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No. CT/GJ/Manual

Date: 28/04/2022

To

As per mailing list attached

Sub: Manual for Glued Insulated Rail Joints (First Reprint -2022).

Ref: Railway Board's letter no. 2021/Track-I/24/1(5)/Misc dated: 19.04.2022.

The Manual for Glued Insulated Rail Joints (1998) was circulated to all Zonal Railways. So far, seven A&C slips to 'Manual for Glued Insulated Rail Joints (1998)' have been issued. Railway Board vide letter referred above has desired that 'Manual for Glued Insulated Rail Joints' be revised incorporating all seven number of A&C slips issued.

Accordingly, 'Manual for Glued Insulated Rail Joints (First Reprint -2022)' is being issued incorporating all the seven number of A&C slips issued till date. The soft copy in pdf format of the 'Manual for Glued Insulated Rail Joints (First Reprint -2022)' is being issued.

This is for your kind information and necessary action at your end please.

DA: As above

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(Pradip Kumar)
Executive Director/Track-II
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भारत सरकार
GOVERNMENT OF INDIA
रेल मंत्रालय
Ministry of Railways

MANUAL
FOR
GLUED INSULATED RAIL JOINTS
(First Reprint-2022)

Embodying all advance correction slips upto number-07 dated -28.02.2020



अनुसंधान अभिकल्प एवं मानक संगठन, लखनऊ -226011
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MANUAL FOR GLUED INSULATED RAIL JOINTS

(Reprint- 2022)

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. This manual is issued under the title “MANUAL FOR GLUED INSULATED RAIL JOINTS”. in consultation with Signal Directorate of RDSO.(reference Signal Engg. Dte. letter no. STS/E/IRJ/PIJ dated: 20.06.97).
- 0.2 The Manual has been further revised in its present form in view of use of rails of different grades of steel such as GR 880, GR 1000 and GR 1080 and experience gained in the intervening period. The procedure for approval of new units for Glued Insulated Rail Joints has also been included as annexure A.
- 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	1. 75R	RDSO/T-1283	RDSO/T- 3008
	2. 90R	RDSO/T- 1276	RDSO/T-1278
	3. 52 Kg	RDSO/T- 671	RDSO/T- 1259
	4. 60 Kg (UIC)	RDSO/T- 2572	RDSO/T-2576
10mm	1. 52 Kg	RDSO/T- 5361	-
	2. 60 Kg (UIC)	RDSO/T- 5843	-

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

- 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,version no.2.1, dated 01.04.2022 or latest (titled “Vendor- Changes in approved status”) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendor’s in

the contracts floated by Railways to maintain quality of products supplied to Railways.

- 0.7 In case of Re-Furbishing of Existing Glued Insulated Rail Joints and In-Situ Fabrication of Glued Insulated Rail Joints “Technical Specification for Re-Furbishing of Existing Glued Insulated Rail Joints and In-Situ Fabrication of Glued Insulated Rail Joints (PROVISIONAL)” shall be referred.

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 B. The input materials shall be procured from RDSO approved suppliers only. The list of approved suppliers of input materials is available in Vendor Directory of Approved Vendors of Quality Assurance (Civil) Directorate of RDSO available in U-VAM portal of www.ireps.gov.in website.

1.2 SPECIFICATIONS:

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

1.3 EQUIPMENTS:

1.3.1 List of equipments required for fabrication of glued joints is given in Annexure-E.

1.3.2 A special jig for assembly (item f of Annexure-E) and a testing frame (item g of Annexure-E) for conducting pull-out test on glued joints shall be manufactured as per guidelines shown in fig. 2 & 3 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 Rails required for fabrication of glued joints shall be straight and USFD tested. These rails shall be issued by the consignee Zonal Railways to the manufacturer. Old/Service rails shall not be used for fabrication of glued joints. New rails need not to be USFD tested again by consignee Zonal Railways if they have received the same from rail manufacturing plant duly USFD tested.
- 2.1.5 The rail piece shall be cut in the middle with 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-I.
- 2.1.9 The fish-plates 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 fish plate shall be sand blasted. Sand blasted rail and fish plate 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. Alternatively, the surfaces may be cleaned with the help of a brush with hard nylon bristles.

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, bushes/sleeves 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 polyethelene sheet to prevent accumulation of dust. A newly fabricated glued joint should also be kept covered by polyethelene 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 tapid 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.
- 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 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 clean-glass cloth carrier shall be placed on the fishplates and evenly pressed so that the glue squeezes out through the glass cloth. 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 glass-cloth carrier on the two fishplates.
- 2.3.6 A layer of glue shall then be applied on the outside of the insulating liners and a clean piece of glass cloth carrier 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 In case of glued joint with 6 mm thick end post, the insulating bushes 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 fish plates made ready as described in Paras 2.3.4 to 2.3.6 shall be placed in position in contact with the rail web. In case of glued joint with 10 mm thick end post, the bonding surfaces of the rails shall be coated with a layer of glue and the fish plates made ready as per Para 2.3.4 to 2.3.6 are to be placed in position in contact with the rail web. The insulating sleeves duly dipped in glue shall then be inserted in the joint holes and subsequently bolts to be inserted for tightening to the required bolt tension.

- 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 glass-cloth carrier 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 embossed on the gauge and non-gauge face sides of the head of the rail of glued joint at 300mm away from the one end of fish plate by punching without causing any damage to rail, in letters/digits of 6mm height at a depth of 10mm 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 Quality Assurance (Civil) Directorate of RDSO.

