सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
रेल मंत्रालय
Ministry of Railways

MANUAL

FOR

GLUED INSULATED RAIL JOINTS

(REVISED 2024)

(Incorporating 'Technical Specification for Re-Furbishing of Existing Glued Insulated Rail Joints and In-situ Fabrication of Glued Insulated Rail Joints (Provisional), January-2020')

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MANUAL FOR GLUED INSULATED RAIL JOINTS

(Revised 2024)

0. FOREWORD:

0.1 The Manual of instructions for fabrication, installation and maintenance of Glued Insulated Rail Joints was first issued in 1982. The manual was revised in 1989, 1998 & 2022 (First Reprint) respectively.

0.2 The Manual has been reviewed and revised in view of use of only 6mm thick end post & experience gained in the intervening period, updated BIS Codes and incorporating the corrigendum upto 'ACS No. 1' of 'Manual for Glued Insulated Rail Joints (First Reprint-2022)'. Further, 'Technical Specification for Re-Furbishing of Existing Glued Insulated Rail Joints and In-situ Fabrication of Glued Insulated Rail Joints (Provisional), January-2020' has also been incorporated. Therefore, a new chapter on "Re-Furbishing of Existing Glued Joints and In-Situ Fabrication of Glued Joints" has been introduced in this manual as chapter-6. Accordingly, the Manual has been issued under the title 'MANUAL FOR GLUED INSULATED RAIL JOINTS (Revised 2024)' in consultation with Signal Directorate of RDSO. (Reference Signal & Telecom Directorate note no. RDSO-SIG0TC (TCMs)/1/2022 dated: 20.09.2024).

0.3 For convenience 'GLUED INSULATED RAIL JOINTS' have been referred to as 'Glued Joints'.

0.4 There are two types of glued joints namely **G3 (L)** type having six bolts and **G3(S)** type having four bolts. G3(L) type and G3(S) type of glued joints can be manufactured from different rail sections as per drawing numbers given below: -

End post Thickness	**Rail Section**	**Drawing No.**	
		G3(L) Type	**G3(S) Type**
6 mm	52 kg	RDSO/T- 671	RDSO/T- 1259
	UIC 60 /60E1	RDSO/T- 2572	RDSO/T-2576

Typical features of G3 type glued joints using 6 mm thick end post are as shown in **Annexure 'G'**.

0.5 G3 (L) type glued joints are for use in LWR/CWR track in all the temperature zones and G3 (S) type joints are for use in fish plated track as well as in SWR track.

0.6 All the provisions contained in RDSO's ISO procedures laid down in the Document No. QO-D-8.1-11, with latest version (titled 'Vendor- Changes in approved status') and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

0.7 The existing Glued Joints which are not performing satisfactorily may be repaired by in-situ refurbishing of joints to minimize the requirement of new joints and optimize utilization of

materials in-service. Re-furbished glued joints shall be allowed on track for an extended service period subject to satisfactory performance.

This Manual covers the working methodology, performance parameters and testing regime for workshop manufactured, in-situ re-furbished & in-situ fabricated glued joints.

Refurbishment of existing glued joints and in-situ fabrication of glued joints shall be done by the RDSO approved firms appearing in the latest updated vendor directory for 'Glued Joints' of Track Design Directorate of RDSO. Vendors having necessary infrastructure as mentioned in Chapter 6, can participate in the tenders for the work of refurbishing & in-situ fabrication of glued joints.

0.8 Development of vendors for glued joints will be undertaken by RDSO as per extant instructions or apex ISO documents of RDSO and RDSO policy letter no. QAC/Vendor/Policy dated 17.09.2021 or latest. For development of vendors, the instructions/stipulations shall be followed as instructed in "IREPS-User Guide for Registration of New Vendors/Contractors" under U-VAM portal of Indian Railways E-Procurement System (IREPS).

CHAPTER-1

MATERIAL, MATERIAL SPECIFICATIONS AND EQUIPMENT FOR FABRICATION OF GLUED JOINTS

1.1 MATERIAL:

The requirement of material for fabrication of one glued joint is given in Annexure-A. The firm shall procure Rails, Fishplates and Bolts & Nuts from RDSO approved/developmental vendors and Glue & Woven Roving Fabrics from the suppliers as per the stipulation to the relevant IS specifications. 'RDSO Approved Vendors' shall mean the vendor having status of 'Developmental Vendors' or 'Approved Vendors' on RDSO vendor directory. The list of approved suppliers is available in Vendor Directory of Approved Vendors of Track Design Directorate of RDSO which is updated from time to time & available in Unified Vendor Approval Module (U-VAM) portal of www.ireps.gov.in website.

1.2 SPECIFICATIONS:

The material shall be as per specifications given in Annexure-B.

1.3 EQUIPMENTS:

1.3.1 List of equipment required for fabrication of glued joints is given in Annexure-D.

1.3.2 A special jig for assembly (item 'g' of Annexure-D) and a testing frame (item 'h' of Annexure-D) for conducting pull-out test on glued joints shall be manufactured as per guidelines shown in Figure-4, 3 & 2 respectively.

CHAPTER-2

FABRICATION / ASSEMBLY OF GLUED JOINTS

2.1 PRE-FABRICATION WORK:

2.1.1 The glued joints shall be fabricated/assembled in a covered shed having clean, dust free and well-lit area, so that there is no possibility of extraneous particle mixing with the glue.

2.1.2 The assembly jig shall be thoroughly cleaned of any dust using a brush before taking up assembly.

2.1.3 One rail piece of minimum 6 m length shall be used for fabricating one glued joint.

2.1.4 Prime quality rails required for fabrication of glued joints shall be straight and USFD tested. These rails shall be procured from approved manufacturer. Old/Service/Industrial-Use rails shall not be used for fabrication of glued joints. New rails need not be USFD tested again if duly USFD tested.

2.1.5 The rail piece shall be cut in the middle by a rail cutting machine. It shall be ensured that the cut is square and the rail ends are square, plane and smooth. Since rail pieces taken from two separate rails are likely to have variations in profile, it is therefore necessary that rail pieces cut from the same rail are jointed together at the cut-end for fabrication of the joint. For this purpose, just before cutting a rail-piece, necessary marking (such as A-A' or 1-1' etc.) shall be put on the adjoining cut-ends with indelible paint and it shall be ensured that the ends with corresponding mark only are jointed together.

2.1.6 The edges of the rail-ends of the two pieces at the cut shall be finished smooth with a flat file. All burrs shall be removed.

2.1.7 Holes in rail pieces shall be drilled at locations following the relevant drawing with a precision drill using jigs to ensure accuracy. It shall be ensured that the holes drilled are not skew.

2.1.8 The burrs around holes shall be removed. The edges of the drilled holes shall be chamfered using the chamfering tools of the type shown in Figure-1.

2.1.9 The fishplates shall have correct profile as per drawing so that contact with rail on the fishing surfaces and web is proper. Drilling of holes in fishplates shall be done by a precision drill using jigs. The edges of drilled holes shall be cleaned of burrs. It shall be ensured that the holes drilled are not skew.

2.1.10 The markings of rail designation, rolling details etc., occurring in the zone of contact of rail and fishplates, shall be ground with a grinder so as to merge with the parent profile/contour.

2.1.11 The matching surfaces of the rail and that of fishplate shall be sand blasted. Sand blasted rail and fishplate surfaces shall be cleaned with the help of a high-speed revolving wire-brush (of

about 500 revolutions per minute) and with a blower to dislodge the metallic dust, caused during sand blasting, from the cavities.

2.1.12 The surfaces of rail, fishplates, insulating components, bolts, nuts & washers shall then be finally cleaned using a suitable chemical such as Trichloroethylene, Acetone, Carbon tetrachloride or Benzene. It shall be ensured that the surfaces, after cleaning, are free from traces of oily substances.

2.1.13 The end-post, bush and insulating liners shall be roughened by Emery Cloth No. 2.

2.1.14 The assembly work shall be commenced as soon as possible and in any case within four hours of sand-blasting. If due to some reasons, the rails and the fishplates could not be used within four hours of sand blasting, the sand blasting operation should be repeated.

2.2 PRECAUTIONS DURING FABRICATION:

The following precautions shall be taken during fabrication of glued joints:

2.2.1 The mating surfaces of rails & fishplates shall be kept clean and free from oily traces and shall not be touched after cleaning.

2.2.2 The jig shall always be kept covered by polyethylene sheet to prevent accumulation of dust. A newly fabricated glued joint should also be kept covered by polyethylene sheet for a minimum period of 24 hours.

2.2.3 The workers shall wear hand gloves and apron while working. Contact of adhesive and cleaning chemicals with any part of body/skin can be injurious and therefore, shall be avoided.

2.2.4 Any splash of resin on the body should be immediately removed with tepid soapy water. The use of solvents in such cases is not warranted.

2.2.5 Smoking within the fabrication area should be strictly prohibited.

2.2.6 At least one set of portable fire extinguisher should be kept in the fabrication area.

2.2.7 The matching of the cut ends A-A' or 1-1' (as the case be) of rails shall be ensured. (Referred para 2.1.5)

2.2.8 Grinding of marking of rail designation, rolling details, etc. shall be ensured.

2.3 FABRICATION / ASSEMBLY:

2.3.1 For fabrication/assembly of glued joints, the two cleaned rail pieces with matching ends shall be placed on the jig as per drg. No. EDO/T-1473 (Figure-4). The rail ends shall be perfectly aligned both laterally and vertically. The two rails shall then be held firmly in position by clamps. The distance between two rail ends shall be marginally more than the thickness of the end-post to be used to enable insertion of the end-post.

2.3.2 The application of the glue shall be commenced only when the finished rails and fishplates have been properly cleaned & have dried completely.

2.3.3 The resin and the hardener shall be mixed as per supplier's instructions in a suitable container. The constituents shall be thoroughly mixed to get a homogeneous mixture (hereafter called as 'glue'). The glue shall be used within its pot life as prescribed by the supplier.

2.3.4 A thick layer of the glue shall be applied on mating surfaces of the fishplates simultaneously by two teams of workmen.

2.3.5 One piece of woven roving fabrics shall be placed on the fishplates and evenly pressed so that the glue squeezes out through the woven roving fabrics. The oozing glue shall be uniformly spread over. A layer of glue shall then be applied on the inside of the insulating liners followed by their placement on the glued woven roving fabrics on the two fishplates. Method of cutting of woven roving fabrics at bolt holes shall be done as per Figure-6.

2.3.6 A layer of glue shall then be applied on the outside of the insulating liners and two clean pieces of woven roving fabrics shall be laid. The oozing glue shall be uniformly spread over.

2.3.7 Glue shall be applied to both the faces of the end-post, before placing it between the two rail ends. Adequate pressure shall then be applied by using screw clamps at the rail ends so that no gap is left between the end-post and the rails.

2.3.8 The insulating bush duly dipped in glue shall be placed in the rail holes. The bonding surfaces of the rails shall then be coated with a layer of glue and the fishplates made ready as described in Para 2.3.4 to 2.3.6 shall be placed in position in contact with the rail web**.**

2.3.9 Bolts, washers and nuts shall then be placed in position and tightened with a torque-wrench. The torque shall be increased gradually on all the bolts in stages of 35 kg-m per bolt. Care shall be taken to tight inner bolts first and then outer bolts. Finally, all the bolts shall be tightened with a torque of 105 kg-m.

2.3.10 About 20 minutes after the initial tightening of bolts, the bolts shall be re-tightened with a torque wrench until a torque of 105 kg-m is attained.

2.3.11 The joints shall be finished by covering all visible edges of woven roving fabrics with glue. Fillet shall then be formed around the fishplate by utilising the oozed out glue. Excess glue shall be removed.

