भारत सरकार
रेल मंत्रालय

GOVERNMINT OF INDIA
MINISTRY OF RAILWAYS

बड़ी लाईन डीज़ल लोकोमोटिव की कर्षण मशीन के टेपर रोलर सस्पेन्शन बियरिंग की विशिष्टि

SPECIFICATION OF TRACTION MOTOR TAPER ROLLER SUSPENSION BEARINGS USED ON BG DE LOCOMOTIVES

विशिष्टि संख्या चा.श. – **0.2402.17** (संशोधन. **02**)
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LIST OF AMENDMENTS

Sl. No.	Amendment date	Revision	Details
1.	October'2004	00	First Issue
2.	May' 2012	01	Second Issue
3.	March '2021	02	Third issue
			Addition of list of Amendments
			Addition of Index
			Addition of clause no. 1.1 (Reference to Make In India)
			Addition of clause no. 1.2 (Vendor changes in approved status)
			Changes in Table-1 of cl. no-3.0
			Deletion of Make of TM in cl. no-4.2 Replacement of RWE by RWE/NDE and GWE by GWE/DE in Cl. No. 4.2,8,14.1.1,15.2.3
			Changes in Table-3 of cl. No-6.1
			Changes in Table-4 of cl. No-6.2
			Changes in cl. No-7.0
			Make of TM is replaced by RDSO Specification of TM for ALCo and HHP Loco in Clause No.8
			Addition of cl. No-9.3 for Performance feedback format.
			Model No. of TM Specific to Make is deleted and word "Tenderer" replaced by "Vendor" in Clause no. 13.2
			Changes in cl. No-14.3 (a)
			Changes in cl.No- 14.7 (latest QAP document no. added)
			Changes in Table-7 of cl. No-15.2.3
			Changes in cl. No-15.2.6 (a)
			Changes in Annexure-2, Sl. No-2

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SPECIFICATION OF TRACTION MOTOR TAPER ROLLER SUSPENSION BEARINGS USED ON BG DE LOCOMOTIVES

1.0 SCOPE:

a) This specification covers technical requirements for manufacture, supply and inspection of traction motor taper roller suspension bearings on BG diesel locomotives. This specifies technical requirements, relevant inspection procedures and acceptance standards.

b) Taper roller bearings and related components shall be suitable for fitment on BG locomotives and DEMU.

c) This specification is revised as specification no. MP.0.2402.17 (Rev.02) to incorporate relevant changes.

1.1 Preference to make in India: The Government of India policy on 'Make in India' shall apply.

1.2 Vendor changes in approved status: All the provisions contained in RDSO's ISO procedures laid down in document no. QO-D-8.1-11, dated 01.07.2020 (Titled "Vendor –changes in approved status) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

1.2 TERMINOLOGY:

As given in IS: 2399- 2002 'Glossary of terms relating to roller bearings'.

2 APPLICATION REQUIREMENTS:

The bearings shall be suitable for specific conditions as characterized below –

2.1 The critical application requirement on motor suspension unit in diesel locomotive requires bearing to perform in the severest conditions- high axial loads, oscillatory motions, difficult operating environments and shock loads.

2.2 Varying loads and speeds close to limiting speed for grease lubrication.

2.3 Limitation on maintenance during operation, and hence long running period before inspection and re-lubrication.

2.4 Higher reliability in performance.

3 APPLICABLE DOCUMENTS:

The specification refers to the following standards as per Table-1:

Table-1

S.No.	Reference Document	Description
1	ISO 76-2006 / IS: 3823-1988	Rolling Bearings- Static Load Ratings
2	ISO 281-2007/ IS: 3824- 2002	Rolling Bearings- Dynamic Load Ratings and rating life (Second revision)
3	ISO: 1132 – 2000/ IS:5692-1988/ISO:1101/ ISO 14405-1	Rolling Bearings- Tolerances- Terms and Definitions
4	ISO 9001- 2015	Quality Management System Requirements
5	ISO:683-17:2014	Ball and Roller Bearing Steels

4 DIMENSION AND DESIGN:

4.1 DRAWINGS:

The taper roller bearings and its related components shall be suitable for mounting on the wheel axle and housings of traction motors as under:

4.2 BOUNDARY DIMENSIONS (in mm):

Boundary dimensions for taper roller suspension bearing shall conform to the dimensions as per Table-2:

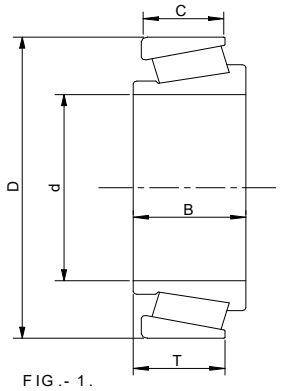


FIG.- 1.

