

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 1 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

INDIAN RAILWAYS



TECHNICAL SPECIFICATION
FOR
TRACTION MOTOR GEARS AND PINIONS
FOR
EMU AND MEMU ROLLING STOCK

S.No	Month / Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1.	August, 2006	1	1,3,5 & 9	The minimum reduction ratio changed to 4:1 from 8:1
2.	August, 2020	Rev.-1	5, 13 & 17	To make the specification more enabling with focus on functional requirements

ISSUED BY
RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAK NAGAR LUCKNOW — 22601

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 2 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

INDEX

S. No.	Description	Page No.
1.	Scope	03
2.	Steel Manufacture	03
3.	Mechanical properties and Chemical composition	04
4.	Manufacture of the gear/pinion blanks	04
5.	Machining of the gear/pinion	06
6.	Dimension and tolerances	07
7.	Heat treatment of traction motor pinion and gear wheel	08
8.	Test on Material	10
9.	Test on finished gears/pistons	10
10.	Markings	11
11.	Guidelines for the manufacture of the Gear/Pinion	11
12.	Protection and packings	11
13.	Guarantee	12
14.	Appendix 'A'	13
15.	Appendix 'B'	15

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 3 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

INDIAN RAILWAYS

TECHNICAL SPECIFICATION FOR TRACTION MOTOR GEAR AND PINION FOR ELECTRIC ML LTIPL E UNIT (EMU) AND MAINLINE ELECTRIC MULTIPLE UNIT (MEMU) STOCK

1. SCOPE:

- 1.1 This specification supersedes the specification No.71-B-M-55 of Nov.1979.
- 1.2 This standard covers the technical requirements for manufacture and supply of Pinions and Gears for traction gears of Electric Multiple Unit and Mainline Electric Multiple Unit stock.
- 1.3 The Pinion and the Gear shall be manufactured strictly in accordance with exhibited drawings, in respect of dimensions and other notes contained therein, and shall also conform to the following stipulations laid down for guidance of manufacture, testing and inspection. It also covers the technical requirements of their manufacture and supply from raw material to the finished stage.

2. STEEL MANUFACTURE:

- 2.1 The steel shall be melted in Basic Oxygen Furnace or Electric Arc furnace followed by secondary refining. The molten metal shall be degassed through vacuum degassing arrangements to ensure freedom from harmful inclusions and gaseous content.
 - 2.1.1 The hydrogen content in the liquid steel shall be 2ppm max.
 - 2.1.2 The size of ingots or concast blooms for the given size of the finished steel product shall be such that a minimum reduction ratio of 4:1 from the minimum cross section area of the ingot or concast blooms to the maximum cross-section area of the product is ensured.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 4 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

2.1.3 Elements not mentioned in IS:4432 (1988) shall not be, intentionally or otherwise, added to the steel without the permission of the purchaser.

3. MECHANICAL PROPERTIES AND CHEMICAL COMPOSITION

Specific mechanical properties and chemical composition of the steel shall conform to alloyed steel designation 15Ni7Cr4Mo2-S to IS: 4432 (1988).

4. MANUFACTURE OF THE GEAR/PINION BLANKS

4.1 Quality of blooms

4.1.1 The semis (bloom) intended for the manufacture of forged blanks of gears/pinions shall be obtained from adequately cropped ingots, free from harmful surface and sub-surface defects, which may impair the end use of the product. When ingot practice is adopted, the internal defects of steel, as evaluated by macro etching test as per IS: 11371-85 shall not be worse than S-2 (sub-surface), R-2 (Random condition) and C-2 (Centre segregation) as per ASTM E-381. When continuously cast billets/bloom are used, the internal defects of steel, shall not be worse than SB-2 (Sub-surface blow holes), SC1 (Sub-surface cracks), CS-2 (Centre segregation) and CL-2 (Centre looseness) as per IS:13352-92 (stock for forging produced from continuously cast blooms, billets and slabs spec.).

