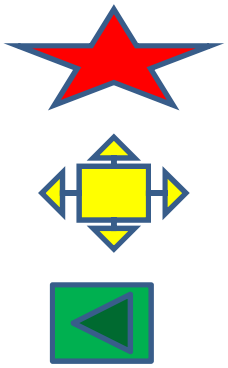
CTRB FAILURES ON BG MAINLINE COACHES

Carriage Directorate RDSO

Possible Reasons for CTRB Failures

- Improper Maintenance
- Defective Component
- Faulty Design



CTRB- Background

- CTRB of the UIC 130 design is fit for 200 kmph operations and is also running at 200 kmph in Europe.
- CTRB design is based on UIC-515-1 and 515-5.
- CTRB is procured as per FIAT/LHB Specifications TS 17.565 Partial Document 103 Ver. 00 and TS 17.565 Partial Document 100 Ver. 01.
- At present on IR, CTRB is running at only 150kmph on regular basis.
- Failures are not attributable to design, but mainly to improper maintenance, refurbishing, consequential damage due to phonic wheels/earthing device or material defects in bearing component(s).

Enroute Coach Detachment – CTRB Failures in Last 07 Years: Railway-wise (Ownership)

Railway	09-10	10-11	11-12	12-13	13-14	14-15*	15-16	Total
ER	-	2	1	1	1	2	-	7
ECoR	-	-	4	-	1	4	1	10
WR	1	1	-	-	-	4	-	6
NR	3	3	2	-	-	2	-	10
ECR	1	-	1	-	-	1	-	3
SER	-	-	-	2	-	-	-	2
SWR	-	-	-	-	1	1	-	2
CR	-	-	-	-	-	-	1	1
Total	5	6	8	3	3	14*	2	41

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* RCF- 12 nos. (New)

Coach Detachments for Last 07 Years- CTRB (Total 40+1=41)

	09-10	10-11	11-12*	12-13	13-14	14-15	15-16	Total Failures
Phonic Wheel Side	4	3	6	1	1	**8**	**1**	24
Earthing Device side	1	3	0	1	1	**5**	**0**	11
Free Side	0	-	1	1	1	**1**	**1**	5
M/s Timken	3	4	7	2	3	**7**	**1**	27
M/s SKF	2	2	0	1	-	**7**	**1**	13
New	1	4	1	1	3	**12**	**2**	24
Refurbished	4	2	6	2	-	2	0	16



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•01 failure at KGP could not be distinguished

CTRB Failures in 2015-16

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurb.	Reasons
1	24.04.2015	Timken	Phonic wheel side	SC Railway Station	12025/ CR 14156/C	New	Hot axle Temp. found 90.4^{0}C Grease oozing Outboard seal broken Both cages melted and broken
2	14.05.2015	SKF	Phonic wheel side	ALD Railway Station	12801/ ECOR 12216/C LWSCN-1	New	One M20 locking stud sheared off and one M20 locking stud found bent and opening torque measured-320N-m. All M8 locking studs found sheared off and deformed. Phonic wheel found deformed Heavy rubbing mark found inside the Axle end cover. Metallic powder found inside the housing. This is the case of locking studs failure not bearing failure.

CTRB Failures in 2014-15

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurb.	Reasons
1	03.04.2014	Timken	Phonic wheel side	Kishnganj (DKZ)/DLI Division	12957/ WR/1185 85/C LWLRRM	New	• Hot axle • Grease completely burnt out due to excessive heat. • Bearing seized • Lower & Upper control arm heavy wear. • Polyimide cage broken • Two rollers are rested at 180 ^{0} C • Heavy skidding mark on wheel disc
2	06.04.2014	SKF	Earthing Side	SGOT (Shojt Road) Divi. All	12958/ WR/1185 85/C LWLRRM	New	• Hot axle , bearing temp. 207^0 C • Bearing seized , outer race was cracked and broken.

Contd.

CTRB Failures in 2014-15

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurb.	Reasons
3	07.04.2014	SKF	Earthing Side	NCB (New Cooch Behar) Divi./Alipurd-uar	12424 UP/ NR/12054/ C ACCW	New	• Hot axle temp.300^0 C • Bearing seized. • All rollers smashed • Grease seal burnt • Races of bearing badly damaged. • Earthing device burnt.
4	27.05.2014	Timken	Phonic wheel side	JJKR(Jaipur Keonijhar Road) Khurda Div.	22812 DN ECoR /12107/C LWACCN	Not visible	• Hot axle bearing temp. 115^{0}C • Speed sensor found in damaged condition due to high heat. • Control arm found discolored due to heat

Contd.

