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Module

Axle Counter Installation, Testing and Commissioning Requirements

Endorsement and Authorisation

For endorsement and authorisation, please refer to NR/L3/SIG/30082

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Issue record

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01	March 2010	Initial issue

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 5th June 2010.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

Reference documentation

See NR/L3/SIG/30082.

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1 Purpose

This standard defines requirements and provides guidance to those involved in planning and undertaking the installation, testing and commissioning of axle counter systems on Network Rail managed infrastructure.

NOTE Whilst written to consider the initial (works) installation, test and commissioning, these requirements also apply, as appropriate, for subsequent re-installation, temporary removal/replacement, etc, e.g. during maintenance activities.

2 Generic Installation Requirements

2.1 Pre-Installation Checks

All materials, components, sub-assemblies and unit assemblies, (including cables and wiring) associated with the axle counter system shall be Network Rail accepted products, subject to manufacturer inspection and be provided with a certificate of conformance.

NOTE Product conformance should include all factory testing and other quality control activities during the production and assembly process.

2.1.1

Data, or factory settings, required for the configuration and operation of the axle counter system shall be validated and installed in accordance with Network Rail requirements, including NR/L3/SIG/30082 Module 003, and the relevant manufacturer installation procedures.

2.1.2

Data and factory settings shall be accepted by a Network Rail representative, and a certificate of conformance provided, prior to incorporation into the axle counter equipment.

2.1.3

Certificates of conformance shall be retained and copies issued to parties such as projects and testers as required as assurance of the material condition and readiness.

2.2 Installation of Equipment

Axle counter systems shall be installed in accordance with the appropriate manufacturer guidelines and using the correct tools.

NOTE For details of the installation process to be used with particular types of axle counter system reference should be made to the relevant product installation section contained in the Appendices.

2.2.1

All equipment shall be labelled and identified.

NOTE Identification should be appropriate to the type of equipment, for example showing which unique axle counter section and function the equipment is associated with, the specific part number, etc.

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2.2.2

The detection point equipment shall be installed in accordance with the verified Detection Point Siting Form, secured against unauthorised access and shall, whenever possible, be installed in a place of safety.

NOTE The preferences, in order of priority, for electronic unit positioning are shown in Table 1 and should be taken into account when siting. The positioning details and constraints will be included in trackside design details, e.g. location area plans or detection point wiring diagram, for reference after initial installation.

Priority	Position	Notes
1	Cess side Green zone >3m from rail edge (preferably on main cable route side)	
2	Cess side Green zone >2m from rail edge (preferably on main cable route side)	With appropriate staff protection
3	In wideway >3m from rail edge (preferably on main cable route side)	
4	In wideway >2m from rail edge (preferably on main cable route side)	With appropriate staff protection
5	On Network Rail private land, e.g. signalbox car park, out of use platform	
6	On Network Rail public land, e.g. station platform or car park	Reason to be stated on Detection Point Siting Form. The preference is for mounting in a half-size apparatus case to provide protection against vandalism, but a padlocked cage is also acceptable
7	Red Zone	Electronic unit may have to be installed in a pit or manhole, with enough space to allow access from below for all cables, and at the side for the diagnostic socket
8	Tunnel or Viaduct	Wall mounted if post not possible. Post mounting should normally be at 900mm which provides easier staff access and avoids a tripping hazard
Prohibited	In an OLE neutral section (between APC magnets or at least 30m either side)	This is to avoid the ISDN communication link being affected by interference as a result in rising earth potential at neutral sections in AC electrified areas. This can cause the common mode varistors to operate, causing imbalance of the ISDN link and leading to a disturbance of the axle counter section concerned.
Prohibited	In a refuge	

Table 1 – Preferences for Detection Point Positioning

2.2.3

The installation of the rail contacts, and in particular the position of the drilled holes, shall take account of the rail type and shall require the use of correct tools, e.g. drilling machine, template, and any adapter plate. The vertical positioning of

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mounting holes shall be calculated / established taking account of the rail wear in accordance with manufacturer guidance.