- (B) Marking of Glued Joints (by inspecting authority)** - Every glued joint shall have distinctive inspection mark of inspecting agency. This marking should be embossed on the gauge and non gauge face sides of the head of the rail of

glued joint at 300 mm away from the another end of fish plate by punching without causing any damage to rail, in letters/digits of 6 mm height at a depth of 10mm 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 polyethelene 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 equipments 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 1m 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 ± 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 100 V 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 fish plates as fixed end. The other end of the glued joint is held to a moving frame with the help of

wedge inserted in slots 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 fish plates 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 posts 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.	75R	110	70
2.	90R	125	85
3.	52 Kg	150	100
4.	60 Kg (UIC)	170	110

3.4.4 The basis for acceptance/rejection of the lot with respect to pull-out test shall be as follows:

Four joints should 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 should 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 100 V DC across the joint and measuring current by an ammeter capable of measuring current upto 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 joint 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.

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. Fish plates 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 with red paint over at least 30 cm length at both ends.

3.9 MAINTENANCE OF RECORDS

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

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 shall be 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 Manual of Instructions for LWR 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 5.5m 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 shall normally not be less than 50mm.

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 As in the case of ordinary insulated joints, the 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 It shall be ensured that live cinders, which may damage glued joints, are not dropped in the vicinity of such joints.

4.3.6 FAILED JOINTS:

Normally no relative movement shall occur between rails and fish plates 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 may 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 200⁰C. 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 fish plate 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 off as scrap as per extant practice.

4.5 Life cycle of Glued Insulated Rail Joints is tentatively fixed at 200 Gross Million Tonnes of traffic.

CHAPTER-5

PROCEDURE FOR JOINT INSPECTION OF GLUED JOINTS IN FIELD

5.0 General:

Glued Insulated Rail Joints are required for provision of track circuits. This being part of track, is installed by Engineering Department. Maintenance of glued insulated 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 insulated rail 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 Insulated Rail 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 insulated joint shall not be less than 10 mega-ohms which is measured using an insulation tester of 100 V 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 clip and end cut liners should be used at glued joints (as well as Nylon Insulated Joints) to avoid contact of clip with the fish plates.
- 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 Insulated 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 insulated joints should behave as monolithic unit, there should not be any relative movement between rails and fish plates or separation of rail/fishplate surface and insulation. In case where glued insulated 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 a frequency of 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-ohms, 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 insulated 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 Insulated Joints shall be ensured in proper and effective condition. Proper elastic rail clip 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 shall normally not be less than 50mm 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-D and shall be jointly signed by P. Way and S&T staff/officer.

5.3 Life Cycle of Glued Joints:

Tentative life cycle of the Glued Insulated Rail Joints is specified in the "Manual for Glued Insulated Rail Joints" Based on the traffic pattern on the section, periodicity of planned replacement of Glued Joint shall be decided by Engineering Department and replacement planned accordingly.

GUIDELINES REGARDING DEVELOPMENTAL INSPECTION OF FIRMS BY RDSO

- A.1 Development inspection of glued joint will be under taken by RDSO after initial development of firm in normal course as per extant instruction or against developmental/educational order placed by Zonal Railway on any firm/or as per decision of competent authority. Separate approval shall be required for each drawing of the glued joints.
- A.1.1 The development of firm against developmental order by Zonal Railway shall be dealt as per extant instructions of Railway Board.
- A.2 After administrative clearance for development of firm, a technical capability assessment proforma will have to be downloaded by the firm/obtained from vendor registration system of RDSO. Firm shall be required to fill in the proforma in duplicate and submit the same to concerned directorate of RDSO for scrutiny along with the necessary charges.
- A.2.1 All the information in the proforma should be clear and to the point and no para should be left blank.
- A.3 The filled in proforma will be scrutinized in RDSO duly calling for any additional information if required.
- A.4 If the proforma details and clarifications given by the firm are acceptable, the works of the firm shall be inspected by RDSO officials for verification of the facilities. The date of inspection of firm's works shall be advised to the firm in advance.
- A.5 During the inspection, the inspecting officer shall have free access to all the sections of the firm's works. Firms shall be required to offer, to the inspecting officer, all necessary facilities to undertake the assessment inspection.
- A.6 After the assessment, if the firm's manufacturing capacities/facilities are found acceptable, the firm will be required to furnish two sets of templates/gauges (Item 't' of Annexure-E) for approval by RDSO along with the templates/gauge approval charges.
- A.7 After approval of templates/gauges, the firm will undertake internal development and submit internal test report (ITR) for scrutiny to RDSO. For internal development, firm will procure rails from authorized source and preserve record for the same.

In case, ITR submitted by the firm is found satisfactory, the firm shall be advised to deposit sample drawl and testing charges.

- A.8 After submission of charges, the firm will undertake manufacture of glued joints in presence of RDSO representative and sample shall be drawn at random from the production undertaken and will be tested as per specified testing scheme given in Chapter-3.
- A.9 The firm shall bear the entire cost of preparation of samples and testing. The firm shall be required to pay the due charges in advance for development of their firm. The amount of charges shall be advised to the firm by RDSO.
- A.10 After the samples are found satisfactory and other conditions fulfilled, the vendor shall be considered for approval. If the development is undertaken against developmental order, the firm will be given permission to undertake manufacture of ordered quantity. After satisfactory supply, it will be considered for approval.

A.11 General Instructions:

- A.11.1 The firm shall be required to procure all components of assembly of the joints from the firms approved by RDSO and should maintain the copies of test certificates wherever applicable.
- A.11.2 Drawings and specification of the glued joints are priced documents and may be obtained either by downloading from RDSO website through RTGS/NEFT payment or from Director General (Track Design) RDSO, Lucknow on payment.
- A.11.3 If the results of testing are not found satisfactory as per specifications, the firm will be required to improve upon the technique of production.
- A.11.4 The firm is required to establish quality assurance program as per the proforma given in Annexure-F, and its satisfactory implementation in addition to manufacture of a minimum number of glued joints as specified by RDSO.
- A.11.5 After approval of test samples (after supply of ordered quantity in case of developmental order), the firm shall be brought as Part-II source in approved list of manufacturer of Glued Joints for the particular rail section and all concerned shall be advised.
- A.11.6 Based on the satisfactory and consistent quality of the firm's product, proven performance and successful implementation of QAP, the firm will be considered for up gradation in Part-I in the approved list of manufacturer after fulfilling the criteria for up gradation as mentioned in General Guidelines of Vendor Development.

