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सत्यमेव जयते

भारत सरकार–रेल मंत्रालय
अनुसंधान अभिकल्प औ रमानक संगठन
लेखनऊ– 226011
Government of India - Ministry of Railways
Research, Designs & Standards Organization,
Lucknow – 226011

No. EL/2.2.13

Date: 08.08.2019

प्रमुख विद्युत अभियंता,	**Principal Chief Electrical Engineers**,
1. मध्य रेलवे, मुम्बई सीएसटी–400 001	1. Central Railway, Mumbai, CST-400 001.
2. पूर्व मध्य रेलवे, हाजीपुर–844 101	2. East Central Railway, Hazipur-844 101.
3. पूर्वतटीय रेलवे, चन्द्रषेखरपुर, भुबनेश्वर–751 017	3. East Coast Railway, Chandrashekhar pur, Bhubaneshwar -751 017
4. पूर्व रेलवे, फेयर्ली प्लेस, कोलकाता–700 001	4. Eastern Railway, Fairlie Place, Calcutta-700 001.
5. उत्तर मध्य रेलवे, ब्लाक ए–2, सुबेदारगंज इलाहाबाद–211 033	5. North Central Railway, Block-A, Subedarganj, Allahabad- 211 033.
6. उत्तर रेलवे, बड़ौदा हाऊस, नई दिल्ली–110 001	6. Northern Railway, Baroda House, New Delhi-110 001.
7. उत्तर पश्चिम रेलवे जयपुर– 302006	7. North Western Railway, Jaipur- 302 006
8. उत्तर पूर्व रेलवे गोरखपुर– 273001	8. North Eastern Railway, Gorakhpur-273001
9. उत्तर पूर्व फ्रेन्टीयर रेलव`माली गॉव गुवाहाटी–781011	9. North East Frontier Railway, Maligaon, Guwahati-781011
10.दक्षिण मध्य रेलवे, रेल निलायम, सिकंदराबाद–500 371	10. South Central Railway, Secunderabad-500 071.
11.दक्षिण पूर्व मध्य रेलवे, बिलासपुर– 495 004	11. South East Central Railway, Bilaspur-495 004.
12.दक्षिण पूर्व रेलवे, गार्डेनरीच, कोलकाता–700 043	12. South Eastern Railway, Garden Reach, Kolkata-700 043.
13.दक्षिण रेलवे, पार्क टाउन, चेन्नई–600 003	13. Southern Railway, Park Town, Chennai-600 003.
14.दक्षिण पश्चिम रेलवे हुबली–580020	14. South Western Railway, Hubli- 580020
15.पश्चिम मध्य रेलवे, जबलपुर–482 001	15. West Central Railway, Jabalpur-482 001.
16.पश्चिमरेलवे, चर्चगेट, मुम्बई– 400 020	16. Western Railway, Churchgate, Mumbai-400 020
17.चित्तरंजन रेलइंजन कारखाना, चित्तरंजन– 713 331	17. Chittaranjan Locomotive Works, Chittaranjan-713 331
18. डीजल रेलइंजन कारखाना, वाराणसी–221004	18. Diesel Locomotive Works, Varanasi-221 004.

Sub: Minutes of Meeting of performance review meeting of traction motor & MSU bearings held at RDSO on 24.05.2019

Ref: RDSO's letter no. EL/2.2.13 dated 12.04.2019

1. Performance review meeting of Traction Motor & MSU Bearings used in Electric Locomotives was held at RDSO on 24.05.2019 for improving reliability of bearings.

2. Minutes of Meeting had been uploaded on RDSO website and it may be downloaded using following path:-
www.**rdso**.indianrailways.gov.in → Directorates → Electric Loco →Reliability Meetings →TM/MSU/Bearings.

8.8.19

(P.K.Saraswat)
for Director General/ Electrical

Copy to:

1. Secretary (Electric Traction), Railway Board, Rail Bhawan, New Delhi-110 001 :- (Kind Attn. Shri A. K. Goswami, DEE/RS) - for kind information please.
2. M/s Schaeffler India Ltd., Maneja, Vadodara-390 013
3. M/s SKF India Limited, 17th Floor Building no. 5B, Cyber City, DLF Phase-III, Gurgaon-122 002 (Haryana)
4. M/s National Engineering Industries Ltd., Khatipura Road, Jaipur-302006
5. M/s Timken India Limited, 2nd floor, Ramnath Building, 18 Community Centre, Yusuf Sarai, New Delhi-110 016

8.8.13

(P.K.Saraswat)
for Director General/ Electrical

Minutes of Meeting of performance review meeting of bearings of traction motor & MSU bearings used in Electric Locomotives at RDSO used in Electric locomotives was held at RDSO on 24.05.2018.