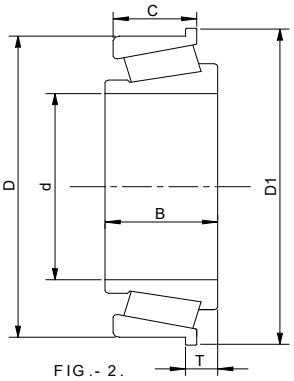


FIG.- 2.

Table-2

S. No.	Description	(For ALCO loco)		(For HHP loco)	
		RWE/NDE (Fig.-1)	GWE/DE (Fig.-1)	RWE/NDE (Fig.-2)	GWE/DE (Fig.-1)
1	Bore ‘d’	255.600	257.175	220.662	221.170
2	OD ‘D’	342.900	358.775	314.325	314.325
3	OD ‘D1’	-	-	336.372	-
4	Brg. overall width ‘T’	57.150	71.438	22.225	61.912
5	Inner width ‘B’	63.500	76.200	66.675	66.675
6	Outer width ‘C’	44.450	53.975	49.212	49.212
7	To clear fillet radius ‘r’	3.3	3.3	3.3	3.3

Note: (1) Cage gauge thickness shall not be less than 3.5 mm.

4.2.1 However, in case of any change in boundary dimensions of a new bearing for a new application, other than the ones shown above, drawings shall be got approved by RDSO.

4.3 TOLERANCE AND INTERCHANGEABILITY:

4.3.1 The taper roller bearings shall be produced to Normal class of tolerance for cone & cup and total width tolerance shall be within the limits of CL2 to CL4 class of tolerance conforming to ANSI/ ABMA Standard 19.2- 1994.

4.3.2 The cup (outer ring) and cone (inner ring) and cage assembly shall be interchangeable meaning that even if cups (outer rings) from different bearings but same make are mixed, the clearances shall remain within the specified range(It is applicable to new unused bearings only).

4.3.3 SURFACE FINISH:

Surface finish shall not be in excess of the following limits (in microns) for cone (inner ring) and cup (outer ring) inner and outer surface with sides. The races and the rollers shall show characteristic polished or lapped surface. The surface shall be free from waves, grindings scratches, list, discoloration and other surface imperfections.

- Cone (inner ring) race way - 0.25 µm
- Cone rib inner sides - 0.25 µm
- Cone bore - 0.8 µm
- Cup raceway - 0.4 µm
- Cup outer diameter - 0.8 µm
- Roller body - 0.25 µm
- Roller sides - 0.25 µm
- Cone & Cup face - 0.8 µm

4.3.4 Retouching of the bearing or its components for concealing a defect is prohibited.

4.4 SPECIAL FEATURES:

4.4.1 Single piece stamped cage ‘L’ riding design with extra thick sheet and extra wide bridge width is preferred. However, if the manufacturer wants to use any other design of cage like roller guided pressed steel cage or single piece pressed steel cage, sufficient information about the alternative cage shall be furnished and the same got approved from RDSO.

4.4.2 Prior to the supplies all components of the bearing assemble unit shall be coated with the suitable and approved rust preventive oil.

4.4.3 Uniform superior surface finish shall be obtained by grinding of track chamfers, honing of tracks and rollers or or parameters as per QAP approved by RDSO.

4.4.4 Selection of rollers shall be done from a closely tolerated band such that the variation of roller diameter in a bearing is within 3 microns.

4.4.5 The bearing components cone, cup and rollers shall maintain dimensional stability up to 120 ºC bearing temperature.

5 GENERAL REQUIREMENTS:

Other requirements for the bearing shall conform to IS: 6453- 1984, technical supply conditions for Rolling Bearing.

6 MATERIAL:

6.1 Material data sheet as follows / specification for cone (inner race), cup (outer race) and rollers once approved by RDSO shall be adhered to and no deviation what so ever shall be permitted without prior approval of RDSO as per Table-3.