4.1.2 During processing, the blooms shall be conditioned to remove injurious surface defects, provided the depth of conditioning does not exceed 1mm for every 15mm of concerned dimension, upto a maximum depth of 20mm and provided that the width of the conditioning is at least four times its greatest depth. The maximum depth of conditioning on two parallel sides at opposite locations shall not exceed one and half times the maximum allowed for one side. The transition between conditional and non-conditional areas shall be gradual. All heavy swarf and/or slag shall be removed. After removal of surface defects from the blooms magnetic particle testing and ultrasonic examination may be carried out on all the blooms to ensure freedom from surface defects and internal defects respectively.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 5 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

Standard for testing method and acceptance criteria may be prepared and RDSO's approval obtained from **Vendor approving authority**.

- 4.1.3 In special cases practically where it is necessary on large material and is not injurious, greater depth of conditioning may be permitted by the Inspecting Authority. The method of conditioning employed for removal of surface defects shall be such that it does not impair the properties of the bloom material.
- 4.1.4 The manufacturer shall be at liberty to choose the method of conditioning, subject to prior approval of the purchaser.
- 4.2 The raw material shall be procured from ~~RDSO~~ **Vendor approving authority** only. Complete details of chemical composition and other tests shall be obtained from steel maker and shall be produced to the inspector.

4.3 Forging of gears and pinions

- 4.3.1 The gear blanks shall be made by a process of upset forging followed by peripheral forging under a power hammer or press with a minimum reduction ration of 4:1 from bloom to the blank stage. The forging and rolling process shall be performed in such a manner that the central axis coincides with the axis of the gear wheel.
- 4.3.2 The pinion blanks shall be made by a process of upset forging followed by peripheral forging under a power hammer or press with a minimum reduction ration of 4: 1 from bloom to the blank stage. The forging and rolling process shall be performed in such a manner that the central axis coincides with the axis of the pinion wheel.
- 4.3.3 No welding shall be permitted on the rough shape of the forged blank. The outside surfaces of the forged blanks shall not show any cracks, fold or other injurious defects. The forged blank shall be provided with adequate allowance for machining all over and shall be suitably annealed to facilitate subsequent machining.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

- 4.4** The firm should give a certificate to the effect that the initial stock has been made from ingot/bloom having at least four times cross sectional area and shall submit the forging sequence of gears/pinions.
- 4.5 Source of manufacture of ingot/bloom must be mentioned.
- 4.6 One stock shall be cut in the presence of Inspecting agency and both macro and micro tests will be done on the same to ensure that sufficient working has been done on the ingot to obtain the stock.

4.7 Pre-machining treatment of forged blanks

- 4.7.1 To relieve the residual stresses, forgings should receive proper pre-machining heat treatment. The pre-machining treatment shall include soaking at 15-30°C above the intended carburising temperature for adequate period to relieve forging strains and to prevent distortion that would otherwise occur in the carburising operation.
- 4.7.2 All forged blanks before any machining is performed on them, shall be tested ultrasonically for ensuring freedom from harmful defects. Standard for ultrasonic testing and criteria for acceptance / rejection of the gear/gear blanks is given at Appendix 'A'.

5 MACHINING OF THE GEAR/PINION

5.1 Fitting surface of Pinion and Gear:

- 5.1.1 For the purpose of this clause, the bores of the Pinion gear are referred to as the fitting surfaces.
- 5.1.2 The fitting surfaces of the gear and pinion shall be ground finished before finish grinding the teeth.
- 5.1.3 The surface texture of the fitting surfaces of gear and pinion shall not be coarser than the values specified in the relevant drawings.

5.2 The gear teeth shall be of involute profile and cut and ground on gear generating machines. Protuberance cutter shall be used for generating the

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 7 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

teeth for automatically producing the most suitable stock allowance for grinding and generating simultaneously the largest possible tooth fillet of semi-circular shape with absolute uniform transition for the involute tooth flank to the tooth root after grinding.

No discontinuity from the ground tooth flank and the machined root fillet shall be permitted.

