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बी जी रेलपथ पर वेल्ड विफलता से बचने के लिए सावधानियाँ

PRECAUTIONS TO BE TAKEN TO AVOID WELD FAILURE ON BG TRACK



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अआसंRDSO
रेल अग्रदूत Transforming Railways
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प्राक्कथन

चूंकि वेल्ड की विफलता रेलवे परिवहन की सुरक्षा को खतरा है, अतः अधिक से अधिक ध्यान वेल्डिंग कार्य के निष्पादन और वेल्ड के जीवन के दौरान मरम्मत पर दिया जाना चाहिए। वेल्ड विफलता की घटना से बचने के लिए यह जरूरी हो जाता है कि सभी सुरक्षा सावधानियॉं और निवारक उपाय लागू किये जाने चाहिये।

केमटेक द्वारा तैयार की गई इस पुस्तिका में विभिन्न चरणों के दौरान वेल्ड में उत्पन्न समान्य दोषों का विस्तृत वर्णन किया गया है तथा यह तकनीकी ज्ञान का एक स्रोत होगा कि कैसे वेल्ड विफलता की घटना को ट्रैक में कम किया जा सकता है।

मुझे आशा है कि यह पुस्तिका रेलवे में ऊपरोक्त कार्यो में शामिल सिविल इंजीनियरिंग कर्मियों के लिए मददगार होगी।

केमटेक, ग्वालियर *(ए.आर. तुपे)*

24 जून, 2015 *कार्यकारी निदेशक*

FOREWORD

Since the failure of weld threatens the safety of Railway transportation, more and more attention is to be paid during execution of welding and service life of weld. It has been imperative to apply all safety precautions and preventive measures to avoid incidence of weld failure.

This handbook is prepared by CAMTech to elaborate the general defects generated in weld during different stages and will be a source of technical knowledge that how weld failure occurrence may be minimized.

I hope that this handbook will be of significant help to Civil Engineering personnel involved in above work in Railways.

CAMTech/Gwalior ***(A.R. Tupe)***
24 June- 2016 ***Executive Director***

भूमिका

भारतीय रेलवे यातायात में जबरदस्त वृद्धि हुई है, यह प्रवृत्ति भविष्य में भी जारी रहेगी। भारतीय रेल पर ज्यादातर ट्रैक लंबाई को, वेल्डिंग द्वारा रेलों को जोड़ कर लॉन्ग वेल्डेड रेल में परिवर्तित कर दिया गया है।

आज की सबसे प्रचलित रेल वेल्डिंग प्रक्रियाओं में फ्लैश बट वेल्डिंग, अल्मिनों थर्मिट वेल्डिंग और गैस दबाव वेल्डिंग हैं। इनमें से रेलों की अल्मिनों थर्मिट वेल्डिंग और फ्लैश बट वेल्डिंग को व्यापक रूप से रेलवे में प्रयोग किया जाता है।

यह महसूस किया गया है कि वेल्डिंग प्रक्रिया और ट्रैक के रखरखाव के दौरान पर्याप्त सावधानी और निवारक उपाय अपनाया जाना चाहिए। यह पुस्तिका वेल्ड विफलताओं को नियंत्रित करने और ट्रैक पर सुरक्षा सुनिश्चित करने के लिए ज्ञानवर्धक तकनीकी जानकारी प्रदान करने के उद्देश्य से तैयार की गई है।

यह पुस्तिका वैधानिक नहीं है तथा इसमें दी गई जानकारी का उद्देश्य केवल मार्गदर्शन करना है। पुस्तिका में प्रस्तुत अधिकांश डेटा एवं जानकारी किसी न किसी रूप में उपलब्ध साहित्य, क्षेत्र सर्वेक्षण तथा इंटरनेट खोज पर आधारित है। अधिक गहराई से जानकारी/ज्ञान के लिए, विषय पर उपलब्ध प्रासंगिक विस्तृत साहित्य को संदर्भ रूप में देखा जा सकता है।

हम **श्री विजय सिंह, उप मुख्यअभियंता/निर्माण, इलाहाबाद** और **श्री राजीव कुमार, निदेशक/ट्रैक-5, आरडीएसओ, लखनऊ** को इस पुस्तिका को अधिक परिष्कृत करने और परिचय-योग्य बनाने के लिए बारीकी से सामग्री की समीक्षा करने और बहुमूल्य टिप्पणियों को उपलब्ध कराने के लिए हम सच्चे अर्थों में उनका आभार व्यक्त करते हैं।

हम इस पुस्तिका के आगे सुधार के लिए पाठकों से किसी भी सुझाव का स्वागत करते हैं।

केमटेक, ग्वालियर *(डी. के. गुप्ता)*
24 जून, 2016 *संयुक्त निदेशक / सिविल*

PREFACE

There have been tremendous enhancements in traffic on the Indian Railways, this trend will continue in future also. The track length on Indian Railways has almost been converted in to Long Welded Rails by joining of rails with welding.