2.4 MARKING:

2.4.1 **(A) Marking of Glued Joints (by manufacturer):**

Every glued joint shall have distinctive mark indicating the glued joint number, month and year of manufacturing and the code of the manufacturer as shown below. This marking should be punched on the gauge and non-gauge face sides of the head of the rail of glued joint at 300 mm away from the one end of fishplate by punching without causing any damage to rail, in

letters/digits of 6 mm height at a depth of 10 mm from top of vertical face of rail, as indicated in Figure-5.

XXXX MM YY AAA

The first four digits indicate the glued joint number starting from 0001 for first joint of every month, the next two digits month of manufacturing followed by last two digits of the year of manufacturing. The end letters shall be code of the manufacturer, assigned by the Track Design Directorate of RDSO.

(B) Marking of Glued Joints (by inspecting authority) - Every glued joint shall have distinctive inspection mark of inspecting agency. Initial/Code of inspecting agency and inspecting authority should be clearly legible in punch marking (seal). This marking should be punched on the gauge and non- gauge face sides of the head of the rail of glued joint at 300 mm away from another end of fishplate by punching without causing any damage to rail, in letters/digits of 6 mm height at a depth of 10 mm from top of vertical face of rail, as indicated in Figure-5.

2.4.2 In order to indicate the UTS of the rail, coding as shown in Figure-5 shall be done by approved enamel paint.

2.5 POST FABRICATION WORKS:

2.5.1 Assembly jig should be covered with polyethylene sheet after fabrication of joint.

2.5.2 CURING

The assembled joint shall then be allowed to cure on the jig for at least 24 hours at room temperature without disturbance. It shall be ensured that no moisture, oil or other deleterious material come in contact with the assembled joint till it is cured.

2.5.3 CLEANING OF TOOLS

All tools and equipment used to be cleaned of glue after the assembly of the joint.

CHAPTER-3

TESTING AND INSPECTION OF GLUED JOINTS

3.0 All the facilities for carrying out stipulated tests on the glued joints should be available at the manufacturing site.

3.1 LOT SIZE:

50 joints or part thereof shall form the lot for the purpose of testing and inspection of the joints.

3.2 DIMENSIONAL CHECK:

3.2.1 Every fabricated /assembled joint shall be checked for vertical and lateral alignment with 1 m long straight edge. The tolerances permitted shall be as under;

(i) Vertical alignment – Variation at the joint shall be within +1 mm and -0 mm measured at the end of 1 m straight edge placed at the top of rail head.

(ii) Lateral alignment – Variation at the joint shall not be more than $\pm$ 0.5 mm measured at the centre of 1 m straight edge placed along the gauge face.

3.2.2 All the other tests shall be carried out only if the joints are dimensionally satisfactory.

3.3 INSULATION RESISTANCE TEST IN DRY CONDITION:

Each joint shall be subjected to insulation resistance test in dry condition. A meggering voltage of 100V DC shall be applied across the joint. The value of the insulation resistance shall not be less than 25 mega-ohms.

3.4 PULL-OUT TEST:

3.4.1 Only if the joints are found satisfactory in dimensional check (Para 3.2) and insulation resistance test in dry condition (Para 3.3), the pull-out test shall be conducted.

3.4.2 The pull out test shall be conducted by suitably gripping the two rail pieces of the joint and subjecting the joint to axial tension. One method of conducting the test is to hold one end of the glued joint with the help of fishplates as fixed end. The other end of the glued joint is held to a moving frame with the help of wedge inserted in slot cut in the glued joint through the moving frame brackets. The arrangement is shown in Figure-2. The other method of conducting the test is to hold the glued joint with the help of fishplates at both ends of the testing frame. One end of the testing frame remains fixed and the other is moved with the help of two hydraulic jacks operated simultaneously, the arrangement is shown in Figure-3. Manufacturer can adopt any other method also with prior approval of RDSO.

3.4.3 Acceptance values:

The test joint shall be considered acceptable if there is no indication of separation between end post and rail end(s) visible to the naked eye, at the pull out load values given in the table below:

S. No.	Rail Section	Minimum pull out load in tonnes	
		G3(L) type joint	G3(S) type joint
1.	52 Kg	150	100
2.	UIC 60/60E1	170	110

3.4.4 The basis for acceptance/rejection of the lot with respect to pull-out test shall be as follow: Four joints shall be randomly selected. Out of these four, two joints are to be subjected to pull-out test. If

(i) Both joints pass, lot is cleared for insulation resistance test in wet condition.
(ii) Both joints fail, lot is rejected.
(iii) One joint fails, remaining two joints shall be tested and if both pass, the lot is cleared for insulation resistance test in wet condition otherwise entire lot is rejected.

3.5 INSULATION RESISTANCE TEST IN WET CONDITION:

Only two joints out of those joints which have successfully withstood insulation resistance test in dry condition (Para 3.3) and pull out test (Para 3.4) shall be tested for insulation resistance in wet condition. The joints shall be immersed in water for 48 hours in suitable clean water tank; and resistance shall be measured immediately after taking out the joint from the water by applying meggering voltage of 100V DC across the joint and measuring current by an ammeter capable of measuring current up to micro-amperes. The insulation resistance determined by the ratio of voltage to current in amperes shall not be less than 3 kilo-ohms for each of the joint. If both the joints pass this test, the lot will be accepted.

3.6 Pieces of the rail of tested joints shall be returned by the manufacturer to the railway / purchaser and payment shall be made by the railway to firm as per tender conditions.

3.7 DISPOSAL OF PULL-OUT TESTED JOINTS:

3.7.1 The pull-out tested joints shall not be repaired or welded and shall be distinctly marked **'NOT TO BE PUT IN TRACK'** on both the surfaces of the web of the rail on either side of the joint with approved enamel **RED PAINT** immediately after the pull-out test.

3.7.2 The pull-out tested joints shall be dismantled soon after the inspection. Fishplates may be re-used in subsequent fabrications if their condition is satisfactory.

3.8 DISPOSAL OF REJECTED LOT:

Each joint of the rejected lot shall be marked **'REJECTED'** with red paint over at least 30 cm length at both ends and shall be got dismantled in presence of inspecting authority & firm's representative and record to be kept as per proforma D in Annexure-F.

3.9 MAINTENANCE OF RECORDS:

Records in respect of fabrication of glued joints should be maintained in the proforma as given in Annexure-F.

CHAPTER-4

INSTALLATION AND MAINTENANCE OF GLUED JOINTS

4.1 PRELIMINARY WORKS;

4.1.1 Sleeper spacing: The sleeper spacing under glued joint shall be the same as that of intermediate sleepers.

4.1.2 Before laying of the glued joint, it shall be ensured that at least ten sleepers on either side of the joint are properly packed to the correct level.

4.1.3 Proper care shall be taken in transporting the joints to site of laying so that no damage is caused during loading, unloading and transportation.

4.2 INSTALLATION OF GLUED JOINTS:

4.2.1 For installation of joint, the following procedure should be adopted:

a) Suitable length of rail, depending on length of the joint to be inserted, shall be cut and removed. The glued joint shall be placed in position and welded at the two ends by an approved method.

b) For installation of a glued joint in an existing LWR, the method used for rectification of the rail fractures, as outlined in the Indian Railways Permanent Way Manual (IRPWM) shall be adopted.

c) While inserting the glued joint in track, its length should be decided such that at the stage of its replacement, changing of adjoining rails is avoided. This would avoid the need of additional AT welds. The length of the glued joints may be reduced upto 5.5 m while inserting in the track in order to achieve this objective.

4.2.2 For the replacement of a defective joint, similar procedure as mentioned above shall be followed.

4.2.3 Insulation resistance of the glued joint shall be checked in association with concerned signaling staff before insertion in track.

4.3 MAINTENANCE OF GLUED JOINTS:

4.3.1 BALLAST

The ballast in track in the vicinity of the glued joints shall be clean to ensure proper packing and efficient drainage. It shall be ensured that the ballast is clear off rails and rail-fastenings. The clearance from the underside of rail to ballast should not be less than 50 mm.

4.3.2 MAINTENANCE

Between two successive tamping of glued joints by track machine, proper maintenance attentions and inputs should be given to glued joint for their upkeep and proper function.

4.3.3 For the upkeep of the insulating properties of the glued joint, assistance should be provided by engineering staff as and when required by signaling staff.

4.3.4 Metal burrs/flow at the ends of the rails shall be removed from time to time to avoid short-circuiting. The burrs/flow shall be removed skillfully avoiding damage to the end-post.

4.3.5 FAILED JOINTS:

Normally no relative movement shall occur between rails and fishplates at the glued joint. In case, failure of the joint occurs by separation of the rail/fishplates surfaces with consequent relative movement, the damaged glued joint shall be replaced as early as possible by a new joint.

4.4 RECLAMATION OF DAMAGED GLUED JOINTS:

4.4.1 The damaged glued joint removed from the track shall be stripped off the glue to reclaim fishplates to the extent possible. This work is best done in a Workshop. For this purpose, the glued joint shall be heated by a blow lamp to a temperature of over 200^0C. As soon as the glue clinging to the threads of fish bolts becomes thin, the nuts shall be loosened and fish bolts shall be pushed out. A chisel shall be inserted between the rail and fishplate and with the help of gentle and careful blows of a hammer, the fishplates shall be removed.

4.4.2 The fishplates shall be cleaned of glue, dried and kept in stock for reuse if required after ascertaining that there is no physical damage.

4.4.3 Released rails, if worn out, may be disposed of as scrap as per extant practice.

4.5 (a) Renewal/replacement of glued joints shall be done on condition basis as prescribed in para 702(1) (f) of IRPWM, 2020.

(b) For the purpose of calculating requirement of glued joints for sanction etc. tentative life of glued joints may be taken as:

(i) UIC 60/60E1 rail section with 6 mm thick end post - 400 GMT

(ii) 52 kg rail section with 6 mm thick end post - 200 GMT

CHAPTER-5

PROCEDURE FOR JOINT INSPECTION OF GLUED JOINTS IN FIELD

5.0 GENERAL:

Glued Joints are required for provision of track circuits. This being part of track, is installed by Engineering Department. Maintenance of glued joints is essential for proper functioning of track circuits. The regular inspection and testing of track circuits is done by Signal Department. Inspections shall be done jointly as per this joint procedure order. Maintenance and replacement of defective glued joints, is to be done by Engineering Department. To prevent in-service failures, the glued joints shall be inspected jointly by Engineering and Signal Departments at SSE/JE level at least once in three months. This inspection may normally be clubbed with joint inspection of points & crossings.

5.1 FOR NEW GLUED JOINTS:

5.1.1 Some loss in insulation resistance is expected during loading, unloading, transportation and multiple handling at the site before installation. Before installation, the insulation resistance of a new glued joint shall not be less than 10 mega-ohms which is measured using an insulation tester of 100V DC. Insulation should be tested across the end post as well as between fish bolts and the rails on either side of the rails. Good quality insulation tester duly calibrated by appropriate test house shall only be used for measurement of insulation resistance. Measurement of insulation of all glued joints shall be done jointly before installation.

5.1.2 ERC-J clips and end cut liners should be used at glued joints to avoid contact of clips with the fishplates.

5.1.3 Only FTC (Fit for Track Circuiting) sleepers shall be used in track circuited areas. The sleeper spacing under glued joints shall be same as that of intermediate sleepers.

5.1.4 At least 10 sleepers on either side of the glued joints shall be properly packed to the correct level.

5.1.5 Proper squaring of the glued joints shall be ensured. The glued joint shall be centrally located over adjoining sleepers as far as possible.

