ISRAEL RAILWAYS LTD
INFRASTRUCTURE DIVISION
TRACK AND RIGHT OF WAY DEPARTMENT

Technical specifications

for the

Flash Butt Welding of Rails

by Mobile Welding Machine

No. E-11-041AB

October 2009
Contents

1. SCOPE 2
2. GENERAL WORKING CONDITION 2
3. TRACK CONDITION 5
4. WELDING RAILS PROPERTIES 6
5. PROCEDURE APPROVAL OF A MFBW MACHINE 6
6. INITIAL APPROVAL OF THE WELDING CONTRACTOR 7
7. FIELD APPROVAL OF THE WELDING CONTRACTOR 8
8. REQUIREMENTS FOR THE WELDING PROCESS 8
9. PROFILE FINISHING OF THE RAIL HEAD 10
10. ADDITIONAL REQUIREMENTS 11
11. QUALITY OF THE WELDS AND WELD INSPECTION ACCEPTANCE REQUIREMENTS 15
12. REJECTION OF WELDS 18
13. TIME FOR CARRING OUT REPAIR WELDS 18
14. CONTRACTOR QUALITY ASSURANCE 19
15. CONTRACTOR’S WARRANTY 19
16. SAFETY PRECAUTIONS 20
17. TECHNICAL DOCUMENTS TO SUBMIT 20
APPENDIX A - DEFINITION OF AREAS OF INSPECTIONS 21
APPENDIX B - GEOMETRIC TOLERANCES 22
APPENDIX C - SAMPLE PAGE OF LOG BOOK 23
1. **SCOPE**

1.1 In accordance with this technical specification, welding of the rails should be carried out by the Electric Flash Butt Welding Method, by means of mobile, self-propelled, equipment having the capability to move on track with standard gauge (1435 mm) as well as on roads and for that purpose, the welding equipment should be mounted on a vehicle having a chassis with two separate sets of axles, one set with railway track wheels and the other with pneumatic wheels.

1.2 Unless specified otherwise, weld production, approval procedure for mobile flash butt welding (MFBW) machine, approval of the welding contractor should be in full conformity with the latest edition of EN 14587-2 **Railway applications - Track - Flash butt welding of rails Part 2: New R220, R260, R260Mn and R350HT grade rails by mobile welding machines at sites other than a fixed plant**.

1.3 The entire welding process should be automatic, computer-controlled, and with graphic recording of the welding parameters during the welding process. Computer outputs of these graphs should be submitted to the Israel Project Manager (IPM) for each and every weld after the weld is completed.

1.4 The welds should be carried out by the contractor as ordered by Israel Railways Ltd. from time to time, in writing on the new and existing lines.

2. **GENERAL WORKING CONDITION**

2.1 The contractor should weld the rails into track units of approximately up to 900 m length each. These units should be welded to one another only after track distressing. At curves and/or special locations, track units of different length may be prescribed by the IPM, but this will not entitle the Contractor to any claim on such behalf.
2.2 It should be the contractor's responsibility to make sure before performing any weld, that the rail ends are straight and free from deformations, distortions and defects. Welds performed by the contractor on defective rails and/or on rails with deformed or distorted ends will not be paid for and the contractor should cut away such welds, at his own expense. Should the contractor reveal rails with defects as aforementioned, he should inform the IPM and should act in accordance with his instructions.

2.3 Rail cutting should be carried out only by means of mechanical or disc saws of type and model subject to the IPM's prior approval.

2.4 Rails with torch cut edges should be cut again by the contractor, using a saw or disc. The new cut should be carried out at a distance of 50 cm from the torch cut edge or even greater distance as may be directed by the IPM.

2.5 In order to bring each pair of adjacent rails into proper alignment and position as required for welding, it will be necessary for the contractor to release rails from their fastenings, to displace ballast and sleepers and to cut rails. Displaced ballast and sleepers should be put back by the contractor in their respective initial positions and the contractor should make sure that the regular axial distance between adjacent sleepers remains unchanged.