Today's the most common rail welding processes are flash-butt welding, Alumino Thermic welding and gas pressure welding. Among them Alumino Thermic welding and Flash Butt welding of rails is widely used in the railways.

It has been realized that adequate precautions and preventive measures should be adopted during process of welding and maintenance of track. This booklet is prepared with the objective to provide informative technical details for controlling weld failures and ensuring safety on track.

This handbook is not statutory and contents are only for the purpose of knowledge dissemination. Most of the data & information in some form or the other are based on literature available, field survey and internet search. For more in-depth information / knowledge, the relevant detailed literature available on the subject may be referred to.

We extend our sincere gratitude to **Shri Vijay Singh, Dy. CE/C, Allahabad** and **Shri Rajeev Kumar, Director/Track-5**, **RDSO, Lucknow** for reviewing contents closely and providing valuable comments to make this booklet more refined and in a presentable form.

We welcome any suggestions from readers for further improvement of this handbook.

CAMTech/Gwalior ***(D.K. Gupta)***
24- June, 2016 ***Joint Director/Civil***

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The correction slips to be issued in future for this handbook will be numbered as follows:

केमटेक/2016/सि/पी.डब्लू.एफ़./1.0/सी.ऐस.#XX दिनांक _____

CAMTECH/2016/C/PWF/1.0/CS. # XX date .....

जहाँ "XX" **संबन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)**

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

प्रकाशित संशोधन पर्चियाँ / Correction slips issued

क्र. सं. Sr. No.	प्रकाशन की तारीख Date of Issue	संशोधित पृष्ठ संख्या तथा मद संख्या Modified Page no. and Item No.	टिप्पणी Remarks

1. परिचय / Introduction

To have long continuous rails for smooth running of track, welding of rails is indispensable. With the development of an increased volume of traffic, higher traffic speeds and higher axle loads, rails are subjected to harsh stressing conditions.

Rails are also subjected to other high mechanical loads and harsh environmental conditions. The main stressing components are;

(i) Rolling contact pressure,

(ii) Shear and bending forces from the vehicle weight,

(iii) Thermal stresses due to restrained elongation of continuously welded rails,

(iv) Residual stresses from manufacturing (roller straightening)

(v) Welding of rails in the field.

With enhanced stressing condition probability of weld failure of rails has also increased considerably. An attempt has been made to highlight the various irregularities while execution of welding and maintenance of weld, which lead to the weld failure. Precautions and preventive measures have also been suggested to control these irregularities.

2. रेलपथ पर वेल्डिंग / Welding of Track

As a measure of better maintainability and cost effectiveness, Indian railways commenced welding rails in the 1950s. Three methods are in use, these being

(i) Alumino Thermic Welding

(ii) Flash Butt Welding

(iii) Gas Pressure Welding

Initially, the ordinary Alumino Thermic welding process with green moulds prepared at site was used extensively. In fact a large majority of the field weld have been done by this process. Due to their relatively poor fatigue strength, weld failures are very common and are a matter of serious concern now. Since 1987, Indian Railways have switched over to the quick Alumino Thermic welding process with short pre-heat, using air and petrol as fuel. Further, improvement contemplated in the use of Oxy-LPG and compressed air petrol to reduce the pre-heating time. The moulds used are prefabricated type.

To minimise the number of field AT welds flash butt welded panel, 130 to 260 m long are used. Flash Butt Welding is being done on Zonal Railways departmentally, using Stationary Flash butt welding Plants of different makes. Mobile Flash Butt Welding Plants, capable of in-situ Flash butt welding of rails joints, are also in operation on some of the Zonal Railways.

Gas pressure welding is solids phase bonding process. In this process, the rail ends butted squarely against each other. This process utilised the mixture of oxygen and acetylene gases for heating the rail ends at a temperature of about 1250-1300^{o}C, and thereupon, the application of high pressure causes the bonding of rails. The quality of welds produced by the plant has been excellent. One reason for not adopting the process widely has been its low output. Indian railways have only one stationary type gas plant which was used in Konkan Railway.

