

REVISION OF SPECIFICATION / STR

**Item Name: Upgraded High Capacity Draft Gear of freight stock.Specification No. .
WD-71-BD-15 (Rev.1)**

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.
2. It is requested that your comments / suggestions with regard to improvements /modifications in specification / STR of the above mentioned item may be submitted in the following format along with the justification for the changes required.

Part A: Basic Information

| SN | Particulars | Information |
|----|--|-------------|
| 1. | Name | |
| 2. | Designation | |
| 3. | Professional Qualification | |
| 4. | Organization / Firm's Name | |
| 5. | Address for Correspondence | |
| 6. | Contact No. | |
| 7. | Email ID | |
| 8. | Whether firm is registered with RDSO for the subject item. If yes, details like date of registration, current status etc If no, firm's experience in manufacturing of subject item or similar item | |
| 8. | Whether any technical document/Report/Study to support suggested changes is available / enclosed for better appreciation | |

Part B: Comments / suggestions on the specification

| SN | Clause No. of RDSO STR/ Spec | Clause, as it exists in RDSO STR/ Spec | Clause , as it should read after incorporation of comments /suggestions in the RDSO Spec / STR | Justification for changes |
|----|------------------------------|--|--|---------------------------|
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Comments may be sent to following address within one month from the date of publication on rdso.indianrailways.gov.in

Director/Wagon
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

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INDIAN RAILWAYS
SCHEDULE OF TECHNICAL REQUIREMENTS
NO. WD-71-BD-15 (Rev 01)
FOR
VENDOR APPROVAL OF UPGRADED HIGH CAPACITY DRAFT GEAR
USED IN UPGRADED HIGH TENSILE CENTRE BUFFER COUPLER

DRAFT

ISSUED BY
WAGON DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANISATION
MINISTRY OF RAILWAYS LUCKNOW- 226011

April 2018

Price:

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0. Preamble

RDSO has issued specification no WD-70-BD-10 (Rev-1) in December 2012 for upgraded high tensile CBC for fitment in BOXNHL and BCNHL wagons. This specification led to development of indigenous manufacturing capability and ensured couplers manufactured against this specification match up to international standards. Couplers to this specification have been performing satisfactorily in the field.

- 0.1 Indian Railways has been trying for transfer of technology for draft gear manufacturing since 1980s. Order for TOT placed on M/s Miner Inc. by Railway Board in March 1989 could not be materialized. RDSO had sent specification no. WD-65-BD-06 for transfer of technology of coupler & draft gear in response to Railway Board's letter no. 2006/M(N)/204/4 dated 29-31/05/2006. The subsequent global tender no. 2007/Dev. Cell/IMW2/2 opened on 27/12/2007 is also yet to be finalized.
- 0.2 At present, the draft gears used in BOXNHL and BCNHL wagons are being procured against RDSO specification no. WD-66-BD-06. RDSO has been making independent efforts to develop knowledge on the draft gear subject.
- 0.3 In the project on "Design and development of 25 T and 32.5 T wagon (freight wagons) for Indian Railways", load environment assessment trials were carried out where measurement of longitudinal forces damped by draft gears was done to see the efficacy of present indigenous draft gears, manufactured as per RDSO specification 49-BD-08, as compared to the draft gears used on AAR railroads. The Load Environment Assessment Trials was done as a part of the ARI project, on an instrumented BOXNM1 wagon for 16000 Km, indicated large number of low load amplitude events than those experienced in even AAR railroads. The report indicated that this may be due to low energy absorption by draft gear.
- 0.4 RDSO entered into a MOU with IIT Roorkee in April 2014 for development of testing regimes for upgrading existing draft gear specification 49-BD-08. Various recommendations of IIT Roorkee have been suitably incorporated in this specification.
- 0.5 This specification shall enable development of indigenous manufacturing and testing capability for draft gears matching international standards. Development of indigenous manufacturing is in line with Government of India's 'Make in India' initiative. It would be prudent to progress in a graduated manner, meeting the imperatives of up gradation of indigenous manufacturing capabilities. Also, cost repercussions of the new improved specifications will need to be established to make it a long term, economically viable solution.

