AUSTRALIAN RAIL TRACK CORPORATION LTD

Signals - Work on Asset

Specification

Issue 1.1 4 May 1999

Australian Rail Track Corporation

1. SCOPE

This document specifies requirements for the work carried out on all signal, level crossing and flashing point indicator installations.

2. SELECT MATERIAL

To be written.

3. PURCHASE

To be written.

4. MANUFACTURE/ASSEMBLE

To be written.

5. LOADING AND HANDLING

To be written.

6. INSTALLATION

6.1 Installation of Signal

6.1.1 General

The minimum distances of the foundations from the track shall be in accordance with the ARA Standards and AN Drawing D80-13.

Properly constructed moulds shall be used for all foundations cast on site. Foundation shall be rigid and level and concrete shall be allowed to properly set before any apparatus is connected thereto or place thereon.

Ready mixed concrete in accordance with Australian Standard Specification AS1379 shall be used wherever practical. Any site mixed concrete for foundations shall meet all the requirements of Australian Standard Specification AS 1379. Maximum coarse aggregate to be 20 mm.

The concrete shall have a minimum compression strength of 30 MPa at 28 days. The Contractor shall prepare test cylinders and arrange independent tests on selected pours as directed.

Concrete mix, when placed in moulds must be fully compacted.

Foundations shall be so constructed that apparatus can be removed without disturbing the foundation.

Dimensions of foundations shall be applicable to level and solid ground. ARTC representative and the Contractor shall jointly decide when deviations from specified sizes are necessary.

The top surface of concrete foundations shall be a flat smooth finish.

The depth of foundations and height above ground level shall be in accordance with the ARA standards and equivalent to existing foundations.

6.1.2 Concrete Foundation for Signal

All signals shall be mounted on concrete foundations. Signal foundations shall be manufactured from reinforced concrete of at least 30 MPa strength.

If pre-cast foundations are proposed the Contractor shall state the method proposed for installation of the foundations to ensure those signal masts, when installed, will be upright. The use of spacers between signal base and foundation is not acceptable.

6.1.3 Rag Bolls for Signal Foundation

Calcium chloride must not be used as an additive in concrete mixes to ensure that reaction with zinc coated or galvanised bolts is avoided.

Rag bolts for signal foundations shall be used.

6.1.4 Mounting and Erecting of Signal

Signals shall be mounted on tubular galvanised steel masts. Signal shall be fitted on top of the mast and provided with ladders and suitable landing or other means of access such as footsteps, etc for maintenance purposes. Design of ladders shall be in accordance with AS1657 or approved American standard. The Contractor shall design the mast such that the ladder does not support the structure. Signal mast shall not be stayed. Ladder shall be mounted only at the rear of the signal.

Signal masts shall be designed for an appropriate live load plus windage equivalent to 160 km/h.

For signals the internal wiring shall be insulated with approved material and conductor size shall be 50/0.25 diameter copper.

The signals shall be erected not less than ARA specified distances from the centre of the track. However, the Contractor in conjunction with the ARTC representative and the Locomotive Driver's representative may revise locations to suit sighting and existing installations and to minimise construction and maintenance difficulties.

In cases where trees, shrubs, etc. obstruct a clear view of the signal aspect the Contractor shall arrange in consultation with the appropriate authority to have such obstructions removed.

Reference drawings:

C65-37	General Arrangement of single unit searchlight signal
C65-116	General Arrangement of triple unit searchlight signal
D80-13	Structural clearance diagram of absolute searchlight location
D80-74	Structural clearance diagram of permissive searchlight location

6.2 Installation of Point Machine

The mechanical connections shall be adequately insulated for track circuiting purposes.

Cables feeding into detector boxes and machines shall be adequately protected mechanically, the cable entry designed to prevent ingress of moisture and anchoring arrangements shall be such that no stress is placed upon the wiring at the terminals.

Points shall be suitably identified in a manner equivalent to existing practices by painting the Point number on the Point machine with the Normal and Reverse positions of each Point indicated by the letters “N” and “R” painted or welded on the gauge plate located at the points of blade

Reference drawings:

D82-70	**Switch Layout McK & H M70 machine 1435mm & 1600mm MG LH layout**
D81-48	Switch Layout McK & H M70 machine 1435mm & 1600mm MG RH layout
D61-7	Switch Layout McK & H M22 machine BG LH layout
D61-11	Switch Layout McK & H M22 machine BG RH layout
D69-39	Switch Layout Nippon KH302 machine SG
C69-64	Switch Layout GRS 9 machine SG RH point closed
A1-89-065	Switch Layout MG RH layout
D68-4	Switch Layout SG & BG for Outlying Switch Lock and Switchstand
RA0-88-004	Switch Layout McK & H M23A machine SG RH non-insulated
RA0-88-005	Switch Layout McK & H M23A machine SG LH non-insulated

6.3 Installation of Track Circuits

6.3.1 General

Track circuits shall be DC, Inverter, AFO or coded track and double rail.

The Contractor shall ensure that polarities at each insulated rail joint are in accordance with the Track Plan or Circuit Plan.

6.3.2 Operating Conditions

For DC or Inverter track circuits the track relay shall release with a minimum train shunt of 0.5Ω applied to any point on the track circuit.

For coded track circuits the track relays shall release with a minimum train shunt of 0.06Ω applied to any point on the track circuit.

The track feed set and relay shall be located near to the track circuit ends.

6.3.3 Bonding

Bond wire shall consist of cut lengths of 16mm 511/.020 welding cable equivalent to existing bond wires. The wires shall be installed on the web of the rail on the running face side as tightly as possible in order to remove any slack between the bonding points.

Cables shall be connected to the rail by a 'Burndy' lug type B25M6 or approved equivalent and connected to a tapered bond pin with internal star washer inserted directly into a 7mm (9/32 inch) hole in the rail. The lug shall be secured to the bond pin by an M6 'Nyloc' stainless steel nut.

The Contractor shall drill 7mm holes in the neutral axis of the rails using a jig to ensure the hole is properly located vertically. The jig shall be approved by the ARTC representative. Pins shall be driven home by hammer from the bond side.

Where parallel bonding is proposed, the rail joints in the section connected in parallel shall be bonded by not less than two bonds, irrespective of the bonding system used.

All parallel bond connections between rails shall consist of duplicated bonds at each end of the parallel rail.

The Contractor shall provide the necessary rail drilling machines.

Where the length of track circuit jumper cables exceeds 20 metres the Contractor shall direct bury the jumper cable and install bootleg risers at each cable end and shall connect to the track. The buried cable shall be minimum 2c 7/1.04 track cable.

6.3.4 Bootleg Risers

The Contractor shall supply and install bootleg risers for the track connecting cables. The bootleg riser shall be installed such that no part projects above rail level or is within 2.3 metres of any rail running face. In special circumstances, where it is necessary to locate a riser within this distance, or height, approval of the ARTC representative shall be obtained.

At certain locations it may be possible to run track connecting cables directly from location boxes. These locations must be identified and approval of the Supervisor obtained prior to running the track connecting cables in this manner.

The Contractor shall install one bootleg riser for track connecting cables from two adjacent track circuits.

Riser terminal boxes shall be fully weather, dust and corrosion proof and be provided with standard (K9800) Railway Signalling locks or bolt down covers. Each track connecting cable shall enter the terminal box through separate entry holes fitted with compression grommets, sleeves or silicone rubber to render them waterproof.

Four separate Weidmuller Klippon type SAK 16/35 feed through terminals with endcaps mounted on TS 35 type terminal rail shall be provided in each riser terminal box (or location box where applicable) for connection of track leads and there shall be adequate room for easy installation or removal of track leads.

In location boxes the terminal rail and Weidmuller terminals shall be attached to a right angle bracket that shall be attached to the back of the location box to enable a ‘straight’ track lead entry and direct connection to the terminals within the location box.

A slot shall be cut at the track lead entry point to the location box that shall give adequate clearance between the cables and the box, and which shall be sealed with silicone rubber to prevent the ingress of dust or moisture following the connection of the track leads.

The relevant parts of section 6.9.1.1 must be adhered to as well as the manufacturers' instructions for terminating cable.

The riser posts shall be 50 mm diameter heavy gauge galvanised steel pipe 700 mm long.

The terminal base shall be clamped to the riser post so that no rotation is possible between the components.

The underground cable from the location box shall enter the bootleg riser for termination. No sharp corner or protrusions likely to cause damage to the track lead cable shall be present in the riser. Approximately one metre of cable slack shall be left coiled below each bootleg riser.

6.3.5 Track Connections

The Contractor shall install the connections between the rail and the bootleg riser or location box where applicable.

Track circuit connecting cables between the track and the bootleg riser terminal box or trackside equipment terminals shall be positioned to keep these cables as short as

possible and as close as possible to their respective insulated joints forming the track circuit. The cable shall be 16 mm 511/.020 welding cable.

In addition to the above coded track circuit connecting cables between the track and the bootleg riser terminal box or trackside equipment terminals shall be twisted once every 150mm.

Cables shall be connected to the rail by a "Burndy" lug type B25M6 or approved equivalent and connected to a tapered bond pin with internal star washer inserted directly into a 7mm (9/32 inch) hole in the rail. The lug shall be secured to the bond pin by an M6 ‘Nyloc’ stainless steel nut.

The Contractor shall drill 7mm holes in the neutral axis of the rails using a jig to ensure the hole is properly located vertically. The jig shall be approved by the Superintendent and Track Owner/Operator or their representatives. Pins shall be driven home by hammer from the bond side, to the satisfaction of the Superintendent and Track Owner/Operator or their representatives.

Where the cable runs between the rails of the track they shall be attached to the side of single timber sleepers with suitable saddles or fastened to concrete sleepers using Pandrol clips.

Reference drawings:

F3435	DC (secondary battery) Track Circuit
F3432	DC (primary battery) Track Circuit

6.4 Installation of Enclosure

6.4.1 General

The batteries shall be housed in a separate compartment from other equipment. Concrete battery well is acceptable. The battery shall be seating on a timber floor.

The equipment enclosure shall be mounted at least 4.5 metre from the centre of the track.

6.4.2 Wiring

The equipment enclosure shall be assembled, prewired and tested with certificate before transported to site.

All internal wiring used in trackside enclosure shall be insulated with approved material and conductor size shall be 32/0.20 diameter copper.

Where wires are subject to vibration eg. wiring to rails, stranded wires shall be used between such apparatus and the nearest junction free of vibration.

Stranded conductors shall be fitted with Utilux ‘Supergrip’ type crimp lugs such as H421A.

When terminating or joining cables or conductors, manufacturer’s instruction for jointing kits, terminals, lugs, etc. must be adhered to and in addition the following conditions must apply:-

- Conductors between terminals and instruments should be of sufficient length to allow access for inspection of apparatus.

- Conductors and cables should be continuous, without joins, between terminals within housings and apparatus.

- In forming eyes or applying terminals to ends of conductors, the conductor should not be nicked or twisted.

- Conductors should not interfere with operating parts of mechanisms.

- Terminal blocks should be installed in accessible locations and neatly arranged on terminal boards in location boxes.

- Where crimp or compression joints are made, the conductors shall not be tinned by soft soldering.

- Crimp or compression joints shall be made so that the conductors are securely retained within a suitable ferrule and made by the use of a tool approved for the purpose.

- The termination or join must be such that there is no undue stress on the joint itself or on the terminals.

- The conductance of the circuit must not be impaired by the inclusion of the joint; the conductivity of the joint must at least equal that of the conductors joined.

- The insulating properties of the joined cables must be maintained.

- The inclusion of the joint in the wiring system must not weaken the system's protection against mechanical damage, fire, shock, chemical deterioration or other hazards.

- Where cables are joined or terminated at any type of terminal, current density at the terminal itself must not be excessive.

- The termination method must be adequate to prevent loose connections when the terminal is subject to vibration that might occur in service.

- Each conductor that is to be terminated singularly to a terminal or to a common terminal with other conductors must be clamped between flat plated or stainless steel metal washers. The flat washers must be of the correct size and material to suit the terminal.

6.4.3 Terminations, Junctions and Labelling of Wires

Wiring labels shall be provided and shall be placed on the wire at the time of installation of the wiring and in a manner equivalent to existing labelling.

Labels shall be durable and of the sleeve type. All labelling shall be in English.

The wiring of terminal blocks on the internal side shall be labelled giving the terminal number.

Internal wiring of location enclosure shall be terminated on adjacent terminations, suitable for ready connection to external cabling. External cable shall be terminated in straight vertical rows.

All external wires and cables, and wires connected to fuses and bus bars shall be clearly and indelibly labelled in an approved manner and in accordance with the Signal Drawings to be supplied. Nomenclature shall be in accordance with that shown.

Wires leading to the relay coils and contacts shall be provided with sleeves identifying their location.

Reference drawings:

C81-607	Small Aluminium Cupboard General Assembly
C81-607	Largel Aluminium Cupboard General Assembly
E101/104	Battery Well Assembly

6.5 Installation of Cable

6.5.1 General

The following signalling cable sizes shall be used by the Contractor:-

2 core 7/1.04	used for signal lighting and 110 volt ac power distribution
2 core 7/1.70	used for flashing lights and point machine
4 core 7/1.04	used for signal lighting and track connection from box to bootleg
4 core 7/1.70	used for auto gate mechanism
7 core 1/1.78	used for control circuit from enclosure to enclosure or equipment
10 core 1/1.78	used for control circuit from enclosure to enclosure or equipment
15 core 1/1.78	used for control circuit from enclosure to enclosure or equipment
20 core 1/1.78	used for control circuit from enclosure to enclosure or equipment
30 core 1/1.78	used for control circuit from enclosure to enclosure or equipment

All internal wiring used in trackside housings shall be insulated with approved material and conductor size shall be 32/0.20 diameter copper. For signals the internal wiring shall be insulated with approved material and conductor size shall be 50/0.25 diameter copper.

Cables supplied shall be installed as described below:

Application	**Type of Cable**	**Installation**
110 volt distribution	PVC insulated PVC sheathed 2 core cable nylon jacketed outer sacrificial PVC sheath	Direct buried in ground 900mm below ground level
Signal control cables	PVC insulated PVC sheathed multicore cable nylon jacketed outer sacrificial PVC sheath	Direct buried in ground or installed in heavy duty UPVC conduit to AS2053 900mm below ground level.

6.5.4 Wiring

Where wires are subject to vibration eg. wiring to rails, stranded wires shall be used between such apparatus and the nearest junction free of vibration.

Stranded conductors shall be fitted with Utilux ‘Supergrip’ type crimp lugs as described below or other equivalent approved lugs unless as otherwise stated in this specification.

Stranded cable size	**Utilux lug**
1mm²	H421A

2.5mm²	H4227
6mm²	H4234
16mm²	H5905A-1

Solid conductors shall be terminated directly to approved terminals and in a manner equivalent to existing terminations using the following methods:-

- The copper conductor shall be bent in a clockwise direction to form a continuous eye without overlap that shall fit exactly over the terminal to which it is to be applied.

- The copper conducter shall not be damaged in any way in forming the eye.

- Only the required amount of insulation should be removed to provide clearance for clamping the conductor evenly between the two flat washers as described below.

When terminating or joining cables or conductors, manufacturer's instruction for jointing kits, terminals, lugs, etc. must be adhered to and in addition the following conditions must apply:-

- Conductors between terminals and instruments should be of sufficient length to allow access for inspection of apparatus.

- Conductors and cables should be continuous, without joins, between terminals within housings and apparatus.

- In forming eyes or applying terminals to ends of conductors, the conductor should not be nicked or twisted.

- Conductors should not interfere with operating parts of mechanisms.

- Terminal blocks should be installed in accessible locations and neatly arranged on terminal boards in location boxes.

- Where crimp or compression joints are made, the conductors shall not be tinned by soft soldering.

- Crimp or compression joints shall be made so that the conductors are securely retained within a suitable ferrule and made by the use of a tool approved for the purpose.

- The termination or join must be such that there is no undue stress on the joint itself or on the terminals.

- The conductance of the circuit must not be impaired by the inclusion of the joint; the conductivity of the joint must at least equal that of the conductors joined.

- The insulating properties of the joined cables must be maintained.

- The inclusion of the joint in the wiring system must not weaken the system's protection against mechanical damage, fire, shock, chemical deterioration or other hazards.

- Where cables are joined or terminated at any type of terminal, current density at the terminal itself must not be excessive.

- The termination method must be adequate to prevent loose connections when the terminal is subject to vibration that might occur in service.
- Each conductor that is to be terminated singularly to a terminal or to a common terminal with other conductors must be clamped between flat plated or stainless steel metal washers. The flat washers must be of the correct size and material to suit the terminal.

6.5.5 Cable Installation

Interlacing or bunching together of cables particularly at corners or entries to location cases shall be avoided. No cable shall be bent to a radius smaller than 12 times the diameter of the cable.

Each cable length shall have a 1 metre length of slack cable buried in the ground adjacent to the termination.

Where subsidiary cables are required to cross running lines, they shall be buried at least 1000 mm below ground level in 100 mm diameter PVC pipe in accordance with ARA standards.

Where cables are required to cross running lines, they shall be buried at least 1000 mm below the ground level.

No trench may be dug under continuously welded track when the ambient temperature is in excess of 35 degrees Celsius, unless the Contractor has obtained prior permission from the Superintendent and Track Owner/Operator or their representatives.

An inspection of each location shall be made to determine the exact nature of the work involved. A negotiated rate shall apply for rock encountered in trenching.

The route of the cable shall be marked by cable termination pillars at 50 m intervals and at change in direction and at cable joint locations. Cable termination pillars shall be supplied and installed by the Contractor. Cable termination pillars shall not interfere with existing or proposed access tracks.

All conduits or direct buried cables shall be installed at a depth of not less than 1000mm. The trench shall be backfilled with clean fill, free of stones, metal or sharp objects.

In rock, shale, stone or gravel areas cable shall be laid on 150mm of sand, and covered with 150mm of sand prior to final backfill.

Minimum conduit sizes shall be in accordance with AS3000.

The Contractor shall supply and install marker tape acceptable to the Superintendent and Track Owner/Operator or their representatives. The marker tape shall be coloured orange and marked "Caution Electrical Cables Below" and installed a minimum 100 mm above these cables. The method of installation shall be reviewed by the Superintendent and Track Owner/Operator or their representatives.

Signalling and 110 Volt Distribution cables shall be jointed at the locations shown on the cable plan using approved epoxy seal type cable jointing kits and in line crimp type conductor sleeves.
The in line crimp sleeves shall be 'Burndy' SBPS025 or SBPS06 or approved equivalent suitable for terminating 2.5mm² or 6mm² conductors respectively.

The cables to be jointed will be both PVC insulated/PVC sheathed, have the same number of conductors, with the same spiral lay at the joint and each with corresponding numbered cores. The joint shall be completed to the manufacturer's specification, with the conductor sleeves staggered so that the crimp sleeve joint of one conductor does not come into direct contact with another.

Approved jointing kits are 'Scotchcast' supplied by the 3M Company. The position of all joints shall be recorded on the Signal Drawings.

Jointing of railway signalling cables shall comply with the relevant sections of British Standard 4G178, Parts 1 and 2.

Where cable leaves the ground at other than in buildings or foundations it shall be protected by a bootleg, a pipe or other covering of suitable size extending above the ground at least 150 mm and the top filled with sealing compound.

Main cabling under roadway shall be installed in a high impact PVC. conduit at a depth of 1000mm. Conduits shall not be filled more than 50 per cent. If this would be exceeded, the Contractor shall supply and install an extra conduit.

PVC conduit shall be supplied and installed at all main undertrack crossings as directed by the Superintendent and Track Owner/Operator or their representatives.
Conduits shall not be filled to more than 50 per cent. If this should be exceeded, the Contractor shall supply and install one (1) extra conduit. Conduits shall be buried to a depth of 1000 mm.

On completion of the cable installation, the Contractor shall leave installed a draw wire in each undertrack and under-road crossing pipe.

Excavations under roadways and track shall be backfilled and mechanically compacted. The Contractor shall obtain approval from the local authority prior to an excavation of the roadway. The method of back-filling and the repaving of the roadway on completion of the excavation shall comply with the local authorities' requirements.

In the event of any services being damaged by the Contractor, the Contractor shall be responsible for all costs connected with the repair of the damaged service concerned.

Approved cable pits shall be installed at either side of road crossings, and as necessary for slack cable and pipe junctioning. The pits shall be large enough to avoid sharp bends in the cables.

The specification assumes that conduit crossings under rail tracks and under road will be laid in open trenches in order to ensure by visual inspection before layered and compacted backfill material is placed that the conduits are adequately supported on a firm and level ground formation and that conduits are in a straight horizontal and vertical alignment.

If the Contractor proposes to make such crossings by an alternative method, the Contractor must state how he proposes to ensure achieving the minimum standard of workmanship defined in the specification as acceptable.

The Contractor shall ensure that fouling of ballast does not occur during excavation and shall arrange disposal of all excess soil.

The Contractor shall mark up on the existing Signal Drawings all easements discovered during cable installation, the easements shall include those for ETSA, SA Gas, SA Water, Telstra and Optus. The marked up Signal Drawings shall be handed to the ARTC representative on the completion of the cable installation on each area.

An inspection of each location shall be made to determine the exact nature of the work involved and the Contractor shall amend construction Signal Drawings for approved variations in work.

Reference drawings:
F6048 Cable Trench Requirement

6.5.6 Terminations, Junctions and Labelling of Wires

All additional terminations and junctions shall be supplied and installed by the Contractor and shall be made on approved standard linked terminals.

Wiring labels shall be provided and shall be placed on the wire at the time of installation of the wiring and in a manner equivalent to existing labelling.

Labels shall be durable and of the sleeve type. All labelling shall be in English.

The wiring of terminal blocks on the internal side shall be labelled giving the terminal number.

All external wires and cables, and wires connected to fuses and bus bars shall be clearly and indelibly labelled in an approved manner and in accordance with the Signal Drawings to be supplied. Nomenclature shall be in accordance with that shown.

6.5.7 Conduit

All conduit and location boxes, supplied and installed by the Contractor shall be made of fire resistant materials and fire resistant methods of installation shall be used throughout. Trunking shall only be used where cables cannot be buried underground.

6.5.8 Cable Termination pillars

Each underground cable route shall be marked over its entire length with cable termination pillars supplied and installed by the Contractor. The cable termination pillar type and inscription shall be submitted for review by the ARTC representative.

All angular deviations, points, spurs from the main run cable joints and other pertinent information shall be indicated on the termination pillar. Termination pillars shall be located directly above or adjacent to all such points and shall not be more than 50 metres apart.

Posts for cable termination pillars shall be supplied and installed by the Contractor. Cable termination pillar installation details shall be submitted for review by the Superintendent and Track Owner/Operator or their representatives.

6.6 Installation of Active Level Crossing

6.6.1 General

The insulated joint and flashing light locations of the island track shall be installed in accordance with drawing number A3.94002. The edge of the road shall include the edge of the pedestrian.

FURTHER TO FOLLOW

7. SERVICING

7.1 Servicing of Interlocking

7.1.1 Relay

7.1.1.1 Servicing Relay – Shelf Type

- Verify from plans that coil resistance matches design criteria.
- Verify from box detail that installed relay contact configuration is equivalent to design criteria.
- Ensure any capacitor or diode connected across the coils is the correct rating and is securely mounted.
- Ensure relay is firmly seated in spring base mounting and is retained by cable ties to prevent accidental displacement.
- Ensure back board and mounting screws afford adequate support for weight of relay.

Visually inspect exterior of relay for:

- Cracks or breaks in casing.
- Condition of coils, coil insulation and leads.
- Check magnetic flux path for signs of rust or corrosion.
- Check termination area for signs of corrosion of terminals or any contamination which may cause tracking on insulating material.
- Ensure all terminations are tight and nuts on unused terminals are firm.
- Check for foreign items, particularly metallic laying in termination area.
- Ensure relay seal is in place and there are no signs of unauthorised interference.

Visually inspect interior of relay for:

- Loose contacts, fingers or tails.
- Burn marks on contacts or carbon deposits on inside of case indicating possible high resistance contacts.
- Any sign of corrosion.

Field test specifications:
Energise and de-energise relay and ensure armature operates freely with no sign of mechanical hesitation.

Maximum contact resistance acceptable in a field situation.

Carbon - Silver 0.05 Ω

Silver - Silver 0.03 Ω

Measured with an approved Low Ohm Meter used in accordance with manufacturer's instruction.

7.1.1.2 Servicing Relay – ‘B’ Type

- Inspect exterior of relay for damage.

- Inspect plug base, ensure it is securely mounted to frame and is not cracked or deformed.
- Inspect interior of relay for signs of contact burning, loose components or corrosion.
- Ensure relay is firmly seated in the plug base and locking pin has fully engaged in relay base.
- Inspect rear of relay base ensuring that all connectors are fully seated in the plug board position indicated on appropriate plans.
- Reliable field measurement of contact resistance is not possible on this type of relay.
- Any relay suspected of high resistance must be replaced and the defective relay returned to the Relay Room for repair.
- Only approved crimping tools are to be used to terminate connectors.
- When changing relays ensure the replacement relay is identical, utilise relay releasing tool to lift locking pin. Do not use excessive force to remove or replace relays.

7.1.1.3 Servicing Relay – 'Q' Type

- Inspect exterior of relay for damage.
- Inspect plug board, ensure it is securely mounted to frame and is not cracked or deformed.
- Inspect interior of relay for signs of contact burning, loose components or corrosion.
- Ensure relay is firmly seated in the plug board and relay unit is retained by an effective clip.
- Inspect rear of relay base ensuring that all connectors are fully seated in the plug board position indicated on appropriate plans.
- Reliable field measurement of contact resistance is not possible on this type of relay.
- Any relay suspected of high resistance must be replaced and the defective relay returned to the Relay Room for repair.
- Only approved crimping tools are to be used to terminate connectors.
- When changing relays ensure the replacement relay is identical.
- Do not use excessive force to remove or replace relays.
- The relay base is pin coded as a safeguard to prevent the insertion of an incorrect relay, therefore it must not be tampered with under any circumstance.

7.1.1.4 Servicing Relay – Sub Miniature

Siemens

- Ensure relay armature voltage matches design criteria.
  - 12 V relays have 716 embossed on the armature.
  - 24 V relays have 721 embossed on the armature.
  - 50 V relays have 726 embossed on the armature.
- Check relay is fully seated in base.
- Observe operation of relay, particularly for excessive contact arcing, if occuring, test circuit current: if below relay contact capacity of 1Amp replace relay.

- Inspect terminations and ensure that insulated sleeving fully covers the solder tab on all used terminations.
- Inspect base for cracks and ensure it is firmly mounted.
- These relays are seen as throw away non vital units, any defective units are to be replaced and not field repaired.

Contact configuation:

	1	2	3	4
Back	8	14	5	11
Front	10	16	7	13
Heel	9	15	6	12

Coil 1 & 4

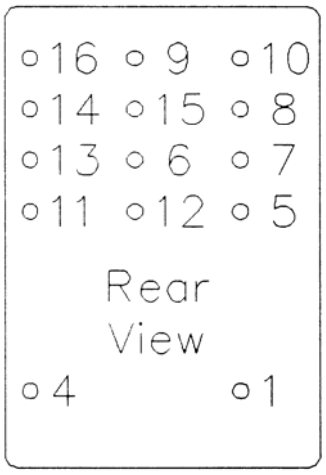


Figure 1 Siemens Plug Base Layout

Omron

Check relay is fully seated in base.

Observe operation of relay, particularly for excessive contact arcing, if occuring, test circuit current: if below relay contact capacity of 3Amp replace relay.

Inspect base for cracks and ensure it is firmly mounted.

These relays are seen as throw away non vital units, any defective units are to be replaced and not field repaired.

Contact configuration:

	1	2	3	4
Back	1	2	3	4
Front	5	6	7	8
Heel	9	10	11	12

Coil 13 & 14

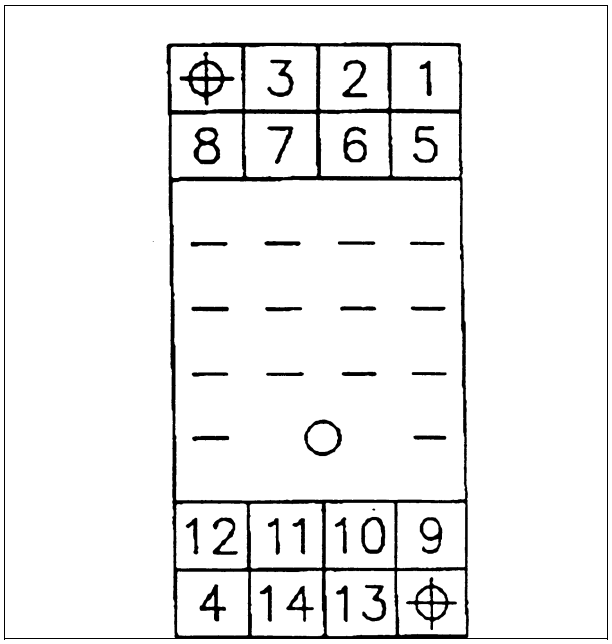


Figure 2 Omron plug base layout

7.1.1.5 Servicing Flasher Unit (Solid State) For Highway Crossings

PTF 2, 3 and 3B Westinghouse.

Check that the relay is fully plugged into relay base and locking clip is fully engaged.

Relay speed needs to be monitored at each inspection

IDEAL 43 FPM

MIN 40 FPM

MAX 46 FPM

Relay is not field serviceable.

wo operating problems are known:

Relay operates with XR energised. Due to ambient air temperature exceeding 40°C (PTF2 and 3 Relays)

Solution. Cool relay or replace with PTF 3B which has a maximum operating temperature of +70°C.

Relay operates with XR energised. Caused by voltage spike induced into battery supply due to lightning.

Solution. Replace relay account damaged transistors.

Iron Core Solid State Flasher Unit.

Ensure unit is securely mounted to backboard / frame.

Visually ensure stand off insulation is effective.

Relay speed needs to be monitored at each inspection

IDEAL 43 FPM

MIN 40 FPM

MAX 46 FPM

Units are not field serviceable.

An operational problem that can occur.

Voltage on C1 and C2 (inputs that hold power transistors in OFF position), MUST be same potential.

Any difference in potential at points C1 and C2 will lead to the partial switch ON of one of the pair of transistors.

Result is a steady light. (Brilliance of lamps is dependent on margin of potential difference).

