



**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

**REPORT ON THE CASES OF FREQUENT DERAILMENTS IN
UDAIPUR -HIMMATNAGAR SECTION OF NORTH-WESTERN RAILWAY**

**Report no.TM-167
May 2012**

126043

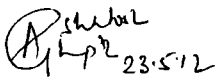
**RESEARCH DESIGN AND STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW-226011**

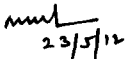
FOREWORD

A team of Directors of RDSO was deputed to study the problems of frequent derailments of YDM4 Locomotives on Udaipur City Himmatnagar section of Ajmer division in North-western Railway.

This report deals with the maintenance practices as observed by the team for maintenance of track in Udaipur City Himmatnagar section of Ajmer Division and maintenance of YDM4 locomotives in Sabarnati Shed. The details of the maintenance practices were collected from the field staff. The recommendations are drawn on the basis of observations made during the field visit and subsequent inputs provided by the field officials.

This report is the property of RDSO and is meant essentially for official use. It may not be loaned, reproduced in part or full or quoted as an authority without prior written permission of Director General, RDSO, Lucknow.


(Ashutosh Gupta)
Director/Track Machine


(N.K. Bamawal)
Director/Motive Power

126044

**Report on the cases of frequent derailments in
Udaipur - Himmatnagar section of North-Western Railway**

1.0 BACK GROUND:

There were three derailments in Udaipur-Himmatnagar section of Ajmer division in North-western Railway, involving YDM 4 locomotives, in the month of January 2012. To study the problem and to suggest remedial measures, a team of two Directors was nominated by DG/RDSO on 02.02.2012.

2.0 MEMBERS OF THE COMMITTEE:

1. N.K.Barnawal, Director(Motive Power)
2. Ashutosh Gupta , Director(Track Machine)

3.0 BRIEF DETAILS OF DERAILMENTS

Dates of Derailment	Train No.	Loco No.	Site/Section /Division	Details of derailment	Major Track feature
05.01.12	19943	6720	Bet UOM - KRCD at 134/2-4 UDZ/HMT/All	Rear Bogie wheel no. 4 & 5 of loco, all wheels of front bogie of SLR and one wheel of 3 rd coach from loco derailed.	<ul style="list-style-type: none"> • CD of 30 kmph followed by CD of 20 kmph, due to CTR work in progress • 2^o curve, rising grad 1 in 106, 90R rail, CST 9 sleeper
21.01.12	19943	6304	UDZ-UMRA at km 115/5-12 UDZ/HMT/All	Front bogie both wheels of 1 st axle (Axle no.06) derailed. Train dragged 413m after derailment	<ul style="list-style-type: none"> • 3^o Curve, 1:150 falling grade, 75R rail, CST 9 sleeper • Super elevation 35mm • Welded rail & reverse jaw sleeper
27.01.12	52928	6306	Bet JYM/ZW at km 156/15 HMT/UDZ/All	1 st axle both wheel derailed.	<ul style="list-style-type: none"> • 7^o curve, rising grad 1 in 250, 90R rail, steel trough sleeper

126045

Ag

ml

4.0 INSPECTION OF THE SECTION:

As there were three derailments of coaching trains, in the same section within a short period of one month, the RDSO team, immediately visited Udaipur, and inspected the section on 04.02.2012, to have a first-hand feel of the section, and the operations there.

During the visit, the team interacted with Sr DME/Ajmer, DEN/Ajmer, PWI/Udaipur City, SSE(C&W) and LI/Udaipur City, and also foot plated in the Udaipur- Himmatnagar section in a YDM4 locomotive. The team also inspected the derailment spots and made random observations of the track.

A team also visited Sabarmati Diesel shed, where YDM4 locomotives are maintained.