1. Foreward

- 1.1 This specification is intended to cover the technical provisions relating to manufacture, testing and infrastructure for producing upgraded high capacity draft gear and does not include all the necessary provisions of the tender/contract.
- 1.2 This Specification is issued under the fixed number WD-71-BD-15. The number after BD indicates year of issue.
- 1.3 This specification draws reference to the following specifications:
49-BD-08, M-901E, M- 901F, M-901G, M-201, M-211, S-119, WD-70-BD-10(Rev-2)

2. Scope

- 2.1 This specification covers the vendor approval, supply and acceptance requirements of Upgraded High Capacity Draft Gears along with draft gear follower suitable for application in freight stock having a standard 625.5mm. (24 5/8") pocket.
- 2.2 This draft gear shall be used along with upgraded high tensile CBC to RDSO specification WD-70-BD-10 (Rev-2) or latest for fitment in wagons with axle load 22.9 T and 25 T. The wagons fitted with these draft gears shall also be used in long haul freight operations.
- 2.3 Scope of supply shall include the draft gear and draft gear follower.
- 2.4 All the provisions contained in RDSO's ISO procedures laid down in document No. QO-D-7.1-11 dated 09/06/2017 (Titled "Vendor – Changes in approved status") and subsequent version/ 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

3. General Requirements

- 3.1 Draft gear follower shall be to AAR Catalogue No. Y46AE as per AAR Standard S - 119.
- 3.2 Complete draft gear and draft gear follower shall be interchangeable across all designs. All components including draft gear castings and springs/rubber pads/elastomer pads etc. shall be interchangeable in the same design.
- 3.3 The draft gear manufacturer shall supply all the spare parts required for maintenance of draft gears supplied by them for use on Indian Railways against specific requirements of Railways. In case of failure, their registration is liable to be cancelled.
- 3.4 The draft gear manufacturer shall submit the gauging procedure including the gauge drawings for approval to RDSO at the time of registration. No change shall thereafter be carried out without the prior approval of RDSO. Draft gear manufacturer shall supply full/partial set of gauges to zonal railways on their request against payment.

- 3.5 The draft gear manufacturer shall submit one set of drawings detailing important controlling dimensions and tolerances of draft gear along with surfaces and dimensions necessary to be gauged at the time of registration. Manufacturer shall also submit the detailed technical parameters of the proposed draft gear design along with internal test records for establishing intended performance. Maintenance manual is also required to be provided to RDSO at the time of registration. Maintenance manual shall contain following information:-
- i) Principle of operation and important design features
 - ii) Illustration explaining the working and maintenance practices
 - iii) Details of attention during overhauling
 - iv) Special tools, capacity & specification of press etc.
 - v) Details of welding equipment & method of welding
 - vi) List of spares along with specification & part No. etc.

4. Particular Requirements

- 4.1 The minimum declared official capacity of draft gear shall be 45000 Foot-Pounds. In official capacity test, the official capacity of no individual gear shall be more than 15 % above or below the average capacity of draft gears undergoing this test. The official capacity is described in para 1.2.2 of Annexure-1. Draft gear shall have a high energy absorption capacity with low re-coil. The level of energy absorption shall not be less than 75 %.
- 4.2 The casting components shall be manufactured through either High Pressure Moulding Line with Intensive Mixture for Green sand mould with Automatic Moisture Control and addition of Binder in fixed rates or through Articulated Mixer (continuous type) with fume extraction facility & Compaction Table for No-Bake System. Casting components will have to be sourced from any RDSO approved class 'A' foundry and they will be inspected by RDSO.
- 4.3 Tup Hammer Set up Requirement:
- I. Draft gear manufacturer must have a 27,000 pound drop test machine, the anvil of which is supported on a rigid foundation.
 - II. Transducer to be used for measuring the reaction force shall be capable of measurement up to 700 T. Transducer response shall be linear within +/- 1 % to a given static load. The transducer shall be adequately compensated against zero drift due to any changes in temperature. The transducer should have good zero stability.
 - III. The overall system, transducer plus the recording instrumentation system, shall be designed so as to permit the calibration by static load method to be established on recording instrumentation with accuracy +/- 2 %. The overall system shall yield a dynamic record that is accurate within +/- 5 % of actual reaction force.
 - IV. LVDT Transducer to be used for measuring the actual travel during testing shall be capable of measuring up to 125 mm.
 - V. Suitable instrumentation to work as signal conditioner and which removes electrical and magnetic noises from electrical signals and converts the millivolts to its measurable units.
 - VI. System to be capable of generating hard copy reports (digital) of dynamic events with a frequency of minimum of 1000 cycles per second. Software shall have the capability of automatic backup.