Table-3

Bearing location of Alco & HHP locomotives	Recommended materials for Bearing components			
	Cone	Cup	Rollers	Cage
Drive End & Non Drive End	Low carbon case carburized steel with major alloys within the limit as follows: Mn=0.30 to 1.50, Cr= 0.25 to 0.90, Ni= 0.20 to 2.00, Mo= 0.40 max. or Case hardened steel SAE 8620 or SAE 8720 Mod or SAE 3310 or Through Hardened Steel 100Cr6 as per ISO 683-17:2014.	Low carbon case carburized steel with major alloys within the limit as follows: Mn= 0.30 to 1.50, Cr= 0.25 to 0.90, Ni= 0.20 to 2.00, Mo= 0.40 max. or Case hardened steel SAE 8620 or SAE 8720 Mod or SAE 3310 or Through Hardened Steel 100Cr6 as per ISO 683-17: 2014.	Low carbon case carburized steel with major alloys within the limit as follows: Mn= 0.30 to 1.50, Cr= 0.25 to 0.90, Ni= 0.20 to 2.00, Mo= 0.40 max. or Case hardened steel SAE 8620 or SAE 8720 Mod or SAE 3310 or Through Hardened Steel grade 100Cr6 or 100CrMnSi6-4 as per ISO 683-17:2014.	Cage shall be manufactured from AISI 1010 or AISI 1008. However, if the manufacturer wants to use any other material, sufficient information about the alternative material shall be furnished and the same got approved from RDSO.

6.2 INCLUSION RATING:

The inclusion rating of the bearing sheet shall be declared by the manufacturer, which shall meet the following cleanliness specifications for through hardened or carburising grade steels conforming to ISO 683-17:2014 as per Table-4 below.

Micro inclusion rating for through hardened steel:

Table-4

A		B		C		D	
Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
2.5	1.5	2.0	1.0	0.5	0.5	1.0	1.0

Micro inclusion rating for carburizing grade steel:

A		B		C		D	
Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
2.5	1.5	2.0	1.0	0.5	0.5	1.0	1.0

6.3 Cage shall be manufactured as per Clause 6.1 of this specification.

7 HEAT TREATMENT:

HARDNESS: Heat treatment process shall be such that uniform case hardness is obtained as per the following limits:

- Cone, cup and rollers- 58-64 HRC (for both Case hardening or Through hardening)
- Case depth and core hardness shall be adequate for the application (only for case hardening).

8 LOAD RATING:

The load rating shall be computed in accordance with ISO: 281, 'Rolling bearings - Dynamic load ratings and rating life' and ISO: 76 'Rolling Bearings- Static load ratings and the limits should not be less than the limits given below as per Table-5:

Table-5

Applicable on loco	Applicable Traction Motor	Bearing location	Dynamic load rating KN	Static load rating KN
ALCO	RDSO Spec.No. MP.0.2402.13 (Rev-03), March 13/(Latest) for Standard Motor & MP.0.2402.12 (Rev-01), Jan.'02/(Latest) for Light Weight Motor	RWE/NDE	512	1183
		GWE/DE	721	1370
EMD (HHP)	RDSO Spec. No. MP.0.2400.52 (Rev-02), July'2013 /(Latest)	RWE/NDE	636	1240
		GWE/DE	636	1240

9 SPECIAL TESTS & FIELD TRAILS:

9.1 In case of development orders or if felt necessary by the RDSO, special tests shall be carried out by the manufacturer to establish the suitability of the bearing. The scope of the special test schedule shall be decided mutually between the RDSO and the manufacturer based on the list of tests given at Annexure-2.

9.2 A field trial on locomotives shall be done as per latest ISO procedures, before clearing the bearing for regular use as per Master list of safety & critical items document no- MP-M-8.1-1 Ver-1.0/ (or Latest).

9.3 FIELD TRIAL SCHEME:

Field trial of bearing shall be carried out and performance to be monitored as per following format:

S. No.	Loco No.	TM Make and Model No.	TM No./ Location	Date of fitment of TM in loco	Date of failure, if any	Remarks

10. PACKING:

The complete bearing assembly in unit shall be packed individually and several pieces may be packed together in suitable containers depending on the size. The packing shall carry company's trademark, part number and Packaging date, and shall conform to international norms so as to protect the product during the transit handling and storage. The manufacturer shall submit complete packing scheme and get it approved by RDSO before executing the purchase order.

11 MARKING:

11.1 Packed containers shall be marked with the following:

a) Manufacturer's name or trade mark
b) Code or direct indication of month and year of manufacture.
c) Designation of the bearing defining the type and dimensions.
d) Quantity.