1. **Present:** As per list enclosed as Annexure - I
2. At the outset, PEDSE welcomed all the participants of the meeting and advised Zonal Railways, CLW and firms to take all the necessary actions to improve the reliability of bearings and to minimize line failures of bearings.
3. Officer along with supervisors from Railways/CLW/ELW BSL and representatives of M/s Schaeffler, M/s SKF and M/s NEI attended the meeting.
4. During the meeting, failures of traction motor and MSU bearings were discussed and firms were advised to take action to improve reliability of bearings. Failure analysis has been made on the basis of failure data received from Zonal Railways.
5. **Bearing failure analysis of Traction Motor type 6FRA6068 of year 2018-19**

5.1. Shed wise loco holding and traction motor holding (as per E-loco) as on 01.04.2019 is given below

Table-1: Population of traction motor type 6FRA6068 (as on 01.4.2019)

Shed	WAP7	WAG9	WAG9H	Total Locos	Nos of TMs
BSL	0	0	21	21	126
AQ	52	89	69	210	1260
KYN	0	1	74	75	450
HWH	63	0	0	63	378
GMO	14	77	114	205	1230
BJU	0	0	25	25	150
VSKP	20	0	141	161	966
GZB	113	0	0	113	678
LDH	0	0	43	43	258
CNB	3	0	54	57	342
ED	4	0	0	4	24
RPM	91	0	0	91	546
LGD	98	73	30	201	1206
KZJ	0	0	36	36	216
GY(D)	0	0	20	20	120
TATA	21	2	161	184	1104
BNDM	0	0	53	53	318
BKSC	0	0	1	1	6
ROU	0	0	5	5	30
SRC	22	0	0	22	132
BIA	30	0	102	132	792
BRC	35	0	0	35	210

TKD	70	30	83	183	888
ET	17	0	0	17	102
NKJ	0	0	36	36	216
Total	**653**	**272**	**1068**	**1993**	**11958**

5.2. There are 11958 Traction Motors of type 6FRA6068 in service and **23916** bearings (DE+NDE) of TM type 6FRA6068 in service.

5.3. **Shed wise failure analysis of year 2018-19**

Based on the failures reported by Railways, shed wise failure analysis is given below:

Table-2: Shed wise FRPCPY for 6FRA6068 TM bearings for last three year.

Shed	2016-17			2017-18			2018-19		
	P	F	%F	P	F	%F	P	F	%F
BSL				180	0	0.00	180	1	0.56
AQ	1848	5	0.27	2100	5	0.24	2520	8	0.32
KYN	768	11	1.43	768	5	0.65	972	3	0.31
VSKP	942	1	0.11	1764	4	0.23	1956	0	0.0
GMO	1704	4	0.23	1908	17	0.89	1956	1	0.05
HWH	408	0	0.00	576	5	0.87	768	1	0.13
CNB	48	0	0.00	132	0	0.00	612	1	0.16
GZB	1080	3	0.28	1044	6	0.57	1200	4	0.33
LGD	2088	5	0.24	2208	3	0.14	1236	2	0.16
BIA	578	2	0.35	1368	10	0.73	1608	4	0.25
TATA	1272	4	0.31	1644	7	0.43	2208	0	0.0
RPM	612	8	1.31	792	7	0.88	1116	2	0.18
TKD	1380	0	0.00	1776	0	0.00	4248	0	0.0
BRC	180	0	0.00	336	8	2.38	432	0	0.0
LDH				252	1	0.40	696	**0**	0.0
ED				96	0	0.00	48	2	4.17
KZJ				372	2	0.54	648	3	0.46
BNDM				384	4	1.04	636	0	0.0
SRC				144	0	0.00	264	0	0.0
ET							216	0	0.0
NKJ				228	0	0.00	408	6	1.47
GTY*								1	0.00
Total	**12908**	**43**	**0.33**	**18072**	**84**	**0.46**	**23928**	**39**	**0.16**
P=Population of bearings (DE+NDE)									

(*Population not given)

5.4. Total 39 bearing failures have been reported in 2018-19 with FRPCPY of 0.16% for bearings of TM type 6FRA6068. Highest FRPCPY of 4.17% was reported by ED shed, which had reported 2 bearing failures with population of just 48 bearings in service. VSKP,TATA, TKD, BRC, LDH, BNDM, SRC & ET sheds had reported zero bearing failures in 2019-19 with total population of 10656 bearings.

5.5. **Shed, loco, bearing type and year wise failure details of last three years**

Table-3: Shed, loco, bearing type and year wise failures details.

Shed	2016-17				2017-18				2018-19				Total
	WAG9		WAP7		WAG9		WAP7		WAG9		WAP7		
	DE	NDE	DE	NDE	DE	NDE	DE	NDE	DE	NDE	DE	NDE	
BSL									1				1
AQ	2	2	1		2	3			6	1	1		18
KYN	7	4			5				3				19
VSKP		1			4								5
GMO	4				7	10			1				22
HWH							2	3				1	6
CNB									1				1
GZB			3				5	1			1	3	13
LGD	4		1		2		1	0	2				10
BIA	2				9	1			4				16
TATA	4				6	1							11
RPM			1	7			1	6			2		17
BRC							8	0					8
LDH					1								1
KZJ					2	0			3				5
BNDM					4								4
NKJ									5	1			6
ED											1	1	2
GTY										1			1
Total	23	7	6	7	42	15	17	10	26	3	5	5	**166**
	30		**13**		**57**		**27**		**29**		**10**		**166**
G.Total	**43**				**84**				**39**				**166**

5.6. Out of total 39 reported TM bearing failures in 2018-19, 29 failures were in WAG9 class of locomotives and 10 failures in WAP7 class of locomotives. Out of 29 failures reported in WAG9 locomotives, 26 were DE bearing failures and 3 were NDE bearing failures. Similarly, out of 10 failures reported in WAP7 locomotives, 5 were DE bearing failures and 5 were NDE bearing failures.

