D.C. TRACK CIRCUIT

1. Introduction

Track Circuit is a low powered electrical circuit in which running rails are used as a part. With the help of track circuit, one can easily identify whether the particular section is clear or occupied by a train/vehicles or Track Circuit is in failed condition.

The advantages of DC track circuit are :

- It is very simple to maintain.
- It is highly reliable for effective and safe running of trains.

A DC track circuit has mainly two ends i.e. feed end and relay end as shown in fig. no. 1.

A track circuit gives two indications.

- Yellow/White/No light indication - When track circuit portion is clear i.e. when line is unoccupied.
- Red indication - When track circuit portion is occupied by a vehicle or track circuit is in fail condition.

2. Requirements

Permanent Way Requirements

- Glued joints or insulation joints of approved type are to be provided for defining boundary of track circuit. In all future works of track circuiting, glued insulated joints is to be preferably been provided.
- Insulated joints wherever provided is to be maintained as square joints. Where staggering can not be avoided the distance between staggered joints shall not exceed the minimum wheel based of the vehicles.
- Rail ends of insulated joints shall be square and true. All rough edges and burrs shall be removed from bolts holes. Battered ends shall be put right and the gap between the rails is to be equal to the thickness of the end post.
- Fish bolts at the joints must be kept tight and the sleepers well packed in the vicinity of the joints.
- Proper drainage should be ensured so as to avoid flooding of tracks during rains, particularly in the yards where watering of coaches is done and in the water columns and ash pits. It would be desirable to provide washable concrete aprons on platform lines at originating stations, in track circuited areas.

- Ballast shall be kept clean throughout the track circuited section should be taken do see that the ballast is kept clear off the rails and rail fastenings. The clearance from the foot of the rail should not less than 50 mm. Well screened ballast right up to the formation level shall be provided.
- Rail ends shall be kept free from brake-dust, sand, rust, other foreign materials etc. all rough edges and burrs at rail ends must be removed.
- To avoid crushing of end posts of insulated rail joints due to creep at least one rail length in either side of insulated joint should be provided with anti creep devices.
- Rail screws should preferably be used in place of dog spikes at insulated joints.
- Wooden sleepers concrete sleepers or any other approved type insulated sleepers shall be provided for track circuiting. Concrete sleepers where used shall have a minimum resistance of 500 ohms between insert-to-insert.
- Where short welded rail panels are used, SWR shall not but against insulated joints. Two rails lengths of 13 meters/12 meters shall be interposed to isolate short welded rail from insulated joint. This standard length of rails shall be anchored effectively to arrest movement in either direction.
- In case of turnouts and crossings, insulated stretchers, insulated gauge ties plates and

insulated crossings plates shall be provided as per approved drawings.

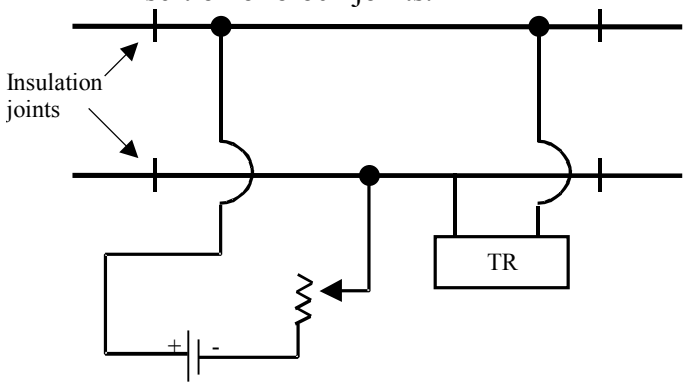
- GEN liners shall be provided in the track-circuited area using concrete sleepers.

3. Types of track circuits

A closed type track circuit shall be provided to prove the clearance of rail track.

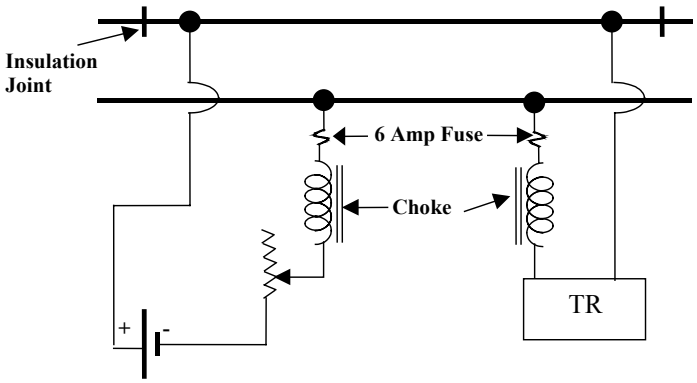
- **Double rail track circuit**

  Double rail track circuit is to be provided on non RE areas, as for as practicable.
  In double rail track circuit both the running rails are insulated from adjoining sections by insertion of block joints.



Double Rail Track circuit
(Figure – 1)

- **Single rail track circuit**
  - In RE area, generally single rail track circuit is used where one of the rails is reserved for the traction return current. This rail is referred to as the un-insulated rails.
  - Any connection from the OHE mast or other structure shall be made only to the un-insulated rails.
  - Similarly, connections for the return current at feeding points as well as from booster transformers and return conductors shall be made only to the un-insulated rail.
  - Other rail carries positive polarity of DC rack circuit. This positive polarity rail is insulated from either side.