Solution: Test wiring and contacts of control circuit for high resistance causing voltage differential.

7.1.1.6 Servicing Relay – NF2

Two types of this relay are in use:-

- Balanced armature type.
- Weighted armature type.

The visible difference being that the balanced armature type when de-energised, rests with the armature making on all four light circuit contacts, while the weighted armature type has a clearly visible weight attached to the armature plate, this weight forces the armature to rest on the side to which the relay is mechanically biased.

The inspection of both types is identical, visually inspect the contact wipe of each set of contacts (3 on each side) as the relay operates, check each contact for burn marks and excessive carbon deposited on the armature.

This indicates wear or burning which will shorten reliable relay life.

Relay speed needs to be monitored at each inspection:

IDEAL 43 FPM

MIN 40 FPM

MAX 46 FPM

For reliable operation the relay must be securely mounted in an approved bracket, and tied in, using large cable ties or secured to a timber shelf with screws.

The relay must be secured in both vertical and horizontal alignment and restrained from excessive movement.

All wiring to this type of relay must be in 2.5mm (50/0.25mm) conductors, fitted with approved lugs applied with the appropiate crimping tool.

Meter test specifications, using a Low Ohm Meter. (Conducted on all normally closed contacts when relay is in the de energised position).

Carbon / Metal 0.05 Ω

Metal / Metal 0.03 Ω

7.1.1.7 Servicing Time Delay Unit

- Check plans to ascertain design time delay.

- Check data label on unit to establish characteristic.
- Activate timer circuit and measure time delay.
- Record time elapsed with a stop watch.
- Any time delay unit which varies from its design time by -0 or +20% must be replaced.
- Check voltage.
- Restore all circuits to normal, and verify correct operation by conducting a Function Test.

7.1.1.8 Servicing Relay (Level Crossing) – XR, XP, XAR, GR and XGR

General

- Check external condition of relay.
- Ensure relay seal is intact.
- Check armature for free operation.
- As the relay coil(s) is de-energised, the armature should not display any hesitation in releasing.
- Check relay is securely mounted to backboard or mounting bracket. Ensure relay is secured with cable ties.
- Ensure "Q" type relays are secured in base and fitted with retaining strap.

XR (Modified GRS 960Ω) (Used in conjunction with NF2 Relays)

- Visually inspect relay contacts for burn marks, wipe and pressure. CARBON / CARBON contacts must make before and break after the SILVER / SILVER contacts. Observe the contacts for burn marks.
- Meter Test:
  - Disconnect parallel contact links, with relay de-energised, test contact resistance using LOW OHM METER.
- Contact Resistance

Carbon / Carbon 0.4Ω

Silver / Silver 0.03Ω

- Replace contact links on completion of test.

McK & H DN11 1000 Ohm (Used in conjunction with solid state Flasher Units)

Visually inspect contacts for signs of burning, wipe and pressure.

Meter Test:

Disconnect parallel contact links, test contact resistance using LOW OHM METER.

Contact Resistance:

Carbon / Silver 0.05Ω

Silver / Silver 0.03Ω

Replace contact links on completion of test.

Check the type of flasher unit used.

For PTF2, 3 and 3B Relays, the triggering circuit is activated with the XR de-energised and heel/back contacts must conform with the above requirements.

Static (IRONCORE) Flasher Unit activation is achieved by opening XR contacts to C1, C2 inputs, this test should prove infinite resistance heel/front with relay de-energised.

"Q" Type Relays

Contact resistance cannot be reliably measured under field conditions. Q type relays carrying flasher relay and gong control circuits must be replaced with a workshop tested relay at intervals not exceeding SIX (6) months.

Relays manufactured by Field and Grant should not be used in this application, as they develop high contact resistance prematurely.

XGR and GR Relay (McK & H DN11 1000 Ohm)

Carry out visual check of relay contacts for signs of contact burns or heat affected fingers or tails.

Sprag gate mechanism or de-energise XGR/GR Relay.

CAUTION: DO NOT ALLOW XGR/GR TO DE-ENERGISE OTHER THAN THROUGH XAP, XA1P AND XA2P PATH TO PREVENT THE GATES LOWERING WITHOUT PRE-WARNING TO ROAD USERS.

Tests

- Meter Test:
  Disconnect parallel contact strapping and test with LOW OHM METER.
- Disconnect gate BL wire from relay.
  Measure heel / front resistance.
- Contact Resistance.

  Carbon / Silver 0.05Ω

  Silver / Silver 0.03Ω

Reconnect wires and tighten termination.

Remove sprag from mechanism or allow gate motors to return gate to normal position.

Verify correct operation of gate mechanism.

If mechanisms are powered down, confirm compliance for both UGR and DGR contacts.

Wiring Requirements

For shelf type relays used as XR,XP, GR or XGR relays, all vital circuits must be wired in flexible conductors and terminated with approved lugs Applied with the appropriate crimp tool.

- Contact identification tags must be fitted to all conductors.
- Gate Motor and Light Circuits must be wired in 2.5mm (50/0.25mm) conductors, Gongs are to be wired in 1mm (32/0.20) minimum.

7.1.2 Solid State

7.1.2.1 Servicing Teknis Telemetry System

- Check that all units are securely mounted to frame.
- Ensure all terminations are firm and inter-connecting plugs are fitted with retaining screws which are firmly tightened. Do not overtighten.

- Inspect all earthing conductors and terminations.
- Inspect line terminations where appropriate.
- Test stand-by batteries in accordance with MI 030402-01.
- Do not leave displays unnecessarily illuminated.
- Dust exterior of units.

7.1.2.2 Servicing Programmable Logic Controller

A number of PLC'S are in use within the ARTC Signal System.

Under no circumstances must unauthorised staff alter the program or terminal wiring. PLC'S are low maintenance items, however, the following points require inspection:

- Ensure unit is firmly attached to base board.
- Ensure unit and housing area are clean.
- Meter test external battery and check physical condition of cells, battery leads and connections. When replacing cells ensure correct input polarity is observed.
- Inspect all terminations on unit to ensure that they are firmly connected.
- For units fitted with internal batteries, an indication of exhaustion of this battery will be given by the ERROR (alarm) indicator flashing.
- If observed proceed as follows:
- It is beyond local resources to carry out the following, assistance from the technical support must be obtained.
    - Turn off power.
    - Remove cover.
    - Replace battery and connector with approved type.
    - CAUTION: This procedure must be accomplished within five (5) minutes of turning power off.
    - Reattach the front cover.
    - Attach the programming console, clear the "Battery Low" message.

If a PLC is replaced, the validity of the entered program must be established by a full Function Test of the installation.

7.1.2.3 Servicing Regulator – Voltage For Highway Crossing Lights

Operational Characteristics

The regulator is designed to operate one lamp only.

The unit requires 1 Volt to drive the circuit, it follows that lamp voltage should be at least 10.8 Volts prior to the installation of a regulator.

The output voltage is not adjustable. It is dependent on the component values used in manufacture, normal output is 9.8 / 9.9 Volts.

Each regulator is individually protected with a 2.5 Amp fuse mounted on the circuit board.

Installation Requirements

The unit must be securely attached to the light body with a smear of heat conducting grease between the lamp body and the metal body of the regulator.

Wiring to the terminal block must be kept clear of the reflector and must be flexible conductors, **ALL WIRES** must be terminated using pin lugs.

Correct lamp polarity must be observed.

Ensure the positive output wire is connected to the centre pin of the lamp.

If the fuse blows on initial voltage application, check input polarity.

The unit is approved for fitting to individual light units and must not be used for multiple lamp applications.

Precautions for installations using regulators.

- Disconnect regulators before meggering circuits.

- When replacing light units, transfer the regulator from the old light unit to the replacement unit and check operation.

  A WARNING SIGN IS TO BE ATTACHED TO THE INSIDE OF THE CROSSING LOCATION ENCLOSURE (ER BOX) AT ALL LOCATIONS WHERE REGULATORS ARE INSTALLED.

In the event of a unit failure, regulators may be by-passed for a short period, if a spare is not available.

The failed unit MUST be returned to the Electronics Workshop for evaluation.

Detail of connections are shown on Figure 3.

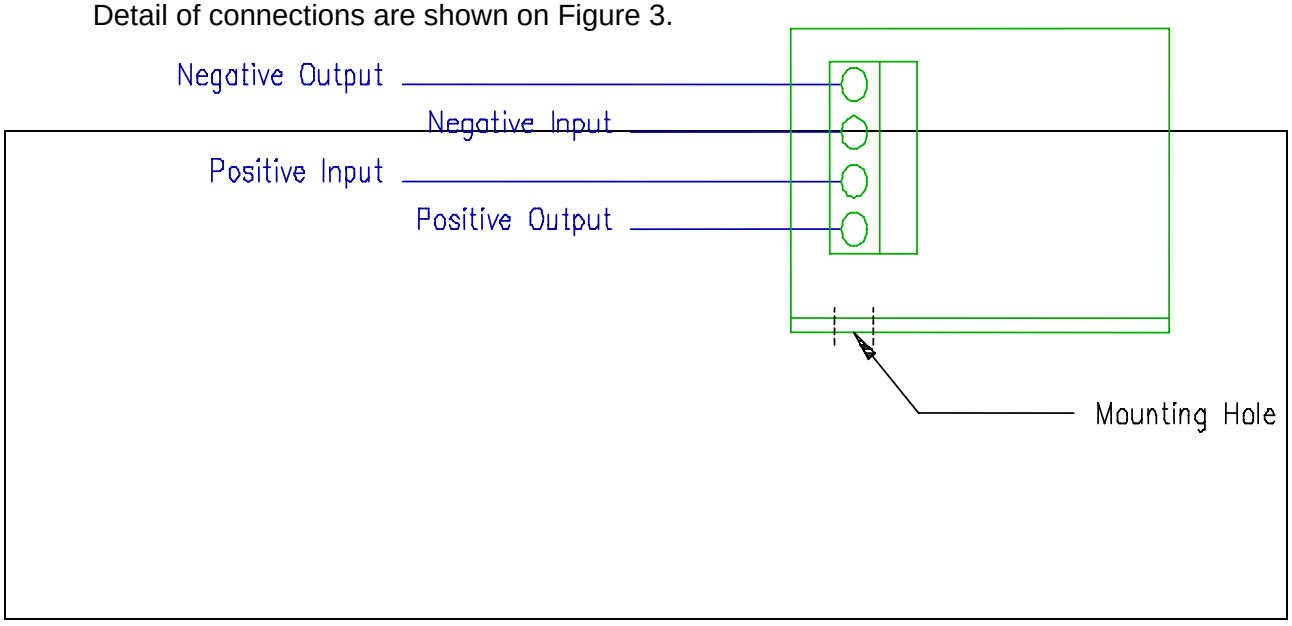


Figure 3: Electronic Voltage Regulator for Highway Crossing Lights.

7.1.2.4 Servicing Regulator – Voltage For Signals (AC Input Voltage)

Operational Characteristics

The regulator is designed to operate one lamp only.

The unit requires 1.7 Volts to drive the circuit, it follows that lamp voltage should be at least 11.2 Volts prior to the installation of a regulator.

The output voltage is not field adjustable, it is preset.

Normal output is 9.5 Volts.

Each regulator is individually protected with a 5 Amp fuse mounted on the circuit board.

Installation Requirements

The unit must be securely attached to the signal lamp assembly with a smear of heat conducting grease between the lamp assembly and the metal body of the regulator.

ALL WIRES must be terminated using pin lugs.

Correct lamp polarity must be observed. Ensure the positive output wire is connected to the centre pin of the lamp.

If the fuse blows on initial voltage application, check input polarity.

The unit is approved for fitting to individual light units and must not be used for multiple lamp applications.

Precautions for installations using regulators.

- Disconnect regulators before meggering circuits.
- When replacing light units, transfer the regulator from the old light unit to the replacement unit and check operation.

WARNING SIGN IS TO BE ATTACHED TO THE INSIDE OF THE LOCATION ENCLOSURE AT ALL LOCATIONS WHERE REGULATORS ARE INSTALLED.

In the event of a unit failure, regulators may be by-passed for a short period, if a spare is not available. The failed unit MUST be returned to the Electronics Workshop for evaluation.

Detail of connections are shown on Figure 4.

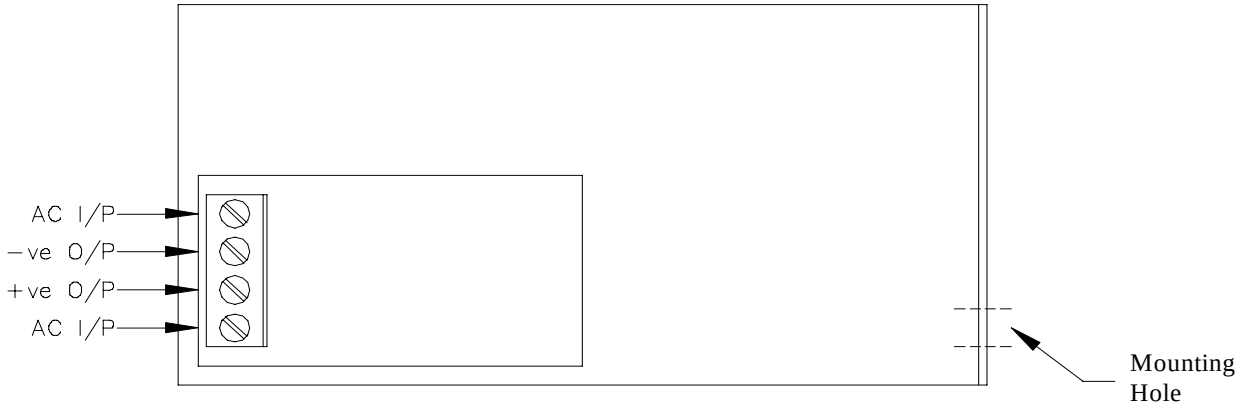


Figure 4 Electronic Voltage Regulator for AC supplied signal lamp

7.1.2.5 Servicing Regulator – Solar Charge

Solar Regulators are virtually maintenance free, however the following visual inspections are required:

Ensure regulator is firmly attached to back board.

- Ensure all connections are tight.
- Check unit for damage caused by vermin or water, if detected seal entry point and ensure damage will not cause failure.
- If fitted, operate switch to "Boost", "Float" and "Off" positions and verify correct output, reset switch to "Float" position at end of test.

Test for earth leakage.

NOTE: Some types of regulator use remote sensing connections to the battery and these should be disconnected to facilitate testing.

Solar regulators must be mounted on an insulating medium to prevent earth leakage due to component break down.

When fitted to concrete enclosures an effective voltage barrier must be installed between unit and concrete wall.

To ascertain state of charge of batteries, do not rely solely on voltage readings, Specific Gravity will give a more reliable indication of capacity and hence health of charging system.

When ordering replacement regulators specify existing type, voltage, size of solar array and cell type to ensure correct regulator is supplied.

Where lamp output terminals are provided verify output voltage.

7.1.2.6 Regulator – Voltage For Signals (DC Input Voltage)

Operational Characteristics

The regulator is designed to operate one lamp only.

The unit requires 1 Volt to drive the circuit, it follows that lamp voltage should be at least 10.5 Volts prior to the installation of a regulator.

The output voltage is not field adjustable. It is preset. Normal output is 9.5 Volts.

Each regulator is individually protected with a 2.5 Amp fuse mounted on the circuit board.

Installation Requirements

The unit must be securely attached to the lsignal lamp assembly with a smear of heat conducting grease between the lamp assembly and the metal body of the regulator.

ALL WIRES must be terminated using pin lugs.

Correct lamp polarity must be observed. Ensure the positive output wire is connected to the centre pin of the lamp.

If the fuse blows on initial voltage application, check input polarity.

The unit is approved for fitting to individual light units and must not be used for multiple lamp applications.

Precautions for installations using regulators.

- Disconnect regulators before meggering circuits.
- When replacing light units, transfer the regulator from the old light unit to the replacement unit and check operation.

A WARNING SIGN IS TO BE ATTACHED TO THE INSIDE OF THE LOCATION ENCLOSURE AT ALL LOCATIONS WHERE REGULATORS ARE INSTALLED.

In the event of a unit failure, regulators may be by-passed for a short period, if a spare is not available. The failed unit MUST be returned to the Electronics Workshop for evaluation.

Detail of connections are shown on Figure 5.

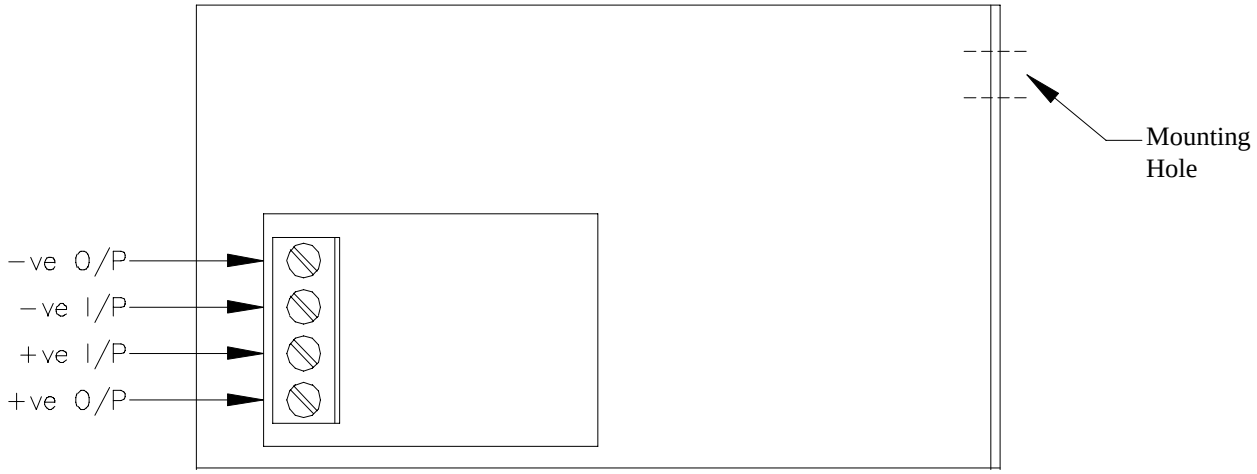


Figure 5 Electronic Voltage Regulator for DC supplied signal lamp.

7.1.2.7 Servicing Inductive Proximity Switch

- Examine proximity switch for external damage.
- Ensure proximity switch is securely mounted.
- Ensure proximity switch is clean and is weather proof.
- Ensure proximity switch power -on L.E.D. is operating.
- Examine proximity switch for alignment, ensuring it is within recommended tolerances.
  - Detecting head of proximity switch to be facing upwards 40-45mm below height of rail head and 8-10mm out from the running face of the rail.
- Ensure proximity mount is clear of any ballast or loose impediments.
- Ensure running face of rail at proximity mount location is free from burrs or lips
- Ensure cable conduit and connection to proximity switch is in good order and secure.

- Function test proximity switch.
  - Observe Detection L.E.D. operate by sweeping a ferrous object through the proximity switch inductive field.
- If proximity switch is to be changed out ensure all cable connections are tight and function test is carried out.
- Ensure yellow cover over proximity switch is in good order, clean, fitted in correct position and secured with conduit clips.

7.1.3 Test

7.1.3.1 Function Test Of A Powered Yard

Speak to Control Centre and state your intention to test, obtain time of expected train movements, remember that some tests will affect adjoining blocks and trains must not be delayed.

After obtaining approval take yard into local control.

Test operation of all routes and signals reading over selected route.

Ensure correct operation of all panel mounted switches and LED'S forming illuminated diagram.

Test locking of switches in accordance with locking chart applicable to the location under test.

During selection and operation of available routes have a meter connected to detect earth leakage.

On completion of tests or expiry of available testing time reset all signals and switches to normal and advise Control Centre that testing has ceased.

Ascertain that control of the yard has reverted from local to remote by requesting Control Centre to operate at least two functions.

7.1.3.2 Shunt Test

Track Shunt Unit:

0.5Ω Shunt

British Standard.

Used for all equipment designed to conform to BS.

This includes all types of DC Track Circuits excluding Coded Track.

0.06Ω Shunt

American Association of Railroad Standard.

Used to test equipment designed to conform with AAR Manufacturing Standards, the use is restricted to :-

- Microcode.

- Electro Code.

- Crossing Predictors.

- DC Coded Track Circuits.

Note: AFO track circuits must be tested in accordance with and using the shunt value specified.

Test relay current and / or voltage to determine if the relay is not over energised and voltage / current complies with relay data label.

Test track polarity of adjoining track circuits to ascertain compliance with Track Plan.

Securely clamp shunt across rails and confirm the track relay assumes its most restrictive state. If this does not occur, the circuit must be adjusted immediately.

Test both feed and relay end of circuit, and ascertain relay assumes its most restrictive state.

Test should be conducted during dry weather when relay current is maximum.

For requirements of Shunt Tests on Microcode tracks. see servicing Microcode

7.1.3.3 Earth Leakage Test

General

NOTE: The action of testing for earth leakage can in adverse circumstances cause false feeds on vital control circuits, and therefore this test must not be undertaken when train movements are expected.

Place positive(+) lead of voltmeter on BL terminal.Negative(-) lead on earth termination. Note reading (if any) This reading is "Negative Earth".

Place negative(-) lead of voltmeter on NL terminal.Positive(+) lead on earth termination. Note reading (if any). This reading is "Positive Earth".

If reading is greater than :-

2 Volt on 10 Volt installation.

3 Volt on 24 Volt installation.

6 Volt on 50 Volt installation.

(Based on 75% of minimum release value of relay).

It must:-

- Be cleared if possible immediately.
- If it cannot be cleared or isolated a SIGNALS COORDINATOR or SIGNALS OFFICER Must be notified.

Switch circuits must be tested with switches indicating both normal and reverse.

In order to completely test an installation ANLR circuits must be de-energised to test signal lighting circuits, these relays must be energised and verified to be so at completion of testing.

To test a yard, all routes and signal movements must be set and operated in order to energise all circuits.

In double cut circuit areas, it is pointless to Earth Test, unless 6.1.6 above is carried out, as the circuit design prevents testing past the first set of open contacts.

Clearing Detected Earth Leaks

When an earth leakage is detected, proceed as follows:

With meter connected as in 6.1.1 or 6.1.2 depending on polarity of earth leak detected, disconnect each wire from link, one at a time, while watching meter reading for a decrease in value.

The wire disconnected which causes a lowering of meter reading is the circuit to earth, further testing of this circuit at various points will result in the location of the breakdown in insulation resistance.

It may be possible to detect a characteristic of the defect by observing the meter reading for polarity reversal, or pulsing at approx 43 or 200 per minute which may refer to PCR, ER or X operation, this may reduce the time taken to clear defective circuits.

7.2 Servicing of Field Equipment

7.2.1 Signal

7.2.1.1 Servicing Signal Mechanism GRS 2A

Tools: Feeler Gauge 0.5mm (0.020")

Materials:

Lens Cleaner Solution.

Suniso 3GS Oil.

Lint Free Cloth.

Fine Glasspaper.

External:

- Examine signal mast and hardware. Check vertical alignment, terminal base, mast ladders, platform, mast cap and all bolts and fastenings.
- Inspect mounting bolts for tightness and signs of corrosion.
- Clean the lens and roundels. Examine for cracks or chips. Replace if necessary.
- Check roundel frame for rust.
- Check signal blade. Clean if required.
- Check mast fittings do not foul arm when travelling from 0° - 90° - 0°.
- Test locking dog operation, ensure end of signal blade cannot be raised by hand more than 230mm above horizontal.
- Check that the blade does not foul on pole line, trees etc.
- Check signal number. Clean if required.

Internal:

Inspect mechanism (including gearbox) for damage.

Ensure mechanism is clean, weather and vermin proof.

Examine drum controller and contacts (Contacts should have 2mm wipe).

Pole changer contacts are to make and break in unison, ensure there is no danger of a short circuit.

Examine commutator. Clean if required.

Examine brushes for serviceable length (Min. gap between rocker arm stops is

2mm).

- Brushes **must** be bedded in if replaced.

- Check operation of operating / snubbing contact, DG and HG motor contacts, examine contact rollers for flat spots.
- Examine holding mechanism. Clean armature and pole faces with lint free cloth, lightly oil pivots, wipe away all excess oil.
- Ensure the phosphor bronze spring on the underside of the armature is just clear of the motor case when the armature is energized.

- Ensure residual spacers are in place, and air gap between poleface and armature is 0.5mm (0.020") minimum.
- Check holding gear.
- Check clutch adjustment. Clutch should slip 3 to 6mm when clutch takes the weight of the signal arm. Adjust by tightening/loosening nut on end of armature shaft.
- Check main shaft for end play (Max. 4mm).
- Examine Signal Lighting Units
- Examine and test Signal Lamps
- Check door seal.

Lubrication (See Figure 1)

Main or Spectacle Shaft: Fill two oil cups and check that oil level falls after a few minutes.

If necessary clean with a wire prod.

Ensure main shaft oil points offer weatherproof seals.

Drive Shaft:

Apply oil to hole in case bearing and ball-seated nipple in bearing plate.

Stub Shaft:

Apply oil to ball-sealed nipple.

First Compound Gear:

Apply oil to holes in pinion hub.

Lock Dog:

Fill oil cup if fitted, otherwise remove plug and oil dog and guides.

Ratchet Gear Mechanism:

Apply oil to all components.

Gear Teeth:

Oil liberally.

Circuit Controller:

Apply oil to hole in central bearing and in front plate.

Motor:

- Fill oil cup at exterior front (drive) end of motor and hole in rear bearing bracket (interior).
- Lightly oil and wipe away excess at the following internal locations:
- Brush Holders:
  Apply oil to the **two** holes in arm bearing.
- Swinging Contact Arm:
  Apply oil to the **one** hole in pivot.
- Magnet Armature:
  Apply oil to the **two** holes in armature bearing.

Oil hinge and padlock. See Figure 1

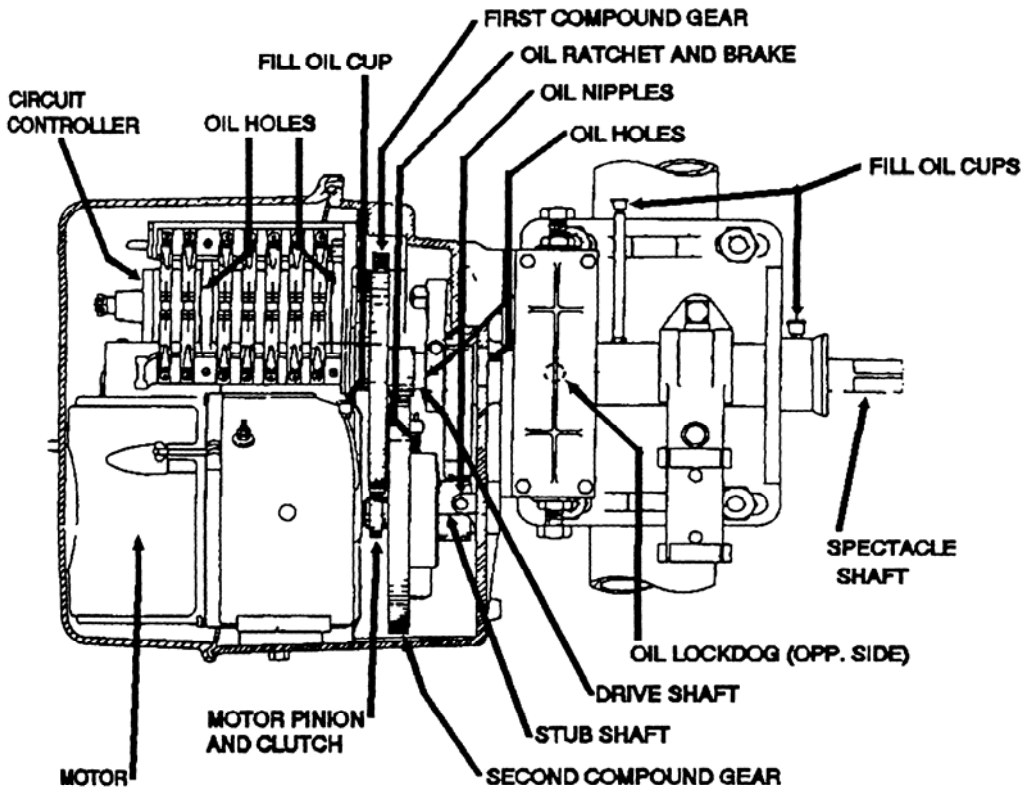


Figure 1 Lubrication Diagram For GRS 2A Signal Mechanism

Mechanism specifications:

Operating current: 2.1-2,4 Amp

Holding gear: Pick up 0.250 mA

Holding 0.015 mA

Clearing time 0-90° 10 sec maximum

7.2.1.2 Servicing Signal – Searchlight Type

Materials:

Lens Cleaner Solution.

18 Watt Signal Precision Lamp.

Suniso 3GS Oil.

External:

Examine signal mast and hardware, check vertical alignment, terminal base, mast ladders, platform, mast cap, all bolts and fastenings.

Examine condition of signal housing, background, hood and paint work.

Clean signal lens, examine for cracks or chips, replace if necessary. Ensure correct orientation of any secondary lens fitted.

Inspect signal number, clean if required.

Internal:

Check unit is weather and vermin proof.

Examine lamp, lamp base and measure voltage.

IDEAL	**9.5 volt**
MIN.	**9.3 volt**
MAX.	**9.8 volt**

Replace if glass envelope is discoloured or lamp expiry date has been exceeded, see MI 030106.

Examine reflector - when replacing reflector unit in retaining ring ensure 'Top' marking is in appropriate position.

Examine and clean inner lens (Compound type), as necessary.

Visually inspect relay for contact condition or damage.

Ensure service is not overdue and relay is held securely in housing.

Test relay voltage.

Check all connections and wiring, ensuring plug blocks are fully engaged on relay pins.

Oil hinge and padlock.

Check door seal and hose fitting.

7.2.1.3 Servicing Signal (Searchlight) – Alignment

Light Output Checks

Before attempting to align the signal, ensure there is sufficient light output by checking the following:

- Correct lamp is installed.
- Lamp envelope is not discoloured.
- Reflector and lenses are clean.
- Check reflector unit orientation in retaining ring.
  Position of "Top" marking is in appropriate positon.
- Lamp voltage is correct:

IDEAL	**9.5 volt**
MIN.	**9.3 volt**
MAX.	**9.8 volt**

Alignment:

Ensure the signal housing is fitted with a sighting device.