5.2 INSPECTION AND MAINTENANCE OF IN-SERVICE GLUED JOINTS:

5.2.1 Good quality insulation tester duly calibrated by appropriate test house shall only be used for in-service inspections.

5.2.2 As glued joints should behave as a monolithic unit, there should not be any relative movement between rails and fishplates or separation of rail/fishplate surface and insulation. In case glued joint does not behave as monolithic unit and insulation resistance is not as per Para 5.2.3 below, the same should be replaced on priority.

5.2.3 Insulation of glued joints shall be checked in dry condition at least once in three months (Quarterly). Insulation condition of fish bolts with respect to rails shall be assessed by measuring insulation between fishplate/fish bolt and rail on either side of the joint. If the insulation is found to be less than 1 mega-ohm, it shall be planned for replacement of glued joint within 15 days. However, if the insulation is found to be less than 3 kilo-ohms, it shall be replaced on priority within 3 days.

5.2.4 A faulty glued joint may be checked by taking voltage readings across the track relay terminals. Any change in voltage reading when the adjacent track circuit feed is shunted or disconnected will indicate faulty insulation joints. Reasons for the same should be analyzed and corrective action be taken in such case. Appropriate action shall be taken for replacement of glued joint as per the criteria given in Para 5.2.3 above.

5.2.5 The replacement of glued joints, wherever required, will be done by Engineering Department. The signal staff as required for connection/reconnection and testing shall be provided at site.

5.2.6 Metal overflow/burrs if any, on the rail table at the joints shall be removed skillfully by engineering staff in presence of S&T staff for avoiding any damage to end post so that, ends do not bridge with each other and cause a potential short. It shall also be ensured that during removal of metal overflow/burrs, no dent/notch is formed in the rail.

5.2.7 Any iron flakes or brake-block dust accumulated at the glued joint or on adjacent rails shall be brushed off by S&T staff so as to avoid possibility of electrical conductivity.

5.2.8 The sleepers and fastenings at glued joints shall be ensured in proper and effective condition. Proper elastic rail clips should be used. Any missing/or incorrectly used ERC shall be replaced.

5.2.9 The ballast in track in the vicinity of the glued joints shall be clean to ensure proper packing and efficient drainage. It shall be ensured that the ballast is clear off rails and rail-fastenings. The clearance from the underside of rail to ballast should not be less than 50 mm for the glued joint.

5.2.10 It shall be ensured that spacing of sleepers under glued joints is same as that of intermediate sleepers. End post location shall be centrally placed between two sleepers as far as possible and in no case it should be on the sleeper.

5.2.11 During inspection, glued joints should be closely observed for any loose/broken/missing bolts, fishplate cracks and rail end batter. Suitable corrective action should be taken in time.

5.2.12 Proper records of all joint inspections of glued joints and actions taken there after shall be maintained in registers at station as per system prevailing on Zonal Railways. The record shall be kept in the format enclosed as **Annexure-C** and shall be jointly signed by P. Way and S&T staff/officer.

CHAPTER-6

RE-FURBISHING OF EXISTING GLUED JOINTS AND IN-SITU FABRICATION OF GLUED JOINTS

6.1 Glued joints are fabricated either at the Railway's Engineering/Bridge Workshops or by approved vendors. This chapter elaborates the uniform working procedure for the work of refurbishing of existing glued joints and in-situ fabrication of glued joints on Indian Railways.

6.2 The manufacturer/supplier shall furnish compliance or deviations, if any, for each clause and sub-clause of the chapter along with technical explanations/details. The manufacturer/supplier shall also furnish the technical and financial implications of the deviations.

6.3 SPECIFICATION OF MATERIALS:

Specification of material is contained in Annexure-B.

6.4 EQUIPMENT:

In addition to equipment at Annexure-D, the essential equipment for re-furbishing/in-situ fabrication of glued joints shall be as under:

i. Portable power pack 3 kW
ii. Mechanical/Hydraulic tensor
iii. Rail jumpers
iv. Hand steel tampers of X- section 4mm x 10mm for compacting slurry in web portion and 4mm x 40mm for compacting slurry in rail head portion during repair of end post
v. Hand held disc cutter for removing metal flow & for operating wire wheel cup brush
vi. 2 nos. rail thermometer (magnetic base type)
vii. Knotted wire wheel cup brush attachable with hand held disc cutter for cleaning fishplates & rails
viii. 10-15 mm dia cylinder abrasive mounted grinding wheel made of stone or wire and 3-5 mm shank along with Hand held drilling machine
ix. Strong magnet to remove iron particles from end post gap using steel hand held tamper
x. Jute bags to cover 20 m rail length to increase rail gap while working in summer
xi. Blow lamp for keeping the rail temperature controlled during winters for fast curing

Note: - Any additional equipment as directed by Engineer-in-Charge shall also be provided.

6.5 IN-SITU RE-FURBISHING OF GLUED JOINTS:

6.5.1 General:

Presently, the glued joints existing in track, failing due to insulation/fishplate failure are required to be replaced with new glued joints. To avoid one additional thermit weld, failed glued joint can be re-furbished in-situ, provided the joint is free from burrs, excessive side/vertical wear, kinks, corrosion, scabbing, battering, etc.

6.5.2 Pre-re-furbishing Activities:

Following activities shall be ensured before taking up refurbishing of existing glued joints:

(i) Glued joints requiring refurbishing should be jointly inspected with S&T department and certified as failed for track circuiting.

(ii) All required materials & equipment and manpower shall be arranged before commencing the refurbishing work.

6.5.3 Repair of End Post:

If only end post at the top is broken and electrical resistance is more than 1 mega-ohm, the repair of the end post will be carried out as under:

(i) A traffic block of minimum 30 minutes shall be taken.
(ii) The joint shall be properly levelled on sleepers and approach sleepers packed.
(iii) Metal flow on rail head should be removed by hacksaw/disk cutter.
(iv) Iron particles in end post gap should be removed by using magnet & hand-held tamper.
(v) The gap between two rails from all sides shall be sealed with the help of an insulated tape.
(vi) Two components of glue (Hardener and Resin) should be mixed and then glue & fiber glass powder is added in the ratio of 1 : 2.3. This slurry is poured in the gap from the top of the rail head and tapped so that slurry fills all voids inside the joint.
(vii) Slurry should be filled in 3 stages, after each stage, it should be tamped by hand tamper to increase density & remove air voids.
(viii) For quick strengthening of glue in winter season, slurry filled portion of end post should be uniformly heated to 80°C by blow lamp for 20 minutes.
(ix) Traffic should be permitted after 20 minutes heating by blow lamp.
(x) After repair of the end post, the electrical resistance shall be jointly measured by JE/SSE (P. Way) and JE/SSE (Signal), and shall not be less than 1 mega-ohm.
(xi) Pull out test & Wet test are not required in case of end post repairs.

6.5.4 Thorough re-furbishing of Glued Joints:

Thorough re-furbishing of existing glued joints is necessitated if there is a loss of resistance due to failure of insulating material, fracture of fishplate or complete working out of end post. Procedure for the thorough refurbishing of existing failed glued joints is as under:

(i) Thorough chamfering of fishplates holes shall be done in pre block period
(ii) Speed restriction of 30 Kmph shall be imposed at the location of refurbishment. Ensure complete fitting of ERCs having adequate toe load on both sides of glued joints. This will resist changes in rail gap.
(iii) A minimum of 120 minutes of traffic block shall be ensured. In case, traffic block available is less than 120 minutes, thorough re-furbishing of glued joints should not be done. Track shall be protected with the help of banner flag and detonators as per provisions of IRPWM, amended from time to time.
(iv) During the traffic block, the glued joint should be heated by a blowlamp to a temperature

of over 200^{0}C.

(v) Nuts shall then be loosened and taken out.

(vi) A chisel shall be inserted between rail and the fishplate with gentle blows of hammer and fishplates shall be removed. Care shall be taken so that no dent mark is formed on the rail.

(vii) New fishplates with bolts & nuts shall be used. Released fishplates, bolts and nuts shall be discarded. Thorough chamfering of rail holes shall be done.

(viii) The gap shall be maintained marginally more than the thickness of the end post to be used to enable the insertion of the end-post. Tensor may be applied if required for this purpose. Alternatively wet jute bags may be placed on 10 m both sides of glued joint to increase the gap by 1-2 mm in hot weather and in cold weather rail may be heated uniformly by blow lamp to reduce gap by 1-2 mm.

(ix) The rail ends shall be properly aligned both laterally and vertically with a straight edge using suitable wedges. The two rails shall then be held firmly in position by clamps and no hammering/disturbance to ends should be done after aligning the rails.

(x) The rail ends and fishplate surfaces shall be cleaned with hand held wire brush, knotted wire wheel cup brush, round files & acetone and dried completely. The application of glue shall be commenced only when the finished rails and fishplates have been properly cleaned and have dried completely.

(xi) The resin and hardener shall be mixed as per supplier's instructions in a suitable container. The constituents shall be thoroughly mixed to get a homogeneous mixture (hereafter called 'glue').

(xii) A thick layer of the glue shall be applied on the mating surfaces of the fishplates simultaneously by two teams of workmen.

(xiii) One piece of clean woven roving fabrics shall be placed on the fishplates and evenly pressed so that the glue squeezes out through the woven roving fabrics. The oozing glue shall be uniformly spread over. A layer of glue shall then be applied on the inside of the insulating liners followed by their placement on the glued woven roving fabrics on both fishplates. Method of cutting of woven roving fabrics at bolt holes shall be done as per Figure-6.

(xiv) A layer of glue shall then be applied on the outside of the insulating liners and two clean pieces of woven roving fabrics shall be laid. The oozing glue shall be uniformly spread over.

(xv) Glue shall be applied to both the faces of the end-post, before placing it between the two rail ends. Adequate pressure shall then be applied using tensor at the rail ends so that no gap is left between the end post and the rails. Alignment shall be checked again at this stage with a straight edge.

(xvi) The insulating bush duly dipped in glue shall be placed in the rail holes.

(xvii) The bonding surfaces of the rail shall then be coated with a layer of glue and fishplates made ready as described in Para (viii) to (x) above shall be placed in a position in contact with the rail web.

(xviii) HTS bolts, washers and nuts shall then be placed in position and tightened with a torque wrench. The torque shall be increased gradually on all the bolts in stages of 35

kg-m per bolt. Care shall be taken to tight inner bolts first and then outer bolts. Finally, all the bolts shall be tightened with a torque of 105 kg-m.

(xix) The sequence of the above operation shall be completed within 45-60 minutes so that a minimum 30 minutes setting time is achieved. Controlled temperature of minimum 70°-80°C shall be applied by blow lamp for 10 minutes on outer side of both fishplates when required in winter season.

(xx) After 10 minutes of uniform heating, the bolts shall be re- tightened with a torque wrench until a torque of 105 kg-m is attained. Then both fishplates shall be uniformly reheated upto 70-80°C for another 10 minutes.

(xxi) The joints shall be finished by covering all visible edges of the woven roving fabrics with glue. Fillet shall then be formed around the fishplate by utilizing the oozed out glue. Excess glue shall be removed.

(xxii) After 30 minutes of re-tightening of the bolts, the joint shall be left for setting with tensor in the clamped condition, if tensor used.

(xxiii) Electrical resistance shall be checked with insulation tester duly calibrated by appropriate Test House ensuring a minimum 10 mega-ohm for the proper functioning of Glued Joint before permitting the traffic movement.