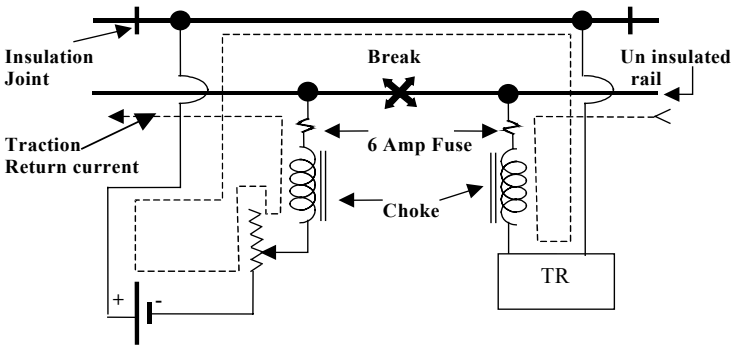


Single Rail Track Circuit
(Figure – 2)

- As far as practicable, the rail adjacent to the O.H.E mast shall be utilised as the insulated rail. However, this may not always be possible, particularly in yards where there are a large number of points and crossings or where the O.H.E masts

are not always on the same side or where track circuits are staggered.

- In single rail track circuits, in the event of a break in the un-insulated rails, very heavy current will flow through the track relay as well as the equipment at the feed point. To avoid this the un-insulated rails of the adjacent tracks shall be cross-bonded at intervals of not more then 100 mts. In case the track circuit is less then 100 mts. The cross bonding shall be provided on the un-insulated rail at either end of the track circuit.

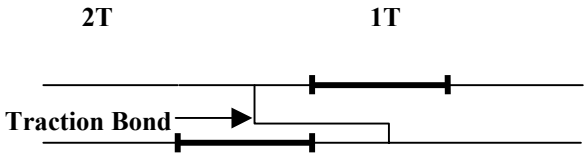


Single Rail Track Circuit with Breakage on Un –insulated Rail

(Figure-3)

- To avoid this the un-insulated rails of the adjacent tracks shall be cross-bonded at intervals of not more than 100 mts. In case the track circuit is less than 100 mts. The cross bonding shall be provided on the un-insulated rails at either end of the track circuit.

- In case of adjacent track circuits, the return rail shall be staggered as shown in fig. Below.



Adjacent Track Circuit
(Figure-4)

4. Length of track circuits

4.1 Minimum length

- The length of the track circuit shall not be less then the maximum wheel base of any vehicle, except in marshalling yards.
- Track circuits shall cover at least two rail lengths (Min.26 meters)

4.2 Maximum length

- As per SEM pera 17.15.5 the maximum length of track circuit under different track parameters are given in the table below.

RE/Non RE area	Sleeper	Section yard Block	Mini. Ballast	TSR in Ohms	Max. length of	Type of track relay to be used

		section	**resistance in Ohms per Km**		**track circuit**	
Non RE	Wooden/ PSC	Block	4	0.5	1000	QT type 4 or 9 Ohms or shelf type relay
Non RE	Wooden/ PSC	Yard	2	0.5	670	-Do-
RE	Wooden	Block	4	0.50	450	QT 9 Ohms AC immune or shelf type 9 Ohms AC immune
RE	Wooden	Yard	2	0.5	450	-Do-
RE	PSC	Block	4	0.5	450	-Do-
RE	PSC	Yard	2	0.5	350	-Do-
RE	PSC	Yard	2	0.5	750	QBAT in cunjuct-ion with QSPA1 with B type choke at relay end.

(Table - 1)

5. Description & working (Closed Type)

- Track circuit is designed to know whether the portion of rail (track circuited) is clear or occupied by a train.

- A D.C. track circuit has two ends i.e. feed end and relay end. Both the ends are insulated by a Nylon joint or glued joint.

- Feed end is connected to power source and relay end is connected to track relay. Track relay will be in de-energised position under following conditions:

    - A vehicle occupies any part of the track circuit or

    - It is short-circuited by any means.

    - Otherwise track relay will be in energised position.

- Since it is a vital safety circuit, hence installation is to be made according to the approved interlocking plan.

6. Specification of equipment required for DC track circuit in RE area.

S. NO.	Equipment	Specification No.
1	Track feed charger	IRS-89/93
2	"B" type choke	IRS-65/83
3	"F" type resistance	RE/S&T/ALD/SPEN/128
4	AC Immunized track relay	BRS 939 A BRS 966 A/BS 1659 WITH RE SPECIFICATION.
5	Secondary cells 40 AH	IS-1651

(Table - 2)

7. Main parts

- **Non- RE Area**

  Following are the main parts of a DC track circuit.

- **Relay**

  - Relay must conform to British Standard Specification No.1659, unless otherwise specially permitted. The approved type issue relays are:
    - Shelf type
    - Q series type

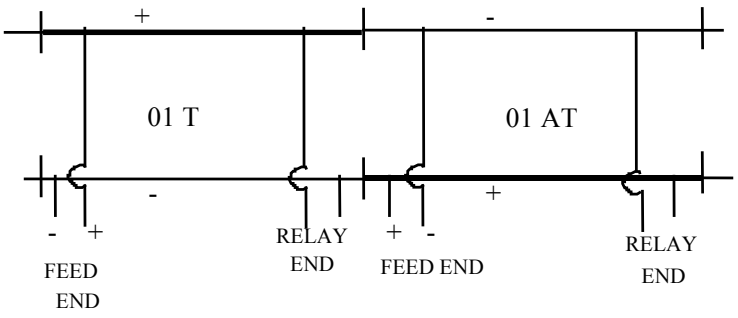
- The resistance of the track relay should be 9 ohm for the length of track circuits up to and less than 100 Mtrs.

- The resistance of the track relay should be 2.25 Ohm for a length of track circuit above 100 Mtrs. if the track is laid on wooden sleepers and 9 Ohm if laid on concrete sleepers.

