AERONAUTICAL GROUND LIGHTING

SERIES CURRENT AGL SYSTEMS AT AERODROMES IN AUSTRALIA

AND

COMPLIANCE BY SPECIFIC DESIGN AND INSTALLATION TO AS/NZS 3000

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The AAA has prepared a guide for the application of Compliance by Specific and Design and Installation to enable AGL infrastructure to be installed compliant with current Electrical Regulations.

**Recognition to Steve Henstock as a primary contributor to the document.**

- The guidance presented herein particularly pertains to the current version of AS/NZS 3000 (2018) and the advice provided must be revalidated for any later issues of AS/NZS 3000;

- The document only applies to AGL series current power supply systems installed within the aerodrome’s airside aircraft movement areas.

- There may be other requirements from the local (state) Electrical Technical Regulator which may be in addition to those outlined in the AAA guide which must be complied with.
• Each State passes legislation enacting the electrical regulations applicable in their local jurisdiction.

• Each State’s legislation enacts the Standard AS/NZS 3000 The Wiring Rules as the definition of the technical rules that manage the design, construction and verification that electrical installations comply with the Regulations.

• AS/NZS 3000 Part 1 defines the “high level safety performance outcomes/conditions” that must be applied and are invoked by Electrical Regulations.

• AS/NZS 3000 Part 2 defines the “deemed to comply” arrangements that if applied will ensure compliance with the Part 1 principles of electrical safety and thus the Electrical Regulations.
AGL Series Current Systems

- AGL series current power supply systems achieve consistent light intensities
- Use either constant current regulators or multi-tapped mains isolating transformers as power sources
- Typically apply maximum current of 6.6A for 100% light intensity setting
- Are easily applied to circuit interleaving
- Provide galvanic isolation between the LV mains supply and the AGL primary circuit (field supply)
- Have the primary cable supplying the lights isolated from earth
- Use in-line current transformers to provide isolation between primary and secondary circuits (maintaining primary circuit continuity)
- Need to accommodate single or multiple earth faults without (significantly) affecting the operation of the installed AGL
- Provide high reliability and serviceability performance
AERONATICAL GROUND LIGHTING INFRASTRUCTURE

- Supply to CCRs, MITs and associated control system

- Field infrastructure
  - Primary series current circuit
  - SITs and secondary cabling
  - Lights

Typically requiring a unique and “complex” electrical solution (not AS/NZS 3000 Part 2) needing consideration for Electrical Compliance
AGL COMPLIANCE – PRE 2000

• The use of AGL series current systems at aerodromes around Australia was previously covered by an exemption for those systems to comply with the requirements of the AS/NZS 3000 wiring rules.

• This exemption (ruling) was initially issued in 1959 to Department of Civil Aviation (DCA) by the EL1 standards committee (responsible for SAA 3000 standard).

• It provided reasoning for the exemption; specifically infrastructure is in a controlled space, isolated from the mains supply, and lighting circuits not energised during daylight hours when earth works could be in progress (?!!).

• The exemption was reaffirmed for various later editions of AS 3000, the last being for the 1991 edition of the wiring rules.

• That exemption expired in year 2000.
Whilst MOS Part 139 Clause 9.22 continued to provide the history and reasoning of the original "dispensation", the anomaly was that the referenced ruling was no longer applicable, and in conflict with current Electrical Regulations Standards.

The advice is no longer promulgated in Part 139 MOS August 2020.

Extract from MOS Part 139 version 1.15 July 2020
Section 9.22
AS/NZS 3000:2000

• The year 2000 issue of the wiring rules was significantly revised.

• Rules were structured to be more aligned with the IEC wiring rules; IEC 60364 - Electrical Installations for Buildings (the International Standard for electrical installations of buildings).

• Restructure of the year 2000 issue of the AS/NZS 3000 wiring rules resulted in the wiring rules being effectively divided into two parts:
  • Part 1 – Scope, Application and Fundamental Principles
  • Part 2 – Installation Practices

• This arrangement has been followed through to the current 2018 issue of the wiring rules.
• Part 1 of the wiring rules provides uniform essential elements that define the minimum regulatory requirements for a safe electrical installation

• Provides ‘high level’ safety performance outcomes that demonstrate acceptable means of compliance;

• Establishes the ‘deemed to comply’ status of Part 2, confirming that installations that comply with Part 2 comply with high level safety conditions of Part 1

• Provides a mechanism for acceptance of alternative design and installation practices that are not addressed, or are inconsistent with those given in the ‘deemed to comply’ Part 2
  • This mechanism is intended to apply where departures from the methods in Part 2 are significant rather than minor aspects
AS/NZS 3000 2018 PART 2

• Part 2 provides installation practices that are deemed to comply with the safety requirements set out in Part 1.

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• Part 2, amongst other things:
  • incorporates and elaborates on ‘high level’ performance outcomes of Part 1 setting out requirements and recommendations to clarify and support compliance;
  • establishes the ‘deemed to comply’ practices and work methods that achieve safety compliance required by Part 1.
FUNDAMENTAL SAFETY PRINCIPLES (AS/NZS 3000 PART 1)

- Protection against dangers and damage;
- Control and Isolation;
- Protection against electric shock;
- Protection against thermal effects in normal service;
- Protection against overcorrect;
- Protection against earth fault currents;
- Projection against abnormal voltages;
- Protection against the spread of fire;
- Protection against injury from mechanical movement; and
- Protection against external influences
COMPLIANCE BY SPECIFIC DESIGN AND INSTALLATION

• AS/NZS 3000 Part 1 provides a mechanism for acceptance of alternative design and installation practices that are not addressed, or are inconsistent with those provided in the “deemed to comply” Part 2.