11.2 Each bearing shall carry on the side face of its cups and cones the following visible and indelible markings –

a) Manufacturer's name/ code/ trade mark.
b) Complete Designation of the bearing.
c) Date code of manufacturing of the production lot.

11.3 The manufacturer shall submit complete marking scheme and get it approved by RDSO before executing the purchase order. Drawing showing the marking arrangement proposed to be followed by the supplier shall be submitted along with the offer.

11.4 If the supplier proposes to use a code this shall be clearly indicated in the tender offer and duly incorporated in 'As Made Drawings' and Maintenance Manuals.

12 LUBRICATION:

12.1 The bearing shall be capable of working for a minimum period of eight years without total change of grease. However, topping-up may be specified on yearly basis.

12.2 The bearing shall be suitable for lubrication as recommended in MP.MI-15 (latest) for Recommendation lubricant & coolant for Diesel locomotives of RDSO.

13.0 ADDITIONAL REQUIREMENTS:

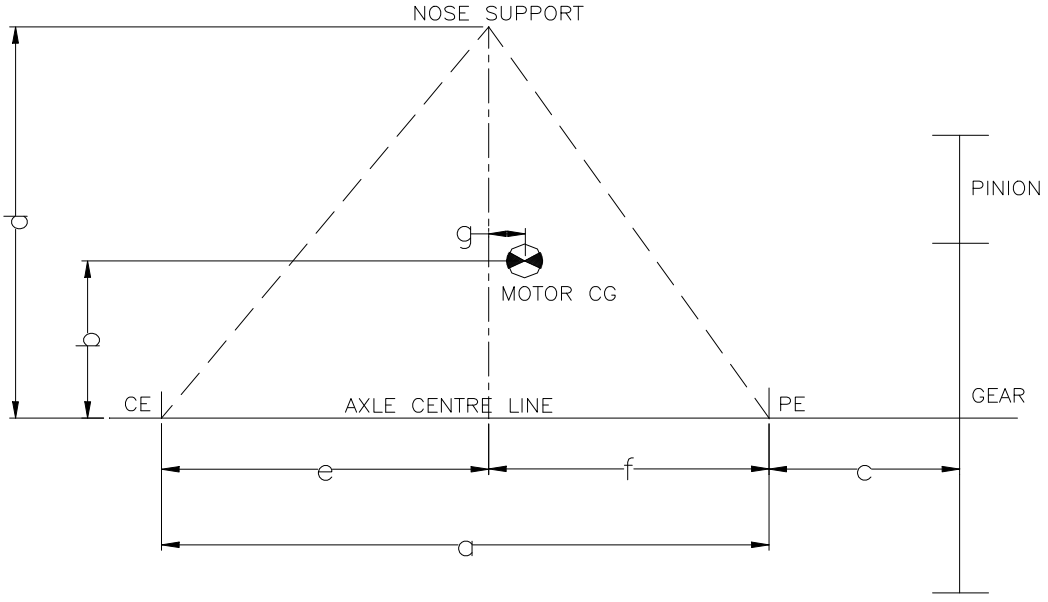
13.1 LIFE EXPECTANCY:

The bearing shall have an average rated life in accordance with clause 8.0 of this specification.

13.2 Vendor shall furnish the calculations regarding rating life of the bearings under the following conditions as per ISO: 281 as per Table-6.

Table-6

S. No.	Item No.	Descriptions	HHP Loco	Alco Loco
1	a	Distance between bearing centers	961 mm	639 mm
2	b	Axle to Motor C of G	513 mm	467.195 mm
3	c	Gear centerline to GWE bearing center	105 mm	294.5 mm
4	d	Axle to motor nose (Distance).	1160 mm	937 mm
5	e	Bogie centerline to RWE bearing center	592 mm	420.5 mm
6	f	Bogie centerline to GWE bearing center	369 mm	218.5 mm
7	g	Motor C of G offset towards RWE bearing	55 mm	8mm (approx)
8	h	Gear radius	418 mm	374.5 mm
9	i	Tractive effort (Maximum at start)	27550 Kg	30450 Kg
10	j	Total no. of motor in a Locomotive	4 Nos.	6 Nos.
11	k	Motor power	640 KW	400KW (approx.)
12	l	Locomotive speed (Maximum & Minimum)	Max.- 160 km/h	Max.-120 km/h
13	m	Helix angle if any in the gears	Not required	Not required
14	n	- Motor weight with pinion - Pinion weight. - Gear weight.	- 2120 Kg. - 39 Kg. - 202 Kg.	- 3338 Kg. - 22 Kg. - 224 Kg.
15	o	Total weight of machine with pinion gear wheel & gear case	3016 Kg.	3690 Kg.



