AVIATION GLOSSARY

DEFINING THE LANGUAGE OF AVIATION

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Compressor Stall – Turbine Aircraft Engine

Compressor Stall

A Compressor Stall in a gas turbine engine is a condition in an axial-flow compressor in which one or more stages of rotor blades fail to pass air smoothly to the succeeding stages. A stall condition is caused by a pressure ratio that is incompatible with the engine rpm. Compressor stall will be indicated by a rise in exhaust temperature or rpm fluctuation, and if allowed to continue, may result in flameout and physical damage to the engine.

Compressor Blades

Compressor Blades are small airfoils and are subject to the same aerodynamic principles that apply to any airfoil. A compressor blade has an **angle of attack** which is a result of inlet air velocity and the compressor's rotational velocity. In other words, the relationship between the air pressure passing across the blade passing through the engine and the air pressure that is due to the rotation of the blade. These two forces combine to form a vector, which defines the airfoil's actual angle of attack to the approaching inlet air.

Imbalance of the Two Vector Quantities

A compressor stall is an imbalance between the two vector quantities, inlet velocity and compressor rotational speed. Compressor stalls occur when the compressor blades' angle of attack exceeds the critical angle of attack. At this point, smooth airflow is interrupted and turbulence is created with pressure fluctuations. Compressor stalls cause air flowing in the compressor to slow down and stagnate, sometimes reversing direction.

Typical Causes of Compressor Stalls

- Excessive fuel flow caused by abrupt engine acceleration when the axial velocity (speed) is reduced by increased pressure in the combustion chamber due to the added combustion and the resultant rotational speed increase
- Operation of the engine outside of its RPM design parameters affecting the rotational speed of the compressor blade
- Turbulent or distorted / disrupted airflow to the engine inlet reducing the axial velocity
- Damage to either the compressor or turbine blades
- Low fuel flow due to abrupt engine deceleration causing a decreased back pressure

Compressor Stall Flight Deck Indications

- An increase in the vibration level of the engine
- An increase in the Exhaust Gas Temperature – EGT

- RPM Fluctuations

Transient and Intermittent or Steady and Severe

Compressor stalls can be transient and intermittent or steady and severe. Indications of a transient/intermittent stall are usually an intermittent “bang” as backfire and flow reversal take place. If the stall develops and becomes steady, strong vibration and a loud roar may develop from the continuous flow reversal. Often, the flight deck gauges do not show a mild or transient stall, but they do indicate a developed stall. Typical instrument indications include fluctuations in rpm and an increase in exhaust gas temperature. Most transient stalls are not harmful to the engine and often correct themselves after one or two pulsations. The possibility of severe engine damage from a steady state stall is immediate. Recovery must be accomplished by quickly reducing power, decreasing the aircraft’s angle of attack, and increasing airspeed.