3. वेल्ड में विभिन्न चरणों में उत्पन्न दोष / Defects in weld generate in different stages

3.1 क्रियान्वयन के दौरान / DURING EXECUTIONS

Since the failure of weld threatens the safety of railway transportations directly, more and more attention is to be paid to the quality of weld during execution of weld.

REQUIREMENTS	FLASH BUTT WELD	AT WELDING
APPROVAL OF QUALITY ASSURANCE PLAN	Quality Assurance Plan of each individual flash butt welding machine shall be approved by RDSO and welding parameters shall be standardised by RDSO before starting execution of welding work.	i) Welding techniques approved provisionally or for regular adoption by Railway Board/RDSO should only be adopted for welding of rails. ii) Thermit welding portions and consumables to be used for welding shall be from RDSO approved firms only.
SECTION OF RAILS	i) New as well as released but serviceable rails of same type (section and metallurgy) shall only be welded together. ii) Welding of rails of different sections of metallurgy shall not be attempted. iii)It is preferable that rails rolled by the same manufacturers are welded together. Minimum length of old but serviceable rails for welding shall be 6 metres.	i) The rolling marks on the web of rails shall be checked before welding. ii) Generally rails of different qualities are not welded together. iii) In unavoidable circumstances, where rails of Grade 710 (72 UTS) rail chemistry and that of Grade 880 (90 UTS) chemistry are to be welded, the portion of Grade 880 (90 UTS) chemistry shall be utilised for welding.
WELDING OF OLD RAILS	i) While welding old rails, it shall be ensured that only serviceable rails are welded. ii) Old rails to be welded shall preferably be match marked before releasing from track to achieve maximum uniformity of profiles in weld zone.	i) The rail ends shall be cut by sawing or using abrasive disc cuter and not by flame cutting. ii) Second hand rails shall be match-marked before releasing from track to enable matching of the rail ends at the time of welding. Kinks, if any, in the rails shall be removed before welding.

FISHBOLT HOLES	i) Welded panels (10/20 rails) for laying long welded rails shall, as far as possible, be without fishbolt holes. ii) If drilling of fishbolt hole is necessitated for the purpose of handling during end unloading; only the second fishbolt hole (one away from the rail end) need be drilled. iii) In case, welding of new rails with fishbolt holes cannot be avoided, it shall be ensured that the outer edge of the hole nearest to the rail end is at least 40mm away from the end to be welded to avoid the heat affected zone of the weld extending up to the edge of the hole. iv) All fishbolt holes shall be chamfered before welding. v) Ends of old rails with fishbolt holes/bond wire holes shall be cropped by a minimum length of 450mm before welding.	iii) While using second hand rail panels for secondary renewal, released from LWR/CWR sections, the ends should be cropped to eliminate fish bolt holes. iv) If rail ends do not have bolt holes, the ends may be cropped to a distance of minimum 150 mm for AT welds and 85 mm for flash butt welds from the center of welded joint to eliminate heat affected zone of welds. End cropping may be suitably increased so as to ensure that rail ends are within the tolerances. v) Even where cracks/flaws have not been detected during visual/USFD examination before welding, the ends of second hand rails should be suitably cropped so as to eliminate fish bolt holes. vi) In case of repair of fractured rail/defective weld with wide gap (75mm gap) weld, the rail shall be cut from center of rail fracture/defective weld 37-38mm each side for making suitable gap of 75mm, provided bolt holes do not fall within 40mm from cut faces.
ULTRASONIC TESTING OF RAILS TO BE WELDED	i) New and old but serviceable rails shall be free from internal defects. In the case of new rails, the ultrasonic testing is required to be done at the rail manufacturer's premises. ii) Old but serviceable rails shall invariably be tested ultrasonically before they are taken for Welding.	Rails shall be tested before welding, with ultrasonic flaw detector apart from visual inspection, so that rails having cracks and internal flaws are excluded from welding.