The following observations were made during inspection by the team:

- (a) Track consists of second hand sleepers and second hand rails. The sleepers are mostly CST-9 of 1968 make or .Second hand ST sleepers. Broad Gauge ST Sleepers have been converted for Meter Gauge use. Some CST-9 sleepers were found to be having cracks. The rails are 75R (Year of mfr. 1964) or 90 R (Year of Mfr. 1989).
- (b) During inspection at several random spots in the section, it was found that due to wear of lug and rail seat, the sleepers were no longer gripping the rail firmly and the keys were working loose.
- (c) There was a deficiency of ballast on outside of the curves.
- (d) The section has steep gradient and sharp curves are required more maintenance effort.
- (e) TRC is not run in the section. The quality of track is assessed through OMS readings.
- (f) One YDM4 locomotive in which the team foot plated for inspection of the Udaipur Himmatnagar Section, it was found that the loco was fitted with Medha 918 M Speed recorder in the driver control stand. However there was no provision for ALP to look at the speed.
- (g) IOH/POH details were not available in loco. Only next schedule due was mentioned in the repair book.

5.0 DOCUMENTS CALLED FOR EXAMINATION

As the committee has not been privy to the observations of the derailment-sites, and other records normally taken for derailment investigations, the committee sought the following informations from Ajmer Division as well as from Sabarmati Diesel shed, for a meaningful analysis of the derailments:

- (a) Divisional level Enquiry reports of the three derailments
- (b) Joint note of Sr Sub-ordinates including prima-facie report of the derailments
- (c) Details of earlier derailments in that section in last two years
- (d) Curve maintenance records of the curves where derailments took place
- (e) Records of all major track maintenance works like rail renewal , CTR, packing maintenance etc, done in last one year at the places where derailments took place.
- (f) Last OMS readings taken in the section on loco as well as on coach
- (g) Copies of rail profile if taken at the derailment sites
- (h) Method being followed in Sabarmati Shed of finding level difference between centre pivot and side bearer of YDM4 loco, and actual readings of this difference in the derailment involved locomotives.
- (i) Last schedule particulars of the derailment involved locomotives, and frequency of light schedule and major schedules of MG locomotives

126046





- (j) Speed recorder reports of the derailment-involved-locomotives

The above details could be made available to the RDSO team only in the first week of May 2012, and the enquiry committee examined those documents in detail.

5.1 Divisional Level enquiry Findings

(a) Deraiment No.1:

Date of Deraiment	Train No.	Loco No.	Site/Section/Division	Details of derailment
05.01.12	19943	6720	Bet UOM - KRCD at 134/2-4 UDZ/HMT/All	Rear Bogiewheel no. 4 & 5 of loco, all wheels of front bogie of SLR and one wheel of 3 rd coach from loco derailed.

Enquiry findings:

Cause of derailment: Improper super elevation and improper gauge.

However DEN, a member of the enquiry committee, in his dissent note stated that for 20 kmph speed, and for the kind of derailment, SE or improper gauge cannot be the cause of derailment. Rather difference in wheel dia of axle 4& bent axle as per measurement of wheel gauge caused the derailment.

(b) Deraiment No.2:

Date of Deraiment	Train No.	Loco No.	Site/Section/Division	Details of derailment
21.01.12	19943	6304	UDZ-UMRA at km 115/5-12UDZ/HMT/All	Front bogie both wheels of 1 st axle (Axle no.06) derailed. Train dragged 413m after derailment

Enquiry findings:

- 1 The POH and IOH were overdue from Jul'11 & June'11 respectively.(Last POH 07.07.2005,Last Yearly Sch 25.06.2010)
- 2 Differences in diameter of wheels in the same axle are found up to 2mm, which became helpful for derailment due to more angle of attack.
- 3 Twisting of underframe as evidenced by less buffer height at the front (515 mm, which is below the limit 535 mm) and uneven height of rail guard from rail level at the long hood side. This together with biased wear on wheels of trailing bogie helped in climbing of wheels on rail.

