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Point Mechanisms

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1.0	May 26		First Issue - supersedes SPS 16 (V1.3) and incorporates Electro Hydraulic Mechanisms, and stretcher bars.

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1 Introduction

1.1 Purpose

The purpose of this specification is to define the requirements for point drive mechanisms for use on Australian Rail Track Corporation Infrastructure.

1.2 Scope

This specification covers electric, electro hydraulic and claw lock point mechanisms.

1.3 Document Owner

The Manager Engineering Services is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

1.4 Reference Documents

The following documents support this procedure:

- SMS 05 The Claw Lock Mechanism Description and Operation
- ESS-00-03 Environmental Conditions
- ESA-11-01 - Cables for Railway Signalling Applications
- ETS-03-00 - Section 3: Points & Crossings
- ESS-06-01 - Facing Point Lock and Detection Testing

1.5 Quality Assurance

Railway Point Mechanism manufacturers and/or assemblers are expected to hold Quality Assurance Certification to AS/NZS ISO 9000:2015.

1.6 Warranty

All point mechanisms and associated parts, supplied to this specification or any Appendix thereto, shall be warranted against defect in manufacture and/or assembly for a period of 2 years from date of manufacture.

1.7 Service Life

Point Mechanisms and all related components shall be manufactured and assembled to maximise reliability, availability and maintainability and shall be designed, manufactured and assembled to provide a minimum service life of at least 25 years given normal consumable item replacement

1.8 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
ARTC	**Australian Rail Track Corporation Ltd.**
Back drive	**Additional drive connection/mechanism associated with the turnout drive arrangement (referenced where insulation is required "to any back drive").**
Circuit controller	**Mechanism providing electrical contacts to detect/prove switch position (used with claw lock electric drives).**
Claw	**Locking element of a claw lock mechanism that locks the switch to the stockrail, operating in a horizontal or vertical plane.**
Claw bracket	**Bracket fixed to the switch rail that supports the claw/drive interface and accommodates switch creep without binding.**
Claw lock (locking bracket / box)	**Fixed component mounted to the stockrail that receives the claw and provides the locking face/engagement.**
Coupling	**Mechanical connection between slides/rods or drive components (e.g., pin/bolt coupling in the vertical plane).**
Detector rod	**Rod(s) connected to the switch rail (where required) to transfer switch movement to detection/circuit controller elements.**
Detector slide	**Sliding element (or equivalent) that operates detection contacts based on switch position.**
DLD	**(Drive/Locking/Detection unit) and Power unit (hydraulic power pack) as used by UNISTAR HR**
Drive bar	**(Claw lock context) Bar transmitting the drive force to the claw lock mechanisms; also subject to insulation requirements.**
Emergency manual operation	**Manual means to operate the mechanism during failures (e.g., crank handle or hand throw lever depending on machine type).**
Facing Point Lock (FPL)	**Positive mechanical device that locks the switch rail to the stockrail and cannot be disengaged by an external force (per specified limits).**
Full stroke position	**End-of-travel position of the drive mechanism at Normal or Reverse.**
Gear train / gearbox	**Mechanical transmission/reduction between motor and the drive/throw mechanism.**
Hand throw lever	**Manual operating lever used for emergency/manual operation**
Latch	**Mechanism that holds a pneumatic motor at the end of stroke; includes engagement distance and manual release provisions.**
Lock slide / lockslide	**Sliding element containing notch(es) that receive the locking element to achieve FPL.**

Term or acronym	Description
Locking dog	**Locking element that enters notch(es) in the lockslide to secure the FPL.**
Non-trailable	**Not designed to be forced through by a trailing movement; forcing is not permitted and may cause damage.**
Overload clutch	**Protective clutch that slips under excessive load to protect motor/gear train.**
Stockrail	**The fixed rail against which the switch rail closes and can be locked.**
Switch (switch rail)	**The movable rail(s) that shift to direct the route through a turnout.**
Switch creep	**Longitudinal movement of the switch rail that the mechanism must accommodate without binding**
Throw (stroke)	**The travel of the drive mechanism from Normal to Reverse**
Trailable	**Ability of the turnout mechanism to be forced through by the passage of a train from the trailing direction without damage**
Turnout	**Track arrangement enabling a train to diverge from one track to another, incorporating switch rails and stock rails.**

2 Conventional Electric Switch Machine

2.1 General

The conventional electric switch machine shall be of the non-trailable type.

Reversal of the machine for left or right hand operation shall involve no more than reversal of the lock and detector slides and, where necessary, re-termination of motor control wiring.

2.2 Maintenance

Machines shall be designed such that regular periodic maintenance requirements are not necessary at less than 12 weekly intervals. Components which do require regular maintenance or lubrication shall be readily accessible and it shall be possible to carry out this regular maintenance without having to disconnect the machine from the turnout.

2.3 Operating Environment

The machine shall be subject to the environmental conditions listed for Category D1 equipment in ESS-00-03 and, in addition, the possibility of water entry during periods of local flooding.

Materials used in and lubricants used in or recommended shall be such that variations in ambient conditions within the specified range have no effect on operation or reliability. Additionally, short-term water entry (e.g. dried and cleaned within 72 hours) shall not cause long-term loss of reliability.

2.4 Performance Requirements

2.4.1 Thrust

The machine shall provide a throw bar thrust equal to or greater than that shown in the test load diagram in Appendix A when the nominal rated voltage is available at the motor terminals. In addition the machine, when in the full stroke position, either normal or reverse, shall be capable of withstanding a force of 1700 Kg applied externally to the throw bar, without suffering damage of any form.

2.4.2 Facing Point Lock

The facing point lock shall be a positive mechanical device which cannot be dis- engaged by a force applied external to the machine. The notch(es) in the lockslide shall not be more than 4 mm or less than 3.2 mm wider than the locking dog which enters them.

2.4.3 Operating Time

With the nominal rated voltage applied at the motor terminals and for the loading requirements of Appendix A, operating times shall not exceed:

- Low voltage (20v DC) machines 15.5 seconds
- Medium voltage (50v DC) machines 11 seconds
- High voltage (110v AC or DC) machines 5.5 seconds

2.4.4 Throw Bar Travel

Throw bar travel shall be 145 - 155 mm

2.4.5 Lock and Detector Adjustment Range

The Facing Point Lock and Detector shall provide for a range of switch openings between 107 and 125 mm unless specifically ordered otherwise. Adjustment shall be infinitely variable between these limits.

Notches in the detector slide and rollers activated therefrom shall be sized and shaped so that the slide movement between the detection contacts being open, with no possibility of momentary make due to vibration, and the detection contacts being just closed, without wipe, is not more than 1.6 mm.

2.4.6 Lock and Detector Marking

To enable simple visual checking of lock and detector adjustment, locks and detectors shall be marked external to the case such that:

With the mark aligned with the side of the mechanism case or a securely fixed pointer, the locking dog is in the centre of the notch in the lockslide and the detection contacts are fully made including any wipe.

For the lock: With the mark on the respective lockslide misaligned by 2.4 mm in either direction, the locking dog shall fail to enter the notch. With the mark on the respective lockslide misaligned by 1.6 mm in either direction, the locking dog shall enter the notch.