CTRB Failures in 2014-15

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurb.	Reasons
5.	15.06.2014	SKF	Earthing Side	MGS Station, MGS Division	12381 UP ER/12227/C LWSCN	New	• Hot axle temp. 137 ^{0} C • Bearing seized • Cage broken • Front seal found broken. • Grease oozing
6.	03.08.2014	Timken	Phonic wheel side	Station, DNR Division	12394 DN ECR/11481/C LS-2	New	• Grease completely burnt out. • Bearing seized • Lower control arm wear. • Heavy skidding mark on wheel disc

Contd.

CTRB Failures in 2014-15

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurb.	Reasons
7.	13.07.2014	Timken	Phonic wheel side	ARW Station, ALD Division	12802 DN ECoR/ 12856/C LWLRRM	New	• Journal Badly scored. All Axle End bolts(M20) sheared. • 4 Nos. rollers are found in melted & deformed condition. • Both side grease seal melted and deformed. • Backing ring , Cone & spacer melted & deformed. • Security Disc & locking plate deformed. • Grease completely burnt out.
8.	01.12.2014	SKF	Earthing Side	Barsali Station/NGP Division	19301/WR /121074	Refurbished	• Hot Axle.

CTRB Failures in 2014-15

S. No.	Date of Failure	Make	Location	Location of Failure	Train No./ Coach No.	New/ Refurbished	Reasons
9.	07.12.2014	SKF	Phonic wheel side	Dehri On Sone (DOS) Station, MGS Division (ECR)	12801 UP ECoR/12423/ LS2	New	• Hot Axle • Phonic wheel crack in to pieces • M-8 bolts sheared off
10.	20.12.2014	SKF	Free Side	Jaipur Division/ NWR	12958/WR/ 110045/LWFAC	Refurbished	• Backing Ring loose • Abnormal Sound
11.	15.01.2015	TIMKEN	Earthing Side	Ambala/NR	NR09149 / LWACCW	Refurbished	• Earthing device failure

Contd.

Photographs of Failed CTRB









Kishanganj (DKZ)/DLI 2014

Photographs of Failed CTRB









NCB/New Cooch Behar -2014



- On 14/10 detained at CNB for R4 axle box cover deficient.
- Control message no 191 from ALD control
- At NDLS, attended for above and allowed return trip.
- In Return, at CNB for R4 axle box cover missing, control arm lower hanging – attended at MGS
- Detached at KGP due to R4 bearing temp 86^{o}C
- Bearing Seal Intact - --- Phonic Wheel damaged







Probable Causes of Failure – RCF Mounted CTRB in 2014-15

- RCF commissioned Wheel shop in 2012.
- Improper axle journal size measurement.
  - Micrometer used should have least count of 1µm instead of 10µm.
  - Axle journal and shoulder diameter found to be higher.
  - Dialing probe of ATL shall not be used for measurement of finish diameter.
- Improper mounting of CTRB- Bearing mounting press is not calibrated. In general, pressure gauges is calibrated instead of bearing mounting press
- Improper mounting of Backing ring- sealant not applied.
- Upper and Lower Control arm not checked before mounting.
- CTRB stacked in haphazard manner- More than 2 years old CTRBs which are pre-lubricated, are mounted .
- Transportation of wheels sets – 2 nos. at a time with FLTs.
- Control Arm fitment method reversed. Control Arm fitted first on CTRB and then on to Bogie frame. Possibility of misalignment at source.
- Tightening sequence of the screws of Security disc is not proper.
- Earthing device found missing/defective in Railways.

LOOSENING OF BACKING RING OF CTRB

Carriage Directorate RDSO

BACKING RING



Carriage Directorate RDSO

LOOSE BACKING RING-M/s TIMKEN

ER reported 07 cases of loosening of backing ring of CTRB of make TIMKEN.

- Drawing of backing ring was studied in association with M/s TIMKEN and it was noticed that interference fit of axle shoulder and backing ring was 9micron (min.).
- M/s TIMKEN submitted a proposal of backing ring with revised tolerance i.e. from 160 (E7) to 160 (F7) which was accepted and M/s TIMKEN advised.