- VII. The facility of following automatic report generation must be available:
- Peak reaction force(Graphical and numeric)
 - Peak Travel (Displacement)(Graphical and numeric)
 - Graph of load and displacement with absorbed energy
- VIII. The software should be capable of calculating the work done and can show multiple records/reports on a single interface.
- 4.4 Track Impact Test Setup Requirement
- I. The test wagon shall be a nominal capacity covered wagon loaded to maximum gross rail weight of 220,000 pound with dry sand. The test wagon shall be in all instances the struck wagon and shall be free to roll after impact with no backup wagons to be used. The test wagon shall be capable of withstanding the test forces without permanent set.
- II. The hammer wagon shall be a nominal capacity covered wagon loaded to a maximum gross rail weight of 220,000 lb with dry sand. This wagon will be fitted with an approved draft gear.
- III. A means for accelerating the hammer wagon (preferably a calibrated inclined track) shall be provided. The accelerating means and its associated equipment shall be capable of producing the accelerating velocity with an accuracy of 0.2 mph.
- IV. In order to minimize the effect of varying atmospheric conditions, the draft gears shall be tested when ambient temperature is between 0 deg C and 35 deg C.

5. Approval Requirements

- 5.1 Indigenous draft gear manufacturer has to possess the infrastructure for testing as per clause no 4.3.
- 5.2 The draft gear manufacturer shall hold a valid Quality Assurance Certification as per ISO 9001 for manufacture and testing of draft gears of railway freight stock.
- 5.3 Indigenous draft gear manufacturer, if offering a proven draft gear design, shall have the certificate of approval from the collaborator principle manufacturer and the same shall be submitted to RDSO. Proven design means draft gear to that design being used in wagons of 25 T axle load or above in an established rail road system. Indigenous draft gear manufacturer has to submit RDSO the test results and certificate from collaborator principal manufacturer that the indigenously manufactured draft gear has already been tested by the collaborator principal manufacturer in their premises and its performance is at par with the product manufactured by principal manufacturer and satisfies all testing requirements mentioned in Annexure -1 or Annexure -2, as applicable .They have to also get their quality assurance plan certified from their collaborator principal manufacturer.
- 5.4 In scenario as described in Clause 5.3, RDSO team of two nominated officials shall carry out an audit of the manufacturing facilities and the quality assurance system to verify if the indigenous manufacturer is capable of manufacturing and testing draft gears to this specification.

If the draft gear manufacturer is seeking the approval for draft gear design complying test regime mentioned in Annexure -1, the following shall be the procedure:

25 draft gears will be manufactured by the manufacturer seeking approval. First article inspection of the two (randomly selected) draft gears for dimensional control as per gauging scheme will be carried out. Five draft gears shall be tested for official capacity test as described in clause 2 of Annexure-1. One draft gear will be picked up by RDSO team and will witness for the endurance test and sturdiness test as detailed in Clause 3 and 4 of Annexure-1. Official capacity test, Endurance test and Sturdiness test shall be conducted on the Tup hammer set up as described in clause 4.3 above.