A.11.7 The approval shall be required to be renewed after a particular period as per the terms of the letter of approval and it shall be the firm's responsibility to approach RDSO at least three months in advance for renewal of approval otherwise the approval is liable to lapse.

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 Bushes/Sleeves**	6 Nos.	4 Nos.
6.	Insulating Liners**	2 Nos.	2 Nos.
7.	Insulating End Post**	1No.	1 No.
8.	Glue	(As indicated in Para C.5.1.2)	
9.	Glass cloth carrier/(Woven rovings)	4 pieces (15 x 100 cm)	4 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 cu.m	0.2 cu.m
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.

C.0 SPECIFICATION OF MATERIAL

C.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 insulated rail joints shall be inspected by purchaser Railway or its nominated inspecting agency (M/s RITES) 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.

C.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 clause 10.9 of IS:1367.
- ii) HTS Nuts: Material and manufacturing process of Hex nuts shall be as per IS:1363 conforming to property clause 12.0 of IS:1367.
- iii) HTS HEX Bolts and Nuts to be used in fabrication of Glued Insulated Rail joints shall be inspected by purchaser, Railway or its nominated inspecting agency (M/s RITES) 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.

C.3 SPECIFICATION FOR PUNCHED WASHERS

Steel of punched washers shall conform to IS:2062.

C.4 SPECIFICATION OF INSULATING BUSHES/SLEEVES, LINERS AND END-POSTS

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

C.5 MATERIALS:

C.5.1 GLASS-CLOTH CARRIER REINFORCEMENT:

Glass-cloth carrier reinforcement shall conform to IS 11273:1992 clause 4.5 type C for the properties not covered below:

- a) Nominal weight : 360 ± 36 gm/sq.m
- 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 rovings shall contain a sizing agent to facilitate weaving and to impart high wet strength to liners, bushes/sleeves and end-posts. The sizing agent used shall be compatible with epoxy resins. Approximate size of glass-cloth pieces are given below for guidance:
 - i) For G3(L): 15 X 100 cm for 60 Kg, 52 Kg and 90R joints 15 X 65 cm for 75R joints
 - ii) For G3(S): 15 X 66 cm for 60 Kg, 52 Kg and 90R joints 15 X 48 cm for 75R joints

C.5.1.2 GLUE: (For making insulating components)

Glue consists of resin and hardener. The nomenclature of resin and hardener manufactured by firms approved at present are as under:

Firm's name	Resin	Hardener
M/s ATUL Ltd	Epoxy resin Lapox L-12	Epoxy hardener Lapox K-6
M/s HUNTSMAN Advanced Materials India Pvt. Ltd.	ARALDITE LY-556	ARADURE HY – 951 IN

Resin and Hardener shall be mixed in the ratio of 10:1.

C.5.2 FABRICATION TECHNIQUE

C.5.2.1 The liners, end-posts and bushes/sleeves shall be fabricated either by the hand lay-up process or by pressure-moulding technique or by any other standard method.

C.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, bushes/sleeves for obtaining the stipulated thickness.

C.5.2.3 The end-post may be built-up by using suitable sized rectangular pieces of glass-cloth. 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.

C.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.

C.5.2.5 The bushes/sleeves are to be fabricated by winding a wide piece of glass-cloth on a bolt-shank and then cutting up the finished tubing into suitable size after curing.

C.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.

C.5.3 DIMENSIONS OF FINISHED PRODUCT:

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

C.5.4 QUANTITY PER JOINT

C.5.4.1 Quantity of raw material required for insulating components for 52kg G3(L) and 60kg G3(L) glued joint, with 10mm thick end-post drawing shall be approximately as under:

S. No	Insulating Components	Qty. reqd. per joint	Fibre Glass cloth (gm)		LY-556 (gm)		HY-951 IN (gm)		L-12 (gm)		K-6 (gm)	
			52kg	60kg	52kg	60kg	52kg	60kg	52kg	60kg	52kg	60kg
1.	Insulating Liners	2	500	560	450	500	45	50	450	500	45	50
2.	End post	1	210	225	180	180	18	18	180	180	18	18
3.	Bushes/Sleeves	6	180	190	150	150	15	15	150	150	15	15

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

C.5.5 Other components of input materials such as glue, glass cloth carrier reinforcement as mentioned at Para C.5.1, C.5.1.2, C.5.4.1 & C.6 of this manual to be used in fabrication of glued insulated rail joint shall be procured by the manufacturer of glued insulated rail joint from their approved sources mentioned in the current Master list of Approved Vendors issued by Quality Assurance (Civil) Directorate of RDSO which is updated from time to time. While procuring these materials from their respective approved sources, glued joint manufacturer must obtain all the relevant inspection certificates/documents from their approved suppliers and preserve the same. Purchasers railway/nominated inspecting agency (M/s RITES) while doing the inspection at the premises of glued joint manufacturer must ensure that these input materials used in fabrication of glued joints have been procured from their respective approved sources by verifying the related inspection certificate/documents and records maintained by glued joint manufacturer.

C.6 SPECIFICATION AND QUANTITY REQUIRED OF GLUE

The tangential shear strength of glue is claimed to be about 120 kg/sq.cm by the manufacturer.

(i) The glue as developed by M/s HUNTSMAN Advanced Materials (INDIA) Pvt. Ltd. For prefabricated type Glued Joints, consists of ARALDITE XY -27 and Hardener XY -28 IN to be mixed in proportion of 100:40. The approximate quantity of combined adhesive required for 52kg rail joint is 1.4kg for G3(L) and for 60kg rail joint is 1.68kg for G3(L). The quantity may be estimated proportionately in case of G3(S) type joints.