A) Interference fit of existing backing ring of M/s Timken :

As per M/s Timken existing drawing No. E-48999 of backing ring & RCF's axle drg.No.LW02100:

- Dia. of shoulder : 160 $^{+0.174/+0.134}$ (t7) i.e. 160.174 to 160.134mm
- Dia. of Backing ring : 160 $^{+0.125/+0.085}$ (E7) i.e. 160.125 to 160.085mm
- Interference :
  1) **160.134-160.125=0.009 (Min.)**
  2) 160.134-160.085=0.049
  3) 160.174-160.125=0.049
  4) **160.174-160.085=0.089 (Max.)**

BACKING RING AND AXLE INTERFACE

As per revised drg. No. E-48999 (Revision “B”) of backing ring of M/s TIMKEN

B) Proposed Interference:

Dia. of Backing ring : 160 +0.083/+0.043 (F7) i.e. 160.043 to 160.083mm

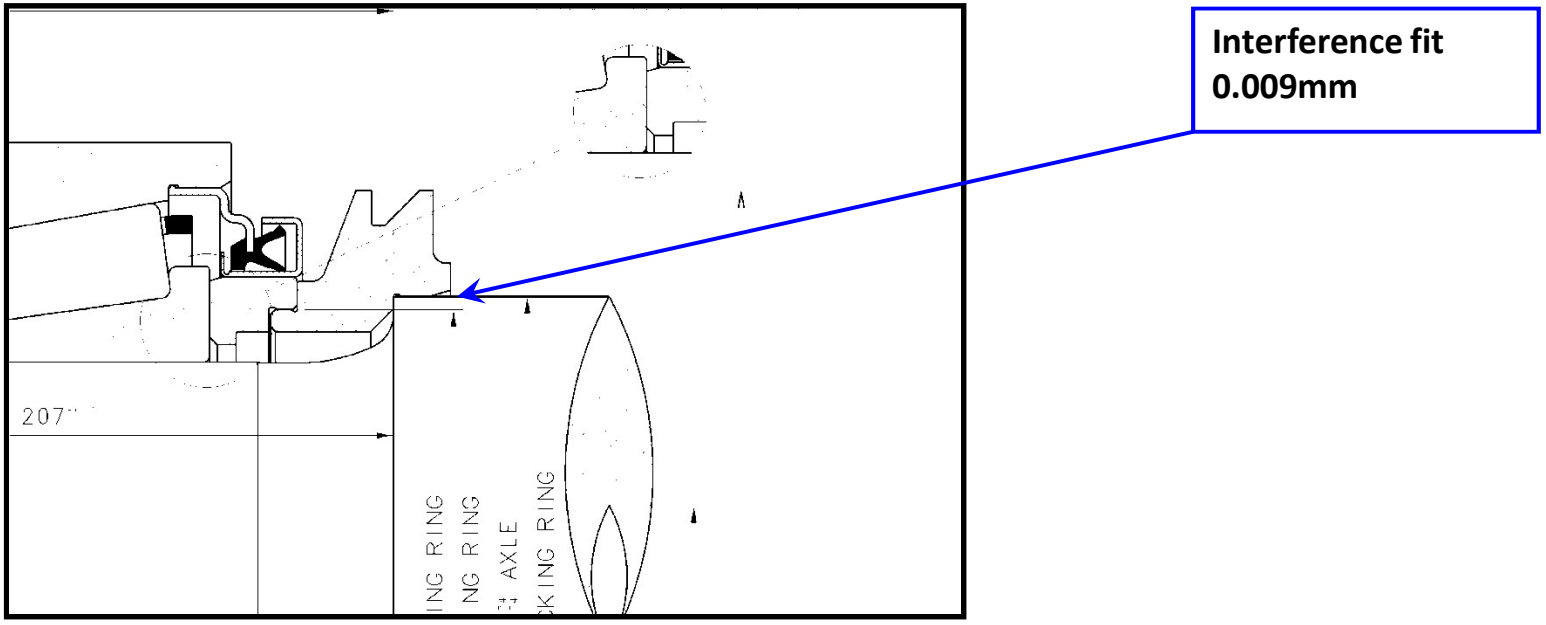
Interference :

1) 160.134-160.083=0.051 (Min.)