For detection: With the mark misaligned by 4.8 mm in the direction of the opening switch, detection contacts shall be open sufficiently to prevent the possibility of momentary make due to vibration. With the mark misaligned by 3.2 mm detection contacts will have made but not completed any wipe or compression.

2.5 Drive Mechanism

2.5.1 Motor

The low voltage DC motor shall be a series wound type.

The medium voltage DC motor shall be a series wound or permag type. The high voltage DC motor shall be a permag type.

The high voltage AC motor shall be a capacitor start induction type. Operating Voltages shall be:

Low voltage DC	20v	±4 volts
Medium Voltage DC	50v	±8 volts
High voltage DC	110v	±15 volts
High Voltage AC	110v	±15v 50 hz

All motors shall be rated for a minimum of 15 minutes full load running per hour. Maximum running currents shall preferably not exceed:

15 amps for low voltage motors

12 amps for medium voltage motors

8 amps for high voltage motors

Starting capacitors for induction motors shall be rated to 220v minimum and terminals shall be provided on the capacitor case.

2.5.2 Clutch

An overload clutch shall be provided to protect the motor and gear train. Preferably the clutch shall be a multi-disk mechanical type.

Clutch slip settings shall be quoted as motor current for DC motors and slip torque or throw bar thrust for Induction motors.

2.5.3 Throw Mechanism

The drive for the throw mechanism shall be non-reversible at each end of the stroke,

i.e. a force applied externally to the throw bar shall not be able to move the throw bar.

2.5.4 Emergency Manual Operation

Emergency manual operation for the conventional switch machine shall take the form of a removable crank handle.

The crank handle shall be indexed such that a handle will only fit into a similarly indexed machine. A minimum of five (5) index codes are required. Crank handles shall fit into the top of the mechanism and be wound in the horizontal plane.

2.6 Electrical

2.6.1 Wiring

All internal wiring shall be double insulated and shall be mechanically protected by bush or conduit where it passes through or close to metal parts

The cable used shall be at least equivalent in both core and insulation to 7/0.5 single conductor described in Specification ESA-11-01. Conductor sizes in the motor operating circuits shall however be sufficient to ensure that voltage drop within the machine does not exceed 0.5 volts.

Installed wiring within the machine shall exhibit an insulation resistance to other wires and to frame of at least 100 MΩ when tested with a 500 volt megger.

2.6.2 Termination

All wiring, except where plug couplers are used, shall be terminated using heavy duty pre-insulated "supergrip" or similar lugs or pins. Where terminated in plug couplers, insulation grip shall be provided and wiring shall be firmly clamped to the plug coupler housing.

All internal wiring is to be brought to a single terminal block for connection to external wiring or cable. Terminals shall be screw post (2BA minimum) or rail mounted clamp type (Klippon SAK6 or equivalent minimum). Locking pins shall be used with rail mounted terminals. The terminals to accept motor mains shall accept conductor sizes from 7/0.85 to 7/1.7.

Plug couplers shall have gold flashed contacts if used in control and/or indication circuits and shall be rated to at least 200% of motor running current if used in the motor operating circuit. Plugs and sockets shall be positively locked closed by clip or collar.

2.7 Control and Indication

2.7.1 Detection and Facing Point Lock Indication

The contacts, which indicate the status of the facing point lock and the detection, shall preferably be operated independently of one another with no mechanical interlocking.

It shall be possible to test the adjustment of the detection without the necessity to disturb or disconnect the facing point lock and to test the adjustment of the facing point lock without disturbing or disconnecting the detection.

The contacts shall be of an enclosed or semi-enclosed type which do not require cleaning.

The driving arrangements of the contacts shall be such that, for normal field maintenance adjustments, there is no necessity to carry out any adjustment between the roller or cam follower in contact with the detector slide and the applicable contact. Any means of adjustment provided in this area for assembly shall be factory sealed.

One changeover contact made Normal and R-NI and one changeover contact made Reverse and N-RI shall be provided for lock indication.

Two changeover contacts made normal and R-NI and two changeover contacts Made reverse and NRI shall be provided for switch detection.

The contacts shall be suitable for switching 5 to 50 V DC and 120V AC low current circuits (gold flashed contacts are required) with a minimum current rating of 2 amps at 120VAC and 0.5A at 50VDC**. The contacts (switches) used shall be capable of operating in an environment of low to medium frequency vibration without variation in contact resistance. Electrical isolation between contacts shall be rated at not less than 1000 volts.

***Note that under some operating conditions a low current (mA) back emf of up to 400v may be experienced when the contacts open under load.*

2.7.2 Motor Control and Cut-out Contacts

Motor control contacts shall be in addition to detection and indication contacts but may be part of the same contact assemblies as the lock indication contacts provided that the electrical separation between contacts is rated to at least 1000 volts.

A contact shall be provided to open the motor circuit when the emergency crank handle is inserted into the machine.

2.7.3 Motor Contactor and Overload Timer

A motor contactor and motor overload timer are not required to be fitted to the machine.

2.8 Mechanism Casing and Couplings

2.8.1 Case

Machine cases may be manufactured from grey, spheroidal graphite or malleable cast iron, cast aluminium alloy or galvanised mild steel. The case material shall be guaranteed against failure due to corrosion or ageing for a period of 25 years.

The case shall be capable of tolerating a sleeper to sleeper misalignment (twisting) of up to 1º with no effect on the operation of the machine.

Case covers shall not exceed 20kg in weight but shall be capable of supporting a 100 kg load in the centre of the cover with a deflection of less than 1.5mm. The inside surface of the cover shall be treated to minimise condensation.

Seal(s) between case and cover shall be proof against entry of dust and water.

A 50 BSP cable entry shall be provided at that end of the mechanism closest to the terminal block.

2.9 Coupling to Points

Drive, lock and detector slides shall be pin or bolt coupled to their respective rods with the pin or bolt in the vertical plane.

Resilient or self-aligning bushes may be used provided that the bush is impervious to oils, greases and ultra-violet light and is suitably rated for the dynamic loads encountered. Otherwise, slides or lugs shall be fitted with hardened steel bushes.

Preferred bolt or pin sizes are 20 or 24 mm for lock and drive and 16 mm for detection.

3 Stretcher Bars

3.1 Function and Purpose

Stretcher bars (referred to interchangeably as stretcher bars and spreader bars within ETS-03-00) are rigid steel cross-members that connect the two switch rails of a set of points, maintaining them at a fixed relationship to each other. When the point machine or mechanical lever drives the switch rails from one position to the other, the stretcher bars transfer this movement along the full length of the switch, ensuring both switch rails move together as a single mechanical assembly.

3.2 Switch Opening

Switch opening is the gap between the back of the open switch rail and the adjacent stock rail, measured through the planed (machined) area of the switch.

ETS-03-00 defines the permitted tolerances for switch opening.

ESS-06-01 defines the detection tolerances for switch opening.

If the stretcher bars are correctly set, the designed switch opening will be present through the full planed length of the switch. The signalling detection system measures this clearance, but typically only at discrete locations — at the point machine (tip of the switch) and, where fitted, at supplementary detector positions through the mid-switch area.

