SLOVENSKI STANDARD
SIST EN 3830:2022

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Aeronavtika - Električni sistem - Analiza obremenitve

Aerospace series - Electrical system - Load analysis

Luft- und Raumfahrt - Elektrisches Bordnetz - Energiebilanz

Série aérospatiale - Réseau électrique - Bilan électrique

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European foreword

This document (EN 3830:2022) has been prepared by the Aerospace and Defence Industries Association of Europe — Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this document has received the approval of the National Associations and the Official Services of the member countries of ASD-STAN, prior to its presentation to CEN.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2022, and conflicting national standards shall be withdrawn at the latest by August 2022.

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Introduction

This document is applicable to a.c. and d.c. aircraft electrical power systems in accordance with EN 2282 and has been prepared under consideration of MIL-E-7016F. It describes the methods and procedures necessary for the preparation of an electrical load analysis.

1 Scope

This document defines the method to establish an electrical load analysis which is used to compare the supply capacity of an electrical power generation system with the power demand of the connected electrical utilisation equipment.

It shall prove that the power sources are capable of supplying these loads under all electrical power system states and aircraft operating conditions and that specified growth capacity for future requirements is ensured.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2282, *Aerospace series — Characteristics of aircraft electrical supplies*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at https://www.electropedia.org/

3.1 Electrical load and power analysis

3.1.1
electrical load and power analysis
an electrical load and power source analysis comprises two parts:

— an analysis of the capacity of an electrical power supply system (power source analysis) ;

— an analysis of the power requirements of the utilisation equipment connected to it (load analysis)

3.1.2
power source analysis
a power source analysis determines the capacity of a power supply system to satisfy the connected utilisation equipment under all specified aircraft conditions and provides a calculation of the percentage load growth capacity

3.1.3
load analysis
a load analysis is essentially a compilation of the electrical loads, grouped in accordance with the busbar arrangement of the supplying power sources, and a summation of the equipment load values required from these during the same aircraft operating conditions as specified for the power source analysis

3.2 Electrical system

3.2.1
electrical system
the electrical system is an assembly constituted by the electrical power sources, utilisation equipment, control and protection devices and all common connections of the installation

3.2.2
power supply system
a power supply system consists of one or more sources of the same nominal voltage and/or frequency, and the corresponding power distribution system

3.2.2.1
power sources
power sources supply the power from the aircraft engines, a power conversion device, a ground power unit or batteries

Examples of electrical power sources are:

— d.c. power sources:

- generators,
- transformer-rectifier units,
- batteries ;

— a.c. power sources:

- generators,
- transformers,
- inverters,
- frequency converters.

3.2.2.2
normal power sources
normal power sources supply electrical power to the utilisation equipment during normal system operating conditions as defined in EN 2282

3.2.2.3
emergency power sources
emergency power sources supply electrical power to the utilisation equipment (or a specified part thereof) in case of a failure of the normal power sources, as defined in EN 2282.

Emergency power sources may have limited (e.g. batteries) or unlimited (e.g. ram air generators) supply duration, in general, they are limited in capacity, requiring a certain amount of load to be shed during their operation

3.2.3
power distribution system
a power distribution system comprises all busbars connected to one or more power sources, including the contactors required to connect or disconnect them

3.2.3.1
busbars
a busbar is an electrical conductor used for the common supply of two or more electrical loads connected to it. According to the intended purpose, various types of busbars may be defined, e.g.:

a) main busbar or "primary busbar"

a main busbar is used for the central distribution of power during normal operating conditions and, in case of more than one identical power sources, may be used to connect them;

b) sub-busbar or "secondary busbar"

a sub-busbar is used to supply a defined group of electrical loads during normal operating conditions. Depending on the function and criticality of these loads, this busbar may be classed as essential busbar, auxiliary busbar, monitoring busbar, etc. ;

c) emergency busbar

the emergency busbar is usually supplied by the normal power source – in case of failure – by the emergency power sources to ensure continuous supply to those loads that are vital during emergency operation;

d) battery busbar

connected to the aircraft battery, this busbar is used to supply utilisation equipment necessary for aircraft ground operations (e.g. canopy, obstruction lights) as well as emergency in-flight operations (e.g. crash switch, firewall valve(s))

3.2.4
utilisation equipment
utilisation equipment is defined as any equipment or any functional group of units consuming electrical energy

3.2.5
primary system
a primary system is characterised by one or more power sources generating electrical power from non electric energy.