NOTE1 The mechanical positioning of the rail contact is important and where older, worn rail is installed this needs to be taken into account. Adapter (field deflector) plates are used with fitment to bullhead rail.

NOTE2 Any specific track related requirements should be stated on the Detection Point Siting Form, e.g. need to retain insulated sole plates (if within three sleeper beds of points), removal of eutectic strips, etc. These should be represented as functional constraints on the appropriate trackside design details such as the location area plan or detection point wiring diagram. Pandrol clips either side of the rail contact should be arranged to allow removal away from the bed containing the rail contact.

2.2.4

Rail contacts shall be positioned taking account of the identified constraints in Table 2 (which may not be a comprehensive list).

Proximity Constraint	Preferred Minimum (measured along the track, nearest edge of equipment to nearest edge of equipment unless otherwise stated)	Non-Preferred Minimum (measured along the track, nearest edge of equipment to nearest edge of equipment unless otherwise stated)	Notes
Another axle counter rail contact	2m	-	Measured direct. Minimises potential for electrical interference
Rail joint, IRJ, weld, adjustment switch or rail irregularity - not due to be recovered or renewed	2m	0.525m	Anything less than the Preferred Minimum shall be justified and agreed with the designer and track engineer. Minimises potential for mechanical shock/vibration, rail movement and unreliability
Rail joint, IRJ, weld, adjustment switch or rail irregularity - due to be recovered or renewed	11m	0.525m	Allows joint to be removed and replaced with a closure rail without requiring rail contact to be removed
Another hole in rail web (used or not)	75mm	-	Hole edge to hole edge
Check or wing rail	1m	-	Rail contacts will not fit between a running rail and a check or wing rail. The track engineer will not normally permit the check or wing rail to be cut
Bullhead Rail	-	-	Adapter (field deflector) plate required or may require rail to be changed
TI 21/Aster Track Circuit - ETU	15m	-	Applies to all track circuit types. Minimises potential for electrical interference
TI 21/Aster Track Circuit - Tuned Zone	5m	-	Applies to all track circuit types. Minimises potential for electrical interference

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Proximity Constraint	Preferred Minimum (measured along the track, nearest edge of equipment to nearest edge of equipment unless otherwise stated)	Non-Preferred Minimum (measured along the track, nearest edge of equipment to nearest edge of equipment unless otherwise stated)	Notes
AWS Inductor	2m	1m	Minimises potential for electrical interference
TPWS Loop	1m	-	Minimises potential for electrical interference
Level crossing - Trespass guards	Not within guards	Within guards	Non-preferred minimum shall be justified and agreed with the designer
Road rail access point	5m	-	Minimises potential for damage
Sleeper/bearer spacing – normal	400mm available between	350mm available between	To make sure the rail contact will fit between sleepers/bearers (the non-preferred minimum allows for NR60 S&C with concrete bearers)
Sleeper spacing – Within 100m of rail adjustment switch	500mm available between	-	Allows for increased rail movement with respect to the sleepers
Pandrol rail fasteners	-	-	Pandrol clips either side of rail contact to be arranged to allow removal away from rail contact bed
OLE neutral section – APC Inductors	30m	-	Prohibited within this distance of, or between, APC inductors
TASS or TCS Balise	100mm	-	Measured at right angles to track. Minimises potential for electrical interference
Miscellaneous metallic equipment in four foot	100mm	-	Measured at right angles to track. e.g. check rails, points drive equipment, ramps, uninstalled rails

Table 2 – Identified Rail Contact Positioning Constraints

2.2.5

Deflector plates shall be fitted, where specified for the particular installation, to provide protection to the rail contacts from items hanging from trains.

NOTE For uni-directional lines deflector plates only need to be fitted on the approach side.

2.2.6

Evaluator equipment shall be installed and securely mounted in accordance with the appropriate manufacturer guidelines.

2.2.7

Cabling that is not within a designated lineside cable route shall be installed in accordance with NR/SP/SIG/19812 and arranged to minimise the risk of damage, tripping, vandalism, etc.

NOTE1 Excessive slack should be lost by separating the electronic unit and rail contacts rather than coiling the cable. For maintenance convenience, the preferred cable length between electronic unit and rail contacts is 8m but longer may be justified in order to achieve a Green Zone position.