2.6 The contractor's attention should be drawn to the fact that various signaling devices are installed along the track and may interfere with the contractor's work. However the contractor should not dismantle, remove or relocate any of the said devices and he should report to the IPM and act in accordance with his instructions.

2.7 Following the welding operation, the contractor should fasten back the rails to the sleepers. For this purpose, only the use of power screwing machines equipped with torque-meters will be permitted and the measured tightening torque should not exceed the range of 230-250 Newton meter.
The contractor should not remove fastening screws from their dowels, in order to prevent penetration of ballast particles or other foreign material into the dowel, a fact which may cause the sleeper to break when the screw is fastened again. Sleepers which will be damaged as a result of the contractor's neglect to comply with this requirement, should be replaced by the contractor, at his own expense.

2.8 At the end of each working day the contractor should collect all the fishplates and their bolts, spring washer and nuts. Each pair of fishplates should be connected into one unit, with the corresponding bolts, spring washers and nuts. All fishplate units should be delivered by the contractor at a location as determined by the Israel Railways Section Supervisor. Cost of these works enters into cost of welding.

2.9 The contractor should clean up the area between the sleepers on both sides of each weld from any dirt and deleterious material and he should put back in place any displaced ballast.

The contractor should not dump any waste material within the railway's right of way and/or its vicinity and/or drainage channels along the track.

2.10 The contractor should fill missing rails during welding process every 400-600 meter (according to the IPM instruction) by rails segments of length 6-9 meter.

2.11 If the contractor works on the existing line, at the end of each working day the contractor must leave the track in a clean and orderly state, fit for the safe traffic of rolling stock and passage of work trains and mechanical track equipment. Leaving the track in the state as aforementioned should include the completion of the final grinding of all welds carried out to the tolerances as hereafter mentioned.

2.12 The contractor should provide all equipment and materials for performance the works, including the equipment for transportation of the rails segments. The equipment should
be subject to the IPM approval, in respect of quality. Any equipment approved by the IPM, brought to the site and found defective, whether before being used or in the course of the works, should be removed from the site by the contractor, at his own expense, and the contractor should provide adequate, approved equipment instead of the removed one. Should such action be found necessary, it should not relieve the contractor from his obligations to complete the works in compliance with contract documents.

2.13 Transportation of all equipment, materials, workmen, etc., in connection with the contractor's work under this contract, as well as storage, watching, etc., should be carried out by the contractor, at his own expense and responsibility. All taxes, fees, wharfage fees (“D’mai Ratzif”), Insurance, duties, custom duties, licenses cost or other payments that are to be paid in connection with the welding works, including but not limited to transportation costs should be considered as part of the weld price and should be borne solely by contractor. At work in the tunnels contractor should supply necessary equipment for ventilation on a workplace.

3. **TRACK CONDITION**

3.1 The track should be consisted of UIC-54, UIC-60 rails connected by means of Vossloh W14 or equivalents fastenings to monoblock sleepers or by means of Vossloh system 300 or equivalents fastenings to slab track.

3.2 Generally, the rails are 18 meter in length, but the IR reserves the right to use rails of different length and the contractor should not be entitled to any claim on such behalf.

3.3 Maximum track gradient is 3 %.

3.4 Minimum curve radius is 250 meter.

3.5 Maximum length of free rail welding capability should be 900 meter.
3.6 The rails to by welded will by already in place before the contractor are given position of the site of works. The rails will be connected by means of fishplates, one pair per rail. Each pair of fishplates will be fastened by two bolts with spring, washers and nuts or with clammers. The track to be welded will already have been tamped, the ballast has been spread and sleepers will be covered, entirely or partly, with ballast material.

3.7 IR reserves the right to use contractors welding machine for ballastless track.

4. **WELDING RAILS PROPERTIES**

4.1 The new rails are with profile UIC-54, UIC-60 according to EN 13674-1.

4.2 The rail grade: R260 (900A).

4.3 Welding should be performed on rails with and without drilled bolt holes. For rails with bolt holes, the centers of the holes should not be closer than 150 mm from the rail ends. The contractor should not weld rails having holes which located closer than 150 mm from the rail ends. Such rails should be encountered on-track. The contractor should immediately inform it to the IPM.