Position a target of sufficient size to be seen clearly on the track (1675mm above left hand rail) at the prescribed distance from the signal.

Loosen the horizontal position holding bolts.

Using the sighting device, swivel the unit until part of the target can be seen clearly through the alignment aid.

Tighten the horizontal alignment bolts.

Loosen the vertical alignment nuts and adjust unit until the whole target appears centred in the sighting device.

Lock the vertical adjustment and reconfirm horizontal adjustment.

Slight errors in signal optics or lamp filament position can cause noticeable displacement of the beam when observed from the prescribed distance.

Final verification and, if necessary, adjustment must be made by an observer located at the target point and in radio contact with the person on the mast.

On completion of adjustment, the signal output must be inspected from the target distance and observed that a satisfactory result is achieved throughout the approach distance.

Alignment distances on straight approaches are:

Main line	1,000m
Loop	500m

Performance of signals on curved approaches can be improved by the use of deflecting lenses.

Each case should be individually assessed and the appropriate lens selected.

Technical Support or ARTC can be referred to for assistance in these cases.

See Figure 2:

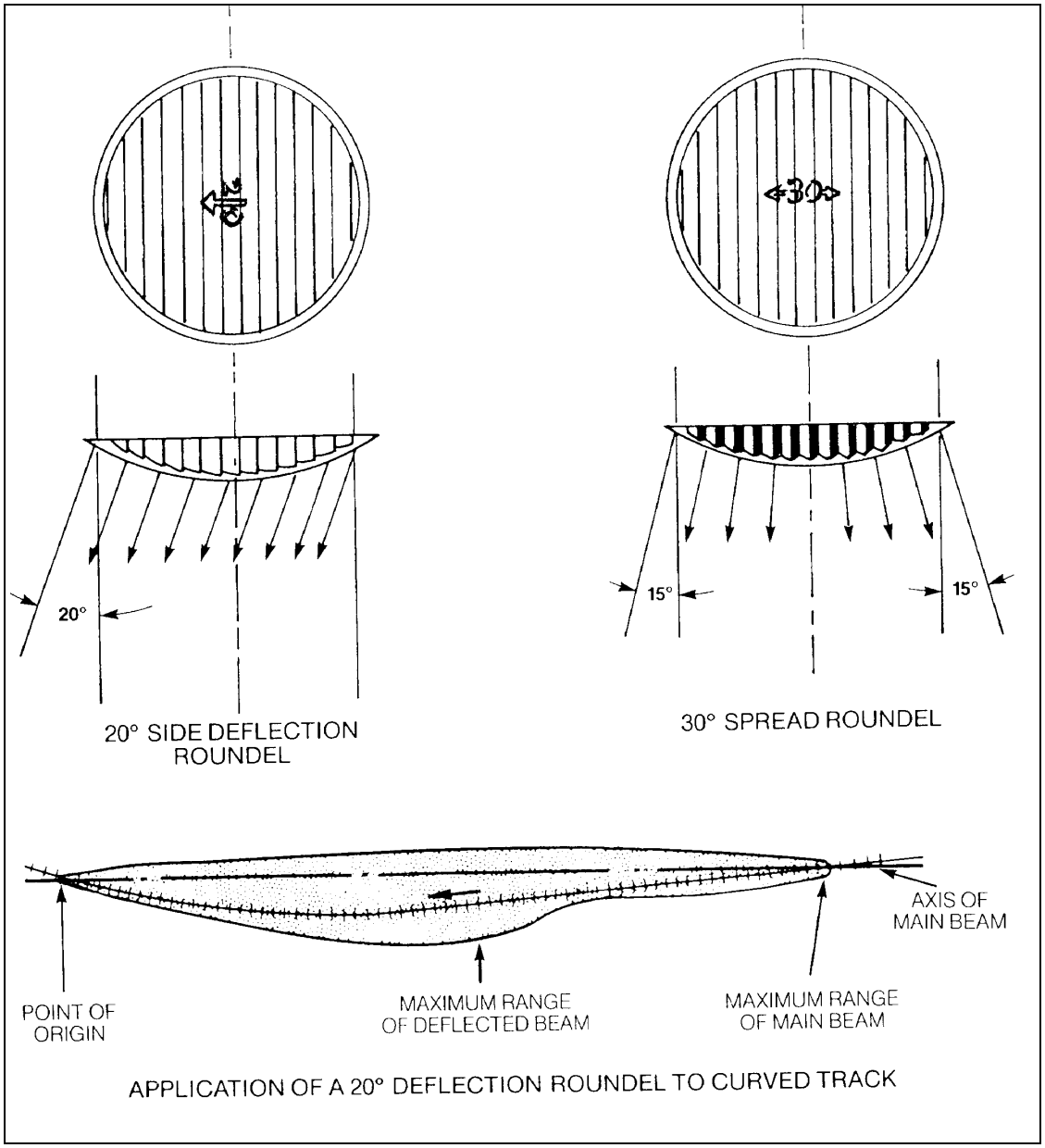


Figure 2 Types of Lenses Available

7.2.1.4 Servicing Enhancer Lamp Replacement

Lamps used : 18 watt 10 volt Single contact S11 Signal Precision.

Lamp Replacement Enhancer Lights (Continually Lit).

Lamp life is rated at 2000 Hours. Change out at twelve (12) weekly intervals.

Check that the printing on the base of the new lamp is 18 Watt, 10 Volt Signal Precision.

The date of the next lamp change out is to be written on a self adhesive label attached to the inside of the signal unit body.

Old lamps which are removed must be destroyed in an environmentally sound manner and not mixed with new lamps.

The centre pin retaining nut must be kept at its outer limit and not come into contact with the lamp holder.

Ensure the lamp contact area is clean and pin spring tension checked before replacing lamp.

Check lamp voltage DC:

IDEAL 9.5 volt

MIN. 9.3 volt

MAX. 9.8 volt

After replacing a lamp/s a test **must** ascertain correct operation.

In the event of premature failure of a lamp, the lamp change out date is not altered but left to be replaced as determined by area lamp renewal roster.

Signal – Low Speed Unit

Ensure unit is firmly seated in its bracket and the bracket is securely attached to mast.

Ensure only an amber lens, sand blasted on both sides, is used and is retained firmly in place.

Clean lens.

Open signal unit, dust internally and clean inside surface of lens.

Ensure that inside surfaces of signal unit are a matt black finish.

Ensure signal unit provides a weather proof/vermin proof enclosure and can be padlocked for security.

Lubricate hinge pins and locking bolt.

Ensure lamp operates.

Measure voltage at lamp terminals:

IDEAL 9.5 volt

MIN. 9.3 volt

MAX. 9.8 volt

Lamp type: 10V, 18 Watt SBC

signal precision

Lamp must be replaced when glass envelope becomes discoloured.

Inspect cable terminations and hose fittings.

Check that a background and hood are securely attached to the unit and are in good condition.

7.2.1.5 Servicing Signal Light Unit

Ensure unit is firmly seated in the bracket and the bracket is securely attached to the mast.

Ensure lens is retained firmly in place.

Clean lens using non-corrosive glass cleaner.

Open unit, dust internally and clean inside of lens.

Ensure that inside surfaces of light unit are a matt black finish.

Ensure unit provides a weather and vermin proof enclosure that can be padlocked for security.

Lubricate hinge pins and locking bolt.

Measure voltage at lamp terminals:

IDEAL 9.5 V

MIN. 9.3 V

MAX. 9.8 V

Lamp must be replaced when one filament has open circuit or glass envelope becomes discoloured.

LAMP TYPES

Signal light unit:

10V, 18W SBC signal precision

or

10V, 2+2 CP ES signal precision.

Marker light unit:

10V, 5W SBC signal precision

or

10V, 2+2 CP ES signal precision.

Inspect cable terminations and hose fittings.

For units utilized as marker lights ensure an effective hood is securely attached to the unit body.

7.2.1.6 Servicing Signal – Colour Light Type

External

- Check signal unit for damage.
- Check foundation and mounting bolts.
- Clean number plates if required.
- Clean outer surface of lens and examine for chips and cracks. Replace if necessary.

Internal

Check signal unit for damage.

Ensure signal unit is weather and vermin proof. Seal any defects detected.

Examine lamps, lamp bases and measure voltage.

IDEAL 9.5 Volt

MIN. 9.3 Volt

MAX. 9.8 Volt

Replace lamp if glass envelope is discoloured or main filament is open circuit.

Ensure lamp holders have spring tension on centre pin.

Dust out signal unit internally, ensure that inside surfaces are a matt black finish.

Examine electrical connections and wiring.

Clean inner surface of lens and examine for chips and cracks.

Ensure internal dividers are in place to prevent light spill from one signal aspect to another.

7.2.1.7 Servicing Signal Lamp Replacement

Lamps used : 18 watt 10 volt Single contact S11 Signal Precision.

Lamp Replacement Signal Lights (Continually Lit).

Lamp life is rated at 2000 Hours. Change out at twelve (12) weekly intervals.

Check that the printing on the base of the new lamp is 18 Watt, 10 Volt Signal Precision.

The date of the next lamp change out is to be written on a self adhesive label attached to the inside of the signal unit body.

Old lamps which are removed must be destroyed in an environmentally sound manner and not mixed with new lamps.

The centre pin retaining nut must be kept at its outer limit and not come into contact with the lamp holder.

Ensure the lamp contact area is clean and pin spring tension checked before replacing lamp.

Check lamp voltage AC/DC:

IDEAL 9.5 volt

MIN. 9.3 volt

MAX. 9.8 volt

After replacing a lamp/s a test **must** ascertain correct operation.

In the event of premature failure of a lamp, the lamp change out date is not altered but left to be replaced as determined by area lamp renewal roster.

Lamp Replacement Signal Lights (Approach Lit).

Inspection interval of ONE year with replacement at a time interval determined by site history, but not to exceed FOUR yearly intervals.

The instructions covered in Parts 4 to 9 above, must be observed.

Marker Lamps

The only approved BC Marker Lamp is 5 Watt, 10 Volt S11 Signal Precision.

\18 Watt 10 Volt LAMPS MUST NOT BE USED

These lamps are changed when the filament is open circuit or the glass envelope becomes discoloured.

Otherwise the instructions for continually lit lamp replacement above must be observed.

Inspection on continuously lit signals at twelve (12) weekly intervals.

Inspection on approach lit signals of ONE year intervals.

2 + 2 CP ES Lamps 18/3.5 Watt Re-base Signal Precision

These lamps are changed when one filament has become open circuit or the glass envelope becomes discoloured.

Otherwise the instructions for continually lit lamp replacement above must be observed.

Inspection on continually lit signals at twelve (12) weekly intervals.

Inspection on approach lit signals at one (1) year intervals.

7.2.1.8 Servicing Enhancer

Materials:

Lens Cleaner Solution.

18 Watt Signal Precision Lamp.

Suniso 3GS Oil.

External

Examine enhancer mast and hardware, check vertical alignment, terminal base, mast ladders, platform, mast cap, all bolts and fastenings.

Examine condition of enhancer housing, background, hood and paint work.

Clean enhancer lens, examine for cracks or chips, replace if necessary. Ensure correct orientation of any secondary lens fitted.

Internal

Check unit is weather and vermin proof.

Examine lamp, lamp base and measure voltage.

IDEAL 9.5 volt

MIN. 9.3 volt

MAX. 9.8 volt

Replace if glass envelope is discoloured or lamp expiry date has been exceeded, see MI 030106-1

Examine flasher unit, check connections, measure voltage output.

IDEAL 9.8volts

Ensure enhancer indications correspond with target indications.

Green - normal

Yellow - reverse.

Examine reflector - when replacing reflector unit in retaining ring ensure 'Top' marking is in appropriate position.

Examine and clean inner lens (Compound type), as necessary.

Visually inspect relay for contact condition or damage.

Ensure service is not overdue and relay is held securely in housing.

Test relay voltage.

Check all connections and wiring, ensuring plug blocks are fully engaged on relay pins.

Oil hinge and padlock.

Check door seal and hose fitting.

7.2.2 Track Circuit

7.2.2.1 Track Circuit (Primary) – Adjustment

Shelf Type (4Ω) Relay

At the relay end, connect an 8Ω variable resistor in the R1 leg and connect to positive rail (as indicated on Track Plan) via track leads.

At the battery end, connect a fixed value resistor(2.2Ω, 5W) in the positive leg between the battery and the track lead.

Check battery voltage is 1.4 V nominal before it is connected to the track.

Connect battery to track, observing track polarity as detailed on Track Plan.

Connect ammeter in coil circuit, adjust variable resistor at relay end until reading is 20% above stated working current compensated to allow for local climatic and track conditions.

Remove ammeter from circuit and ensure terminations are secure.

Shunt Test track circuit.

"Q" Type (4Ω) Relay

Follow steps 1,2,3 and 4 above.

At the relay end adjust 8Ω resistance unit to give 0.75V across R1 and R2 of the relay.

Shunt Test track circuit in accordance with SECTION 2.1.3.2 SHUNT TEST.

7.2.2.2 Track Circuit (Secondary) – Adjustment

At the relay end, connect a 30Ω variable resistor in the R1 leg and connect to positive rail (as indicated on Track Plan) via track leads.

At the battery end, connect a 4Ω variable resistor with approximately 3Ω in circuit in the positive leg between the battery and the track lead.

Check that open circuit battery voltage is between 2.0 V and 2.4 V.

Connect ammeter in series with the positive lead of the track relay.

Adjust variable resistor so that current reading is 20% above the stated working current of the relay, compensated to allow for local climatic and track conditions.

Tighten feed resistor.

Remove ammeter from circuit and ensure terminations are secure.

Shunt Test track relay.

7.2.2.3 Servicing Track Circuit – Inverter

Measure DC voltage applied to input terminals of inverter (12V nominal).

Open circuit output from an inverter is 6V AC from each of the three output pairs.

Inverters can in adverse conditions require a 1.5A input, charger output must be sufficient to counteract this and maintain the BL in fully charged condition.

Relay current adjustment

Due to a higher rail voltage inverter track circuits are more susceptible to track leakage.

Usually satisfactory results can be achieved by placing all available resistance (including the fixed component) in circuit on the feed side (8 Ohm.) and completing final adjustments using the relay side resistor to obtain a current 20% above normal working current.

Shunt test track relay in accordance with

Electrical Inspection.

- Check terminations are tight
- Check unit is firmly mounted on backboard (in aluminium enclosures insulating strips must be inplace between the unit and the equipment rack frame).
- Inspect lightning arrestor for damage to holder or cartridge.
- Inspect earth connection.

In Service Problems

Inverters are susceptible to voltage spikes (lightning), arrestor equipment must be examined regularly and correctly maintained.

Track diodes are prone to damage by lightning.

Open circuit in track or track connections will result in AC applied to relay terminals and an AC voltage applied to the feed side of the break.

Track leakage is indicated by low relay current but must be substantiated by further tests and track inspection.

7.2.2.4 Servicing Track Circuit Westinghouse AFO Type M.

Connect all blocking reactors and coupling units to the rail circuits as required.

Connect the transmitter and receiver to the track circuit at terminals 3 and 4 via the lightning arrestors as specified in plans.

Connect the AFO relay to the receiver at terminals 5 and 6.

Observe correct polarity.

Using a voltmeter, check the D.C. supply that will be used at the transmitter and receiver for correct voltage (10 - 12 Volts).

Connect voltmeter across the relay terminals.

Connect output terminals 3 and 4 from the surge ripple filter to input terminals 1 and 2 on the transmitter and receiver.

Ensure correct polarity.

Connect the power leads to terminals 1 and 2 on the surge ripple filter.

Ensure correct polarity.

CAUTION: The equipment may be damaged if power is applied to the wrong terminals.

When power is applied, a DC voltage of 7 - 9 Volts should be developed across the relay terminals.

If the relay does not pick up, loosen the lock nut on the receiver output control and turn the control shaft clockwise, until the relay picks up. Then lightly tighten the lock nut.

Connect a track shunt across the track at the receiver end.

Loosen the receiver output control lock nut and adjust the receiver output control so that the relay just drops out with the shunt in place, observe the voltage reading.

This adjustment should be made when the ballast is in good condition. This will avoid any appreciable increase in the relay voltage with any improvement in ballast.

Tighten the control lock nut and check the voltage to see that tightening the lock nut has not changed the voltmeter reading.

If necessary, loosen the nut, re-adjust the control and re-tighten the nut.

Remove the track shunt. The AFO relay should then pick up.

When either or both of the AFO units are replaced the circuit must be re-adjusted.

Remember that the AFO track circuit is, firstly a track circuit and like conventional track circuits must be properly adjusted to maintain adequate shunting sensitivity.

Qualified personnel adjust conventional track circuits according to rules. Use the same safeguards for AFO track circuits.

The adjustment is provided to allow adequate margin. It should be used just as carefully as in conventional track circuits.

Summary of adjustment procedure.

Make final adjustment in dry weather with circuit unoccupied.

Connect all AFO units to rails in track sections.

Place track shunt across rails at receiver end.

Adjust receiver output control until relay just releases.

Tighten the output control lock nut.

Remove track shunt. Relay should then pick up.

When either or both of AFO units are replaced, the circuit must be re-adjusted.

7.2.2.5 Servicing Track Circuit – Electro Code

- Inspect track leads in accordance with.
- Inspect equipment housing in accordance with.

- Inspect batteries and power supply in accordance with.
- Inspect insulated joints in accordance with.
- Conduct earth leak test in accordance with.
- Inspect enclosures-wiring and fittings in accordance with.
- Inspect lightning arrestors / surge suppressors and associated terminations for physical damage and tightness with particular attention to Earth terminations.
- Inspect Electro Code unit:
  - Examine unit for external damage or deterioration.
  - Ensure unit is securely mounted.
  - Ensure unit is dust free, internally and externally.
  - Ensure cards are fully seated in motherboard.
  - Ensure all external terminations are tight.
  - Check all indicating lamps are flashing correctly.
- Test and verify compliance of equipment to manufacturers specification as set below, record all readings on appropriate card. (Refer Electro Code 4 manual, section X-2).

Supply voltage -	Min 10.0v .
	Max 16.0v.
Supply current -	Min 650ma.
	Max 900ma.
	with lock lamp drive 1.5 times lamp current.
Input voltage-	Min 10.0v
	Max 14.0v.

Receiver Sensitivity

Release current-	Ideal	350ma.
	Min	270ma
	Max	420ma
Pick up current-	Ideal	500ma
	Min	440ma
	Max	590ma

Shunting Test

Using 0.06 ohm shunt, observe that the LED indicator on the 7K module is extinguished.

Track Circuit Receiver Current

1000-1300ma (dry circuit).

7.2.2.6 Servicing Track Circuit – Microcode

- Inspect track leads in accordance with.
- Inspect equipment housing in accordance with
-
- Inspect batteries and power supply in accordance with.
- Inspect insulated joints in accordance with.
- Conduct earth leak test in accordance with.
- Inspect wiring and enclosure in accordance with.
- Inspect lightning arrestors / surge suppressors and associated terminations for physical damage and tightness with particular attention to Earth terminations.
- Open unit and check for data recorded on CPU card display, note and record any fault codes recorded and reset display to zero by turning off unit at main switch then restore power.
- Ensure cards are fully seated in motherboard and all external terminations on Microcode unit are tight.
- Dust unit internally and externally, then refit cover plate.

Conduct Shunt Test (Record Result)

Shunt Test

Using a 0.06 Ohm shunt, correctly attached to the appropriate rails, the following observations should be made.

Full and Half Units

Under shunt condition all five receiver LED's located on the upper half of the logic card will be extinguished.

Special Repeater Units

Under shunt condition.

Master side:

Track LED's extinguished 50% of time.

Slave side:

Track LED's extinguished.

7.2.2.7 Servicing Track Feed Unit (TFU)

General

Track Feed Units in use within the system fall in to two distinct types:

TFU as used in conventional DC circuits:

- Input 110V AC.
- Variable Output (Max. 6V DC)

Modified TFU, used in diode tracks (this unit is as above but has the bridge rectifier removed.
NOTE: These must be labelled as a modified unit.

- Input 110V AC.
- Variable Output (Max. 10V AC).

The two units are not interchangeable without removal or replacement of bridge as appropriate.

Electrical Inspection

Measure input voltage (AC 110V).

Measure output voltage.

Measure track relay voltage and/or current as applicable to type of relay.

Output is varied by using various marked tappings to increase/reduce track voltage.

Ensure relay operation complies with relevant maintenance instructions.

If TFU is changed out, test track circuit operation, shunt value and track polarity.

Physical Inspection

- Inspect unit for physical damage.
- Inspect unit for water or vermin damage.
- Check unit is firmly attached to back board.
- Check all terminations are tight.

Relay Adjustment "Q" Type (9Ω).

At the relay end adjust 30Ω resistance unit to give 1.75V across R1 and R2 of the relay.

It may be necessary to vary output tappings of the TFU in order to obtain required reading.

DN11 (4Ω) McK&H.

This relay when connected to a modified TFU unit is adjusted in accordance with.

7.2.2.8 Servicing Track Circuit – DC Coded Track

Use WABCO test meter in accordance with manufacturer's recommendations.

- Inspect track leads.
- Inspect equipment housing.
- Inspect batteries and power supply:
- Inspect insulated joints.
- Conduct Earth Leakage Test.
- Inspect wiring and enclosure.
- Conduct Shunt Test and record results.

- Test and verify compliance of equipment to manufacturer's specifications set out below.
- Examine equipment for external damage or deterioration.
- Check that equipment is securely mounted in equipment cases.
- Check cable terminations are tight and relays are tied down using cable ties.

Code Transmitters

Type – Union Switch and Signal Co. PC-250TR

Operating Voltage – 10V DC (Min. 8V, Max. 14V).

Contact – 2 heel front and 2 heel back silver platinum to silver platinum.

Coil resistance:

120 cycles/min. – 40 Ohms
180 cycles/min. – 60 Ohms

Power contact on time should be 42-48%.

Code frequency variation:

10/12 Volts
120 code - 123± 0.5 cycles/min.
180 code – 184± 1 cycles/min.
Test over 3 minutes and average cpm for final reading.

Contact resistance:

0.05Ω silver/platinum contacts
(front and back);
0.5Ω tungsten contacts (drive function).

Code Following Relay

Type – WABCO style CD.

Operating Voltage – 10 Volts.

Contact – 2 front-heel-back combinations.

Coil resistance 225 Ohms.

Pickup current – 13mA.

Snubbing resistor – 510 Ohms.

Code Following Track Relay

Type – Union Switch and Signal Co. Style P4.

Coil resistance 0.3 Ohms.

Minimum rated current:

0.320 Amp.

Pickup current:

Min. 0.225 Amp.

Max. 0.320 Amp.

Drop away current 0.116 Amp.

Contact:

2 front-heel-back combinations.

Armature – spring suspended from relay top plate.

The P4 relay is biased so that with improper polarity or no energy applied to the coil the armature will close the back contacts.

Front Contact Proving Relay

Type – McKenzie and Holland Style

Snubbing rectifier:

Style RE1 – 1.2 seconds.

Operating voltage – 10V DC.

Coil Resistance 1000 Ohms.

Contacts:

2 front-heel-back combinations.

The front contact proving relay is used to prove that front contact coding is being received and that the track relay is not chattering without making the front contacts.

Decoding Transformer HR-DU

Style W7.

Operating voltage 10V.

Circuit:

Diagram 1

The sections between 2P and 3P and between 3P and 4P Serve as the primary. The Section between 1P and 2P Serves as an auto winding to step up the voltage for a More efficient operation of the decoding units. The Winding designated 1H, 2H, 3H serves as the secondary.

Arc Suppressor

Style CA

Circuit Diagram:

Diagram 2

HR Relay

Type – McKenzie and Holland Style DN18C.

Operating Voltage 1.45 Volts.

Coil resistance – 64 Ohms.

Contacts:

4 front-heel-back combinations.

Arc suppressing resistance:

250 Ohms.

The relay is immune to single operation of the TP relay and will remain or become de-energised when the TP relay is held steadily energised.

It is immune to the effect of rectifier ripple.

Contact resistance:

carbon/silver 0.18Ω max.

silver/silver 0.03Ω max.

Code Following Magnetic Stick Relay

Type – Union Switch and Signal Co. Style CDP.

Operating voltage – 10V DC.

Coil resistance – 135 Ohms

Arc Suppressing resistance:

510 Ohms.

Contact:

4 normal-heel-reverse silver platinum combinations.

Current:

Max. pick up 0.0106 Amp.

Min. pick up 0.0094 Amp.

It will be noted that the circuit for the CTP relay includes one of its own polar contacts.

This contact selects positive energy when it is poled to the left and negative energy when it is poled to the right.

It will be noted that energy flows through the coils only for the length of time that it takes the armature to shift.

The code generated is known as corrected code as the correction compensates for contact wear on code transmitter contacts.

Decoding Unit DR-DU

Style Y10

Operating Voltage 10V.

Circuit Diagram:

Diagram3

The components between 1T and 2T are

7.2.2.8.1.1.1 Tuned to resonance for the particular

Frequency for which they are designed –

in this instance 180 code which is equivalent

to 3 cycles per second.

DR Relay

Type – McKenzie and Holland Type DN11.

Coil Resistance – 55 Ohms.

Current Drop away:

0.104 Amp. At 0.570 Volts.

Pick up: 0.0197 Amp. At 1.09 Volts.

Contact:

4 front-heel back combinations.

7.2.2.9 Servicing Rail Bonds

Ensure all mechanical joints installed in the track circuited area are effectively bridged by a bond wire.

Ensure bond wire is firmly attached to rail by either weld, bond pins or bond plugs and nuts.

ll bond wires must be kept clear of ballast to allow easy inspection and reduce corrosion.

Any broken, corroded or badly frayed bond conductors must be replaced immediately.

Nuts on bond terminals must be checked for tightness.

Bonds on switch layouts must be installed as shown on typical plans.

Any loose joints detected must be reported to the Track Supervisor.

7.2.2.10 Servicing Bonding Requirement For Dual Gauge Track Circuit

Bonding Of Rails For Dual Gauge Track Circuits

To ensure the safe reliable operation of signal and crossing equipment it is essential that all train movements are detected by the track circuits. While this is easily and reliably achieved on single gauge installations with a built in fail safe feature, the same is not true for dual gauge track where, due to a parallel path effect, the integrity of the system relies solely on a correctly installed and well maintained bonding system.

Positioning Of Track Leads

The feed end track cables must always be attached to the common and broad gauge rail.

The relay end track cables must always be attached to the common and standard gauge rail.

Rail To Rail Bonding

Rail to rail bonds made from steel rope and secured to the rails using channel pins are to be fitted in the gap between the broad and standard gauge rails.

The practice of using Cadweld bonds to the foot of the rails is not recommended as inspection for continuity is difficult.

Placement Of Rail To Rail Bonds

A rail to rail bond must be fitted within 100mm of the point of attachment of a track lead.

On continuous welded rail, the rails must be bonded at intervals of not more than 75 metres.

On plated rail tracks the rails are to be bonded whenever a fish plate bond is installed, preferably on the relay side of the joint.

This inspection should be conducted at four weekly intervals and the date of inspection recorded on the Level Crossing history card/log book.

7.2.2.11 Servicing Track Leads and Termination

Examine track leads for physical damage.

Examine cable insulation for damage under rail or between sleepers and box anchors.

Examine rail connections.

Check bond pins, bond plugs and rail connectors are tight and free from corrosion.

Ensure track leads are correctly crimped and free from corrosion.

Ensure track lead terminations are tight and not touching any part of the bootleg body.

Ensure track leads are secured to sleepers and affixed to star droppers where track leads enter directly into trackside equipment housings, or "pull apart" terminal system is used inside equipment housing.

Leads should be secured to rail clips on concrete sleepered track.

Ensure correct track polarity as per Track Plan.

Placement of track connections.

- A basic requirement of all track circuits is to prove track occupancy and/or rail continuity.

  Track lead connections should be located to maximise the total length of rail detected.

  For this reason track leads must be positioned within 900mm of the insulated joint endpost.

Terminations.

- Steel wire rope track leads are to be terminated directly in to the rail using channel pins.

  The use of lugs and threaded bond pins is not recommended.

- When reterminating threaded bond pins a new nut should be used.

  Nyloc nuts are not reusable with the same locking effect.

7.2.3 Insulation

7.2.3.1 Servicing Insulated Rail Joint

Examine mechanical components of joint.

Check for cracked or broken plates or filler blocks.

Ensure all bolts are tight.

Ensure joint is adequately supported by sleepers and secure against lateral movement, if not advise Area Coordinator.

Check that joint endpost is not shorted out by baseplates, rail anchors, dogspikes, rail fasteners for resilant pads.

Check condition of insulating material and ensure it is captive within joint components.

Examine rail ends, remove any burrs or rolled over metal that may bridge endpost insulation.

Ensure endpost is not higher than head of rail.

Ensure shims on Vulcabond joints have not detached from joint and are likely to bridge end post insulation.

NOTE: Only qualified perway employees are permitted to open rail ends on insulated joints.

Servicing Insulation – Switch and Rod-Line

Clean area to allow detailed visual inspection.

Examine physical condition of all metal components of joint.

Ensure all bolts are in place and tight.

Check all insulating material is present and captive within metal work.

Change out defective insulation as required, installing all insulation components as detailed in appropriate plans.

7.2.3.2 Servicing Signal Aerial Termination

- Inspect solder joint to ensure it is electrically and mechanically sound.
- Check that drip point is not long enough to form a short circuit with adjoining terminations.
- Ensure line wire has not pulled through whipping, causing excessive strain on joint area.
- Check that drop wire insulation is intact and continuously sleeved, with particular attention given to the area where conductors separate near the cable gland.
- Ensure drop wire is adequately supported by bridle rings on cross arm.
- Check that drop cable is adequately supported in cable gland and weight of dropper is not held by cable terminations.
- Ensure drop cable is adequately secured to pole.
- nsure pole line fittings are tight and cross arm is in good condition.
- Line wires to be clear of trees, foreign feeds, earth potential and foreign bodies.

7.2.4 Power Supply

7.2.4.1 Servicing Battery – Cegasa Primary Cell

Maintenance of Primary Battery

The Cegasa battery does not require any maintenance work except to change it out before the expiry date.

The change out procedure is simply to undo the battery leads and connect a new battery.

