भारत सरकार (GOVERNMENT OF INDIA)
रेल मंत्रालय (MINISTRY OF RAILWAYS)
रेलवे बोर्ड (RAILWAY BOARD)

****

No. 2018/CE-II/CS/1 New Delhi, dated 08.02.2019

The General Managers (Engg.)- CR, ER, ECR, ECoR, NR, NCR, NER, NFR, NWR, SR, SCR, SER, SECR, SWR, WR, WCR and Metro Railway/Kolkata.
The General Manager (Const.), N.F.Railway, Guwahati.
The General Manager/CORE/Allahabad.

The CAO/Const. All Indian Railways.
FA & CAO, All Indian Railways.
The General Managers (Engg.) – ICF/Chennai, RCF/Kapurthla, DLW/Varanasi, CLW/Chittranjan, Rail Wheel Factory /Yelahanka, Bangalore & DMW/Patiala.

The Director General (Track), RDSO/Alambagh, Lucknow.
Chief Commissioner of Railway Safety, Lucknow.

Managing Director, IRCON, New Delhi.
Managing Director, RITES, New Delhi.
Managing Director, DMRC, Metro Bhawan, Barakhamba lane, New Delhi.
Managing Director, CONCOR, New Delhi.
Managing Director, RVNL, August Kranti Bhawan, Bhikaji Cama Place, New Delhi.
Managing Director, DFCCIL, Pragati Maidan, Metro Station, New Delhi.
Managing Director, PIPAVAV Railway Corp. Ltd., 14th Floor, B-Wing, Statesman House 148, Barakhamba Road, Canaught Place New Delhi Central Delhi

Managing Director, MRVC, Church Gate station Building 2nd Floor, Mumbai – 400020.

Managing Director, RLDA, IRCON Office Compound, Next to Safdarjang Rly. station, Motibagh-I, New Delhi.
Managing Director, Konkan Railway Corporation Ltd, Belapur Bhawan, Sector-11, CBD Belapur. Mumbai. Pin - 400614.

Director, IRICEN, Pune.
Director, IRIEEN, Nasik.
Director, IRISET, Secunderabad.
Director, IRIMEE, Jamalpur.
Director, IRITM, Vill. Kanausi, Hardoi, Manik Nagar, Lucknow.
Director General, Railway Staff College, Vadodara.
Genl. Secretaries, AIRF, NFIR, IRPOF, FROA, AIRPFA, DAI (Railways) Rail Bhawan, New Delhi.

Sub: Correction Slip No. 149 to the Indian Railways Permanent Way Manual.

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Ministry of Railways (Railway Board) has decided that correction/addition as indicated in the enclosed Correction Slip No.149 dated 08.02.2019, to relevant para of the IRPWM, be made.

Receipt of this letter may please be acknowledged.

(Pradeep Nagar) 8/2/19
Director Civil Engg.(P)
Railway Board

No. 2018/CE-II/CS/1 New Delhi, dated. 08 .02.2019

Copy to :

Sr. PPS/PS to CRB, FC, ME, MRS, MS, MT, M(Tr.), Secretary.

AM(CE), AM(Works), AM(Budget), AM(Elect.), AM(Fin.), AM(Sig.), AM(Plg.), AM(Staff), AM(Mech. Engg.), AM(PU.), AM(Tele.), AM(TT), PED(Bridge), PED(Vigilance), PED(Stn.Dev.Engg.) PED(Safety), DG(RS), AM(C&IS), AM(T&C), AM(Comml.).

EDCE(P), EDTK(M), EDTK(MC), EDTK(P), EDCE(G), EDCE(B&S), ED(L&A)I, ED(Stn. Dev. Engg.) ED(Works), ED(WP), EDV(E), ED(Project Monitoring), ED(Safety), EDF(X)I, EDF(X)II, ED/INFRA/Civil.

DTK(MC), DTK(M), DTK(P), DCE(B&S), DCE(B&S)II, Dir(Works)-I, Dir(Works)-II, Dir.Works(Plg.), ED/E(Co-ord), DVE-I & DVE-II,

Director/C&IS - for uploading on Railway Board website.