- 5.3 The tooth profile shall be given the ‘tip’ and ‘root’ relief in accordance with the specification mentioned in the relevant drawings. The longitudinal crowning shall be provided as specified in the relevant drawings.
- 5.4 All sharp edges on the teeth of the gear/pinion shall be rounded off. The rounding/chamfering may be done by hand with a round smooth file.
- 5.5 The working face of the teeth shall be free from defects such as heterogeneity in metal and forging/cutting/grinding imperfections. Any repair of these surface defects shall be prohibited.
- 5.6 The end faces of the teeth shall also not show defects similar to clause 5.5 particularly near the root circle.
- 5.7 The inner bore shall be ground before the grinding of teeth. The taper of the pinion shall be checked by means of taper plug gauge and the ‘Go and not Go’ plug gauges, as necessary.
- 5.8 The tooth profile shall be perfectly symmetrical. The symmetry may be checked by means of a gauge carefully fitted to the profile and applied by reversal.

6. DIMENSION AND TOLERANCES

- 6.1 The dimensions, tolerances and surface finish specified in the relevant drawings shall be strictly adhered to.
- 6.2 Machining of the reference surface of pinion and gear or of the reference taper on traction motor pinion must be carried out according to the indications of the drawings.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 8 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

7. HEAT TREATMENT OF TRACTION PINION AND GEAR WHEEL:

7.1 After being stabilized by annealing, the rough forged blanks shall be machined and teeth are to be rough cut and adequate machining allowance left on those portions, which are not to be case hardened. The pinion bore shall be rough machined out cylindrically. The machining of the teeth shall then be finished, keeping sufficient grinding allowance to permit defects in profile to be eliminated by grinding.

7.2 Case hardening

The active tooth surface of the gear shall be suitably case carburised, hardened and tempered to obtain the specified case depth and hardness, as indicated in the relevant drawings. Guidelines for procedure of heat treatment of surface may be taken from IS:4432.

7.2.1 Effective case depth

7.2.1.1 Definition and measurement

The effective case depth is defined as that at which a hardness of 500HV 30(50RC) is obtained. The depth is measured perpendicularly inwards from the surface. The available case depth after finish grinding shall be 1.8mm minimum.

7.2.1.2 Depth of case of carburised and hardened gears

For checking the case depth, one 'test-piece' shall be provided per container when box carburising and, at least one but preferably two (towards top and bottom of furnace) when gas carburising. The test piece shall be of a section, which adequately simulates that of the teeth, which it represents and shall be placed near to but not on the gear teeth. The 'test-piece' shall be of the approved materials.

After carburising, the test piece shall be hardened and tempered alongwith the gears it represents, and then broken. Hardness survey of the case shall be carried out after grinding and polishing as per IS: 64 16 (Method of measuring case depth of steel). The results shall be as specified in clause 7.2.1.1.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 9 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	--------------	--------------------------------------	------------------------------------

Alternatively the end of the teeth remote from the traction motor side may be ground back at an angle to reveal the case for visual examination of hardness testing.

7.2.2 Hardness of case hardened layer

The surface hardness of the gear after grinding whether measured at tip, flank or root shall not be less than 650 HV 30 or 58 RC (620 HB). For the position where effective case depth is measured on either 'test-piece' or gear the hardness shall not be less than 500 HV 30 (50RC).

7.2.3 Micro Examination

At least one 'test-piece per carburising bath shall be microscopically examined for establishing absence of cementite network or free cementite etc., the carburised case. Retained austenite content of 15% - 30% may be permitted in the carburised case.

8. TEST ON MATERIAL

8.1 The following tests shall be conducted at the works of the gear manufacturer or in an approved test house at the cost of the manufacturer on the test samples selected. At least one sample per cast shall be subjected to the following tests :-

- i) Ultimate tensile strength
- ii) Yield stress
- iii) Elongation percentage
- iv) Reduction in area

8.2 Test Sample

A sample from ingot/bloom of relevant cast selected at random shall be forged to minimum reduction ratio of 4:1 and the test bar of diameter as per relevant material specification shall be turned from the forging and the reference test bars after simulated case hardening and tempering and blank carburising alongwith gear/pinion of the same cast shall be tested. The test pieces shall carry the following identification marks:

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 10 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

a) Steel used

b) The cast number

Note: Blank carburising means the thermal treatment associated with carburising as applied to a test piece without using any carburising medium.

8.3 Chemical composition

One test sample, per cast, shall be chosen for this test. The cuttings from the samples used for testing the physical properties, can also be used for determining the chemical analysis as per IS:228 (Method of chemical analysis of steel).