• It details responsibilities, documentation and verification criteria for designers or installers that seek to apply an alternative method to the “deemed to comply” methods contained in Part 2.
## COMPLIANCE BY SPECIFIC DESIGN AND INSTALLATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Clause</th>
<th>Requirement</th>
<th>AGL Non-Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 3: Selection and Installation of Wiring Systems</td>
<td>Clause 3.8.1</td>
<td>Conductors shall be clearly identified to indicate their intended function as active, neutral, earthing or equipotential bonding conductors.</td>
<td>Series current systems do not have conductors that can be identified as “active” or “neutral”; and standard conductor colours not utilised (Table 3.4).</td>
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<td></td>
<td>Table 5.3</td>
<td>Selection of appropriate underground wiring system</td>
<td>Design criteria for pit and duct “civil works” are integral to the electrical installation</td>
</tr>
<tr>
<td>Section 5: Earthing Arrangements and Earthing Conductors</td>
<td>Clause 5.1.3</td>
<td>The MEN protective earthing arrangement is required to be applied to electrical installations.</td>
<td>Application of earths to any conductor anywhere in series current systems is contrary to the operation requirements and intent of the series current systems.</td>
</tr>
<tr>
<td></td>
<td>Clause 5.1.4</td>
<td>Permits alternative earthing systems (to the MEN system)</td>
<td>Requirements of Part 1 of AS/NZS 3000 to be satisfied; with reference to the IEC 60634 series of standards (applicable for LV systems).</td>
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<td>Clause 5.2</td>
<td>Requires protective earthing providing fault protection in the form of automatic disconnection</td>
<td>AGL circuits need to continue operation even with an “earth fault” in the field.</td>
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<td>Clause 5.7</td>
<td>Requirements with regards to the earth fault loop impedance required to enable protection to operate and isolate the circuit in the event of an earth fault</td>
<td>AGL circuits need to continue operation even with an “earth fault” in the field; no “earth fault loop impedance” applicable</td>
</tr>
<tr>
<td>Section 7: Special Electrical Installations</td>
<td>Clause 7.4.3</td>
<td>Separated circuit voltages shall not exceed 500 V.</td>
<td>AGL series current systems operate as separated circuits. The majority (but not all) of AGL series current systems have system voltages exceed 500V when measured between the circuit conductors.</td>
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<td>Clause 7.6.2.1</td>
<td>Electrical installations operating at high voltage shall be installed in accordance with AS 2067.</td>
<td>AGL series current systems operate at voltages from around 250V up to 5000V. Objective is to justify that whilst AGL circuits may operate at voltages exceeding 1000V, and cognisance may be taken of some AS2067 requirements, the use of CbySD&amp;I is to avoid formal application of AS2067.</td>
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<td>- Primary circuit cabling installed “reduced” depth of cover (500 instead of 750 mm)</td>
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</tbody>
</table>
ADOPTION OF AS/NZS 3000 PART 1.9.4 - JUSTIFICATION

• AGL Series Current Systems are required to provide a safe operating environment for aircraft

• AGL Series Current Systems are not recognised in the Part 2 “deemed to comply” provisions

• International (IEC) standards provide guidance of installation practice and reasoning that demonstrate Compliance by Specific Design and Installation

• AGL facilities are located in restricted access areas; with works within the aerodrome restricted access area strictly controlled

• Electricians tasked with maintenance responsibility can be identified and trained for the unique characteristics of the solution

• Maintenance practices that support the unique installation arrangement may be adopted
1.9.4.2 Acknowledgment by the owner or operator of the electrical installation and retainment of design documentation
Any departures from Part 2 of this Standard shall be formally acknowledged.

A copy of the design documentation (see Clause 1.9.4.3) shall be retained on site.

1.9.4.3 Documentation
Why Part 2 not adopted, and how compliance with Part 1 is achieved
Details of where the design requires specific installation (and maintenance) use by the owner or operator of the electrical installation.

1.9.4.4 Verification
All parts of an electrical installation that do not comply with Part 2 of this Standard shall be verified [by Designer – Cl 1.9.4.3 (f)] as complying with the specific design and with Part 1 of this Standard prior to being placed in service.

1.9.4.5 Competency requirements of designers
Persons undertaking designs that depart from Part 2 of this Standard shall be competent.
The AGL Designer must determine that “Deemed to Comply” provisions of Part 2 cannot be applied to deliver the required AGL infrastructure.

Agreement and acknowledgement must be sought from the Electrical Asset Owner/Operator to apply the provisions of Compliance by Specific Design and Installation

• This establishes commitment under the Electrical Regulations to maintain the unique installation

AGL Designer prepares design documentation detailing the specific solution that whilst deviating from the Part 2 deemed to comply provisions provide compliance to AS/NZS 3000 Part 1

Installation Contractor to be provided with documentation that details the reasoning for and specific solution that enables compliance, and upon constructing the works as detailed, is able to provide an Electrical Certificate of Compliance as per Electrical Regulations.

Construction works to be independently assessed and verified as complying with the specific design and with Part 1 of this Standard prior to being placed in service.

- This activity may be undertaken by the Designer or an alternative competent person.
The AAA prepared a guide provides:

• further background to this process

• templates of the typical reasoning that may be applied in the design and construction of compliant AGL infrastructure.

• Templates for the required design certification and verification, owner/operator acknowledgements, and installation certifications
THANK YOU