Ensure polarity connected matches design requirement.

The following describes the characteristics, installations and maintenance of Cegasa Batteries.

Battery Characteristics

The Cegasa AS10-4 Battery is an alkaline, air depolarised cell, with nominal rated 2400 ampere/hour capacity.

Battery Loading

Acceptance test graphs show that a full capacity battery will discharge under the following conditions:

- 400 mA continuous, at 1.4 Volts for approximately 225 days, the voltage will then drop off and the battery will collapse at about 250 days.
- 800 mA continuous, at 1.4 Volts for approximately 110 days, the voltage will then drop off and the battery will collapse at about 130 days.

Derating of Cell Capacity

THE CELL CAPACITY DOES REQUIRE DERATING under the following conditions:

- **Shelf life**

  The battery capacity is reduced by 5% (pro rata) in the first 12 months.

  A further reduction of 4% (pro rata) in the next 12 months.

  The above represents a total loss of capacity of 9% after a shelf life of 24 months.

  The shelf life is indicated by the USE BEFORE DATE shown on the side of the battery.

- **Climatatic Condition**.

  If the battery is used in a climate where the humidity is below 25% the nominal rated capacity must be reduced by up to 15%.

  This factor requires installation experience in the field.

  Until this is acquired, all batteries used on the Pt Pirie - Broken Hill corridor are to be derated a further 10% in addition to the shelf derating.

Battery Life

The battery is fitted in an opaque case, that prevents visual examination of the active elements.

Expected Battery life is to be determined by reference to the Edison ST22 Cell (2200 A/H in parallel).

The life expectancy is to be marked on the maintenance card as that time being:

THE MOST COMMONLY RECORDED CHANGE OUT PERIOD IN WEEKS.

If the derating calculation is less than the life of an ST22, then the life expectancy is to be determined by the procedure below.

Examples of derating and battery renewal date.

- SHELF LIFE: Use battery by 9/94
  Todays date Feb 10, 1994
  5% for first 12 months

  (1/20 of 2400 = 120 A/H)

  Capacity now 2400 minus 120:
  =2280 A/H

  We have also used 5 months of the second 12 months.

  Calculation is 5/12 of 4% = 1.6%

  1.6% of (2280)

  =36.48 A/H

  Capacity is now minus (2280 - 36) = 2244 A/H

- CLIMATE DERATING: Battery to be used Hillgrange - Yunta.

  10% of (2244)

  =224.4 A/H

  Capacity is now minus (2244 - 224) =2020 A/H

  Battery now has a capacity due to shelf and climate derating of:

  2020 A/H

- RENEWAL DATE: Most common recorded period of ST22 change out:

  55 weeks (example only).

  ST22 A/H capacity used in one week:

  = Cegasa consumed per wk.

Life = divided by

2020/40) = 50.5 weeks

Correcting to lower figure of 50 weeks:

Battery is to be renewed 50 weeks after Feb 10, 1994.

RENEWAL DATE:
JANUARY 25, 1995.

Safety

The batteries do not contain any liquid, but are alkaline in their electro-chemistry, and if the case is ruptured, will not have any spillage but handling the contents will require ALKALINE CHEMICAL precautions.

Installation

Use old stock first

Examine cell for physical damage.

Watch particularly that carrying strap is secure and not frayed as cells are quite heavy (8.25 kgs).

Calculate derating factors:

Reference section 6.4.3 i) and ii).

Determine change out date as per section 6.4.3 iii).

Record THE WEEK when the battery is to be changed on the maintenance card.

Remove four vent tabs, observe polarity, connect battery.

Cegasa batteries have a higher discharge voltage than ST22's and will require a small adjustment to track current, one month after installation, when the voltage has stabilised to its expected 1.4 Volts.

Maintenance

Cegasa batteries do not require any in service maintenance.

The normal routine inspections for displaced batteries, possibly strained leads, or any other irregularity are to be observed.

Cell should be wiped clean to avoid the possibility of earth leaks.

DISPOSAL of EXHAUSTED or DAMAGED CELLS: Components will not deteriorate.

Dispose correctly by burying in earth pits in approved areas.

7.2.4.2 Servicing Battery – Secondary (YCP-11)

Precaution:

As batteries on charge generate explosive gases care must be taken to prevent any cause of ignition by sparks either from electrical, static discharge or smoking.

Allow adequate ventilation for battery.

Visually inspect the following:

- Sediment level is well below bottom of the plates.
- The plates are parallel with each other for their entire length.
- The plate stack is one solid assembly and does not contain any which have slipped or fallen.
- The plates are firmly attached to their terminals.
- Terminal posts emerge from the battery case vertically in all planes.
- Cells on which posts are twisted or warped must be changed. If a cell forms part of a BL, see Part 6.9, below.
- Check for electrolyte leakage, clean if required.
- Earth leaks can be caused by voltage tracking down the side of battery jars.
- Measure Specific Gravity (1210 at 15°C electrolyte temperature), adjust reading by +4 points for each 5° below 15°C, -4 points for each 5° above 15°C.
- Adjust electrolyte level, if required, using distilled water from a clean container.
- Check condition of intermediate leads, battery leads and connections. These should be clean, tight and lightly smeared with Vaseline, prior to assembly.
- Battery terminals are to be scraped clean at 12 monthly intervals on crossing installations and 24 monthly intervals on signal installations.
- The date on which cleaned is to be recorded on battery history cards.
- Cells forming BL's should be of equal voltage. If voltage variations greater than 5% are noted, it must be investigated and cured or the battery changed out.
- Cell's forming BL's are not seen as separate entities, when a BL is changed out ALL cells are to be replaced.

Recording of Voltage

- When entering individual cell voltages of a BL on the record card, the following sequence must be used:-
- First enter the voltage reading of the cell connected to the positive (+ve) output lead, then enter the remaining in consecutive order.
- This system enables comparison of individual cell voltages over a period of time.

Measurements

- Individual Cell Voltage:
  - 2.3 Volts Max.
  - 1.98 Volts Min. on load.
- Total BL Voltage.
- Total BL Voltage on load
  - (CHARGER OFF).
  - Load to be equal to normal duty load for 15 mins.
- Earth Leak Test.
- Charge Current.
- Specific Gravity.

7.2.4.3 Servicing Battery – Gell Cell Type

General

This type of battery, by design and manufacture, requires a low level of maintenance.

Inspection

- Inspect case for signs of distortion (indicating over-charging), cracking or leakage of electrolyte, ensure pressure relief caps are intact.
- Clean casing.
- Inspect terminations for mechanical strength and electrical continuity.
- NOTE: Do not open circuit battery from charger as the rise in voltage applied to the equipment from some types of charger will cause irreparable damage.
- If necessary isolate solid state equipment before commencing any operation which may endanger the equipment.
- Measure and record battery voltage "on-load", with charger isolated.
- Yearly conduct a capacity test to comply with the manufacturer's specification.
- When recording individual battery voltages on the record card, enter the voltage of the battery connected to the positive output lead first, then enter for the remaining batteries in order. This enables comparison of individual battery voltages over a period of time.
- Servicing Battery Automotive Type
- Check Specific Gravity of individual cells.
- Fully charged cells should be 1240 at 25°C and correction for temperature variation of +7 for each 10°C below 25°C and -7 for each 10°C above 25°C.
- Check and adjust electrolyte levels correcting if necessary using distilled water.
- Electrolyte should be 6 mm above the cell plates. Do not overfill.
- Check voltage of battery (on load).
- If in a bank of batteries check individual battery voltage.
- Normal cell voltage for batteries on float charge is 2.3V to 2.4V per cell ie 13.8V to 14.4V per six cell battery.
- Check connections are clean and tight, if necessary scrape terminals and connections and lightly recoat with Vaseline.
- Clean exterior of battery.
- Battery should be mounted on timber base or plinth and should not be located directly on a cement floor.
- Any battery which becomes fully discharged due to fault conditions should receive a full charge as soon as possible to reduce the impact of sulphation.
- When recording individual cell voltages of a battery on the record card, enter the voltage of the cell connected to the positive output lead first, then enter the remaining cells in order.
- This enables comparison of individual cell voltages over a period of time.

7.2.4.4 Servicing Battery – Secondary (Yuasa XS)

Precaution:

As batteries on charge generate explosive gases, care must be taken to prevent any cause of ignition by sparks either from electrical, static discharge or smoking.

Allow adequate ventilation for battery.

Visually inspect the following:

- All cells are fitted with a cataytic converter, the other cap in the lid is to be a blank filler cap.
- All interconnected cells must be of equal Ampere Hour capacity.
- Sediment level is well below bottom of the plates.
- The plates are parallel with each other for their entire length.
- The plate stack is one solid assembly and does not contain any which have slipped or fallen.
- The plates are firmly attached to their terminals.
- Terminal posts emerge from the battery case vertically in all planes.
- Cells on which posts are twisted or warped must be changed.If a cell forms part of a BL, see Part 6.11, below.
- Check for electrolyte leakage, clean if required. Earth leaks can be caused by voltage tracking down the side of battery jars.
- Measure Specific Gravity (1215 at 20°C electrolyte temperature), adjust reading by +4 points for each 5° below 20°C, -4 points for each 5° above 20°C.
- Adjust electrolyte level, if required, using distilled water from a clean container.
- Check condition of intermediate leads, battery leads and connections.
- These should be clean, tight and lightly smeared with Vaseline, prior to assembly.
- If alternative terminal treatments are to be applied, the manufacturer's instructions are to be followed.
- Battery terminals are to be scraped clean at 12 monthly intervals on crossing installations and 24 monthly intervals on signal installations.
- The date on which cleaned is to be recorded on battery history cards.
- Cells forming BL's should be of equal voltage. If voltage variations greater than 5% are noted, it must be investigated and cured or the battery changed out.
- Cell's forming BL's are not seen as separate entities, when a BL is changed out ALL cells are to be replaced.

Recording of Voltage

When entering individual cell voltages of a BL on the record card, the following sequence must be used:-

First enter the voltage reading of the cell connected to the positive (+ve) output lead, then enter the remaining in consecutive order.

This system enables comparison of individual cell voltages over a period of time.

Measurements

Individual Cell Voltage:

- 2.15 Volts Max.
- 1.95 Volts Min. on load.

Total BL Voltage.

Total BL Voltage on load

(CHARGER OFF).

- 1 ohm load bank connected for 15 minutes.

Earth Leak Test.

Charge Current.

Maximum after load test applied.

Minimum (float current).

Specific Gravity.

7.2.4.5 Servicing Battery – Secondary (BESCO Enerlyte)

Precaution:

As batteries on charge generate explosive gases, care must be taken to prevent any cause of ignition by sparks either from electrical, static discharge or smoking.

Allow adequate ventilation for battery.

Visually inspect the following:

- All interconnected cells must be of equal Ampere Hour capacity.
- Sediment level is well below bottom of the plates.
- The plates are parallel with each other for their entire length.
- The plate stack is one solid assembly and does not contain any which have slipped or fallen.
- The plates are firmly attached to their terminals.
- Terminal posts emerge from the battery case vertically in all planes.
- Cells on which posts are twisted or warped must be changed.If a cell forms part of a BL, see Part 6.10, below.
- Check for electrolyte leakage, clean if required.
- Earth leaks can be caused by voltage tracking down the side of battery jars.
- Measure Specific Gravity (1240 at 25°C electrolyte temperature), adjust reading by +5 points for each 5° below 25°C, -5 points for each 5° above 25°C.
- Adjust electrolyte level, if required, using distilled water from a clean container.
- Check condition of intermediate leads, battery leads and connections.
- These should be clean, tight and lightly smeared with Vaseline, prior to assembly.
- If alternative terminal treatments are to be applied, the manufacturer’s instructions are to be followed.
- Battery terminals are to be scraped clean at 12 monthly intervals on crossing installations and 24 monthly intervals on signal installations.
- The date on which cleaned is to be recorded on battery history cards.
- Cells forming BL's should be of equal voltage. If voltage variations greater than 5% are noted, it must be investigated and cured or the battery changed out.
- Cell's forming BL's are not seen as separate entities, when a BL is changed out **ALL** cells are to be replaced.

Recording of Voltage

When entering individual cell voltages of a BL on the record card, the following sequence must be used:-

First enter the voltage reading of the cell connected to the positive (+ve) output lead, then enter the remaining in consecutive order.

This system enables comparison of individual cell voltages over a period of time.

Measurements

Individual Cell Voltage:

2.30 Volts Max.

1.93 Volts Min. on load.

Total BL Voltage.

Total BL Voltage on load

(CHARGER OFF).

1 ohm load bank connected for 15 minutes.

Earth Leak Test.

Charge Current.

Maximum after load test applied.

Minimum (float current).

Specific Gravity.

7.2.4.6 Servicing Battery – Secondary (BP PVSTOR 2P 566)

Precaution:

As batteries on charge generate explosive gases, care must be taken to prevent any cause of ignition by sparks either from electrical, static discharge or smoking.

Allow adequate ventilation for battery.

Visually inspect the following:

Sediment level is well below bottom of the plates.

The plates are parallel with each other for their entire length.

The plate stack is one solid assembly and does not contain any which have slipped or fallen.

The plates are firmly attached to their terminals.

Terminal posts emerge from the battery case vertically in all planes.

Cells on which posts are twisted or warped must be changed.If a cell forms part of a BL, see Part 6.9, below.

Check for electrolyte leakage, clean if required.

Earth leaks can be caused by voltage tracking down the side of battery jars.

Measure Specific Gravity (1225 at 15°C electrolyte temperature), adjust reading by +4 points for each 5° below 15°C, -4 points for each 5° above 15°C.

% of Charge	SG at 15 degrees C.
100	1.225
90	1.216
80	1.207
70	1.198
60	1.189
50	1.179

40	1.171
30	1.163
20	1.153
10	1.145
0	1.135

- Adjust electrolyte level, if required, using distilled water from a clean container
- Check condition of intermediate leads, battery leads and connections.
- These should be clean, tight and lightly smeared with Vaseline, prior to assembly.
- If alternative terminal treatments are to be applied, the manufacturer's instructions are to be followed.
- Battery terminals are to be scraped clean at 12 monthly intervals on crossing installations and 24 monthly intervals on signal installations.
- The date on which cleaned is to be recorded on battery history cards.
- Cells forming BL's should be of equal voltage. If voltage variations greater than 5% are noted, it must be investigated and cured or the battery changed out.
- Cell's forming BL's are not seen as separate entities, when a BL is changed out **ALL** cells are to be replaced.
- A gas recombination cap must be fitted to each cell

Recording of Voltage

When entering individual cell voltages of a BL on the record card, the following sequence must be used:-

First enter the voltage reading of the cell connected to the positive (+ve) output lead, then enter the remaining in consecutive order.

This system enables comparison of individual cell voltages over a period of time.

Measurements

Individual Cell Voltage:

2.25 Volts Max.

1.92 Volts Min. on load.

Total BL Voltage:

Total BL Voltage on load

(CHARGER OFF).

1 ohm load bank connected for 15 minutes.

Earth Leak Test.

Charge Current.

Maximum after load test applied.

Minimum (float current).

Specific Gravity.

Signal Standby Generator

Check oil level, top up if required,

Check for fuel leaks.

Check fuel level, top up if required.

Record the condition of starter battery:

Charge Rate.

Cranking Voltage:
Measured at battery terminals.
12V system, voltage under load
〉10.5V.
24V system, voltage under load
〉20V.

Measure Specific Gravity (SG) and adjust electrolyte level using distilled water from a clean container,if required.

SG 1260 at electrolyte temperature of 15°C, varies
+4 for each 5° below 15°C
-4 for each 5° above 15°C.

Check terminals.
Clean and if required, coat with Vaseline, prior to re-assembly.

Check alternator output voltage.

Record "Shut Down" time.

Record "Total Hours" run.

Clean machine and enclosure.

7.2.4.7 Servicing Power Supply – 50/24V DC

- Ensure that the unit is secured against movement.
- Check that the unit is supplied from an earthed outlet, the primary supply cord is in sound condition and the unit carries a valid test compliance label.
- Check the exterior of unit for damage, with particular attention to meters and LED'S on the front panel.
- Ensure an appropriate voltage warning label is clearly displayed on the exterior of unit and door is securely locked.

Open unit door and check following points.

- Termination of DC cables.
- DC cables for damage.
- Entry of DC cables to unit to be electrically sound.
- Check internal cabling for condition, heat deterioration and that terminations are tight.
- Test output at DC terminals:
  - Voltage to be -5% to +10% of rated output.
- Ensure heat sinks are effective.
- Termination of AC cable.
- Termination of earth wire.

Close and secure door.

7.2.4.8 Servicing Rectifiers (RX and RT Types)

- Examine physical condition of rectifier.

- Ensure rectifier is securely mounted in a dry, vermin proof environment.
- Ensure rectifier has a free circulation of air.
- Do not crowd other apparatus against it.
- Check all wiring and connections.
- Check that AC terminals are insulated.
- Check that AC and DC voltage and DC charging current does not exceed specifications as stated on nameplate.
- To adjust the charging current, loosen the large nut on top of reactive choke and shift the laminated iron block endways, moving the block outwards increases the charging current.
- Hold the adjustment by re-tightening the large nut.

7.2.4.9 Servicing Transformer

Note: This equipment is connected to voltage that may cause personal injury and therefore appropriate safety precautions must be in place to avoid an incident.

Physical Inspection

- Ensure unit is free of mechanical damage, firmly mounted to base board and clean.
- Inspect unit for damage caused by vermin or water. Seal enclosure to prevent further damage if necessary.
- Ensure all cable terminations are tight. Isolate primary input voltage, if necessary.
- Check that terminations and earthing comply with AS 3000.
- Terminals exceeding 32 V must be fully shrouded to prevent accidental physical contact.

Electrical Tests

- Measure output voltage of secondary windings.
- If below expectations measure primary input voltage.
- Measure secondary output current and ensure connected load does not exceed transformer capacity.
- Megger testing, if necessary, should only be carried out with mains isolated and all external wiring disconnected.

All readings should show high values of insulation.

Primary to frame or earth.

Secondary to frame or earth.

Primary to secondary windings.

Re-terminate any wires removed for testing and restore power.

7.2.4.10 Servicing Power Supply (RZ100 and RZ100T Units)

Type Description

- RZ 100 (for single cell)
  - AC input 6V from an external transformer
  - DC output 2.15V - 2.3V.
  - DC output 2.5A max

- RZ 100 (for 5 - 12 Cells)
  - AC input 20V - 25V from an external transformer
  - DC output 10.75V - 18.4V
  - DC output 2.5A max
- RZ 100T:
  - AC input 110V or 240V from signal power reticulation system.
  - DC output 2.15V - 27.6V
  - DC output 2.5A max

Set up for RZ100T

For lower DC voltage, tap transformer secondary at 6V for one cell.

For five or more cells use 15V output.

Set up RZ100T

Set primary of transformer to match AC input of 110V or 240V.

Final Adjustment

- Once AC input is set and secondary output tapping is correct, connect digital meter to output terminals, using trimpot set output voltage to suit cell type installed.
- For 2 volt (nominal) output, ensure a 15 Ohm shunt is connected across the digital multimeter terminals, prior to final adjustment of output voltage.
  - NOTE: 15 Ohm shunts manufactured by the Electronics Section are red in colour.
- For 12 volt and 24 volt (nominal) outputs, a 12K Ohm shunt as used for Earth Leak Tests is connected across the digital multimeter terminals, prior to final adjustment of the output voltage.
  - NOTE: 12K Ohm shunts manufactured by the Electronics Section are black in colour.

Electrical Inspection

- Ensure all terminations are tight.
- Measure and record output voltage and charge current.
- Conduct Earth Leakage Test as required by SECTION 2.1.3.3 EARTH LEAKAGE TEST.
- Ensure voltage warning label is attached to exterior of equipment enclosure, where voltages exceed 32 Volts.

Physical Inspection

- Ensure unit is firmly attached to baseboard.
- Check unit for vermin or water damage.
- Ensure case lid is firmly attached.
- Ensure all units where output exceeds 2.5V are mounted on insulating channel in aluminium enclosures.

7.2.4.11 Servicing Power Supply (RZ42 Unit)

Maintenance Procedure For RZ42 Revision 6 Units

- RZ42 units are a constant potential battery charger.

- The unit has a trimpot mounted on the front panel, this is used to adjust the open circuit output (maximum battery voltage).
- The output voltage is set to suit the type and number of cells installed at the location.
- Confirm operation of charge fail relay (where fitted) and ensure fail indication is received at control centre.

Installation procedure

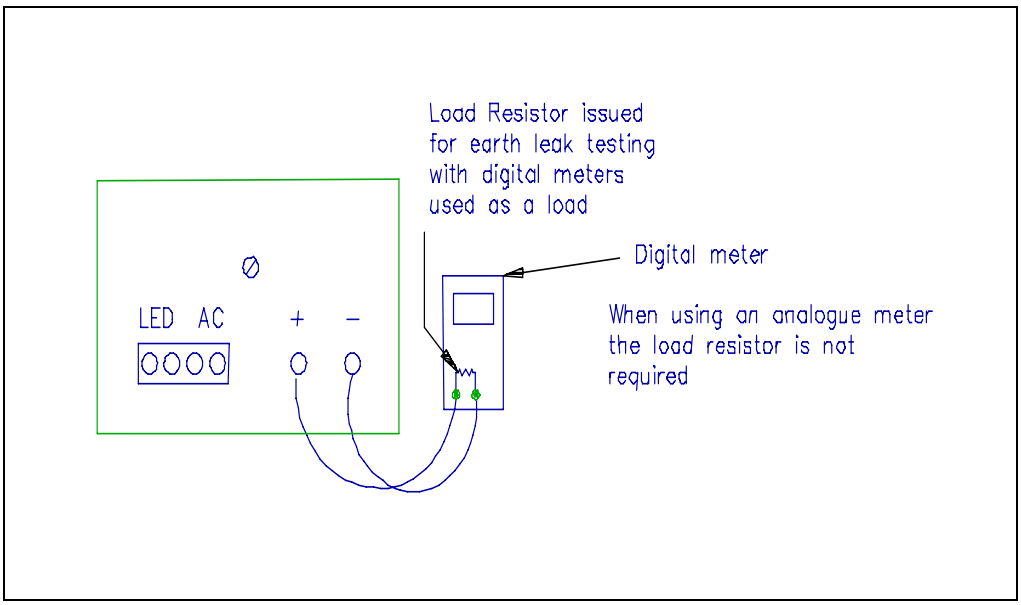
- Ensure capacity of unit (8 or 15 Amp) complies with the approved design plans
- Match AC input voltage and transformer input voltage.
- Secondary output of transformer is tapped at 16 and 20 Volts.
- The 20 Volt tapping is only used in eight cell applications.
- Securely attach unit to backboard.
- In aluminium boxes insulating channel must be installed between unit and mounting rails, a cover plate must be fitted to the back of the unit to prevent vermin damage or accidental personal contact with high voltage terminals.
- Connect AC supply to input terminals. If the input is 240 Volt, ensure requirements of AS 3000 regarding earthing are met.
- Before connecting either output wire, set output as specified above using the trimpot (meter set up as shown in Figure 1).
  - **Note:** Output wire must be 2.5mm^2 (minimum) flexible conductors.
  - 

Figure 1 RZ42 Meter Setup

Connect output to load and measure charge current.

The LED mounted on the front panel indicates charge current is available.

(Terminals are provided for the connection of a remote LED, this facility must be used in place of existing neon indicator and be clearly visible from the external inspection position).

NOTE: ONLY REVISION 6 TYPE UNITS ARE TO REMAIN IN SERVICE.

ANY UNITS NOT CLEARLY IDENTIFIED AS SUCH MUST BE CHANGED AS SOON AS POSSIBLE.

7.2.4.12 Servicing Solar Panel

Physical Inspection

- Check mast, foundation, bolts and fastenings before climbing on support frame.
- Visually inspect surface of panel for chips or cracks.
- Ensure panel is sealed against water and dust penetration.
- Clean surface of panel and flush with clean water.
- The panel should be totally clean to avoid the forming of "hotspots" which can damage the Photovoltaic cells.
- Check terminations, conduits and junction boxes for damage.
- Ensure panel is aligned due North for maximum output.
- Check panel mounting and retaining devices for effectiveness.

Electrical Test

Measure and record array output voltage, noting the time and prevailing weather conditions.

Capacity of panel can be measured by connecting a high scale amp meter across the array output terminals after disconnecting array from battery/regulator terminals.

NOTE: On large arrays in ideal conditions this reading may exceed 15 A.

Test that blocking diode is installed and effective.

Test for Earth Leakage on array output in accordance with SECTION 2.1.3.3 EARTH LEAKAGE TEST.

On a yearly basis ensure that individual panels forming an array are tested to establish individual performance.

Ensure any terminations broken for testing are reconnected and the operation of boost and float (if fitted) charging circuits is proven.

Grease angle and sleeve cranks, compensators and indicator mechanisms, if fitted.

7.3 Servicing of Enclosure

7.3.1 Relay Room

External

- Inspect exterior of building for damage to doors, walls and roof.
- Ensure gutters and downpipes are clear of debris.
- Ensure externally mounted switchboards and meter enclosures are locked with appropriate padlocks (K98CM locks for ETSA meter enclosures).
- Ensure area surrounding building is clear of excessive weed growth or flammable material.

Internal

- Check doors and locks for correct operation.
- Check building for internal structural damage.
- Check operation of lighting circuits.
- Ensure floors and equipment are clean.
- Check air vent mesh (if fitted) for cleanliness and security.
- Check that the building is not being used for unauthorised storage of flammable or objectionable material.

7.3.2 Control and Indication Panel

- Request approval to take panel into "Local Control".
- Operate each switch and signal selector in turn and confirm effectivness, ease of operation and that the unit is firmly mounted in board.
- Ensure that all LED's or indication lamps operate as appropriate.
- Check operation of "Power On" indicator.
- Using appropriate yard layout confirm that panel is representative of the area it mimics.
- Inspect wiring cubicle for loose hardware, wiring terminations or defective wire crimps.
- Ensure locks fitted to control desk are effective and prevent unauthorised entry.
- On completion of testing, if illuminated diagram is not required for train working purposes it should be turned off.

7.3.3 Relay / Battery Enclosure

7.3.3.1 Enclosure and Environ

- Ensure surrounding area is free of weeds.
- Ensure box is securely mounted and vertical in all planes.
- Ensure enclosure is in no danger from subsidence of surrounding area.
- Ensure the enclosure provides a clean, weather and vermin proof housing for enclosed equipment.
- Louvres fitted to boxes must be intact and be fitted with an effective insect screen.

- In aluminium enclosures the cable entry duct must be sealed with a concrete slurry to prevent vermin entry.
- Fibreglass boxes are to have a silicon seal around mounting bolts to prevent water entry causing the back board to rot.
- Ensure enclosure locking system is effective and secured with an operational, approved key operated lock.
- Ensure hinges are intact and lubricated.
- Ensure backboard provides a solid base and is securely attached to box.
- Ensure all equipment rails in aluminium enclosures are securely mounted.
- Ensure earthing if necessary conforms to AS 3000 or ARTC Standard as appropriate.
- Ensure all cable entry chutes are intact and provide protection continuously between ground level and the interior of the box.

7.3.3.2 Enclosure – Wiring and Fittings

General

- Ensure all relays are securely mounted.
- Plug-in Relays:
- "Q" Type - fitted with retaining strap.
- "B" Type - locking pin and contact terminations fully engaged.
- Shelf Type Relays:
- Ensure relay is retained in mounting bracket by cable ties.

Other Equipment and Cables

- Ensure all other equipment is firmly secured to backboard or equipment rails.
- Ensure the rails/boards are in satisfactory condition and held secure.
- Examine terminal blocks and fuses for cracks and flaws.
- Bare metal bridging straps on 2BA blocks must be kept clear of equipment mounting rails in metal enclosures.
- Fuse holders should be fitted with one piece contact springs and not the soldered or riveted type, check fuse cartridges for correct rating as per box detail and that no corrosion is present on contact surfaces.
- Ensure any required earthing is in place and complies with AS 3000 or A.N. Standards as applicable.
- Ensure all cables are terminated correctly and appropriate size lugs have been fitted with an approved crimp tool to all flexible conductors.
- Ensure all terminations are double nutted and tight.
- Ensure all non working wires are fully insulated and tied off or cut off.This does not prevent termination of spare conductors as shown on plans.
- All plans to be neatly stored.
- Record cards are to be kept in a card holder appropriately mounted on the enclosure.
- Ensure all equipment is kept clean.
- Check all cables and wiring insulation for damage and deterioration.

7.3.4 Enclosure – Lightning Arrestor

- Examine enclosure for external damage.
- Ensure enclosure is securely mounted.
- Ensure enclosure is weather and vermin proof.
- Ensure inside of enclosure is clean.
- Ensure arrestor cartridges are clean and intact.
- Change out if glass envelope is cracked or electrode/contact area is burnt or corroded.
- Ensure all cartridges are effectively earthed and correctly connected to earth stake.
- Ensure earth wire is secured to conduit.
- Ensure earth wire is as short as possible and is routed directly to the termination point.
- Examine all cable insulation and terminations.
- Check arrestor blocks for defects.
- Ensure cable glands are tight and aerial droppers are securely attached to pole and underground conduit is securely clamped.
- Ensure HIGH VOLTAGE sticker is visible on exterior of enclosure.
- (If applicable).
- Secure with padlock.

7.3.5 Enclosure and Environ – Battery Well

- Examine exterior of Battery Well for damage.
- Ensure the Battery Well is weather and vermin proof.
- Ensure Battery Well can be locked securely with chain passing through both handles.
- Ensure the Battery Well is level and surrounds are clear of weed growth.
- Examine internal lid liner.
- Ensure lid liner is securely fixed to the lid.
- Ensure timber grid is in good condition.
- Ensure cable entry conduit and termination board are secure.
- Ensure Battery Well clearly displays "Corrosive Warning" label.

7.3.6 Enclosure – Trackside Shelter

- Inspect the exterior of the shelter.
- Ensure that it provides weather and vermin proof protection and stands vertical in all planes.
- Ensure structure is not endangered by earth subsidence or soil erosion.
- Ensure locking system is operative and padlocks operate freely.
- Examine external earth connection (If required).
- Clean interior of enclosure.
- Check batteries if fitted.

- Ensure method of cable entry and degree of protection inside shelter is appropriate and cable is fastened to wall as necessary.
- Establish contact with Train Control or Signalman and verify clarity of transmission and reception.