(xxiv) J-clips shall be re-fastened. Tensor if used shall be removed. Traffic block shall be cancelled after ensuring complete rail fittings. Before, passing the traffic, it shall be ensured that no extra materials i.e. settled glue etc. remain on the top of the head and gauge face side of the rail.

(xxv) Re-furbished glued joints shall be supported on wooden blocks for a minimum period of 24 hours.

(xxvi) Speed restriction of 30 kmph should be continued for 24 hours after refurbishing work for proper curing of refurbished glued joint with the least disturbance.

6.5.4.1 Post Re-furbishing Work:

(i) All tools and equipment used should be cleaned off to remove glue immediately after the re-furbishing.

(ii) Megger test to check the insulation of re-furbished glued joints must be done jointly with JE/SSE (P. Way) and JE/SSE (Signal).

(iii) Record of the refurbishment of glued joints should be maintained in a register for monitoring their performance. The record must indicate month/year of refurbishment, name of the agency and results of the Megger test.

6.5.4.2 Precautions During Re-furbishing of Existing Glued Joints:

The following precautions shall be taken during re-furbishing of glued Joints:

(i) The mating surfaces of rails & fishplates shall be kept clean and free from oily traces and shall not be touched after cleaning.

(ii) The workers shall wear hand gloves and apron while working. Contact of adhesive and cleaning chemicals with any part of the body/skin can be injurious and, therefore, shall be avoided.

(iii) Any splash of resin on the body should be immediately removed with tepid soapy water. The use of solvents in such cases is not warranted.

(iv) Smoking within the fabrication area should be strictly prohibited.

(v) The first aid box shall be made available at the site.

(vi) Rail jumpers must be used in electrified areas for return current.

(vii) A set of fire extinguishers should be ready for use.

6.6 IN-SITU FABRICATION OF GLUED JOINTS:

6.6.1 General:

Glued joints can also be fabricated at the site to save effort needed in transportation and also avoid at least 02 thermit welds. In-situ fabrication of glued jointwould preferably be carried out outside the running track i.e. on cess. In case it is required to be inserted in the running track, adequate traffic block (Minimum 120 minutes) should be ensured. In case, the traffic block available is less than 120 minutes, in-situ fabrication of glued joints should not be done.

6.6.2 Pre-fabrication Activities:

Following activities shall be ensured before taking up fabrication of glued joints:

(i) The exact location of glued joints shall be identified and marked in advance.

(ii) All required materials & equipment and manpower shall be arranged before commencing the in-situ fabrication work.

6.6.3 Selection of Rails:

During the selection of rails for in-situ fabrication of glued joints, following shall be ensured:

(i) The rails to be converted into glued joints should be free from burrs, excessive side/vertical wear, kinks, corrosion and scabbing etc.

(ii) The rails shall be straight and USFD tested.

(iii) Old free rail joints having battering etc. should be avoided for fabricating glued joints.

(iv) Flash butt/thermit welds should be avoided within 4.0m from the glued Joints.

6.6.4 Methodology for in-situ Fabrication of Glued Joint:

Methodology for in-situ fabrication of glued joints is as under:

(i) In case, the fabrication is done in running track:

a. Thorough chamfering of fishplates holes shall be done in pre block.

b. Speed restriction of 30 kmph shall be imposed at the location of in-situ fabrication of glued joints. Ensure complete fitting of ERCs with adequate toe load on both sides of glued joints. This will resist changes in rail gap.

c. A minimum of 120 minutes traffic block shall be taken and track shall be protected with the help of banner flag and detonators as per stipulated provisions in IRPWM, amended from time to time.

d. Thorough chamfering of rail holes shall be done.

e The gap shall be maintained marginally more than the thickness of the end post to be used to enable the insertion of the end-post. Tensor may be applied if required for this purpose. Alternatively wet jute bags may be placed on 10 m both sides of glued joint to expand the gap by 1-2 mm in hot weather or rail may be heated uniformly by blow lamp to reduce gap by 1-2 mm in cold weather.

(ii) The rail ends shall be properly aligned both laterally and vertically with a straight edge using suitable wedges. The two rails shall then be held firmly in position by clamps and no hammering/disturbance to ends should be done after aligning the rails.

(iii) The rail ends and fishplate surfaces shall be cleaned with hand held wire brush, knotted wire wheel cup brush, round files & acetone and dried completely. The application of glue shall be commenced only when the finished rails and fishplates have been properly cleaned and have dried completely.

(iv) The resin and hardener shall be mixed as per supplier's instructions in a suitable container. The constituents shall be thoroughly mixed to get a homogeneous mixture (hereafter called 'glue').

(v) A thick layer of the glue shall be applied on the mating surfaces of the fishplates simultaneously by two teams of workmen.

(vi) One piece of clean woven roving fabrics shall be placed on the fishplates and evenly pressed so that the glue squeezes out through the woven roving fabrics. The oozing glue shall be uniformly spread over. A layer of glue shall then be applied on the inside of the insulating liners followed by their placement on the woven roving fabrics on both fishplates. Method of cutting of woven roving fabrics at bolt holes shall be done as per Figure-6.

(vii) A layer of glue shall then be applied on the outside of the insulating liners and two clean pieces of woven roving fabrics shall be laid. The oozing glue shall be uniformly spread over.

(viii) Glue shall be applied to both faces of the end-post, before placing it between the two rail ends. Adequate pressure shall then be applied using tensor at the rail ends so that no gap is left between the end post and the rails. Alignment shall be checked again at this stage with a straight edge.

(ix) The insulating bush duly dipped in glue shall be placed in the rail holes.

(x) The bonding surfaces of the rail shall then be coated with a layer of glue and fishplates made ready as described above shall be placed in a position in contact with the rail web.

(xi) HTS bolts, washers and nuts shall then be placed in position and tightened with a torque wrench. The torque shall be increased gradually on all the bolts in stages of 35 kg-m per bolt. Care shall be taken to tight inner bolts first and then outer bolts. Finally, all the bolts shall be tightened with a torque of 105 kg-m.

(xii) The sequence of the above operation shall be completed within 45-60 minutes so that a minimum of 30 minutes setting time is achieved in case the execution is done under traffic block. Controlled temperature of minimum 70-80°C shall be applied by blow lamp for 10 minutes on outer side of both fishplates when required in winter season.

(xiii) After 10 minutes of uniform heating, the bolts shall be re-tightened with a torque wrench until a torque of 105 kg-m is attained. Then outer side of both fishplates shall be uniformly reheated upto 70-80°C for another 10 minutes.

(xiv) The joints shall be finished by covering all visible edges of the woven roving fabrics with glue. Fillet shall then be formed around the fishplate by utilizing the oozed out glue. Excess glue shall be removed.

(xv) After 30 minutes of re-tightening of the bolts, the joint shall be left for setting with tensor in the clamped condition. Tensor shall be used whether fabrication is done on cess or in-situ.

(xvi) Electrical resistance shall be checked with insulation tester duly calibrated by appropriate Test House and ensured a minimum 10 mega-ohm for the proper functioning of Glued Joints before put in track/permitting the traffic movement.

(xvii) In-Situ fabricated glued joints shall be supported on wooden blocks for a minimum period of 24 hours.

(xviii) ERCs/J-clips shall be re-fastened. Tensor if used shall be removed. Traffic block shall be cancelled after ensuring complete rail fittings. Before, passing the traffic, it shall be ensured that no extra materials i.e. settled glue etc. remain on the top of the head and gauge face side of the rail.

(xix) If fabrication is done in running track, speed restriction of 30 kmph shall be imposed for 24 hours after completion of work for proper curing of in-situ fabricated glued joint with the least disturbance.

6.6.5 Post-fabrication Work:

(i) All tools and equipment used should be cleaned off glue immediately after the fabrication of the In-situ glued joints.

(ii) Megger test to check the insulation of In-situ fabricated glued joints must be done jointly with JE/SSE (P.Way) and JE/SSE (Signal).

(iii) Record of In-situ fabricated glued joints should be maintained in a register for monitoring their performance. The record must indicate month/year of In-situ fabrication, name of the agency and results of the Megger test.

6.6.6 Precautions during Fabrication of In-situ Glued Joints:

The following precautions shall be taken during fabrication of in-situ glued joints:

(i) The mating surfaces of rail & fishplates shall be kept clean and free from oily traces and shall not be touched after cleaning.

(ii) The workers shall wear hand gloves and apron while working. Contact of adhesive and cleaning chemicals with any part of the body/skin can be injurious and, therefore, shall be avoided.

(iii) Any splash of resin on the body should be immediately removed with tepid soapy water. The use of solvents in such cases is not warranted.

(iv) Smoking within the fabrication area should be strictly prohibited. The first aid box shall be made available at the site.

(v) Rail jumpers must be used in electrified areas for return current.

(vi) A set of fire extinguishers should be ready for use.

6.7 TEST REQUIREMENTS AND PERFORMANCE PARAMETERS:

6.**7.1 For In-situ Re-furbished & In-situ Glued Joints:** All facilities for carrying out stipulated tests on re-furbished and in-situ glued joints shall be available in the laboratory of the vendor.

6.7.2 Lot Size:

50 joints or part thereof, including 02 joints prepared with the same material and in the same environmental conditions on cess shall form a lot for testing and inspection of re-furbished & in-situ glued joints.

6.7.3 Following tests shall be conducted on re-furbished & in-situ glued joints:-

6.7.3.1 Dimensional Check

Every Re-furbished/In-situ glued joint shall be checked for vertical and lateral alignment with a 1 m long straight edge. The tolerances permitted shall be as under:

i) Vertical Alignment :- Variation at the joint shall be within +1 mm and -0 mm measured at the end of a 1 m straight edge placed at the top of the railhead.

ii) Lateral Alignment :- Variation at the joint shall not be more than $\pm$ 0.5 mm measured at the center of a 1 m straight edge placed along the gauge face.

Note: Dry test, Pull out test and wet test shall be carried out only if the Re- furbished/In-situ glued joints are dimensionally satisfactory.

6.7.3.2 Insulation Resistance Test in dry condition

Each glued joint shall be subjected to an insulation resistance test in dry condition. A megger voltage of 100V DC shall be applied across the joint. The value of the insulation resistance shall not be less than 10 mega-ohms.

6.7.3.3 Pull Out Test

(i) If the joints are found satisfactory in the dimensional check and insulation resistance test in dry condition, the pull-out test shall be conducted. Pull out test shall be carried out as per Para 3.4 of Chapter-3.

(ii) Pull out test shall be conducted on two Glued Joints prepared on cess with the same material & under the same environmental conditions representing a lot of 50 joints or part thereof.

(iii) If both joints pass, further insulation resistance test in wet condition shall be conducted on the samples.

(iv) If anyone of the two joints fails, two additional glued joints shall be randomly taken

from the lot. If required, the glued joints for this purpose would be taken out from the track in case these have already been put in track. If anyone of these two joints fails, suitable penalty should be imposed on the firm by the Zonal Railways with no further payment for that particular lot of glued joint. The glued joints which are already installed will continue to be used in track with regular monitoring.

(v) Each joint of the rejected lot shall be marked "O" marks with yellow paint on the web of rail both side, so that SSE/JE maintenance can keep them under observation.

6.7.3.3.1 Acceptance Value:

The test joint shall be considered acceptable if there is no indication of separation between end post and rail end(s) visible to the naked eye, at the pull-out load values given below:

(a) UIC 60 /60E1 Rail- 1700 KN (Minimum)

(b) 52 kg Rail – 1500 KN (Minimum)

6.7.3.4 Resistance Test in Wet Condition:

This test shall be conducted on two joints out of those joints which have successfully withstood insulation resistance test in dry condition and pull out test. This test shall be carried out as per procedure mentioned in Para 3.5 of chapter-3. The insulation resistance determined by the ratio of voltage to current in amperes shall not be less than 3 kilo-ohms for each of the joints. If both the joints pass this test, the set of joints will be considered passed in this test, otherwise suitable penalty shall be imposed on the firm by the concerned Zonal Railway for the represented lot of joints.