Adequate clearance must be maintained continuously through the entire planed length of the switch. Stretcher bars achieve this by rigidly coupling both switch rails together, they ensure that when one switch rail opens to provide flangeway clearance, the opposite rail closes against its stock rail, and the designed switch opening is maintained at every point along the machined section of the switch rail.

3.3 Primary Functions

The primary functions of stretcher bars are to:

- Maintain switch opening through the full planed length: by coupling both switch rails, stretcher bars ensure the designed clearance between the open switch rail and stock rail is held continuously.
- Distribute the driving force from the point operating equipment along the length of the switch rails, so that the closed switch rail contacts the stock rail at all required points along its machined length;
- Maintain closed switch rail fit: ensure the switch rail closes firmly against the stock rail. Refer to ETS-03-00 for permitted tolerances on closed switch rail gap;
- Resist back-driving forces: prevent trailing movements through the points from displacing the switch rails beyond their designed limits; and
- Provide a mounting point for detection: lock stretcher bars in particular connect the locking and detection mechanism of the point machine to the switch rails, enabling the signalling system to verify the position of the switch rails.

3.4 Types of Stretcher Bar

There are two primary functional categories of stretcher bar:

Intermediate Stretcher bars maintain a constant distance between the two switch rails at intermediate positions along the switch, providing the primary mechanical integrity of the switch rail assembly. Depending on the design, their length can be fixed or adjustable.

Lock stretcher bars are fitted at the point of drive, connecting the locking mechanism of the point operating equipment to the switch rails. They are the means by which the point machine locks the switch rails in position, enabling the detection system to confirm that the points are correctly set and facing point locked.

Lock stretcher bars are fitted to all conventional electric power-operated points and to mechanically operated facing points fitted with a facing point lock.

4 Electro-Hydraulic Switch Machine

4.1 General

The conventional electro-hydraulic switch machine shall be of the non-trailable type.

Reversal of the machine for left or right hand operation shall involve no more than reversal of motor drive wiring.

4.2 Maintenance

Machines shall be designed such that regular periodic maintenance requirements are not necessary at less than 26 weekly intervals for a minor lubrication or 52 weekly intervals. Components which do require regular maintenance, or lubrication shall be readily accessible, and it shall be possible to carry out this regular maintenance without having to disconnect the machine from the turnout.

4.3 Operating Environment

The machine shall be subject to the environmental conditions listed for Category D1 equipment in ESS-00-03 and, in addition, the possibility of water entry during periods of local flooding.

Materials used in and lubricants used in or recommended shall be such that variations in ambient conditions within the specified range have no effect on operation or reliability. Additionally, short term water entry (e.g. dried and cleaned within 72 hours) shall not cause long-term loss of reliability.

4.4 Performance Requirements

4.4.1 Thrust

The hydraulic pressure is set prior to the machine leaving the factory, but provision shall be provided to ensure thrust equal to or greater than that shown in the test load diagram in Appendix A when in normal operation. In addition, the machine shall be fitted with an over pressure valve in the hydraulic system, which will release excessive pressure in the event of a failure. When in the full stroke position, either normal or reverse, the point machine shall be capable of withstanding a force 5 – 6kN applied externally to each drive bar, without suffering damage of any form.

4.4.2 Facing Point Lock

The facing point lock shall be a positive mechanical device which cannot be dis- engaged by a force, up to 90kN applied external to the machine.

4.4.3 Operating Time

With the nominal rated voltage applied at the motor terminals and for the loading requirements of Appendix A, operating times shall not exceed:

- Low voltage (20v DC) machines 15.5 seconds
- Medium voltage (50v DC) machines 11 seconds
- High voltage (110v AC or DC) machines 5.5 seconds

4.4.4 Throw Bar Travel

Available throw bar travel shall be 34mm - 160 mm

4.4.5 Lock and Detector Adjustment Range

The Facing Point Lock and Detector shall provide for a range of switch openings between 34mm and 160mm unless specifically ordered otherwise. Adjustment shall be infinitely variable between these limits.

4.4.6 Lock and Detector Marking

To enable simple visual checking of lock and detector adjustment, locks and detectors shall be marked external to the case such that:

With the mark aligned with the mechanism case or a securely fixed pointer, the lock prism is engaged in the lockslide and the detection contacts are fully made.

For the lock: With the mark on the respective lock plate misaligned by 2.4 mm in either direction, the lock prism shall fail to enter the notch. With the mark on the respective lockslide misaligned by 1.6 mm in either direction, the lock prism shall enter the notch.

For detection: With the mark misaligned by 4.8 mm in the direction of the opening switch, detection contacts shall be open sufficiently to prevent the possibility of momentary make due to vibration.

4.5 Drive Mechanism

4.5.1 Motor

The low voltage DC motor shall be a series wound type.

The medium voltage DC motor shall be a series wound or permag type. The high voltage DC motor shall be a permag type.

The high voltage AC motor shall be a capacitor start induction type. Operating Voltages shall be:

Low voltage DC	20v	±4 volts
Medium Voltage DC	50v	±8 volts
High voltage DC	110v	±15 volts
High Voltage AC	110v	±15v 50 hz

All motors shall be rated for a minimum of 15 minutes full load running per hour. Maximum running currents shall preferably not exceed:

- 15 amps for low voltage motors
- 12 amps for medium voltage motors
- 8 amps for high voltage motors

Starting capacitors for induction motors shall be rated to 220v minimum and terminals shall be provided on the capacitor case.

4.5.2 Clutch

An overload clutch shall be provided to protect the motor and gear train. Preferably the clutch shall be a multi-disk mechanical type.

Clutch slip settings shall be quoted as motor current for DC motors and slip torque or throw bar thrust for Induction motors.

4.5.3 Throw Mechanism

The drive for the throw mechanism shall be non-reversible at each end of the stroke,

i.e. a force applied externally to the throw bar shall not be able to move the throw bar.

4.5.4 Emergency Manual Operation

Emergency manual operation for the conventional switch machine shall take the form of a removable crank handle.

The crank handle shall be indexed such that a handle will only fit into a similarly indexed machine. A minimum of five (5) index codes are required. Crank handles shall fit into the top of the mechanism and be wound in the horizontal plane.

4.6 Electrical

4.6.1 Wiring

All internal wiring shall be double insulated and shall be mechanically protected by bush or conduit where it passes through or close to metal parts

The cable used shall be at least equivalent in both core and insulation to 7/0.5 single conductor described in Specification ESA-11-01. Conductor sizes in the motor operating circuits shall however be sufficient to ensure that voltage drop within the machine does not exceed 0.5 volts.

Installed wiring within the machine shall exhibit an insulation resistance to other wires and to frame of at least 100 MΩ when tested with a 500 volt megger.

4.6.2 Termination

All wiring, except where plug couplers are used, shall be terminated using heavy duty pre-insulated "supergrip" or similar lugs or pins. Where terminated in plug couplers, insulation grip shall be provided and wiring shall be firmly clamped to the plug coupler housing.