- **Track Feed**

  Power supply given to DC track circuit at feed end:

  - Approved type of primary cells or lead acid secondary cells shall be used.
  - Where primary cells are used, two batteries in parallel shall be used to increase reliability.
  - Where secondary cell(s) is/are used, they shall be used with battery charger/solar panels of adequate capacity.
  - Separate feed shall be provided for each track circuit.
  - The polarity of a DC track circuit must differ with adjacent DC track circuit as shown in fig. no.5



Track Feed and Relay Arrangement with Adjacent DC Track Circuit
(Figure-5)

- **Adjustable Resistance 0-15 Ohms and 0-25 Ohms**

  This resistance is used at power source and feed end voltage is adjusted according to the condition of ballast and pickup voltage of track relay.

■ Cables

The cable from feed location/cabin to feed end junction box and relay end junction box to relay location should preferably be made of copper conductors of min. 2.5 Sq.mm. cross-section.

■ Bond wires

A straight track portion of welded rails does not need any props to enhance its conductivity. But if smaller panels or individual rails are to be included, the ordinary fish plated and bolted joints themselves cannot give good electrical continuity. In such cases, the rails are to be connected with continuity Rail bonds.

- ♦ Bond wires shall be of an approved type or 8 SWG GI bond wires may be used for rail bonds.
- ♦ These bond wires are fitted with channel bond pins, which have grooves to hold the wires.
- ♦ It is desirable to used bond wire clips to secure the bond wired.

■ Object of track bonding

The objectives of track bonding are:

- ♦ To provide a path for traction return current, which ensures that no component of the track/traction return network rises above 25 Volt to remote earth, under normal traction load conditions and 430Volt under traction short circuit conditions.
- ♦ To ensure that protective equipment operates satisfactorily.
- ♦ To minimize damage to installations due to traction short circuit.
- ♦ To maintain correct operation of track circuits.

■ Bonding of single rail track circuits

- ♦ The track circuit rail must be series bonded in order to ensure that defective bonding can not cause a wrong side failure of the track circuit. Accordingly, the bonding arrangement of the track circuit rail must ensure that the conductive path between the track circuit feed connection and the relay or receiver end connection is interrupted in the event of a disconnection.
- ♦ Because of traction return considerations, it is not possible for the traction return rail to be series bonded. It is therefore essential to avoid bonding disconnection to minimize the risk of loss of train shunt.

■ **Insulation Rail Joint**

Two types of insulated joints are presently in use.

- ♦ Nylon insulated rail joints [Supplied by S&T dept.]
- ♦ Glued joints [Supplied by Engg. dept.]

For one Nylon insulation joint, following insulation components are required :

- ♦ Bushes 8 nos.
- ♦ End post 1 no.
- ♦ Channel side plate LH 2 nos.
- ♦ Channel side plate RH 2 nos

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For one Nylon insulation joint, following insulation components are required:

- Bushes 8 nos.
- End post 1 no.
- Channel side plate LH 2 nos.
- Channel side plate RH 2 nos
- Nylon insulating plate 4 nos.
- Steel backing plate 4 nos.

Maintainer shall select suitable insulation components with care, as these are available in various sizes to suit Rail sections of 90 R, 52 kg., 60 Kg. etc.

■ Track lead junction box

Track Circuit is provided with two track lead junction boxes, one at feed end insulation joint and another at relay end insulation joint. Jumpers are used for connecting track feed to rails from feed end junction box. Similarly jumpers are used for connecting rails to relay end junction box.

Cable from power source and feed end jumpers are terminated in feed end junction box. Similarly cable from track relay and relay end jumpers are terminated in relay end junction box.

- **Main parts of DC track circuit on RE area**

  In RE area, all parts are similar to NON-RE's track circuit except choke & relay.

- **Choke B type 0-3 Ohm, impedance 120 Ohm.**

  This is used for the safety of track circuit. This prevents damage to the feed source at the time of a caternary snap resulting in heavy currents in un-insulated rail.

- **Relay**

  - Relay must be AC immunised.
  - Track relay resistance must be 9 ohms only for any length of track circuit.
  - The permissible lengths for different types of track relays are shown in table I

S. NO.	TYPE OF TRACK RELAY	AC IMM. OF TRACK RELAY	TYPE OF SLEEPER	MAX. LENGTH POSSI--BLE	REMARKS
1	ACI Shelf type or QTA2 type.	50 V	Wooden	450 m	A 10 V induced voltage drop is considered in 90 m long rail length @ 600 Amp. current.
2	QBAT type	80 V	Wooden	750 m (with relay end choke)	-do-
3	ACI shelf type or QTA2.	50 V	Wooden Wooden	200 m 300 m	The voltage drop will be more @ 800 Amp. In S/L & 1000 Amp. in D/L track circuits.

S. NO.	TYPE OF TRACK RELAY	AC IMM. OF TRACK RELAY	TYPE OF SLEEPER	MAX. LENGTH POSSI--BLE	REMARKS
4	QBAT type	80 V	Wooden Wooden	450 m 450 m	800 Amp. in S/L & 1000 Amp. in D/L track circuits.
5	ACI shelf type or QTA2 type.	50 V	Concrete	350 m	The workable length is restricted to a lesser value due to 0.6/Km. Ballast Resistance minimum permitted.
6	QBAT type	80 V	Concrete	350 m	-do-

(Table - 3)

- Length of DC track circuit is restricted depending upon rail return current with caternary current restricted to 300 amps. on single track section and 600 amps on double track section. Length of DC track circuit shall be restricted depending upon the use of type of relay and sleepers.
- The length of DC single rail track circuit in AC electrified area with AC immune 9 ohms shelf type relay shall not exceed 450 meters where wooden sleepers are used and 350 meters where concrete sleepers are used. The length of track circuit can be extended up to 450 meters when QTA2 plug in relay used.
- Restriction on the track circuit length due to use of concrete sleepers can be relaxed up to 450 meters by CSTE of Railway if adequate ballast resistance can be consistently obtained.