If the draft gear manufacturer is seeking the approval for draft gear design complying test regime mentioned in Annexure -2, the following shall be the procedure:

25 draft gears will be manufactured by the manufacturer seeking approval. First article inspection of the two (randomly selected) draft gears for dimensional control as per gauging scheme will be carried out. Two draft gears shall be tested for official capacity test as described in clause 2 of Annexure-1. One draft gear will be picked up by RDSO team and will witness the endurance test and sturdiness test as detailed in Clause 3.1 and 3.2 of Annexure-2. Official capacity test, Endurance test and Sturdiness test shall be conducted on the Tup hammer set up as described in clause 4.3 above. One draft gear will be picked up by RDSO team and will witness the rating impact velocity test and maximum impact velocity test as described in Clause 2.1 and 2.2 of Annexure-2. One draft gear shall undergo the final track calibration test as per clause 4 of Annexure-2. Track impact test and final track calibration test shall be done on a set up as described in Clause 4.4 above. If infrastructure as prescribed in clause 4.4 is not available with indigenous manufacturer, the Track impact test and final track calibration test can be conducted at premises of principal collaborator manufacturer.

In case the inspection and type tests are satisfactory, manufacturer will be placed in the List of RDSO Vendors for Developmental Orders with following addendum

Maximum permitted quantity-6000 Nos draft gear

- 5.5 Indigenous draft gear manufacturer, if offering a new draft gear design (i.e. design not proven), shall have to submit the complete design details of proposed draft gear to RDSO. They have to also submit the internal (or at an reputed agency as approved by RDSO) test results for either official capacity test, endurance test and sturdiness test as detailed in Annexure-1 or Track impact test, endurance test and sturdiness test as detailed in Annexure-2, as applicable. On satisfaction of design documentation and its validation, RDSO team of two nominated officials shall carry out an audit of the manufacturing facilities and the quality assurance system to verify if the indigenous manufacturer is capable of manufacturing and testing draft gears to this specification. Inspection and type testing procedure shall be same as described in Clause 5.4 above. In case the inspection and type tests are satisfactory, manufacturer will be placed in the List of RDSO Vendors for Developmental Orders with following addendum

Maximum permitted quantity-6000 Nos draft gear

- 5.6 The ceiling of 6000 Nos mentioned in Para 5.4 & 5.5 shall be withdrawn when the following is met:
- 2000 draft gears have completed one ROH period of satisfactory service.
 - Satisfactory compliance to general service check mentioned in Annexure -3 on four draft gears which have completed one ROH period of service.
 - No unresolved non-conformances or not more than one line failure per year on manufacturing account.
 - An audit of the manufacturing facility by RDSO/ RDSO nominated third party to ensure compliance of prescribed manufacturing facilities and adherence to approved quality assurance plan.
- 5.7 This specification is meant for import substitution of draft gears currently being supplied against RDSO specification WD-66-BD-06. Therefore, eligible vendors as per Para 5.4 who have supplied draft gears of the same design against WD-66-BD-06 and their 2000 nos. have been in field service for more than two years shall be placed in the List of RDSO Vendors for Developmental Orders without any ceiling on the numbers of draft gears supplied

6 Annual Type Testing

Indigenous manufacturer shall carry out annual type testing in the premises of principal collaborator draft gear manufacturer or at any AAR approved facility through third party or at independent third party testing house. The following shall be the annual type tests: Either the Official capacity test (two draft gears) , Endurance Test (One draft Gear) and Sturdiness Test(same draft gear after completion of endurance test) as described in Annexure -1 or Official capacity test (two draft gears) , Endurance Test (One draft Gear), Sturdiness Test(same draft gear after completion of endurance test), Track impact test (One draft gear) and Final Track Calibration test (One draft gear) as described in Annexure-2, as applicable . The samples for annual type test shall be picked up by RDSO team. These annual type testing reports shall be submitted to Wagon Dte/RDSO by the indigenous manufacturer. Failure in either carrying out the annual type testing or failure in annual type testing shall lead to withdrawal of vendor approval.

7 Production Testing

- 7.1 The Draft gear manufacturer shall conduct the official capacity test (as defined in Clause 2 of Annexure-1) of 5% of Purchase Order or 5 in 100 whichever is higher and maintain as a part of its internal records.
- 7.2 The Inspecting Authority shall audit check the QAP records of manufacturer to ensure that draft gear components are manufactured as per QAP of the manufacturer and meets the requirements of dimensions, chemical properties, mechanical properties as laid down in QAP.