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8/2/19

INDIAN RAILWAYS PERMANENT WAY MANUAL

CORRECTION SLIP NO. 149 DATED 08-02-2019

1. Existing Para 316(2) shall be replaced with the following:

(2) As a good practice, the laying standards of track geometry **(as shown on the next page)** during primary renewals should be achieved (Track laid with new materials). Track geometry will be recorded three months after the speed is raised to normal – **(see on page 122)**

2(a) For BG and MG, to be measured in floating condition:

Gauge	Sleeper to Sleeper variation	2 mm
Expansion gap	Over average gap worked out by recording 20 successive gaps	± 2mm
Joints	Low joints not permitted High joints not more than Squareness of joints on straight	± 2mm ± 10mm
Spacing of sleepers	With respect to theoretical spacing	± 20mm
Cross level	To be recorded on every 4th sleeper	± 3mm
Alignment	On straight on 10m Chord	± 2mm
	Variation over theoretical versines on curves of radius more than 600 m (On 20 m chord)	5 mm
	Variation over theoretical versines on curves of radius less than 600 m (On 20 m chord)	10 mm
Longitudinal level	Variation with reference to approved longitudinal sections	50 mm

2 (b) Standard Deviation and Peak based limits for unevenness and alignment for BG as measured by TRC, shall be as under:

(i) SD Based

SN	Parameter	Speed up to 100 Kmph	Speed above 100 kmph and up to 160 kmph
1.	UN-1	2.0 mm	1.4 mm
2.	UN-2	-	1.9 mm
3.	AL-1	1.4 mm	1.1 mm
4.	AL-2	-	1.3 mm

(ii) Peak based

SN	Parameter	Speed up to 100 Kmph	Speed above 100kmph and up to 160 kmph
1.	UN-1	6.0 mm	4.0 mm
2.	UN-2	-	6.0 mm
3.	AL-1	4.0 mm	3.0 mm
4.	AL-2	-	4.0 mm

Note: (i) Refer Para 604(3) for chord lengths relevant for UN1, UN2, AL1 and AL2.
(ii) The limits for alignment are variation from the design versine for curves.

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2. Existing Chapter VI - **TRACK RECORDING, ANALYSIS AND MONITORING** shall be replaced with the following:

Chapter VI

TRACK RECORDING, ANALYSIS AND MONITORING

601. Introduction -Inspection by foot, trollies, locomotives, and rear vehicles enable the Permanent Way staff to carry out assessment of the quality of track. These inspections, though important, are qualitative and enable assessment based on individual experience. Objective assessment of track is done by track recording cars, Oscillograph cars and Oscillation Monitoring System.

602. Track Recording Equipment– Following track recording equipments are in use on Indian Railways at present:
(1) Track Recording Cars.
(2) Oscillograph Car.
(3) Oscillation Monitoring System

603. Track Recording Car – Two types of track recording cars are currently in use in Indian Railways, one with contact type gauge sensors and other with contactless laser based sensors. Both types of TRCs are based on inertial principle of track measurements and it is possible to have discrete values of track geometry parameters on selected sampling interval, under loaded condition.(See Para 604(4)).

604. Measurement by Track Recording Cars –

(1) Both types of TRCs as mentioned under para 603 have the ability to measure Track geometry parameters on two user selectable chords in the range of 2 to 20 meter. One chord is termed as short chord while the other is termed as long chord denoted by suffix 1 & 2 respectively (See Para 604 (3)). Contact type sensors are fixed on measuring frame mounted on the axles of rear bogie of TRC. LASER based contactless sensors are mounted on a sensor beam welded on the rear bogie of the Coach

(2) Parameters Measured

- Unevenness of Left & Right Rail (on two user selectable chords)
- Alignment of Left & Right Rail (on two user selectable chords)
- Twist (calculated on two user selectable bases)
- Variation of gauge (on 50 meter moving average) and/or variation of gauge over nominal gauge
- Vertical and lateral accelerations on coach floor above bogie pivot
- Curve details
- Speed of Recording

(3) Short and Long chords for track parameters are as under:

SN	Parameter	Short Chord / Base	Long Chord/Base
1	Unevenness	9.0 Metre (UN-1)	18.0 Metre (UN-2)
2	Alignment	9.0 Metre (AL-1)	15.0 Metre (AL-2)
3	Twist	3.0 Metre (TW-1)	15.0 Metre (TW-2)

(4) Inertial Principle Used in TRCs – TRC measures lateral and vertical accelerations with the help of accelerometers placed at coach floor/bogie frame. The acceleration values obtained are integrated twice to get loci of the location of accelerometers. The relative displacements between rail and accelerometer locations are obtained from displacement transducers (LVDT)/ LASER based contactless sensors. The loci of accelerometers are combined with relative displacement obtained from sensors to derive the vertical and lateral profile of the rail. These measurements are further corrected for roll and yaw motion of coach using gyroscopes.

605. Reporting of TRC results–Details required to be reported in **exception reports being generated by** TRC for each block of 200 Metre and for each kilometer:

(a) Details for every block of 200 Meter

- Standard Deviation value of Unevenness of Left & Right Rail on two user selectable chords
- Standard Deviation value of Alignment of Left & Right Rail on two user selectable chords
- Average speed for 200 metre block
- Parameter Index for Unevenness (UI), Alignment (AI)
- Track Quality Index (TQI)
- Maintenance Instructions corresponding to Unevenness and Alignment over PML and NBML
- Vertical and Lateral Ride Index
- Average gauge of block over nominal gauge (1676 mm)

(b) Results reported for whole Kilometer

- Number of peaks above Need Based Maintenance Limits (Para 607 (2(b)) on long chord and short chord
- 10 highest peak values of each parameter with location on long and short chord as obtained from measured worst peaks in each 50 m block of a kilometer.
- 10 highest peak values of vertical and lateral accelerations exceeding Urgent Maintenance Limits (Para 607 (2)) with location
- Vertical and lateral accelerations with location taken from the one measured worst peak in each 50 m block
- TQI and Average Speed
- Vertical and Lateral Ride Index

606. Frequency of Track recording –Track geometry monitoring of Metre Gauge routes is not being done by track recording car. Broad Gauge routes should be monitored by TRC as per the following frequencies (except for the routes where track recording has been dispensed with):-

i) Routes with speeds above 130 kmph	- Once in 2 months
ii) Routes with existing speeds above 110 kmph and upto 130 kmph.	- Once in 3 months
iii) Routes with existing speeds above 100 kmph and upto 110 kmph.	- Once in 4 months
iv) Routes with existing speeds up to 100 kmph	- Once in 6 months

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607(1) Maintenance Limits for Alignment and Unevenness parameters –Track shall be categorized under following three categories for planning and maintenance of alignment and unevenness, based on TRC results:

(i) Track requiring planned maintenance
(ii) Track requiring need based maintenance
(iii) Track requiring urgent maintenance

Planned Maintenance Limit (PML) - These tolerances provide track maintainer a guidance to plan through maintenance of track in a complete block section. These limits, if exceeded, require that track geometry condition be analyzed and considered for planned maintenance operations. Planned Maintenance Limits are based on SD values of Unevenness and Alignment, as these parameters affect Ride quality.

Need Based Maintenance Limit (NBML)–These limits are for applying timely correction before the defect size grows to the level of 'Urgent Maintenance Limit (UML)', requiring traffic slow down. Allowable time for attention to defects exceeding the NBML would depend upon the magnitude of the defect and various factors affecting track geometry deterioration such as sectional speed, axle load, traffic volume, etc.

Urgent Maintenance Limits (UML)–These are laid in terms of acceleration limits on comfort consideration. The permitted speed should be slowed down and restored only after attending the track, wherever acceleration peaks exceed Urgent Maintenance Limits (UML).

607 (2) Various Limits for Alignment and Unevenness are stipulated as below:

(a) Planned Maintenance Limits(PML) – SD values:

Parameter	Speed up to 100 Kmph	Speed above 100 kmph and up to 110 kmph	Speed above 110 kmph and up to 130 kmph	Speed above 130 kmph and up to 160 kmph
UN-1	5.0 mm	3.8 mm	3.3 mm	2.9 mm
UN-2	-	5.4 mm	5.1 mm	4.4 mm
AL-1	3.3 mm	2.5 mm	2.5 mm	1.9 mm
AL-2	-	4.1 mm	3.5 mm	2.5 mm

Note : Peak based limits are not stipulated for unevenness and alignment for planned maintenance as planned maintenance is to be carried out by track machines based on standard deviation values.

