

AEROSPACE RECOMMENDED PRACTICE

SAE ARP906

REV.
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Issued 1968-11
Revised 2001-04

Supersedes ARP906A

Glossary, Aircraft Engine Starting and Auxiliary Power Systems

1. SCOPE:

The Aircraft Engine Starting and Auxiliary Power System Glossary presents definitions of terms commonly encountered and associated with aircraft engine starting and auxiliary power systems. Terms have been arranged alphabetically.

1.1 Purpose:

The purpose of the Aircraft Engine Starting and Auxiliary Power System Glossary is to promote the consistent usage of terms commonly encountered and associated with aircraft engine starting and auxiliary power systems. The usage of terms presented herein will serve to promote clarity and avoid many misunderstandings throughout the aerospace industry.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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Documents

Document Sharing Hub

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP147	Nomenclature, Aircraft Air Conditioning Equipment
AS194	Nomenclature - Engine Cooling Fan
ARP243	Nomenclature, Aircraft Hydraulic and Pneumatic Systems
AS425	Nomenclature and Abbreviations for Use On The Flight Deck
ARP480	Nomenclature Guide for Propulsion Systems Support Equipment
ARP1931	Glossary of terms with Specific Reference to Electrical Wiring and Cable
AIR1615	Thesaurus for Fuel System Components
AS8033	Nickel Cadmium Vented Rechargeable Aircraft Batteries

1999 (Annual) SAE Aerospace Standards Index

Tomsic, Joan L., SAE Dictionary of Aerospace Engineering, 2nd Edition, 1998, 758 pp.

TSB003, Rules for SAE Use of SI (Metric) Units

2.3 Definitions:

ACCUMULATOR: Pressure vessel used to store fluid under pressure, fluid typically held under pressure by a piston or diaphragm backed by a compressed spring or pressurized gas, usually a component of hydraulic or fuel systems.

AIR BOTTLE: Container specifically designed to store gases at a designated pressure, designed to a maximum or minimum pressure, typically twice the storage pressure, supplied air pressure is typically regulated down to starter entry working pressure, typically spherical or cylindrical with hemispherical ends.

AIRCRAFT QUALITY: Workmanship and finish of a component of sufficiently high grade to insure satisfactory operation, reliability and durability consistent with the application and storage life requirements.

AIR FLOW PARAMETER: Mathematical expression of gas flow, $\frac{W\sqrt{T}}{P}$ or $\frac{W\sqrt{\theta}}{\delta}$, with conditions of pressure and temperature defined at the component inlet interface, sometimes called Air Flow Factor, Air Flow Function, or Corrected Flow.

AIRFLOW or WEIGHT FLOW: Amount of air provided to the starter inlet, flow rate controlled by the starter nozzle size and depends on the pressure and temperature of the air, describes amount of air ingested into an APU or a design condition for a heat exchanger.

AIRFRAME MOUNTED ACCESSORY DRIVE (AMAD): Accessory drive package consisting of a gearbox and secondary-power components, mounted to the airframe remote from the main engine, may be powered by an APU; by the propulsion engine through a PTO (power take-off) shaft; by bleed air; or by a combination of the three, sometimes referred to as the Airframe Mounted Accessory Gearbox (AMAG) or Accessory Drive Gearbox (ADG).

2.3 (Continued):

AIRSTART ENVELOPE: Portion of the flight envelope (altitude and airspeed) in which airstarts may be successfully initiated, generally divided into assisted and unassisted (windmilling) subenvelopes.

AIR STARTING: Process of starting a main propulsion engine while inflight by either windmilling, or with starter-assist.

AIR TURBINE STARTER: Air turbine device that provides shaft power to start an engine, generally includes an inlet scroll, turbine, reduction gears, an engagement mechanism or clutch and may include a speed switch or speed signal to signal cutoff speed, a machine that converts the kinetic energy of moving air to mechanical power by the impulse of the fluid upon blades arrayed about the circumference of the shaft, sometimes referred to as "Pneumatic Starter".

ANTI-DRIVE END: End of the starter or accessory opposite the end which mates with the engine, or driver device.

ASSISTED WET CAVITY: Oil lubrication arrangement used in some starters that denotes partial shared oil lubrication with the propulsion engine gearbox, arrangement eliminates shaft seals and assures a supply of oil.

AUTO-SHUTDOWN: Uncommanded shut down of the APU, usually caused by the activation of one or more built-in self-protection features to limit the rotor speed, oil temperature, exhaust gas temperature or other APU engine parameter.

AUTOSTART: Associated with digital engine controls such as FADEC, sequence steps in starting a power plant engine programmed into the control and initiated by pushing a button in the cockpit, typically, if the engine does not successfully complete the first attempt, the control will "lean" the fuel schedule for two additional start attempts before shutting off, also utilize in an APU.

AUXILIARY POWER: Non-propulsive power generated on board the aircraft for the purpose of providing pneumatic and/or shaft power and/or electric power.

AUXILIARY POWER UNIT (APU): Internal combustion engine (usually a gas turbine) used to generate shaft power and/or bleed air to power the aircraft's accessory components, applications of power generated by APU:

- a. Providing air for the environmental control system and starter.
- b. Driving the AMAD or starting the main propulsion engine.
- c. Driving electrical generators and hydraulic pumps, sometime emergency power components.

BACKLASH: Limited rotational motion of shafting in a component or power drive train, when shaft torsion applied in clockwise then, counterclockwise direction.

2.3 (Continued):

BACK PRESSURE: Static differential pressure level measured between the starter exhaust pressure (P_2) and altitude ambient pressure usually due to nacelle venting restrictions and/or overboard ducting.