- In view of increased AC immunity due to the presence of biased magnetic arrangement, QBAT relays can be used up to a maximum length of track circuit of 750 meters using one "B" type choke and the relay end, under minimum ballast resistance of 2 Ohms/km. Operation of track circuit with this type of relay will required four cells delivering 8.8 volts QBAT relays shall be used in conjunction with QSPA relays confirming to BRS 933A.
- As an interim measure, length of DC track circuit may be retained at the existing level at higher caternary current of 800 amps. on single track section and 1000 amps. on double track section by providing "B" type 120 Ohms impedance choke in series with track relay. Audio frequency track circuit shall be used on sections where caternary current exceed 300 amps. on single track section and 600 amps. on double track section.

8.0 D.C. Track Circuit Parameters

The performance of a D.C. track circuit depends upon the parameters explained below :

- **Ballast resistance**
  - This is the total resistance of various leakage paths across the track circuit rails offered by ballast and sleepers.

- The ballast resistance of the dc track circuit should be as high as possible. Its value also changes for track circuit situated in different areas as below :

AREA	**BALLAST Resistance**
Block section	4 ohm/km
Station section	2 ohm/km
D/rail track circuit with concrete sleeper	1 ohm/km
S/rail track circuit with concrete sleeper	0.6 ohm/km (In RE area)

- **Train shunt resistance**

  - This is the maximum value of resistance, when applied across the track, drops the track relay. The min. permissible value is 0.5 Ohm for DC track circuit.
  - Maximum permitted voltage at relay terminal under maximum ballast resistance condition shall not be more than 250% of relay pickup value for shelf type relays and 300% for plug in type relays.

  - The permitted voltage under minimum ballast condition shall be 125 % of relay pick up value.

- The maximum permitted relay terminal voltage with 0.5 Ohm TSR (Train Shunt Resistance) shall be less than 85% of drop away value of relay.

- **Rail resistance**

  - The resistance of rail and bonding per 1000 mtrs. of track should not exceed 0.5 Ohm for track circuits longer than 700 Mtrs.

  - A rail and bond resistance up to 1.5 ohm per 1000 meters of track may be allowed for length of track circuit less than 700 Mtrs.

  - **Minimum length of Track Circuit :** Double rail track circuit on non-RE area shall not exceed 1300 Mtrs. on wooden sleepers and 670 Mtrs. on concrete sleepers.

9.0 Intallation

- **Track Feed**

  - Track feed equipment and secondary cells shall be installed in separate location box & as near as possible to the track.

  - Separate track feed shall be used for each track circuit.

  - The no. of secondary cells required for track circuit shall be selected as per length of track circuit/type of sleeper/type of relay.

  - The track feed charger cell selector knob shall be kept in a position of no. of cells selected.

  - The rating of the fuse at feed end shall be decided depending upon no. of cell selected.

  - The track feed equipment wiring shall be done with 7/0.37 cable.

  - Slow to pick up repeater relay (QSPA1) shall be used in conjunction with plug-in-type track relays i.e. QTA1/QTA2 relays.

- The QSPA1 relay used in conjunction with plug-in-type track relay having no back contact, shall be kept in location box and it shall be kept in relay room, if track relay is having back contact.

- In the case of short track circuit (up to 50 m.), the track relay and QSPA1 relay shall be kept in track feed location box and beyond 50 m. a separate location box shall be used.

- Connect all the spare contacts in parallel to the loaded contacts.

- **Insulation joints**

  - Select the correct insulation components as per Rail section i.e. 90 R, 52 Kg. & 60 Kg. etc.
  - Check that track circuit rail section is welded or not, if not than provide rail joint bonding. These bonding are provided by drilling 7.2 MM. holes in the rail webs closer to the fish plate joints on either ends and on rail joints. The bond wires are inserted into the holes along with channel pins which are having grooves to hold the wires.

- Insulation joint must be located according to the approved interlocking plan.
- The ends of rails, where insulation joint are fitted, must be square and smooth. There should not be any burr or rough edge which can damage the insulation material.

- The gap between the rails where the end post is provided must be maintained properly. Fig. no. 5 & 6 are example of improper gaps, which results in crushing of insulation material frequently.
- Holes must be proper in accordance with fish plate hole i.e. oblong holes crush the bushes.
- Jumper connections must be so made that the whole of track circuit is in series as shown in fig. no.3.
- The insulated rail joint shall be installed at least one rail length in advance of the signal.
- In case of turnouts and crossings, insulated stretchers, gauge tie plates and crossing plate shall be provided.
- The distance between the Track Circuit termination and fouling mark shall not be less than 3.0 Mtrs.
- Insulated rail joints shall be as for as possible not be provided on the outer rail in curves.

- Steel backing plate of 4 MM. thickness with bends shall be used at ends to prevent damage to insulating plate.

- In case, the top edge of the Nylon end post protrudes above, the top of the rail surface, it shall be made in level with the rail surface by cutting off the extra portion of the end post.

