SAFETY BRIEF

Number 6

Pneumatic Systems

While accidents due to pneumatic system failures are rare, they are almost always fatal.

Pneumatic systems, commonly known as vacuum or pressure systems, power the heading and attitude indicators in most general aviation (GA) aircraft, and in some aircraft, also power the autopilot and de-ice systems. For pilots who regularly fly at night or in instrument meteorological conditions (IMC) these systems are essential. This ASF Safety Brief explains how the pneumatic system works, how to recognize a system failure, and system redundancy options.

Basic Operation

Pneumatic systems in GA aircraft are pretty straightforward. The heart of these systems is a pressure or vacuum-creating engine driven air pump.

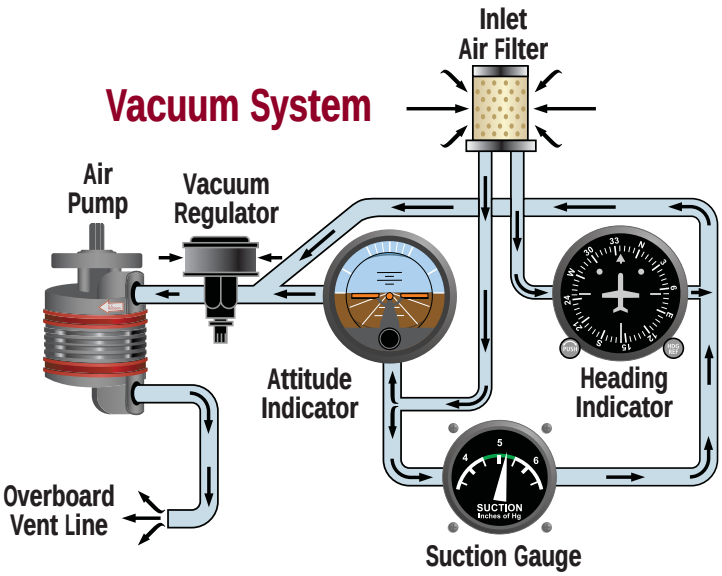
The air pump draws air into the system through a filter. The fast-moving stream of air passes over the vanes within the heading and attitude indicator gyros, causing the gyroscopes to rotate at about 10,000 RPM. In many aircraft, the same air pump powers the autopilot and de-ice systems.

There are two basic types of air pumps: wet and dry. Wet air pumps use engine oil to lubricate the inside of the pump. The more common dry air pumps have graphite vanes inside the casing which self-lubricate as they rotate.

Early Recognition of System Failure

Recognizing a pneumatic system failure early is important during any operation, but when flying IMC or night VFR it could be the difference between life and death.

To accurately and quickly recognize a pneumatic system failure, you must first understand which flight instruments are pneumatically powered. In most aircraft, these would be the heading and attitude indicators, although in some newer aircraft these flight instruments are electrically powered. Check the aircraft's pilot operating handbook (POH) for specifics.



The heading and attitude indicators in many GA aircraft are powered by the pneumatic system.

If the autopilot is also powered by the pneumatic system, the consequences of a system failure are magnified; just when the autopilot is needed the most, it's no longer reliable.

Signs of Failure

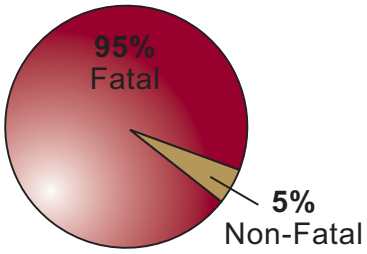
Early recognition of pneumatic system failure is complicated because the first warning signs can be subtle. Vacuum or pressure powered flight instruments will slowly begin to give conflicting and inaccurate information, so proficiency in instrument scanning is vital. It's important to include the suction or pressure gauge as part of your scan pattern, because a low reading will often signal a failure before the gyros start giving inaccurate indications.

Pilots should consider installing easily visible annunciator warning lights, inoperative flags on the gyros, or flow indicators for early warning of a pneumatic systems failure.

Early recognition of a pneumatic system failure can significantly decrease the chances of spatial disorientation.

Annunciators and flags provide an early indication of a pneumatic system failure.

While pneumatic system failures alone do not cause accidents, spatial disorientation does, and tragically these accidents are almost always fatal. (See figure below.)



(1995-2004)

To help avoid spatial disorientation:

- Install a backup power supply to the pneumatic system (see the Redundancy section below)
- Keep the suction gauge in your instrument scan
- Become and stay proficient at partial panel flying
- Cover up inoperative instruments during a failure
- Make timed turns instead of using the heading indicator
- Notify ATC of the situation and declare an emergency
- If in IMC, consider flying toward the closest VMC
- Check the weather at the nearest airport with a precision instrument approach
- Ask ATC for a "no gyro approach"

Pneumatic system failures can occur at any time, regardless of the age of the system. Causes include:

- Contamination by solid particles from within the pneumatic system that can damage the pump and plug valve openings.
- Liquid contamination from oil, water, or engine cleaning solvents.
- A loose fitting or damaged hose allowing contaminants into the system past the filter.
- Worn out, misused, or incorrectly routed hoses.
- Abrupt engine deceleration (which can be caused by the propeller hitting water or tall grass).
- Sudden engine stoppage, such as that caused by a prop strike against a solid object.

Whether you're an aircraft owner, renter, or operator defense against pneumatic system failure begins with a review of the maintenance logs and a talk with the mechanic who most recently worked on the aircraft. Study and adhere to the aircraft and component part manufacturer's recommendations regarding inspection and replacement intervals of pneumatic system component parts.

Redundancy

Redundancy in a pneumatic system can take a load of worry off your plate. While many newer aircraft come with redundant systems, older aircraft usually do not. Pilots who frequently fly in IMC or night VMC should install pneumatic system redundancy.

Redundancy comes in several forms. Options include:

- Electrically-powered backup attitude and heading indicators
- Air pump redundancy with an electric or engine driven pump
- Standby vacuum system that utilizes the pressure differential from the engine's intake manifold

Points to Remember

Here are the key points to remember about pneumatic system failures:

- Pneumatic systems fail. Expect it and be prepared.
- You can lessen the likelihood of a failure by making sure the pneumatic system has been properly maintained.
- Consider installing a backup system and a prominently placed annunciator.
- Stay current on instrument scanning techniques and partial panel flying.

With these points in mind, you can feel more at ease the next time you need to rely on your pneumatic powered flight instruments and systems.

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