5. **PROCEDURE APPROVAL OF A MFBW MACHINE**

5.1 Procedure approval should be carried out for each individual machine (no type approval) by testing weld samples produced in accordance with EN 14587-2. Approval test include visual inspection, step across the weld measuring, magnetic particle or dye penetrate examination, bend testing, macro examination, micro examination, hardness testing, fatigue testing.

5.2 The fatigue test should be either a staircase test or past the post test.

5.3 Procedure approval testing should be carried out on the rail profile 60-E1 grade R260.
5.4 In additionally, bend test for UIC 54E1, rails R260 should be preformed. The test result should be reported according to section 5.4 of EN 14587-2.

5.5 Minimum bend test requirements for MFBW machine approval must be:
For UIC 60E1 R260 rails:
- Minimum bend test deflection - 20mm,
- Minimum bend test force - 1600 kN.

For UIC 54E1 R260 rails:
- Minimum bend test deflection - 25 mm,
- Minimum bend test force - 1330 kN.

5.6 The Approval test results must be given by the contractor to IR before the beginning of the welding works.

5.7 In event of reduce in the welding quality the IR should have the rights to request for additional approval test.

6. **INITIAL APPROVAL OF THE WELDING CONTRACTOR**

6.1 Initial approval of the welding contractor should be provided according to section 7.2 in EN14587-2.

6.2 The welding contractor should be use welding procedures and MFWB that are approved in accordance with the requirements according to section 5 in EN 14587-2.

6.3 The contractor should operate an independently approved and audited quality management system.

6.4 The welding contractor should maintain a system that ensures the competence of their welding operators by appropriate training and assessment. Rail welding should be carried out by experience welders certified for this purpose by any official railways authority or manufacturer of the welding machines. The contractor should not be permitted to employ welders with an experience of less 500 flash butt welds. Furthermore the employment of every welder should be subject to approval by the IPM.
The IPM will be entitled to disqualify any welder whose performance in unsatisfactory or to demand that such welder passes additional qualification tests which should be determined by the IPM.

6.5 The welding contractor should maintain a management and supervision system of flash butt welding that complies with the requirements of this Technical Specification.

7. FIELD APPROVAL OF THE WELDING CONTRACTOR
The approval should be granted after execution of 30 welds on track (carried out in 2 shifts) if they satisfied the weld acceptance criteria in this Technical Specification.

8. REQUIREMENTS FOR THE WELDING PROCESS
8.1 All welding should be carried out on a mobile flash butt welding machine using an automatic, programmed welding sequence or sequences in according to last edition of EN 14587-2. The welding program (setting) should be determined during procedural trials and once approval has been granted, should not be changed.

8.2 Areas of electrical contact on the rails and the machine should be cleaned to bright metal to give a consistent and good electrical contact at the interface. The rail brand markings should be removed as necessary from any electrical contact area.

8.3 Rails of the same profile should be positioned in the welding machine such that the welding interface is central to the contact electrodes.

8.4 Rails should be secured in the welding machine by clamps of such a surface shape or contour, that when a clamping force is exerted on the rails, there should not be any deleterious marking of the rails.

8.5 Horizontal and vertical alignment must be done completely automatically.
8.6 Any step between the rails across the weld in the welded condition (after trimming only) shall not exceed those dimensions:
- Vertically on the longitudinal centerline of the running surface - 0.5 mm,
- Horizontally on the aligned face or edge 14 mm below the running surface - 0.5 mm,
- Horizontally on both edges of the rail foot - 2.0 mm.
Checking should be made using the gauge according to section 4.9 in EN 14587-2.
A weld with a step exceeding the maximum dimension as specified in that section should be removed from welded string. The weld should be removed by cutting at a minimum distance of 100 mm on each side weld.

8.7 The rail should not be damaged either thermally or mechanically by the cleaning operation, the removal of brand markings or through poor electrical contact. Rails of the same profile should be positioned in the welding should immediately follow progressive flashing. Sufficient forging pressure should be applied to ensure that voids are closed and oxides are expelled such that they are kept to a minimum at weld interface. The weld interface should extend into the upset.