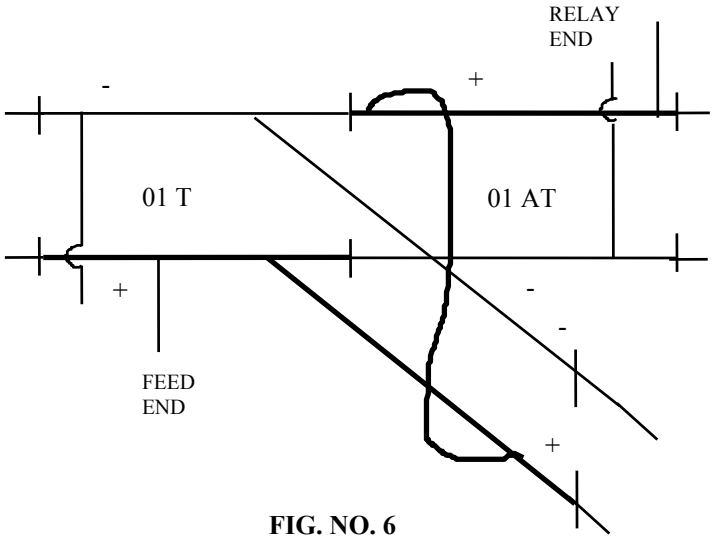


FIG. NO. 6

- Increase the track circuit length by 7' beyond fouling mark in BG and 5'.5" in MG in point track circuits.

- Where DC track circuit are adjacent, the polarity on adjacent the rail should be opposite.

- **Relays**

  - Relay end should be located at the entering end of train where ever possible.

  - Where relays are likely to be subjected to vibration they shall be mounted on shock absorbers.

  - Shelf type relays must be housed with antitilting arrangement.

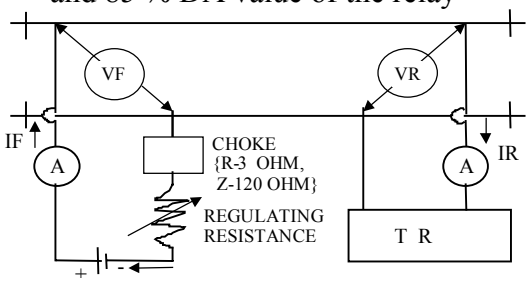
    - All the contacts of the track relay shall be loaded as far as possible. Where spare contacts and available, they shall be connected in parallel to the loaded contacts

  - Connections between track relay and track repeating relay must be made in accordance with approved wiring diagram.

  - The regulating resistance shall be adjustable and of an approved type. It must have markings to show the value of resistance introduced in the circuit.

10.0 Failsafe adjustment of track circuit

- Select the required track relay and calculate and record 250%, 125 % of Pick Up value and 85 % DA value of the relay



A= Ammeter, V= Voltmete r, TR= Track Relay

FIG.NO. 7

- Find out the minimum permitted value of ballast resistance for the given track circuit length by formula given below and shown in fig. no. 4 :

$$\text{Ballast resistance} = \frac{VF+VR}{2\,(IF-IR)}$$

- Connect the relay directly to cell with regulating resistance in series. (Cell voltage must be 2.2 Volts)
- Connect a resistance equivalent to min. ballast resistance across the relay and adjust the regulating resistance so that

the voltage across the relay is just above 125 % of rated pick up value.

- Now disconnect the equivalent ballast resistance connected and take reading across the relay without changing the value of regulating resistance and the voltage shall not be more than 250 % of rated pick up voltage, if voltage is high, increase the value of regulating resistance and ensure the voltage is not exceeding 250 % limit.
- Shunt the relay with 0.5 Ohm TSR and check the voltage at relay terminal, it shall be less than 85 % of DA (drop away) value of the relay.
- Now disconnect the relay and power supply and connect the same without any alteration in regulating resistance to the rails at the respective end i.e. relay to the relay end and power to the feed end.
- Test the track circuit with 0.5 Ohm shunt and check up the relay voltage which should be less than 85 % of DA (drop away) value and relay is in dropped condition.
- Measure and record the actual value of voltage and working current.
- If the track relay voltage is less than 125 % of rated pick up value it means ballast resistance is less than minimum required value and if it is impossible to improve

the value of ballast resistance than split the track circuit.

- **Dead section**

  - By any means the dead section should not be longer than the minimum distance between the wheel of a four wheeler vehicle. So that the vehicle must shunt adjacent live portion of track circuit while being on dead section.
  - In BG section, the distance between two axle of a four wheeler is 6 m. (20') and in MG/NG sections, it is 3.6 m. (12').

  - The dead section may be due to:

    - Creep (in curved portion mainly)

    - Cross over out of square

    - A track portion is excluded of adjacent track circuits due to level crossing or bridge/culvert or a rail portion where tramline crosses the track.

- **Glued joint**

  Before installation insulation of glued joint must be tested. Glued joint should be kept in dry wooden sleepers.

- **Insulation test in dry condition**

The value of resistance shall not be less than 25 Mega ohms when a meggering voltage of 100 V DC is applied across the joint and resistance is calculated by dividing the voltage by current..

- **Insulation test in wet condition**

Wet sand can be applied on the joint for 24 hr. and thereafter the value of resistance shall not be less than 3 Kilo ohm when obtained with application of 100V DC megger.

- **Precaution**

  - Joint must be well packed 10 sleepers on either side of glued joint.

  - No damage shall be caused to the joint while inserting in the track.

  - **Working of Trap circuit**

If a dead section in excess of 10.8 mtrs. (36 feet) occurs, such as on girders bridges, a special trap circuit should be provided as shown in fig no.7.

Suppose the train is entering from left & it is trapped in the dead section, BTR which has

dropped cannot pick up since ATR has already picked up and CT is unoccupied, hence CTR is also in picked up position.