6.7.4 Pieces of the rail and other components of tested joints shall be returned by the manufacturer/ supplier to the railway.

6.7.5 Pull out test joints shall be distinctly marked "NOT TO BE PUT ON TRACK" on both sides of the joint with approved enamel RED PAINT immediately after the pull-out test.

6.7.6 The pull out tested joints shall be dismantled soon after the inspection. Fishplates may be reused in subsequent fabrications if their condition is satisfactory.

6.8 FIELD PERFORMANCE PARAMETERS:

Service Life (Minimum):

a) 150 GMT for re-furbished glued joints

b) 200 GMT for in-situ fabricated glued joints

6.9 WARRANTY:

6.9.1 The manufacturer shall ensure that in-situ refurbished glued joints, in-situ fabricated glued joints shall give a minimum 50% service life in terms of GMT as stipulated in Para **6.8** above.

6.9.2 Any component of in-situ refurbished/in-situ fabricated glued joints (except rails) failing or proving unsatisfactory during the warranty period shall be completely replaced by the manufacturer. All associated expenses shall be borne by the manufacturer.

6.10 INSPECTION:

The inspection of in-situ refurbished glued joints/in-situ fabricated glued joints shall be done by the purchaser. The purchaser's authorized representative shall have free access to the manufacturer's plants/labs at all reasonable times to inspect the processing and testing of all the joints and/or their components. All the tests (Lab & Field) shall be conducted in the presence of the purchaser's authorized representative. All the expenses occurred towards the above testing shall be borne by the manufacturer.

6.11 QUALITY CONTROL:

The quality control in refurbishing/fabrication of in-situ glued joints shall be ensured by a QAP approved by Engineer in-charge of the work on the similar lines of QAP approved by Track Design Directorate of RDSO.

6.12 MAINTENANCE OF RECORDS:

(i) Marking of Glued Joints : Every in-situ fabricated/refurbished glued joint shall be marked indicating the type of glued joint, serial number of glued joint, code of firm/workshop as assigned by Track Design Directorate of RDSO. Branch/workshop team number is to be generated by firm/workshop on which the order is placed for duly maintaining the record for traceability as shown below. This marking should be punched on the gauge and non-gauge face sides of the head of the rail of glued joint at 300 mm away from the one end of fishplate by punching without causing any damage to rail, in letters/digits of 6 mm height at a depth of 10 mm from top of vertical face of rail.

IS/RF-XXXX-AAA-BB-MM-YY

IS = Stands for In-situ

RF = Stands for refurbished glued joints

XXXX in four digits = Serial number of glued joints starting from 0001 for each contract separately. The same procedure of numbering shall be followed by departmental workshops also.

AAA in three digits = Code of firm/workshop as assigned by Track Design Directorate of RDSO.

BB in two digits = Branch/workshop team number is to be generated by firm/workshop duly maintaining the record for traceability for in-situ/refurbished glued joint

MM & YY in two digits each = Month and year of fabrication of glued joint.

In case of refurbishing, new marking shall be done separately while old marking shall be painted in black colour.

(ii) A detailed record for the traceability of each in-situ refurbished/in-situ fabricated glued Joint shall be kept as per the format given in Annexure-H**.**

ANNEXURE-A

MATERIALS REQUIRED FOR FABRICATION OF GLUED JOINT

Materials required for fabrication of one glued joint is as under:

No.	Description	Quantity	
		G3(L)	G3(S)
1.	Rail piece of required length	1 No.	1 No.
2.	Fishplates	2 Nos.	2 Nos.
3.	HTS bolts with nuts	6 Nos.	4 Nos.
4.	Punched Washers	12 Nos.	8 Nos.
5.	Insulating Bush**	6 Nos.	4 Nos.
6.	Insulating Liners**	2 Nos.	2 Nos.
7.	Insulating End Post**	1 No.	1 No.
8.	Glue	(As indicated in Para B.5.1.2)	
9.	Woven roving fabrics	6 pieces (15 x 100 cm)	6 pieces (15 x 66 cm)
10.	Acetone or Trichloroethylene Or Carbon Tetrachloride or Benzene (for cleaning tools, rails, etc.)	Half lit. approx.	
11.	Kerocleanse Chemical (for cleaning hands)	Half lit. approx.	
12.	Release agent	25 gm approx.	
13.	Sand (For sand blasting)	0.2 cum	0.2 cum
14.	Cotton waste or liner rags	0.5 kg approx.	
15.	Emery cloth No. 2	2 sheets	2 sheets
16.	Approved paints i.e. red, yellow and blue as per requirement		

**The insulating components shall be made at the manufacturing site and shall not be procured from outside agencies.

ANNEXURE-B

SPECIFICATION OF MATERIALS

B.1 SPECIFICATION FOR FISHPLATES:

i) Material and manufacturing process of fishplate shall conform to IRST-1 as amended from time to time.

ii) The dimensions of fishplate shall conform to relevant drawing of the glued joints.

iii) Special fishplates to be used in fabrication of glued joints shall be inspected by purchaser Railway or its nominated inspecting agency at the premises of fishplate manufacturer firm. Inspection shall be done as per Para 19 of IRST-1 as amended from time to time. After inspection every accepted fishplate shall be plainly stamped with the inspecting officer's stamp at one end of each fishplate on its outer side in the presence of inspecting officer. The inspection certificate of inspecting agency shall be sent by manufacturer of special fishplate along with the supply to glued joint manufacturer. The glued joint manufacturer will check the supply with respect to the details mentioned in Inspection Certificate of inspecting agency and then only put these in use.

B.2 SPECIFICATION FOR HTS BOLTS & NUTS:

HTS Bolts and Nuts shall comply with the following specifications: -

i) HTS Bolts : Material and manufacturing process of HEX Bolts shall be as per IS:1363 conforming to property class 10.9 of IS:1367 (Part 3).

ii) HTS Nuts : Material and manufacturing process of HEX Nuts shall be as per IS:1363 conforming to property class 12 of IS:1367 (Part 6).

iii) HTS HEX Bolts and Nuts to be used in fabrication of glued joints shall be inspected by purchaser, Railway or its nominated inspecting agency at the premises of HTS HEX Bolts and Nuts manufacturer firm. The inspection certificate of inspecting agency shall be sent by manufacturer of HTS HEX Bolts and Nuts along with the supply to glued joint manufacturer. The glued joint manufacturer will check the supply with respect to the details mentioned in Inspection Certificate of inspecting agency and then only put these in use.

B.3 SPECIFICATION FOR PUNCHED WASHERS:

Steel of punched washers shall conform to IS:2062: 2011 (Reaffirmed 2021) or latest.

B.4 SPECIFICATION OF INSULATING BUSH, LINERS AND END-POSTS:

The insulating components viz. bush, liners and end-posts shall be made with the following materials in the premises of manufacturer as per the procedure indicated under para B.5.2.

B.5 MATERIALS:

B.5.1 WOVEN ROVING FABRICS

B.5.1.1 Woven roving fabrics shall conform to IS 11273:1992 (Reaffirmed 2018) or latest, clause 4.5 type C for the properties not covered below:

a) Nominal weight : 360 ± 36 gm/sqm

b) Nominal thickness: 300 ± 30 microns

c) Construction:

i) Ends per 100 mm : 61± 2.5%

ii) Picks Weave per 100 mm: 55.2± 2.5% plain

d) Binder : The glass roving shall contain a sizing agent to facilitate weaving and to impart high wet strength to liners, bush and end-posts. The sizing agent used shall be compatible with epoxy resins. Approximate size of woven roving fabrics pieces are given below for guidance:

i) For G3(L) : 15 X 100 cm for UIC 60/60E1 and 52 kg joints

ii) For G3(S) : 15 X 66 cm for UIC 60/60E1 and 52 kg joints

B.5.1.2 GLUE:

Resin and Hardener shall be mixed in the ratio of 10:1 for making insulating components and in the ratio of 100:40 for fabrication of Glued Joints or as per instruction of the glue manufacturing firm.

B.5.2 FABRICATION TECHNIQUE

B.5.2.1 The liners, end-posts and bush shall be fabricated either by the hand lay-up process or by pressure-molding technique or by any other standard method.

B.5.2.2 The hand lay-up process is similar to the method described earlier in Para 2.3.6, 2.3.7. The components are to be fabricated by building-up layer after layer till sufficient thickness is achieved. Generally, 20 layers of cloth would be needed for end-posts of 6 mm thickness and 5 layers for liners, bush for obtaining the stipulated thickness.

B.5.2.3 The end-post may be built-up by using suitable sized rectangular pieces of woven roving fabrics. Nominal pressure shall be maintained till the piece is cured. The rectangular piece shall then be cut and profiled to the shape of the end-post.

B.5.2.4 The liner may be fabricated in the hollow of a rail-web by placing a rail piece with its web horizontal and by building up layer after layer. Nominal pressure shall be maintained in this case also till the piece is cured.

B.5.2.5 The bush are to be fabricated by winding a wide piece of woven roving fabrics on a bolt-shank and then cutting up the finished tubing into suitable size after curing.

B.5.2.6 In all the above cases, a coat of a release agent "Releasil-7" or a similar product shall be applied on the surface on which the component is fabricated to enable easy separation of the same after curing.

B.5.3 DIMENSIONS OF FINISHED PRODUCT:

The liners, end-posts and bush shall be given final finish conforming to the dimensions shown in the relevant drawings.

B.5.4 QUANTITY PER JOINT

B.5.4.1 Quantity of raw material required for insulating components for 52kg G3(L) and UIC 60/60E1 G3(L) glued joints, with 6 mm thick end-post drawing shall be approximately as under:

S. No	Insulating Components	Qty. reqd. Per joint	Woven roving fabrics (gm)		Epoxy resin (gm)		Hardener (gm)	
			52kg	UIC 60 /60E1	52kg	UIC 60/ 60E1	52kg	UIC 60/ 60E1
1.	Insulating Liners	2	500	560	450	500	45	50
2.	End post	1	125	135	105	108	11	11
3.	Bush	6	25	36	30	31	3	3

B.5.4.2 Quantity of raw material required for G3(S) type joints can be obtained by reducing proportionately.

B.6 SPECIFICATION OF GLUE AND QUANTITY REQUIRED:

(i) The tangential shear strength of glue should be more than 120 kg/sq.cm (as per IS: 12994)

(ii) The approximate quantity of glue required is 1.4 kg for 52 kg G3(L) and 1.68 kg for UIC 60/60E1 G3(L) rail joints. The quantity may be estimated proportionately in case of G3(S) type joints. The weight of raw material indicated above is approximate and includes allowance for wastage and is based on experience gained at the time of development of these joints in RDSO.

(iii) Detailed instructions regarding the method of storage, mixing, pot-life and minimum period of curing of adhesive at various temperatures shall be obtained by purchaser from the suppliers and shall be scrupulously followed.

(iv) The resin and hardener shall be of the same firm as approved i.e. resin of one firm and hardener of another firm cannot be used.

ANNEXURE-C

JOINT INSPECTION OF GLUED JOINTS

Division/Rly. .....

Station/Yard.....Glued Joint serial No. as provided by manufacturer.....

Route/Major Section .....Glued Joint type-UIC 60/60E1 & 52 kg, 6 mm thick end post .....

Block Section if any.....Month & Year of manufacture.....