9. TEST ON FINISHED GEARS/PINIONS

9.1 Hardness

The hardened teeth of all gears after appropriate heat treatment shall be tested for surface hardness. The hardness shall be measured at four equidistant points in the proximity of the root circle of the teeth. The average value of the four readings shall conform to the values specified in the relevant drawings. The variation between the maximum and minimum values shall not exceed 20 points HV.

9.2 Crack detection

After heat treatment, all the gears/pinions should be subjected to crack detection by suitable method such as magnetic particle examination, die penetrant method or fluorescent test. If considered necessary, ultrasonic testing can also be employed to check any internal cracks in the finished gears.

9.3 Equipment

The pistons and toothed wheels shall be positioned as to their meshed gears in relation to the working distance between centres, as shown on the drawings. Engagement shall take place smoothly without knocking or jamming with a continuity of rotation such that the angular velocity of the driven gear shall not be changed owing to the teeth.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 11 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

10. MARKINGS:

10.1 All parts supplied according to this specification shall bear the following markings stamped in suitable size of letters and figures in the place shown in the drawing, at a suitable distance from root circle for identification purpose.

10.1.1 Makers name.

10.1.2 Drawing No.

10.1.3 Cast number.

10.1.4 Consecutive number.

10.1.5 The date of manufacture (No. of the month and two digits of the yr.).

11. GUIDELINES FOR THE MANUFACTURE OF THE GEAR/PINION

Guidelines for the manufacture of the Gear/Pinion are enclosed as Annexure 'B'.

12. PROTECTION AND PACKING:

12.1 The gears/pinions shall be suitably protected against oxidation and corrosion by three coats of ready mixed paint brushing Bituminous, to IS: 158 (Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purpose) or with any other approved anti-rust compound capable of being removed easily by white spirit or kerosene oil, allowing sufficient drying time between each coat. After the last coat has dried, the gears shall be covered with waterproof paper. The gears/pinions shall then be suitably placed to prevent any damage during transport and handling.

12.2 The parts are suitably protected by an appropriate packing against the impact or friction susceptible to cause a deterioration whatsoever to their surfaces, prejudicial to their use.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 12 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

13. GUARANTEE

- 13.1 The gear and pinion shall be guaranteed to give trouble free service for a period of 24 months from the date of dispatch or 18 months from the date of commissioning whichever is earlier. During that period any gear and pinion, which is withdrawn from service because of tooth failure or excessive, wear, attributable to faulty material. workmanship or design, shall be replaced by the supplier free of charge.
- 13.2 The Inspecting Officer shall inspect the finished parts and authorize delivery. However, this authorization does not relieve the supplier of his liability with respect to the imperfections, which may appear subsequently.

DRAFT

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 13 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

APPENDIX 'A'

Standard for Ultrasonic Testing and Acceptance of Traction Gears and Pinions.

1. Gears/pinion forgings shall be tested ultrasonically for soundness from one of the two side (flat) faces. In case of gears the scanning could be restricted to the rim portion. The scanning shall be done with a 2/2.5MHz, 25mm dia probe. The ultrasonic test unit used shall be RDSO Vendor approving authority model.
2. The range shall be so adjusted that the back echo from the opposite face for a particular size of gear/pinion under test shall occur at the extreme end of the screen and its amplitude shall be approx. 75% of the full screen height. With this setting the scanning shall be done by moving the probe circumferentially. In case the radial thickness of the rim of the gear and that of the pinion is considerable, the scanning may be done following multiple concentric paths separated by one probe position.

Criteria for Acceptance/Rejection

- .1 Any flaw indication, the amplitude of which is greater than 25% of that of back echo obtained from an adjacent location, shall be rejected.
- .2 Flaw indications the amplitude of which are less than 25% of back echo obtained from adjacent location may be accepted provided the back echo at that location is not less than 80% of the original and the total number of such flaw indications obtained on that gear/pinion is less than 5 and each flaw is separated from the other by more than 25 mm distance. Where there is a continuous flaw indication, the spread of the flaw shall not cover more than one probe position in any direction. Where such indications are obtained, scanning should be done in all radial directions at that location to verify the spread of flaw.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 14 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

- 3 Where there is a flaw indication in the first quarter of the usable length of the trace, the same shall be confirmed by a scan from the opposite face.
- 4 Where the back echo is reduced to less than 80% of the original the gear shall be rejected.