5.7. **Loco & bearing type wise failure details of last three years.**

Table-4: Loco type &bearing type wise failures

Year:2016-17, 17-18 & 18-19			
Loco	DE	NDE	Total
WAG9	91	25	116
WAP7	28	22	50
Total	119	47	**166**

Table-5: Make wise & year wise failure of bearings

Make	Bearing	2016-17	2017-18	2018-19	G. Total
FAG (IMP)	DE	10	40	21	71
	NDE	9	12	3	24
Sub Total		19	52	24	95
SKF (IMP)	DE	19	16	10	45
	NDE	5	9	5	19
Sub Total		24	25	15	64
NSK	DE	0	1		1
	NDE	0	0		0
Sub Total			1		1
Not KNOWN	DE	0	5		5
	NDE	0	1		1
Sub Total			6		6
G. Total		**43**	**84**	**39**	**166**

Table-6: Line Failure (LF) & Shed Detection (SD) cases of last three years

Cause of failure	2016-17		2017-18		2018-19		Total
	LF	SD	LF	SD	LF	SD	
Bearing seizure/cause not identified	11	2	27	0	19		59
Cage Broken/ defective	7	1	12	1	8		29
Inner racer cracked	0	4	3	2			9
Inner racer rotate	0	0	2	6		1	9
Outer racer cracked	1	1	1	0	3		6
Outer racer rotate	2	3	0	0	4		9
Lubrication problem	0	3	0	0			3
Oil ingress	0	0	2	0	1		3
Bearing temp.excess	0	0	0	1			1
High Metal Content	0	0	0	15		2	17
other	2	6	5	7		1	21
Grand Total	23	20	52	32	35	4	166
	43		**84**		**39**		**166**

Table-7: Line failure (LF) distribution of bearings for last three years

Make	Bearing	2016-17	2017-18	2018-19	G.Total
FAG (IMP)	DE	8	33	21	62
	NDE	2	2	2	6
Sub Total		10	35	23	68
SKF (IMP)	DE	11	9	8	28
	NDE	2	3	4	9
Sub Total		13	12	12	37
Not Known	DE		5		5
Grand Total		**23**	**52**	**35**	**110**

Table-8: Shed detection (SD) of bearing defects for last three years

Make	Bearing	2016-17	2017-18	2018-19	G. Total
FAG (IMP)	DE	2	7	0	9
	NDE	7	10	1	18
Sub Total		9	17	1	27
SKF (IMP)	DE	8	4	2	14
	NDE	3	9	1	13
Sub Total		11	13	3	27
NSK	DE		0		0
	NDE		1		1
Sub Total			1		1
Not Known	DE		1		1
Grand Total		20	32	4	56

5.8. It is observed that number of line failures is higher than shed detection cases and effort has to be made by sheds to improve the maintenance to eliminate the line failure cases.

5.9. From below table, it is observed that in 2018-19, for WAG9 class of locomotives, DE bearing FRPCPY is 0.31% and NDE bearing FRPCPY is 0.04%. FRPCPY of M/s Schaeffler (FAG) make DE bearings is 0.72% & NDE bearings is 0.04%. FRPCPY of M/s SKF make DE bearings is 0.31% & NDE bearings is 0.06%. FRPCPY of M/s Schaeffler (FAG) make DE bearing is higher than M/s SKF.

Table-9: Make wise failure analysisforWAG9TM bearings for year 2018-19

Make	DE			NDE		
	P	F	%F	P	F	%F
FAG (IMP)	2373	17	0.72	2457	1	0.04
SKF (IMP)	3230	9	0.31	3132	2	0.06
NSK	65	0	0.00	66	0	0.00
Not Known	2652	0	0.00	2669	0	0.00
Total	8320	26	0.31	8324	3	0.04

5.10. From below table, it is observed that in 2018-19, for WAP7 class of locomotives, DE bearing FRPCPY is 0.13% and NDE bearing FRPCPY is also 0.13%. FRPCPY of M/s Schaeffle make DE bearings is 0.50% & NDE bearings are 0.25%. FRPCPY of SKF make DE bearings is 0.05% & NDE bearings is 0.16%. FRPCPY of M/s FAG is higher than M/s SKF.