14.0 TECHNICAL DETAILS TO BE FURNISHED BY THE MANUFACTURER:

14.1 A complete set of detailed drawings of taper roller bearing showing overall dimensions, tolerances reference to IS specifications or equivalent standard specification for material of each component along with grades, classes etc. as applicable, mounting details shall be submitted to RDSO for prior approval and for the purpose of carrying out inspection accordingly.

14.1.1 INFORMATION TO BE SUBMITTED BY MANUFACTURER TO RDSO FOR THE APPROVAL OF DRAWING:

i) Drawing of the bearing (GWE/DE & RWE/NDE) showing.
- Bore with tolerance.
- Outer dia. with tolerance.
- Bearing width with tolerance.
- Inner width with tolerance.
- Outer width with tolerance.
- Material of rings (cone & cup), rollers and cage.

ii) Technical data sheet.

iii) Step by step life rating calculations as per ISO 281.

iv) Confirmation that bearings are strictly in accordance with the specification. If there are deviations from any clause, they must be clearly listed clause wise.

v) Required frequency of maintenance of bearing. This is necessary to evaluate the bearings from maintenance requirement point of view.

14.2 Detailed marking and packing scheme on each individual component.

14.3 The manufacturer shall supply free copies of the approved maintenance manual for overhaul purpose.

The maintenance manual shall have following minimum information-

a) Description of bearings:
- Type of bearing – Taper / Cylindrical
- Class of tolerance with Spec. no.
- Number of rollers
- Type of cage construction in accordance with clause 4.4.1 & 6.3
- Material spec. for cone, cup, roller and cage as per clause 6.1
- Surface finish as per clause 4.3.3
- Maximum permissible speed with grease lubrication
- Type of profile on rollers (Drg. required)
- Type of profile on raceways (Drg. required)
- Suitability for application (Traction / Industrial)
- Recommended grease as per clause 12.2
- Protections against corrosion as per clause 4.4.2

b) Initial mounting and lubrication of the bearings

c) Extraction and dismantling of bearing for overhaul and remounting

d) Procedure of bearing examination (minimum period of three years)

e) Drawings for components and assembly

14.4 Full calculation in support of the design capacity and life expectancy of the taper roller bearing offered as per clause 13.2.

14.5 Any additional information required as per this specification.

14.6 DEVIATION STATEMENT:

The supplier shall submit item wise deviation statement.

14.7 QUALITY ASSURANCE PROGRAMME:

14.7.1 Supplier shall submit their internal quality assurance programme in accordance with ISO document no- QM-RF-8.1.3 Ver-1.0 (or latest).

14.7.2 Supplier shall, on demand by RDSO/ Purchaser/ Inspecting authority nominated by RDSO/ Purchaser, make the records of checks carried out during internal quality assurance available for scrutiny.

14.7.3 Details of extent to which bearings proposed to be offered are in use on traction motors on other Railways. This information shall include details of year wise supply to the Railway and the numbers supplied in each year.

15.0 INSPECTION: The taper roller bearings shall generally be inspected at the manufacturers premises in accordance with the procedure laid down in Clause 15.2 of this specification.

15.1 The imported roller bearings shall also be inspected at the manufacturer's premises by R.A or any other authorized representative.

15.2 ACCEPTANCE INSPECTION:

15.2.1 GENERAL:

a) Inspection shall be carried out by purchaser or inspection authority nominated by purchaser.
b) Inspection of the bearings shall be carried out at the contractor's premises.
c) For this purpose, the contractor shall provide, free of charge, labor and appliances required by inspecting officer for inspecting whole of the work under contract at the firm's premises.

15.2.2 PRESENTATION OF DELIVERY:

a) On completion of manufacture including marking as per clause 11.0 fully assembled bearings shall be presented for inspection in lots.
b) The bearings shall be in un-lubricated and unpacked condition.
c) In case of developmental order at least 5 bearings shall be presented for inspection in un-assembled condition.

15.2.3 INSPECTION SCHEDULE FOR TYPE TESTS AND ACCEPTANCE TESTS - tabulated below as per Table-7:

TYPE TESTS: Type tests shall be carried out by RDSO at firm's premises on newly developed bearings or bearing with existing approved design but developed by a new manufacturer.

ACCEPTANCE TESTS: Acceptance tests shall be carried by purchaser at particular firm's premises on the bearing which is already developed and type tested for the same manufacturer as per relevant drawing duly approved by RDSO.