Similarly, for the train coming from right direction and is trapped in the dead section, BTR which has dropped cannot pick up since CTR already picked up & AT is unoccupied.

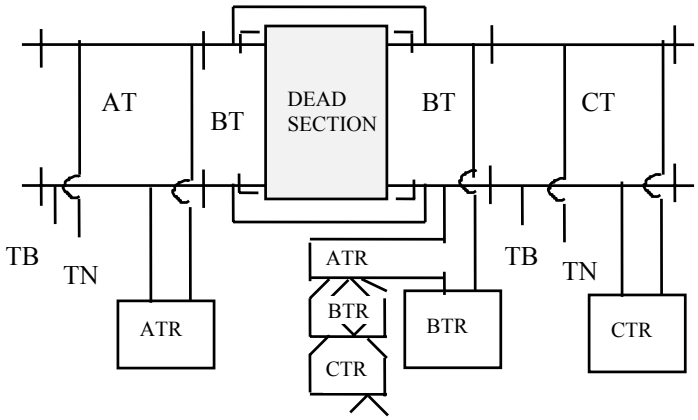


FIG.NO. 8

- **Cut section arrangement of track circuits**

Where cut section track circuits are installed, the track relays concerned, when de-energised shall open the track feed and shunt the track circuit as shown in figure below.

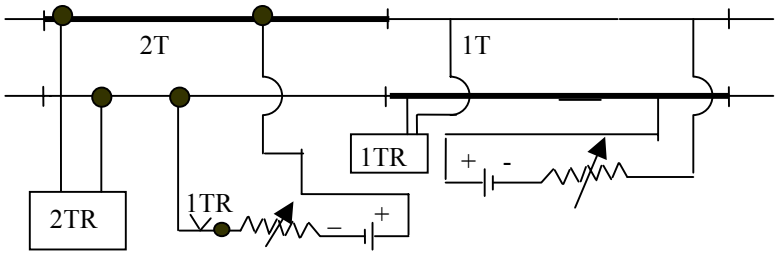


FIG.NO. 9

- **Termination of track circuit**

  For track circuited points or lines in a station, track circuit termination shall be provided sufficiently before the fouling mark so as to avoid infringement to the standard dimension by any portion of vehicle. The distance track circuit termination and fouling mark shall not be less than 3 meters.

- **Loading of track relay contacts**

  All the contracts of track relay shall be loaded as far as possible. Where spare contacts are available, they shall be connected in parallel to the loaded contacts.

- **Measurement of stray direct current before installation of DC single rail track circuits**

  Before installing a DC track circuit in areas, which are to be AC electrified, stray direct current tests

shall be carried out so as to ensure that DC track relay shall not operate with the stray currents.

- These test shall be carried out only on non electrified sections.
- If there are already existing track circuit in the area, these shall be disconnected do safe guard against false readings being recorded in case of leakage of block joints.
- The length of track required being track circuited should be insulated by means of block joints on either end of the rails. The rail joints in the track circuited length may or may not be beyond for purpose of these tests.
- Selecting a suitable earth, which shall not exceed 5 Ohms in resistance test shall be carried out.
- A suitable type of Milli Voltmeter and millimeter shall be used for recording voltages.
- These stray current and real earth voltage measurements shall be recorded in accordance the diagram for measurements indicated below.

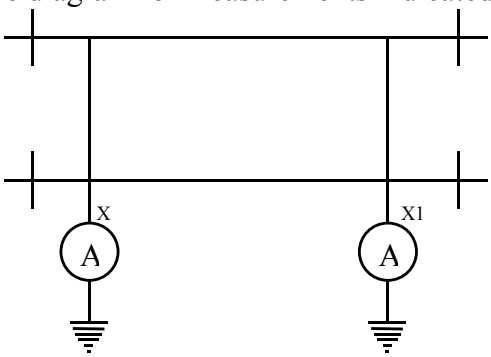


Fig No.10

- For measurement of stray current set up the circuit as shown above and measure current simultaneously.

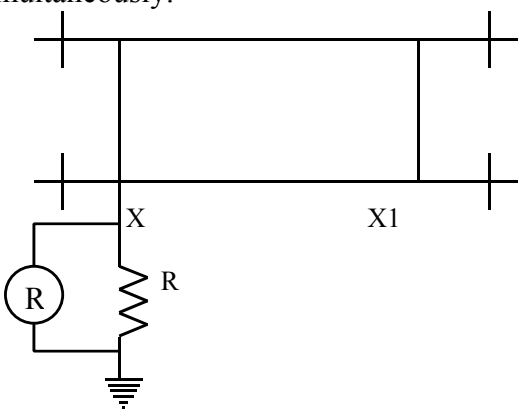


Fig No. 11

- Where 9 ohms, 4 ohms or 2.25 ohms relays are used, use 9 ohms, 4 ohms or 2.25 ohms resistance and measure the voltage once at "X" and next at "X1".
- These measurements shall be recorded at different periods of the day – one in the morning, one in the afternoon and one in the evening. These tests shall be extended for three days.
- Where stray current / voltages are observed the length of the direct current track circuit shall be cut down so as not exceed the following limits for each length of track circuit.
  - The rail earth voltage as measured across 09 ohms, 4 ohms or 2.25 ohms shall not exceed 0.1 volt.

- The total stray current as measured shall not exceed 100mA. Where all track circuit to be installed on the line are less than 100 meters long., the highest acceptable figure stray current 10mA.

11.0 Maintenance

■ Insulation joint

- Every joint must be tested by maintainer to ensure high resistance. If the value of I.R. is below 5 Mega ohm, such joint should be marked and insulation must be replaced on priority as it may fail intermittently.