DEFECTIVE RAILS	Rails having cracks or other defects such as heavy corrosion pits or which are worn by more than 2mm depth at rail seat shall not be welded.	i) In order to achieve satisfactory running on welded rail panels, rails with excessive scabbing, wheel burns, corrugations and wear of rail seats shall not be used for welding. ii) The rail flange bottom shall be visually inspected to ensure freedom from defects like dent, notch, corrosion, etc.
RAIL END GEOMETRY FOR FLASH BUTT WELD	i) End-bends in the vertical plane not greater than 0.7mm on a 1.5metre straight edge. Sagging ends not permitted. ii) End-bends in the horizontal plane not greater than + 0.7 mm on a 1.5 metre straight edge. iii)Deviation of the end from the square not greater than + 0.6mm.	i) For both new as well as second hand rails, before welding, it should be ensured that the end bends of the rails are within +0.5 mm, -0 mm in vertical and $\pm$ 0.5 mm in lateral direction, when checked with one metre straight edge. ii) End squareness should not be greater than $\pm$ 0.6 mm.
OTHER REQUIREMENTS	NIL	i) Welding shall be supervised by trained welding supervisor and carried out by trained welder having valid competency certificate from RDSO / TPP, NR, Lucknow / TWC, Vijayawada in their possession. ii) A welding supervisor shall supervise not more than two welding teams deployed within 50 m distance at a time.

3.1.1 फ्लैश बट वेल्डेड रेल जोड़ों में दोष से बचने के लिए सावधानियां / PRECAUTIONS TO AVOID DEFECTS IN FLASH BUTT WELDED RAIL JOINTS

Following precautions shall be taken to avoid various defects in the welded joints:-

(i) Oxide inclusion-- The rail end faces and the adjoining surface of the rail profile to a width of about 25mm all round shall be cleaned properly by portable grinders or brushing machine or shot blasting to remove loose scale, rust, scabs, dust, paint etc. Oil and grease, if present shall be removed by Carbon Tetrachloride or Benzene.

(ii) Lack of fusion – Preheating cycle and time, flashing and butting stroke as standardised by RDSO shall be strictly maintained during welding to avoid this defect.

(iii) Poor joints due to defect in rails – Rail ends having cracks and other visible rolling defects should be cropped before welding.

(iv) Notches and chisel marks adjacent to the weld joints - During stripping by chiseling and finishing by grinding, care should be taken that notches, dents or chisel marks are not formed on the rail surface as such flaws may act as stress raisers in service leading to premature failure.

(v) Copper penetration/arching on rail foot bottom surface - During flash butt welding, the two copper blocks (electrodes) below the rails get worn out and grooved/dented due to rail movement. Besides this, after the flashing/burning off operations, lot of loose oxides of metal are deposited on the copper blocks. Due to the above reasons, current flow between the rail foot surfaces and the copper block is not continuous resulting in arcing and formation of local melting/denting and even copper penetration at the rail foot surface. Such affected area results in premature fracture. Therefore, after each operation loose oxide/metal shall be cleaned by brushing the copper block surfaces and with compressed air pistol. The copper blocks shall be periodically reconditioned or replaced with new ones, wherever surface depressions exceeding 1 mm in depth are found due to wear.

(vi) Use of treated water for cooling system – The pipes / tubes for circulation of water for cooling purpose are, generally, of small diameter. Due to presence of impurities in water, scaling on the inner side of the pipe takes place resulting in less circulation of cooling water and consequent problems. Therefore, suitably treated water should be used for cooling system. The welding plant should not be operated if the cooling system is non-functional.

(vii) End squareness of rail end faces must be ensured. Better weld strength with minimum value and nearly parallel shape of HAZ can be achieved using prefect matching of rail ends.

(viii) Secondary output of current should be sufficient enough to achieve complete fusion of butting faces of rails.

(ix) Butting stroke should be sufficient for complete coalescence (Not less than 12 mm).

(x) Throughout uniform and smooth auto trimming of the squeezed out metal and complete grinding using profile grinder around the butt joint is essential.

(xi) Minimum and nearly parallel Heat affected Zone of the joint should be achieved by setting the weld parameters.

(xii) Facilities for auto recording of weld parameters including final butting pressure shall be available.

(xiii) When welding is carried out in-situ, minimum 20 minutes time after trimming is required to pass train through the weld with proper packing and support below the joint.

3.1.2 ए टी वेल्डेड रेल जोड़ों पर दोष से बचने के लिए सावधानियाँ/ PRECAUTIONS TO AVOID DEFECTS IN AT WELDED RAIL JOINTS

(i) It should be ensured that the portion being used matches with type and chemistry of rail.

(ii) Rail ends should be square.

(iii) Alignment of rail ends should be perfect as checked by straight edge.

(iv) Rail ends should be properly cleaned with kerosene oil and wire brushes.

(v) Stop watch should be provided to the welding supervisor at each welding site.