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NOTE2 To avoid moisture ingress and contamination, cabling between the electronic unit and rail contacts should be terminated at installation and should not be left with either end unterminated at the trackside.

2.2.8

Wiring shall be terminated securely and designated pairs between evaluator and detection points twisted to within 25mm of the termination.

NOTE Relevant links should be removed until the equipment is ready for powering up.

2.2.9

All necessary earthing arrangements shall be installed in accordance with the appropriate installation guidelines.

2.3 Setting Up and Adjustment of Equipment

Evaluators and each detection point shall be set up in accordance with the appropriate guidelines including configuration with the allocated unique address where appropriate.

NOTE For details of the setting up process to be used with particular types of axle counter system reference should be made to the relevant product set up section contained in the Appendices. Setting up, adjustment and the fitting of electronic cards should only be undertaken by competent staff, e.g. the testers of a new or revised installation, maintenance staff responding to a fault, etc.

2.3.1

All parts of the axle counter system shall be checked for security, correct connection, damage and any signs of moisture before being powered up.

NOTE This should include any local power supplies and cabling / transmission arrangements.

2.3.2

Detection points shall be bonded to the nearest suitable rail or designated earth to minimise EMI effects and for staff protection, prior to powering up the detection point. The detection point need not be bonded to the same line or rail as the associated rail contact.

NOTE Where any existing track circuits remain in use, it may be necessary to provide temporary bonds unless a common rail is available.

2.3.3

Prior to powering up, it shall be confirmed that the axle counter equipment is not connected to any other parts of the signalling system that are in operational use, e.g. controlled by or visible to the signaller.

2.4 Post-Installation Reliability Checks

Before any axle counter equipment is set to work the quality of the installation shall be checked for compliance with standards, relevant manufacturers installation instructions and good practice guides.

NOTE Experience has shown that using the correct installation practices will improve the reliability of axle counter systems. Manufacturers installation instructions may be used to supplement Network Rail's standards provided that they do not contravene the requirements of those standards.

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2.4.1

The installation shall be physically checked by installers before being handed over to testers and a certificate of installation shall be produced.

2.4.2

Any specific reliability checks for the axle counter type shall be made (see Appendices).

NOTE The overall systems configuration, cabling and power supply arrangements should also be considered (see NR/L2/SIG/30081 sections 6.8, 6.9 and 6.10).

2.4.3

The evaluator equipment housing arrangements shall be checked to confirm that an acceptable temperature range can be achieved, in line with the operating specification of the system concerned.

NOTE This is likely to be affected by the density of equipment within cabinets or rooms. Network Rail specifies that REBs have heating / cooling systems triggered by temperatures of +15°C and +22°C respectively and that new REBs have air conditioning. Arrangements to monitor and maintain this should also be in place. Where air conditioning is not provided, forced ventilation may be required in a cabinet containing several evaluators, however this should be avoided as fans are prone to failure and require additional maintenance and it is preferable to use a second cabinet, or confirm with the manufacturer that the particular arrangement does not require forced ventilation.

2.5 Documentation

Installation records, including procedures for setting up and initial measured values, shall be made available in an appropriate format to the tester of the equipment.

3 Generic Testing and Commissioning Requirements

The general requirements for testing and commissioning of safety critical signalling systems are set out in NR/L2/SIG/30014 and NR/SP/SIG/11231 and shall apply to the axle counter system.

NOTE This document does not detail procedures that are part of the normal testing process, such as the test log process or the production and independent checking of test certificates and test results. For details of specific testing processes to be used with particular types of axle counter system, reference should be made to the relevant Appendix.

3.1 Arrangement for Testing

The commissioning strategy for the axle counter system (including decommissioning of any existing systems) shall be agreed with the designated project engineer.

NOTE As it is normal practice for axle counters to be overlaid on the existing train detection system, tested and brought to a fully functional state (set to work) before final commissioning, the strategy should also consider how any works carried out after this will be carried out and tested, including the controlled changeover.