- Sleepers edge from insulation joint must be 4.5 " so that dog spikes/pandrol clip may not short the insulation.

- Remove accumulation of brake-dust, dirt, other foreign matter and formation of burrs from insulated joints.

- Ensure provision of anti-creep devices on either side of the insulated joint, specially which are in block section and near by long welded rail (LWR).

- Interpose two-rail length of 13m/12m to isolate SWR from insulated joint.

- Ensure tightness of fish plate bolts and proper packing of ballast in the vicinity of the joint.

- Ensure proper drainage to prevent joint being flooded with rainwater.

- Ensure sound condition of gauge tie plate insulation, stretcher bar insulation, D type insulation and rodding insulation.

- Ensure no leakage of current on account of muddy portion between feed end and relay end. If leakage is more then advise to PWI for deep/shallow screening of ballast.

- For glued joints on wooden sleepers, ensure provision of dog spikes. The spikes should not protude below the sleeper.

Insulation rail joint

- Before opening an insulated rail joint, the components required for replacement, confirming to the rail section, shall be kept ready by the side of the track.
- For replacement of an end post when there is no gap at the insulated pail joint, loosen the rail fastening and pull back the rail sand insert end post between the rail ends.

- It is imperative that when an insulated rail joint is provided at least three sleepers on either side of the insulated rail joint shall be packed properly.
- Fish bolts shall be kept tight. Nuts shall be tightened several times during the first two weeks after installation/replacement, until all components of an insulated rail joint are firmly set.
- A metal flow is seen often at the rail table at the joints. Such metal flow of metal forms a lip and creates sharp burrs at the rail ends. Projections formed at the rail ends shall be chiseled without damaging the end post so that these do not bridge the rail expansion gap and cause a short circuit.
- Brake block dust, which may accumulate on the head and sides of the end post and top surfaces of the fish plate, shall be brushed off frequently so that the possibility of electrical conductivity being established between the rail ends is eliminated.
- Special type pandrol clips (J types) shall be provided at nylon insulated joints/ glued joint to avoid touching of pandrol clip with the fish plate.
- Periodic coating by insulating varnish/epoxy over the nylon insulated joint/glued joint to avoid shorting due to brake dust shall be done.
- A faulty insulated joint may be detected by taking the voltage readings across the track

relay terminals and noting if this reading changes when the adjacent track circuit feed is shunted or disconnected. Any change in the voltage reading will indicate a faulty insulated joint.

- **Bond wires**
  - Bond must be checked for rigid connection with rail to avoid the possibility of high resistance.
  - To avoid failures, two bond wires (in parallel) may be provided.
  - Bonds shall be painted with alluminium paint, where bond corrosions are excessive.
  - On every visit maintainer should ensure that the bond wire has rigid connections with rails.
- **Ballast**
  - Ballast must be maintained clean throughout the track circuited section and care should be taken to see that clearance of ballast from the foot of the rail shall not be less than 50 MM. Ballast shall be kept free from vegetation.

- The ballast resistance of the track with both rails insulated should not be less than 2.0 Ohm/Km. with wooden sleepers and 1.0 Ohm./Km. with concrete sleepers in non-RE area and 0.6 Ohm/Km. with concrete sleepers in RE area.
- In case of concrete sleepers. ensure provision of rubber pads & availability of insulated liners up to 97%.

- **Drainage**

- Special attention shall be paid during the rains to track drainage. Defects, if any, shall be reported to the Permanent Way Inspector.
- All cases of defective valves of overhead water pipes in track circuited area shall be reported to the Inspector of Works.

- **Relay**
  - Maintained pick up and drop away values within the limits specified by the manufacturer.
  - Relays shall be inspected visually every two years and the following visual checks conducted.
    - Movement of armature and contact carriage
    - Wiping of contacts
    - Arcing of contact if any

- Pitting or charging of contacts
- Dust on contacts
- Electroplating
- Corrosion, rusting of components
- Presence of fungus, if any
- Charring of cover neat contacts (for plug in relays)
- Correctness of label
- Presence of seal

- The relay that is any way defective should be changed at once and sent to shops together with a brief report stating the nature of the defects. On no account should any attempt be made by the line staff to rectify the relay.
- Track relays of all type shall be periodically over hauled every 10 years subject to a max. of 12 years. The duration may be reduced depending on local conditions, decided by CSTE.
- Check for arcing of contacts, corrosion, presence of fungus after every six-month.
- Ensure no moisture/ leakage of water near by track relay.

- **Track charger and battery**
  - On every visit maintainer should put the charger in off position for one hour &

then check insulation joint, bond wires etc.

- Check the current & voltage at feed end and relay end with & without charger as shown in Fig. no. 8 & 9, ensure that it is with in limit i.e. less than 250% of PU value.

- Check the battery connection, specific gravity and voltage.

- **Joint inspection of track by ST and permanent way inspector**

  The track-circuited portion of the track shall be jointly inspected by SSE/Signal and SSE/Pway at least once in six months. This is and addition to routine inspections to be carried out by each branch. The condition of rail and insulation at the rail joints, ballast and sleepers, abnormal collection of brake dust, rusting of the rail and drainage of the yard shall be particularly noted. It shall be ensured that percentage of missing liners for track circuit length not to exceed 3% maintenance work found necessary on insulation joints after such inspection should be carried out jointly.

- **Train Shunt**

  A train shunt test shall be taken every quarter and every time the track circuit adjusted or any alteration is made.