(vi) Pressure in the tanks/cylinder should be properly maintained during pre-heating.

(vii) Correct gap between rail ends at head, web and foot shall be ensured.

(viii) Correct preheating time for rail ends shall be ensured.

(ix) Tightness of clips fitted with hose connections to compressor tank and burner shall be checked before commencing preheating.

(x) Nozzles of burners shall be cleaned periodically to avoid back fire.

(xi) The tapping shall be done within the time specified for that particular technique. For special type of welding i.e. 75mm gap, combination joint etc. the time of reaction and tapping shall be as stipulated by RDSO for that particular welding technique.

(xii) Boiling portion shall be tapped outside the welding gap.

(xiii) No moist portion/ torned bag portion shall be used for welding.

(xiv) Dampness in moulds can lead to porosity and early fatigue failure of welds.

(xv) Only those contractual agencies as have clearance from the RDSO/Railway Board can execute welding work. Supply of portions must be from sources approved by RDSO/Railway Board.

(xvi) Many weld failures show evidence of badly cut rail ends. The evenness and verticality of a rail cut depends solely upon the skill of the welder. With portable disc cutters, less skill is required to produce good cut.

(xvii) A Thermit weld done in situ shall be joggle fish plated. (para 502 of IRPWM & USFD Manual Revised -2012). Anti corrosive painting of all the Thermit welds should be carried out as per provision of manual for fusion welding of rails by AT process.

(xviii) The compressor tank shall be kept 2 to 3 meter away from heating torch to prevent fire hazard.

(xix) Welders should be provided with gloves and coloured glasses.

3.1.3 अनुचित वेल्ड निष्पादन की वजह से ए टी वेल्डिंग में प्रमुख दोष/MAJOR DEFECTS IN AT WELDING BECAUSE OF IMROPER WELD EXECUTION

Sr. No.	Type of defect	Cause of defect	Preventive steps to be taken to avoid the defect
1.	Longitudinal crack in rail web.	Cutting of wear resistant grade rails by flame cutting.	Flame cutting of rail ends is prohibited due to likelihood of cracking in web.
2.	Lack of fusion in rail foot.	Flame cutting of rail ends.	When producing the welding gap, never flame cut rail ends without using a cutting guide.
3.	Cold spots-lack of fusion.	Gap between rail ends too wide-rail ends outside the collar formation.	Maintain the welding gap between rail ends specified in the approved parameters of the technique. Never attempt to weld a gap which is too wide, with standard mould.
4.	Cold spot-lack of fusion and associated local porosity.	Mould fitted vertically but off center to the weld gap.	Take care to centralise the mould to the gap. Never try to fit both mould halves simultaneously.

5.	Lack of fusion on foot of one rail end.	Moulds fitted centre to the gap but inclined to the vertical.	Take care to fit mould both vertical and central to the weld gap. Do not incline mould to the vertical.
6.	Gross lack of fusion on rail end.	Standard moulds fitted to rails of dissimilar depth.	Do not try to weld worn to new rail, or rails dissimilar depth with standard mould.
7.	Porosity in the thermit steel.	Luting sand too wet. Luting sand must be moist but not too wet.	Never use wet luting sand.
8.	Sand inclusion in the rail foot and sand-burn marks transversely across the rail head.	Dropping of luting sand into the mould.	Take care when sealing the mould with luting-sand. It must not be allowed to drop into the mould.
9.	Gross porosity throughout the whole weld section.	Use of damp crucible is detrimental to thermit reaction and results in gross porosity of weld metal.	Carefully dry out the crucible lining using the preheating burner.
10.	Gross porosity throughout the whole weld section.	Use of damp portion. Moisture present in portion reacts with aluminium and its characteristics thereby affecting the Thermit reaction and resultant steel. This change cannot be reversed by drying out.	It is essential only to use dry thermit portions. Never use portions which have been damped and dried out.
11.	Gross inclusion of slag in the rail head.	Pouring without the plug in the position.	After preheating, fit the sand core with the riser aperture of the mould and press Down lightly.
12.	Gross slag inclusion in rail head on one side.	Pouring off centre to the plug.	Ensure that the crucible is positioned centrally the over the sand core and the crucible does not move during the thermit reaction. Never allow the thermit steel to pour directly into either pouring gate.