7.3.7 Enclosure – Power Supply (Signal / Level Crossing)

- Examine enclosure for external damage.
- Ensure enclosure is securely mounted.
- Ensure installation complies with AS 3000, with particular attention to earthing requirement.
- Check that enclosure is weather and vermin proof.
- Ensure backboard is in good condition.
- Ensure all cable terminations are tight and free of corrosion.
- All crimp lugs used in this application are to be of an approved type and applied with the appropriate crimp tool.
- Ensure all high voltage terminations are effectively shrouded to prevent accidental contact.
- Ensure all fuse holders are clean and free from defects.
- Ensure fuse links are clean, free of defects and of correct current rating.
- If a "POWER ON" indication is required ensure that it is clearly visible from external inspection position.
- Ensure that all equipment in the enclosure is clean and in a safe operating condition.
- Ensure padlocks are effective and operate freely.
- Secure enclosure, ensure correct padlock orientation ie. K9800 to AN equipment and K98 CM to metering enclosure.
- Ensure HIGH VOLTAGE label is attached to exterior of enclosure door.
- Report any damage to meter or other supply authority equipment directly to the appropriate supply authority.
- Where a Residual Current Device (RCD) is installed, ensure:
- t is not protecting vital signal power circuits.
- It is regularly tested using the in-built trip button.

7.3.8 Enclosure – Cable Pit and Cable Junction Point

Cable Junction Point

- Clear area around pillar, box or pot of weeds.
- Ensure adequate drainage exists and under normal conditions location is not prone to flooding.
- Ensure unit is secured with a serviceable approved lock.
- Ensure unit provides a weather and vermin proof environment for enclosed junction.
- Inspect terminations and associated blocks for damage, corrosion and tightness.
- Ensure termination blocks are firmly secured to the body of the junction point.

- Ensure any jumpers installed are kept clear of lids or covers, and tied in to prevent movement.
- Clean inside of junction point.
- Ensure all gaskets form effective seal.
- Reassemble and lock. Inspect for vertical alignment.

Cable Pit

- Clear surrounding area of weeds.
- Inspect lid. Ensure lock is approved type.
- Check metal lids for corrosion.
- Check pit walls for damage.
- Refit lid/s and secure if necessary.
- In an area where road traffic presents a threat of damage to the installation, the use of protective markers is encouraged.

7.3.9 Enclosure – Manual Operation Device

7.3.9.1 Push Button and Test Switch Box

- Inspect physical condition of enclosure, to ensure it offers a weather and vermin proof environment. If not, seal the unit.
- Check that free standing push button boxes are vertical and have not been damaged.
- Ensure that any signs attached are appropriate, clean, in good condition, correctly orientated and firmly mounted.
- Ensure unit is secured with appropriate lock, the hinges and catches operate freely. Lubricate if necessary.
- Open unit and ensure buttons/switches are securely mounted and clearly marked with name and/or function.
- Clean cable termination area, inspect condition of cable insulation and tightness of terminations and that the correct lug size has been used where appropriate.
- Ensure terminations on push buttons/test switches are tight.
- Ensure switch/button mechanism operates freely and is not subject to mechanical binding.
- Spring loaded buttons must release to their normal position without mechanical hesitation.
- Test operation of each function initiated/cancelled by the button/switch.
- Test switches are to have contacts wired in parallel to reduce failure rate.

7.3.9.2 Crankhandle/Key Box

Three systems are in use, the maintenance action dependant on the type used:-

Key Smash Box Enclosure

In this system the presence of the key is not detected by the signal circuitry. Maintenance consists of ensuring the key is on site, operates all switch machine operating stand locks in the vicinity, and is then returned to a securely locked smash box enclosure.

Crankhandle Smash Box Enclosure

In this system the presence of the crank is detected by rotary contacts located in the lower section of the smash box.

Maintenance consists of ensuring the enclosure is securely mounted on the wall or back board, followed by inspection of the contacts and associated operating cam and mounting points of the contact/cam assembly. Contact integrity should be proven in the appropriate WZR circuit. Contacts must be adjusted so as to open just before the crankhandle has been rotated sufficient distance to allow removal from its enclosure.

In both of the above, locks securing the smash panel must be effective and prevent removal of the crank or key other than by breaking the glass. The area must be kept clear of broken glass which may present a danger to employees.

Panel Operating Keys

In this system the key's presence and position is detected by the signal system. To remove the key to unlock the switchmachine it must be rotated 90 , this action opens contacts in the WZR circuit, contact integrity should be proven by observing WZR when key is rotated in the barrel.

Ensure the key barrel is firmly mounted on the control panel.

7.3.10 Enclosure – Bootleg

- Ensure Bootleg is upright, above ground level and free from ballast and weeds.
- Check Bootleg for external damage.
- Ensure Bootleg head is securely attached to mounting pipe.
- Ensure Bootleg is internally clean and weather and vermin proof.
- Track lead entrance holes must be sealed with rubber grommets or silicon sealant.
- Ensure terminal blocks are free from defects and securely mounted to Bootleg base.
- Ensure track lead terminations are tight, free from corrosion and clear of Bootleg wall.
- Ensure Bootleg terminations correspond to the position of the track lead connections.
- Secure Bootleg lid (padlock / bolt).

7.4 Servicing of Level Crossing

7.4.1 Servicing Level Crossing Highway - Crossing Light Unit

- Clean and inspect roundel for signs of scratching or deterioration of shiny outer surface.
- Confirm correct type is fitted.
- Clean and inspect side light glass.
- Open unit and dust interior.
- Check lamp expiry date tag. Replace lamp and tag if overdue.
- Clean inside of roundel with soft cloth.
- Check condition of all gaskets and seals.
- Clean reflector.
- Check reflector for signs of deterioration of surface or cracking.
- Check tightness of terminal studs and ensure they do not foul on lamp body when door is fully closed.
- Check air vent mesh is in place, intact and allows the free flow of air.
- Any heavy deposits of rust need to be investigated. The most likely source is corrosion of the supporting pipe work.
- Check visible wiring for signs of insulation deterioration.
- Ensure that any regulator fitted, is firmly attached to the body of the fitting.
- Ensure the lamp contact area is clean and pin spring tension checked before replacing lamp.
- Check lamp envelope for signs of discolouration, replacing if necessary, check voltage at lamp after replacing.
- Lubricate if necessary, door hinge pin (RP-7 or similar) and the door locking bolt with anti-seize compound or petroleum jelly.
- Check physical condition of hood and background.

7.4.1.1 Servicing Level Crossing – Roundels

General

ARTC uses five different types of ROUNDELS in Level Crossing protection equipment:

70° Spread 200mm.

30/15° Spread 200mm.

70° Spread 300mm.

30/15° Spread 300mm.

32/20° Spread 300mm.

Uses

32/20° Spread 300mm roundels are used only on the overhead cantilever signals located at Alice Springs. Their use is not approved at any other location.

30/15° roundels are used in the appropriate sized unit, forming front or long distance lights.

70° roundels are used in the appropriate sized unit, where, due to their ability to optically spread light over a wider area, they are used as back or short distance lights.

Their other uses are as sub-lights to cover traffic entering the crossing from side roads located adjacent to the crossing or in difficult curved approaches as approved by a senior Signals Officer.

Figure 1 shows the correct placement of roundels for a typical road / rail intersection.

Care

Roundels require cleaning at each maintenance cycle. This must be done by flooding the roundel with a quantity of NON ABRASIVE GLASS CLEANER and gently clean the roundel with a soft cloth. It is necessary to frequently turn the cloth to reduce scratching of the surface.

Roundels in good condition exhibit a smooth shiny surface. If this surface becomes scratched the roundel must be changed out.

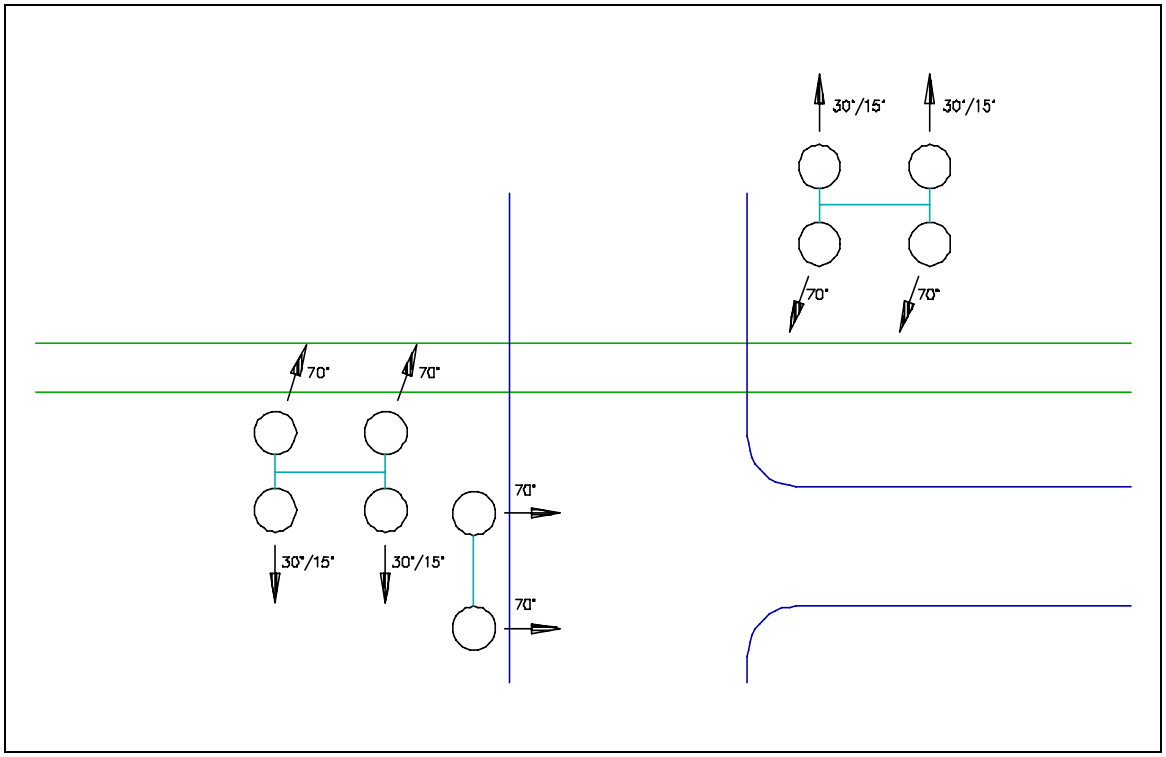


Figure 3: Typical Placement of Roundels

Installation

The roundel must be held firmly in the light unit by its retaining clips.

All clips must exert equal pressure on the roundel.

Roundels are marked " TOP ". This must be located in the vertical position when the door of the fitting is in the fully closed position.

When replacing a roundel ensure that an effective weatherproof gasket is in place to prevent the ingress of water through the front of the fitting.

7.4.1.2 Servicing Level Crossing – Alignment of Highway Crossing Lights

General

The aligning of Highway Crossing Light Units in accordance with these instructions must not be commenced until adequate protection has been afforded to highway and pedestrian traffic.

When aligning, care must be taken to ensure no unsafe conditions are created.

To obtain the range and efficiency intended, signal precision lamps must always be used in the light units.

When alignment of light units has been completed, tests must be made immediately to determine that the equipment functions as intended.

Local conditions which limit speed of approach traffic, or the distance at which the signal can be seen by drivers of vehicles approaching the Crossing will vary the point of alignment up to a maximum of 300 metres.

Front Lights

- Continuously light one lamp.
- Open door wide so clear beam is displayed.
- Adjust light unit vertically to align axis of beam 1675 mm above pavement at selected alignment distance. Both lamps should be aligned to the same point.
- Adjust light unit horizontally to align axis of beam to centre of the approach lane at the selected alignment distance, maintaining vertical alignment.
- Tighten clamps and close door, check alignment.
- Repeat above instructions on other front light units.

Back Lights

- Continuously light one lamp.
- Open door wide so clear beam is displayed.
- Adjust light unit vertically to align axis of beam 1675 mm above pavement at a point 15 metres in approach to the signal on opposite side of track.
- Adjust light unit horizontally to align axis beam to the point, with symmetric patterned roundels, maintaining vertical alignment as in instruction Part 6.3.3, above.
- Tighten clamps and close door, check alignment.
- Repeat above instructions on other back light units.

Alignment Checks

After units have been aligned, clamps tightened and doors closed, they must be checked with lights flashing and lamps operating at recommended voltage to ensure certain a flashing light aspect is visible within a range of 300 metres.

As a general rule the alignment point (Front Lights) for various road speeds are:

60 km/h road speed	100m
80 km/h road speed	200m
110 km/h road speed	300m

Alignment should be checked on completion by making approach runs in a road vehicle. On curved approaches lights should be aligned to adequately cover the safe braking zone of the approach.

Alignment Using Laser

Alternate method of alignment of Highway Crossing Lights using laser alignment equipment.

- Isolate lamp from supply source.
- Set laser at the required alignment point on the Highway (200 to 300m) at 1675mm above pavement.
- Open door so a clear beam is received.
- Remove lamp.
- Fit Alignment screen (BC Fitting) adaptor.
- Aim laser beam to centre of test light reflector.
- Ensure lighted cross matches the cross on the alignment screen.
- If misaligned move crossing light to align both crosses.
- Tighten crossing light alignment bolts.
- Re-check if misaligned.
- Remove alignment screen adaptor.
- Close door and secure.
- Reconnect supply on test light lamp.
- Check light for correct alignment.

7.4.1.3 Servicing Level Crossing – Lamp Replacement

Crossing Lamps

Lamps used:

18 Watt, 10 Volt Single Contact S11 Signal Precision.

Lamp life rated at 2000 hours. Change out life 4 years.

Voltage:

- Ideal 9.8 Volts
- Min. 9.6 Volts
- Max. 10.2 Volts

Half of the lamps on a crossing will expire on the same day.

Check that the printing on the base of the new lamp shows 18 Watt, 10 Volt S11 Signal Precision.

The date of the next lamp change out is to be written on a self adhesive label attached to the inside body of the light unit.

Old lamps which are removed, must be destroyed in an environmentally sound manner and not mixed with new lamps.

The centre pin retaining nut must be kept at its outer limit and not come in contact with the lamp holder.

Ensure the lamp contact area is clean and pin spring tension checked before replacing lamp.

The reflector unit is pre-focussed and force must not be applied in an attempt to remove the lamp.

After replacing a lamp(s), a Function Test MUST be carried out to ascertain the correct operation of the crossing. Also, alignment of lamp units must be checked.

In the event of premature failure of a lamp the lamp change-out date must not be altered but left to be replaced with the remaining half set.

Auto Gate Lamps

Lamps used are:

18 Watt, 10 Volt Single Contact Signal Precision

or

18 Watt, 12 Volt Double Contact Automotive type

Identification of lamp type depends on light unit.

Life of both types of gate lamps is until failure, or until blackening of the glass envelope is detected during routine maintenance.

Ensure correct lamp voltage when changing lamps.

Voltage of Automotive type lamps:

Ideal 12 Volts

Min. 11 Volts

Max. 14 Volts

7.4.2 Highway Crossing Gong (WRRS-Western Cullen)

Service A

Ensure gong is securely attached to the mast with sounder facing and parallel with the roadway.

Unlock and open door.

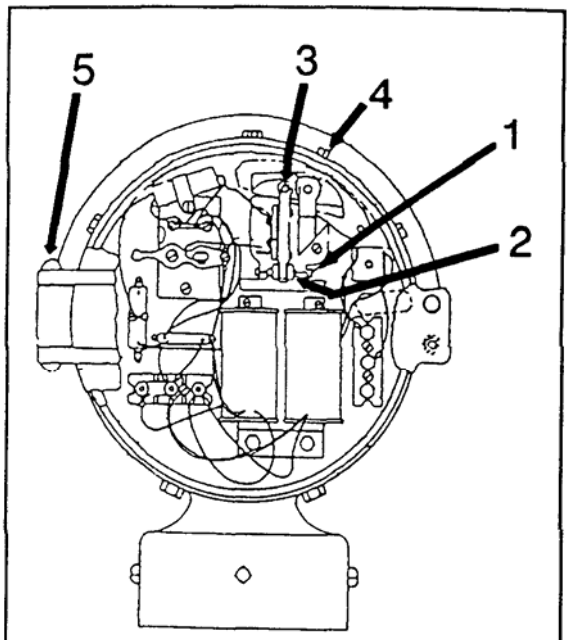


Figure 1 WRRS – Western Cullen Gong

Examine contacts for abnormal wear and burn marks, clean to a smooth surface.

If insufficient contact thickness replace Gong.

Check contact Gap 0.0625"

Check armature pole face gap (NOT less than 0.020").

Check operating current (600/700 ma).

Check beats per minute:

IDEAL 200

MIN. 185

MAX. 210

Check all screws and nuts for tightness.

Check internal leads and terminations.

Close and lock door

Service B

- Perform Service A.
- Lubricate the following points: (See Figure 1)
  - Armature pin (No.1)
  - Operating link (No.2)
  - Operating Clevis pin (No.3)
  - Hammer shaft (Through Hole)
    Sealed plug (No.4)
  - Hinge Pin (No.5)
- Mark sounder and gong body to assist in reassembly.
- Remove sounder and clean inner surface.
- Inspect hammer for abnormal wear in rivets.
- Inspect striker arm for cracking.
- Spray inner surface of sounder with "RP-7".
- Reassemble aligning reference marks.
- Ensure unit operates satisfactorily.

7.4.3 Servicing Level Grossing – Auto Gate Mechanism

Shock Absorber

- Lower the gate and check the horizontal alignment.
- Raise the gate and check vertical clearance.

Contacts

- Refer Operating Manuals:
  - WRRS Page 33
  - WC Page 15

Motor Control Relay

Field adjustments are NOT recommended.

Field Tests:

- Verify pick up and release values.
- Refer operating manual.

Descent Time

- Refer operating manuals:
  - WRRS Page 34
  - WC Page 23

Ensure that the slide contact on the resistance unit is bearing on the winding with firm pressure, and that the lock nut is tightened to hold the slide securely in place.

Release of Hold-Clear Device

The drop away voltage of the hold-clear device should be taken with a voltmeter and resistance slide.

The drop-away voltage should not be less than 2.5 Volts.

Clearing Time

Refer operating manuals:

WRRS Page 22

WC Page 38

Ensure all parts of the mechanism are protected against weather, vermin and ingress of foreign substances.

Lubrication

- Refer operating manuals:
  - WRRS Page 23
  - WC Page 38

Circuit Controller

- Refer operating manuals:
  - WRRS Page 33
  - WC Page 24

Arc Suppressor (Testing)

- Refer operating manual:
  - WC Page 24

Motor

The motor brushes should be periodically inspected for wear.

Replace brushes when less than 16mm in length.

Hold Clear Device

Check the armature support bracket.

Check engagement between the ratchet wheel and pawl.

Refer operating manual:

- WRRS Page 34
- WC Page 25

Check armature support bracket for adjustment.

Refer operating manuals:

- WRRS Page 25
- WC Page 36

Wiring

Ensure all wiring is held clear of gears and moving parts.

7.4.4 Level Crossing Test

7.4.4.1 Level Crossing Function Test

Test each track circuit for correspondence with the Track Plan regarding location and track polarity.

Shunt each track circuit to ensure that the respective relay responds in accordance with the box detail and track circuit diagram.

Sequentially de-energise track circuits using the track shunt and establish the operation of directional stick relays for each path.

Sequence test (see Figure 1):-

- De-energise 1TR
- De-energise 2TR
- Restore 1TR
- De-energise 3TR
- Restore 2TR
- Restore 3TR
- Ensure each function in XR circuit, when open circuited individually, fully de-energises XR. (Test with Meter)
- Ensure, with XR de-energised, that ER and X function operate. Test time delay devices as per SECTION 2.1.1.7.
- On completion of tests ensure all relays have assumed their normal position as per circuit diagram.
- Check power supply / charger circuit for correct operation.

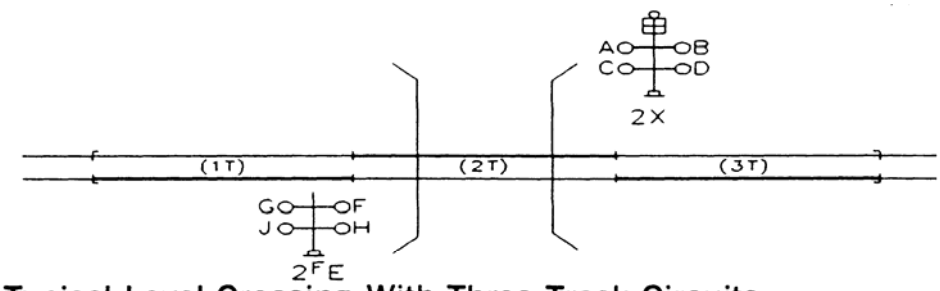


Figure 1 Typical Level Crossing With Three Track Circuits

7.4.4.2 Level Crossing Operation Test

- Inspect all equipment for damage or vandalism.

- Open test switch enclosure.
- Check that the " POWER ON " indication is illuminated.
- Operate test switch.
- Observe function of lights, audible warning device and, if applicable, auto gates.
- Ensure that the lights are flashing and clearly visible from a vehicle driver's position on the roadway, the audible warning device emits a clear, loud note and, if applicable, that auto gate mechanisms function correctly.
- Restore test switch to normal position and ensure that all crossing warning devices restore to normal.
- Record test in "on-site" record book.
- Close and secure enclosure.
- Report to Train Control any malfunction of crossing equipment.

7.4.4.3 Level Crossing – Lamp Voltage Test

- Open the light unit then activate the level crossing lighting circuit.
- Place meter on DC volt scale, then connect meter leads to lamp input terminals and measure voltage after one (1) minute and three (3) minutes, respectively, of operation.
- Lamp voltage Specifications:-
  - IDEAL 9.8 Volt.
  - MIN. 9.6 Volt.
  - MAX. 10.2 Volt.

NOTE:

Excessive lamp voltage shortens lamp life.

Lower applied voltage reduces lamp output lumens.

The centre pin of the lamp holder must be positive polarity (this reduces the possibility of positive earth leaks).

Ensure centre pin locking nut is at the outer end of travel.

Ensure all termination points are tight.

If voltage regulators are fitted, refer to SECTION 2.1.2.3 for further information and installation requirements.

Ensure termination studs do not foul on the light body when door is fully closed.

Close the unit and secure.

7.4.5 Level Crossing – Mast and Hardware

- Check foundation for horizontal and vertical alignment.
- Check for signs of subsidence or erosion affecting foundation.
- Check four (4) foundation nuts are tight and fitted with washers.
- Check mast base for cracks in casting.
- Check four (4) clamp bolts on split base.
- Ensure terminal lid on split bases is weatherproof and secured with K9800 padlock if designed to be locked.

- On auto gate installations check that the mechanism and support brackets are secure.
- Check that signs are orientated to approaching traffic, and associated brackets and U-bolts are tight.
- Ensure mast caps, strobe lights (if fitted) and gong(s) are firmly attached to mast top.
- Ensure ladders are firmly attached.
- Ensure cross arm is firmly bolted to mast and seated in the cut-out on the mast.
- The lid must offer a weather proof seal. Inspect for cracks in cross arm assembly.

7.4.6 Approach Warning Signs

Inspection

Ensure:

"STOP ON RED SIGNAL"; "TRACK SIGN" (if fitted) RAILWAY CROSSING X BUCKS

are securely attached to crossing Mast.

Check signs for vandalism or defacement.

Ensure sign is clean, if required clean off road grime using cleaning fluid. Rinse with clean water.

Inspect signs for deterioration of reflective material or separation of material from backboard.

Change out Procedure

General:

All bolts, U bolts and nuts must be galvanised.

Ensure a washer is placed between the nut and sign face.

Care must be taken when tightening nuts to prevent damage to sign.

Railway Crossing X Bucks

Ensure filler block is placed between the two sign components.

Track Signs (If Necessary)

Ensure correct numeral is used.

Sign Orientation

Signs should be oriented at approximately right angles to, and facing, the traffic they are intended to serve. At curved alignments, angles of placement should be determined by the courses of approaching traffic rather than by the road edge at the point where the sign is located.

To avoid possible and undesirable reflection from the surface of the sign, it should be turned about 5° away from the normal headlight beam (see Figure 1. Next page).

After signs are installed it is good practise to test them by trial approach in a motor vehicle.

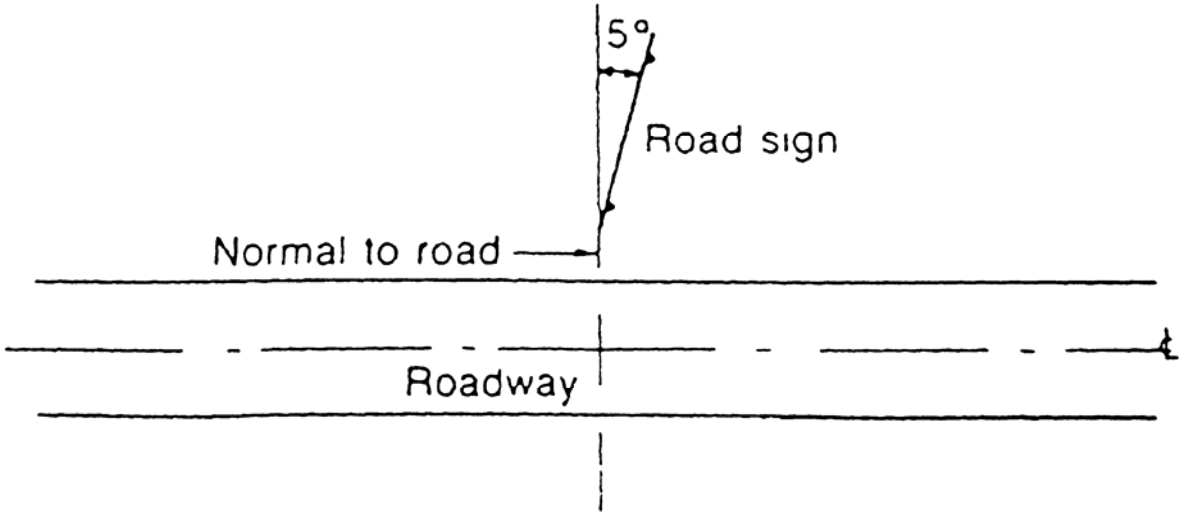


Figure 1 Method of Avoiding Specular Reflection on a Road Sign

ADVANCE WARNING SIGNS

All signs are under the care and maintenance of the controlling Road Authority, with the exception of the following installations where A.N. is also the road authority:

Access Road Keswick Passenger Terminal.

Access Road Islington Freight (Two Crossings).

Access Road Dry Creek Bogie Exchange

As these signs contribute to the overall safety of the crossing, regular checks to ascertain their presence should be made.

STANDARD APPROACH SIGNS

The Appendix, pages 3 to 7 inclusive, show requirements for installations conforming to AS 1742, Part 7-1987. Any new installations or major alterations should conform to AS 1742, Part 7-1993, as shown on pages 8-10.

Any non-compliance should be reported to the Regional Signal Support Officer.

RAILWAY LEVEL CROSSING WIDTH MARKER ASSEMBLY

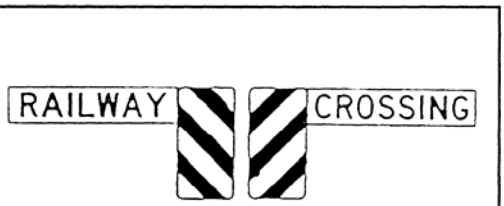


Figure 2

RAILWAY LEVEL CROSSING FLASHER LIGHT AHEAD ASSEMBLY

Figure 3 RLC–E

The assembly is used where basic signs at the crossing are considered inadequate. The RLC-L assembly is located immediately in advance of either the RLC-B

assembly or the RLC-F assembly and on each side of the railway level crossing as shown in Figure 2 above.

The assembly shall not be used in conjunction with the Railway Level Crossing STOP assembly as width markers distract the road users attention from the STOP sign.

Alternatively, if the road approach to the railway level crossing is on a sharp curved alignment, it may be desirable to erect both RAILWAY and CROSSING SIGNS together on one side of the carriageway on the outside of the curve at the end of the approach straight with a Unidirectional Hazard Marker mounted above them. The width markers are then mounted on either side of the road at the level crossing.

The RLC-E assembly shall be used to give advance warning of a crossing controlled by flashing lights including those where auto gates are installed in conjunction with lights. It is located on the left side of the carriageway between the RLC-F assembly and the RLC-C assembly as shown in Figure 3 above. When the crossing is on the side road, an RLC-J assembly is used instead of an RLC-E assembly (see Figure 5 next page).

RAILWAY LEVEL CROSSING WARNING ASSEMBLY

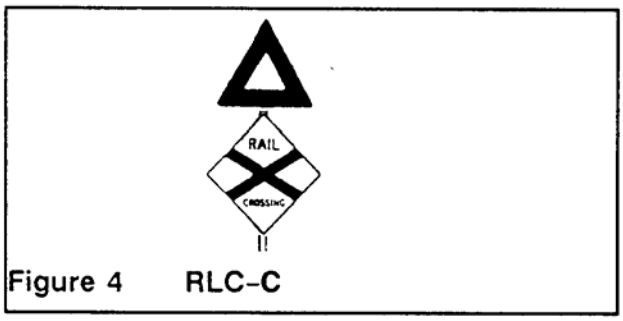


Figure 4 RLC–C

The RLC-C assembly is used to give advanced warning of a level crossing. It shall be used in advance of a crossing as the first warning device regardless of the method of control except when the level crossing is on a side road. It is located on the left side of the carriageway as indicated in Figure 8, page 6. It may be repeated on the right side of the carriageway if necessary for added emphasis, or if the carriageway has two or more lanes on approach.