(ii) Similarly, the Glue as developed by M/s ATUL Ltd for prefabricated type Glued Joints consists of Epoxy resin Lapox A-83 and Hardener Lapox K-83 to be mixed in proportion of 100:40. The approximate quantity of combined adhesive required for 52kg rail joint is 1.4kg for G3(L) and for 60kg rail joint is 1.68kg for G3(L). The quantity may be estimated proportionately in case of G3(S) type joints.

NOTE:

(i) 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.

- (ii) 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.

- (iii) The resin and hardener should be of same firm as approved i.e. resin of one firm and hardener of another firm cannot be used.

JOINT INSPECTION OF GLUED INSULATED JOINTS

Division/Rly.

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

Route/Major Section ...Glued Joint type-60kg/52kg, 6/10 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/ChainagePurchase Order No.....

Year of last deep screeningInspection 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/ Rubber Pad/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

.....

LIST OF ESSENTIAL EQUIPMENTS REQUIRED FOR FABRICATION

AND TESTING OF GLUED JOINT

a)	Rail cutting machine	1 no.
b)	Drilling machine with required drill bits	1 set
c)	Electric grinder	2 sets
d)	Protective goggles	2 nos.
e)	Sand blasting equipment with 10 hp compressor	1 no.
f)	Jigs for assembly of joints	4 nos. (min)
g)	Pull-out strength testing frame complete with 200t capacity hydraulic jack and pressure gauge duly calibrated	1 no.
h)	Straight edge 1 m long with 15mm notch at centre	1 no.
i)	Steel brushes (stiff)	2 nos.
j)	Steel brush (round) attachment of electric grinder	2 nos.
k)	Steel pans about 30 cm dia. For mixing glue	2 nos.
l)	Split washer rollers	2 nos.
m)	Receptacle (to clean tools etc.)	1 no.
n)	Torque wrench 105 kg m capacity	1 no.
o)	Pair of scissors for cutting of glass cloth	1 no.
p)	Files (round and flat)	1 set
q)	Spanners/adjustable spanners suitable for tightening of HTS bolts & nuts	1 set
r)	Weighing balance with set of suitable weights	1 set
s)	Chamfering tool with bolts & nuts as per figure 1	2 sets (min)
t)	Templates of fishplates duly approved by RDSO	2 sets
u)	Vernier Calipers, steel scales, steel tapes of various sizes, inner & outer caliper and filler gauges in mm	1 set
v)	Megger 100V DC for testing insulation resistance in dry condition	1 no.
w)	An Ammeter capable of measuring current upto 1 micro ampere for insulation resistance in wet condition	1 no.
x)	Electric heaters in winters to maintain temperature above 20 ⁰ C in the shed required for hardening of glue in 24 hrs.	Nos. as required
y)	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.

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)	FISH PLATES	
	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 IRS T-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	
	i) Source of supply	(To be recorded for each supply.)
	ii) Availability of certificate for material conforming to specifications	
	iii) Marking on bolts & nuts	
	iv) Storage facility	
	v) Quantity in hand	
d)	FIBRE GLASS (WOVEN ROVINGS)	
	i) Source of supply	(To be recorded for each supply.)
	ii) Condition of storage	
	iii) Quantity in hand	
e)	INSULATING COMPONENTS-END POST	
	i) Size and shape variation, if any	(To be recorded per 100 Nos.)
	ii) Thickness variation, if any	
	iii) Glue used for making and ratio:	
	iv) Whether roughened properly before use	
	v) Quantity in hand	

- f) 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) BUSHES/SLEEVES (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) Sprit level
 - e) Torque wrench and other wrenches
 - f) Calibration of Torque wrench to be done every six month
 - g) Chamfering tools as per drawing (fig.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 sprit 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 fibre glass cloth 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) Bushes are inserted in rail-holes duly dipped in glue. Sleeves are inserted around bolts.
- 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 fish-plates 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

- 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

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

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-G

A. PROFORMA FOR MAINTAINING RECORD OF PRODUCTION

Page No. 1

S. No.	DATE OF MANUFACTURE	JOINT NO.	DRG. NO.
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Page No. 2

DATE OF INSPECTION	TOTAL NOS. OFFERED	NO. OF JOINTS FAILED	REMARKS AGAINST FAILURE i.e. NATURE OF FAILURE etc
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Page No. 3