However Sr.DME(P), a member of the enquiry committee, in his dissent note gave the following dissent note:

- (i) Design of wheel is such that the two wheels on same axle can travel unequal distance and the 2mm difference in the same axle does not have any relation with the derailment.
- (ii) Less buffer height was found on the free end of the loco, and as such it has nothing to do with derailment. As per him, the less buffer height was caused due to wrong shunting in the shed and there is no any relation with the frame twisting.

[Handwritten signature]

[Handwritten signature]

126017

Rail guard is fitted on the loco underframe, and uneven height of the rail guard can be due to improper location of hole.

- (iii) There were several deficiencies in track like (a) Gauge under load was found to be more at a distance 2m from the POM (b) Twist was also more (c) Variation in track gauge under load indicated loose packing (d) versine readings were found beyond limit at two places. The same were ignored by the EC.

But the above points raised by SrDME(P) were refuted by other members of the enquiry committee, in a subsequent note.

(c) Derailment No.3:

Date of Derailment	Train No.	Loco No.	Site/Section/ Division	Details of derailment
27.01.12	52928	6306	Bet JYM/ZW at km 156/15 HMT/UDZ/All	1 st axle both wheel derailed.

Enquiry findings:

1. Bad engine man ship by driver.
2. Root wear of wheel no. 1 (RH) found 5.56 mm, which is beyond the limit of 5 mm as specified in the RDSO drawing no. CSL-2127/M.
3. Wheel gauge found 928 mm in a place of axle no. 3, which is beyond the limit of 927 ± 0.5 mm.
4. Locomotive was running after completion of own codal life (Date of Commission of Loco 30.04.1972, Last IOH 11.12.2008). The IOH was overdue from Dec'12.

Sr DME(P) however in his dissent note stated that:

- (i) The loco speed, as per the speed record was less than the limit before derailment. Higher speed at some other time does not indicate that derailment took place because of this.
- (ii) Root wear permitted is 6 mm and not 5 mm.
- (iii) There was loose packing, as indicated by depression of track under load (which can be 10.8 mm under load of a loco). Versine variations were also not within limits at two places.

However other members of the EC contested the dissent note by Sr DME(P), mentioning that as there was no point of mount indicating sudden variation in draw bar force, it is a case of bad engine man ship. The limits in variation of versine is only for passenger comfort, and not for safety. They also countered other points, and indicated 0.5 mm variation in wheel gauge at quarter point may lead to wobbling, and smaller lateral clearance in axle 2 and 5 may affect flexibility in curve negotiation.

126048

5.2 OMS Readings

- (a) OMS readings first sent by the Division, which pertained to 05.02.2012 showed vertical and lateral accelerations of this sections from km 112 to 319 on coach as well as on loco. However the instrument did not record for the stretches, where derailments took place, probably because of the speed being less than 30 kmph due to speed restriction. From the readings of the other stretches of the section it was noticed that vertical accelerations in coach were high at several places (beyond 0.3g, and at some places even 0.35g) even at



 Page 4 of 10

speed of 40 kmph (at one place it reached 0.33g at 30 kmph speed). Lateral acceleration was shown zero throughout the section. Ride indices on coach were recorded as RI(Vertical)=2.94,RI(lateral)=2.60.

- (b) OMS readings for loco, which were taken on 06.02.2012 showed zero vertical and lateral acceleration peaks throughout the section, and the Ride indices on loco were recorded as RI(vert.) = 2.92 and RI(Lat.) = 2.52.
- (b) As the OMS readings did not cover the stretches where derailments took place, division was requested to send OMS readings of those stretches as might have been taken before imposition of speed restriction(before the derailments) .The OMS recordings as taken on 25.12.2011 were sent subsequently, which indicates 461 no. of vertical peaks, and 40 no. of lateral peaks in the acceleration range 0.2 to 0.25g,100 vertical peaks and 1 lateral peak in range 0.26 to 0.3g , and 22 vertical peaks and 1 lateral peak in the range 0.31 to 0.35g. At the derailments spots, (i) At km 134 , one vertical and one lateral peaks of acceleration 0.25g were noticed at speed 34 kmph.(ii) At km 115/10-11,one vertical peak of 0.21g , and another vertical peak of 0.27g were noticed at speed 37 kmph , (iii) At km 158 , near the third derailment spot , there were five vertical peaks of range 0.21 to 0.24 g at 44 kmph speed.