RAILWAY LEVEL CROSSING WARNING ASSEMBLY

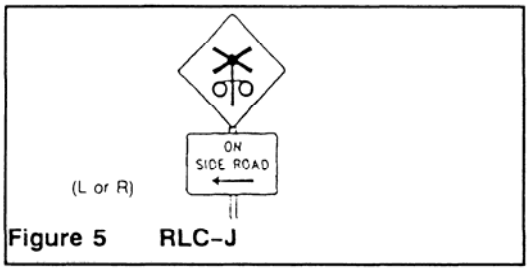


Figure 5 RLC–J

RAILWAY LEVEL CROSSING WARNING ASSEMBLY

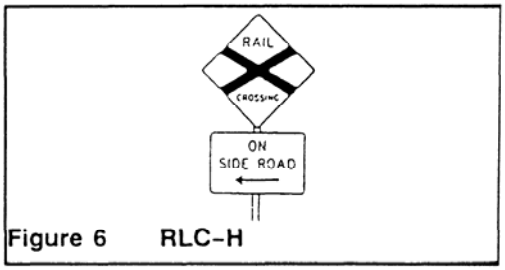


Figure 6 RLC–H

The RLC-J assembly is used to give advanced warning on a through road of a level crossing which is controlled by flashing lights when the level crossing:

- is on a side road;
- is too close to the intersection to provide the appropriate distance required for erection of the RLC-E assembly on the side road.

The RLC-J assembly shall be used in conjunction with the RLC-H assembly. It is positioned between the intersection and the RLC-H assembly.

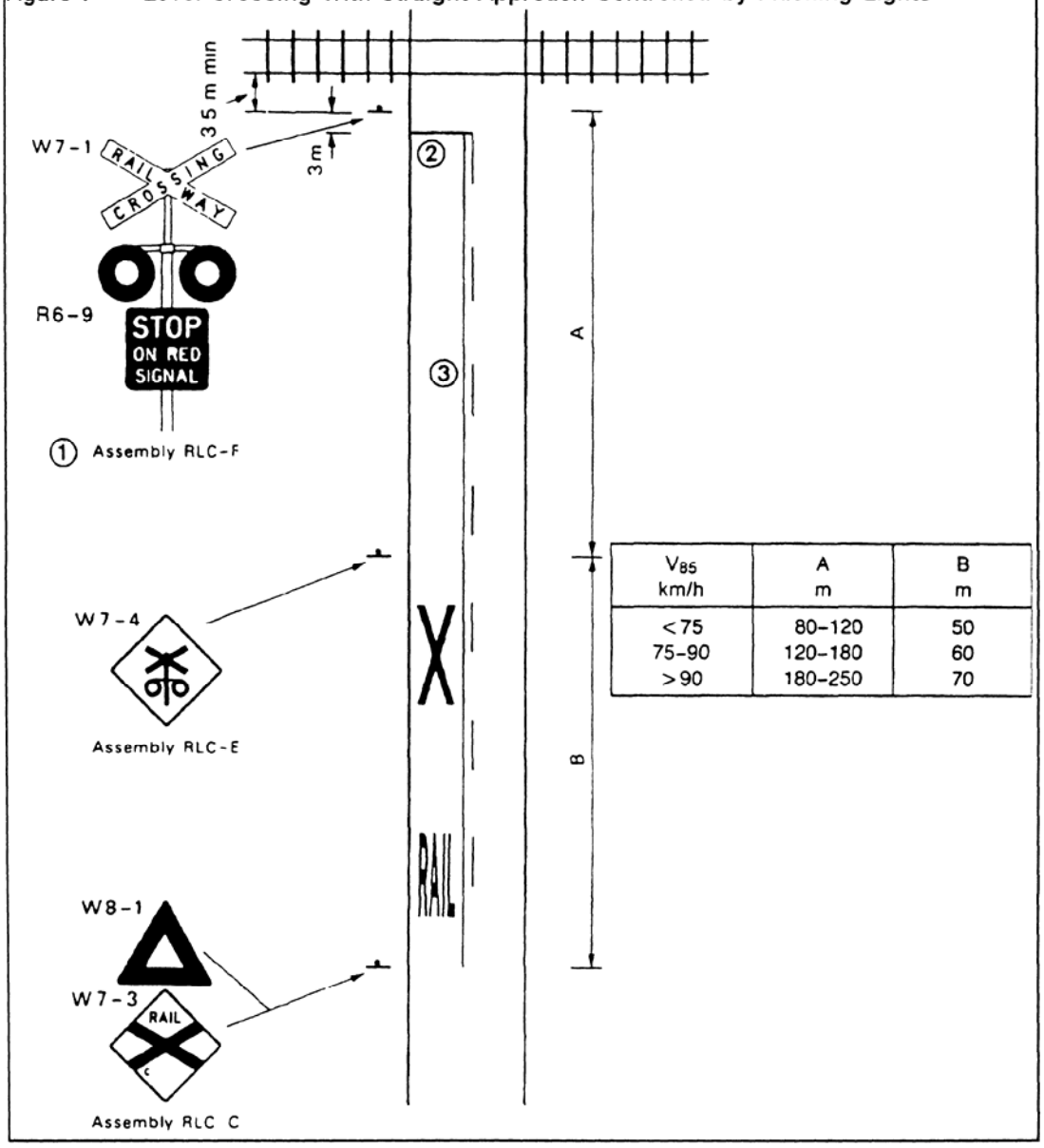
Both signs are positioned on the left side of each approach to the intersection, on the through road as indicated in Figure 9, page 7.

The RLC-H assembly is used to give advanced warning when the level crossing:

- is on a side road;
- is too close to the intersection to provide the appropriate distance required for erection of the RLC-C assembly on the side road.

The RLC-H is positioned on the left side of each approach to the intersection on the through road.

Figure 7 Level Crossing With Straight Approach Controlled by Flashing Lights



V_{85} km/h	A m	B m
<75	80–120	50
75–90	120–180	60
>90	180–250	70

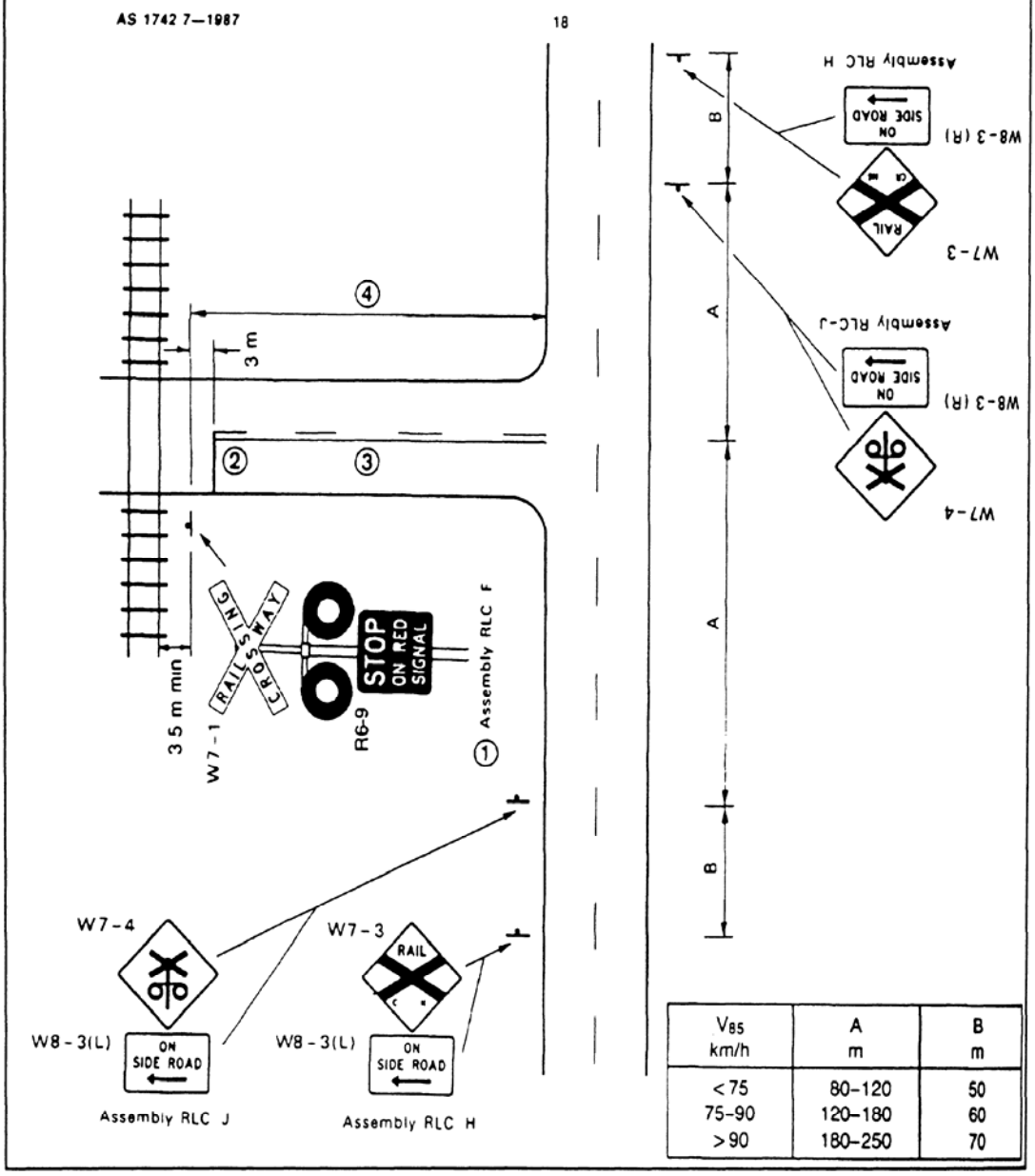
NOTES:

If more than one track, the TRACKS sign may be added.

Stop lines are required on sealed roads at level crossings controlled by flashing lights.

On sealed roads the barrier line should extend at least to the RLC-C assembly.

Figure 8 Level Crossing on a Side Road Controlled by Flashing Lights



V_{85} km/h	A m	B m
<75	80–120	50
75–90	120–180	60
>90	180–250	70

NOTES:

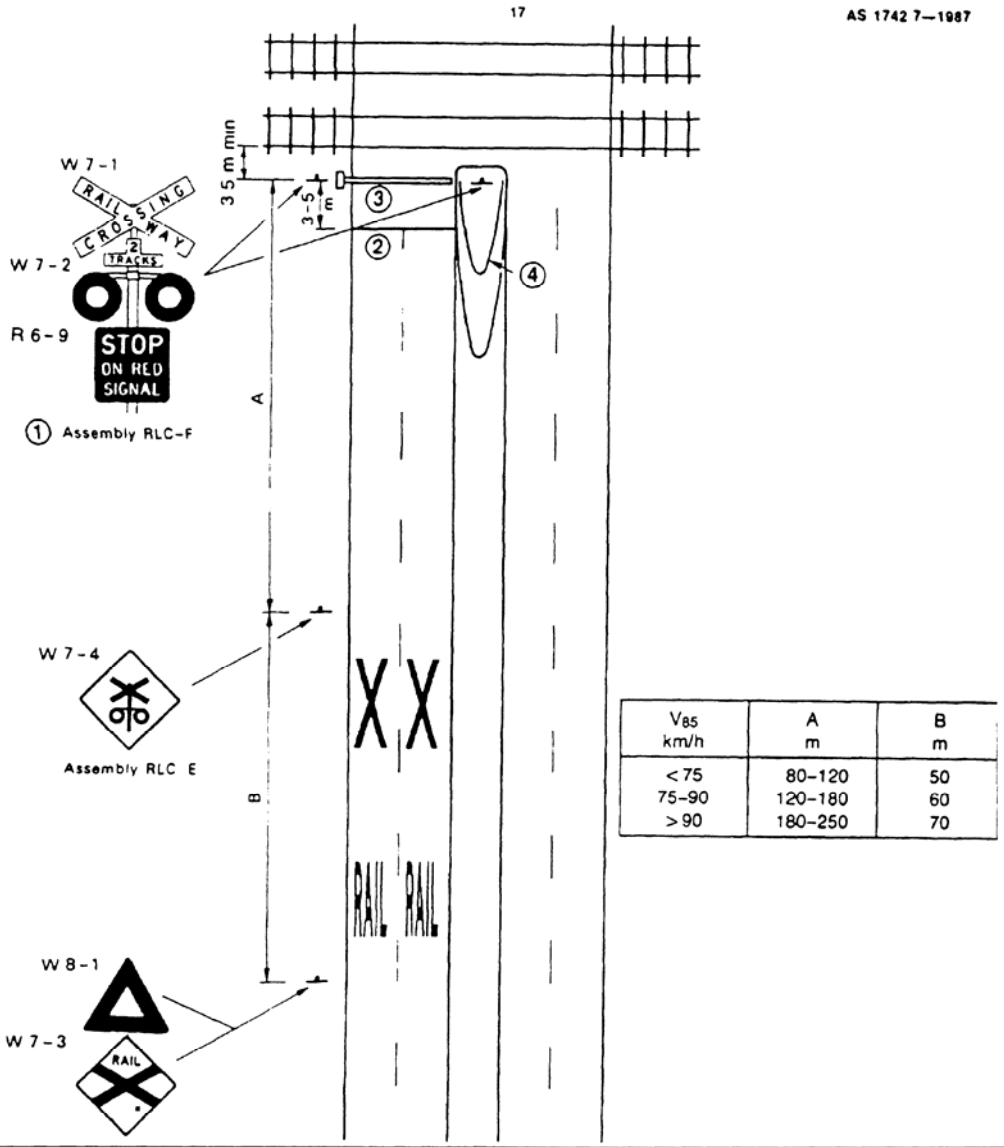
If more than one track, the TRACKS sign may be added.

Stop lines are required on sealed roads at level crossings controlled by flashing lights.

The barrier line extends from the level crossing to the through road.

This distance is less than that required to allow satisfactory display of the assembly RLC-E on the side road i.e. less than dimension A.

Figure 9 Level Crossing With Straight Approach Controlled by Flashing Lights And Half Boom Gate



V_{85} km/h	A m	B m
< 75	80–120	50
75–90	120–180	60
> 90	180–250	70

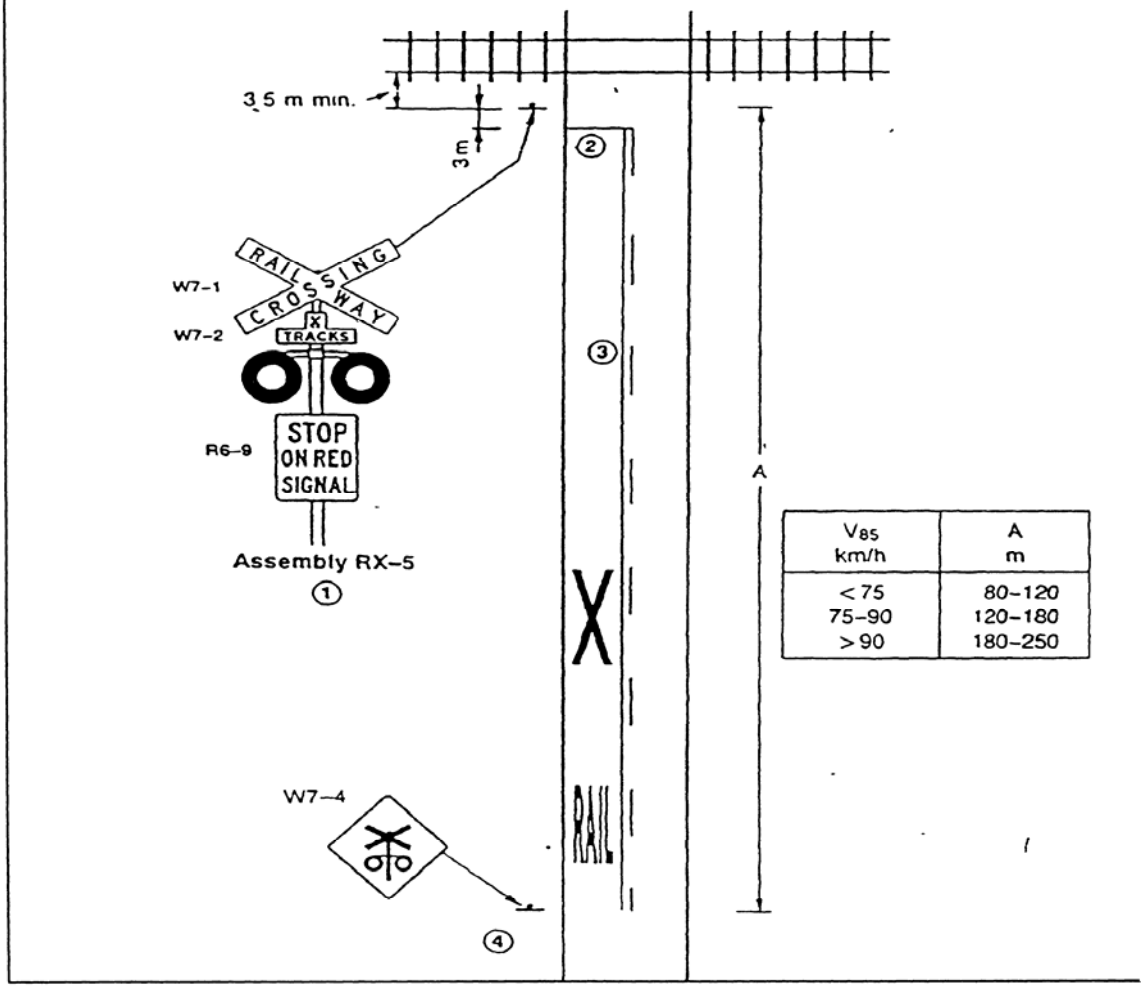
NOTES:

If more than one track, the TRACKS sign may be added.

Stop lines are required on sealed roads at level crossings controlled by flashing lights.

Auto gates may be provided.

Figure 10 Level Crossing with Straight Approach Controlled by Flasing Lights (Active Control)



V_{85} km/h	A m
< 75	80–120
75–90	120–180
> 90	180–250

NOTES:

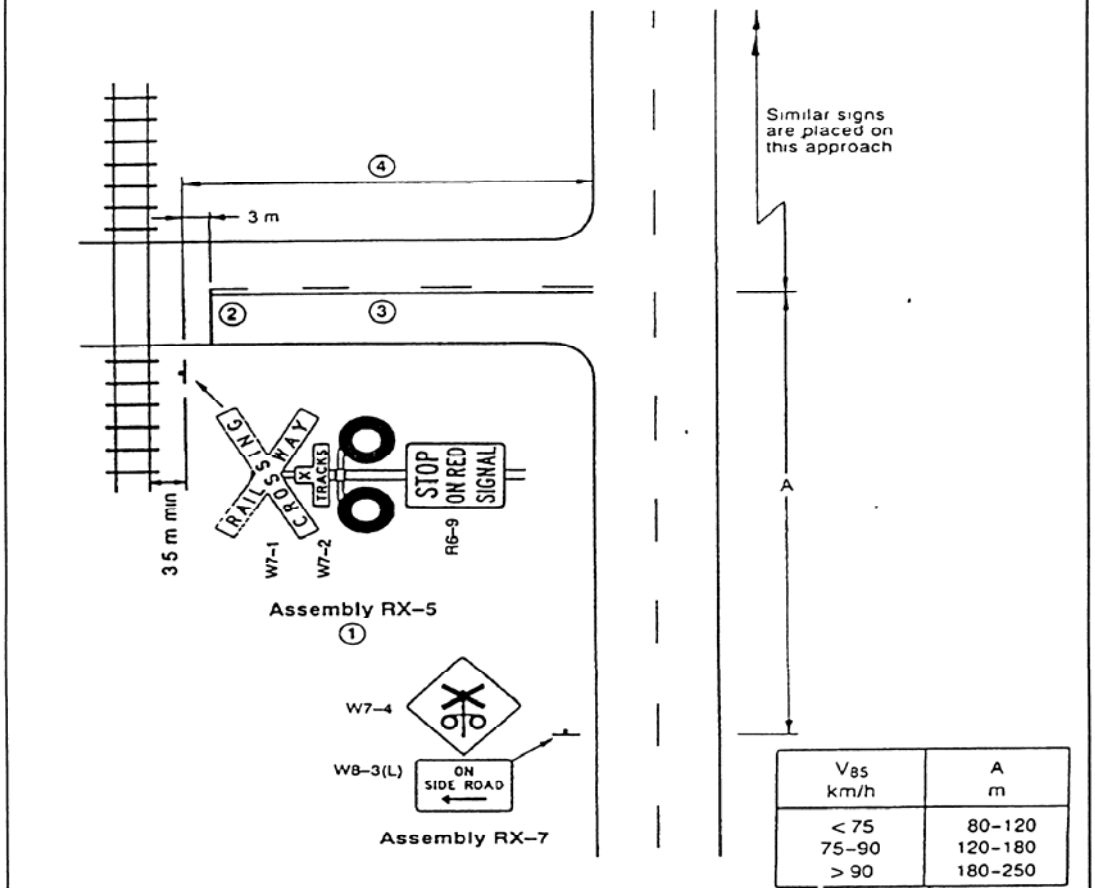
If more than one track, the TRACKS sign W7-2 is added below W7-1.

Stop lines are required on sealed roads at level crossings controlled by flashing lights.

The barrier line should extend at least to the W7-4 sign.

The W7-4 sign may need to be repeated on the right-hand side of the carriageway.

Figure 11 Level Crossing on a Side Road Controlled by Flashing Lights (Active Control)



V_{85} km/h	A m
< 75	80–120
75–90	120–180
> 90	180–250

NOTES:

If more than one track, the TRACKS sign W7-2 is added below W7-1.

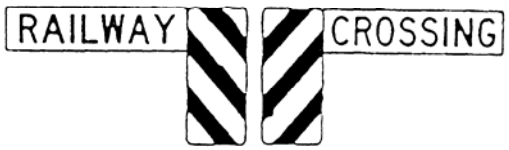
Stop lines are required on sealed roads at level crossings controlled by flashing lights.

A half-boom barrier may be provided.

The W7-4 sign may need to be repeated on the right-hand side of the carriageway.

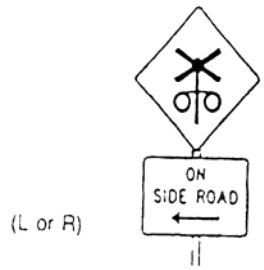
RAILWAY LEVEL CROSSING WIDTH MARKER ASSEMBLY

Figure 12 RX-9



RAILWAY LEVEL CROSSING FLASHING LIGHT AHEAD ON SIDE ROAD ASSEMBLY

Figure 13 RX-7



The RX-9 assembly is used where basic signs at the crossing are considered inadequate. It is located immediately in advance of the RX-5 assembly and one each side of the railway level crossing.

Alternatively, if the road approach to the railway level crossing is on a sharply curved alignment, it may be desirable to erect both the RAILWAY and CROSSING signs together on one side of the carriageway on the outside of the curve at the end of the approach straight.

In either of the above installations, care needs to be taken that the signs or assemblies do not obstruct sight lines to trains for road users, including pedestrians, or other road traffic at any crossing.

If a STOP sign is required in conjunction with this assembly, an oversize sign or a second sign on the right side of the carriageway, or both, may be required to ensure that the STOP sign is conspicuous.

The RX-7 assembly shall be used to give advance warning on a through road of a level crossing which is controlled by flashing lights when the level crossing –

- is on a side road; and
- is too close to the intersection to provide the appropriate distance required for erection of the W7-4 sign on the side road.

The assembly is positioned on the left side of each approach to the intersection, on the through road as indicated in Figure 11.

RAILWAY LEVEL CROSSING FLASHING LIGHT AHEAD SIGN

Figure 14 W7-4

The W7-4 sign shall be used to give advance warning of a crossing controlled by flashing lights, including those where boom barriers are installed in conjunction with the lights.

This sign may be repeated on the right-hand side of the carriageway for added emphasis, e.g. on high volume roads. It may also need to be repeated at a long distance (e.g. 500m) in advance of the crossing, in which case, Distance plate, is mounted below the sign.

7.4.7 Servicing Level Crossing Auto Gate

7.4.7.1 Servicing Arm and Hardware

Gate

- Inspect for cracks, splits or twists, check for tightness of joints and reinforcing bolts, ensure bolts holding gate to support bracket are tight.

Paint Work

- Ensure gate is protected from weather by a complete covering of paint or powder coating. Minor chips, fair wear and tear exempted.

Gate Lights

- Auto Gate Arm Lights

Gate Wiring Harness

- Ensure wiring harness is firmly attached to the timber arm side wall and junction boxes complete with lids are firmly attached.

Gate Support Bracket

- Examine for cracks and rust (include welds).

Support Arms

- Examine for cracks particularly near mounting position on drive shaft.

Counterweights

- Ensure counterweights are firmly attached to support arms.
- Check that the weight retaining straps are fitted and held firmly in position.

Gate Alignment

- Check vertical alignment 85°- 90°.
- Check horizontal alignment 0°
- Ensure the gate is positioned parallel to the stop line.
- Ensure the gate arm in the vertical position is not fouling any mast hardware, and clear of power lines and trees.

For aluminium gates, the following must also be checked.

- Ensure the reflective material is firmly attached.
- Ensure cable entry grommet is in correct position.
- Check that the shear pin is intact and retained by a split pin.
- If a blowdown bracket is installed, ensure cushioning material is intact.

7.4.7.2 Servicing Level Crossing Auto Gate Arms (Timber) – Change-Out

Transportation of Auto Gate Arms

Gates are to be adequately secured to the vehicle ladder rack/s.

It is the drivers onus to comply with road traffic legislation regarding insecure loads.

Protruding Loads

Any load protruding more than 1 metre from the body line of the vehicle must be protected as follows:-

BY DAY - A WHITE or light coloured flag securely attached to both ends of the protrusion.

BY NIGHT - An operative RED light attached to both ends of protrusion.

At all times protruding sharp edges and ends must be bagged to lessen injuries or damage as a result of a collision.

Exercise caution with regard to proximity to leading vehicles when carrying long loads, and fouling of opposing traffic at intersections.

Change-out of Auto Gate Arms

Two methods are used:

Method 1.

Gate is changed by obstructing road traffic.

Method 2.

Gate is changed by obstructing rail traffic.

With Western Cullen Mechanisms fitted with mechanism support bracket both of the above methods are possible, however the older WRRS mechanisms can only be handled using Method 1.

Method 1. Obstructing Road Traffic

- Disconnect gate lamp cable terminations and remove cable from mechanism.
- Remove two (2) bolts from both the upper and lower plates of the gate support bracket and slightly loosen the remaining four (4) bolts.
- Insulate `G' (motor drive) contact.
- Open XR contact in gate mechanism and allow crossing to operate until road traffic has stopped.
- Release holding mechanism and allow gate to lower.
- Insert stands under counterweights and secure.
- Raise counterweight arm until parallel with roadway.
- Remove remaining bolts from gate support bracket, while supporting the gate arm, with all bolts removed it is possible to remove gate from the support arms.
- Slide the new gate arm on to the support arms and install all eight (8) bolts (bolts are inserted with heads located in locking slot in support arm).
- Tighten all bolts, remove counterweight stands and remove insulation from `G' contact and allow gate arm to rise.
- Ensure that the gate arm is not obstructed by mast hardware and holding mechanism operates correctly.
- After traffic has cleared operate the crossing by the test switch, and observe that both gates release, lower and snub in unison.
- Reconnect gate lamp terminations and confirm correct operation.
- Check horizontal torque.
- Restore test switch and observe both gates clear at the same rate and latch normally.

Method 2. Obstructing Rail Traffic

- Disconnect gate lamp cable terminations and remove cable from mechanism.
- Remove two (2) bolts from both the upper and lower plates of the gate support bracket and slightly loosen the remaining four (4) bolts.
- Loosen mechanism holding U-bolts and remove two (2) bolts from conduit termination casting on top of split base.
- Insulate `G' (motor drive) contact.
- Open XR contact in gate mechanism and allow crossing to operate until road traffic has stopped.
- Release holding mechanism and allow gate to lower.
- Rotate mechanism 90 to put gate arm parallel with roadway.
- Bridge XR contact in mechanism.
- Insert stands under counterweight arm and secure. Raise counterweight arm until parallel with roadway.
- Remove remaining bolts from gate support bracket, while supporting the gate arm, with all bolts removed it is possible to remove gate from the support arms.
- Slide the new gate arm on to the support arms and install all eight (8) bolts. (Bolts are inserted with heads located in locking slot in support arms).
- Tighten all bolts, remove counterweight stands.
- Remove XR bridge and allow crossing to operate.
- When all road traffic has stopped, rotate mechanism across roadway.
- Align gate parallel to stopline.
- Remove 'G' contact insulation and allow gate to rise and ensure gate is not obstructed by mast hardware, and holding mechanism operates correctly.
- Tighten mechanism holding U-bolts and refit conduit adaptor to top of split base.
- After traffic has cleared operate the crossing by the test switch, and observe that both gates release, lower and snub in unison.
- Reconnect gate lamp terminations and confirm correct operation.
- Check horizontal torque.
- Restore test switch and observe both gates clear at the same rate and latch normally.

Horizontal Torque Adjustment

(See Figure 1)

Adjust to 50 foot pounds by loosening the nut on bolt(s) "A" and sliding weight(s) "B" horizontally in or out until scale reads 10 pounds at a point on the arm five feet (1525mm) from the centre of the main shaft, indicating a torque of 50 foot pounds.

When proper torque adjustment has been obtained, tighten nut on bolt "A" just enough to prevent weight from sliding lengthwise in the slot.

Clear Position Torque Adjustment

(See Figure 2)

Using spring scale.

Allow gate arm to clear and latch. Attach spring scales as shown in Figure 2 (between point "A" and "B").

Insulate `G' (motor drive) contact.

Open test nut in mechanism and allow gate arm to fall 5 degrees against scale chain, and read scale.

Before adjusting the counterweights re-latch hold clear device by closing test nut and manually assisting the armature back against the pole faces.

Loosen nut(s) on bolt(s) "C" enough to permit adjustment and shift counterweight(s) "D" horizontally in or out by means of bolts "E" and "F" until scale reading agrees with value in Table 1, for the corresponding length of the gate arm.

Tighten all bolts.

CAUTION: Before restoring mechanism to service ensure insulating material is removed from motor drive contact.