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(b) Need Based Maintenance Limits (NBML) :

(i) **SD and peak based values:**

Speeds upto 100 kmph

Parameter	SD Value (mm)	Peak Value (mm)
UN-1	6.8	20
UN-2	-	-
AL-1	4.9	15
AL-2	-	-

Speeds above 100 kmph and upto 110 kmph

Parameter	SD Value (mm)	Peak Value (mm)
UN-1	5.5	17
UN-2	7.5	23
AL-1	3.9	12
AL-2	6.7	20

Speeds above 110 kmph and upto 130 kmph

Parameter	SD Value (mm)	Peak Value (mm)
UN-1	4.9	15
UN-2	7.4	22
AL-1	3.6	11
AL-2	5.3	16

Speed above 130 kmph and upto 160 kmph

Parameter	SD Value (mm)	Peak Value (mm)
UN-1	4.4	13
UN-2	6.6	20
AL-1	3.6	11
AL-2	4.9	15

Note: Limits for alignment are variation from average versine for curves. Instructions regarding maintenance/realignment of curves stipulated under Para 421 shall remain applicable.

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(c) Urgent Maintenance Limits:

Speed Band	Lateral and vertical acceleration peak
Upto 100 kmph	0.30g
Speed above 100 kmph and upto 110 kmph	0.30g
Speed above 110 kmph and upto 130 kmph	0.25g
Speed above 130kmph and upto 160 kmph	0.20g

Note: The permitted speed should be reduced to a suitable lower speed level keeping in view the aforesaid criteria.

607(3) Gauge and Twist: Limits of the Twist and Gauge for guidance of Engineering officials for planning the need based maintenance on the suitability (riding quality for passenger comfort) are as under:

(a) Gauge variations: The limits for tight and slack gauge should be followed as indicated in Para 224(2)(e)(v) as a good practice.

(b) Twist:

(i) On straight and curve track, other than on transitions –Generally within 2mm/metre and upto 3.5mm/metre on isolated locations**.

(ii) On transitions of curves - Local defects should not exceed 1mm/metre and upto 2.1 mm per metre on isolated locations**.

** 'Isolated locations' shall not exceed 10 per km.

Note: Twist to be measured on a base chord of 3.5 m.

607.(4) The stability of train against derailment depends upon on several factors such as track geometry, vehicle characteristics & state of their maintenance and speed of the particular vehicle at relevant point of time etc. Rail wheel interaction is thus, a complex phenomenon and therefore, safety tolerance for track alone cannot be prescribed in Isolation. Accordingly, safety tolerances for maintenance of track have not been prescribed on Indian Railways. Each derailment case, therefore, needs careful examination of all available evidences, in respect of track, rolling stock, speed and other factors considered relevant, to arrive at the cause.
The provisions and tolerances mentioned in Para 607 (2) and 607(3) and elsewhere in this manual are with a view to maintain track geometry for good riding comfort.

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607(5) Following track parameters for guidance of field officials are stipulated for maintenance of track where speeds are low such as worksites, yard lines, etc:

Speed Band (in kmph)	Peak value of UN in mm at 3.6 m chord	Peak value of Twist in mm at 3.6 m chord	Permissible Gauge range
45	22	22	-10 to +27 mm
30	24	25	-10 to +27 mm
15	33	30	-12 to +27 mm

608. Arrangements for running track recording car –Monthly program for running of TRCs on various zonal railways are issued by RDSO, well in advance. On receipt of program from RDSO, Zonal railways will arrange for suitable power, crew, consumables, and path to ensure that the Track Recording Car has an uninterrupted run. ADENs & SSEs headquartered at originating/halting stations will coordinate for proper placement, watering, charging and other assistance to RDSO Special.