13.	Fracture through weld centre.	Immediate imposition of tensile forces on weld metal cause internal tearing of weld metal which leads to total transverse fracture.	During solidification and immediately after thermit weld should not be subjected to tensile force.
14.	Cracking of weld after cooling at rail ends.	Failure to use the correct thermit portion and welds. Procedure as approved for specific rail section/rail chemistry.	Always check the chemistry and type of rail to be welded and use correct type of Portion and adopt correct welding parameters at the time of welding of rail joints.
15.	Presence of fin in bottom parting line.	Improper mould fixing and improper luting.	Proper mould fixing and proper luting.

3.1.3.1 एटी वेल्ड में हॉफ मून दरार की जांच / DETECTION OF HALF MOON CRACK IN AT WELDS

Half moon cracks are found to be present in the rail foot center of AT welds and are oriented transversely. In AT welds these defects are associated with fins formed during AT welding. For avoiding such defects and consequent failure in service, procedure laid down for visual examination by sectional SSE/JE/P.Way and USFD examination by SSE/P.Way / USFD as per para 8.7 and 8.1 (b) of USFD manual revised -2012, should be followed.


Half Moon Crack

3.2 सेवा के दौरान / DURING SERVICE

3.2.1 रेल व्हील के कारण परस्पर क्रिया / DUE TO RAIL WHEEL INTERACTION

(i) Due to high speeds, heavy axle loads and mixed type of traffic adverse affect on the rails caused rail surface defect, like shelling, spalling, plastic flow of metal, corrugation, head checks etc. are basically due to high stresses in rail. Gauge corner defects are generated leading to shelling and then fracture.

(ii) Rail profile grinding has to be used more intensively to avoid heavy stress at the surfaces of rail wheel contact.

(iii) Due to dynamic stress caused by vertical and lateral loads particularly by vehicle with flats Tyre or when the vehicle runs on the poorly maintained joints.

(iv) Due to skidding of wheels.

3.2.2 रखरखाव के दौरान / DURING MAINTENANCE

(i) Corrosion due to atmospheric conditions in coastal areas.

(ii) De-stressing of rails at higher temperature.

(iii) Non-painting of head collar of AT welds.

(iv) Non-chamfering of fish bolt holes.

(v) Metallurgical defects due to heating, flame/gas cutting of rails or adjacent to rails, since rails are thermally very sensitive. Localized heating produces very hard, brittle and crack metallurgical structure, which may lead to sudden failures.

4. ट्रैक के रखरखाव के दौरान सावधानियां और रोकथाम / Precautions and preventions during maintenance of track

Generally failure took place in winter season, so some of the activities required to be executed in field by maintenance staff, are given below:-

(i) De-stressing of LWR/CWR whenever due. Special attention should be given to the location where high temperature de-stressing was done for BCM or other planned work and de-stressing to be done again at appropriate temp.

(ii) Duty hours of Keymen should be changed so that failures, if any, can be detected in time. Keymen and patrolmen should be suitably trained to detect fractures and to take protective measures.

(iii) WF prone locations of LWR/CWR should be identified and measures like recoupment of missing fitting and de-stressing at lower temperatures for winter season may be taken as per requirement.

(iv) It should be ensured that there are no arrears of USFD testing.

(v) All Arrangements for cold weather patrolling should be made as per para 9.1.2 (ii) of LWR Manual.

(vi) A close watch on rail temperatures should be kept and temperature record register should also be maintained by the SSE (P-Way).

(vii) Rails having corroded flange should be kept under special watch.

(viii) Inspection of LWRs/CWRs & SEJs by SSE/JE (P-Way) as per para 8.1.5(i) of LWR Manual.

(ix) DFWR welds more than three month old to be removed either by replacing the rail or by 75 mm gap AT welding. (As per para 8.14 of manual for ultrasonic testing of Rails & Welds)

(x) Systematic attention to cupped weld and replacement of corroded /wheel burnt or worn out rails should be completed before onset of winter.

(xi) Joggling of A.T. welds should be done in accordance with para no. 502 (CS no. 131 dated 11.01.2013) of IRPWM, which is illustrated below:

(a) A Thermit weld done in situ shall be joggle fish plated with four clamps till tested as good by USFD.
(b) Joggled fish plate with clamps or two far end bolts on good AT welds shall be provided on bank having height 5m or more.
(c) Joggled fish plates with far end tight bolt shall be provided on AT welds which have undertaken traffic equal to or more than 50% of stipulated fatigue life (GMT) of the rail.
(d) For bridges and curves, action as per IRPWM para 277 (a) (7) and para 429 shall be taken, however, these are mentioned below:

Para 277 (a) (7)- joggle fish plate with clamps or two far end bolts on good AT welds shall be provided on bridges having length of water way as 100 m or more and on approaches up to 100 m length.