Figure 1 Horizontal Torque Adjustment

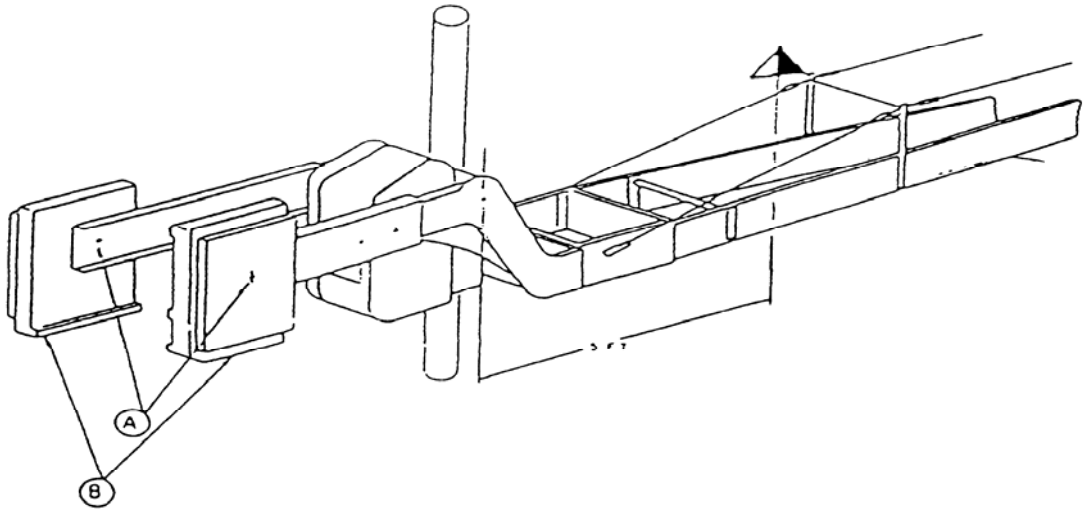


Figure 2 Clear Position Torque Adjustment

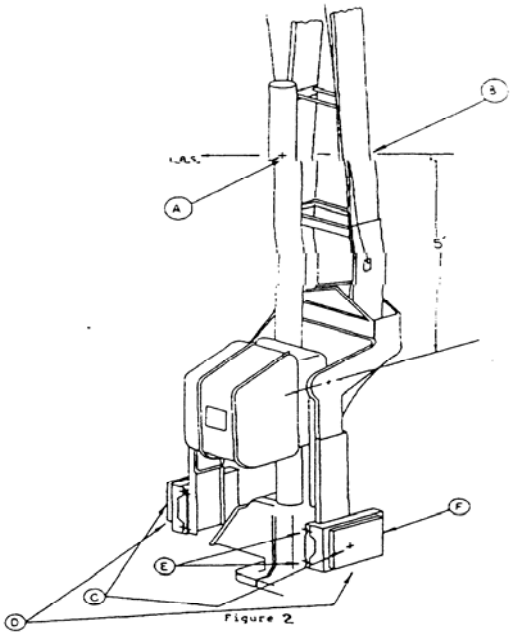


Table 1. Table of Clear Position Torque Values For Gate Arms

Gate Arm Length (Feet)	Gravity Torque in Clear Pos. (Ft. Lbs)	Scale Reading (Lbs.)	Distance X Feet[1]	Approx. Lbs. of Counterweight Total Lbs.[2]
14	175	35	5	160
15	175	35	5	160
16	175	35	5	160
17	175	35	5	160
18	180	36	5	160
19	190	38	5	210
20	200	40	5	210
21	210	42	5	210
22	220	44	5	210
23	230	46	5	210
24	240	48	5	210
25	250	50	5	370
26	260	52	5	370
27	270	54	5	370
28	280	56	5	370
29	290	58	5	370
30	300	60	5	370
31	310	62	5	570
32	320	64	5	570
33	320	64	5	570
34	340	68	5	570

[1] *Distance of 1525mm is the span in millimetres measured parallel to the gate arm from the mechanism shaft to the point at which the spring scales are attached.*

[2] *Will vary somewhat with weight of gate arm and lights. Extensions on counterweight arms of gates 35"to 44"long reduce the weight required.*

7.4.7.3 Auto Gate Arm (Aluminium) – Changeout

Transportation of Auto Gate Arms

Gates are to be adequately secured to the vehicle ladder rack/s.

It is the drivers onus to comply with road traffic legislation regarding insecure loads.

Protruding Loads

Any load protruding more than 1 metre from the body line of the vehicle must be protected as follows:-

BY DAY - A WHITE or light coloured flag securely attached to both ends of the protrusion.

BY NIGHT - An operative RED light attached to both ends of protrusion.

At all times protruding sharp edges and ends must be bagged to lessen injuries or damage as a result of a collision.

Exercise caution with regard to proximity to leading vehicles when carrying long loads, and fouling of opposing traffic at intersections.

Change Out of Auto Gate Arms

Two methods are used:

Method 1.

Gate is changed by obstructing road traffic.

Method 2.

Gate is changed by obstructing rail traffic.

With Western Cullen Mechanisms fitted with mechanism support bracket both of the above methods are possible, however the older WRRS mechanisms can only be handled using

Method 1. Obstructing Road Traffic

- Disconnect gate lamp cable terminations and remove cable from mechanism.
- Insulate `G' (Motor drive contact).
- Open XR contact in gate mechanism.
- Release holding mechanism and allow gate to lower.
- Insert stands under counterweights and secure.
- Raise counterweight arm until parallel with roadway.
- Loosen two (2) bolts from gate support bracket, while supporting the gate arm it is then possible to remove the gate from the support bracket.
- Slide the new gate arm into the support bracket and install appropriate shear pin and split pin.
- Tighten both bolts and lock nuts (DO NOT OVER TIGHTEN).
- Remove counterweight stands.
- Remove `G' contact insulation and allow gate to rise and ensure gate is not obstructed by mast hardware and holding mechanism and latches normally.
- Reconnect gate lamp terminations and confirm correct operation.
- After traffic has cleared operate the crossing by the test switch, and observe that both gates release, lower and snub at the same time.

- Check horizontal torque.
- Restore test switch and observe both gates climb in unison and latch normally.

Method 2. Obstructing Rail Traffic

- Disconnect gate lamp cable terminations and remove cable from mechanism.
- Loosen mechanism holding U-bolts and remove two (2) bolts from conduit termination casting on top of split base.
- Insulate `G' (Motor drive contact).
- Open XR contact in gate mechanism and allow crossing to operated until road traffic has stopped.
- Release holding mechanism and allow gate to lower.
- Rotate mechanism 90° to put gate arm parallel with roadway and bridge XR contact in mechanism.
- Insert stands under counterweights and secure.
- Raise counterweight arm until parallel with roadway.
- Loosen two (2) bolts from gate support bracket, while supporting the gate arm it is then possible to remove the gate from the support bracket.
- Slide the new gate arm into the support bracket and install appropriate shear pin and split pin.
- Tighten both bolts and lock nuts (DO NOT OVER TIGHTEN).
- Remove XR bridge and allow crossing to operate.
- When all road traffic has stopped, rotate mechanism across roadway.
- Remove `G' contact insulation and allow gate to rise and ensure gate is not obstructed by mast hardware and holding mechanism and latches normally.
- Tighten mechanism holding U-bolts and refit conduit adaptor to top of split base.
- After traffic has cleared operate the crossing by the test switch, and observe that both gates release, lower and snub at the same time.
- Reconnect gate lamp terminations and confirm correct operation.
- Check horizontal torque.
- Restore test switch and observe both gates climb at the same rate and latch normally.

Horizontal Torque Adjustment (See Figure 1).

Adjust to 85 foot pounds by loosening the nut on bolt(s) "A" and sliding weight(s) "B" horizontally in or out until scale reads 17 pounds at a point on the arm five feet (1525mm) from the centre of the main shaft, indicating a torque of 85 foot pounds.

When proper torque adjustment has been obtained, tighten nut on bolt "A" just enough to prevent weight from sliding lengthwise in the slot.

Clear Position Torque Adjustment

The clear position torque adjustment for aluminium gate arms is the same as detailed in the Clear Position Torque Adjustment section of 7.4.7.2.

Figure 1 Horizontal Torque Adjustment

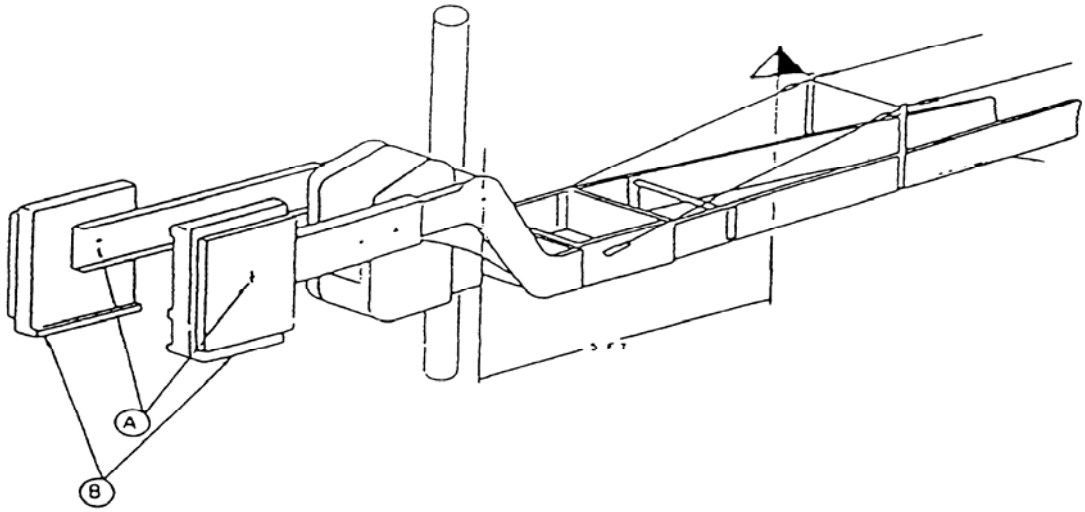
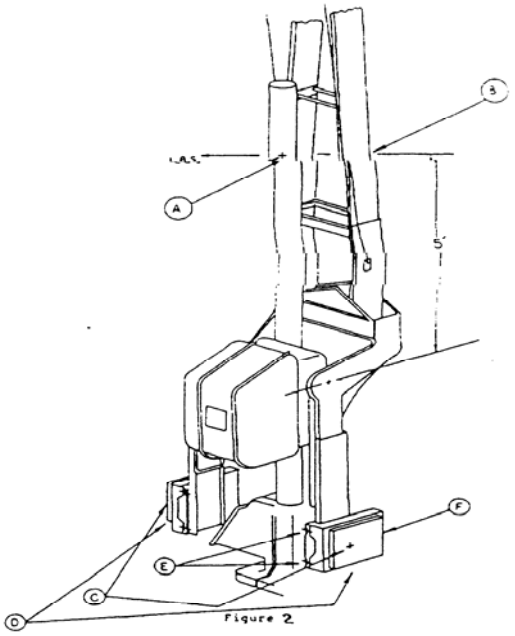


Figure 2 Clear Position Torque Adjustment



7.4.7.4 Level Crossing Auto Gate Arm Lights

Western Cullen Type 1585

Lamp Type

10V, 18W Single Contact S11 Signal Precision.

- Ensure mounting bolts are secure.
- Side shields are secure and parallel to roadway centre line.
- Ensure cable compression gland is secure and cable is double insulated where it enters the gland.
- Check for excessive wear on pivot bolt and bush.

- Check terminals on gate are secure and fitted with appropriate cover.
- Check that the centre contact moves freely and has no sign of corrosion.
- Ensure lens is secure and not cracked.

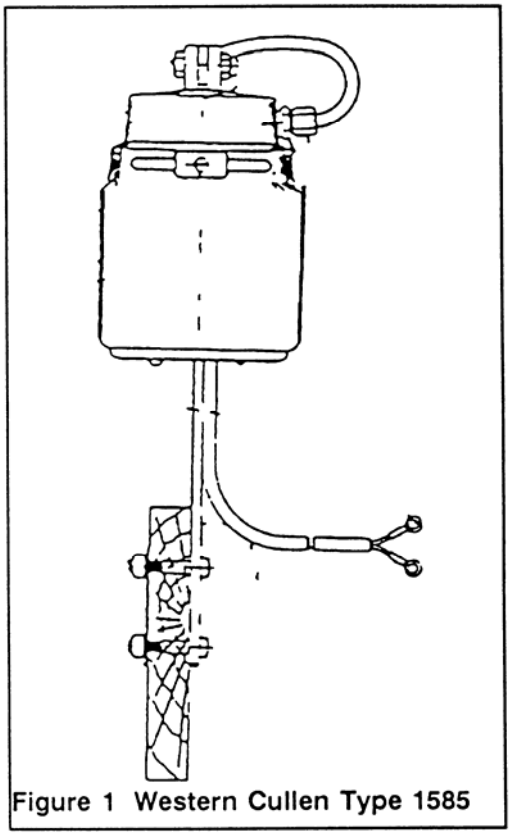


Figure 1 Western Cullen Type 1585

Western Cullen Hayes Type 1591

Lamp Type

10V, 18W Single Contact S11 Signal Precision.

- Ensure mounting screws are tight.
- Ensure cable compression gland is secure and the cable is double insulated where it enters the gland.
- Ensure the lens is secure in lamp body and not cracked.
- Ensure seals are intact:
  - In termination base.
  - In lens body.

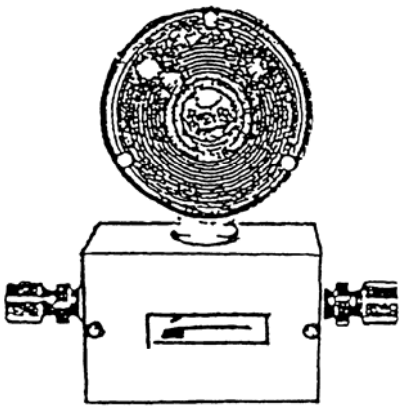


Figure 2 Western Cullen Hayes Type 1591

Hella Type 2129

Lamp Type

12V, 18W Double Contact Automotive Type.

- Ensure lens is secure and seals are intact.
- Ensure lens is not cracked.
- Ensure light unit is aligned to roadway and locking nut is tight.

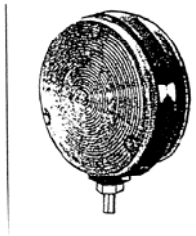


Figure 3 Hella Type 2129

7.4.8 Level Crossing Traffic Lights Alignment Procedure

General

The aligning of light units in accordance with these instructions must not be commenced until adequate protection has been afforded for highway and pedestrian traffic.

When aligning, care must be exercised that no unsafe conditions are created.

To obtain the range and efficiency intended, signal precision lamps must always be used.

When aligning of light units has been completed, tests must be made immediately to determine that the equipment functions as intended.

The units are supplied prefocussed and alignment can be carried out with any aspect permanently lit. It is not necessary to individually align each aspect, however, it is good practice to observe each aspect before completion to ensure satisfactory performance.

Alignment Procedure (See Figure 2)

Continuously light one lamp.

Adjust light unit vertically to align axis of beam 1675mm above pavement at 130m from mast on which light is mounted.

Adjust horizontal direction to evenly cover road.

Note: A characteristic of the reflector is a wide angle beam of evenly distributed light, a “hot spot” as evenly distributed light, a “hot spot” as seen in conventional level crossing lights, does not occur. (See Figure 1).

Secondary Lights

Continuously light one lamp.

Adjust unit vertically to align axis of beam 1675mm above pavement at 80m from facing stop line.

Adjust horizontal direction to evenly cover roadway.

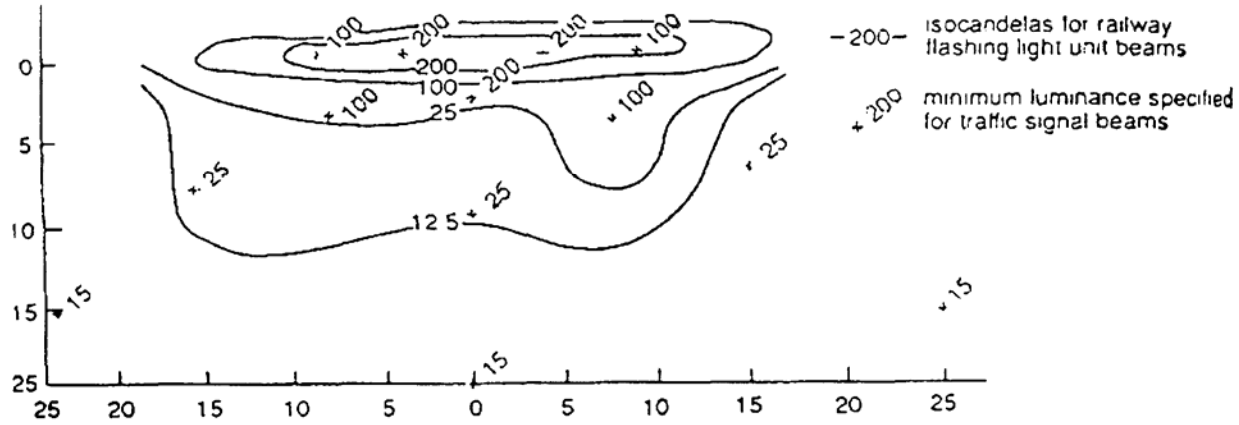


Figure 1 Comparison of Beam Patterns For Railway Flashing Light Beams and Traffic Signals

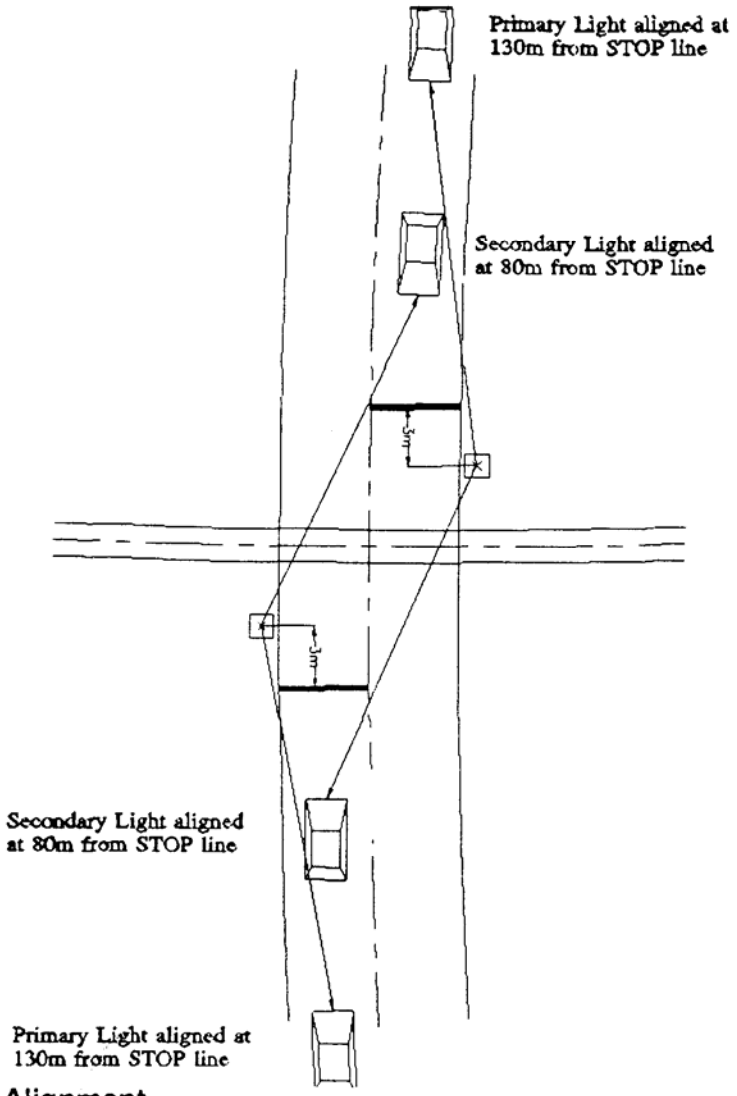


Figure 2 Light Alignment

7.4.9 Strobe Light Unit

Ensure unit is firmly secured to the mast top. To prevent theft, units are to be retained using steel wire rope attached to the base of the light unit, running the length of the mast and terminated on a spare position within the split base.

Check lens for cracks or other defects.

Clean lens using glass cleaner and clean cloth. If a diffuser is fitted to the light unit, ensure correct orientation i.e. to reduce light output in the direction of approaching trains.

Ensure correct operation of unit, flash rate 80 ± 10 per minute. If defective, the units are not field serviceable and should be returned for workshop attention.

7.5 Servicing Point Actuator

7.5.1 Power Operated Point

7.5.1.1 Servicing Point Machine – Westinghouse (McK&H) MS M23A M23A MKII

- Check physical condition of point machine; internal,external and layout.
- Ensure blade abuts stockrail in both Normal and Reverse positions.
- Check lock clearance in both Normal and Reverse positions (Max. clearance is 2mm)
- Check detection in both Normal and Reverse positions, with point of blade open:
  - 4mm - contacts make
  - 6mm - contacts open
- Lubricate as per Figure 1.
- Motor maintenance:
  - Check/clean commutator.
  - Check for sufficient brush length.
  - Check brush spring pressure:
- Ensure brushes slide freely in their holders and seat fully on the commutator.
- Check all wiring and electrical connections.
- Ensure correct manual operation (Normal and Reverse positions).
- Verify that crank handle cut-out switch operates in accordance with manufacturer's specification.

Clutch maintenance:

- Check clutch operation and slip current (12.0 A ± 10%) or run +50% which ever is greater.
- Check selector clutch adjustment.
- Check controllers and contacts.
- Check all fastenings are secure.

When complete, test operation of point machine manually and then electrically.

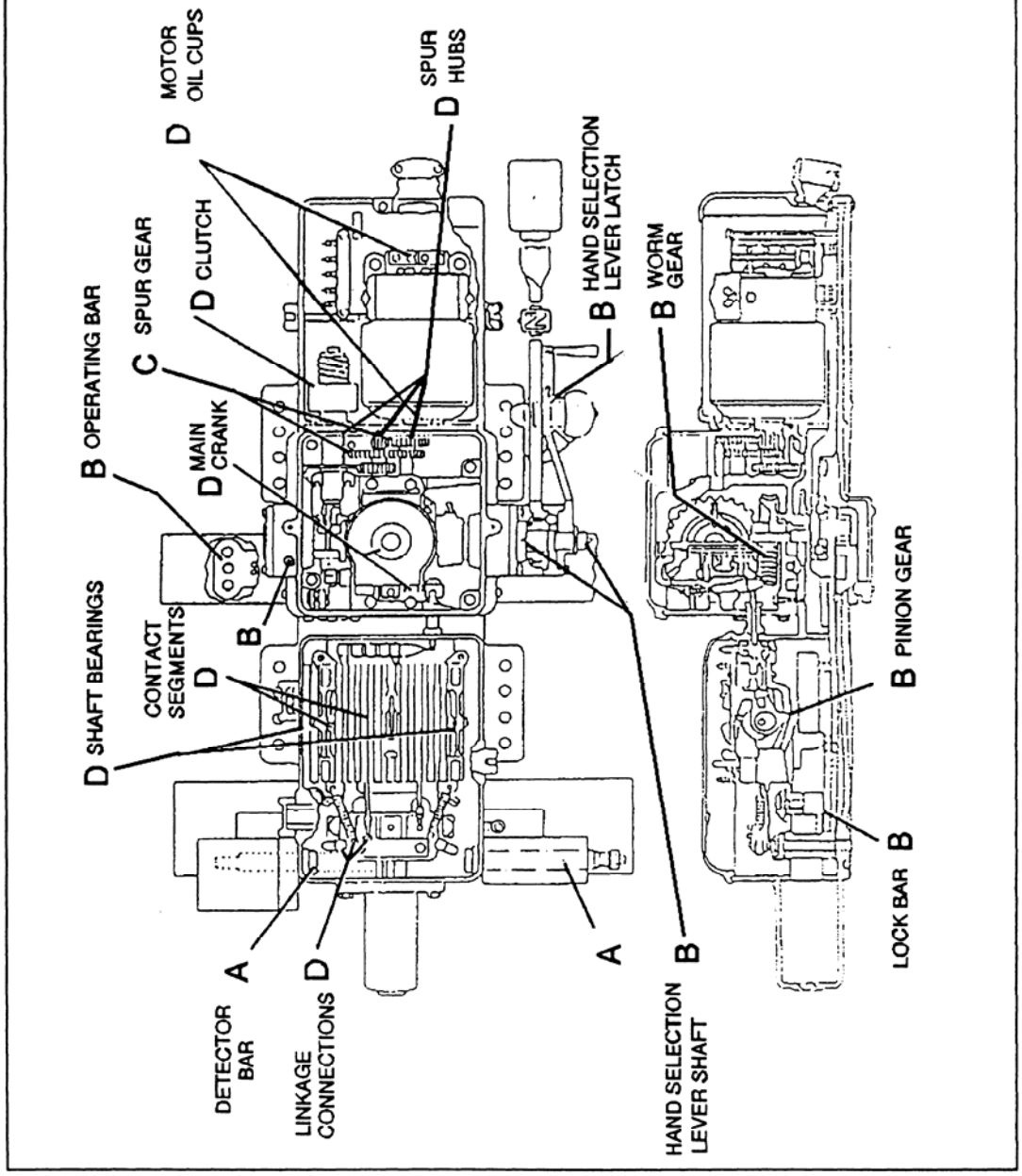
Legend for Figure 1

Lubricants

A Molybond 122L (dry)

B Molvbond CA10

Figure 1 Lubrication Diagram For M23A (or M23B) Switch Machine



7.5.1.2 Point Machine – Westinghouse M70 MK11 and 111

- Check physical condition of switch machine; internal, external and layout.
- Ensure blade abuts stockrail in both Normal and Reverse positions.
- Check lock clearance in both Normal and Reverse positions. (Max. clearance is 2mm).
- Check detection in Normal and Reverse, with point of blade open:
  - 4mm - contacts make
  - 6mm - contacts open
- Lubricate as per Figure 1 or 2.
- Motor maintenance:

- Check/clean commutator.
- Check for sufficient brush length.
- Check brush spring pressure:
- Ensure brushes slide freely in their holders and seat fully on the commutator.

- Check all wiring and electrical connections.
- Ensure correct manual operation (Normal and Reverse).
- Verify that crank handle cut-out switch operates in accordance with manufacturer's specification.
- Clutch maintenance:
  - Check clutch operation and slip current (12A Mklll, 15A Mkll).
  - Check motor protection unit and cut off time (10 sec ± 25%).
- Check controllers and contacts.
- Check all fastenings are secure.

When complete, test operation of point machine manually and then electrically.