3.2 Scope of Testing

The scope of the testing shall include all elements of the axle counter system from the rail contacts to the signaller's interface (display or panel) via the evaluator, interlocking and cabling/transmission arrangement.

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3.2.1

The following testing related to axle counter systems shall be required:

- Axle counter site specific data testing;
- Testing of axle counter specific controls in interlocking;
- Testing of axle counter controls / indications in MMI;
- Cable and transmission system testing;
- Power supply testing;
- Axle counter relay interface circuitry testing (where applicable);
- Detection point testing, including confirmation of rail contact position with respect to critical dimensions;
- Evaluator testing;
- Axle counter local functional and correspondence testing;
- Through testing;
- Correspondence testing – rails to MMI;
- On-site principles testing of axle counter specific controls;
- Final pre-commissioning checks.

3.3 Test Preparation

As part of the pre-testing activity testers shall check that a certificate of installation has been completed for the axle counter system and that the system is fit for testing.

3.4 Evaluator and Detection Point Equipment Testing

The evaluator and detection point equipment shall be tested in accordance with the particular system requirements to confirm it is as designed and functioning correctly.

3.4.1

Any unique addresses for each detection point and the geographical configuration of each evaluator shall be confirmed during testing.

3.5 Testing of Power Supplies

Power supply systems shall be tested in accordance with standard testing principles to confirm that the arrangements provided have been installed as designed, conform to laid down requirements and work satisfactorily.

3.5.1

Any uninterruptible power supply shall be tested in accordance with the manufacturer requirements and to check that there is no effect on the train detection output during any transition.

3.6 Testing of Controls and Indications

All track sections shall be checked for appropriate naming and, where applicable, the correct prefix, in accordance with the design details.

NOTE Further information for the identification of axle counter sections can be found in NR/L2/SIG/30081.

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3.6.1

Any 'function keys' and / or VDU 'soft keys' applicable to axle counters shall be checked to refer to 'Track Sections' rather than 'Track Circuits'.

3.6.2

For tests involving a VDU MMI, all functions shall be tested by using both the cursor and the keyboard at least once.

3.6.3

The principles testing of the axle counter system will be an integral part of the overall principles testing, however there are a number of critical items that shall be checked during these tests related specifically to the axle counter system operation (as required by NR/L2/SIG/30080 and the system features provided):

- MMI controls, indications and incremental counters;
- Conditional reset and application of interlocking controls including application of reminders (aspect restriction and IRR);
- Conditional restoration of interlocking controls including removal of reminders (aspect restriction and IRR) for plain line sections and routes through points;
- Preparatory reset controls and indications;
- Application and removal of EPR;
- Application and removal of STR.

3.6.4

Restoration arrangements, including associated reminders and indications, shall be tested to check that they are in conjunction with NR/L2/SIG/30080 and that each axle counter section fails to restore unless the conditions are correct.

NOTE Care should be taken to confirm that the permutations of routes, sections occupied and aspect restriction removal conditions are thoroughly explored.

3.6.5

EPR, and the associated reminders and indications, shall be extensively tested to check that the EPR can only be set and removed when the correct conditions are met, as required by NR/L2/SIG/30080.

3.6.6

STR, and the associated reminders and indications, shall be extensively tested to check that the STR can only be set and removed when the correct conditions are met, as required by NR/L2/SIG/30080.

3.7 Cables and Transmission System Testing

The transmission system used for the axle counter system shall be tested in accordance with the system manufacturers requirements.

NOTE The handover from installation should include all cables terminated but with interconnecting links left out.

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3.7.1

The following checks shall be made before carrying out cable tests:

- Twists are provided in cable pairs up to the termination point;
- Cable pair allocation conforms to the manufacturers requirements;
- Cables are terminated correctly (stripping length is correct);
- A percentage check of any cage clamp terminal connections at each location, physically removing terminated pairs from the cage clamp terminals to measure that they have been correctly stripped. If any one cable fails then a 100% inspection shall be carried out.

3.7.2

Any diverse transmission arrangement, including changeover, shall be tested to verify functionality and to check that there is no effect on the train detection output during the transition.