All internal wiring is to be brought to a single terminal block for connection to external wiring or cable. Terminals shall be screw post (2BA minimum) or rail mounted clamp type (Klippon SAK6

or equivalent minimum). Locking pins shall be used with rail mounted terminals. The terminals to accept motor mains shall accept conductor sizes from 7/0.85 to 7/1.7.

Plug couplers shall have gold flashed contacts if used in control and/or indication circuits and shall be rated to at least 200% of motor running current if used in the motor operating circuit. Plugs and sockets shall be positively locked closed by clip or collar.

4.7 Control and Indication

4.7.1 Detection and Facing Point Lock Indication

The contacts, which indicate the status of the facing point lock and the detection, shall preferably be operated independently of one another with no mechanical interlocking.

It shall be possible to test the adjustment of the detection without the necessity to disturb or disconnect the facing point lock and to test the adjustment of the facing point lock without disturbing or disconnecting the detection.

The contacts shall be of an enclosed or semi-enclosed type which do not require cleaning.

The driving arrangements of the contacts shall be such that, for normal field maintenance adjustments, there is no necessity to carry out any adjustment between the roller or cam follower in contact with the detector slide and the applicable contact. Any means of adjustment provided in this area for assembly shall be factory sealed.

One changeover contact made Normal and R-NI and one changeover contact made Reverse and N-RI shall be provided for lock indication.

Two changeover contacts made normal and R-NI and two changeover contacts Made reverse and NRI shall be provided for switch detection.

The contacts shall be suitable for switching 5 to 50 V DC and 120V AC low current circuits (gold flashed contacts are required) with a minimum current rating of 2 amps at 120VAC and 0.5A at 50VDC**. The contacts (switches) used shall be capable of operating in an environment of low to medium frequency vibration without variation in contact resistance. Electrical isolation between contacts shall be rated at not less than 1000 volts.

***Note that under some operating conditions a low current (mA) back emf of up to 400v may be experienced when the contacts open under load.*

4.7.2 Motor Control and Cut-out Contacts

Motor control contacts shall be in addition to detection and indication contacts but may be part of the same contact assemblies as the lock indication contacts provided that the electrical separation between contacts is rated to at least 1000 volts.

A contact shall be provided to open the motor circuit when the emergency crank handle is inserted into the machine.

4.7.3 Motor Contactor and Overload Timer

A motor contactor and motor overload timer are not required to be fitted to the machine.

4.8 Mechanism Casing and Couplings

4.8.1 Case

Machine cases may be manufactured from grey, spheroidal graphite or malleable cast iron, cast aluminium alloy or galvanised mild steel. The case material shall be guaranteed against failure due to corrosion or ageing for a period of 25 years.

The case shall be capable of tolerating a sleeper to sleeper misalignment (twisting) of up to 1° with no effect on the operation of the machine.

Case covers shall not exceed 20kg in weight but shall be capable of supporting a 100 kg load in the centre of the cover with a deflection of less than 1.5mm. The inside surface of the cover shall be treated to minimise condensation.

Seal(s) between case and cover shall be proof against entry of dust and water.

A 50 BSP cable entry shall be provided at that end of the mechanism closest to the terminal block.

4.8.2 Coupling to Points

Drive, lock and detector slides shall be pin or bolt coupled to their respective rods with the pin or bolt in the vertical plane.

Resilient or self-aligning bushes may be used provided that the bush is impervious to oils, greases and ultra-violet light and is suitably rated for the dynamic loads encountered. Otherwise, slides or lugs shall be fitted with hardened steel bushes.

5 Claw Lock Mechanisms and Drive Systems

5.1 The Claw Lock Mechanism

5.1.1 General

The claw lock mechanism shall be able to be driven by electric, pneumatic or hydraulic power units with a drive stroke between 180 and 200 mm. Sequence of operation shall be as shown in the diagrams in Appendix B, Figure B 1.

The mechanism shall be fixed to the switch and stockrail, and detector rods (where required) shall be fixed to the switch where shown in Appendix B, Figures B2 and B3.

Claw Locks shall provide for a switch opening of 125 ± 3 mm at the tip of the switch and, where used as 2nd and 3rd drives, for openings between 90 and 60 mm.

Bolts used in the assembly and fitting of the claw lock mechanism shall be zinc plated (or equivalent) and be fitted with self locking nuts. Galvanised bolts, if supplied, shall have the thread cleaned with a die nut to suit the self locking nuts.

5.1.2 Construction

Claws, brackets, drive bars and claw locks (locking bracket or box) shall be made of materials which are inherently suitable for, or are surface treated to be suitable for the bearing, friction and vibration loads which may be encountered with turnouts which require up to 500kg operating forces and are carrying up to 30 tonne axle loads.

All bearing surfaces, including pins and bushes shall be capable of a minimum of 350,000 operations before the total combined wear between the claw pivot pin and the locking face attached to the stockrail exceeds 1.5 mm.

The claw bracket shall provide for at least 25mm of switch creep (longitudinal movement) without causing any binding in the claw lock mechanism.

5.1.3 Adjustment

Adjustment of the mechanism shall be by shim between the claw bracket and the switch, preferably augmented by an eccentric bush around the claw pin. Shims shall be provided in 0.8, 1.6 and 2.4 mm thicknesses.

5.1.4 Lubrication

Provision shall be made for lubrication of the claw pin and rubbing surfaces on the claw, claw bracket and claw lock.

5.1.5 Drive Bar Insulation

The drive bar shall be insulated between the claw lock mechanisms on each side of the turnout. The assembled drive bar when tested with a 500 volt megger shall show a minimum insulation resistance of 100 Megohm. Insulation shall also be provided where the drive bar connects to the operating mechanism and to any back drive.

5.1.6 Connection to Operating Mechanism

The end of the drive bar shall be provided with two holes drilled in the vertical axis of 20.5 mm diameter at 76 ± 0.5 mm centres for connection of a link to the power unit. The innermost of these

holes shall be between 145 and 155 mm from end of the notch in the drive bar and the outermost hole shall be within 40 mm of the end of the drive bar. Refer to Appendix B figure B4

6 Electric Drive Systems for Claw Locks

6.1 General

The electric machine for the operation of claw locks shall be trailable and shall be of the dual control type; i.e. emergency manual operation shall be by hand throw lever in place of crank handle.

The mechanism shall contain a drive assembly (motor, clutch and gearbox) to operate the claw lock and a circuit controller to detect the position of the turnout switches.

Reversal of the machine for left or right hand operation shall involve no more than reversal of the detector slides and, where necessary, re-termination of the motor control wiring.

6.2 Maintenance

The provisions of Clause 2.2 shall apply

6.3 Operating Environment

The provisions of clause 2.3 shall apply

6.4 Performance Requirements

6.4.1 Thrust

The machine shall have an electric motor of sufficient capacity and be geared such that a maximum thrust of 9kN can be delivered at the nominal motor voltage and running current at any point in the stroke. (This figure assumes that the overload clutch is set to maximum capacity and that any breakaway trail clutch is by-passed.)

Machines shall be delivered ex-factory with the break-away trail clutch set to 3.9 - 4.2 kN unless otherwise stipulated in the particular order or contract.

It shall not be possible for any force less than the trail clutch setting to cause the machine to commence to move from the normal or reverse position.