TABLE-7

S. No	Description	RWE/NDE		GWE/DE	
		Type Tests (Brg. in disassembled Condition)	Acceptance Tests (Brg. in assembled Condition)	Type Tests (Brg. in disassembled Condition)	Acceptance Tests (Brg. in assembled Condition)
1.	**Outer Ring (Cup)**				
	OD size	✔	✔	✔	✔
	OD roundness	✔	✔	✔	✔
	OD taper	✔	✔	✔	✔
	OD square ness w.r.t. face	✔	✔	✔	✔
	Width	✔	✔	✔	✔
	Face parallelism	✔	✔	✔	✔
	Face flatness	✔	✔	✔	✔
	Raceway roundness	✔	✔	✔	✔
	Raceway taper	✔	✔	✔	✔
	Eccentricity of OD w.r.t. Track	✔	✔	✔	✔
	Surface finish on raceway	✔	✔	✔	✔
	Surface finish on face	✔	✔	✔	✔
	Surface finish on OD	✔	✔	✔	✔
	Hardness	✔	✔	✔	✔
	Case depth	✔	✔	✔	✔
	Cup Flange width (for HHP Loco)	✔	✔	This is without flange.	This is without flange.
	Cup OD at flange (for HHP Loco)	✔	✔	This is without flange.	This is without flange.
	Chemical composition, Microstructure, Inclusion rating	✔	X	✔	X
	MPI Test	✔	X	✔	X
	Thermal Stability Test	✔	X	✔	X
2.	**Inner Ring (Cone)**				
	Bore size	✔	✔	✔	✔
	Bore roundness	✔	✔	✔	✔
	Bore taper	✔	✔	✔	✔
	Bore square ness w.r.t. face	✔	✔	✔	✔
	Width	✔	✔	✔	✔
	Face parallelism	✔	✔	✔	✔
	Face flatness	✔	✔	✔	✔
	Raceway roundness	✔	X	✔	X
	Raceway taper	✔	X	✔	X
	Eccentricity of bore w.r.t. Track	✔	X	✔	X
	Rib width variation	✔	X	✔	X
	Surface finish on raceway	✔	X	✔	X
	Surface finish on both the sides of raceway	✔	X	✔	X
	Surface finish on bore	✔	✔	✔	✔
	Hardness	✔	✔	✔	✔

S. No	Description	RWE/NDE		GWE/DE	
		Type Tests (Brg. in disassembled Condition)	Acceptance Tests (Brg. in assembled Condition)	Type Tests (Brg. in disassembled Condition)	Acceptance Tests (Brg. in assembled Condition)
	Case depth	✔	X	✔	X
	Chemical composition, Microstructure, Inclusion rating	✔	X	✔	X
	MPI Test	✔	X	✔	X
	Thermal Stability Test	✔	X	✔	X
3.	**Roller**				
	Large OD size	✔	X	✔	X
	OD roundness (3pt)	✔	X	✔	X
	OD taper	✔	X	✔	X
	Length	✔	X	✔	X
	Head run out	✔	X	✔	X
	Surface finish OD (Cylindrical portion)	✔	X	✔	X
	Hardness	✔	X	✔	X
	Case depth	✔	X	✔	X
	Chemical composition, Microstructure, Inclusion rating	✔	X	✔	X
	MPI Test	✔	X	✔	X
	Thermal Stability Test	✔	X	✔	X
4.	**Cage**				
	Sheet thickness	✔	X	✔	X
	Hardness	✔	X	✔	X
	Chemical composition, Microstructure	✔	X	✔	X
5.	**Bearing in assembled condition**				
	Total width	X	✔	X	✔
	Overall flange width (for HHP Loco)	X	✔	X	✔
	Cage float (Axial play)	X	✔	X	✔
	Interchangeability by replacing cup with another cup. Check total width after replacing the cup.	✔	✔	✔	✔
	Radial Run-out	✔	X	✔	X

15.2.4 TEMPERATURE:

All measurement shall be carried out at ambient temperature. The gauges and measuring instruments and the parts to be inspected shall be stabilized at this temperature before any test is carried out.

15.2.5 REFERENCE SIDE:

The side face opposite the bearing designation marking shall be considered the reference side.