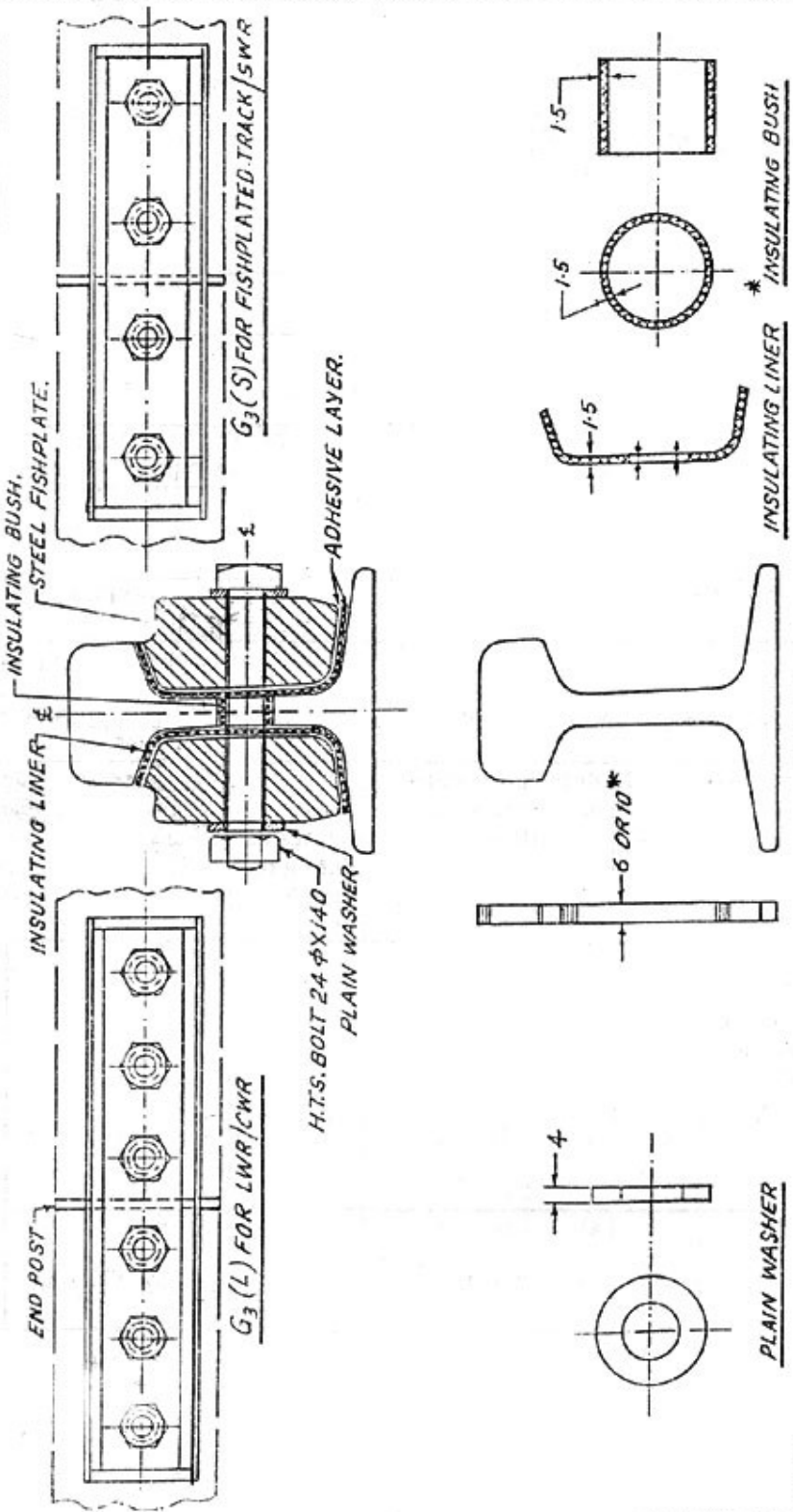
DATE OF DESPATCH	CONSIGNEE	JOINT NOS. DESPATCHED
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B. PROFORMA FOR MAINTAINING RECORD FOR GLUE & FIBRE GLASS

Opening balance as on 1 st 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 1 st day of the current month (Kg)		
Glue for making joints (Kg)	Glue for making insulating components (Kg)	Fibre Glass (Kg)	A	B		A	B	C	A	B	C
A	B	C	A	B	C	A	B	C	A	B	C
a) Resin	a)		a)	a)		a)	a)		a)	a)	
b) Hardener	b)		b)	b)		b)	b)		b)	b)	

ANNEXURE H

TYPICAL FEATURES OF G₃ TYPE GLUED INSULATED JOINTS



NOTE: * SLEEVE SHALL BE USED IN PLACE OF INSULATING BUSH WHEN GLUED JOINTS ARE FABRICATED WITH 10 mm END POST.