DRAFT

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

APPENDIX 'B

**GUIDELINES FOR THE MANUFACTURE OF THE
GEAR/PINION**

1. General

Before commencement of manufacture of Gears/Pinions, the Contractor shall submit the followings to the purchaser.

1.1 Detailed manufacturing drawings to the Purchaser for approval. These drawings shall be complete in respect of the following:

- i) Dimensions and tolerances include design data such as:-
 - a) Tooth shape detail.
 - b) Number of teeth.
 - c) Module.
 - d) Normal pressure angle.
 - e) PCD.
 - f) Bare circle dia.
 - g) Shift of profile.
 - h) Addendum and Dedendum modification.
 - i) Span gauge; dimension over number of teeth.
 - j) Tooth depth.
 - k) Gear centres distance.
 - l) Chordal thickness.
 - m) Weight of gear.
- ii) Surface finish at different locations of gear/pinion. Surface finish at root of the teeth should also be shown.
- iii) Basic rack details.
- iv) Permissible errors if any.

These drawings shall form the basis for inspection of finished gears/pinions in respect of dimensional and surface finish parameters.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

1.2 Details of forging operations to be carried out on the semi- product (bloom/billet). These details shall consist of:

- i) Dimensions of semi-product stock used for forging of gear/pinion blanks.
- ii) Information regarding various stages of forging with sketches.
- iii) Calculations showing overall forging ratio.

1.3 The method of checking the gear depth as intends to follow and dimensioned sketch of spy piece as intends to use.

1.4 Details of internal quality control system during manufacture of traction gears as practiced at Contractor's works.

2. Stage Inspection of Purchaser:

2.1 Contractor shall make available steel mills certificates in respect of steel manufacturing process, type of steel and chemical composition of semi product proposed to be used for manufacture of gears/pistons for examination by Purchaser/Inspecting Officer nominated by him.

2.2 The Purchaser or an Inspecting Officer nominated by him shall be specifically carrying out the following inspection.

- i) Take samples for testing of material as per Clause 7 of the Specification. For this purpose, the expected date of receipt of raw material shall be advised well in advance to Purchaser/Inspecting Official nominated by Purchaser.
- ii) Witness the forging operation to ensure that the procedure advised as per para 1.2 above is generally adhered to. The programme of forging including the address of Forging Facility shall be advised to Purchaser/Inspector nominated by Purchaser well in advance to enable him to be present during forging operations.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by

Ref: CG-WI-4.2.1-1 Ver.1.0	Page 17 of 17	Date/Month of issue: August, 2020	Specification No. C-K303 Rev.-1
----------------------------	---------------	--------------------------------------	------------------------------------

2.3 Forged blanks shall be inspected by the Purchaser/Inspecting Officer nominated by the Purchaser, prior to further machining.

2.4 Gear blanks and spy pieces shall be stamped by the Purchaser/Inspector nominated by him.

3 Final Inspection:

Inspection of finished gears/pinions along with test pieces shall be carried out by the Purchaser/Inspecting Officer nominated by the Purchaser as per the terms of the specification and the approved drawing.

4 The Purchaser/Inspecting Officer shall have the power to visit at any reasonable time and without prior notice, the Contractor's or his Sub- Contractor's works to inspect the progress and quality of the work and the Contractor shall provide free of charge, all equipment, labour, gauges etc. required by him for this purpose.

5 Contractor's Responsibilities:

The Contractor is to be entirely responsible for the execution of the contract strictly in accordance with the terms of the specification and contract, notwithstanding any approval which purchaser of the inspecting Officer pay have given:

- a) of the drawings prepared by the Contractor.
- b) of his sub-contractors for materials,

of the test carried out either by the Contractor or by the purchaser or the Inspecting Officer.

Signature			
Name & Desig.	Brijesh Kumar JE/Carriage	Dinesh Kumar Sahu JE/Carriage	Shailendra Kumar Sharma Jt. Director/E&S and Brake/Carriage
	Prepared by	Checked by	Approved by