- 7.3 It should be possible for Inspecting Authority to find out QAP test / inspection records of draft gear components with Serial no. cast on draft gear housing. On failure to meet this requirement, whole lot shall be rejected.
- 7.4 Two draft gears shall be selected by the Inspecting authority from a lot of not less than fifty (50) draft gears. They shall be measured both in assembled and in disassembled condition. The dimensions shall be checked with gauges which should be in conformity with Manufacturer's approved drawings.
- 7.5 At least 2 draft gears out of every 100 draft gear or part thereof shall be shall be drop – hammer tested to in presence of Inspecting Authority to ensure minimum capacity of the specification under which it has been approved. The test shall consist of the minimum number of blows required to produce the minimum capacity required. If any unacceptable gears are found, this will necessitate testing of the next 50 untested gears to 100% capacity. If any defective gears are found within that 50,100% capacity testing shall be continued until 50 consecutive gears have been tested without failure.
- 7.6 Draft gear follower(if Grade 'E' cast steel) shall be tested for Chemical composition, Mechanical properties, Impact Test, Hardness and Dimensions as per procedure given in RDSO specification for Upgraded High tensile CBC No. WD-70-BD-10 (Rev-2) or latest. Draft Gear follower (if rolled steel) shall be Test, General requirement of casting acceptance, Marking, Weight variation tested for material, heat treatment and hardness as given in AAR S-119.

8. Painting

Draft gear and draft gear follower shall be painted with Firozi paint on only exposed surfaces excluding working portions.

9. Marking

- 9.1 The manufacturer shall get the marking scheme for manufacturer's code, batch no., serial no. etc approved from RDSO. All draft gear components should have clear and legible manufacturer's code, batch no, month and year of manufacture etc. which shall remain legible throughout the entire service period of Draft Gear. The Draft Gear components found having illegible marking at the time of fitment in Railway Workshops, Maintenance depot or on Wagon Builders premises shall be treated as rejected and shall be replaced by the manufacturer free of cost. The cost of transportation shall be borne by the manufacturer.
- 9.2 The marking shall be made at the casting/forging stage itself so that the marking shall remain legible during entire service life of the components. Metallic markings (made from engraving process in CNC Machine) shall be used. Cores prepared from Shell core making process to be used for marking of serial numbers only during casting process. The manufacturer will not be permitted to provide manufacturer's code batch no., serial no. etc by electric arc welding in case these are not visible at casting / forging stage.

10. Warranty

The Contractor shall at his expense, replace the Draft Gears and components failing or proving unsatisfactory in service attributed to defective/faulty design, defective material or poor workmanship within a period of 72 months after their delivery or 60 months after the date of fitment whichever is earlier. This warranty shall survive

notwithstanding the fact that the equipment may have been inspected, accepted and payment thereof made by the purchaser for the replaced equipment and period of 60 months would commence when the replaced component is commissioned in service. The sole judge in this case would be the purchaser whose decision shall be final and binding.

11. Record of Internal Acceptance Tests

The manufacturer will maintain a list of all internal acceptance tests being carried out by him at various stages of manufacturing of the product. Proper record of such internal acceptance tests shall be maintained by him and also included in the QAP. At the time of inspection of the product, these records shall be put up to the Inspecting Authority for scrutiny and countersign.

The manufacturer shall maintain records for a minimum period of six years of all weights, mechanical test reports, chemical test reports and heat treatment records as applicable to the purchased draft gear. These records shall be made available to the purchaser upon request. The manufacturer shall also maintain records for a minimum of six years that provide traceability from the serial number of individual draft gear, where applicable to the records stated above.

12. Reconditioning

The manufacturer shall also undertake reconditioning of Draft gear against Zonal Railways request. The reconditioned draft gear assembly shall perform satisfactory in service and shall meet the requirements laid down in clause 10 above.

13. Upgradation to Approved Vendors

A manufacturer will obtain status of Approved Vendor when following is met

- 2000 draft gears have completed one POH of satisfactory service.
- Manufacturer should have manufactured 10000 draft gears.
- No unresolved non-conformances or more than one line failure per year on manufacturing account.
- An audit of the manufacturing facility by RDSO/ RDSO nominated third party to ensure compliance of prescribed manufacturing facilities and adherence to approved quality assurance plan.

