

AIRWORTHINESS BULLETIN

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Electrical Load Analysis

1. Effectivity

All aircraft fitted with an electrical system.

2. Purpose

This AWB is intended for use by licenced aircraft maintenance engineers (LAME) and covers what is allowable under the scope of their licence. There is detail on when a part 21 approval is required.

3. Background

3.1 Purpose

The main purpose of the electrical load analysis (ELA) is to estimate the electrical system capacity needed to supply the worst-case combinations of electrical loads in normal and abnormal operations. There is further information on the design including all the applicable airworthiness standards and amendment of an ELA in AC 21-38.

The ELA approved under part 21 can take the form of an ELA supplement, which in its simplest form can document required changes to any buses. This supplement will require an update of the ELA report which is amended as part of the aircraft records.

3.2 ELA regulation

The ELA is considered part of the technical data defined in r21.008 that describes the design and is used to show a finding of compliance with the applicable airworthiness standards and subsequently with technical data regulation r21.009.

This data is only approved under a type certificate (which includes STC) or under modification under subpart 21M.

The ELA report when complete and current becomes part of the aircraft records.

3.3 When to do an ELA

An ELA is undertaken initially during the type certification of an aircraft as part of the substantiating technical data.



There is no requirement to conduct another ELA prior to such time that a modification is incorporated. The aircraft manufacturer's original ELA report, if it exists, is acceptable provided there have been no modifications to the original configuration.

Similarly to whenever equipment is added, a weight and balance calculation is undertaken. The same rigour is required when adding or removing any electrical equipment. This may include any non-required equipment which still may have an impact on the aircraft electrical system. An ELA is then required for any changes in the aircraft electrical system.

Aircraft that have previously been certified to older FAA Civil Aviation Regulations, for example CAR 3 aircraft, did not require specifically require an ELA. Introduction of new equipment may require an ELA, which would require an approval under part 21.

3.4 Imported aircraft

Prior to issue of an Australian Certificate of Airworthiness for an aircraft, the issuing delegate needs to ensure that the aircraft's electrical system is compliant with the applicable airworthiness standard and any unique CASA operating regulations. For further information on what is involved refer to AC 21-02 and Certificates of Airworthiness Manual.

New aircraft imported directly from the manufacturer or a used aircraft that has a valid export Certificate of Airworthiness from a recognised country National Aviation Authority, EASA or countries with which Australia has agreements, is assumed as compliant.

Where there is a clear case of non-compliance with the applicable airworthiness standards, refer the matter to CASA Airworthiness Engineering Branch who may contact the national aviation authority of the state of design for clarification. The ELA report provided with the aircraft may not show all the assumptions and justification behind the design in stating a case for non-compliance.

3.5 When a Part 21 approval is required

If there have been additional modifications to the aircraft, the service bulletin instructions may require Part 21 approval in order to ensure the aircraft is still compliant with the applicable design standards and any unique CASA regulations.

It is acceptable for a LAME to install equipment using approved data from the aircraft OEM or approved model list (AML) STCs as approved Part 21 data, including making an amendment to the aircraft records in the technical log/log book for updated electrical loads.



3.6 On aircraft testing

The LAME may perform the ELA as part of the verification steps identified in the Part 21 approved data or as a periodic maintenance task if requested by the operator or CAMO.

At a minimum, the Part 21 approved data should indicate the change in load to the affected aircraft bus or power source.

3.7 When an ELA report is unavailable

Without the ELA report it may prove difficult to understand the assumptions and calculations used in the original ELA.

If not stated in the ELA report or detailed from the TC or STC holder, when any additional equipment is connected the maximum recommended rating should not exceed:

- 85% of the maximum rating of the circuit breaker
- 80% of the maximum capacity of the aircraft power source

Equipment may have a higher temporary inrush current where the starting power is in excess of the steady-state power requirements which is defined as transient power. If all equipment is switched on simultaneously, the transient power may exceed the circuit breaker rating. This is not necessarily a non-compliance issue as nominal operating loads in steady-state will reduce after startup.

Certified Part 23 aircraft or Part 27 rotorcraft usually have simple electrical bus design and no automatic load shedding (see Figure 1). Part 25 and 29 aircraft usually have complex, redundant source electrical buses. The sum total of circuit breaker loads can exceed the aircraft power source as different loads are used in certain phases of flight. They are never intended to get switched on all at once.