6.4.2 Operating Times

The provisions of clause 2.4.3 shall apply

6.4.3 Throw Bar travel

Throw bar travel shall be within the range 180 to 200 mm

6.4.4 Detector (Circuit Controller) Adjustment

Detection shall, at the least, provide for switch openings in the range 110 to 135 mm

6.4.5 Motor

The provisions of clause 2.5.1 shall apply.

6.4.6 Clutch

The provisions of clause 2.5.2 shall apply

6.4.7 Emergency Manual Operation

Emergency manual operation shall be by hand throw lever. The machine shall also be provided with a power - manual selector lever which operates in the following sequence when changing from power to manual operation:

- Opens control circuits.
- Engages the hand throw lever then disengages the motor mechanism.
- Unlocks the hand throw lever.

From manual to power the selector lever shall:

- Prove that the hand throw lever is fully thrown (either direction) then lock the hand throw lever
- Engage the motor mechanism then disengage the hand throw lever
- Close control circuits.

The hand throw lever and selector lever shall be locked in the power position with a device locked by a "Fortress" key or similar. The device shall be such that the key is retained in the lock when the hand throw and/or selector levers are free to be moved.

6.5 Electrical

6.5.1 Wiring

The provisions of clause 2.6.1 shall apply

6.5.2 Termination

The provisions of clause 2.6.2 shall apply. In addition where a plug coupler and sockets are used to reconfigure the machine for right or left hand switch closed layouts, the unused socket shall be covered with a plate or have a dummy plug fitted with the words "Do Not Remove" engraved into it.

6.5.3 Control and Indication

One changeover contact made Normal and R-NI and one changeover contact made Reverse and N-RI shall be provided for lock indication.

Two changeover contacts made normal and R-NI and two changeover contacts Made reverse and N-RI shall be provided for switch detection.

The contacts shall be of an enclosed or semi-enclosed type which do not require cleaning.

The contacts shall be suitable for switching 5 to 50 V DC and 120V AC low current circuits (gold flashed contacts are required) with a minimum current rating of 2 amps at 120VAC and 0.5A at 50VDC**. The contacts (switches) used shall be capable of operating in an environment of low to medium frequency vibration without variation in contact resistance. Electrical isolation between contacts shall be rated at not less than 1000 volts.

***Note that under some operating conditions a low current (mA) back emf of up to 400v may be experienced when the contacts open under load.*

6.5.4 Motor Control and Cut-out Contacts

Motor Control contacts shall be provided in addition to the detection and indication contacts but may be part of the same contact block as the indication contacts provided that the electrical separation between contacts is rated to at least 500 volts.

A cut out contact operated by the selector lever to open circuit the motor when the lever is moved from the power position shall be provided.

6.5.5 Motor Contactor and Overload Timer

A motor contactor and a motor overload timer are not required to be fitted to the machine

6.5.6 Case

The provisions of clause 2.8.1 shall apply.

7 Pneumatic Motor for Claw Locks

7.1 General

The motor (cylinder) shall be single ended, double acting and self latching at each end of its stroke. A stainless steel piston rod and hard chrome (or stainless steel) bore shall be provided and the motor shall be foot mounted.

Exterior surfaces (where not stainless steel) shall be zinc plated or powder coat finished light grey. Clamping bolts shall be stainless steel.

Latches shall engage at least 6mm from the end of the motor stroke to provide sufficient piston travel after latching to operate detection switches. The shape of the latching mechanism shall be such that the risk of “dog locking”, due to the motor drifting back and bearing against the latch, or the piston moving before the latch is clear, is reduced to the greatest possible degree.

Each latch shall be provided with a manual release. Provision shall be made to restrict access to the manual releases, so that manual release of latching cannot be affected, without unlocking a padlock. The cover(s) or releases themselves shall be secured by a padlock with a 10 mm bow diameter.

The actuators for the detection switches shall be provided with a cap which will operate the required two switches at the same time and which is secured by a locknut. Both cap and locknut shall be adjustable by means of an open ended spanner. The actuator assembly shall be provided with a spring return mechanism such that return of the actuator to the innermost position (ie piston unlatched position) can be guaranteed, without lubrication other than that from the pneumatic system, for 500,000 operations.

7.2 Electrical

The motor shall be provided with two (2) indication switches at each end which will detect that the motor has completed its stroke (to within 4 mm) and has latched.

The switches used shall be two microswitches, OMRON D4C-1201 or D4C-1601 or MICRO SWITCH 914CE1-3, at each end of the motor.

The microswitches shall be enclosed in an IP65 rated cast aluminium terminal box mounted on the side of the motor opposite the air ports. Terminals provided within the termination box for the connection of incoming cable shall be equivalent to "Klippon SAK4" or 2BA screw stud. The opening in the box for the switch actuator shall be sealed between motor and box with a suitable O-ring or Gasket.

Wiring between microswitches and terminals shall utilise the 4 core cable supplied with the microswitches. Only sufficient sheath shall be removed to permit termination with bootlace ferrules in the terminals. The unused core from each cable is to be capped with insulated end caps or additional terminals must be fitted to which the core can be terminated.

Wiring between microswitches and terminals shall be to the circuit shown in Appendix C Figure C1. Entry for external cables shall provide for a 25 BSP conduit fitting.

