Addendum & Corrigendum Slip No. 04
To
The Manual for Flash Butt Welding of Rails (Reprint-April 2022)

1. Existing Para 3.1.2 is replaced with the following:

3.1.2 **Permissible vertical wear of rails to be welded**: The vertical wear in old rails to be welded (measured as per Para 702 (1)(b)(iii) of Indian Railways Permanent Way Manual) shall be within the limits specified below:-

Rail Section	Standard height of the new rail	Minimum height of worn rail
60kg (UIC)/60E1	172.00 mm	164.00 mm
IRS-52kg	156.00 mm	150.00 mm

2. Existing Para 3.1.3 is replaced with the following:

3.1.3 **Permissible lateral wear of rails to be welded**: Old rails to be welded shall preferably show similar pattern of side wear and the minimum width of rail head shall be as specified below:-

Rail Section	Standard width of the head of new rail	Minimum width of the head of old rail
60kg (UIC)/60E1	72.00 mm	66.00 mm
IRS-52kg	67.00 mm	61.00 mm

3. Existing Para 3.2 is replaced with the following:

3.2 DIFFERENCE IN HEIGHT OF RAIL ENDS TO BE WELDED: The individual rail ends for new rails may have a maximum difference in height of 1.2mm at the welded joints. This is illustrated in Fig.3.2. The difference in height shall be transposed to the foot of the rail.

4. Existing Para 3.3.1 is replaced with the following:

3.3.1 The difference in the width of rail heads of two rails to be welded shall not exceed 1.0mm for new and 2.0mm for old rails. For new rails, it is preferable to restrict the difference in width of rail heads to 0.5mmby adopting procedure laid-down in Para 4.2.

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5. Existing Para 5.3.4.1(third line) is replaced with the following:

- 110 UTS and R350HT Grade rails- 7 Kg/mm^2 on cross sectional area.

6. Existing Para 5.4 is replaced with the following:

5.4 POST WELD HEAT TREATMENT: 72 UTS and 90 UTS rails do not require any special post weld heat treatment. Head hardened and heat treated rails need post weld heat treatment to ensure the variation in hardness within acceptable limits in heat affected zone. Typical post weld heat treatments for head hardened/heat treated rails are given in Annexure II. However, any other suitable advance technique for post weld heat treatment may be adopted and shall be mentioned in the QAP of flash butt welding plant.

7. Existing Table 1 of FBW Manual is replaced with the following:

Table 1

VALUES OF MINIMUM BREAKING LOAD AND DEFLECTION IN TRANSVERSE LOAD TEST

SN	Rail Section & Grade	Span (in meter)	Min. breaking load (in Ton)	Minimum deflection at the center at the actual transverse breaking load (in mm)	Frequency of testing	
					Stationary FBW Plant	Mobile FBW Plant (working as mobile or in stationary mode)
1	60E1 Grade-R350HT	1.00	163 (1600KN)	20	1 in 100*	1 in 100*
2	60E1 Grade-R260	1.00	150	20	1 in 100**	1 in 100*
3	60 kg (UIC)/ 60E1, Grade-1080HH	1.25	115	30	1 in 500	1 in 100*
4	60 kg (UIC)/60E1 90 UTS Grade-880/ R260NC	1.00	150	20	1 in 1000	1 in 100*
5	IRS-52 kg 90UTS	1.00	115	20	1 in 1000	1 in 100*

6	60 kg UIC MM (72 UTS)	1.00	135	30	-do-	1 in 100*
7	52 kg MM (72 UTS)	1.00	100	30	-do-	1 in 100*

* Sample joints for first 1,000 joints will be tested at frequency of 1 in 100 joints and subsequently at a frequency of 1 in 500 joints.

** Sample joints for first 1,000 joints will be tested at frequency of 1 in 100 joints and subsequently at a frequency of 1 in 1000 joints.

8. Existing Para 13 is replaced with the following:

13. WELDING TEAM FOR MOBILE/STATIONARY FLASH BUTT WELDING PLANT

13.1 Welding team may consist of minimum one supervisor and two welders. The educational qualification of supervisor should be min. Diploma in Mechanical/ Electrical Engineering or BSc and that of welder should be minimum class X or equivalent, passed. Welders and supervisor already working in Mobile/Stationary FBW Plant may continue if Chief Track Engineer/Chief Engineer (construction) is satisfied about the quality of welds by these operators. Zonal Railways shall also ensure periodical training of welders and Supervisors of Mobile/Stationary Flash Butt Welding Plants.

