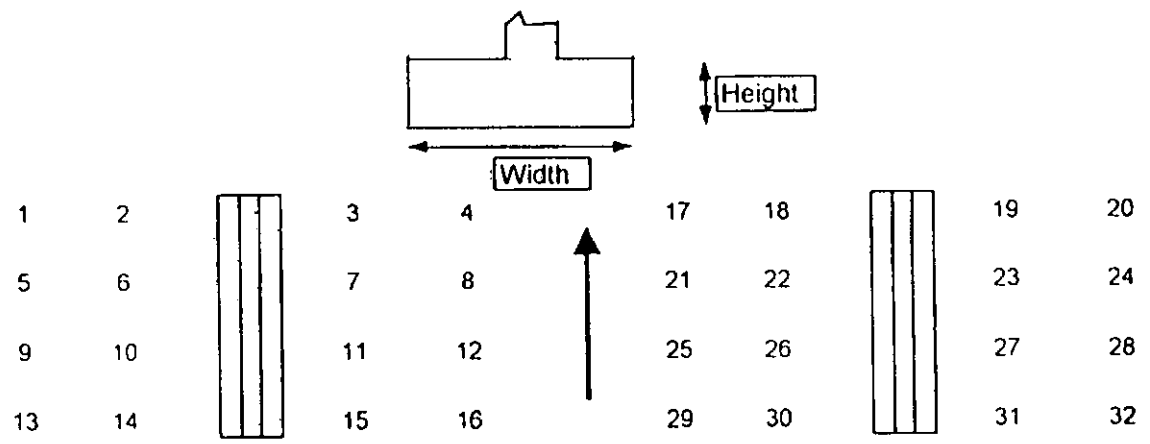
Annexure - XXIV

## REPORT ON THE PERFORMANCE OF ORDINARY TAMPING TOOLS

| | | | |
|---|---|---|---|
| Date of fitment: | 12/1/99 | | |
| Type of Tamping Machine: | CSM 09-32 | Inspection Date: | 17/1/1999(after day's work) |
| No. of Insertions: | 8425 | Machine No.: | 901 |
| Kms Tamped: | 10.95 | Railway: | Nothern Railway |
| Type of Ballast: | Hard Stone | Station: | Shahabad Markanda |




WORKING DIRECTION

| LEFT HAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 1 | 128.23 | 40 | |
| 2 | 104.37 | 38.77 | |
| 3 | 109 38 | 54.14 | |
| 4 | 124 48 | 54.99 | |
| 5 | | | Replaced on 16/1/99 |
| 6 | | | Replaced on 16/1/99 |
| 7 | 118 96 | 33.17 | |
| 8 | 128 66 | 31.7 | |
| 9 | | | Replaced on 16/1/99 |
| 10 | | | Replaced on 16/1/99 |
| 11 | 126 17 | 41.59 | |
| 12 | 131 38 | 56.48 | |
| 13 | 122 88 | 37.56 | |
| 14 | 91 66 | 41.57 | |
| 15 | 111.95 | 57.58 | |
| 16 | 125 1 | 57.74 | |

| RIGHTHAND SIDE | | | |
|---|---|---|---|
| Tool No. | Width | Height | Remarks |
| 17 | 123.17 | 57.08 | |
| 18 | 110.6 | 50.05 | |
| 19 | 113.19 | 43.7 | |
| 20 | 126.51 | 50.23 | |
| 21 | 125.98 | 47.2 | |
| 22 | 125.54 | 46.75 | |
| 23 | | | Replaced on 16/1/99 |
| 24 | | | Replaced on 16/1/99 |
| 25 | 125.06 | 43.48 | |
| 26 | 108.67 | 47.05 | |
| 27 | | | Replaced on 16/1/99 |
| 28 | | | Replaced on 16/1/99 |
| 29 | 125.77 | 55.56 | |
| 30 | 105.68 | 56.16 | |
| 31 | 115.09 | 52 5 | |
| 32 | 126 63 | 53.07 | |

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## ACKNOWLEDGEMENT

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1. J.S.Mahrok, Joint. Director/TM-II
2. D.C.Mitra, Assistant Research Engineer/Large Machine
3. Neerendra Prasad , Chief Technical Assistant /Civil
4. S.K.Nema, Chief Research Assistant/Civil
5. Anand Kumar, Senior Researcj Assistant /Civil.
6. Sant Lal, PA/JDTM-II.