To establish the actual loads connected to a bus in an aircraft flight condition under normal and abnormal conditions, the loads and conditions may require checking against the aircraft flight manual or supplement on equipment usage under certain conditions or phases of flight.

It is acceptable to use the aircraft ammeter for this purpose if the meter has clear graduation to read aircraft loads being connected in turn on the scale; however it is preferable to use a calibrated current clamp.





Figure 1 - Simple aircraft electrical bus

If these electrical load limits are not specified from the part 21 approvals it is acceptable to use the maximum recommended rating in this AWB (see above).

An entry may be written into the aircraft technical log/log book for installation of the equipment using the approved installation documentation and conditions representative in the aircraft flight manual or supplement.

When certifying for the installation or periodic maintenance check, it is acceptable to write in the technical log/log book the amount of spare capacity remaining on the affected buses or power sources. Documenting of spare capacity must take into account the most onerous loads drawn from the installed equipment observed during testing.

3.8 Amending of records

After testing, amend the aircraft records in the technical log/log book for the altered electrical load on that bus.

ELA reports may become cluttered over time with multiple amendments. It is easier to read if there is a new ELA report created representative of the current aircraft configuration.



3.9 Information required for modification of an aircraft

The aircraft owner, continued airworthiness management organisation (CAMO) or registered operator is responsible for ensuring that the appropriate aircraft records are maintained which includes the current ELA report.

The current ELA report or technical log/log book is required as technical data when application for a modification request to CASA, an authorised person or a relevant approved design organisation is sought. For further information on this regulation see r21.420(1)(b) and guidance in paragraph 5.7.2.1 of AC 21-08.

Installation of equipment may require a change in the aircraft flight manual or supplement. See AC 21-34 for when this is required.

3.10 Service bulletins and ATSO

Service bulletins or other supporting documentation written by TSO component manufacturers is not necessarily approved data for installation and therefore may require additional part 21 approvals to install in a specific aircraft.

Instructions provided from an ATSO (or TSO) holder are not tailored for a specific aircraft installation and an ATSO authorisation is not an installation approval. TSOs are a minimum performance standard which includes environmental qualification.

There is no information in the approved data an ATSO (or TSO) which details required amendments to an aircraft electrical bus. For further information on ATSO see section 2 of AC 21-601. The TSO does not state what type of aircraft it may be installed into. It is up to the modification authorised person or approved design organisation to evaluate that the environmental qualifications supplied by the manufacturer are suitable for the intended installation.

For further details on what are applicable airworthiness standards see AC 21-38.

4. Recommendations

- A delegate issuing an Australian Certificate of Airworthiness must ensure that an ELA is supplied with the aircraft or ensure that an aircraft is compliant with the applicable airworthiness standards and any unique CASA operating regulations.
- Part 21 approval is required to install an ATSO component or if issued from service bulletin by a component manufacturer.



- The registered operator, owner or CAMO must provide the current ELA report, technical log or log book to CASA, a 21M authorised person or 21J approved design organisation when requesting a modification or alteration.
- Update the ELA report as part of the aircraft records in the technical log/log book whenever a modification is incorporated or removed.
- LAME can conduct an ELA test on aircraft to find compliance as part of an engineering order or other approval issued under part 21.
- Connected loads must not exceed maximum loads as determined in the approved data or if unavailable should not exceed the maximum recommended ratings in this AWB.
- When certifying for maintenance involving ELA, update the technical log/log book with the spare capacity details of the affected buses or power sources.
- In cases where the ELA is incorrect from the OEM, contact CASA Airworthiness Engineering Branch who may refer the matter to the national aviation authority of the state of design.

5. Reporting

Report all instances of ELA discrepancies to CASA via the DRS system available on the CASA website.

Information concerning where ELA is not available, inaccurate, or does not represent the actual aircraft configuration should be provided.

6. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link email address:

AirworthinessBulletin@casa.gov.au

or in writing, to:

Airworthiness Engineering Branch Aviation Group Civil Aviation Safety Authority GPO Box 2005, Canberra, ACT, 2601