13.2 Test for competency certificate of supervisor/welders of Mobile/ Stationary Flash Butt Welding Plant will be conducted by concerned Zonal Railway/PSU/Metro Railway as per this Manual and after satisfactory result; the competency certificate will be issued in the proforma given in Annexure-XII by the authority as detailed in (i) & (ii) below.

(i) Competency certificate to welding team (supervisor & welders) of Stationary Flash Butt Welding Plants (Departmental / Rail manufacturing Agencies) shall be issued by CTE of concerned Zonal Railway.

(ii) Competency certificate to welding team (supervisor & welders) of Mobile Flash Butt Welding Plants shall be issued by CTE/Chief Engineer (construction) of concerned Zonal Railway /General Manager (equivalent to SA grade officer and above) of concerned PSU/Metro Railway.

For guidance, test scheme as well as syllabus for written test and interview is given as under:

13.2.1 **Part-I** (Written Test and Interview)

13.2.1.1 Written Test

(i) Welding parameters and its influence on quality of welding and heat affected zone.
(ii) Suitability of rail for welding.
(iii) Preparation of rails to be welded including pre-straightening of rails.
(iv) Procedure of welding of rails.
(v) Record of welds.
(vi) Post weld straightening of joints.
(vii) Finishing of joints.
(viii) Marking of joints.
(ix) Testing of welds.
(x) Precautions to avoid defects in Flash Butt Welding rail joints.

13.2.1.2 Interview

A personal interview of these candidates shall be taken by competent authority as per syllabus. The candidate must be conversant with details of Flash Butt Welding of rails and the machine, welding defects, their causes and remedies. The candidate found suitable in interview shall be allowed for further tests.

13.2.2 **Part-II** (Practical Test)

Six number of test welds shall be made by welder in presence of competent authority. The length of rail piece shall be minimum 0.75 meters of 90 UTS or higher grade rails. Any rail section/sections may be used free from any external and internal defects. Examination of welded rail joints shall be done as per clause 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2 and 10.2.3 of this Manual.

On the basis of test conducted as mentioned above, competency certificate shall be issued for rail sections/grades as under:

Sl. No.	Practical test conducted on rail section/grade	Competency will be valid for FB welding of rail section/grade
1	90 UTS	90UTS (60 Kg, 52 Kg, R260, R260NC) & 72UTS rails
2	1080HH/R350HT	1080HH, R350HT, 90UTS (60 Kg, 52 Kg, R260, R260NC) & 72UTS rails

13.3 Validity of competency certificate: Validity of competency certificate of supervisor/welders of Mobile/Stationary Flash Butt Welding Plants shall be as under:

(a) Supervisor/Welders of Mobile Flash Butt Welding Plant- One year from the date of issue

(b) Supervisor/Welders of Stationary Flash Butt Welding Plants-Two years from the date of issue

9. A new Para No. 15 is added as under:

15 Periodic Quality Audit: Periodic quality audit of Flash Butt Welding Plants shall be conducted as per schedule given below:

15.1 Periodic Audit of Stationary FBWP:- RDSO to conduct periodic audit once in three years.

15.2 Periodic Audit of Mobile FBWPs:- Zonal Railway should nominate an official for periodic audit of Mobile FBWP once in a year during contract period and submit report to RDSO. Further, RDSO has to conduct periodic audit once in three years.

15.3 It will be responsibility of the Railway/agency to approach RDSO for quality audit of their Stationary/Mobile Flash Butt Welding Plant at least three months in advance from the due date of quality audit (three years from the date of approval of QAP/previous audit).

15.4 In case the firm has not offered their plant for periodic quality audit by RDSO, concerned QAP will become invalid automatically after completion of three years from the date of its approval/ previous quality audit and the same will be deleted from TMS. If periodic quality audit of the plant is delayed on the account of RDSO, the QAP shall remain valid till such time quality audit is performed by RDSO.

10. Existing footnote at Annexure-IV is deleted:

11. Existing sub para (iv) of Annexure-IV B is replaced with the following:

Head finishing (on top table surface): + 0.2 mm at the centre of a 10cm straight edge.

