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## Commitment to Environmental Excellence - Contrails

### Exhaust Gases and Emissions

Often, military aircraft can be seen taking off with a black smoke appearing from the engines. This smoke is mainly soot particles, similar to diesel engines. Commercial aircraft also produce the same type of soot particles, but usually not to the same degree as military aircraft. This is for two reasons: the type of fuel and the type of engines.

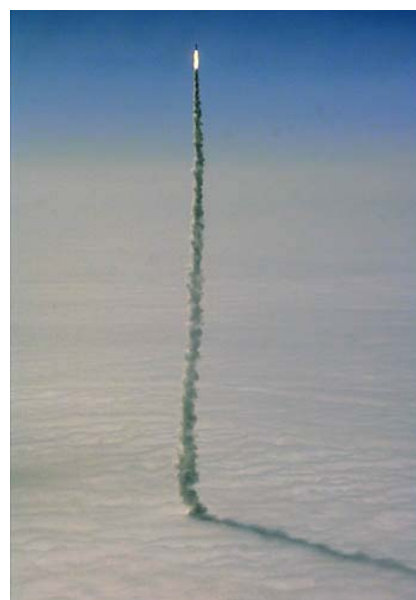
Most military aircraft use JP-8 jet fuel which is a blend of commercial Jet Aviation Fuel -1 (or Jet A-1) with three extra additives. The additives are used to control ice formation, control biogrowth (molds and slimes), and inhibit corrosion. The military uses these additives because of the unique environments the military operates in, the type of self-sealing fuel tanks used, and the type of metals, plastics, and sealant used on military aircraft. Several specialized aircraft like the SR-71 and U-2 use different fuels than JP-8, but are developed from the same base stock. Fuels research is always ongoing. The newest fuel being brought into production is JP-8+100. Dubbed JP-8+100 because the additive package can increase the thermal stability of military fuel by 100 degrees Fahrenheit, the improved fuel helps prevent gums and deposits that can foul fuel lines.

Military engines are also designed with different performance characteristics than commercial aircraft. Military aircraft and engines also tend to be older and less efficient than commercial aircraft and produce more emissions. Engines are optimized for fuel consumption and power rates at a particular cruising altitude. At take-off, the engines are usually very inefficient and produce more emissions than when at the optimal cruising altitude. Older military aircraft like the B-52 and C-130 can leave a black smoke exhaust even at cruising altitude, while aircraft like the KC-135R with new engines produce an invisible exhaust plume. Typical pictures of aircraft exhaust emission are shown below.





Space launch vehicles and missiles produce a different type of exhaust than aircraft. The propulsion system on military rockets and missiles is usually made of solid rocket fuel. Missiles and rockets produce smoke plumes as a result of the solid fuel burning. The hot gases escaping from the motor can also create contrails, but the smoke and contrail combine to form a single exhaust plume. For more information on Air Force propulsion and fuels programs, see the [Air Force Research Laboratory Propulsion Directorate](#).





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