Table-10: Make wise failures analysis for WAP7 TM bearings for year 2018-19

Make	DE			NDE		
	P	F	%F	P	F	%F
FAG (IMP)	799	4	0.50	816	2	0.25
SKF (IMP)	1902	1	0.05	1886	3	0.16
Not Known	1019	0	0.00	1018	0	0.00
Total	3720	5	0.13	3720	5	0.13

5.11. From table below, it is observed that, out of total 39 bearing failures in 2018-19, 20 failures happened within one year, which indicates bearing fitment issues. All the sheds are requested to follow all the instructions related to bearing fitment properly to avoid failures due to fitment issues. 4 number of bearing failure reported during 7 years to 9 years, it means sheds are not replacing the bearings as per prescribed periodicity

Table-11: Age wise failure analysis of TM bearings for the year-2018-19

Loco	<6M	6M to 1Y	1Y to 2 Y	2Y to 3Y	3Y to 4 Y	4 to 5 Y	5Y to 6Y	6Y to 7Y	7Y to 8 Y	8Y to 9Y	>9Y	Total
WAP7	3	2	2	1	1	0	1	0	0	0	0	10
WAG9	8	7	2	2	1	3	2	0	1	2	1	29
Total	11	9	4	3	2	3	3	0	1	2	1	39

- TM bearings of 6FRA6068 are must change item in IOH & POH. Periodicity of IOH & POH is given below:

Schedule	WAG9	WAP7
IOH	6 years ± 6 M or 12 lakh kms	4 years± 6 months or 12 lakh kms for WAP7
POH	12 years ± 6 M or 24 lakh kms	9 years ± 6 months or 24 lakh kms

6. 6FXA7059 Traction Motor Bearings failure analysis

6.1. Population of TM type 6FXA7059 as on 01.04.2019 is given below:

Table-12: Population of 6FXA7059 TM as per e-loco (as on 01.04.2019)

Shed	Nos of WAP5	Nos of TMs
GZB	94	376
BRC	70	280
Total	164	656

Failure of TM Bearing		
2016-17	2017-18	2018-19
Nil	Nil	Nil

6.2. No TM bearing failures of TM type 6FXA7059 had been reported by GZB & BRC from 2016-17 to 2018-19. FRPCPY for TM bearings of TM type 6FXA7059 is zero.

6.3. TM bearings of 6FXA7059 are must change item in IOH & POH. Periodicity of IOH & POH is given below:-

- **IOH: 4.5 years ± 6 M or 12 lakh kms whichever is earlier**
- **POH: 9 years ± 6 M or 24 lakh kms whichever is earlier**

7. Hitachi TM (HS 15250A) bearing failure analysis of 2018-19

7.1. Population of TM type HS15250A

Table-13: Population of TM type HS15250A as per E-Loco (as on 01.04.2019)

Shed	WAP4	WAG5 HA/HB	WAG7	Total	Nos of TMs
BSL	43			43	258
AQ			54	54	324
KYN			50	50	300
ASN		76	35	111	666
HWH	91			91	546
MGS	92		129	221	1326
GMO			43	43	258
WAT	21		0	21	126
ANGL			196	196	1176
LDH(D)			11	11	66
LDH	29		109	138	828
KJZY			44	44	264
JHS		117	90	207	1242
CNB	48		110	158	948
GD(D)	3		30	33	198
AJJ	52	89	0	141	846
ED	99		98	197	1182
ED(D)			24	24	144
BZA	43		114	157	942
LGD	25			25	150
KZJ			140	140	840
GTL(D)			28	28	168
KZJ(D)			20	20	120
TATA			39	39	234
BNDM		2	186	188	1128
BKSC			125	125	750
BKSC(D)			5	5	30
SRC	80			80	480
BIA			118	118	708
BRC	72	35		107	642
BL		121	68	189	1134
ET	75			75	450
ET(D)		25		25	150
NKJ		94	92	186	1116
NKJ(D)	0	39	1	40	240
Total	**773**	**598**	**1959**	**3330**	**19980**