12. Existing Annexure-I is deleted:

ANNEXURE-I
(Para-5.4)

POST WELD CONTROLLED COOLING TREATMENT FOR 110 UTS ALLOY STEEL RAILS

------Deleted------

13. Existing Annexure-II is replaced with the following:

Annexure-II
(Para 5.4)

POST WELD AIR QUENCHING TREATMENT FOR FLASH BUTT WELDING OF 60 KG HEAD HARDENED/HEAT TREATED RAILS

During welding of head hardened/ heat treated rails using the normal welding procedure, the average hardness of the HAZ of the rail becomes considerably less than the parent rail hardness. This lower hardness is due to transformation of rail steel occurring at a cooling rate much lower than that achieved during the original head hardening operation. Such a hardness difference can lead to differential plastic deformation during the wheel-rail contact which may cause localised cupping on the running surface at the welds.

Head hardened/ heat treated rails, therefore, must be subjected to controlled cooling treatment (slack quench) to improve the sagging heat affected zone hardness.

A fabricated air quenching gadget as shown in Figure 5.4(b) shall be used for enhanced cooling of the rail joints made with head hardened/ heat treated rails. The length of this gadget is approx. 250mm and width 190mm. There are series of drilled holes of 3mm diameter in the gadget and their position is shown in figure. The gap maintained between the inner faces of the gadget is approx. 120mm which will enable gap of approx. 25mm between the railhead side surfaces and the gadget. This will result in efficient application of air quenching jet. Within one minute of welding, air quenching should be carried out while the rail surface temperature is in the region 900-950^{0}C. The air pressure should be approximately 2kg/cm^2 and duration of application should be about 1 minute.

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14. Existing Annexure-X is replaced with the following:

ANNEXURE-X
(Para-5.6.2)

Procedure to be followed for approval of Quality Assurance Program (QAP) for Mobile Flash Butt Welding Plants

1.0 The mobile flash butt welding plants used on Railways are mostly outsourced. In order to expedite the approval of QAP and minimize the time gap between award of contract and start of work, the following procedure shall be followed.

2.0 **Submission of General Quality Assurance Programme:**

2.1 The general QAP, containing the information as per Annexure-XI of Manual shall be submitted in soft copy in pdf format of size<20MB to RDSO by the agency/ Plant owner separately for each Mobile Flash Butt welding Plant proposed to be deployed. Availability of Railways' order (Letter of acceptance) will not be required at this stage.

2.2 The complete QAP (excluding details of welding team, and standardized welding parameters) so submitted by the firm will be scrutinized and approved by RDSO after ensuring compliance of relevant provisions of this manual.

2.3 Approved soft copy of General Quality Assurance Programme will be issued to the concerned agency, which has approached for approval.

3.0 **Approval of Welding Team:**

3.1 Once the contract is awarded, the firm will approach concerned Zonal Railway/PSU/Metro Railway for approval of welding team as per Para 13 of Manual.

3.2 The competency certificate to welding operators and supervisors will be issued by Chief Track Engineer/Chief Engineer (Construction) of Zonal Railway/GM (equivalent to SA grade officer and above) of PSU/Metro Railway after conducting necessary test as per Manual and other instructions on the subject.

4.0 **Submission of Final Quality Assurance Programme:**

4.1 After the agency has got the welding team approved by concerned Zonal Railway/PSU/Metro Railway, the firm will undertake internal test to provisionally fix the welding

parameters for rails of different sections/ metallurgy as required to be welded.

4.2 After completing above exercise, the agency will submit the final Quality Assurance Programme (Duly updating the earlier approved General QAP with details of welding team approved by Zonal Railway/PSU/Metro Railway with competency certificates and welding parameters as decided by the firm during internal test) to RDSO through concerned Railway/PSU/Metro Railway Administration for standardization of welding parameters and approval of final QAP.

5.0 **Standardization of Welding Parameters and approval of QAP:**

5.1 After the final QAP submitted is found satisfactory during scrutiny, the standardization of welding parameter for concerned Rail section/ UTS as requested by agency/ Zonal Railway/PSU/ Metro Railway will be undertaken by RDSO as per Para 5.6 of Manual.

5.2 The standardized welding parameters and marking code allotted by RDSO will be attached with the final QAP submitted by the agency/ Zonal Railway/PSU/Metro Railway. The final QAP duly containing the standardized welding parameters shall be approved by RDSO and issued to the concerned Zonal Railway/PSU/Metro Railway and the firm for undertaking the Flash Butt welding work as per provisions of this Manual.