2) 160.134-160.043=0.091

3) 160.174-160.083=0.091

4) 160.174-160.043=0.131 (Max.)

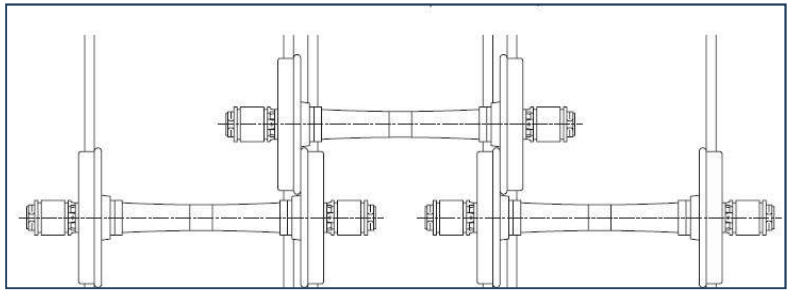


- **Storage**

- **Care should be taken so that wheel does not touch the bearing during storage.**













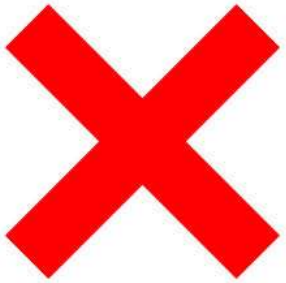


Stacking of the boxes should not be more than 2 high

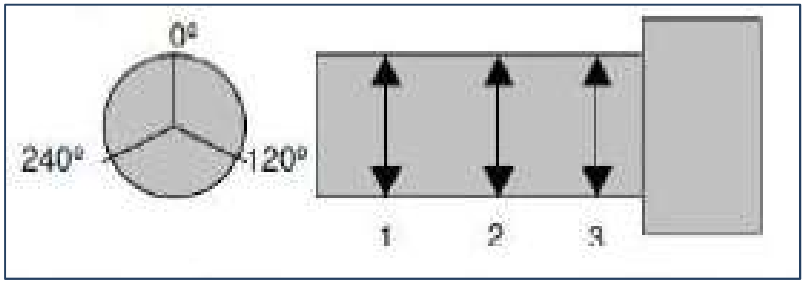
- **Transportation**

  - **Care should be taken so that wheel does not touch the bearing during transportation.**
  - **Do not use wire ropes on journal while lifting the wheel set.**





- **Measure Axle journal & Shoulder (Dust guard) diameter**





- Use calibrated micro meter with least count of 1 micron.
- Measurements required:
  - Axle journal diameter – measured at three different places along the journal as shown above.
  - Axle shoulder diameter or Dust guard dia.
  - Check tapped hole using plug gauge.
  - Taper of diameter of axle journal length should not exceed 0.020 mm for TIMKEN make CTRB and 0.012 mm for SKF make CTRB.
- Check tapped hole and ensure it is free from dust.
- Demagnetize axle before mounting the bearing.
- DO NOT USE WHITE LEAD.

Diameter (mm)	Journal dia.	Dust guard dia.
Minimum	**130.043**	**160.134**
Maximum	**130.068**	**160.174**

• Bearing Mounting

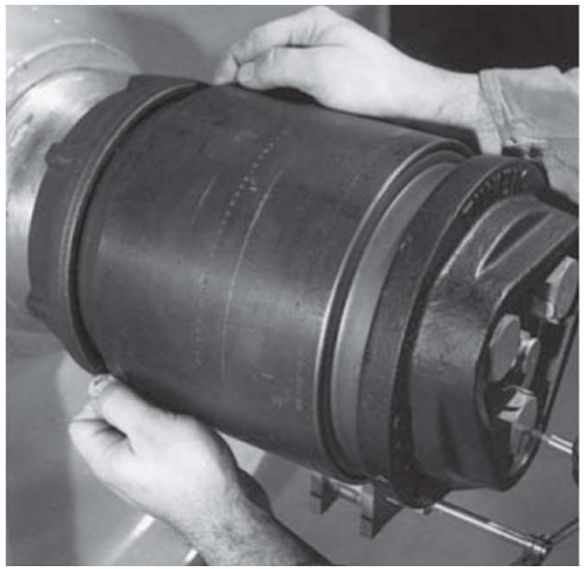


Seating force (T)
25 – 44 (Timken) for New backing ring- with higher interference

Seating force (T)
28-32 (SKF)

- Use calibrated hydraulic press with the tooling suggested by the bearing manufacturer.
- Clean the axle journal and shoulder surfaces and apply the rust preventive.
- Press the bearing onto the journal, once the bearing stops moving further note down the pressure reading (**X**) which should be in the range of 17-29 T. Increase the pressure to **1.5 times X in case of TIMKEN make CTRB** to make sure the bearing is seated properly.
- Rotate cup of while CTRB getting pressed-in.
- Insert a feeler gauge between backing ring I.D. and axle shoulder to verify backing ring has been pressed fully.