8.8 Excess upset should be automatically trimmed. Weld trimming should conform to requirements of section 4.10 in EN 14587-2. Removal of the excess upset should not cause any mechanical or thermal damage to the rails. The surface of the trimmed area should be free from cracking. Attention should be given to any small cracks at the edge of the trimmed upset occasioned by the exit of the shear blades, that it should be confirmed they are contained within the upset. Any dressing of the weld following the removal of upset should not cause damage to the rail or weld nor reduce either to a dimension below the original rail profile.
9. **PROFILE FINISHING OF THE RAIL HEAD**

9.1 **Initial grinding**
Initial grinding must be produce according to section 8.8.1 in EN 14587-2.

9.2 **Final grinding**
Profile finishing grinding of the rail head should be carried out and contained in the shortest possible length but should not exceed 250mm for each side of the weld.

9.3 **Geometrical acceptance criteria**
The straightness of the welded joint after profile finishing should be measured vertically and horizontally within a 1m span. The horizontal straightness of the rail head should apply to running edges only. Field side of the rail head should be ground to profile for ultrasonic testing.

- Vertically weld alignment on the running surface should be from +0.1mm up to +0.3mm.
- Horizontally weld alignment on the rail head should be from 0mm up to +0.3mm.
- Running surface flatness, measured over the length of the ground area must be not more 0.15mm.

Straightness and flatness across the weld should be measured according to EN 14587-2 as follows:

- The vertical straightness across the running surface should be measured along longitudinal centre line of the rail with the weld centrally between and referenced to datum points of the rail 500mm either side of the weld.
- The horizontal straightness of the weld across the rail head should be measured on the gauge face at a point approx. 14mm below the raining surface and referenced to datum points on the rail 500mm either side of the weld centerline.

a) The running surface flatness at the level of weld should be measured by means of 1m straight edge positioned over the ground area. The maximum gap between the straight edge and the ground running table of the rails should be not more 0.15mm.
9.4 The welding machine and/or management system equipment should be capable of displaying the following parameters:
- Welding current;
- Upset force or pressure;
- Displacement;
- Welding time;
- Welding program identification and setting details.
Welding parameters should be monitored and recorded. These records should be referenced to the appropriate welds.
Contractor should send to IPM files with these records.
Contractor should provide IR licensed copy of the software for reading these files for use during action of the contract.

10. **ADDITIONAL REQUIREMENTS**

10.1 Grinding and final grinding should be carried out along the entire circumference of the weld, including the bottom of the rail, to the IPM's satisfaction. Final grinding should not be carried out beyond a distance of 250 mm from each side of the weld.

10.2 After the weld is completed and its surrounding area is cleaned as specified above, the contractor should clean the area of the rail as follows (all numbers of areas hereafter refer to the illustrate numbers in Appendix A of these Specifications):

a) **Areas 1, 2, 5, 6 and 7:**
   A strip of at least 500 mm from each side of the weld should be cleansed.
   All material residues which may have formed as a result of grinding of the rail head should be removed.

b) **Areas 3 and 4:**
   All material residues should be removed and a strip of at least 100 mm from each side of the weld should be metal-brushed until a clean surface, free from any rust and foreign bodies, is obtained.
c) **Bottom of Rail:**
This area should be treated as specified for areas 3 and 4. After cleaning, the area will be checked by means of a mirror in the IPM's presence and to his satisfaction. The contractor should be responsible for keeping the welds clean until all tests, as specified in Paragraph 10.3 hereafter are successfully completed, regardless of any delay which may occur between welding and testing. If necessary, the contractor should carry out any additional cleaning as may be required for the proper performance of testing, at no extra cost.

10.3 Each and every weld should be marked and numbered according to a special code as shown hereafter which will enable to trace the date of welding, the welder's identity, etc. The weld should be marked by such a means that it can be identified in situ for a minimum of 10 years. Marking should be done on a clean surface on the internal area of the rail stem (the area facing the other rail in the track), at 500 mm distance from the weld, by means of approved paint. The paint should be resistant against water, abrasion and scratches. The marking code should be in accordance with the following example:

**XY.c.05.123.45**

Where:

- **XY** - Code of the railway line;
- **c** - Welder's identification code;
- **05** - Year;
- **123** - Km mark;
- **45** - Weld number in Km.