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Figure-1

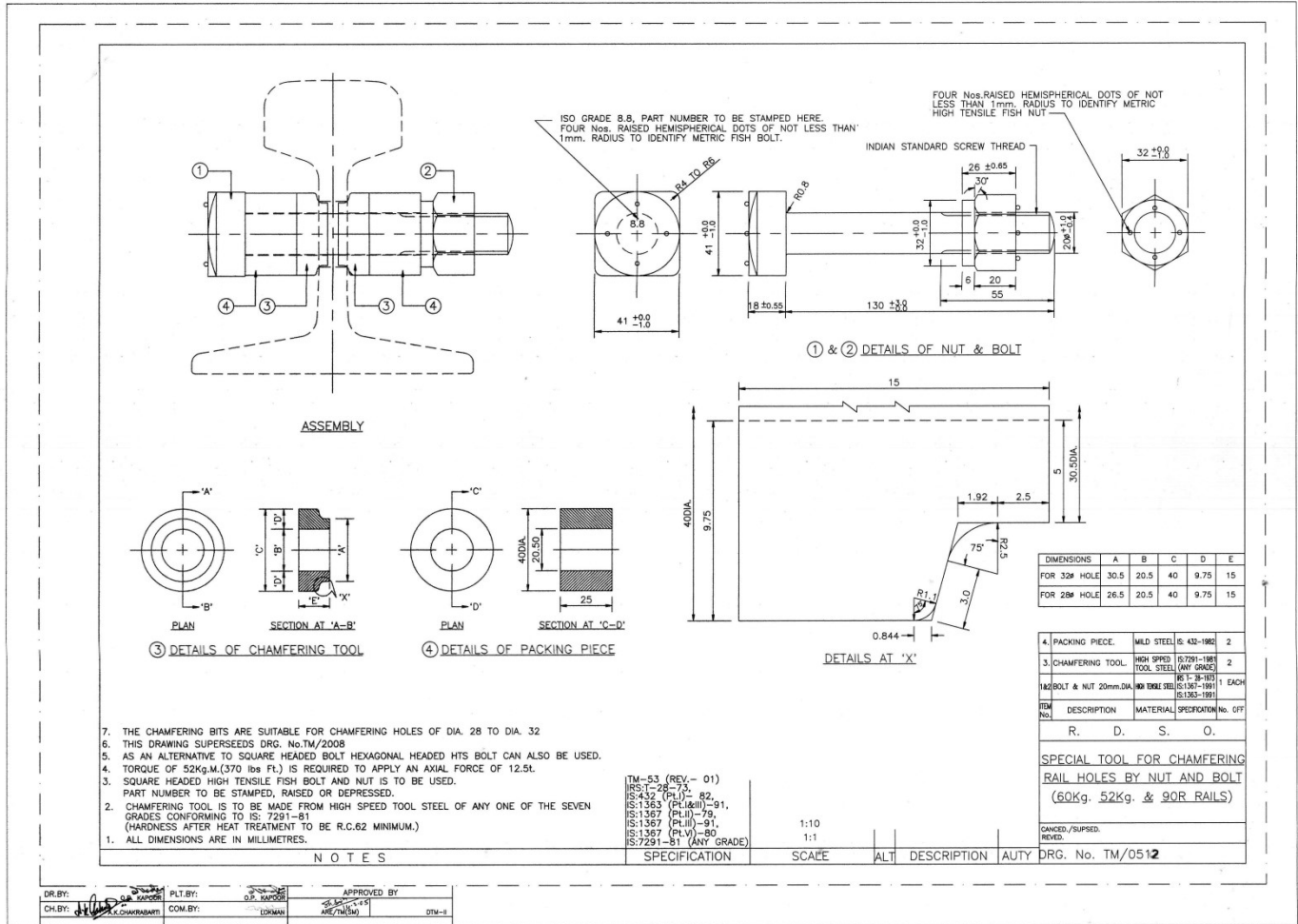
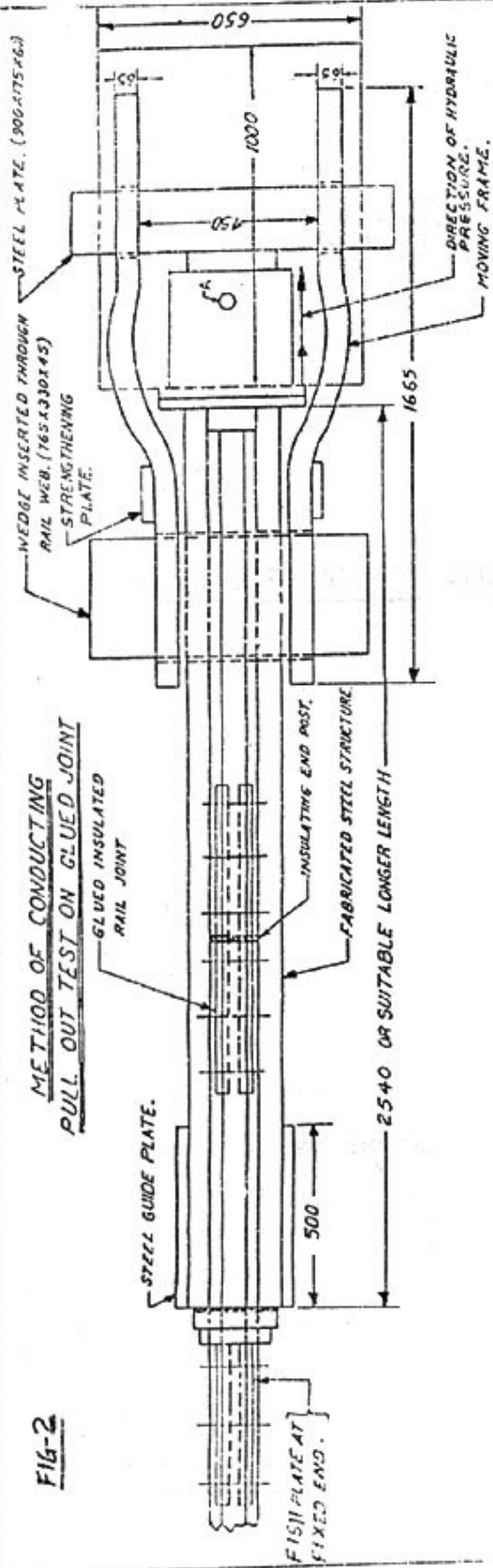
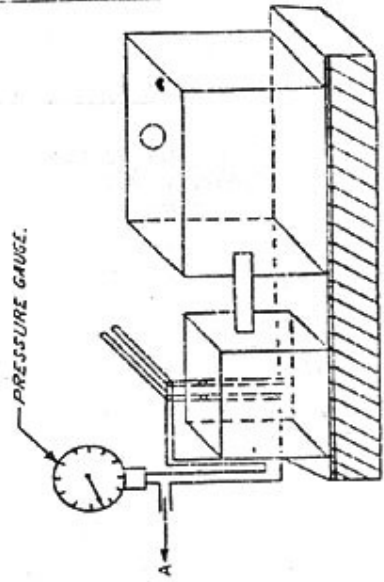


Fig-2

**METHOD OF CONDUCTING
PULL OUT TEST ON GLUED JOINT**



— PRESSURE GAUGE.