• Check Mounted End Play (MEP)



- Apply the end cap and evenly tighten the cap screws using torque wrench.
- Mount the magnetic base on cup O.D.
- Position the indicator stem on to cap screw head.
- Oscillate the cup while forcing the cup towards wheel hub and pull the cup away from wheel hub by slightly oscillating the cup.
- Take the indicator reading.
- The reading should fall between

As per CAMTECH Handbook, 0.025mm to 0.330mm (for new CTRB make TIMKEN) and 0.025mm to 0.500mm (for in service CTRB make TIMKEN)

0.099mm to 0.389mm (Best fit values for CTRB make TIMKEN)

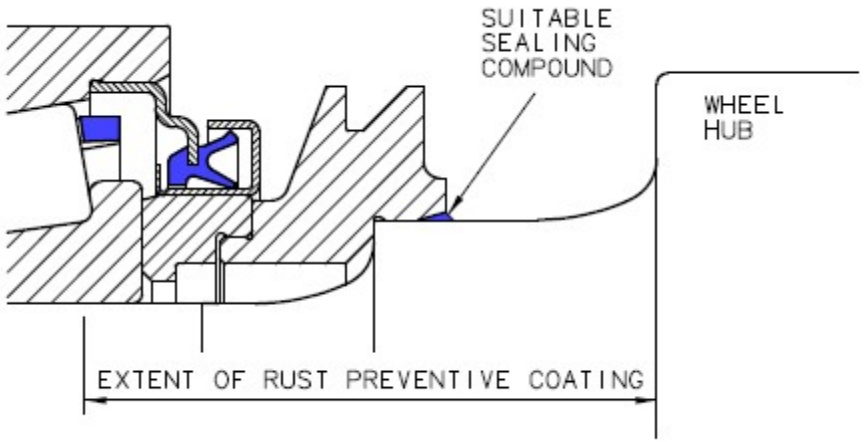
- If the reading is not within the limit remove the bearing and press it on other axles in case of TIMKEN make- selective assembly.

0.10mm to 0.40mm (for CTRB make SKF)

0.02mm (Minimum acceptable value for CTRB make SKF)

- **Apply sealant**

  - Apply suitable sealant between backing ring and axle interface. This will minimize risk of ingress of water through backing ring contact area.



Action Taken by RDSO

- Following action has already been taken to prevent such failures in future:
  - Technical Audit of RCF and Workshops and Coaching Depots in ECoR, ER, SER and NFR by RDSO along with OEMs.
  - Circulated Do's and Don'ts of CTRB maintenance to Rlys.
  - Design review meeting with OEMs
  - Modifications of Backing ring by M/s TIMKEN
  - Mounting pressure calculation by M/s SKF
  - Preparation of RDSO specification of CTRB
  - Maintenance Manual of LHB design coaches and Handbook on CTRB maintenance issued by CAMTECH.
  - Preparation of Technical Posters

Action Taken.....2

- Following instructions have been issued:
  - Material of M8 Hex Head Screws have been specified as steel to IS:1367 part-3 property class 10.9. Sources / Make (TVS, UNBRAKO, LPS) have also been specified.
  - The control arm should be stocked in pair and its dimensions should be maintained as per maintenance manual.
  - Drain holes of control arm should be cleaned before fitment of control arm.
  - Railways should ensure that Earthing device is properly maintained.
- A check list has been issued for bearing examination in depots and another one for thorough examination in workshops.

Action Taken……..2

RDSO issued drawing of fasteners of CTRB:

- Drawing No. of M20X60 screw: CG 15067 (Axle end screw)
- Drawing No. of M8X35 bolt : CG 15071 (Phonic Wheel)
- Drawing No. of M8X35 screw : CG 15070 (Earthing Device)
- Tolerance (6H) on threads of tapped holes of Axle and Security disc specified.
- Railways are advised to follow these procedures during locking/unlocking of locking screws/bolt:
  - The axle end holes should be checked with GO–NO GO thread plug gauge for correct size and thread condition.