3.7.3

The following cable tests shall be applied to the axle counter data link (where applicable to the transmission arrangement and when appropriate to the state of connection, i.e. needing to be isolated or powered up):

- Cable conductor continuity and resistance unbalance tests;
- Conductor insulation resistance tests;

NOTE During this element of testing the tester should check that only one wire/core is terminated in each terminal. On completion of this cable testing within an interlocking area (with any defects resolved) each axle counter circuit may be linked up end to end.

- Cross talk tests;
- Data link polarity and resistance tests;
- Noise and attenuation tests.

3.7.4

Appropriate static and dynamic communication link tests shall be performed to verify that axle counter data links are fit for purpose before being commissioned.

NOTE For cabled systems this should include Time Domain Reflectometer static tests. Where deemed necessary, e.g. on discovery of unreliable data link performance, Bit Error Rate dynamic tests may also be undertaken.

3.7.5

Any defects shall be resolved before removing any testing straps and reconnecting circuits.

3.8 Technician Interface Testing

The diagnostic systems shall be tested in accordance with the particular system requirements to confirm that they are functioning correctly.

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3.8.1

Where provided, the facility to override the last-count-in control, and the process for use, shall be tested (see NR/L2/SIG/30080 section 7.1.2 and NR/L2/SIG/30080 Appendix B.4.5).

3.9 Function and Correspondance Testing

The axle counter system shall be tested in accordance with the particular system requirements to confirm that it is installed as designed, conforms to specified requirements and that it functions correctly.

3.9.1

Functional testing shall be performed on every axle counter section within the interlocking area to confirm that the interlocking and MMI arrangement (including any data) is correct.

NOTE Testers should satisfy themselves that the area of MMI / interlocking data they are responsible for testing performs in line with the specifications and design of the system being implemented.

3.10 Reliability Testing – Performance Soak Test

Axle counter systems are required to have high reliability characteristics and new systems shall be subject to a performance soak test on site.

NOTE Axle counter systems should be set to work for a period of time prior to the commissioning in order to identify any premature equipment failures or poor performance. This can include operating in parallel with an existing train detection system.

3.10.1

This test shall include all transmission systems, cabling, power supplies, modems, protocol converters, connections to interlockings / object controllers, etc. connected and powered up in their final arrangement.

NOTE Elements of the above may be excluded from this requirement with the prior agreement of the designated project engineer if works are due to be undertaken in the commissioning period / blockade. Other testing is not precluded during the performance soak test period.

3.10.2

The performance soak test shall:

- be planned to cover a minimum period of six weeks prior to the commencement of the commissioning period / blockade but may be reduced to four weeks if no critical failures are recorded;
- be subject to an interim report to review progress with the designated project engineer (based on data from a period of at least one week);
- be fully documented in a final report.

3.10.3

Once the configuration of the system to undergo the performance soak test is agreed with the designated project engineer (and prior to the commencement of the test) the number of critical and non-critical system failures that can be expected during the test period shall be agreed and recorded. This shall be based on the Mean Time Between Failures (MTBF) for the equipment as agreed with the designated project engineer at contract award.

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NOTE These arrangements may involve a number of contractors, each of whom should have an agreed scope of responsibility before the test starts.

3.10.4

Throughout the performance soak test period the number of system failures shall be recorded using the specified FRACAS system and categorised as either:

- a critical system failure;
- a non-critical system failure.

3.10.5

The root cause of all failures shall be identified and all failures detailed in a completion report which shall be issued to the designated project engineer on completion of the test.

NOTE1 No Fault Found (NFF) failures may be classified as either critical or non-critical failures depending on the service affecting nature and the geographical extent of the failure. All NFF failures should be recorded. Where a number of similar NFF failures occur, an investigation into that failure should be arranged with specialist investigation teams being established to identify the root cause.

NOTE2 A '2 strikes and out' policy should be adopted for all axle counter system electronic cards associated with any section that has failed NFF for a second time in any three month period.