OR

- 2000 draft gears of the same design supplied by the manufacturer against WD-66-BD-06 have completed one POH of satisfactory service
- Manufacturer should have supplied 10000 draft gears of the same design against WD-66-BD-06
- No unresolved non-conformances or more than one line failure per year on manufacturing account.

- An audit of the manufacturing facility by RDSO/ RDSO nominated third party to ensure compliance of prescribed manufacturing facilities and adherence to approved quality assurance plan.

DRAFT

1.0 DEFINITIONS

1.1 Travel

1.1.1 The combined maximum draft and buff travel shall not exceed 6 ½ inches. Maximum buff travel must be attained at a coupler horn clearance of not less than ¼ inch.

1.1.2 **“Maximum Travel”** shall be the travel at a point where two successive free falls of the tup hammer at the same height will produce a reaction of 800,000 pounds or greater in buff and 500,000 pounds or greater in draft or at a point 0.01 inch before contact of over-solid stops, whichever occurs first.

Note: Travel and reaction force will be calculated as the average of the two travels and two reaction forces as produced by the two successive free falls of the tup hammer.

1.1.3 **“Rating Travel”** shall be the travel at a point where two successive free falls of the tup hammer at the same height will produce a reaction of 500,000 pounds or greater or at a point 0.01 inch before contact of over-solid stops, whichever occurs first.

Note: Travel and reaction force will be calculated as the average of the two travels and two reaction forces as produced by the two successive free falls of the tup hammer.

1.2 CAPACITY

1.2.1 The capacity of a gear is the weight of the tup hammer in pounds multiplied by the total fall in feet.

1.2.2 The **“official capacity”** shall be the capacity determined at the **“Rating Travel”** in the official capacity test.

1.2.3 The capacity at **“Maximum Travel”** in buff shall be determined.

2.0 OFFICIAL CAPACITY TEST

2.1 The capacity of each gear shall be determined by a test made as follows: Start at zero free fall of the tup hammer, continue with ½-in. increments until 1-5/16-in. travel has been reached or exceeded, then 1-in. increments to within ¼ in. of as received “Official Rating Travel,” then ½ in. increments to within 0.10 in. of as received “ Official Rating Travel,” then ¼-in. increments until the gear reaches a reaction force of 500,000 lb or greater. A second blow shall be given at the same height free fall and the reaction force recorded. If two successive blows at the same height of free fall produce a reaction force of 500,000 lb or greater, the travel and capacity as determined from the average of the two blows will be established as “Official Rating Travel,” and “Official Rating Travel,” capacity, respectively. However if a second free fall at the same height produces a reaction force of less than 500,000 lb, the tup hammer will continue to be raised in ¼-in. increments until two successive blows at the same height produce a reaction force of at least 500,000 lb. the point where two blows at the same height produce a reaction force of at least 500,000 lb will be established as the “Official Rating Travel.” After establishing this value, the tup hammer will be raised in ½-in. increments until the gear reaches a reaction force

recorded. If two successive blows at the same height of free fall produce a reaction force of 800,000 lb or greater, the travel and capacity determined from the average of the two blows will be established as "Official Maximum Travel" and "Official Maximum Travel" capacity, respectively. If a second free fall at the same height produces a reaction force of less than 800,000 lb, the tup hammer will continue to be raised in 1/2-in. increments until two successive blows at the same height produce a reaction force of at least 800,000 lb. The point where two blows at the same height produce a reaction force of at least 800,000 lb will be established as the "Official Maximum Travel."

- 2.2 In order to pass this test, average capacity of gears tested must not be less than declared official capacity in buff at the "Official Rating Travel. No individual gear official capacity shall be more than 15 % above or below the average capacity of draft gears undergoing this test.
- 2.3 Each gear must also comply with the horn clearance requirements at "Maximum Travel," paragraph 1.1.1
- 2.4 The calibration of gear as required during and following the completion of the Endurance and Sturdiness Tests shall be made in accordance with the following procedure: Start at zero free fall of tup hammer, continue with 1/2-in. increments until 1-5/16-in. travel has been reached or exceeded, then 1-in. increments to within 1/4 in. of "Official Rating Travel," then 1/2-in. increments to within 0.01 in. of "Official Rating Travel," then 1/4-in. increments until the gear reaches "Official Rating Travel." After establishing this value, the tup hammer will be raised in 1/2-in. increments until the gear reaches "Official Maximum Travel."