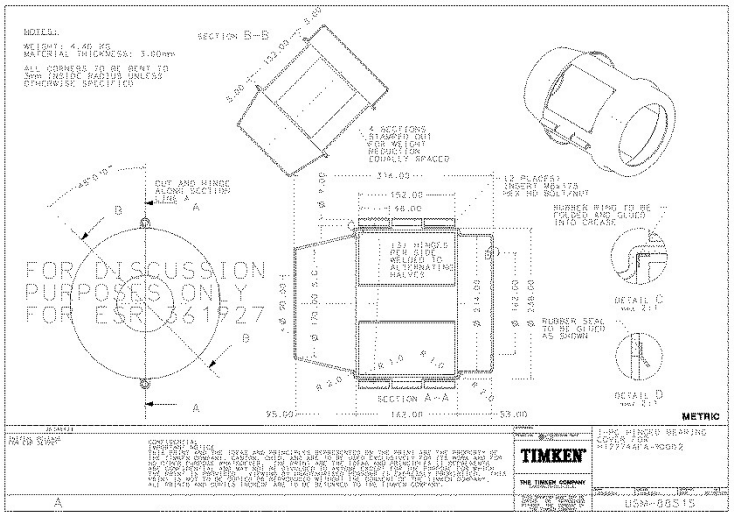
Action Taken……..3

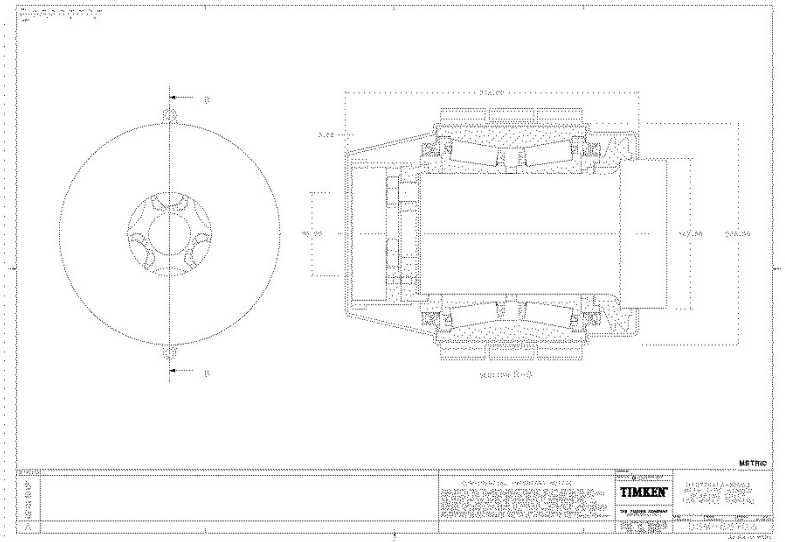
- If any of the tapped hole is worn out, the axle shall be detained in workshop for thorough examination.
- End locking plates should be replaced every time its folds are opened to unscrew bolt.
- The condition of threads of the screws/bolts should be checked with GO-NO GO thread ring gauges and worn out screws/bolts replaced.
- The Hex head head should be free from any damages and should have proper spanner grip. Screws/ bolts in service should not be reused unless they meet the above standards.
- Screws/bolts while fitting should have no radial or axial play.

MC/CTRB/Genl. Dated 06.07.2015

Action Taken.....4

- Protection of CTRB during tyre turning (RDSO letter No. MC/RB/Defects Dated 05.09.2014)
- Instructions for continuous rolling of stabled coaches (TIMKEN maintenance manual).
- Vibration measurement trials were conducted with M/s TIMKEN for assessment of Loads. Improved cage design is being implemented by M/s TIMKEN (RDSO letter No. MC/CTRB/Defects Dated 17.08.2015).





Way Forward

- RDSO specification of CTRB based on EN12080 issued.
- EOI for registration of vendors issued by RDSO.
- Firms (TIMKEN, SKF, NEI and FAG) are upgrading their systems for registration.
- Development of specification of CTRB Mounting Press.
- Development of Sensorised CTRB with Temperature Sensor.

THANK YOU

Carriage Directorate RDSO