Figure 1 Lubrication Diagram For M70 MkII Electric Switch Machine

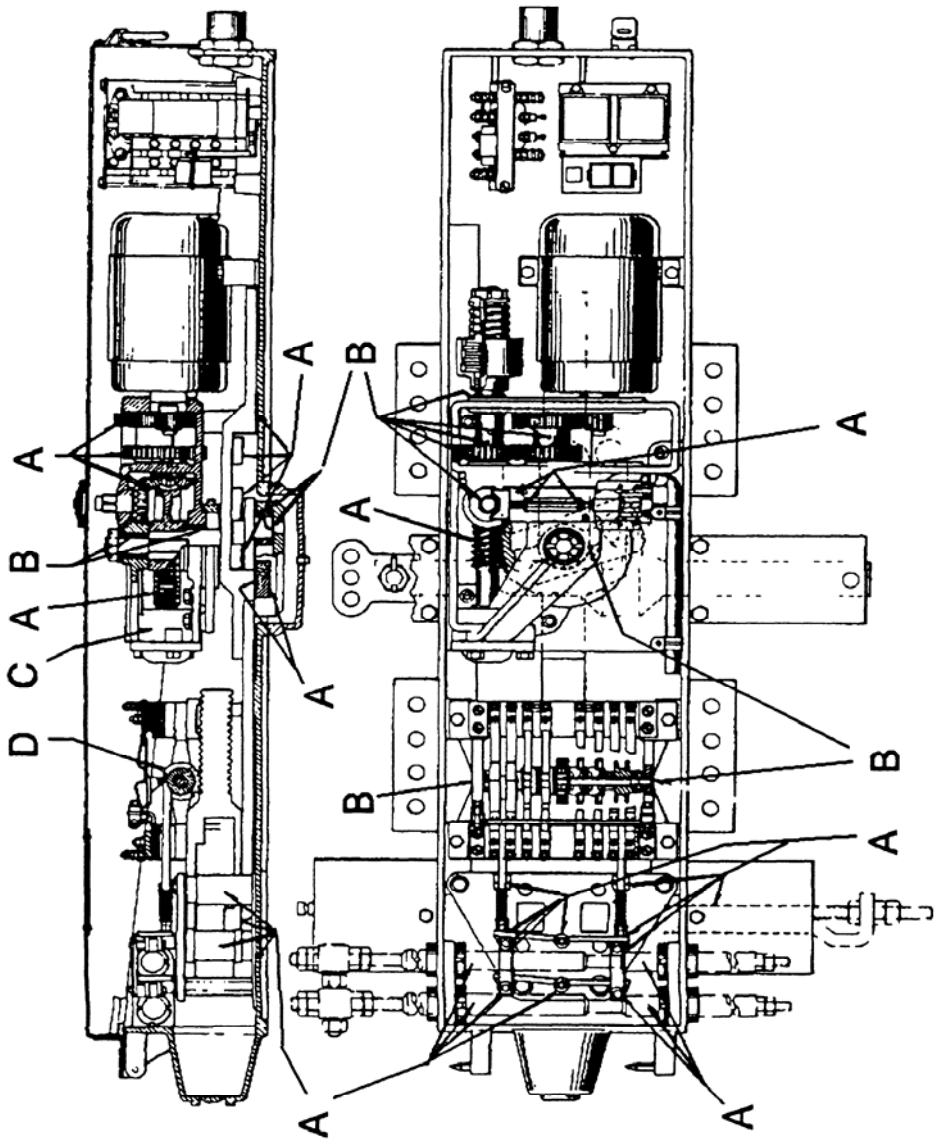
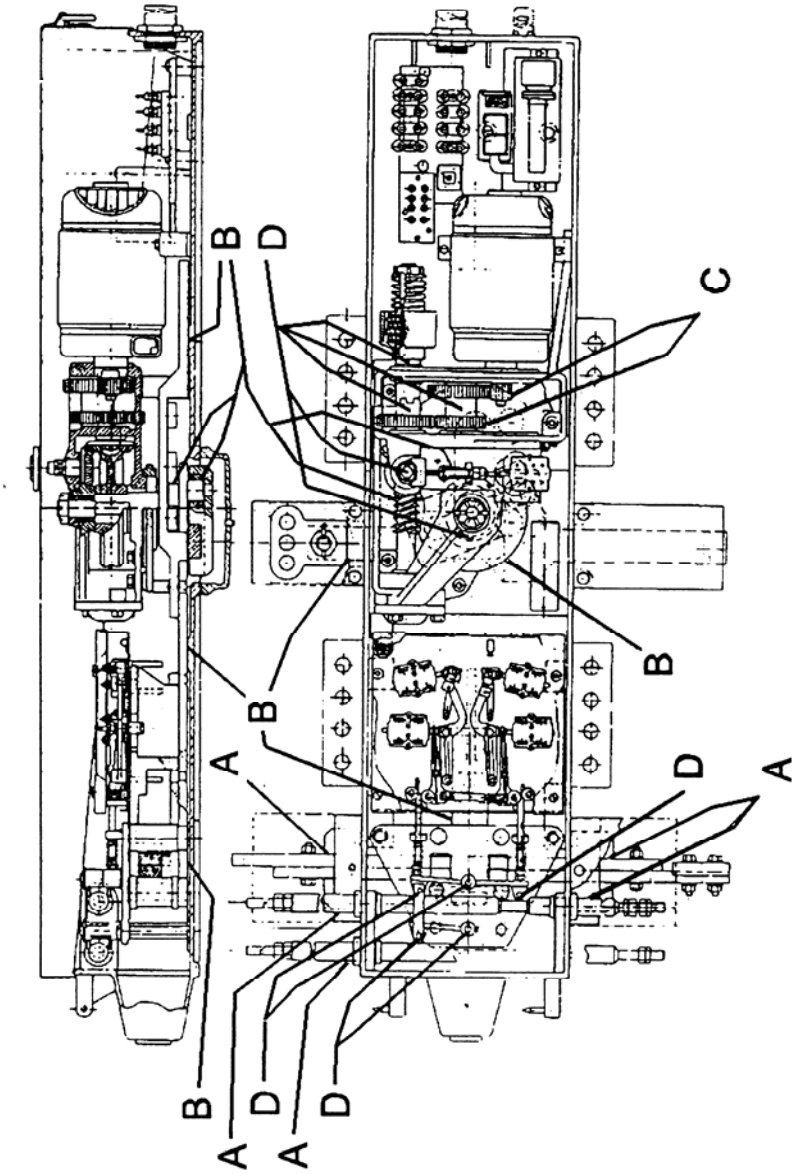


Figure 2 Lubrication Diagram for M70 MkIII Electric Switch Machine



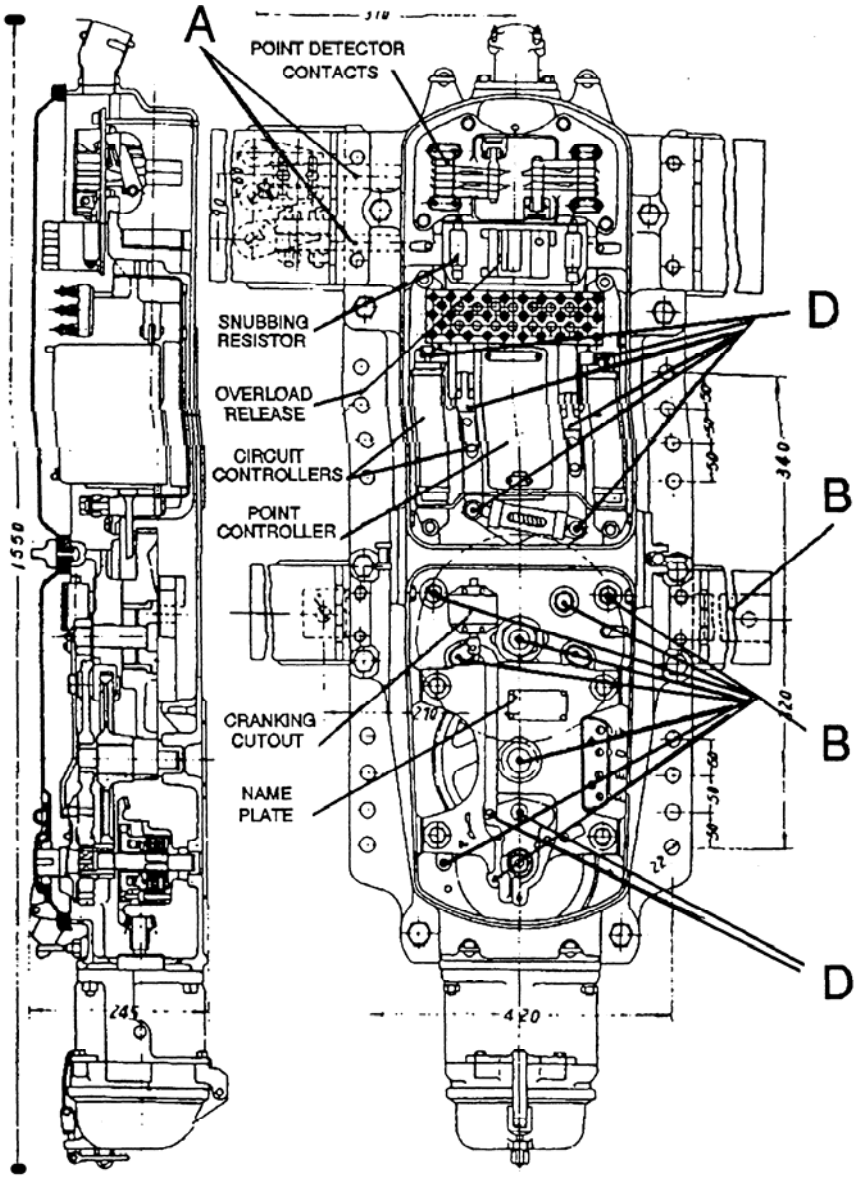
7.5.1.3 Point Machine – Nippon Series

- Check Physical condition of point machine; internal, external and layout.
- Ensure blade abuts stockrail in both Normal and Reverse positions.
- Check lock clearance in both Normal and Reverse positions. (Max. clearance is 2mm.)
- Check detection in both Normal and Reverse positions, with point of blade open:
  - 4mm - contacts make
  - 6mm - contacts open
- Lubricate as per Figure 1.
- Motor maintenance:
  - Check/clean commutator.

- Check for sufficient brush length.
- Check brush spring pressure.
- Ensure brushes slide freely in their holders and seat fully on the commutator.

- Check all wiring and electrical connections.
- Ensure correct manual operation. (Normal and Reverse positions).
- Verify that crank handle cut-out switch operates in accordance with manufacturer's specification.
- Clutch maintenance:
  - Check clutch operation and slip current (5.5 A).
  - Check operation of overload release relay.
- Check controllers and contacts.
- Check all fastenings are secure.
- When complete, test operation of point machine manually and then electrically.

Figure 1 Lubrication Diagram For Nippon Series Switch Machines



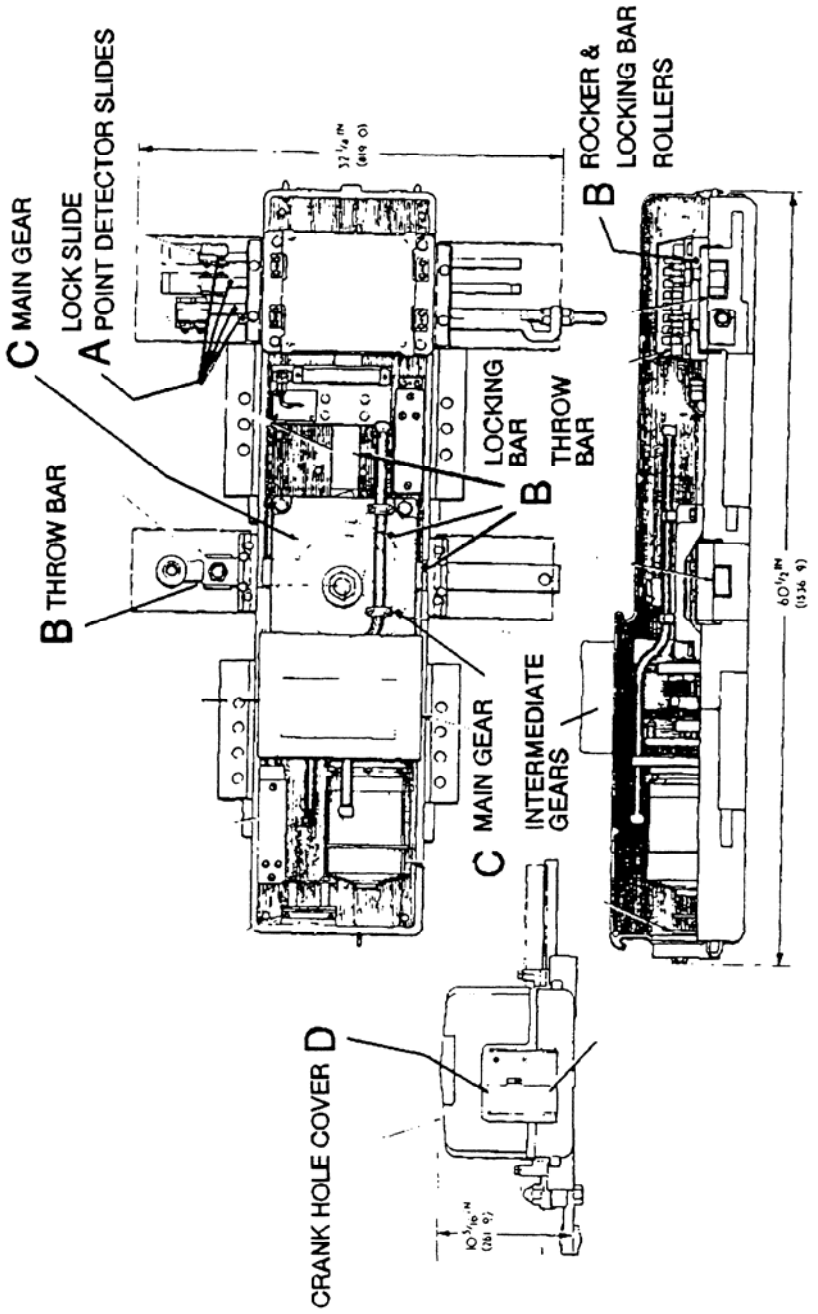
7.5.1.4 Point Machine – GEC HW

- Check physical condition of point machine; internal, external and layout.
- Ensure blade abuts stockrail in both Normal and Reverse position.
- Check lock clearance for both Normal and Reverse positions (Max. clearance is 2mm).
- Check detection in both Normal and Reverse positions, with point of blade open:
  - 4mm - contacts make
  - 6mm - contacts open
- Lubricate as per Figure 1.
- Motor maintenance:
  - Check/clean commutator.

- Check for sufficient brush length.
- Check brush spring pressure.
- Ensure brushes slide freely in their holders and seat fully on the commutator.

- Check all wiring and electrical connections.
- Ensure correct manual operation (Normal and Reverse positions).
- Verify that crank handle cut-out switch operates in accordance with manufacturer's specification.
- Clutch maintenance:
  - Check clutch operation and slip current (12.0 ± 1.5 A).
  - Check operation of overload release relay.
- Check controllers and contacts.
- Check all fastenings are secure.
- When complete, test operation of point machine manually and then electrically.

Figure 1 Lubrication Diagram for GEC HW Electric Switch Machine



7.5.2 Servicing Manual Operated Point

7.5.2.1 Switchstand

Inspect and lubricate Switch Layout in accordance with SECTION 2.5.5

Inspection

Examine the switchstand and layout for damage caused by "runthrough".

Check that the switchstands legs are straight, not twisted, and that the switchstand shaft is not twisted, there is no damage to the yoke, table or handle and that the actuating rod is correctly aligned and not deformed.

After noting the position of the switches, unlock the switchstand.

If the switch has been, or is suspected of having been, "runthrough", the switchstand must be replaced with a new or reconditioned unit.

The switches must not be used for train movements unless clamped in the required position.

Lubrication

Grease the table bearing, actuating rod pin, main shaft pivot and the handle pivot on the switchstand.

Check targets (if applicable) for condition, and correct indication.

Clean if necessary.

Adjustment

To adjust the blade to fit to stockrail:

Loosen the TWO thin lock nuts securing the thimble furthest from the blade to be adjusted.

Rotate the thick nut until the blade nose touches the stockrail.

Rotate the thick nut an extra one half turn to apply a light pressure.

Check the blade fit by operating the switchstand. If the fit is correct, tighten the TWO thin lock nuts.

Repeat the procedure for the opposite blade.

Switchstand Layout With Outlying Switch Lock.

Check that the lock opening at the point of the blade to stockrail is **2 millimetres**.

Adjustment is made by the thread that locates the lock rod to the switch front bar.

Open the switch lock door, noting that the door switch plunger is operating correctly, and reverse the lock handle.

Operate the switchstand, observing that it moves smoothly and completely through its full travel.

Switchstand With Circuit Controllers

Check the rods, pins and bearings. Clean and lubricate if required.

Layout With Rodline And Derail

The rodline and derail should operate smoothly through its full travel, the derail ramp is clear of the flange path in Reverse, and a shoulder on the derail that mates flush to the gauge face of the stockrail in the Normal position.

Adjustment is by the adjustable sleeve crank and adjustable jaw at the derail.

On Completion of Maintenance Action

Return the switchstand to the original position (Normal) and secure with an "S" lock.

Return the Outlying Switch Lock handle to the normal locked position, close and lock the doors and ensure correct lock orientation:

JA409 lock on signal equipment side.

"S" lock on operations side.

7.5.2.2 GRS9 Switch Machine Circuit Controller Adjustment

Normal Point Detection

Put the hand-throw lever in its normal position, and adjust the detector bar so that the detector roller on the latch-bar actuator is in the normal notch in the detector bar as shown in **Figure 1.**

Check that the contacts on the normal controller are now positioned as they should be when the switch is in its locked normal position.

Connect the detector bar to the switch point.

Adjust the connections so that the detector bar is pulled slightly toward reverse - just enough to start the detector roller up the side of the notch in the detector bar.

Check for slight motion of the latch-bar actuator away from the end wall of the machine housing.

Check that contacts have not been changed from positions set up in step 1 above.

Lock adjustments in place.

Throw the switch toward reverse far enough to open the normally closed point an inch or two, then return toward normal, at the same time putting a 6 mm obstruction gauge between the point and the stock rail, 150 mm back from the tip of the point.

Continue the motion of the hand-throw lever toward normal, exerting force as required, until the mechanism comes to a solid stop. This will happen when the locking dog hits the lock rod, since the lock rod will be out of position because of the obstruction.

Note the position, open or closed, of the contacts on the circuit controller. These should now be reversed from the positions, open or closed, that they were in for step 1.

Leave the hand-throw lever in the last position reached, and insert a point-detector adjustment gauge over the end wall of the machine housing, as indicated in **Figure 2**, clamping the gauge to the housing by means of screw A.

The gauge should be inserted so that the inclined surface is in contact with the latch-bar actuator, but should not be forced beyond this point.

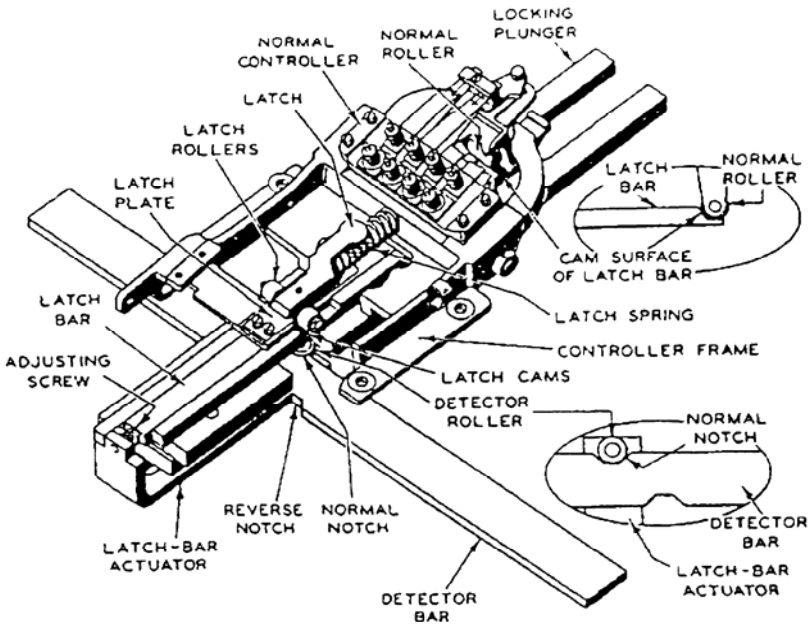


Figure 1 **Normal Circuit Controller Mechanism With Switch Points and Hand-throw Lever in Normal Position**

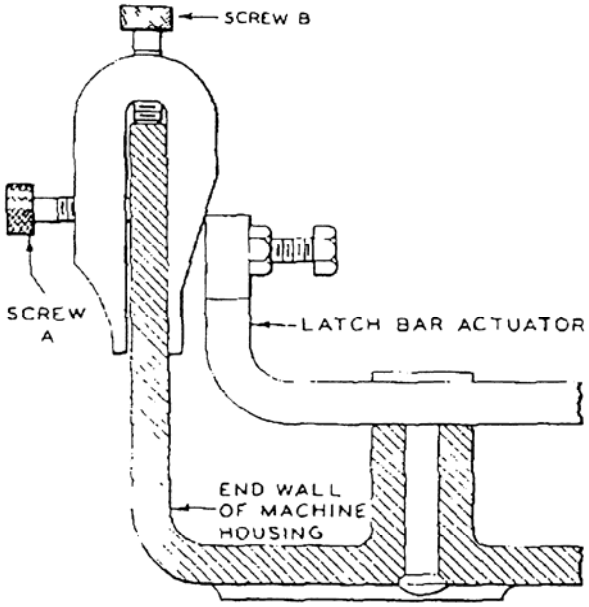


Figure 2 **Point-detector Adjustment Gauge in Position to Check Normal Point Detector. GRS No.P50-756.**

Open the switch points slightly, remove the obstruction gauge, and return the hand-throw lever to the full normal position.

Examine the circuit controller contacts. These should still be in the positions noted when the switch point was blocked by the obstruction gauge. (Slight motion of the controller rocker as the switch is thrown full normal is not objectionable, so long as the contact positions remain satisfactory.)

If the controller contacts do not remain as noted above, readjust the connections to the switch point.

Throw the switch about half-way toward reverse, and remove the point-detector gauge from the housing.

Normal and Reverse Point Detection

Same as for: *Normal Point Detection* - Bearing in mind that all references to "controller" in that section refer to the normal controller.

Throw the switch reverse.

Check that the reverse circuit controller contacts are in the proper positions, open and/or closed as required for this switch position.

Loosen screw C, Figure 3 on the reverse controller clamp.

By turning one of the hex heads on either end of the shaft on which the clamp is mounted, centre the reverse detector roller in the reverse notch in the detector bar.

Tighten the clamp screw.

Throw the switch toward normal far enough to open the reverse-closed point an inch or two, and then return toward reverse, at the same time putting a 6 mm obstruction gauge between the point and the stock rail 150 mm back from the tip of the point.

Continue the motion of the hand-throw lever toward reverse, using such force as can be conveniently applied by hand, until the lever will go no farther.

On machines with reverse locking, this will happen when the reverse locking dog hits the lock rod assembly, since the lock rod is out of position because of the obstruction.

On machines not equipped with reverse locking, the limit of travel of the hand-throw lever under reasonable force varies with the switch point adjustment.

Note the position, open or closed, of the contacts on the reverse circuit controller. These should now be reversed from the positions, open or closed, that they were in for step 6 preceeding.

Leave the hand-throw lever in the last position reached, and set the point-detector gauge on the floor of the machine housing, under the reverse controller clamp, as shown in Figure 3.

Back out screw B on the top of the gauge until it comes into snug contact with the bottom surface of the reverse controller clamp, but do not force it beyond this point.

Leaving the gauge in this position, remove the obstruction from the switch point, and throw the switch to full reverse.

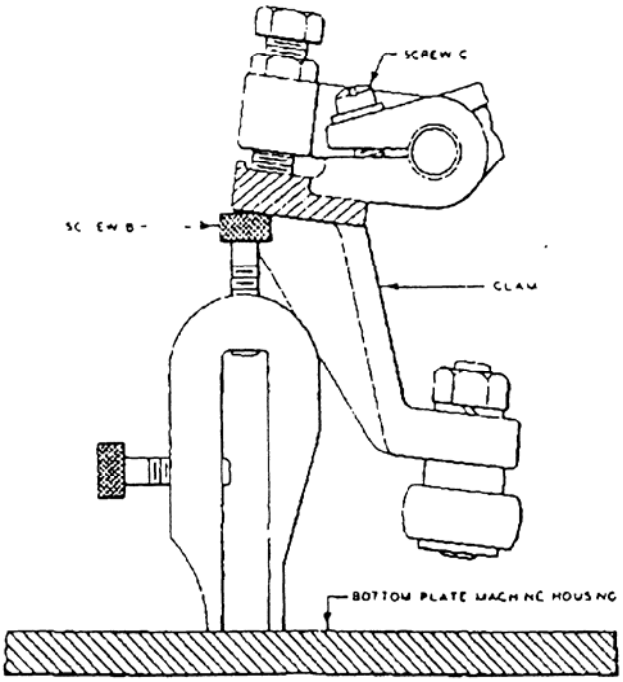


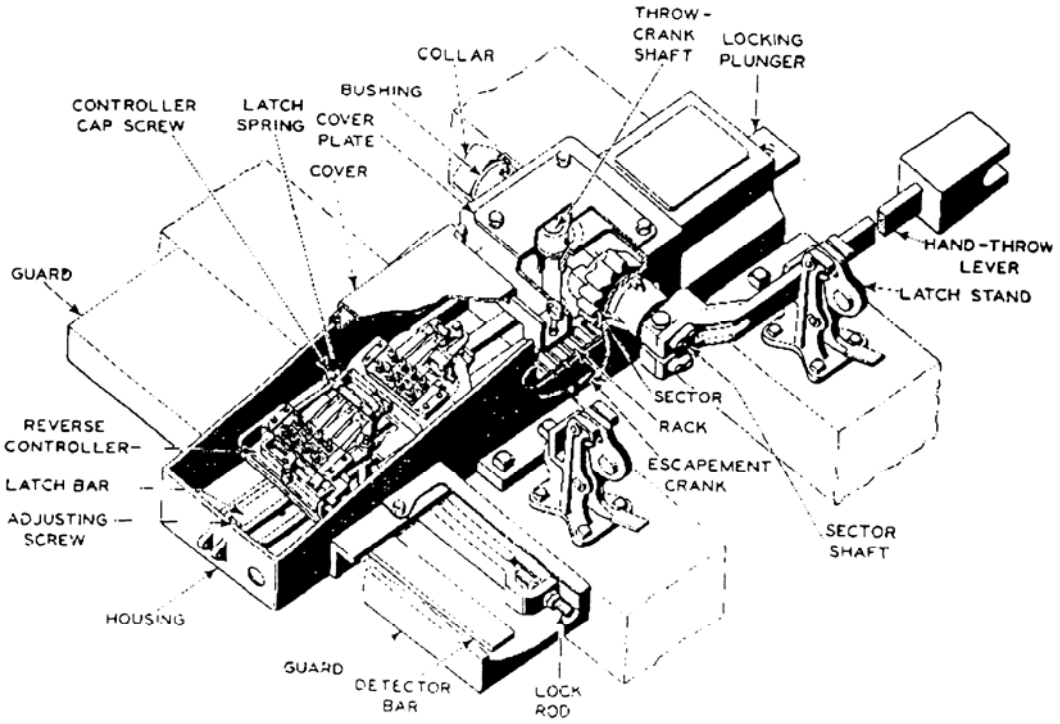
Figure 3 **Point-detector Adjustment Gauge in Position to Check Reverse Point Detector**

Examine the reverse controller contacts. These should still be in the positions, open or closed, noted when the switch point was blocked by the obstruction gauge. (Slight motion of the reverse controller as the switch is thrown full reverse is not objectionable so long as contact positions remain satisfactory.)

If the reverse controller contacts do not remain as noted when the point was obstructed, repeat step 7.

Remove point-detector gauge from the machine.

Figure 1 GRS Model 9 Switch Machine – Cutaway View



Spring Lever

Service the Switch Layout in accordance with SECTION 7.6.1.

Mechanism Inspection

Check the lever mechanism, pins and cranks for wear, the mechanism spring for fractures and tension, the spring adjustment nuts for tightness and that the actuating rod is correctly aligned and not deformed.

Check that the mechanism is not coil bound at half travel, and that the blade pressure is the same in Normal and Reverse positions.

Adjustment

If the blade pressure in Normal and Reverse positions varies:

Check that the problem is not blade fit or a binding heel.

To balance the pressure, adjust where the actuating rod thread connects to the front spreader bar. When the lever is at half travel, the blades should also be at half travel.

If the spring tension is insufficient to close the blade from half travel, check the spring condition and the point of blade opening.

Note: The point of blade opening should be 115 millimetres. If it is wider, the spreader bars should be reset, renewed or redrilled.

Lubrication

Grease and/or oil the lever mechanism.

7.5.3 Locking Devices

7.5.3.1 Outlying Switch Lock

Perform physical maintenance to associated Switchstand and other equipment etc., in accordance with SECTION 7.5.4.1.

External

Examine unit for physical damage.

Ensure unit is securely mounted to switch layout.

Ensure all fittings are secure.

Internal

Ensure housing is not damaged and is weather and vermin proof.

Check lock 2mm (plunger has clearance in lock bar).

Examine drum controller contacts (clean, adjust and lubricate sparingly with Vaseline, as required).

Examine door contact assembly (clean, adjust and lubricate, as required).

Check armature and indicating arm, lightly oil linkages.

Check all connections and terminations.

Return OSL to NORMAL position and secure.

Ensure correct padlock orientation i.e. 'S' lock on operation side and JA409 lock on signal equipment side.

7.5.3.2 Switch and Lock Mechanism

Service the Switchstand in accordance with SECTION 7.5.4.1.

Service the Switch Layout in accordance with SECTION 7.6.1.

Lock Mechanism Inspection

Examine the mechanism for:

- Loose rivets, bolts, pin wear, alignment and damage.
- Flat spots on the rollers and that the rollers rotate freely.
- Wear or indentation on the actuating rod crank where it comes into contact with the driving bar roller.
- Excessive wear or rounded edges on the lock bar cutouts or the locking dogs on the driving bar.

Operation

Operate the switchstand.

The correct method is:

Release the switchstand handle and move the switch to about half travel.

Reposition your body for balance, and complete the operation in one smooth action.

Adjustment

- Loosen the TWO thin lock nuts securing the thimble furthest from the blade to be adjusted.
- Rotate the thick nut until the nose of the blade touches the stockrail.
- Rotate the thick nut an extra one half turn to apply light pressure.

- Check the blade fit by operating the switchstand.
- If the fit is correct, tighten the TWO thin lock nuts.
- Repeat the procedure for the opposite blade.
- Check that the driving bar in the mechanism travels fully to the stops in both Normal and Reverse positions. Adjust as necessary to get full travel.

Note: If the driving bar does not travel fully to the stops, the lock dogs may not enter the lock bar cutouts.

- Check that the lock opening in both Normal and Reverse positions, at the point of blade to stockrail, is **2 millimetres**.
- Adjustment is made by the thread on the end of the lock rod,where the rod connects to the front bar.
- Adjustment will effect the lock clearance in Normal and Reverse positions.
- Minor adjustment may also be made by altering the blade opening.
- This is done by adjusting the length of the front bar.

*Note: Any adjustment to the blade opening or front bar, will effect the lock clearance and blade pressure or fit, in both Normal and Reverse positions, and all will have to be reset***.**

Lubrication

Mechanism:

Grease the pins, driving bar, crank, bearing surfaces and the lock bar guide.

7.5.4 Circuit Controller

Examine physical condition of circuit controller and associated linkage.

Ensure controller is firmly attached to the timbers.

Check mechanical linkage for excessive wear.

Ensure cable entry and lid are sealed against weather and vermin.

Ensure terminal board is firmly attached and free from cracks.

Examine main bearings, rollers and cams for wear, lubricate main bearings through grease nipples if fitted, oil cams, rollers and pivots, wipe off excess oil.

Examine contacts for corrosion, burn marks and wipe (0.75mm).

Adjustment

- Switch Controller
  - Insert 4mm switch gauge between blade and stock rail. Contacts should be just making.
  - Insert 6mm switch gauge between blade and stock rail .Contacts should be clearly open.
- Derail Controller.
  - Normal detection contacts open when the derail block is raised 25mm above the crown of the rail.
  - Reverse detection contacts close when the derailing block is within 25mm of full reverse travel.
- Facing Switch Lock Controller.

- Detection contacts should open just before the locking plunger is withdrawn from its slot or hole in the bar.

7.5.5 Switch Layout

Layout Inspection

- Clear area of weed growth and debris to facilitate inspection.
- Examine all bolts and fastenings for tightness (bolts on blade and spreader bars must be fitted with split pins).
- Check all bars and rods for distortion or damage, straighten if necessary.
- Check physical condition of timbers, bearers and chairs.
- Ensure all rods and bars are not fouled by ballast or debris when travelling and are not fouling on timbers.
- Check track gauge, alignment and that track is adequately tamped.
- Check stockrail for damage or excessive burr that will effect alignment or seating of the blade to the stockrail.
- Check blade fit to stockrail, examine point of blade for chips or cracks.
- Check placement and tightness of distance studs and tighten if necessary.
- Remove any foreign matter between the blade and stockrail.
- Measure blade opening:
  - Ideal 115mm
  - Min.110mm
- Measure flange clearance:
  - Ideal 45mm
  - Min.40mm
- Report clearances of less than 40mm to the Area Coordinator.
- Inspect any associated rod lines for alignment, physical defects and any obstruction to free movement.

Lubrication

- Check lubrication of chairs and stockrails, ensure area is covered with an even coat of Rocol and is free from chips, flaking or corrosion.
- If necessary to recoat, clean surface of rust and loose material, apply thin even coat of Rocol allowing time to dry before turning switches to inspect/lubricate the other side.
- Lubricate thimbles with oil. Ensure Molybond lubricant is not built up on the shoulder of the thimble.
- Oil pivot points on layout i.e. circuit controller rod, heel pivot, applying a light coat to actuating rod threads.
- Grease angle and sleeve cranks, compensators and indicator mechanisms, if fitted.
-