15.2.6 GENERAL INSPECTION:

a) Inspection as per clause 15.2.6(b) to 15.2.6(e) shall be carried out on sample bearing in the lot offered.

b) Diameter of bore of cone (inner ring) and outer diameter of cup (outer ring) shall be measured.

c) Appearance of bearings shall be visually examined (without magnification). All essential portions of the taper roller bearing shall be clean and free from defects such as porosity, burrs, hardening cracks, grinding marks, indentations and rust mark etc.

d) Functioning of all bearings shall be checked as per the method agreed between inspecting authority and supplier.

e) Only those bearings of a lot which meet requirements in respect of para (b), (c) and (d) stipulated on approved drawings above shall form the lot for the purpose of sampling inspection as per Clause 15.3.

15.3 SAMPLING INSPECTION:

15.3.1 Inspecting Authority shall select bearings at random from each lot presented for carrying inspection as per clause 15.3.2 to 15.3.8. The size of sample to be selected for these tests shall be as indicated below in Table-8.

Table-8

Number of bearings in the lot offer for inspection	Number of sample bearings to be selected
Up to 100	2*
101 – 250	3
Over 250	4

***** The number of bearings to be selected from a lot equal to or less than 50 bearings is subject to agreement between customer and supplier. The bearings selected for sampling inspection shall be degreased, if necessary.

15.3.2 Radial run-out of cone (inner ring) and cup (outer ring) raceway of each of sample bearings shall be checked. **- Type Test**

15.3.3 Radial run-out of cone (inner ring) and cup (outer ring) in the assembled bearings shall be checked. **- Type Test**

15.3.4 The length and diameter of all rollers on each sample bearing shall be measured and variation therein determined**. - Type Test**

15.3.5 Magnetic particle test shall be carried out on both rings and 3 rollers of each sample bearings. It shall be carried out as per procedure agreed upon between the purchaser/ RDSO and contractor. The rings and rollers should not show any signs of cracks or harmful defects. After this test, bearing components shall be demagnetized. **- Type Test**

15.3.6 Before and after the tests as per Clause 15.3.5 sample bearings shall be checked as per method agreed between purchaser and contractor for residual magnetism. **- Type Test**

15.3.7 Hardness of cone (inner ring), cup (outer ring), 3 rollers and cage of each sample bearing shall be checked. **- Type Test**

15.3.8 Surface finish of cones (inner ring), cups (outer ring) and all rollers of sample bearings shall be checked in accordance with Clause 4.3.3 & Table-7 of Para 15.2.3 of this specification.

15.3.9 In case any of the sample bearings when tested as per Clauses 15.3.2 to 15.3.8 does not meet the requirements of this specification, the whole lot shall be rejected.

15.3.10 Bearing rejected as a result of tests in Clause 15.3.2 to 15.3.8 may be re-offered for inspection as per agreement between purchaser and contractor.

15.4 CHEMICAL COMPOSITION:

15.4.1 Manufacturer shall furnish ladle analysis micro structure and inclusion rating of steel for each heat. This shall correspond to the stipulations in the approved drawings **- Type Test.**

15.4.2 Manufacturer shall furnish actual chemical composition of cage material for each heat out of which cages on bearing lot offered have been manufactured. This shall correspond to the stipulations in the approved drawings **- Type Test.**

15.4.3 Inspector may order retest on cone cup, rollers and cage of one bearing out of every 1000 bearings inspected **- Type Test.**

15.4.4 In case the results of tests at clause 15.4.3 or the analysis in clauses 15.4.1 and 15.4.2 do not conform to stipulations on approved drawings, the whole lot of bearings shall be rejected **- Type Test.**

15.5 EXAMINATION OF FRACTURED STRUCTURE:

This test shall be done on both the rings (cone & cup) and 3 rollers of one bearing out of every 1000 bearings inspected. The rings and rollers shall be fractured by a method chosen by the contractor to show the structure of a brittle fracture. Fracture structure shall on visual examination not show any discontinuity, laminations, flaws, shrinkage cavities or other material defects **- Type Test.**