  Shunt test shall be taken not only at relay end but also at other parallel portions of the track, such as turnouts and cross over.

- **Track circuit test card**

  Test cards shall be easily accessible for inspection by officials.

  Test cards shall be kept up to date in accordance with the instructions given on the card. Reading shall be recorded every six months.

_____Railways
Signal and Telecommunication Department
TRACK CIRCUIT TEST RECORD CARD

1. Station of section of line	2. Track circuit no.
3. Type of relay	4. Date installed
5. PU volts	6. DA volts
7. PU current	8. DA current
9. Resistance of relay	10. Length of track circuit (M)
11. Length of leads from feed end to track (M)	12. Length of leads relay to track
13. Type of ballast	14. Type of track feed
15. Type of track feed conductor	16. Size of conductor to relay
17. Type of sleeper and condition	18. Type of insulated joints
19. No. of ASH pint in track	20. No. of L/xing in track
21. No. of insulated joints in track	Ballast Resistance= $\frac{V_F + V_R}{(I_F - I_R)}$
Rail Resistance= $\frac{V_F - V_R}{{}^1/_2 (I_F + I_R)}$	Current at Relay = Voltage at Relay terminals / Resistance of relays
22. Date	23. Weather
24. Condition of ballast wet/damp/ dry	25. Percentage of ballast clear of rails
26. Drainage of track good, fair or bad	27. Condition of rail surface
28. Condition of bonds and jumpers	29. Condition of insulated joints
30. Condition of track battery	
Track feed end	
31. Feed resistance	32. Voltage at battery of track feed voltage
33. V_F voltage at rails	34. I_F current at rails
Relay end	
35. V_R voltage at rails	36. Voltage at relay terminals
37. I_R current at relay terminals	38. Ballast resistance
39. Rail resistance and bond resistance	40. Drop shunt value
41. Pick up shunt value	42. Signature of section engineer/ signal Signature of senior section engineer /Signal
	Station_____

(Table - 4)

12.0 Uses of track circuit in signalling circuit

- To indicate occupied / unoccupied condition of a track.
- To prevent reception/dispatch of a train in an occupied section.
- To put back a signal to it's ON position immediately after passage of train.
- To prevent operation of a point under wheels.
- To lock the route in the face of an approaching train.
- To prove the arrival of a train.
- To control the aspects of a signal in an automatic signalling area.
- To achieve one slot one train system of working.
- To assist effective working of an axle counters by suppressing counting of trolley wheels.
- Prewarn facility to gate man at the time of train approaching to gate.

- To close and open the level crossing gate automatically.
- To introduce automatic block working.
- To provide Red lamp protection arrangement.
- To introduce Intermediate block signalling.
- To introduce directional sequential arrival of a train in RRI area.

13.0 Do's and Don'ts

DO's

- Check all safety parameters and record the exact values in track history card.
- Check insulation joint regularly and at the same time see its previous value. If changing, then replace such insulation joint promptly.
- Check the due date of overhauling of each track relay and send them timely for overhauling.

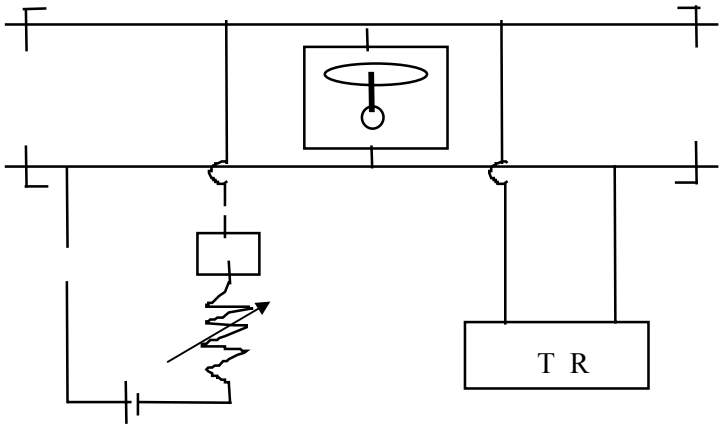


FIG.NO. 13

- Megger the track circuit tail cable after every six months and if the value is less than 1 mega ohm then such cable should be replaced promptly.

- Measure the stray current, as shown in the fig. no.10 by disconnecting the feed. If stray current persist then try any one method.
    - Interchange the positive and negative connections of the rails, so that stray voltage becomes opposite to the track feed.
    - Interchange the feed and relay ends of the track circuit. Stray voltage may disappear.
    - Splitting the track circuit, so that value of stray voltage will be negligible.
- Check the bond wire connections to avoid high resistance, which are causes of voltage drop.
- Prefer to provide track lead junction box vertically to avoid water accumulation in the junction box as shown in fig. no. 8.
- Apply glue/epoxy on the rail and fish plate of those joints, which are shorting due to iron filings and iron powder.

- At the time of replacing the insulation joint apply quick drier paint on the rail and fish plate.

- Try to replace the insulation joint when the temp. is between 20^0 -35^0 C.

- At insulation joint pandrol clip should be opposite in direction so that pandrol clip's small portion should be towards fishplate or use **J Pandrol clip** to avoid touching of pandrol clip with the fish plates.

DON'T

- Bypass the regulating resistance at any time.

- Tamper with the track relay at the time of track circuit failure.

- Disturb the antitilting arrangement of track relay.

- Forget to give disconnection memo to on-duty ASM/CASM at the time of attending failure.

- Adjust the track circuit beyond the limit of track circuit parameters given earlier.

- Forget to clean the insulation joint on every visit.
- Permit relay end voltage to be lesser than 125 % of pick up voltage of relay.

■■■■■