3.0 ENDURANCE TEST

- 3.1 All gears shall be subjected to the Endurance Test. The cycle will be as follows:
 - One blow at 1-in. free fall,
 - One blow at 1-in. and one at 1-1/2. Free fall,
 - One blow at 1-in., one at 1-1/2-in., and one at 2-in. free fall, etc.

Proceed thus up to a free fall that produces the same travel determined at Maximum Travel in the Official Capacity Test or to a point 0.01 in. before contact of over-solid stops, whichever shall occur first. When this point is reached, the Endurance cycle shall start over again.

- 3.2 During the Endurance Test, gears are to be calibrated after 5,000,000 ft lb and 15,000,000 ft lb of energy input up to the "Maximum Travel," paragraph 1.1.2, in buff and to the "Rating Travel," paragraph 1.1.3, in draft, in accordance with the procedure specified in paragraph 2.4. The test shall end when not less than 25,000,000 ft lb of energy has been delivered to gear, provided failure does not occur before this point. Endurance testing of the draft gear to be tested in draft shall end when not less than 15,000,000 ft lb of energy has been delivered to each gear, provided failure does not occur before this point. After completion of test, gears shall be calibrated in accordance with the procedure specified in

paragraph 2.4 to the “Maximum Travel.” Draft gear tested in draft shall be calibrated to the “Rating Travel.”

- 3.3 In order to pass this test, none of the gears shall develop a capacity below 80% of the “Official Capacity.” The capacity of each gear must be measured at the same travel that was determined at “Official Rating Travel” during the Official Capacity Test.
- 3.4 Each gear must also comply with the horn clearance requirements, paragraph 1.1.1.

4.0 STURDINESS TEST

- 4.1 All gears shall be subjected to the Sturdiness Test. Based on the free fall of the tup hammer that produced “Maximum Travel” (or “Rating Travel” in the case of the draft gear tested in draft) during the calibration after the Endurance Test, proceed as follows:
- Ten drops at plus ½ in.,
 - Ten drops at plus 1 in.
 - Calibrate gears in accordance with the procedure specified in paragraph 2.4 to “Maximum Travel” in buff and “Rating Travel” in draft,
 - Ten drops at plus 1-1/2 in.,
 - Ten drops at plus 2 in.
 - Calibrate gears in accordance with the procedure specified in paragraph 2.4.
- 4.2 At the end of this test, gears will be taken apart for inspection. In order to pass this test, none of the gears may develop any of the following defects:
- 4.2.1 A capacity below 70% of the “Official Capacity.” The capacity of each gear must be measured at the same travel that was determined at “Official Rating Travel” during the Official Capacity Test.
- 4.2.2 Failure of an essential part.
- 4.2.3 Widening or spreading of any part that causes binding in the standard pocket.
- 4.3 Each gear must also comply with the horn clearance requirements, paragraph 1.1.1.

1.0. DEFINITIONS

1.1. Travel:

1.1.1. The design travel shall be not less than 2 in. in buff and combined draft and buff travel shall not exceed $6 - \frac{1}{2}$ in. Maximum buff travel must be attained at a coupler horn clearance of $\frac{1}{2}$ in. Maximum draft travel must be attained at a coupler horn clearance of not more than 7 in.

1.1.2. "Maximum Travel" shall be the travel that will produce a reaction of 800,000 lb or greater in buff and 500,000 lb or greater in draft.

1.1.3. "Rating Travel" shall be the travel at reaction of 500,000 lb.

1.2. Impact Velocity:

1.2.1. "Rating Impact Velocity" shall be the velocity that produces 500,000-lb reaction force.

1.2.2. "Maximum Impact Velocity" shall be the velocity at 800,000-lb reaction force.