Cost of these works enters into cost of welding.

10.4 The defective weld should be removed by mechanical means, by cutting completely through the rails at positions 100 mm minimum on each side of the weld, which will ensure the removal of the weld and damaged rail.
Replacement welds (welds to be carried out instead of rejected ones) should be marked as specified in Paragraph 10.6 hereafter.

10.5 The Contractor should keep a log book, in which all welds and tests should be recorded. Columns Nos. 0-5 should be filled by the Contractor and Columns Nos. 6-18 should be filled by the representative of the testing firm. A sample page of the log book is shown in Appendix C hereafter. The pages of the log book should be filled by whole kilometer (km xx.000 km xx.999). Data pertaining to more than one km should not be entered in the same page, however one particular kilometer may (and generally will) be included in several pages. No payment should be made for welds unless and until they are properly recorded in the log book.

10.6 Should any weld be rejected by the IPM, the contractor should act as follows: the rail on each side of the weld side should be cut by means of an approved mechanical saw and should be removed from the site. Each cut should be made in the middle of the gap between two adjacent sleepers. The contractor should insert, instead of the removed segment rail, new rail segment (which will be provided by the IR at its warehouses). The new segment should be cut by the contractor to the length necessary for its proper insertion and welding. The ends of the new segment should be welded by the contractor to the existing rails, in accordance with the relevant requirements of this technical specification. Minimum lengths of the segment should be 6m. According to IPM requirements welding can be made by Electro-Thermit method on Contractor cost. Should any of the two repair welds, as described above, be found defective and rejected by the IPM, the contractor should perform repeated repair welds. The cut-away segment (6m in length minimum) should be removed and a
new segment should be inserted in its place and welded to the existing rails, all as specified above for the first repair. Notwithstanding what said above in this Paragraph, if any defective weld (not including repair welds) is rejected on the spot, before the next weld is commenced, the repair weld may be carried out by cutting away the defective weld (at least 100 mm from each side of the weld), bringing the two new rail ends together and performing one single weld. The use of this method should be subjected to the IPM approval and such approval should be granted only after the contractor will have proven, to the IPM's entire satisfaction that this method is not harmful to the track and will not adversely affect the progress of the works.

Repair welds should be marked as specified in Paragraph 10.3. above, subject to the following alterations:

a) The letters "A" and "B" should be added respectively, to the markings of the two repair welds. For example, the two welds to be performed instead of weld No. XY.c.05.123.45 should be marked XY.c.05.123.45A and XY.c.05.123.45B respectively.

b) Should repair welds be rejected, the repeated repair welds should be marked using the next letters (c, d, e, etc., in alphabetical order).

All repair welds should be fully tested and should be recorded in the log book as specified in Paragraph 10.5. above.

10.7 The contractor's measuring and recording equipment should be calibrated at all times during the period of works.

Prior to the commencement of works, the contractor should perform all necessary calibrations as aforesaid and should have them checked by an independent laboratory subject to the IPM's approval. The contractor should obtain from the laboratory all necessary certificates and hand them over to the IPM.
The use of measuring and recording equipment without approved certificates of calibration will not be permitted.

10.8 At the end of each working day, the contractor should submit to the IPM (by hand, by facsimile or by E-mail) the relevant pages of the log book, duly filled with the data pertaining to the same day. At end of each month the contractor should submit to the IPM these results in Excel format.

11. QUALITY OF THE WELDS AND WELD INSPECTION ACCEPTANCE REQUIREMENTS

11.1 All of the welds and rails areas should be inspected by contractor using:
- Checking step across the weld according paragraph 8.6.
- Visual testing for welding trimming, clamping or profile finishing imperfections, such as tears, cavities, cracks, geometrical non-conformities damage and thermal damage in particular in the electrode contact areas.
- Geometrical testing according geometrical testing criteria paragraph 9.3.