Para 429- Maintenance of Thermit welds on curves: Joggle fish plate with clamps or two far end bolts on good AT welds shall be provided on curves 3° or sharper.

5. वेल्ड विफलताओं को नियंत्रित करने और ट्रैक पर सुरक्षा सुनिश्चित करने के लिए निर्देश / Instructions for controlling weld failures and ensuring safety on track

5.1 फ्रैक्चर होने का खतरा वाले स्थानों की पहचान / IDENTIFICATION OF FRACTURE PRONE LOCATIONS

Analysis of weld failures should be done on division with special emphasis on causes, nature and frequency of defects to identify the block section & kms., which are prone to fractures. Reasons should be ascertained & time bound preventive /corrective action, as deemed fit should be taken to detect & control the fractures well in time. Particular attention should be given to locations where deep screening has not been done for last more than 5 years, since such locations are more vulnerable with respects to occurrence of weld failures.

5.2 रेलपथ का पराश्रव्य परीक्षण / USFD TESTING OF TRACK

Ultrasonic testing of track should be effectively utilized to control weld failures. Provisions of USFD manual revised -2012 are below for observance:

5.2.1 Frequency of USFD Rail testing on need based concept (NBC) should be ensured as per the following schedule. There should not be any overdue section. Frequency of testing (Rail head centre & Gauge face/ non-gauge face corner) of BG route.

GMT	≤ 5	<5≤ 8	>8≤12	>12≤16	>16≤ 24	>24≤40	>40≤60	>60≤80	>80
Frequency in month	24	12	9	6	4	3	2	1.5	01

(i) Whenever, rails are not tested in manufacturing plant, the test free period shall not be applicable and the rail testing shall be done at the periodicity given as per above table right from the day of it's laying in the field.

(ii) However, the rail having sectional weight & grade equal to or higher than 52 kg/90 UTS shall be ultrasonically tested covering gauge face & non gauge face corner of rail head on passage of every 40 GMT traffic during test free period.

5.2.1.1 In section where BOXNHL wagon are plying, USFD testing should be carried out at a frequency one grade higher than the specified frequency in the USFD manual revise 2012. On section with GMT more than 60 the existing stipulated frequency of USFD manual may be continued.

5.2.2 Frequency of testing of rail head in welded joints by 0^0 & 70^0 probe shall be the same as for rails mentioned above and shall be carried out along with rail testing.

5.2.3 Testing of flange portion of AT welded joints

5.2.3.1 Conventional AT welds: - periodic testing shall be done at every 40 GMT after first periodic test on completion of one year service life by weld.

5.2.3.2 SKV welds: - In SKV process, initial acceptance test is to be done immediately after welding. After one year, first periodic testing is to be carried out. Frequency of subsequent periodic test will be based on GMT and will be as under:

GMT	>45	>30 ≤45	>15 ≤30	0-15
Frequency in years	2	3	4	5

5.2.3.3 The testing interval of USFD testing of defective AT welds (DFWO) should be reduced by 50% of normal testing interval of AT welds to avoid fractures of defective welds. All DFWR welds should be removed from track within 3 months.

5.2.4 The hand probing of weld head / web and bottom flange should be carried out as per the frequency stipulated in para 8.15.1 of USFD Manual Revised - 2012. Instruction exists to test all AT welds on important & major bridges and bridge approaches (100m either side), in tunnels and on tunnel approaches (100 m either side), with the minimum frequency of once in a year. This should be completed before onset of winter.

5.2.5 In case of flash butt welds, normally, there is no need for hand testing (with 45^0 & 70^0 probes); however Chief Engineer may order hand probing with these probes in case failure rates are high in his opinion.

5.2.6 Action to be taken after detection of defects in weld shall be as per para. 6.4 & 8.14 of USFD Manual, revised-2012. All IMR (R) and IMR (W) (welds) should be replaced within 03 days of detection. All OBS (W) should be provided with clamped joggled fish plates within 03 days, after detection of defects in AT welds (DFWO) and (DFWR) action to be taken as per para 8.14 of USFD Manual Revised-2012.