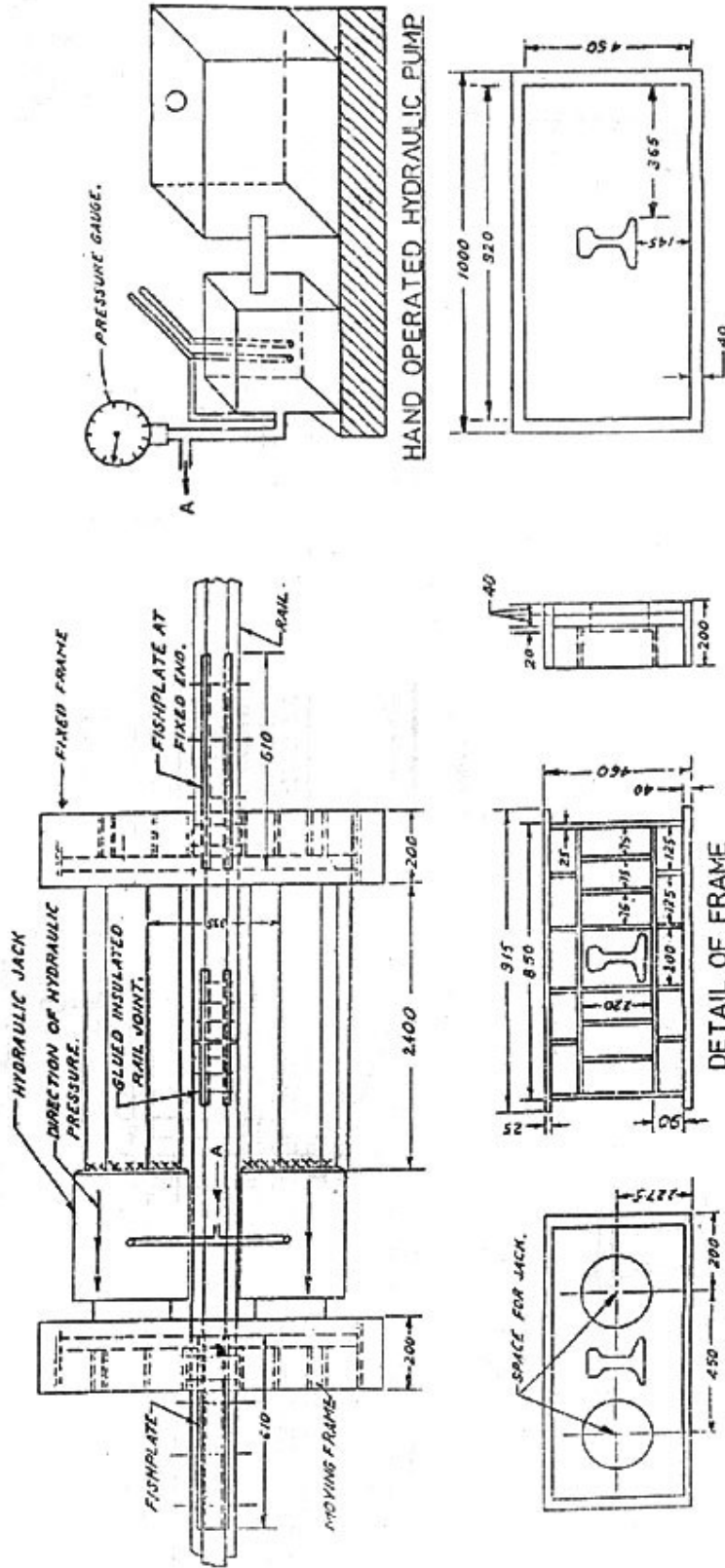


HAND OPERATE HYDRAULIC PUMP

3. THE ABOVE METHOD IS ONLY SUGGESTION. THE MANUFACTURER IS FREE TO ADOPT ANY OTHER SUITABLE VARIANT AND OBTAIN BSI'S APPROVAL BY SENDING WORKING DRAWINGS OF PULL-OUT TESTING FRAME.
2. THE DETAILED DIMENSIONS OF STEEL BAR, SLOT, STEEL FRAME, WEDGES ETC. MAY BE MODIFIED/CALCULATED BY MANUFACTURER TO SUIT THE PULL-OUT LOAD TO BE APPLIED.
1. ALL DIMENSIONS ARE IN MILLIMETRES.

FIG - 3

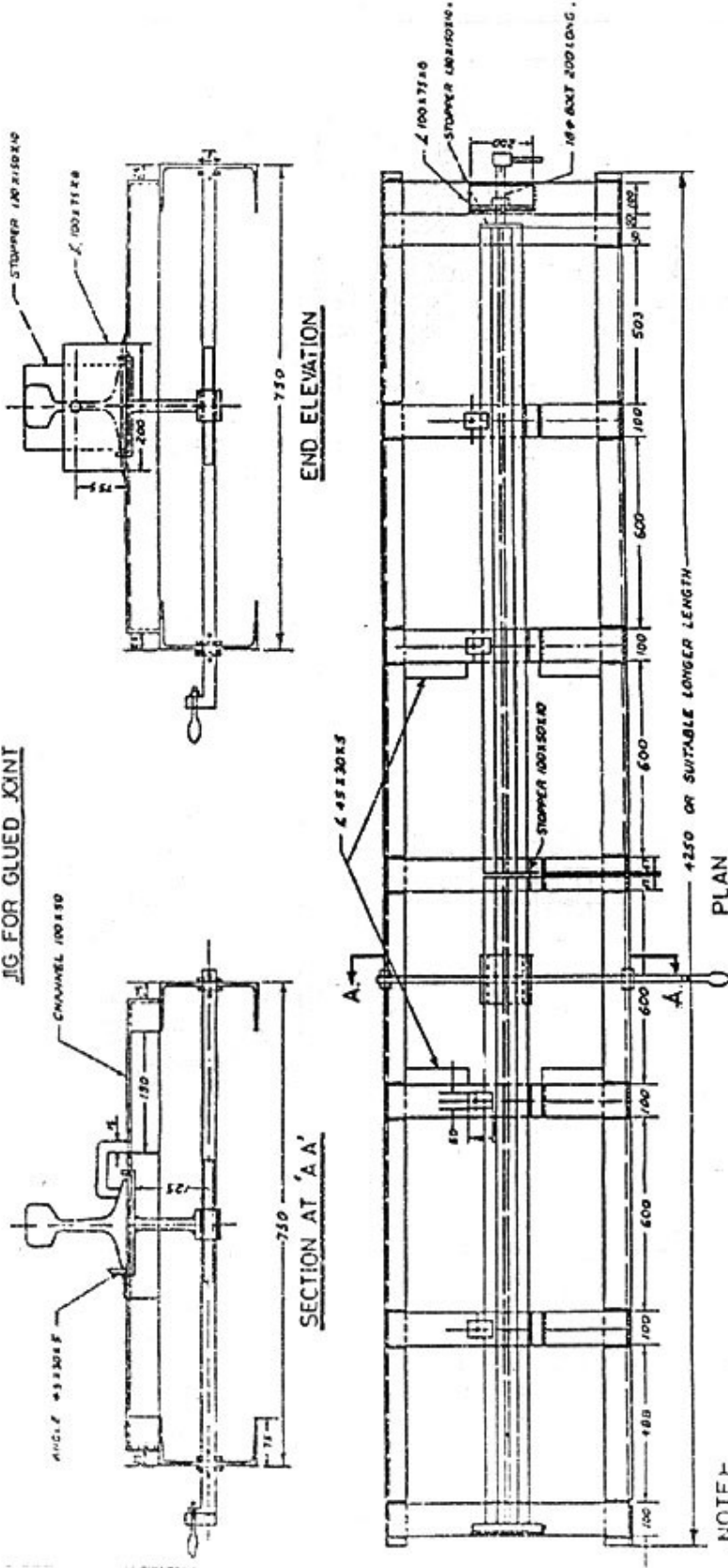
METHOD OF CONDUCTING
PULL OUT TEST ON GLUED JOINT