11.2 Welds should undergo visual, geometric and ultrasonic inspection as specified hereafter, by a qualified testing company appointed by the IR. Furthermore, the IR reserves the right to suspend works of the contractor and to perform additional tests, as specified hereafter, if the quality of welding, in his opinion, is unsatisfactory. Testing as aforementioned should be carried out at the IR's expense. However, the cost of repeated testing due to the failure of welds to comply with the requirements of the specifications should be borne by the contractor. Weld might be inspected by magnetic particle inspection according to IPM instructions.

11.3 Visual inspection test
All of the welds should be inspected visually for welding, trimming, pressing, clamping or profile finishing defects.
The inspection should include the contact positions of the electrodes on the rails. The defects specified in Table 1 should not be permitted.

Table 1

<table>
<thead>
<tr>
<th>Welding</th>
<th>Trimming</th>
<th>Pressing or Clamping</th>
<th>Profile Finishing</th>
<th>Electrode Contact Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tears, Cavities, Excessive heating, Lack of bond, Oxidation Cracks</td>
<td>Undercutting, Notches, Damage</td>
<td>Damage, Slipping, Marking</td>
<td>Lack of profile, Overheating Damage</td>
<td>Burns, Damage</td>
</tr>
</tbody>
</table>

11.4 Geometrical Testing
All of the welds should be subject to Geometrical Testing. This test should be performed by means of a 1.0 m long steel straightedge and a feeler gauge or, alternatively, by means of specialized electronic equipment.
Running surface flatness – 0.2mm over a length of 500 mm
The tolerances of the vertical and horizontal alignment should be according paragraph 9.3 and as shown in Appendix B hereafter.
The vertical alignment of the running surface should be measured along the longitudinal center line of the rail with the weld centrally between and referenced to datum points on the rail 500 mm either side of the weld.
The horizontal alignment of the head should be measured on the inside face of the rail head at a point 14 mm below the running surface and referenced to datum points on the rail 500 mm either side of the weld.
Surface flatness at the weld should be measured using a 1 m straight edge positioned centrally about the weld.

11.5 **Magnetic particle inspection**
In accordance with EN 1290.
The profile finished area around of the electrode contacts should be checked. The inspected area should be free of cracks. If any defects are revealed the welding process should be deemed unsuitable.

11.6 **Ultrasonic inspection**
According to the instructions of IR the welds should be examined on the ultrasonic testing.
Welds with the following defects would not be acceptable: cracks, lack of fusion, cold shuts, hot tears slag, isolated pores, general porosity, inclusions.
The basis of welding treatment is a defect with size of 2 mm² which is equal to 0 dB.
The following parameters should be considered in weld quality control:

a. Every weld with defect of 16 dB or greater should be disqualified.
b. Weld with 3 defects should be disqualified (no consider the defects size).
c. Weld with defect size (amplitude) 9-15 dB defect length of 30 mm or greater should be disqualified.
Defect length ($\Delta X$) should be measured from both sides by amplitude reducing of 6 dB.
d. Weld with defect size 9-15 dB defect length of 25-29 mm emergency fish plates should be installed, and after a year re-check should be made, if the defect grows the weld should be disqualified.
e. Weld with defect size 9-15 dB defect length up to 25 mm. after a year re-check should be made, if the defect grows the weld should be disqualified.
12. **REJECTION OF WELDS**
Any weld which will not comply with the requirements of Paragraphs 9.3, 11.3, 11.4, 11.5, 11.6 above should be rejected. Furthermore, any weld in which there will be found, upon visual inspection, signs of "burning", cracks, geometric irregularities (bulges and pits) in the welded surface as compared to the original rail surfaces, should be rejected on behalf of the visual inspection only.
Furthermore, should the computer output of the recorded parameters (electric current, upset force and platen travel distance) show that the weld to which the output refers, was performed beyond the tolerances specified by the contractor, such weld should be rejected.
Rejected welds should be cut away by the contractor at his own expense, and should not be paid for by the IR Ltd.