Following officials should accompany the TRC run :

For Group 'A' Route

Zonal Railway headquarter- A SAG/JAG Officer nominated by PCE/CTE
Division- Sectional Sr. DEN/DEN, ADEN and SSE

Other than Group 'A' routes

Railway- An officer from the Track Cell not below SS/JA Grade
Division- Sectional Sr. DEN/DEN, ADEN and SSE

Sectional Sr. DEN/DEN shall ensure proper liaison in the Control office for suitable path and monitoring of the special.

609. Actual running of Track Recording Car –Maximum recording speed of contact sensor based TRC is 100 Kmph and of LASER contact less sensors based TRC is 160 Kmph. Measurement of Track parameter recording is independent of speed above a minimum speed of 20 Kmph. However, zonal railway officials should ensure that the Track Recording Cars are run at the maximum speed of Section/TRC. The recording done below minimum speeds of 20 Kmph is taken as "Non-recorded". The track recording car specials must have a through run over the section between two major stations and run on through lines at all stations. Recording should be done during day light hours. Before start of any run, it should be ensured that calibration of the system has been done satisfactorily. The printout of TRC results being printed after completion of each kilometer should be taken by the P. Way staff after day's run for record for taking maintenance action.

610. Action to be taken on Track Recording Results–Spots/blocks requiring attention as per parameter limits, and acceleration peak limits set as UML under para 607(2)& 607(3) should be noted by the ADEN and SSE accompanying the car and requisite attention should be given to these spots/blocks. Track Recording results should be analyzed in the Divisional Office. A comparison of the records of each section shall be made with the previous run. Analysis shall be done for identifying the locations needing attention for onward transmission to concerned maintenance units.

Special attention should be paid by the maintenance units to the places where magnitude of irregularities is high and where the defect locations are reappearing in successive recording runs.

611. Oscillograph Car :

(1) Brief Description of the Car-The main equipment in this car is an accelerometer. The acceleration is recorded in the form of digital data recording. Thus, the vertical and lateral accelerations on any part of the vehicle where the accelerometer is installed can be recorded. In track monitoring runs, accelerations at the vehicle floor level are recorded by keeping the accelerometer as close to the bogie pivot as possible.

(2) Details of recording- The following parameters are recorded in the oscillograph car runs-

a. Vertical acceleration
b. Lateral acceleration.

(3) Frequency of Recording - Oscillograph cars are used to monitor riding quality of track as distinct from actual track geometry recorded by Track Recording Cars. Recording is done at Maximum sanctioned speed of the section. The frequency of recording shall be as under:

(i) On routes having speed above 110 kmph and up to 130 kmph – once in 6 months
(ii) On routes having speed above 130 kmph and up to 160 kmph – once in 4 months

612. Analysis of Oscillograph Car data and interpretation of results –

(1) Data obtained from the oscillograph car is analyzed for vertical and lateral acceleration.

(2) Vertical and lateral accelerations above the threshold values are separately counted. Threshold value of acceleration may be taken as follows:-

(i) Loco Cab floor- Threshold value of acceleration in vertical mode is taken as 0.20 g for all locos (Diesel and Electric).

Threshold value of acceleration in lateral mode is taken as 0.20g for diesel and electric locos with double stage suspension.

In case of locos with single stage suspension, threshold value may be taken as 0.30g both for lateral and vertical acceleration.

(ii) Passenger Coach Floor -Threshold value of acceleration for both vertical and lateral modes shall be taken as 0.15g.

(iii) Analysis is done km wise and results are given under the following heads, on the basis of the peaks counted above threshold values for a particular locomotive:

- Station Yards
- Other than Station Yards (Isolated locations)
- Active continuous stretches
- Speed grouping table is also prepared.

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Typical Statement prepared in connection with an Oscillograph run are given below (Statement 'A' to 'C') –

STATEMENT ' A '

Oscillograph Results (Para 612)

Total length of Section : 232 Kms.
Length recorded : 185 Kms.
Date of recording : 22nd March 2018

Section : BBQ—KZJ.
Loco No.....
Type of Loco.....