7.2. There are 19980 number of TM type HS 15250A in service and **39960** bearings in service in TM type HS 15250A.

7.3. Based on the failures reported by Railways, shed wise bearing failure analysis of TM type HS 15250A is given below:

Table-14: Shed wise FRPCPY for HS15250A Traction Motor bearings

Shed	2016-17			2017-18			2018-19		
	P	F	%F	P	F	%F	P	F	%F
BSL	588	1	0.17	516	2	0.39	516	2	0.39
AQ	620	0	0.00	648	1	0.15	648		0.00
KYN	1404	26	1.85	1404	1	0.07	1404		0.00
ANGL	1800	2	0.11	1956	2	0.10	2352	2	0.09
VSKP	492		0.00	264	2	0.76	252		0.00
MGS	2172	3	0.14	0	0	0.00	2652	8	0.30
GMO	696	12	1.72	516	11	2.13	384	2	0.52
HWH	1092	3	0.27	1092	2	0.18	1092	1	0.09
ASN	1200	1	0.08	1200	6	0.50	1200	4	0.33
JHS	2484	2	0.08	2484	4	0.16	2484	4	0.16
CNB	2460	5	0.20	2076	0	0.00	1896	1	0.05
GZB	444	0	0.00	420	1	0.24	180		0.00
BZA	2040	2	0.10	2100	6	0.29	2220	4	0.18
KZJ	1920	30	1.56	1920	1	0.05	1920	2	0.10
LGD	480	0	0.00	420	0	0.00	300		0.00
BIA	708	0	0.00	1416	2	0.14	1416	2	0.14
BNDM	2424	7	0.29	2460	0	0.00	2232	4	0.18
TATA	780	1	0.13	468	0	0.00	468		0.00
SRC	960	2	0.21	960	7	0.73	960	2	0.21
BKSC	1200	1	0.08	1500	0	0.00	1500	2	0.13
AJJ	1656	5	0.30	1632	7	0.43	1692	2	0.12
ED	2264	92	4.06	2264	92	4.06	2366	5	0.21
RPM	336	0	0.00	192	0	0.00			
ET	900	1	0.11	1900	0	0.00	900		0.00
NKJ	2256	6	0.27	2256	2	0.09	2232	1	0.04
TKD	348	2	0.57	348	0	0.00			
BL	1968	3	0.15	1812	0	0.00	1814		0.00
BRC	1140	2	0.18	1416	4	0.28	1284	1	0.08
LDH	1968	0	0.00	1980	3	0.15	1632		0.00
KJGY							468	1	0.21
Total	38800	209	0.54	37620	156	0.41	38464	50	0.13

7.4. Total 50 bearing failures have been reported in 2018-19 with FRPCPY of 0.13% for bearings of TM type HS15250A. Highest FRPCPY of 0.52% is reported by GMO shed, which had reported 2 bearing failures with population of 384 bearings in service.

7.5. AQ, KYN, VSKP, GZB, LGD, TATA, RPM, ET, TKD , BL & LDH sheds had reported zero bearing failures for TM type HS 15250A in 2018-19.

7.6. Shed wise and type wise distribution of bearing failures of HS 15250A in 2018-19 is given below:

Table-15: Shed wise &bearing type wise failures of 2018-19

Shed	DE	NDE	G. Total
AJJ	1	1	2
BRC	1		1
BSL	1	1	2
ED	2	3	5
GMO	2		2
HWH	1		1
JHS	4		4
NKJ	1		1
KJGY	1		1
BIA	2		2
BZA	2	2	4
CNB	1		1
BKSC	2		2
KZJ	1	1	2
ANGL	2		2
SRC	1	1	2
ASN	4		4
BNDM	4		4
MGS	8		8
Total	**41**	**9**	**50**

- It is observed that in Hitachi TM also, failures of DE bearing are higher than the NDE bearing. Out of 50 bearing failures reported, 41 are DE bearing failures and only 9 are NDE bearing failures.

7.7. **Make wise & bearing type wise failures of TM type HS 15250A in 2018-19**

Table-16: Make wise & bearing type wise failure details of bearings of 2018-19

Make	DE			NDE		
	P	F	%F	P	F	%F
FAG (IMP)	4812	1	0.02	4042	2	0.05
FAG (IND)	3313	9	0.27	3311		0.00
NEI	2770	23	0.83	2539		0.00
NSK	1097	5	0.46	1314	1	0.08
SKF (IMP)	3344	1	0.03	3711	1	0.03
SKF (IND)	2009	2	0.10	2481	5	0.20
Total	**17345**	**41**	**0.24**	**17398**	**9**	**0.05**

7.8. Total 50 bearing failures have been reported in 2018-19 with FRPCPY of 0.24% for DE & 0.05% for NDE bearings of TM type HS15250A respectively. FRPCPY for DE bearing is higher than NDE bearing.

7.9. For DE bearings, M/s NEI had contributed largest number of failures (23) with highest FRPCPY of 0.83%.

7.10. It is observed that performance of indigenous bearings of both FAG and SKF is not at par with their imported bearings. Both the firms were requested to improve the quality and reliability of their indigenous bearings.

7.11. It is observed that number of line failures is higher than shed detection cases and effort has to be made by sheds to improve the maintenance to eliminate the line failure cases.

Table-17: Make wise & failure type wise bearing failures of HS 15250A of 2018-19

Make	LF	SD	Total
FAG (IMP)	1	2	3
FAG (IND)	7	2	9
NEI	18	5	23
NSK	5	1	6
SKF (IMP)	1	1	2
SKF (IND)	6	1	7
Total	38	12	50

Table-18: Bearing type wise, Line failure & Shed detection of HS 15250A of 2018-19

Bearing type	LF	SD	G.Total
DE	33	8	41
NDE	5	4	9
G.Total	38	12	50

7.12. **Age wise failure distribution of bearing failures of HS 15250A of 2018-19**

Table-19: Age wise failure distribution of bearing failures of HS 15250A of 2018-19

Type	<6M	6M to 1Y	1Y to 2 Y	2Y to 3Y	3Y to 4 Y	4 to 5 Y	5Y to 6Y	6Y to 7Y	7Y to 8 Y	8Y to 9Y	9Y to 10 Y	10Y to 11 Y	11Y to 12 Y	>12Y	Total
DE	2	3	6	2	5	9	4	0	1	1	4	1	1	2	41
NDE	0	1	2	2	0	1	0	0	2	0	1	0	0	0	9
Total	**2**	**4**	**8**	**4**	**5**	**10**	**4**	**0**	**3**	**1**	**5**	**1**	**1**	**2**	**50**

7.13. Hitachi TM bearings are must change item in POH. Periodicity of POH is given below:

- **WAP4:** 6 years ±3 months or 15 lakh kms whichever is earlier.
- **WAG5 &WAG7:** 10 years ±3 months or 12 lakh kms whichever is earlier.