Line No.....Date of laying.....

Track Circuit No. .....Name of the manufacturer…..

Location KM/Chainage .....Purchase Order No……..

Year of last deep screening .....Inspection Certificate No.....

Date of Inspection	Glued Joint (New/ Old)	Condition of bolts	Condition of Insulation materials/ end posts/ whether end post is centrally placed between sleepers	Condition of Rail ends Burrs, metal flow etc.	Condition of Fittings ERC-J Clip/ Glued Joint/ Rail Pads /End Cut GFN Liners etc.	Condition of packing, sleepers, sleeper spacing & squaring	Resistance of Glued Joint measured with the calibrated megger	Signature of SSE/JE P-Way with remarks if any	Signature of SSE/JE Signal with remarks if any	Action Taken	Remarks

ANNEXURE-D

LIST OF ESSENTIAL EQUIPMENT REQUIRED FOR FABRICATION AND TESTING OF GLUED JOINT

a)	Gantry Crane /Hydra crane Facilities (2T (min.))	1 no.
b)	Rail cutting machine, Hacksaw/Circular saw/Band Saw	1 no.
c)	Drilling machine with required drill bits	1 set
d)	Electric grinder	2 sets
e)	Protective goggles	2 nos.
f)	Sand blasting equipment with 10 hp compressor	1 no.
g)	Jigs for assembly of joints (Figure -4)	4 nos. (min)
h)	Pull-out strength testing frame/Jig complete with 1No. 200T or 2 Nos. of 100T capacity hydraulic jack and pressure gauge duly calibrated (Figure-2 & 3)	1 no.
i)	Straight edge 1m long with 15 mm notch at centre	1 no.
j)	Steel brushes (stiff)	2 nos.
k)	Steel brush (round) attachment of electric grinder	2 nos.
l)	Steel pans about 30 cm dia. for mixing glue	2 nos.
m)	Split washer rollers	2 nos.
n)	Receptacle (to clean tools etc.)	1 no.
o)	Torque wrench 105 kg-m capacity	1 no.
p)	Pair of scissors for cutting of woven roving fabrics	1 no.
q)	Files (round and flat)	1 set
r)	Spanners/adjustable spanners suitable for tightening of HTS bolts & nuts	1 set
s)	Weighing balance with set of suitable weights	1 set
t)	Chamfering tool with bolts & nuts as per Figure-1	2 sets (min)
u)	Templates of fishplates duly approved by RDSO	2 sets
v)	Vernier Calipers (min.15 cm), steel scales, steel tapes of various sizes, inner & outer caliper and filler gauges in mm	1 set
w)	Megger 100 Volt DC for testing insulation resistance in dry condition	1 no.
x)	An Ammeter capable of measuring current upto 1 micro ampere for insulation resistance in wet condition	1 no.
y)	Electric heaters in winters to maintain temperature above 20^0C in the shed required for hardening of glue in 24 hrs.	Nos. as required
z)	200 tonnes capacity proving ring duly calibrated by NPL, or NCCBM, required for in house calibration of pressure gauge used in pull out strength test unit	1 no.
aa)	Rubber hand gloves	Nos. as required
ab)	Brushes for glue application	Nos. as required
ac)	Emery Cloth	As per required

Note: - Any additional equipment as directed by Engineer-in-Charge shall also be provided.

ANNEXURE-E

PROFORMA FOR QUALITY ASSURANCE PROGRAMME

S. No.	ITEM	OBSERVATION
I.	MATERIAL	
a)	RAILS	
	i) Rail Section	(To be recorded for each section of rail for each supply.)
	ii) Condition of Storage	
	iii) Ultrasonically tested	
	iv) Availability of Test Certificate	
	v) Straightness	
	vi) Quantity in hand	
b)	FISHPLATES	
	i) For which rail section and drg. No.	(To be recorded for each drg. of fish plate for each supply.)
	ii) Condition of storage	
	iii) Source of supply	
	iv) Availability of Certificate if material conforming to IRST-1	
	v) If conforming to template approved by RDSO	
	vi) Holes position w.r.t. centre line of rail hole (measured with the help of template)	
	vii) Straightness	
	viii) Twist	
	ix) Quantity in hand	
c)	HTS BOLTS AND NUTS	(To be recorded for each supply.)
	i) Source of supply	
	ii) Availability of certificate for material conforming to specifications	
	iii) Marking on bolts & nuts	
	iv) Storage facility	
	v) Quantity in hand	
d)	WOVEN ROVING FABRICS	(To be recorded for each supply.)
	i) Source of supply	
	ii) Condition of storage	
	iii) Quantity in hand	
e)	INSULATING COMPONENTS-END POST	(To be recorded per 100 Nos.)
	i) Size and shape variation, if any	

ii) Thickness variation, if any
iii) Glue used for making and ratio:
iv) Whether roughened properly before use
v) Quantity in hand

f) INSULATING COMPONENTS-LINERS

(To be recorded per 100 Nos.)

i) Size and shape variation, if any
ii) Thickness variation, if any
iii) Glue used and its ratio
iv) Position of holes w.r.t. centre line of fishplate
v) Dia. and distance of holes
vi) Whether roughened properly before use
vii) Quantity in hand

g) INSULATING COMPONENTS-BUSH

(To be recorded per 100 Nos.)

i) Size, dia. and shape variation, if any
ii) Thickness variation, if any
iii) Glue used and its ratio
iv) Whether roughened properly before use
v) Quantity in hand

II. ASSEMBLY AND TESTING EQUIPMENTS

(Observation to be recorded on weekly basis, say every Monday.)

Availability and condition of the following:

a) Sand blasting equipment and compressor
b) Assembly jigs with facility for alignment for vertical and lateral adjustment
c) Provision for end-pressure arrangement
d) Spirit level
e) Torque wrench and other wrenches
f) Calibration of Torque wrench to be done every six month
g) Chamfering tools as per drawing (Figure-1)
h) Pull-Out testing frame having 200T capacity Hydraulic jack with pressure gauge
i) Calibration of Pressure gauge to be done every six month
j) Megger for measuring dry insulation resistance
k) Separate meter or arrangement for measuring insulation resistance in wet condition capable of measuring from 0 to 100 kilo-ohms

III. GENERAL OBSERVATIONS AT THE TIME OF ASSEMBLY OF JOINTS

(To be recorded for assembly of each joint.)

a) Rolling marks on rail are ground before assembly of joint.
b) Position of holes w.r.t. dimensions shown in drg. vertical and horizontal.
c) Rail holes are chamfered with proper chamfering tool and with proper torque.
d) Rail is placed properly on assembly jig, aligned properly and checked with the help of straight edge and spirit level.
e) Rails and fishplates are first cleaned with wire-brush and then rail, fishplates and Bolts & Nuts are cleaned with Acetone or Benzene.
f) Resin and Hardener weighed separately in the ratio prescribed by the firm and stirred properly before use.
g) Method of application of glue and putting the insulating components and woven roving fabrics are according to Manual of Instructions.
h) End pressure is given at the joint after insertion of end-post in position duly soaked in glue.
i) Bush are inserted in rail-holes duly dipped in glue.
j) Bolts are inserted without difficulty and tightened in stage of 35 kg-m torque upto 105 kg-m torque initially (Central bolts are to be tightened first).
k) Final tightening is checked after 20 min. with 105 kg-m torque.
l) Oozed out glue is applied around the fishplates to fill the fillets.
m) Insulation resistance is checked immediately after making the joints.
n) Joints are not disturbed before 24 hrs. at room temperature.

IV. OBSERVATIONS AT THE TIME OF TESTING THE JOINTS

(To be recorded for each joint to be tested with the joint No.)

a) The slots are cut properly and rounded
b) Eccentric loading is not applied
c) Load is applied without jerks
d) Loading is stopped when crack appears at the joints
e) Value of load applied at appearance of crack or completion of testing

f) Insulation resistance is recorded after pull-out test and then the joint is immersed in water for 48 hours for wet insulation resistance test
g) Insulation value obtained

V. GENERAL

a) Availability of required drawing, specification, literature, etc.
b) Display of Board for identification of resin and hardener with their prescribed ratios for use
c) Display of boards for calibration of pressure gauge and torque wrench
d) General working conditions e.g. proper lighting, ventilation, cleanliness etc.

Date:

Signature and Name of Inspecting Engineer with date of inspection

ANNEXURE-F

PROFORMA FOR MAINTAINING RECORD FOR

A. PRODUCTION

Page No. 1

S. No.	DATE OF MANUFACTURE	JOINT NO.	DRG. NO.

Page No. 2

DATE OF INSPECTION	TOTAL NOS. OFFERED	NO. OF JOINTS FAILED	REMARKS AGAINST FAILURE i.e. NATURE OF FAILURE etc

Page No. 3

DATE OF DESPATCH	CONSIGNEE	JOINT NOS. DESPATCHED

B. GLUE & WOVEN ROVING FABRICS

Opening balance as on 1st of last month (kg)			Receipt of material during the month (kg)			No. of joints fabricated during the month	Consumption during the month (kg)			Opening balance on 1st day of the current month (kg)		
Glue for making joints (kg)	Glue for making insulating components (kg)	Woven roving fabrics (kg)										
A	**B**	**C**	**A**	**B**	**C**		**A**	**B**	**C**	**A**	**B**	**C**
a) Resin b) Hardener	a) b)		a) b)	a) b)			a) b)	a) b)		a) b)	a) b)	

C. RAIL: The register shall be separate for each rail category i.e. UIC 60/60E1/52 kg etc.

To be maintained P.O. wise

P.O. No. …… dated …….. of ……..Rly

S. No.	Invoice no./I.C. No.	Quantity of rail received		Qty. of rail balance (if any) in MT/ Nos./Length	Inspection call No & date	Offered Qty of Glued Joints (Nos)	Rail consumed (Nos. /length)	Rail Balance (Nos. /length	Signature of	
		in MT	Nos./ length						Firm's rep.	Insp. official
1	2	3	4	5	6	7	8	9	10	11