3. THE ABOVE METHOD IS ONLY SUGGESTION. THE MANUFACTURER IS FREE TO ADOPT ANY OTHER SUITABLE VARIANT AND OBTAIN RRSO'S APPROVAL BY SENDING WORKING DRAWING OF PULL-OUT TESTING FRAME.
2. THE DETAILED DIMENSIONS OF STEEL BAR, SLOT, STEEL FRAME, WEDGES ETC. MAY BE MODIFIED/CALCULATED BY MANUFACTURER TO SUIT THE PULL-OUT LOAD TO BE APPLIED.
1. ALL DIMENSIONS ARE IN MILLIMETRES.

FIG. 4

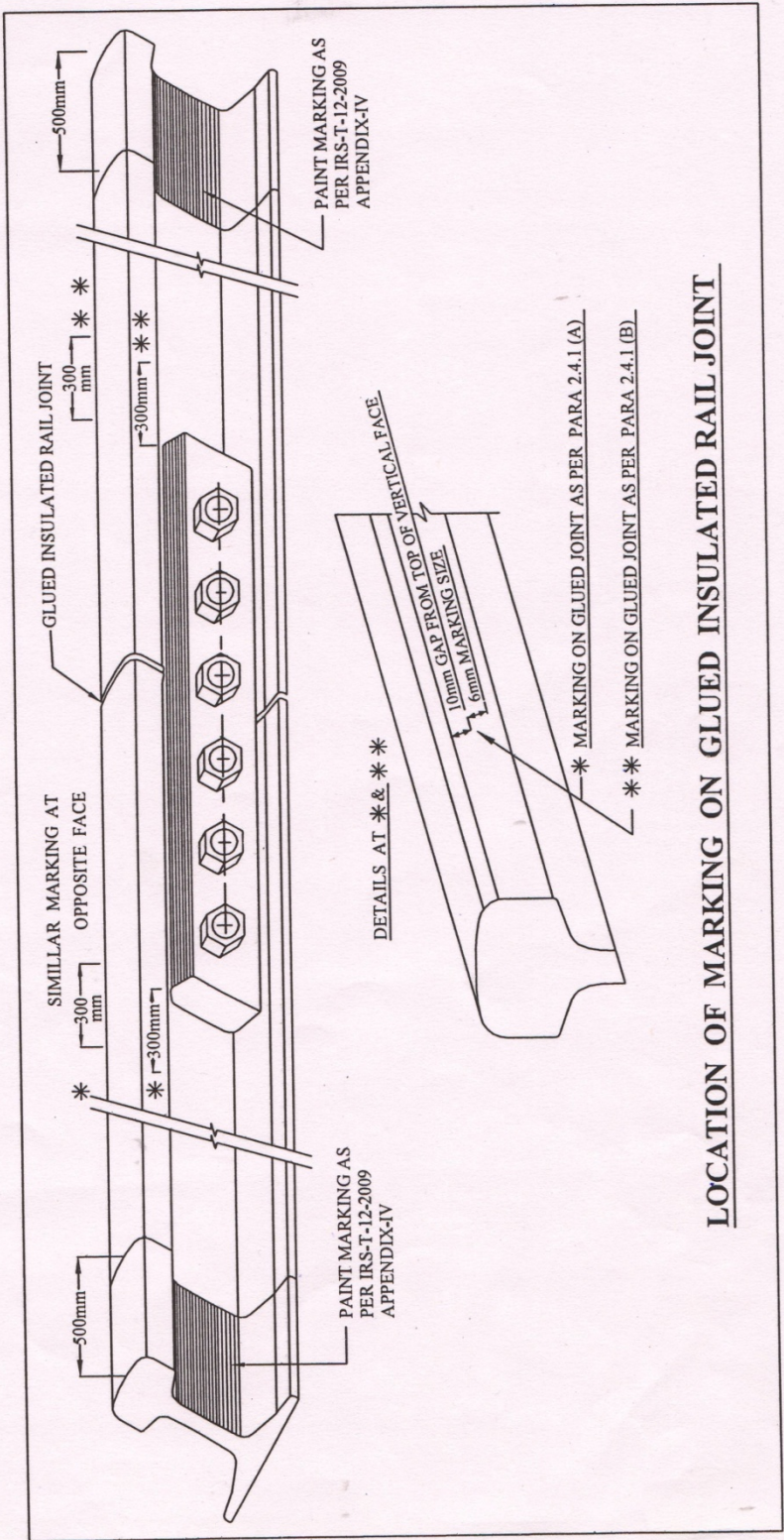
JIG FOR GLUED JOINT



NOTE - THIS DRAWING HAS BEEN PREPARED FOR MAKING A GLUED JOINT WITH 4" LONG RAILS IN CASE JOINTS ARE TO BE MADE WITH LONGER RAILS. END ARRANGEMENTS MAY BE SLIGHTLY MODIFIED SO AS TO APPLY NOMINAL ANNUAL PRESSURE DURING FABRICATION. LATERAL SUPPORT SHALL BE ARRANGED AT LEAST AT 2 LOCATIONS ON EITHER SIDE OF THE JOINT. A VERTICAL SUPPORT SHALL BE ARRANGED AT THE CENTRE OF THE JOINT.

EDO/T-1473

FIGURE - 5



LOCATION OF MARKING ON GLUED INSULATED RAIL JOINT