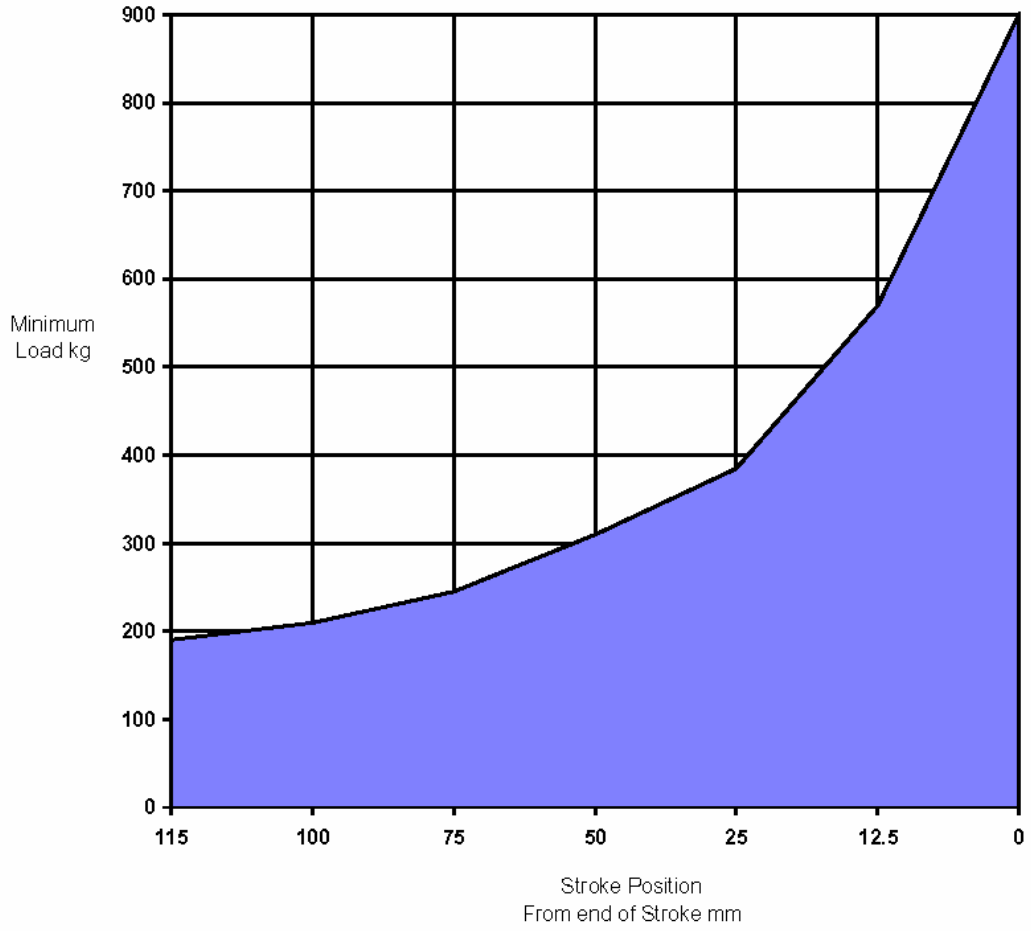
7.3 Motor (Cylinder) Dimensions

Motor dimensions shall be:-

Motor Bore	125 mm
Motor Stroke	190mm – 200mm

Piston Rod	
Diameter	38mm
Retracted	12 – 16mm
Clearance	
Thread Length	150mm
Thread	M33x3.5
Mounting Hole Centres	
Longitudinal	450mm
Transverse 90mm	
Centre Line Piston Rod to Mounting Plate	90mm
Mounting Hole Diameter	16mm
Air ports	15 BPS
Air Port Location	Side – opposite terminal box

8 Appendix A - Figure A1 Switch Machine Test Load Requirements

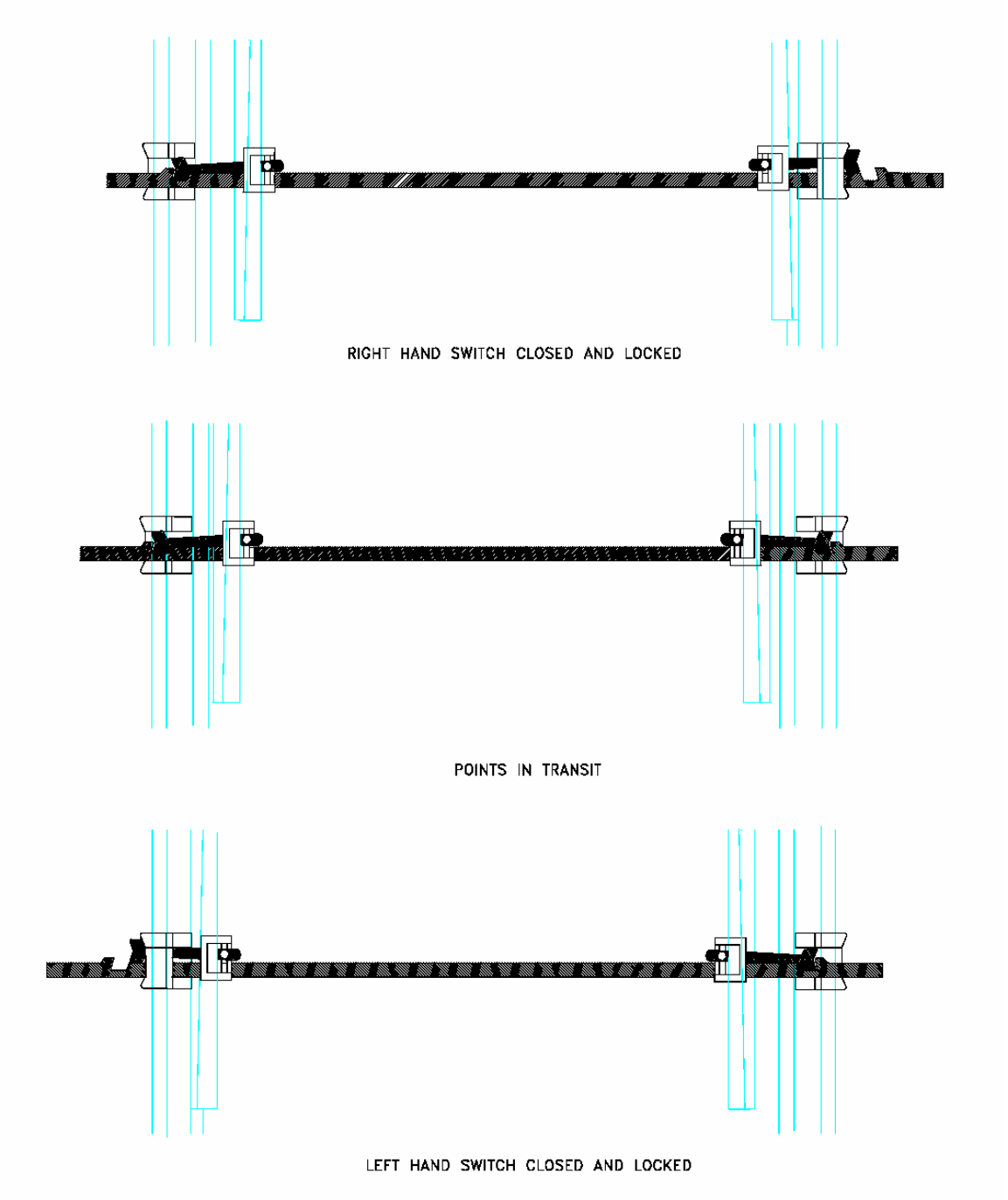


Machine performance shall always be equal to or above the curve

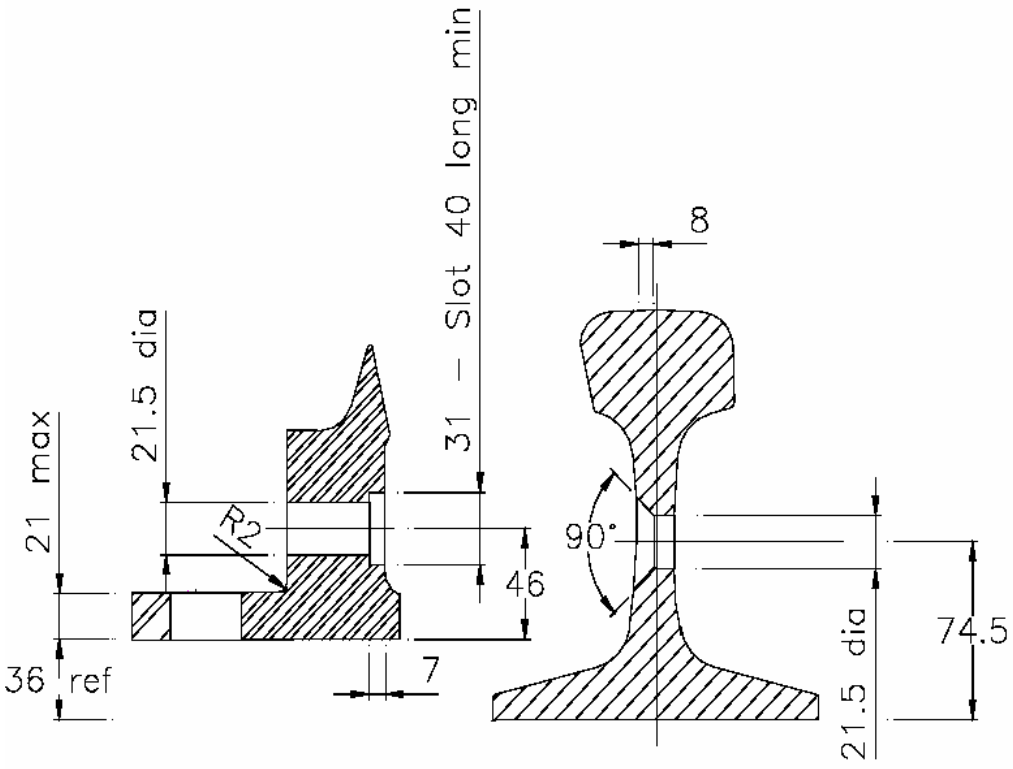
Assumes clutch is set to maximum capacity