1.2.3. "Official Rating Velocity" shall be the average of the final rating impact velocities of the draft gears tested.

2.0. TRACK IMPACT TEST

2.1 Rating Impact Velocity Test

- The rating of each draft gear shall be determined as follows: Start with an impact of 4mph and continue in 0.5 mph increments up to velocity that produces a reaction force of at least 450,000 lb but less than 500,000lb. Thereafter, continue in 0.25- mph increments until a reaction force of 500,000 lb is reached or exceeded. The rating velocity shall be obtained by straight line graphical interpolation between the closest points above and below the 500,000- lb reaction force level to the nearest 0.1 mph.
- In order to pass this test, the velocity shall be not less than 5 mph.

2.2 Maximum Impact Velocity Test

Continue impact velocity test in 0.25-mph increments until a reaction force of 800,000 lb or a velocity of 12 mph is reached. The maximum velocity shall be obtained by straight line graphical interpolation between the closest points above and below 800,000-lb reaction force level to the nearest 0.10 mph.

3. DROP HAMMER TEST

3.1 Endurance Test

All gears shall be subjected to Endurance Test. The cycle will be as follows:

One blow at 3-in. free fall,

One blow at 3-in. and one at 6-in., free fall,

One blow at 3-in. one at 6-in., and one at 9-in, free fall,

Produced thus up to a free fall produces the "Rating Travel" established in the Rating Impact Velocity Test or to within 0.1 in. from solid, whichever occur first. When this point is reached, the endurance cycle shall start over again.

- The test shall end when no less than 1,000 total drops have been delivered to each gear provided failure does not occur before this point.

3.2 Sturdiness Test

- All gears shall be subjected to Sturdiness Test. Based on the “Maximum Travel” established in the Official Maximum Impact Velocity Test (or “Rating Travel” established in the Official Rating Impact Velocity Test in the case of the draft gear is tested in draft) with as few drops of the tup hammer as possible, determine the free fall of the tup hammer that produces 800,000 lb reaction force in buff or 500,000 lb in draft on two successive drops. Using this free fall height, proceed as follows:
Ten drops at plus 1/2- in.
Ten drops at plus 1 in.
- Continue the test in plus 1/2-in. increments until two successive drops produce reaction forces of 1000,000 lb in buff. Then make 10 drop at this free-fall height. A minimum of 30 buff drops must be made. When required for gears tested in draft, continue in 1/2-in. increments until two successive drops produce reaction forces of 800,000 lb in draft. Then make 10 drops this free-fall height. A minimum of 60 drops (30 in buff and 30 in draft) must be made when testing in both buff and draft.

4. FINAL TRACK IMPACT CALIBRATION TEST

In order to satisfactorily pass these specifications, each gear will be subjected to a rating Impact Velocity Test and must meet the following conditions:

- At no time during the test may the rating velocity of any gear fall below 5 mph at 500,000lb reaction.
- The final rating impact velocity for each gear shall be obtained by averaging the rating velocities obtained before and after the Endurance and Sturdiness Tests, as defined in paragraph 2.1.
- Each gear shall withstand one impact velocity test at 12 mph or a reaction force of 1,000,000 lb, which ever occur first.
- The official Rating Velocity for the gear shall be average of the final rating impact velocities of the gears tested.

General Service Check scheme for up gradation to part II status

1. After completion of one ROH period of field service, four draft gears shall be taken out in presence of Wagon Dte authorised representative.
2. First, all of these draft gears are required to be re-calibrated as per clause 2.4 of Annexure-1.
3. These four draft gears should not be having any of the following defects:
 - Failure of an essential part.
 - Widening or spreading of any part that causes binding in the draft gear pocket.
 - There should not be excessive wear or damage to draft gear pockets or draft gear attachments due to gear action.
4. The combined maximum draft and buff travel of these four draft gears shall not exceed 6 ½ inches. Maximum buff travel must be attained at a coupler horn clearance of not less than ¼ inch.
5. The recalibration capacity of each gear at 1-5/16 in travel shall not be less than 6000 ft lb.
6. The recalibration capacity of each gear at its rating travel shall be not less than 85 % of its official capacity in its original configuration.