8. 3-Phase loco MSU bearings failure analysis for 2018-19

8.1. Failure analysis based on failure data as received from Railways is given below:

Table-20: Shed wise 3- phase loco MSU bearing failures of 2018-19

Shed	DE	NDE	G. Total
GMO		1	1
NKJ	2	2	4
AQ	3	1	4
GZB	1		1
VSKP	3	6	9
G. Total	**9**	**10**	**19**

Table-21: Loco type wise & bearing type wise of MSU bearing failures of 2018-19

Loco type	DE	NDE	G. Total
WAG9	5	10	15
WAP7	4		4
G. Total	**9**	**10**	**19**

Table-22: Shed wise FRCPCY of 3- phase loco MSU bearings of 2018-19

Shed	P	F	%F
GMO	2540	1	0.60
NKJ	408	4	0.98
AQ	2520	4	0.16
GZB	1200	1	0.08
VSKP	1956	9	0.46
KYN	972	0	0
CNB	612	0	0
LDH	696	0	0
SRE	145	0	0
KZJ	588	0	0
LGD	2412	0	0
BIA	1608	0	0
BNDM	636	0	0
TATA	2208	0	0
SRC	264	0	0
ET	204	0	0
TKD	4248	0	0
BRC	492	0	0
Total	**23709**	**19**	**0.08**

P=population of bearings (DE+NDE)

8.2. It is observed that only 19 MSU bearing failures were reported with FRPCPY of 0.08%.

8.3. KYN,CNB,LDH,SRE,KZJ,LGD,BIA,BNDM,TATA,SRC,ET,TKD & BRC sheds had reported zero failures of MSU bearings.

Table-23: Cause wise 3-phase loco MSU bearing failure analysis of 2018-19

Type of failure	DE	NDE	G. Total
Bearing seizure/cause not identified	3	2	5
Cage Broken/ defective	2		2
Metal content high	2	5	7
Oil ingress	1		1
Roller came out		1	1
MSU bearing abnormal sound	1		1
MSU enclosure bolt broken		1	1
other		1	1
Grand Total	9	10	19

Table-24: Line failure (LF) and Shed detection (SD) distribution of 2018-19

Shed	LF	SD	Total
GMO	1		1
NKJ	4		4
AQ		4	4
GZB	1		1
VSKP		9	9
Grand Total	6	13	19

8.4. It is observed that, out of total 19 bearing failures in 2018-19, 7 failures happened within 1 year, which indicates bearing fitment issues. All the Work shop/POH shops are requested to follow all the instructions related to bearing fitment properly to avoid failures due to fitment issues.

Table-25: Age wise failure distribution of 3-Phase MSU bearing in 2018-19

Type	<6M	6M to 1Y	1Y to 2 Y	2Y to 3Y	3Y to 4 Y	4 to 5 Y	5Y to 6Y	6Y to 7Y	7Y to 8 Y	8Y to 9Y	9Y to 10 Y	10Y to 11 Y	11Y to 12 Y	>12Y	Total
DE	1	4	3	0	0	1	0	0	0	0	0	0	0	0	9
NDE	0	2	3	2	1	1	0	0	1	0	0	0	0	0	10
Total	**1**	**6**	**6**	**2**	**1**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**19**

- 3-Phase MSU bearing are must change item in POH. Periodicity of POH is given below:

WAG9	12 years ± 6 months or 24 lakh kms. whichever is earlier
WAP7	9 years ± 6 months or 24 lakh kms. whichever is earlier

9. Hitachi MSU bearings failure analysis for 2018-19

9.1. Failure data as received from Railways is given below:

Table-26: Shed wise conventional loco MSU bearing failures of 2018-19

Sheds	DE	NDE	G.T.
ED	1	1	2
KJGY	2		2
BZA	8	10	18

KZJ	3	1	4
SRC	4		4
MGS	1	1	2
GT	**19**	**13**	**32**

Table-27: Shed wise FRCPCY of conventional loco MSU bearing failures of 2018-19

Shed	P	F	%F
ED	2366	2	0.08
KJGY	468	2	0.42
BZA	2222	18	0.81
KZJ	1917	4	0.21
SRC	960	4	0.42
MGS	2652	2	0.08
BSL	516	0	0
KYN	1404	0	0
CNB	1896	0	0
GZB	1896	0	0
SRE	470	0	0
LGD	300	0	0
BIA	1416	0	0
TATA	468	0	0
AJJ	1692	0	0
ET	948	0	0
NKJ	2232	0	0
BL	1836	0	0
BRC	1284	0	0
Total	**26943**	**32**	**0.11**

9.2. It is observed that total number of MSU bearing failures were reported is 32 with FRPCPY of 0.11%. Out of these, 19 failures were of DE bearing and 13 failures were of NDE bearing.

