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GLOSSARY, AIRCRAFT ENGINE STARTING SYSTEMS

1. **INTRODUCTION:** The purpose of this glossary is to present specific definitions of terms commonly encountered and associated with aircraft engine starting systems, and to promote their usage throughout the aviation industry.

Usage of the terms presented herein will serve to promote clarity and avoid misunderstandings.

Terms have been arranged alphabetically.

2. **BASIC TERMS AND THEIR DEFINITIONS:**

ACCUMULATOR: Usually associated with hydraulic starting systems, used to store hydraulic fluid under pressure.

AIR BOTTLE: A container suitable for storing a quantity of air under pressure. May be made of steel, titanium, fiberglass or other suitable material with or without a plastic liner.

AIR TURBINE STARTER: A prime, engine initiating device, incorporating a turbine wheel driven by compressed air that may be heated. Starter also generally includes an inlet scroll, reduction gears, an engaging mechanism and a switch to signal cutoff speed.

ANTI-DRIVE END: The end of the starter opposite the end which mates with the engine, or drive device.

AUXILIARY POWER UNIT (APU): An internal combustion engine used as the prime mover for equipment which supplies a starter with a desired medium of energy.

BACK PRESSURE: The pressure level measured in the exhaust collector of the starter.

BLEED AND BURN: A phrase to describe a process whereby air is extracted from a compressor or air accumulator, and to which fuel is added and is burned to increase the air temperature.

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BOOST PRESSURE: The pressure level in the boost pump outlet transmission line and in the main system inlet line generally associated with fuel and hydraulic systems.

BREAK-IN: A procedure required to produce desired surface conditions on component parts (e.g., gears, piston and cylinder) operating relative to each other.

BREECH: The chamber provided on cartridge starters to receive and fire the cartridge.

CARTRIDGE: A gas generation device, packaged to include ignition, propellant and other required items.

Monopropellant: A cartridge using a single propellant

Bi-Propellant: A cartridge using a fuel and an oxidizer, generally in liquid form.

Solid Propellant: A cartridge which incorporates a fuel and oxidizer in a solid form.

Double Base - A homogeneous mixture of fuel and oxidizer.

Composite base - A heterogeneous mixture of fuel and oxidizer.

CLUTCH, JAW: A type of engaging mechanism that makes use of a pair of face splines that will transmit torque from the starter to the engine in one direction. These splines are generally moved axially into engagement with each other by the starter engaging mechanism during the start cycle; disengagement occurs when the speed of the engine driven side of the engaging device exceeds the speed of the starter driven side.

CLUTCH, OVERRUN: A type of clutch mechanism that employs sprags, rollers, and pawls, etc., with appropriate driving and driven members. This clutch drives in one direction only, overrunning in the other direction.

During overrunning, which occurs when the driven member's speed exceeds the driving member, the sprags, rollers, and pawls, etc., (carried by the driven member) are caused to lift clear of the driving member.

COMPRESSOR BLEED VALVE: A valve used to control air flow from a turbine driven compressor to provide:

- a. Compressor stall margin during starting and/or acceleration.
- b. Compressed air for starting and/or other purposes.

CONSECUTIVE STARTS: Start cycles which follow each other at close intervals. The engine may or may not have come to rest before the second or successive starts.

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

CONTAINMENT: The ability of the starter to retain within its envelope all fragments of the turbine (s) or other rotating components if these parts are caused to fail.

CRANK (verb): To rotate the main shaft of an internal combustion or gas turbine engine by means of a starter.

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

CROSS BLEED STARTING: The starting of one engine utilizing cross bleed air from another operating engine on the same or adjacent aircraft.

CUTOUT SWITCH: A speed sensing device, usually incorporated in the starter, used to terminate the start cycle at a predetermined cutout speed.

CUTOUT SPEED: See "Speed, Starter Cutoff"

DISENGAGEMENT: The uncoupling of the starter from the engine by means of the starter clutch, or engaging device. Normally occurs at starter cutoff speed or starter maximum speed.

DUAL RATIO: Dual purpose gear box which permits engine starting at one speed and pumping or a generating capability from the starter driven at another speed. The two gear systems are isolated from one another by overrunning clutches.

EFFICIENCY, VOLUMETRIC: Percentage ratio of actual flow to that exact flow established by design parameters of record (e. g. , speed, displacement) for a specific item.

ENERGY LIMITED: A starter that operates from a finite energy source, and can provide only a fixed amount of energy on a given start. Examples include cartridge starter, fuel-air starter, hydraulic starter operating from an accumulator, and battery operated electric starter.

ENGAGEMENT: The automatic connecting of the starter gearing to the engine at the beginning of the start cycle.

GEAR RATIO: The ratio of the revolutions per unit time of one shaft to the revolutions in the same unit time of another shaft connected to it by a gear device. Starter gear ratio usually expressed as ratio of starter turbine speed to starter output speed.

GROUND POWER: A power source that remains on the ground and is not airborne.