15.6 DISPOSAL OF REJECTED BEARINGS:

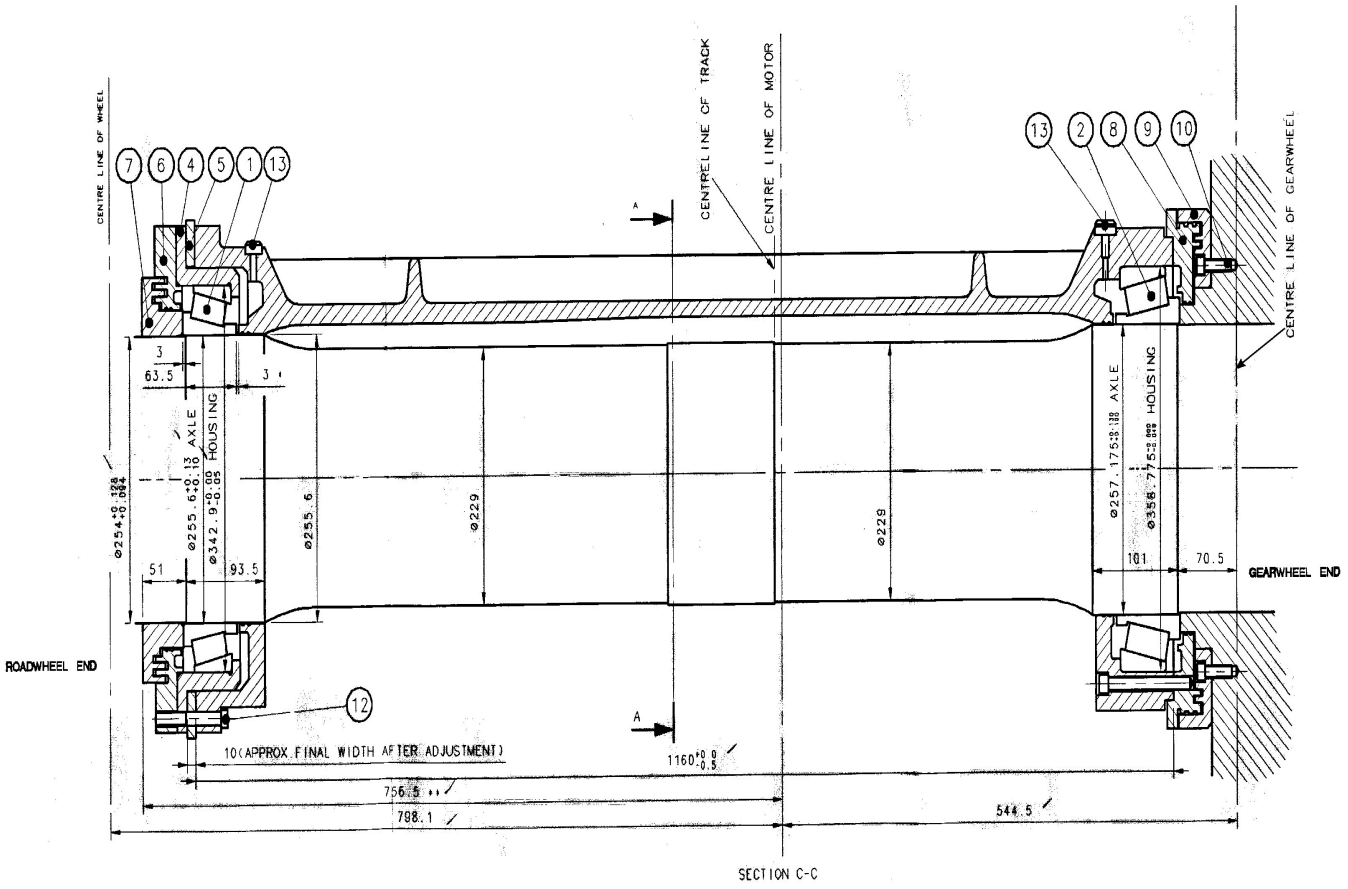
15.6.1 Bearings, which are finally rejected, shall be marked in a distinguishable manner and shall be disposed of in such a manner as the RDSO/ inspecting authority may direct.

15.6.2 Purchaser/ RDSO/ Inspecting Authority shall have power to visit at any reasonable time and without previous notice, to inspect the manufacture and quality of work at any stage.

15.6.3 Purchaser / RDSO / Inspecting Authority shall have free and ready access to manufacturer’s quality assurance records and procedures etc.

ANNEXURE-1

GENERAL ARRANGEMENT OF TAPER ROLLER SUSPENSION BEARINGS



ANNEXURE- 2

SPECIAL TESTS FOR TAPER ROLLER SUSPENSION BEARINGS

1. Non- destructive tests on bearing components including all dimensions, run-outs, surface finish and hardness in accordance with this specification and ultrasonic examinations of bearing and rollers.

2. Destructive tests including chemical analysis of materials of different elements, hardness survey through the cross section of rings and rollers, microstructure of rings and rollers etc.-**Type test**