A primary power source is independent from any other electrical power source.

EXAMPLES

— generator, main-engine driven, with connected loads;

— generator, auxiliary-power unit driven with connected loads;

— battery, as an emergency power source with connected loads.

NOTE In the case of a variable speed control frequency system being the main power source, the variable speed control frequency components are considered as a generator.

3.2.6
secondary system
a secondary system is characterised by a power source that transforms/converts primary source power to supply the loads connected to it. The secondary power system is entirely dependent upon the primary system considered as a single load of the primary system, together with the connected loads.

Examples for a secondary system on an aircraft with:

— d.c. primary system: d.c./a.c. inverter with connected loads;

— a.c. primary system:

- transformer with connected loads,
- transformer-rectifier with connected loads.

3.3 Power ratings

3.3.1
nominal power ratings
the nominal power rating of an electrical device/unit of equipment, either power source or load, is its nameplate rating which normally corresponds to continuous operation

3.3.2
power source overload capacity
the overload capacity of a power source is the potential output power, exceeding the nominal power for short time intervals, and depends on the equipment specification, for example:

— 100 % rated power at continuous operation;

— 150 % rated power for 5 min;

— 200 % rated power for 5 s.

These figures (overload capacity and time intervals) may vary in line with the requirements specified for the considered power source

3.3.3
power source interval rating
the interval rating of a power source is its maximum output power for a time interval defined in line with the equipment overload capacity

3.4 Available power

3.4.1
available power
available power is the power which can be used simultaneously under steady-state conditions, taking into account the specified conditions of use in the aircraft and the rated power of each power source

3.4.2
derating factor
the derating factor takes into account the effects of environmental and operating conditions of the power sources (except batteries) which normally limit the full utilisation of the rated output power. The derating factor is the product of the corresponding individual rating factors as applicable from the following subclauses

3.4.2.1
mechanical rating factor
the mechanical rating factor takes into account a possible reduction of the generator output power, resulting from the mechanical drive to the power input of the generator at rated load.

The mechanical rating factor is 1, if the thermal rating factor already results in a power reduction

3.4.2.2
electromagnetic rating factor
the electromagnetic rating factor equals the ratio of maximum allowable load at operating speed to rated load. This rating factor shall be 1, if a power supply system is already limited by the mechanical or thermal rating factor

3.4.2.3
thermal rating factor
the thermal rating factor takes into account the effect of varying environmental and operating conditions of the cooling medium (oil or air) and the subsequent implications on the power source output. Utilising the specific thermal capacity of the unit, a factor of 1 may be applied for the time interval of 5 s, as in this case the effects of temperature, altitude and pressure drop may be neglected. For time intervals longer than 5 s appropriate figures shall be obtained from calculations and/or test documentation.

For power supply systems already limited by the mechanical or the electromagnetic rating factor, the thermal rating factor shall be 1

3.4.2.4
paralleling rating factor
this factor shall be applied whenever power sources are operating in parallel. For generators, the paralleling factor shall be 0,9 unless more precise load sharing capabilities can be established

3.4.2.5
voltage drop factor
the voltage drop factor takes into account the power output limitation resulting from the voltage drop between the generator output terminals and the related busbar. It represents the ratio between the nominal voltage of the aircraft electrical system at the point of regulation, and the voltage measured at the outputs terminals of the generator at rated loaf.

If the generator system is designed for nominal power at the busbar, the voltage drop factor is 1

3.4.3
derated source power
the derated source power available at the input terminals of the utilisation equipment results from the product of the power source interval rating and the derating factor (3.4.2) composed of the individual rating factors above