5.3 Feed Back from Diesel Shed

Records of last major schedules of the locomotives involved in the derailments were collected. The loco 6720, which was involved in the derailment on 05.01.12,was commissioned on 11.04.1992, had completed about 20 years, and undergone last major schedule (which involves running out of bogie and dismantling of undergear) on 21.08.2010 (M-36 sch). The second loco 6304, which was involved in the derailment on 21.01.12, had completed about 39 years of life, and underwent last major schedule (involving running out and dismantling of undergear) on 25.06.2010 (M-36 Sch).The third loco 6306 , which was involved in derailment 27.01.12, was also about 39 to 40 years old, and underwent last major schedule (involving running out and dismantling of undergear) on 13.01.11(M-24 Sch).

As per the feedback of Diesel shed ,Sabarmati, regarding query of the RDSO team, the shed measures the height of Centre pivot pin, and side bearer pads, and maintains the level difference between them, as given in the maintenance manual of the ALCO locomotives, however the same is recorded in the bogie overhaul section. Sabarmati was earlier following 18 month major schedule, and they have subsequently switched over to 24 month major (M-24 Sch), somewhere in 2010-2011, in line with broad gauge ALCO locomotives.

126049
40927

5.4 Curve Maintenance Records & other Feed backs from Division

- (a) As per the curve maintenance records sent by the division, the curve readings taken after every 6 month shows satisfactory readings, and it is also understood that there was no need to do curve alignment, and as such no curve alignment was done in the recent past,

- (b) Prior to the last three derailments in January 2012, there were no derailments in that section in the previous two years.
- (c) As per the information provided by DEN/Ajmer, the following major track maintenance works were done at the places where derailments took place

Km	Derailment date	Major track maint. work
134/3-4	05.01.2012	CTR done in 2011-12
115/10-11	21.01.2012	TSR done in 2010-11
157/2-3	27.01.2012	CTR done in 2003-04

- (d) It is understood, on going through the enquiry proceedings, that thorough packing was done in the stretch of the second derailment on 21.01.12, in December 2011 (as seen from the statement of SSE(P-way)).

6.0 STUDY AND ANALYSIS OF THE DERAILMENTS

- (a) In all the three derailments which took place in the same section, the consequential effects on the trailing stocks were very limited. All the derailments took place in curves. In the case of derailment on 05.01.12, CTR work was under progress. As it transpires from the study of the enquiry proceedings, there were many missing fitting track items (as noticed from the joint observation, and from the statements of the TI).
- (b) A sleeper is satisfactory as long as it can hold gauge, provide satisfactory rail seat and permit rail fastenings being maintained in tight condition. Otherwise sleeper requires to be reconditioned or replaced. Even during inspection of the section by the team on 04.02.12, it was found that the keys were deficient at several places, and due to wear of the rail seats, the keys were working loose
- (c) The depth of ballast cushion at the site of the derailment on 05.01.12, was found as less as 60 mm. During inspection of the section by the team on 04.02.12, it was found that the ballast was insufficient. Poor OMS recordings both before and after the derailments too indicate the same fact.
- (d) Although the rail profiles sent by DEN/S/Ajmer shows rail wear within limit, the track mainly consists of second hand old rail, and the rail is bound to be worn one. Worn rail too, under conducive environment, can persuade wheel flange to ride over it.
- (e) It is understood that in case of derailment on 05.01.2012, the speed restriction was 20 kmph and loco speed was about 20 to 22kmph due to CTR work.
- (f) The aim of packing is to ensure that the rails are at their correct relative levels, and that no sleeper has any void between it and its void. It is noted from the statement of witness in the




course of enquiry regarding derailment on 21.01.12, after through packing, track measurements are done, but not recorded. Through packing of the stretch was done in the stretch where the second derailment took place in the period from 18.12.11 to 24.12.11.