9 Appendix B

9.1 Appendix B -Figure B1 Claw Lock Operation

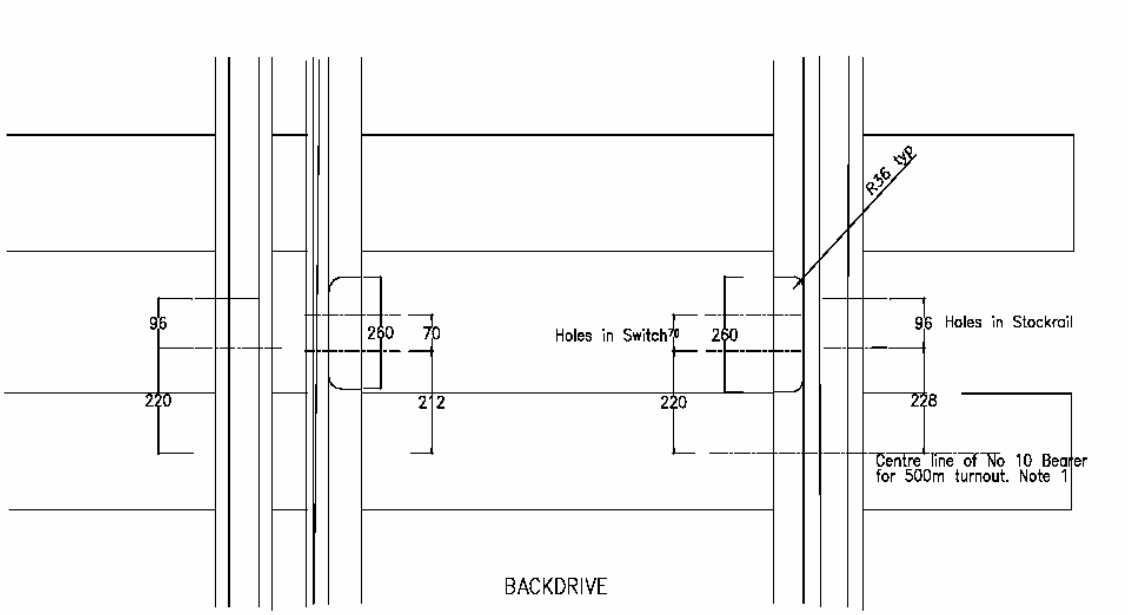


9.2 Appendix B - Figure B2 Switch & Stockrail Drilling for Claw Lock

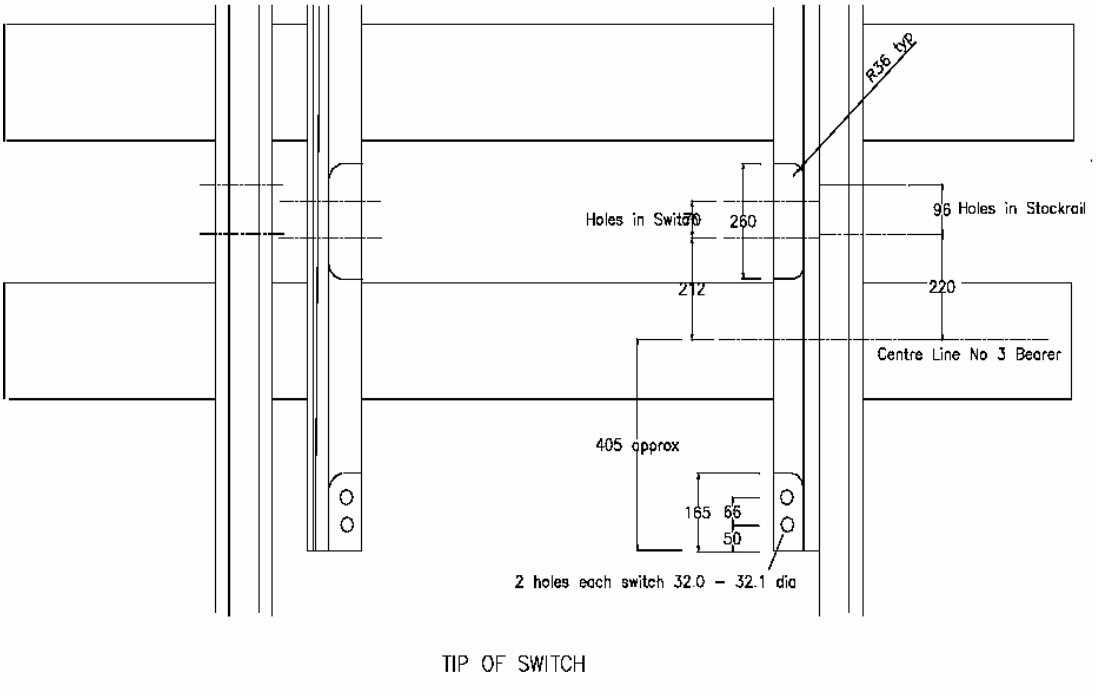


Tolerance: +/– 0.5 mm

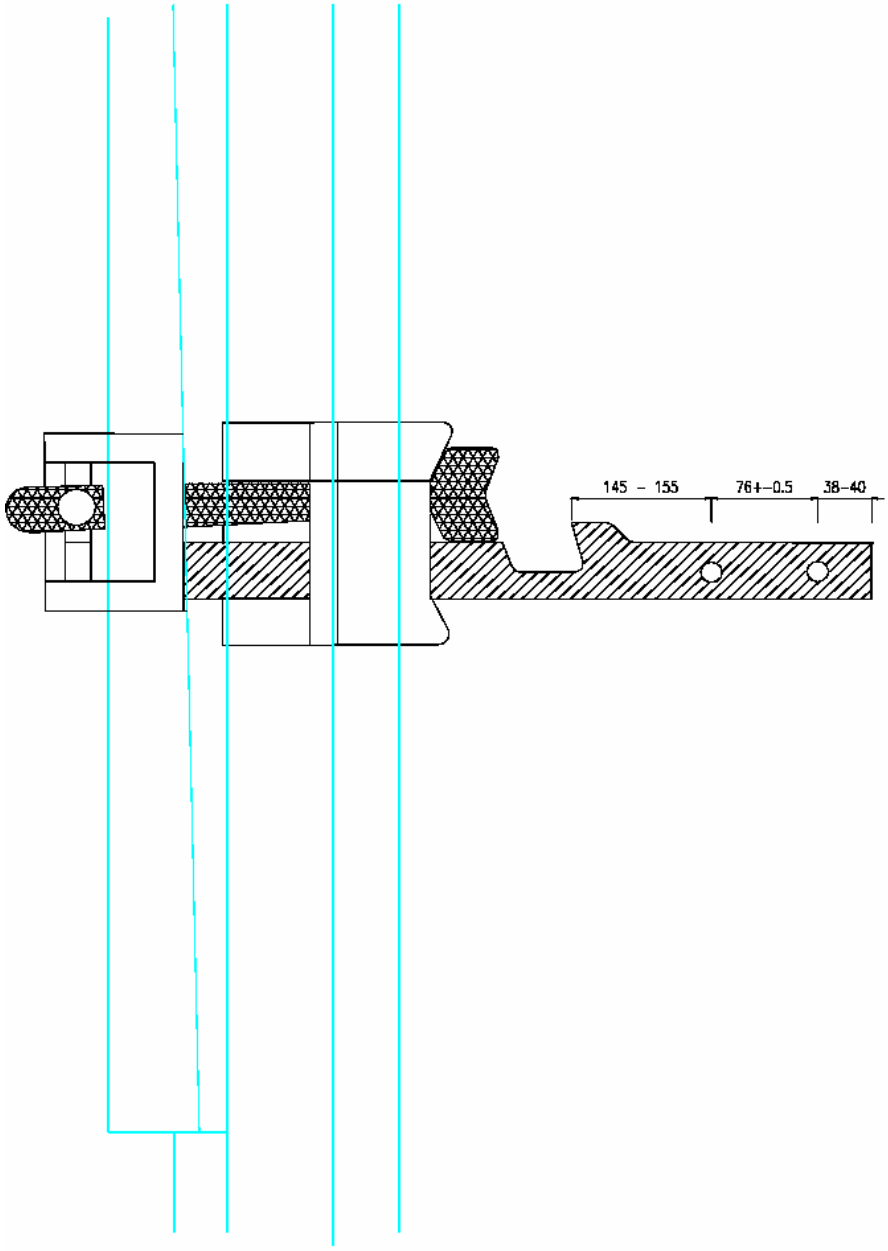
9.3 Appendix B - Figure B3 Switch and Stockrail Drilling for Claw Lock



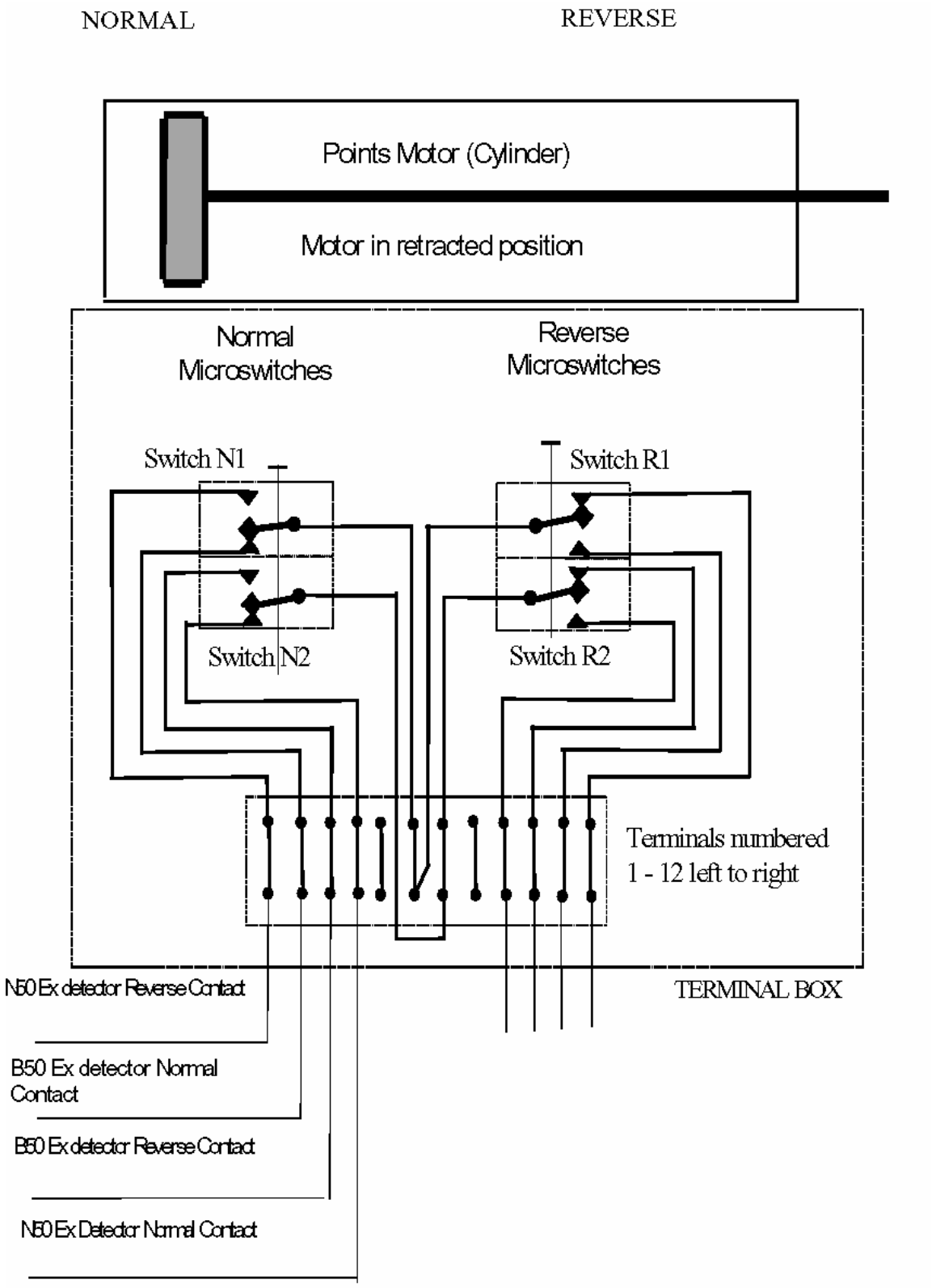
Note 1:
Turnout manufacturer to determine location of backdrive for 300m, 500m, 800m and 1200m turnouts



9.4 Appendix B - Figure B4 Drive Connection for Claw Lock



10 Appendix C - Figure C1 Pneumatic Motor Detection Circuit



Retracted position is “normal” as drawn. If the extended position is “normal” wiring and terminal numbering will be as drawn but contact position will be mirror image.