9.3. BSL, KYN,CNB,GZB,SRE,LGD,BIA,TATA,AJJ,ET,NKJ,BL and BRC sheds reported zero failures in year 2018-19.

9.4. ED, KJGY, AQ, ANGL, VSKP, GMO, HWH, ASN, JHS, LDH, BNDM, BKSC and RPM had not provided the population of Hitachi MSU bearings.

Table-28: Make wise of conventional loco MSU bearing failures in 2018-19

Make	DE	NDE	G. Total
FAG (IMP)	4	5	9
FAG (IND)	1		1
NEI	4	2	6
SKF (IMP)	1	1	2
TIMKEN (USA)	1	3	4
TIMKEN (IND)	1	2	3
NOT KNOWN	7		7
G. Total	**19**	**13**	**32**

Table-29: Make wise of conventional loco MSU bearing failures in 2018-19

Make	DE			NDE		
	P	F	%F	P	F	%F
FAG (IMP)	321	4	1.25	331	5	1.51
FAG (IND)	1601	1	0.06	1605		0.00
NEI	1293	4	0.31	1284	2	0.16
NOT KNOWN	4926	7	0.14	4927		0.00
SKF (IMP)	173	1	0.58	175	1	0.57
TIMKEN (USA)	893	1	0.11	888	3	0.34
TIMKEN (IND)	1325	1	0.08	1345	2	0.15
G. Total	**10532**	**19**	**0.18**	**10555**	**13**	**0.12**

Table-30: Make wise of conventional loco MSU bearing failures in 2018-19

Type of failure	DE	NDE	G. Total
Bearing seizure/cause not identified	6	2	8
Cage Broken/ defective	4	4	8
Metal content high	4	5	9
Inner racer rotate	1	1	2
other	4	1	5
Grand Total	**19**	**13**	**32**

Table-31: Line failure (LF) and Shed detection (SD) distribution for year 2018-19

Shed	LF	SD	Total
ED	2		2
KJGY	2		2
BZA		18	18
KZJ		4	4
SRC	1	3	4
MGS	2		2
Grand Total	**7**	**25**	**32**

Table-32: Age wise failure distribution of conventional loco MSU bearing in 2018-19

Type	<6M	6M to 1Y	1Y to 2 Y	2Y to 3Y	3Y to 4 Y	4 to 5 Y	5Y to 6Y	6Y to 7Y	7Y to 8 Y	8Y to 9Y	9Y to 10 Y	Total
DE	1	0	0	2	2	5	2	2	3	1	1	19
NDE	0	0	1	1	0	6	1	1	2	0	1	13
Total	**1**	**0**	**1**	**3**	**2**	**11**	**3**	**3**	**5**	**1**	**2**	**32**

- Conventional MSU bearings are must change item in POH as given below:

Loco	POH
WAP4	6 years ± 3 M or 15 lakh kms. whichever is earlier
WAG5 & WAG7	10 years ± 3 M or 12 lakh kms. whichever is earlier

10. Instructions issued by RDSO to improve the reliability of 3-Phase TM & MSU bearings.

10.1. TM Bearings are essentially maintenance free. No maintenance is prescribed during IT, IA/IB. Lubrication with specified quantity of specified grease is prescribed during IC & MOH. Replacement of TM bearings (DE+NDE) is prescribed during IOH &POH. Proper handling &fitment as per ABB Maintenance manual and lubrication of the bearings as per SMI-307 needs to be ensured.

10.2. As per SMI-307, Periodicity of re-greasing in minor schedule from existing IC schedule to every alternate schedule (i.e. Ist IB, 2nd IA, 2nd IC) for Traction Motor (TM) bearings of 6FRA6068 TM have been modified. Lubrication will be carried out using grease gun equipped with digital grease meter as per SMI-322.

10.3. Fitment of bearing of 3-phase TM type 6FRA6068 shall be as per SMI-278 dated 23.12.2013.

10.4. List of important instructions issued by RDSO related to TM & MSU bearings is given below:

Table-33: List of important SMI/MS/TC related to of 3-Phase TM & MSU bearings.