- (g) As per the records, the speed of the train was found to be 2 to 3 kmph more than the speed restriction of 20 kmph, in case of the derailment on 05.01.12. In case of derailment on 21.01.12 also, the speed was found to be 56 to 58 kmph, 40 second before the speed restriction of 50 kmph. It was noticed by team that the speed indicator is provided to the driver only, and as a result it is not possible for the ALP to keep a watch on the speed which he normally does in other BG locomotives.
- (h) The maximum service limit of variation in wheel diameter is 8 mm for all wheels within the same bogie, and 25 mm for any two wheels of the same loco. The wheels have got in built conicity, and this much variation in wheel diameter in service should not be a cause for derailment. This is more so in curves, where the wheel diameters at the contact points are bound to be different. But it is important that permissible limits for wheel diameters as laid down are adhered to, during tyre turning and wheel change.
- (i) It was found and recorded that in the case of derailment on 21.01.12, the buffer height of the loco at the leading end was found to be less than the permissible limit at the leading end (free end) of the loco. It was also stated that there was some damage done in the shed during winching, and due to this the buffer height got affected. Although the less buffer height was at the leading end of the loco, and may not contribute in that derailment, it is important that buffer height is an important parameter, and if there was any damage during shed movement etc., the same should have been recorded.
- (j) YDM4 locomotives are provided with equalizer which equalizes the axle loads in case of off loading of any axle. Normally due to traction there is slight amount of offloading on the front axle which is taken care with the help of equalizer in case of YDM4 loco. Less height of buffer at the leading edge, as noted during the course of loco readings at Sabarmati Diesel shed after the derailment on 21.01.12, (if it was there before the derailment) will only reduce offloading of the leading wheel if the equalization effect of the equalizer is not considered.
- (k) Out of the three different YDM4 locomotives involved in the three derailments in different stretches of the section, two locomotives were overaged (age about 40 years). It is also seen from the informations collected, that loco no. 6304, which was involved in the derailment on 21.01.12, was under GRS from July 2008 to June 2010. In case of loco 6306, there is a gap of two years between M-36 schedule (done in 11-12-08) and M-24 Sch (done in 13.01.2011), which shows a delay of 6 months in major overhauls (considering that the shed switched over to 24 month major overhaul somewhere in 2010-2011). It can also be understood that due to the old age of the locomotive, and their being in relatively small no,

126051

there is likely to be the problem of getting proper/genuine supply of spares, which may be required during major overhauls.

- (l) From the shed maintenance records, it was noticed that during last M-36 schedule (as done in case of loco 6720 and 6304, involved in first two derailments) and M-24 schedule of loco 6306 (which was involved in the third derailment), bogie run out, bogie dismantling , overhauling etc have been done. Considering that the shed switched over to 24 month major schedule (M24 Sch) from the earlier 18 month (M-18) schedule,, as had been done for all ALCO BG locomotives long back , the locomotives cannot be considered to be due schedule
- (m) As per the details made available by Sabarmati Shed, the vertical offset between centre pin and side bearer load pad is measured, and the value is maintained as per the recommended limit. However the exact values as maintained are not mentioned in the check sheet.
- (n) Versine variations have been found beyond limits before the points of drops, in last two derailments. For derailment on 21.01.12, station to station variation of versine was found just 3 mm beyond the permissible limit at 70 m in rear from point of mount, while in the case of derailment on 27.01.12, this was found 8 mm more at a distance of 60 m in rear from point of drop. Although these variations might not have directly caused the derailments, but do indicate that proper maintenance of curves require to be done.
- (o) In case of derailment on 27.01.12, no point of mount has been found which may indicate sudden variation in force. The driver was found to have oversped at some places, although at the place of derailment his speed was within limit.