5.2.7 No untested rails by USFD shall be laid in the track whether for new lines or layouts or renewals or for repair works or even temporary works such as service rails for PQRS work. For repairs and casual renewals, a location wise imprest of tested rails of various lengths (13m, 9m, 6m) shall be prescribed for each SSE/P.Way by Sr. DEN/DEN. (Para 252 (4) of IRPWM).

5.3 Cold weather patrolling shall be introduced when rail temperature is less than td-30^0 C.

5.4 Majority of weld failure occur during the early hours of morning. The roster duty hours of keyman in winter should be so adjusted as to ensure one round of track inspection in early morning to enable detection of any weld failure.

5.4.1 Special locations required to be watched by the keyman should be entered in the keyman's book.

5.4.2 The special fittings like joggled fish plates and other material provided in the section which are vital for safety and restoration of traffic should also be mentioned in the keyman's book.

5.4.3 Keyman should be regularly counselled and monitored for ensuring the following special duties and responsibilities in LWR/CWR territories during winter months:

(i) To keep a sharp look out in cold morning, during winters to detect any fractures.
(ii) To take prompt action to protect the track and carry out emergency repairs to permit the restoration of traffic promptly and report to JE/SSE/P.Way and nearest station master as per para 7.2.2 and 7.2.3 of LWR Manual.
(iii) To keep a special watch on the rails and welds marked for observation by the USFD team.

5.4.4 For imposing caution after stopping the first train and passed at a speed of 10 kmph and 20 kmph for subsequent trains for safety, keyman should be provided proforma slips by SSE/P.Ways. Keyman after filling location and speed will hand over the same to Driver or ASM and obtain acknowledgement.

5.5 Ensure that all required equipments for cold weather patrolling are available in working order with SSE/JE (P-Way).

5.6 For urgent temporary repairs of location of weld failures, spare joggled fish plates, clamps wooden blocks should be kept at every km, middle of km, gate lodges and gang huts or even as dummies in the track.

5.7 All Thermit welding should be done by trained staff having valid competency certificate and proper equipments.

5.8 JE/P.Way, SSE/P.Way should invariably visit the site of fractures and adjoining track (1/2 km) on both sides also to find out cause of fracture to see the conditions of track i.e. less ballast cushion, loose packing, missing fitting, conditions of sleeper & condition of rails.

5.9 No. new holes should be drilled without proper equipments and champhering. All locations of the holes in the rails should be visually examined for any cracks.

5.10 Missing fittings be recouped, if any immediately.

5.11 On weld failure prone locations, the following scheme of things should be tried in the worst weld failure locations at least one km either lines (UP & DN both or SL), consecutively.

(i) New rubber pad should be provided on first adjacent sleeper in addition to existing rubber pad, with the new ERCs.
(ii) On the second adjacent sleepers of either side of weld rubber pads should be replaced with new one along with ERCs.
(iii) These locations should be monitored very closely for change in behavior and action to be taken accordingly.

6. सम्बंधित चित्र/Related figures



Flash Butt Weld Failure



A.T.Weld Blow Hole at Foot



AT Weld Failure Horizontal



Big Hole in AT Weld Riser



Porosity in The Thermit Steel



Riser High in AT Weld

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संदर्भ / REFERENCE

01	Manual for Flash Butt Welding of Rails
02	Manual for Fusion Welding of Rails by the Alumino-Thermic process.
03	Manual for Ultrasonic Testing of Rails & Welds
04	CTE/NCR/Allahabad's Instructions dated 14.09.2015.

टिप्पणी / NOTES

गुणवत्ता नीति

रेलों में यात्री और माल यातायात की बढ़ती माँग को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली में अनुसंधान, डिज़ाइनों और मानकों में उत्कृष्टता तथा सतत सुधारों के माध्यम से सांविधिक और नियामक अपेक्षाओं को पूरा करते हुए सुरक्षित, आधुनिक और किफ़ायती रेल प्रौद्योगिकी का विकास करना।

QUALITY POLICY

To develop safe, modern and cost effective Railway technology complying with Statutory and Regulatory requirements, through excellence in Research, Designs & Standards and Continual improvements in Quality Management System to cater to growing demand of passenger and freight traffic on the Railways.

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हमारा उद्देश्य

अनुरक्षण प्रौधौगिकी और कार्यप्रणाली को उन्न्यन करना तथा उत्पादकता और रेलवे की परिसम्पत्तियों एवं जनशक्ति के निष्पादन में सुधार करना जिससे अंतर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस संदर्भ में कोई विचार और सुझाव देना चाहतें हों तो इस पते पर लिखें।

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Our Objective

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

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