5.3 The adherence to provisions of Manual and QAP will be ensured by the concerned Zonal Railway/PSU/Metro Railway.

6.0 **Validity of QAP**:

6.1 The Final Quality Assurance Programme (QAP) of a particular Mobile Flash Butt Welding Plant need not be re-approved by RDSO unless the firm has failed to get the quality audit conducted by RDSO within stipulated time as mentioned in Para 15 or there is major change in Quality Control setup or new type of rail to be welded or there is a revision/amendment to FBW Manual to provisions related to quality assessment of FB welds/procedure of welding/ methodology of standardization of welding parameters. The final decision whether there is major change in Quality Control setup or not will rest with the Chief Track Engineer/ Chief Engineer of Zonal Railway and GM (equivalent to SA grade officer and above) of PSU/Metro Railway, where plant is being deployed.

6.2 In case of change of operator/ supervisor or expiry of their competency certificates, concerned Zonal Railway/PSU/Metro Railway shall take action for approval of welding team.

Approved competency certificates shall be attached with the RDSO approved QAP.

15. Existing Annexure-XI is replaced with the following:

ANNEXURE-XI
(Para-5.6.2)

Information to be provided in Quality Assurance Programme for Mobile/Stationary Flash Butt Welding Plants

1. Cover page of the QAP

   This shall indicate the Name and relevant details of the Agency; Details of Flash Butt Welding machine (Make, Model & Serial no. etc. and carrier vehicle registration no. in case of Rail-cum-Road Vehicle type Mobile Plant).

2. Index.

3. Brief description about the firm/ company and General information about the addresses and contact numbers of office and work stations, branches and sister concerns and the details of ISO certification, if firm is already a ISO certified company having Operation and maintenance of Mobile/ Stationary Flash Butt Welding Plant in scope. If firm is not already ISO certified, ISO certification including Operation and maintenance of Mobile/ Stationary Flash Butt Welding Plant in scope shall be ensured before submission of Final QAP.

4. If firm is ISO certified,

   (a) Quality policy of the company as per ISO certification.

   (b) Certificate to this effect that the approved QAP is a controlled document and a quality record of ISO quality control system of the vendor.

5. Organization chart emphasizing quality control set-up.

6. Qualification and experience of key personnel and officials deployed for operation and in quality control cell including supervisor and welders of the machine.

   Details of competency certificate of the welders and supervisor issued by Zonal Railway/PSU/Metro Railway as per clause 13.2 of Manual shall be specifically indicated.

7. Brief description on the Mobile/Stationary Flash Butt Welding Machine and other machinery & plant deployed. (Serial no., model no., make, date of manufacturing, AMC details and brief working procedure of the machine).

   (Mobile/Stationary Flash Butt Welding machine must have facility for display and storage of all the welding parameters in re-producible electronic forms at the time of F.B. welding of rail joints. A certificate in this regard along with brief on the facility for display/ storage capacity of the machine must be specifically mentioned in the QAP).

8. Recommended Welding parameters for various rail sections and rail metallurgies as per operating manual of FBW machine specified by Manufacturer.
9. Process flow chart for complete process (from receipt of rail to dispatch of welded panels).
10. Procedure for Standardization of welding parameters as per clause 5.6 of the manual.
11. Procedure of the field approval of welding procedure as per clause 5.7 of Manual in case of MFBWP.
12. Quality Assurance System covering the following:
    (a) Scope
    (b) List of standards, codes and reference documents.
    (c) Inspection & Testing process of incoming rails as per clause 2 to 4 of Manual.
    (d) Detailed description of procedure of regular welding of rails.
        (i) Welding Process and In process check:
            - Inspection of Copper/ Melloroy electrodes for electrical contact.
            - Rail alignment.
            - Welding sequence including stripping.
        (ii) Weld Record for each joint duly indicating actual weld parameters vis-à-vis parameters standardized by RDSO.
        (iii) Post weld heat treatment for 110 UTS, HH & R350HT rails, if applicable.
        (iv) Post weld straightening.
        (v) Finishing of joints to achieve geometrical standards given in Annexure IV of Manual.
        (vi) Marking of joints for Mobile/Stationary FBW plants. (Marking code shall be assigned by RDSO at the time of approval of final QAP).

        The formats duly indicating the frequency of in process check shall be part of QAP.
    (e) Product Control:
        (i) Tests for every flash butt welded joint.
            - Visual inspection.
            - Dimensional check.
            - Ultrasonic test.