7.0 RECOMMENDATIONS

- (a) Riding stability depends upon the interaction between the rolling stock and the track, and it is not right to view one in isolation. Many times, when derailments occur it is difficult to pin point the extent of contribution of one aspect vis a vis others. So it is important that all respective relevant parameters are kept within the permissible limits.
- (b) The Udaipur- Himmatnagar section does not have the facility for recording track parameters by track recording car, due importance is required to be given to OMS recordings. It is important to keep the OMS instruments in good fettle, and duly calibrated. The OMS run should be carried out once in two months and peaks must be attended immediately. OMS readings for loco, which were taken on 06.02.2012 showed vertical and lateral acceleration peaks as zero throughout the section, which seems to be very unlikely. The OMS recordings should be done with due care, and must be analyzed critically.

(Signature)

(Signature)

126052

- (c) During the maintenance of CST-9 sleepers care is to be taken to see that the plate is boxed evenly so that it may not tilt either inward or outward. Tilting will disturb the gauge and will not give proper wearing. Defective plates should not be boxed with ballast unless replaced. The worn out keys can be used with appropriate side of liners or should be replaced by oversized keys. Saddle plates of suitable thickness can be used on the locations of excessive rail seat wear.
- (d) Steel trough damaged sleepers should not be boxed with ballast until replaced. ST sleepers having worn out rail seats can be reconditioned by welding a pad plate and new drilling of holes
- (e) The shoulder ballast width should be 330 mm in case of curves of radius less than 600 m. The shoulder ballast on the outside of the curve should be 380mm in case of curves sharper than 600m radius.
- (f) After CTR work, track readings should be taken promptly and recorded. The observations after derailments after such maintenance works require to be taken more meticulously.
- (g) The section has steep gradient and sharp curves with worn out sleepers, rails etc, and as such more maintenance effort is required. The inspection of curves should be done regularly and meticulously and action was taken by the PWI. The joints on the curves sharper than 300m were staggered even at the end of the curves. It must be ensured that the rail joints are square at the beginning and at the end of the curve. Regular lubrication of the outer rail of the curves should continue to avoid ^{outer rail} rail ~~plate~~ ^{gauge} wear
- (h) The wear of rails should be regularly measured. The wear of rails of curves sharper than 2° should be recorded immediately. The lateral vertical and total loss of section should be recorded. Necessary action after analysis of records should be planned.
- (i) Check Rails are provided on curves sharper than 8°. Additional locations can be decided by Chief Engineer taking into consideration the negotiability of rolling stock and the curve geometry (para 426 of IRWPM)
- (j) In the maintenance Check Sheets of major schedule, the level difference between centre pivot and loading pad should be properly mentioned. In the Checklist at Loco Shed specific readings should be recorded; generalized remarks like 'found OK' should be avoided. RDSO has issued one Instruction Bulletin IB No. MP.IB.VL – 02.11. 10 Rev. 00 dated 26.02.2010. The same should also be followed, in addition to MP MI 92.
- (k) Speed indication should be provided in the locomotive to the ALP also .Proper slave unit of the existing microprocessor speed recorder, or additional speed indicator should be provided in the loco cab so that the ALP also can see and watch the speed.





120053

(l) Most of the locomotives running on MG line are very old and need proper maintenance efforts. Due importance should be given to the maintenance of these locomotives as they, despite being old, are used for hauling passenger trains too. Due consideration should be given to the age of locomotives, their utilization and availability of spares while deciding their maintenance schedules, and they should not be considered at par with not -so- old BG locomotives.

(m) A proper action plan should be made and monitored in line with the above mentioned points.



126054