Station Yards (Peaks above Threshold values)

S I. No.	Name of Yard and Location	Speed in Km. p. h.	Vertical acceleration	Lateral acceleration	Remarks
1	SRUR FP-2	100	..	0.26	
2	MCI TP-1 TP-2	100 100	0.22 0.22	..	
3	PPZ FP-1 FP-2	100 105	0.20 0.20	.. ..	
4	BGSF 324/10-11	110	..	0.22	
5	OPL 343/5-6	100	0.26	..	
6	HSP TP-1	100	0.20	..	

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STATEMENT ' B '

Date of recording : 22nd March 2018 — Section : BPQ—KZJ (Km 367-K.m. 135)

Loco No..... — Length recorded: 185 Km.

Type of Loco..... — Total length: 232 Kin.

Oscillograph Results in Places other than Station Yards

Isolated Locations (Peaks above Threshold value)

S I. No.	Location	Speed in K.m. p. h.	Vertical acceleration	Lateral acceleration	Remarks
1	146/1-2 ...	100	..	0.28	Curve.
2	148/15-16	110	..	0.28	Br.
3	149/7-8 ...	110	0.28	..	
4	149/7-8 ...	110	0.35	..	Br.
5	151/8-9 ...	110	..	0.24	
6	151/8-9 ...	110	..	0.32	
7	151/11-12...	105	..	0.24	
8	160/7-8 ...	110	..	0.22	Curve
9	164/9-10 ...	110	0.24	..	
10	168/1-2 ...	100	and so on.	0. 30	

STATEMENT ' C '

Date of recording : 22nd March 2018 — Section : BPQ—KZJ (Km. 135-Km. 367)

Loco No. :..... — Length recorded : 185Km.

Type of Loco :..... — Total length :232Km.

OSCILLOGRAPH RESULTS

Active Continuous Stretches

Sl. No.	Kms.		Distance in Km.	Speed in Km.p.h.	Active in mode	Total No of peaks above 0.20'g.	Maximum value	No. of peaks between 0.20g. 0.35g.	No. of peaks above 0.25g.	Remarks
	From	To								
						Nil				

Note – If there are on an average more than 10 peaks above the threshold value per km., the length may be included in this statement.

613. Use of Oscillograph Car recordings -

(1) Threshold values of acceleration are given in Para 612(2). Track should be attended to at all such locations where peaks above threshold values are reported so as to ensure good riding.

(2) Efforts should be made not only to check the extent of defect but also to find out whether it is occurring in an active patch (defined as per Statement A, B and C of Oscillograph Results (para 612); as it may lead to excessive oscillations.

614.Oscillation monitoring System-

(1) General- OMS equipments are used for Oscillation monitoring by using a portable accelerometer and transducers converting the oscillations to electrical signals which can be recorded electronically and processed on PC.

(2) Operation- OMS equipment is kept in the cabin of locomotive or on the coach floor, as close to the bogie pivots as possible. It is preferable that same coach and the same vehicular position are used in successive runs. The accelerations are transferred to electronic recorder and are readable on the LCD display on real time basis. The stored data can be transferred to TMS Computer for maintenance planning.

This equipment measures the track performance by measurement of vehicles response in terms of vertical and lateral accelerations. The real time output of the equipment is in the form of value of peaks exceeding the limiting value, their location and Ride index. These values are available for both vertical and lateral accelerations.

(3) Frequency of Recording-

A) Broad Gauge-

Speed above 100 Kmph- Once every month
Others- Once in two months

B) Meter Gauge-

Speed above 75 Kmph-Once every month
Others-Once in two months

(4) Recording of Defects- To assess the track quality, vertical and lateral acceleration peaks exceeding the values as below, are to be considered.

Broad Gauge :

Routes above 110 Kmph on A & B routes- Greater than 0.15 g.

Other routes up to 110 kmph- Greater than 0.2 g.

Meter Gauge : Greater than 0.2 g.

(5) Classification of Track Quality- Following criteria is to be used (average total number of peaks per km) to classify a continuous section for track quality (SSE/ Pway's jurisdiction/ Subdivision/ division) :

	Very Good	Good	Average
Speed above 110 kmph	Less than 1.0	1-2	Greater than 2
Others	Less than 1.5	1.5-3.0	Greater than 3

The above criteria are for only judging the quality of track.

(6) Action shall be taken in accordance to Para 607 (2) for attention to track.

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