SN	Date	About
SMI-324	24.08.2018	Use of Portable oil dust checker (Metal content checker) for condition monitoring of Gear case oil.
SMI-323	20.08.2018	Procedure of measurement of axial clearance and limit of axial clearance for traction motor type 6FRA6068.
SMI-322	27.04.2018	Use of grease gun equipped with digital grease meter
SMI-318	16.10.2017	Use of Bore Gauge for measurement of internal diameters
SMI-314	29.9.2017	Use of Dial Snap Gauges for measurement of shaft diameter
SMI-307	5.6.2017	Revision of the periodicity of re-greasing in minor schedule from existing IC schedule to every alternate schedule (i.e. Ist IB, 2nd IA, 2nd IC) for Traction Motor (TM) bearings of 6FRA6068 TM
SMI-306	17.4.2017	Induction heating of MSU for bearing fitment
SMI-301	8.11.2016	Use of Induction Heater for heating of End Shields for bearing fitment
SMI-300	2.11.2016	Defining periodicity of overhauling schedule of MSU of WAG9/WAG9H/WAP7 locomotives
SMI-278	24.12.2013	Fitment procedure of TM 6FRA6068 DE bearings
MS-466	15.11.2017	Modification in drawing of Outer bearing cap DE to achieve adequate lateral thrust in Traction motor(TM) assembly of 6FRA6068 TM
MS-460	12.06.2017	Modification in drawing of bearing cap NDE to achieve adequate lateral thrust in Traction motor(TM) assembly of 6FRA6068
MS-456	9.1.2017	Modification in drawing of supporting ring to achieve adequate 'C' Clearance in MSU assembly of 6FRA-6068 TM
MS-439	23.11.2016	Modification in drawing of Outer Bearing Cap (DE) to drain

		out ingressed gear case oil from TM type 6FRA6068.
MS-415, amend-3, Rev.1	02.07.2019	Modified interferences between TM assembly components, in order to ensure adequate interference between assembly components of traction motor type 6FRA6068
TC-151	24.04.2019	Technical Circular for measurement of 'C' Clearance in MSU assembly of 6FRA-6068 Traction motors in WAG/WAP7 class Locomotives
TC-123	23.9.2014	Must Change Items in POH
TC-117 Rev.1	28.09.2018	Technical Circular on Year of manufacturing codification on TM & MSU Bearings.
TC-104	16.7.2010	Storage & Handling of Lubricants

Table-34: List of important SMI/MS/TC related to Conventional Loco TM & MSU bearings

SN	Date	About
SMI-221	24.07.2000	The maintenance practice to be followed during AOH maintenance schedule of MSU of traction motor HS 15250A/TAO - 659
SMI-220	19.07.2000	Preventive measures to arrest the failures of commutator end armature bearing type NH 324 of traction motor type HS 15250A due to shear off /breakage of its locking HEX head bolts, size M16 X 35L
SMI-217, Amend- 1	07.04.2000	Remedial measures to arrest the failures of MSU of traction motor type HS15250a/TAO-659 due to the dropping of its adjustment washer/ failure of its taper roller suspension bearing
MS-414, Amend- 1	29.01.2013	Modified interferences between TM assembly components, in order to ensure adequate interference between assembly components of traction motor type HS15250A
MS-280	29.01.1998	Provision of grease outlet i.e. drain hole in 'CE' outer bearing cap of TM type HS 15250 A and procedure for re-greasing of armature roller bearing (PE & CE)

12 Other issues discussed during the meeting:

12.1 M/s SKF , M/s Schaeffler were requested to study & give offer for DE side insulated bearing for 6FRA608 TM for improvement of reliability.

12.2 All the bearing manufacturers were requested to expedite the supply of bearings to Loco sheds and production units and gear for supply of bearings as per increased loco production targets. It was informed that about 6000 sets of 3 phase TM bearings are required per annum to meet the production and replacement requirements.

(P.K.Saraswat)
for Director General/ Electrical

Annexure-I

List of Participants:

SN	Name (S/Shri)	Designation	Railway
	RDSO		
1.	O.P. Kesari	PEDSE	RDSO
2.	P.K. Saraswat	DSE (TM)	
3.	Pratibha Gupta	JDSE (C&S)	
4.	Rajesh Kumar	ADE (TM)	
5.	Girraj Kishore	ADE (C&S)	
6.	L.C. Mahawar	SSE/Elect.	
7.	Mohd. Azeem	SSE/Elect.	
	Railways		
8.	Sanjay D.	AWM/ELW/BSL	CR
9.	Prabhat Kumar	AEE/TRS, ELS/HWH	ER
10.	SM Tikotkar	SSE/ ELW/BSL	CR
11.	Sandeep Verma	SSE/ CNB/NCR	NCR
12.	MahendraPratap	SSE/ E3-TM/CNB	NCR
13.	K.L. Kachhoria	SEE/TRS/GZB	GZB
14.	S.P. Verma	SSE/ELS/TKD	WCR
15.	B. Samanta	SSE/ELS/GMO	ECR
16.	Sanjay Kumar	SSE/DLW	DLW
17.	Ritesh Patel	JE/TRS/BSL	CR
	Firms		
18.	Sangeet Jain	DGM	M/s SKF
19.	AbhisekSharma	Asst. Manager	M/s SKF
20	SantoshLele	Application Engg.	M/s Schaeffler
21	SubhashishSantra	Sales	M/s Schaeffler
22	Shiv Dutta Sharma	AGM/R&D	M/s NEI
23	Amrendra Singh	Att. Manager	M/s NEI