3.10.6

The designated project engineer shall review the performance soak test completion report and decide on the appropriate action to be undertaken. Where any failure or irregular operation occurs during the performance soak test, the action to be undertaken will depend on criteria such as:

- The success in identifying the root cause of the failures;
- The success of any duplicated / system redundancy in mitigating the effect of the failure;
- The cause and probability of root causes reoccurring in the operational system;
- The extent of implementation and extent of remedial actions implemented to rectify the root cause of the failures;
- The geographical impact of the failures;
- The reduction in safety integrity of the system caused by the failures;
- The performance impact of the failures;
- The availability of alternative commissioning periods and resources.

3.10.7

Examples of the actions to be taken are:

- Defer commissioning until the required system availability is achieved;
- Extend or restart the performance soak test period;
- Agree remedial actions / campaign changes to be implemented post commissioning.

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3.11 Commissioning

The axle counter system shall be commissioned in accordance with Network Rail's requirements having successfully completed all the other required testing as a pre-requisite.

NOTE Commissioning of the axle counters should not normally require a test train, however the commissioning tests may utilise a test train where programmed as part of a wider Commissioning Plan, coordinated by the person in charge of the testing. For commissionings that also involve interlocking changes, this could be carried out in conjunction with the route proving activities, if a route proving train is being utilised.

3.11.1

The commissioning tests shall prove that the extent of the new or revised axle counter system is fully operational, working as designed and shall:

- Verify the correct operation of each detection point;
- verify the fringe / interlocking cross-boundary controls and, where applicable, level crossing operation;
- identify any latent timing issues.

3.11.2

Successful completion of testing shall be recorded on the appropriate test certificates and, as a minimum, the following documentation shall be provided:

- A summary certificate of test completion;
- An error log;
- A product acceptance or product trial certificate (where the version of axle counter system provided is not already accepted for use on Network Rail's managed infrastructure).

NOTE Test / audit sheets should be used to record the detailed testing undertaken, supporting the test certificates.

3.12 Handback

The following activities shall have been completed before handback of the infrastructure into maintenance:

- Provision of all 'as built' records;
- Provision of all required spares;
- Provision of all axle counter system documentation required by Network Rail, e.g. Operations & Maintenance Manuals;
- Provision of technician training;
- Provision of specified test equipment including any diagnostic software.

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Appendix A Installation Requirements for Thales AzLM System

A.1 System Components and Compatibility

Component compatibility for the Thales system shall be checked prior to installation.

A.2 Reference Direction

The reference direction for the detection point shall be set up as required by the design by:

- connecting Rx1/Tx1 to the Sk1 terminals of the EAK30H;
- connecting Rx2/Tx2 to the Sk2 terminals of the EAK30H.

NOTE The rail contact that is first passed by an axle in the reference direction is defined as rail contact 1 (Rx1/Tx1) and the second as rail contact 2 (Rx2/Tx2). Information is available in the Zp30H Installation Guideline.

A.3 AzLM Cables

The construction and performance requirements for the following cables are defined in NR/L2/SIG/30060 and shall be adopted:

- Cables carrying the ISDN signal between the EAK and the disconnection box or termination point (star-quad);
- Cables carrying the ISDN signal between the disconnection box or termination point and the ACE equipment (multi-twisted-pair).

NOTE The use of cable to the old specification (RT/E/PS/0031) is not acceptable for use on new projects after December 2009.

A.3.1

32/0.20mm twisted pair blue/yellow jumper wires shall be used between the PDCU and cable terminations, and between cable to cable terminations.

A.4 AzLM Reliability Checks

The following good practice shall be adopted during installation as a fundamental contribution to achieving system reliability.

A.4.1

All cables entering the underside of the EAK (electronic unit) shall pass through cable glands which shall be appropriately sized to fit the respective cable and shall clamp the cable to provide effective cable strain relief. A heat shrink sleeve shall also be applied.

NOTE The communications cable enters the EAK through one of three pre-formed glands on one side of the base. However, the entry glands to the EAK are sized according to the largest cable to enter the EAK and there is no secure cable clamp around the smaller communications cables. This has resulted in a cable slipping loose from its gland and damaging the internal cores.

A.4.2

Incoming communications cables shall be secured to the post of the electronic unit with large cable ties between the exit from the cable route and the entry to the EAK via the glands.