HOT START: An engine start during which allowable engine turbine gas temperature limits are exceeded.

HUNG START: Operation of a gas turbine engine when the combined power output of the engine and starter are insufficient to provide acceleration to idle speed without exceeding engine operating limits.

IMPINGEMENT STARTING: A starting method wherein nozzle (s) are built into the engine such that the starting fluid works directly on one of the engine turbines.

INSPECTION TESTS: Those tests performed upon a production starter to determine acceptability prior to shipment.

INSTALLATION DRAWINGS: Drawings which define the exterior size of the unit and include data on all connection points, ports, etc.

LIGHT-OFF: The initiation of combustion in the combustor of a gas turbine.

MICRON RATING: Unit of measure usually associated with filtration quality where one micron equals 1.0×10^{-6} meters (3.937×10^{-5} inches).

MODEL SPECIFICATION: A specification covering the essential detail and technical requirements of a specific unit design, including a description of the procedures by which it will be demonstrated that the requirements have been met.

MOMENT OF INERTIA: A measure of the resistance offered by a body to angular acceleration. The mass moment of inertia is usually expressed in slug ft² or when multiplied by the gravity constant (g), lb ft².

Its point of application must be expressed, as it varies as the square of a gear ratio.

MOTOR (Verb): To rotate an engine at constant speed, without attempting to cause a light-off in the engine.

MOUNTING PAD: The pad upon which the starter is attached. Consists of a fixed pad with studs or suitable attaching means concentrically located with respect to a shaft which has a spline or similar power transmitting means.

OUTPUT SHAFT: The starter shaft which connects the starter to the engine.

OVERRUN: Refers to the relative speeds of the engine and starter after the start cycle has been completed.

OVERSPEED SWITCH: A switch provided within a starter to stop the energy source to the starter on attainment of a predetermined speed.

POWER LIMITED: A type of starter which can put out only a limited amount of power during a start cycle. Examples: any starter operating on a constant power supply such as pneumatic, electric, or hydraulic ground cart or airborne auxiliary power unit.

PRECHARGE PRESSURE: That pressure to which a liquid type accumulator is charged, prior to loading with fluid to be stored.

PROOF PRESSURE: The pressure above normal operating pressure which is used to non-destructively test a pressure container.

QUALIFICATION TEST: Those tests which are run on one or more units that are representative of the production article, to test the performance, endurance, environmental and special features of a design to demonstrate the suitability of the unit for production and use in service.

QUICK ATTACH-DETACH (QAD) MOUNTING FLANGE: A disconnect device that can attach the starter to the engine using simple tools on a single fastener. Usually incorporates a special flange which is pre-bolted to the engine pad.

QUICK DISCONNECT: A disconnect that can be uncoupled or coupled without the use of tools, commonly employed in hydraulic and pneumatic lines.

RATED CONDITIONS: The inlet and outlet conditions at which the starter is designed to operate and performance calibration is desired. Usually expressed in terms of pressure, temperature, flow rate, current and volts.

RE-ENGAGEMENT: The act of the starter engaging the engine while the engine is at any speed condition other than rest.

RISE RATE, INITIAL INSTANTANEOUS PRESSURE: The pressure rise rate, expressed in psi/sec, developed from the tangent to a pressure time curve.

RUN-IN: See Break-In.

SEAL DRAIN: A drain provision to remove seal leakage oil from the engine accessory drive cavity, and/or accessory housing.

SELF CONTAINED: Obsolete - see Self Sufficient

SELF SUFFICIENT: A starting system independent of all sources of energy external to the aircraft.

SERVICE LIFE: The operable period of a starter usually measured in start cycles, and/or hours of engine overrunning.

SHEAR SECTION: A special section, usually in the starter output shaft, that is designed to shear or fail at or above a specified torque level.

SLIP CLUTCH: A clutch which may be incorporated into a starter to limit the maximum torque (impact and steady) that can be transmitted by the starter to the engine.

SPEED:

Engine Idle: The rotor speed at which the engine will operate with the power lever in the idle position.

Engine Lite-Off: The rotor speed at which combustion can be initiated without exceeding specified engine limits.

Engine Self-Sustaining Speed: The engine rotor speed from which the engine is capable of accelerating to idle speed without the assistance of a starter, within specified engine limits.

Free Running: See "No Load"

No Load: The peak speed to which the starter will normally accelerate with the load disconnected. In electrical starter-generator systems, this is the minimum speed to which the starter will assist the engine at minimum voltage.

Overrunning: The speed at which the starter overrunning element is driven by the engine.

Pad: Engine rotor speed as related to the accessory pad.

Rotor: The speed of the engine rotor.

Runaway: See "No Load". In electrical starter-generator systems, this is the speed to which the starter-generator will go without load at maximum applied voltage.

Starter Cut-Off: The speed, specified by the engine manufacturer, to which the starter must assist to produce an acceptable start.

START SWITCH: Any switch or other device used to initiate a start cycle.