(ii) Additional Tests on sample flash butt welded joint.

- Hardness test.
- Transverse Load test.
- Macro examination.
- Micro examination.

Formats as per Manual for each of the above mentioned tests shall form part of QAP.

(f) System Control as per clause 11 to 14 of Manual as under:

(i) Handling of high strength rails, if applicable.

(ii) Periodical maintenance of mobile/stationary flash butt welding machine as per procedure and frequency laid down by OEM (Original Equipment Manufacturer).

(iii) Periodical inspection of mobile/stationary flash butt welding machine by OEM or his authorized representative at an interval of two years or execution of 20,000 joints whichever is earlier to conduct technical audit of its health, as per clause 14.1 of Manual.

(iv) Availability of sufficient stock of genuine spares.

(g) List of various gauges/ templates e.g. feeler gauge, straight edge etc. along with their calibration status and plan.

13. Quality Assurance System- Inspection & Testing covering the following:-

S. No.	Process	Sample size and frequency of inspection/testing wherever applicable	Parameters for inspection/tests	Method/measuring/ equipments	Accuracy	Acceptance limit/ specified value	Reference documents	Standard format no. for maintaining results	Rejection details (reprocessed/ scrapped)

14. List of tools & plants and testing equipments available with FBW machine for execution of rail welding along with calibration status and plan.

15. List of Registers maintained and their standard formats with unique number.

Following registers/records are mandatory:

1. Record of Weld Register (Proforma as per Annexure –III of Manual),
2. Dimensional Check Register (Proforma as per Annexure–VIA of Manual),
3. USFD Test Register (Proforma as per Annexure – VIB of Manual),
4. Hardness Test Register (Proforma as per Annexure – VIC of Manual),
5. Transverse Load Test Register (Proforma as per Annexure– VID of Manual),
6. Macro Examination Register (Proforma as per Annexure– VIE of Manual),
7. Micro Examination Register (Proforma as per Annexure– VIF of Manual).
8. Daily Progress Register (Proforma as per Annexure–'A' attached),
9. Joint Rejection Register (Proforma as per Annexure –'B' attached),
10. Customer Complaint Register (Proforma as per Annexure– 'C' attached).

16. A blank format as given below shall be part of the final QAP of mobile flash butt welding plant for entering the details regarding movement of the machine and work executed. This format shall be placed after Index page of QAP. While submitting initial QAP for approval, Column no. 1, 2, 3 & 6 shall be filled by the firm. During movement of the machine from one work site to another work site against a contract agreement/ different contract agreement details shall be filled and signed by firm and Railway/PSU officials in the proforma.

Movement details of Mobile Flash Butt Welding Plant

Sl. No.	Railway	Division/ Section	Period		CA/WO No. and quantity of FB welds ordered	Name of welder	FB Welds executed	Cumulative FB welds executed	Signature	
			From	To					Firm's official (Plant in-charge)	Railway officials with designation
1	2	3	4	5	6	7	8	9	10	11

17. The QAP covering all the information must be given in the form of single document indicating name of the firm, effective from, document no., revision number and page no. 'x' of 'y' on each page. QAP shall be digitally signed by (with name and designation) 'Prepared by', 'Checked by' (QC in-charge) and 'Approved by' by competent authority. All certificates/supporting documents shall be attached as Annexure to the QAP. In case of General QAP, details of welding team, and standardized welding parameters need not to be included.

16. A new Annexure-XII is added as under:

Annexure-XII
(Para 13.2)

COMPETENCY CERTIFICATE

Welder's/Supervisor's official ID No.: _____,

Adhar No.:_____

Photo duly attested by issuing authority

(Signature of Welder/Supervisor)

Shri _____FB welder/supervisor son of Shri _____ sponsored by M/s _____ has been examined as per procedure and syllabus mentioned in Para 13 of the Manual for Flash Butt Welding of Rails-Revised 2012 (Reprint April 2022) with latest amendment. He has been found competent to execute flash butt welds with mobile/stationary flash butt welding plant model:_____, Make: _____.

This competency certificate is valid upto_____for FB welding of ----------{rail section(s)/grade(s)}

Date: _____

(Signature)
Chief Track Engineer/Chief Engineer (Construction)

_____Railway,

or

(in case of PSUs/Metro Railway)
Name:
Designation with Grade:
Name of Organization
Seal:

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