BATTERY POWER - Imp RATING: Maximum power discharge current, declared as a minimum by the manufacturer and expressed in amperes, which the fully charged, 23 °C cell or battery shall be capable of delivering immediately prior to the conclusion of a 15 s maximum power discharge, controlled so as to maintain a constant terminal voltage at 1/2 of the rated value. See AS8033.

BLEED AND BURN: Describes a process whereby air (extracted from a compressor or air bottle) is combined with fuel and burned to release the potential energy of the mixture.

BLOWOUT: Used to indicate that a combustor has ceased burning its fuel; i.e., the fire has been blown out. Sometimes called "Flameout".

BREAK-IN: Initial run procedure used to condition mating surfaces on component parts (e.g., gears, piston and cylinder) operating relative to each other, after break-in, best practices require replacing the lubricant to remove residual burrs and wear particulates.

BURST PRESSURE: Maximum pressure that a unit or vessel must withstand without rupture or catastrophic failure, typically two times the proof pressure, minimum burst pressure test applied at maximum operating temperature. See "Proof Pressure".

CARTRIDGE STARTER: Accessory starter mounted physically on a gas turbine and powered by hot gases from a one-shot, solid-propellant cartridge with a built-in initiator, for manned aircraft, the starter's combustion chamber is designed so that the cartridge is easily replaceable, some unmanned vehicles (such as cruise missiles) have a starter incorrectly described as a "Cartridge Starter"; however, utilize a combustion chamber preloaded with a one-shot, non-replaceable charge of solid propellant.

- a. **BREECH:** Combustion chamber on a cartridge starter that contains the cartridge and in which the cartridge is fired.
- b. **BREECH CAP:** Removable portion of the breech, which contains the electrical contacts for initiating combustion.
- c. **BREECH CHAMBER:** Fixed portion of the breech, which directs the cartridge gas to the starter.

2.3 (Continued):

CARTRIDGE: Gas generation device, packaged to include ignition, propellant and other required hardware, utilize solid propellant composed of both the fuel and the oxidizer mixed together in a solid form.

- a. **MONOPROPELLANT:** Cartridge using a single propellant, e.g., Hydrazine in liquid form.
- b. **BI-PROPELLANT:** Cartridge using a fuel and an oxidizer, generally in liquid form.
- c. **SOLID PROPELLANT:** Cartridge which incorporates a fuel and oxidizer in solid form, two bases, Double Base - a homogeneous mixture of fuel and oxidizer while, Composite Base a heterogeneous mixture of fuel and oxidizer.

CHARGE TIME: See "Fill Time".

CHOP:

- a. **FUEL CHOP:** Shutoff of fuel when engine is running.
- b. **THROTTLE CHOP:** Rapid throttle movement from any power setting to idle or cutoff.

CLUTCH: See "Engaging Mechanism".

COMPRESSOR BLEED VALVE: Valve used to control air flow from an engine compressor to provide:

- a. Additional compressor stall margin during starting and/or acceleration, used for stall margin during operation at high shaft/low pneumatic loads on integral bleed APU.
- b. An air source for various applications.
- c. Quick flow dump capability to prevent surging when flow demand is instantaneously terminated.

CONSECUTIVE STARTS: Attempts to start the engine that closely follow a previous start attempt, engine may or may not come to rest before the next start attempted.

CONSTANT HORSEPOWER LINE: Locus of points on a curve where the product of torque and speed is constant.

CONTAINMENT: Ability of the starter or APU to retain within its envelope all high energy fragments of the turbine(s) or other rotating components if these parts are caused to fail by separation.

2.3 (Continued):

CONTAINMENT DEVICE: Shroud or shield surrounding a selected area(s) of an APU and/or air turbine starter that will retain within its envelope all high energy fragments of a turbine(s) or other rotating components if the rotating components fail, may be an integral part of the component housing.

CORRECTED SPEED: Of a turbine or compressor utilized to present performance adjusted for temperature variation. usually expressed as $\frac{N}{\sqrt{T}}$ or $\frac{N}{\sqrt{\theta}}$ where, T and θ defined as temperature and corrected temperature respectively at the inlet of the starter or APU, T and θ are corrected to standard conditions.

CRANK (verb): To rotate the main shaft of an engine prior to lightoff by means of a starter.

CRANKING SPEED: See "Speed".

CROSS BLEED: Ducted air from the compressor section of an operating engine to another unfired engine such that this compressed air can be used for starting the unfired engine or for other purposes.

CROSS-BLEED STARTING: Starting of one engine utilizing cross-bleed air from another operating engine.

CUTOUT SWITCH: Switch activated by a speed sensing device used to terminate starter operation at a predetermined engine rotor speed, sometimes located on the output shaft side of the starter.

CUTOUT SPEED: See "Speed, Starter Cutoff".

CUTTER: Feature in a starter to ensure turbine wheel containment, severs the turbine disk in the event of turbine wheel overspeed or failure, both axial and radial containment of rotating material considered. See "Containment Device".

DECOUPLER: Device used to decouple the starter from the engine (or AMAD gearbox) in the event the starter clutch locks-up resulting in the engine driving the starter turbine, sometimes used to decouple the AMAD from engine so that starter may be used to motor the AMAD for electrical, hydraulic, or fuel boost power during ground maintenance.

DELAYED LIGHTOFF: Delay in initiation of combustion in the combustion of a gas turbine engine or rocket relative to expectations.

DETAIL SPECIFICATION: Aircraft or engine manufacturer's document or military specification used to define the applicable design and performance parameters required for a particular starter or component application.