D. REJECTED GLUED JOINTS:

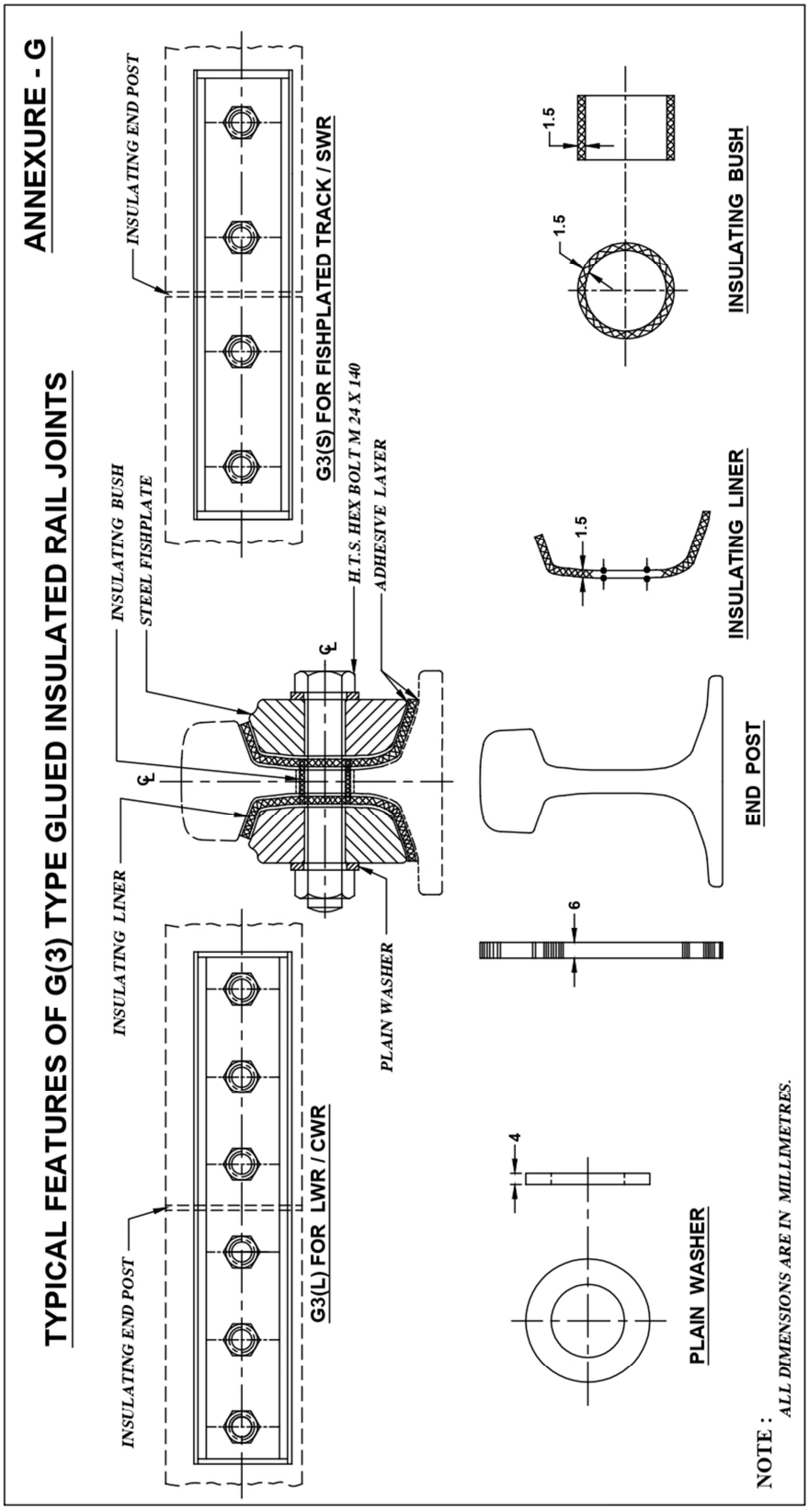
To be maintained P.O. wise

P.O No. …….. dated …….. of ……..Rly

S. No.	Date Of Inspection	Total Nos. Offered	No. Of Joints Passed	No. Of Joints Rejected	Remarks Against Rejected Joints	Signature Of	
						Firm's rep.	Insp. official

ANNEXURE-G

TYPICAL FEATURES OF G3 TYPE GLUED JOINTS



ANNEXURE- H

PROFORMA FOR MAINTAINING RECORD OF PRODUCTION OF IN-SITU REFURBISHED/IN-SITU FABRICATED GLUED JOINTS

P.O./Work Order No. ……dated …… of ……..Rly

S No.	Date of re-furbishing/ fabrication	Location as per TMS guidelines	Line UP/DN /SL	Block time/ On cess	Resistance of Glued Joint in dry condition (In mega-ohms)**	Name of Agency	*Team No.	Name of agency Supervisor	Name of Railway Supervisor	Sign of Railway Supervisor	Remarks

*Branch/workshop team number is to be generated by firm/workshop duly maintaining the record for traceability for in-situ/refurbished glued joint