13. **TIME FOR CARRING OUT REPAIR WELDS**
13.1 After the welding of track sections is completed, further works will be carried out on these sections by the IR or its contractors. These further works will include track distressing, which can be carried out only after all welds along the track units are properly complete, including repair welds where necessary, and after all welds have successfully passed the specified tests.

13.2 In the light of the above-mentioned limitation, the Contractor should make sure that all necessary repair welds are carried out by him immediately after being notified to do so by the IPM and under no circumstances after more than 72 hours after receiving such notice. Should the contractor fail to comply with the requirement of this paragraph, he should compensate IR. As specify in Paragraph 13.3 hereafter.
13.3 **Liquidated damages:**
   a) Contractor should compensate IR for each rejected weld detected during the warranty period, by the sum of 600 N.I.S. as liquidated damages.
   b) Repaired welds are necessary; the Contractor should perform the repair welds at its own cost and should be entitled to payment for only one weld.

14. **CONTRACTOR QUALITY ASSURANCE**
14.1 The contractor should operate an independently approved and audited quality management system. Additionally a product quality plan should be validated by the purchaser. The quality system should contain a system of traceability for all welds produced. A quality management system conforming to EN ISO 9001:2002 or equivalent will be deemed to satisfy the requirements.

14.2 The Contractor should establish his own quality assurance system on site, in order to minimize negative test results. The said quality assurance system should include (but should not be limited to) control of the welding process visual inspection and geometric testing. All side flash butt welding should be produced under a comprehensive system of factory production control which ensures confidence in the conformity of the finished product. Manufacturers having a factory production control system which complies with EN ISO 9001:2002 or equivalent should be recognized as satisfying the minimum requirements specified by this clause.

15. **CONTRACTOR’S WARRANTY**
The Contractor should be fully responsible for the quality and performance of the welds for the period of one year after the completion and acceptance of the works under this contract.
16. **SAFETY PRECAUTIONS**
The contractor should act in accordance with the "Safety Appendix" attached to the contract.

17. **TECHNICAL DOCUMENTS TO SUBMIT TOGETHER WITH PROPOSAL**
The Contractor shall submit, together with his proposal the following information:
17.1 Name and details of the Manufacturer of the welding equipment; name and details of the specific model which the Contractor intends to use in the performance of the Works.
17.2 Maximum track gradient capacity.
17.3 Maximum length of free rail welding capacity which shall include support on or by frictionless rollers or similar, to enable free longitudinal or lateral movement.
17.4 A sample output of the diagrams as required above (current, upset force and platen travel distance).
17.5 Proof that the particular model which the Contractor proposes to use in the works under this Contract is suitable for the welding of UIC-60 and UIC-54 rails.
17.6 Full specifications of the proposed welding equipment, including drawings, photographs and sketches.
17.7 Specifications of the proposed grinding and polishing equipment (including grinding stones), together with drawings, photographs and sketches.
17.8 A statement of the tolerances of the recorded parameters (current, upset force and platen travel) beyond which the weld shall be considered defective and shall be cut away. Following which the Contractor shall perform a new weld.
17.9 The method of work proposed by the Contractor, including a full description of the sequence of operations, number of workmen and their functions, etc.
APPENDIX A

DEFINITION OF AREAS OF INSPECTIONS
0.1 mm ≤ a2 ≤ 0.3 mm;  b1 = 0 mm;  0 mm ≤ b2 ≤ 0.3 mm.
### APPENDIX C

**SAMPLE PAGE OF LOG BOOK**

<table>
<thead>
<tr>
<th>Number</th>
<th>Welder's code and weld number</th>
<th>Date of welding</th>
<th>Polisher's name</th>
<th>Date of polishing</th>
<th>Name of polisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Welder's code and weld number</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Location of weld (km)</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Date of welding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*English Translation of Columns 0-5 (to be filled by the Contractor)*

- **0**: Number
- **1**: Welder's code and weld number
- **2**: Location of weld (km)
- **3**: Date of welding
- **4**: Date of polishing
- **5**: Name of polisher

<table>
<thead>
<tr>
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<th>ชื่อนักสอบ</th>
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*BSDIラジオ*