** All the values of resistance to be measured and minimum value amongst all to be recorded

FIGURE-1

SPECIAL TOOL FOR CHAMFERING RAIL HOLES BY NUT AND BOLT

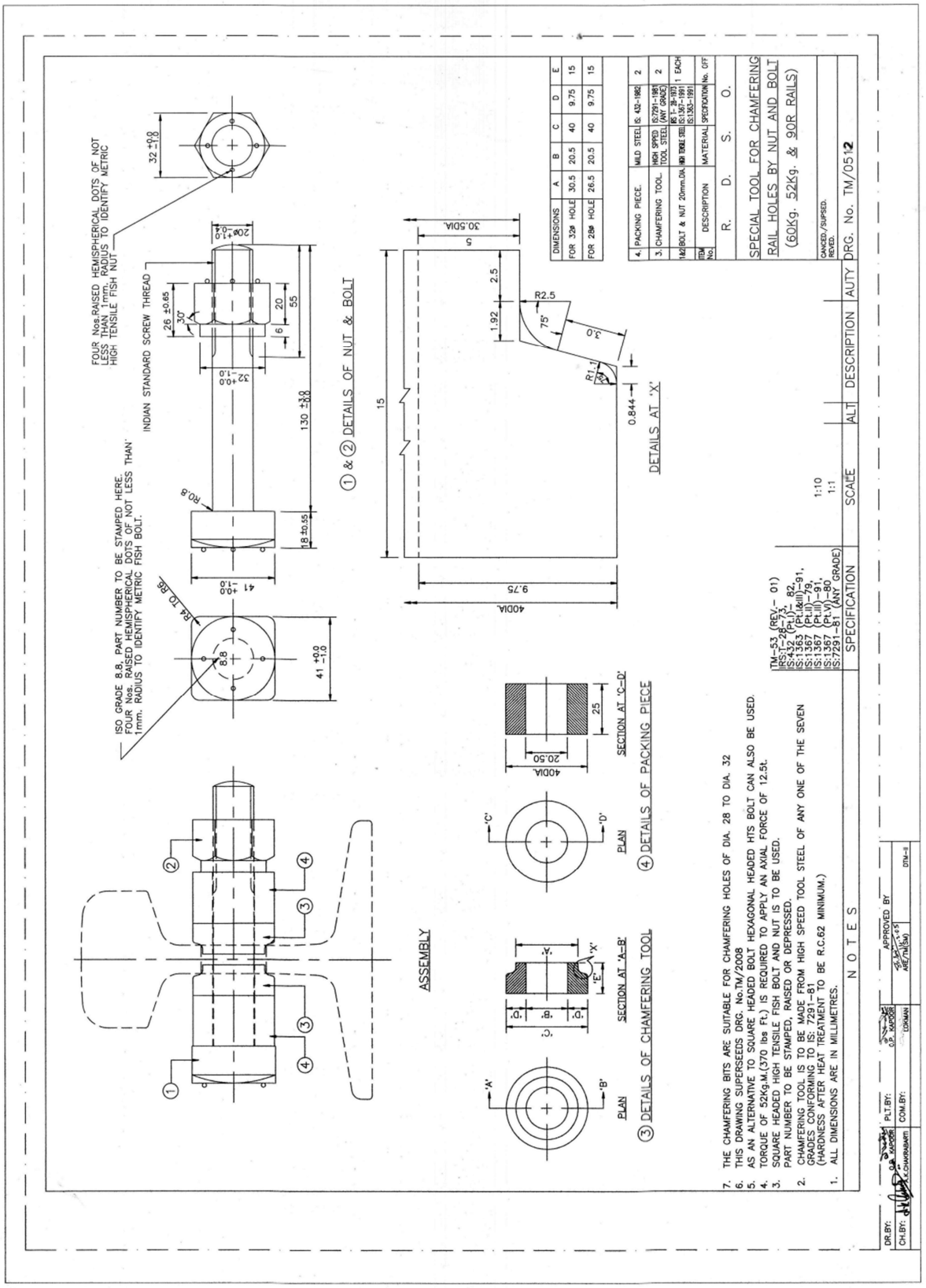


FIGURE-2

METHOD OF CONDUTING PULL OUT TEST ON GLUED JOINT

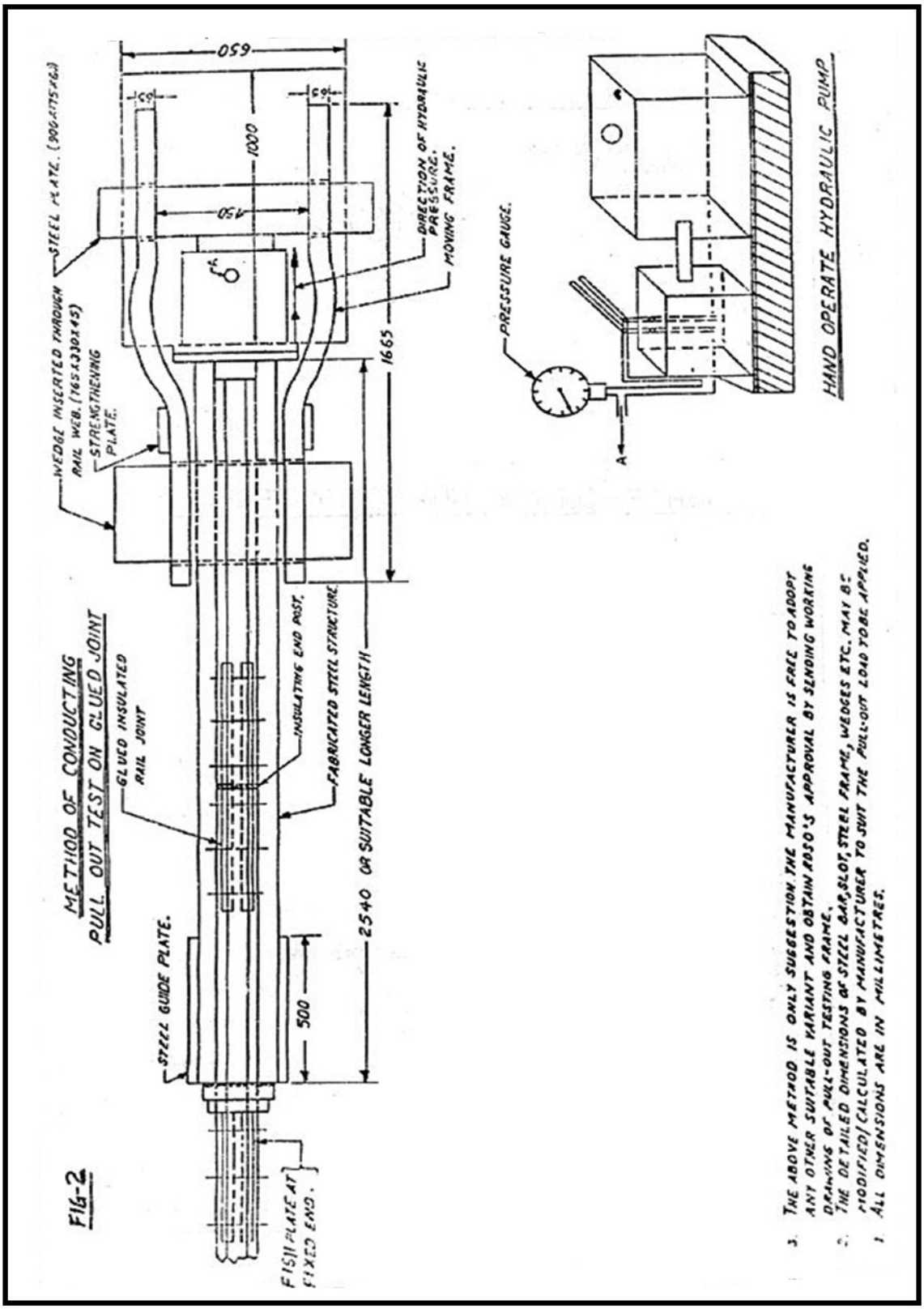


FIGURE-3

METHOD OF CONDUTING PULL OUT TEST ON GLUED JOINT

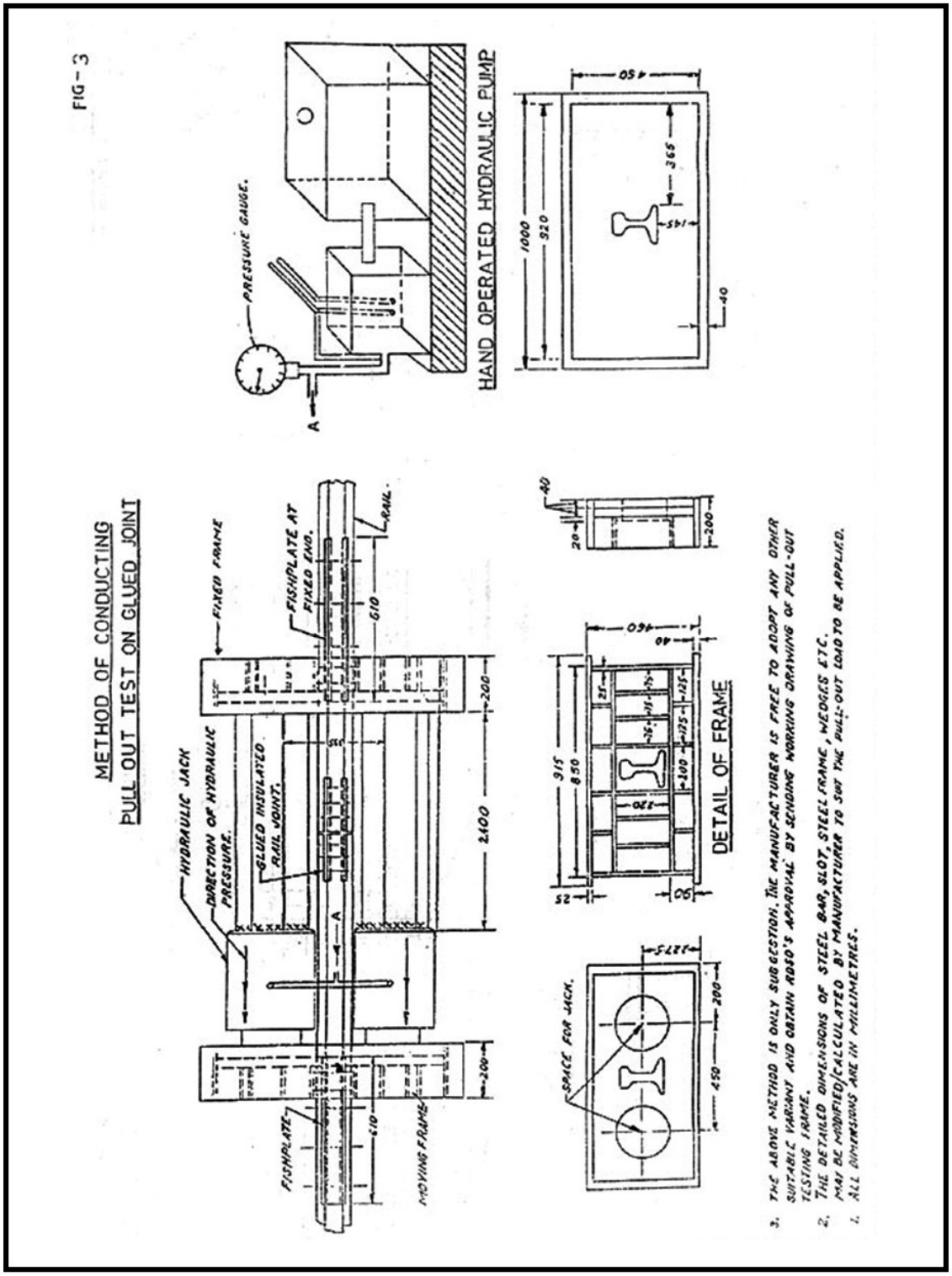


FIGURE-4

JIG FOR GLUED JOINT

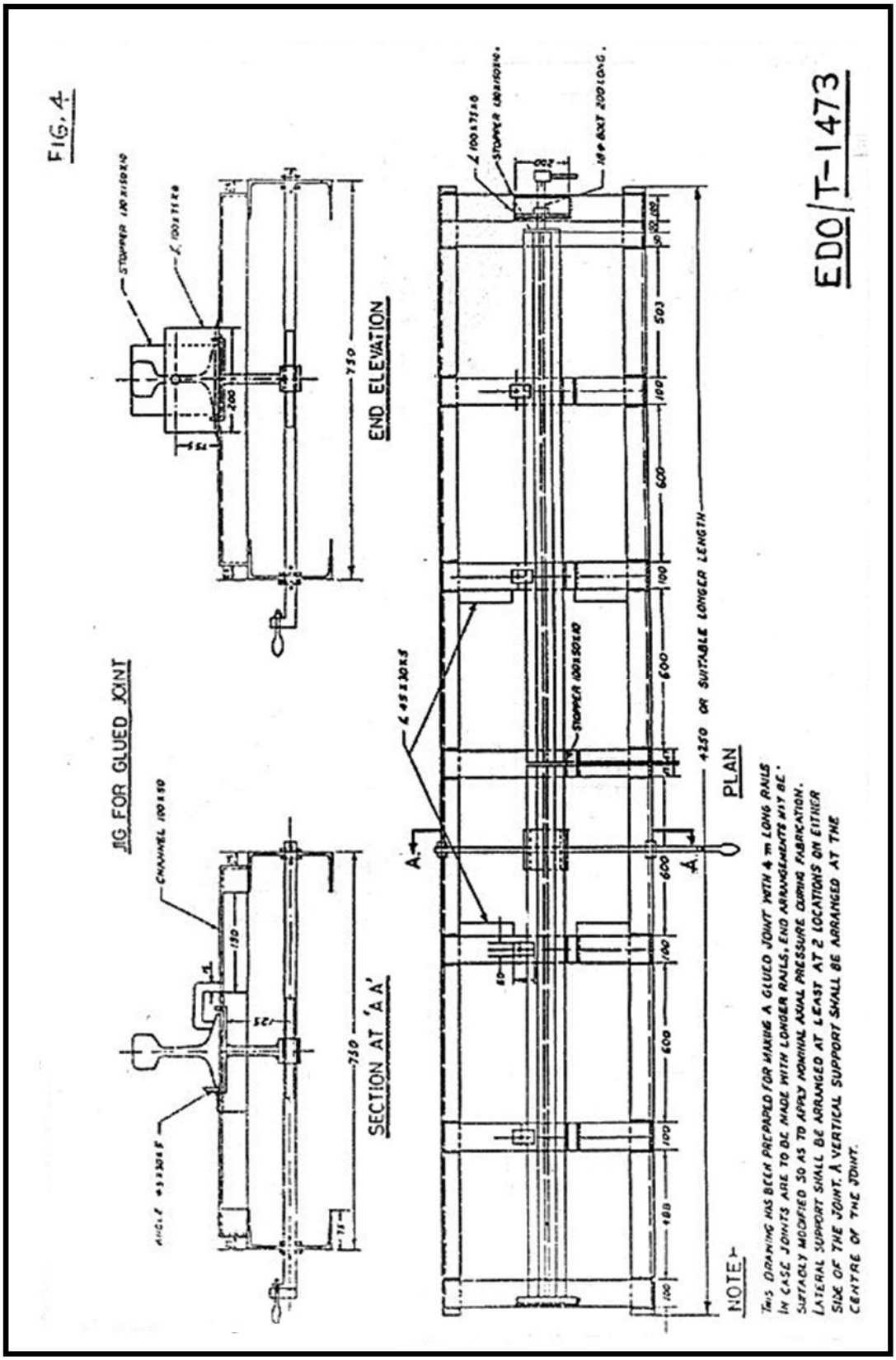


FIGURE-5

LOCATION OF MARKING OF GLUED JOINT

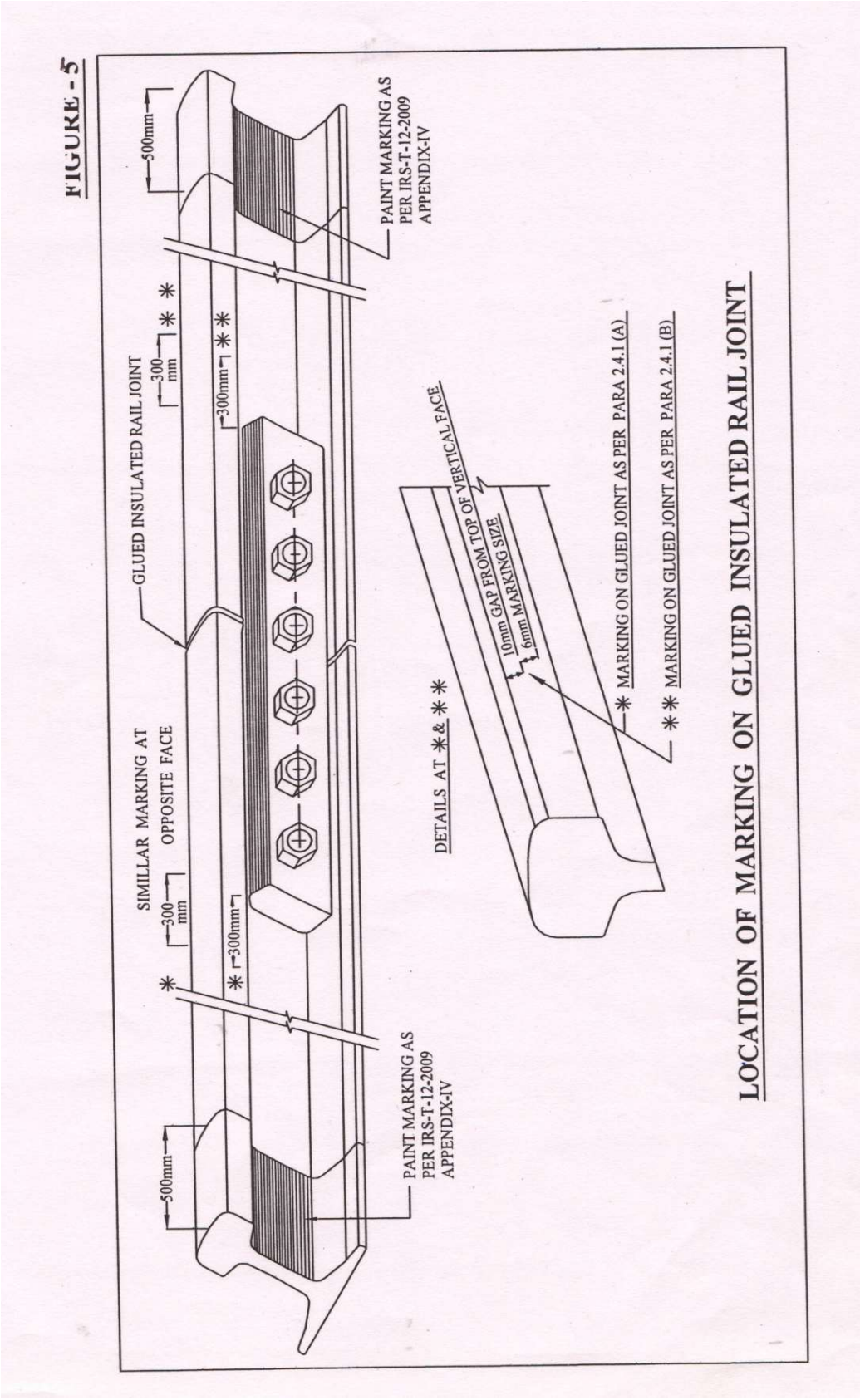


FIGURE-6

METHOD OF CUTTING OF WOVEN ROVING FABRICS AT BOLT HOLES