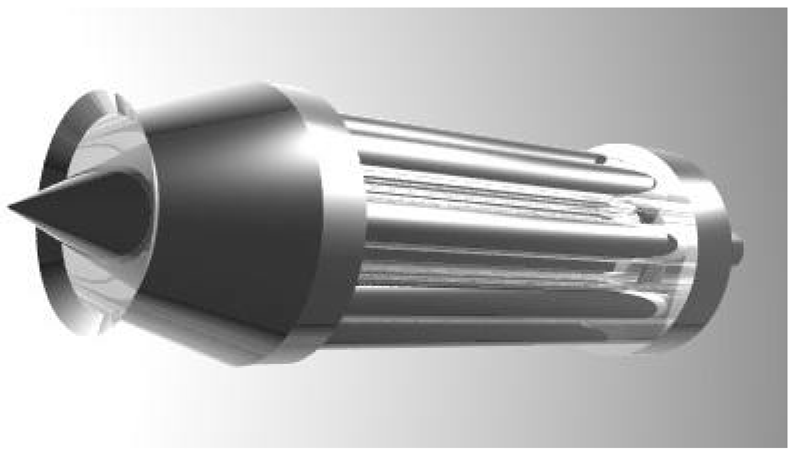
# X-jet



*The 21st-century Pulsejet*

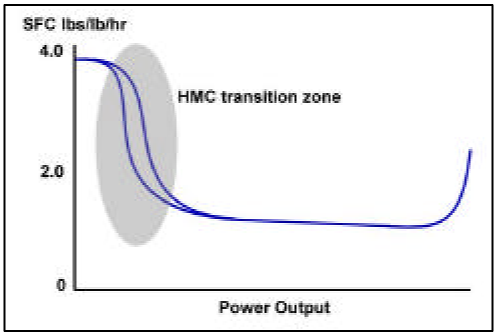
Shock-induced combustion and innovative design combine to produce a pulsejet with turbojet performance levels and a range of features well suited to small aircraft and UAVs

- ✓ Low cost
- ✓ No moving parts
- ✓ No complex ancillaries required
- ✓ Low maintenance
- ✓ High durability
- ✓ High power to weight ratio
- ✓ TSFC better than 1.2 lbs/lb/hr
- ✓ Convenient form-factor
- ✓ Low external operating temperatures
- ✓ Small off-aspect IR signature
- ✓ Flexible fuel options
- ✓ Near instant throttle response

# The X-Jet Engine

Development work on the X-Jet engine is now at a third-prototype construction stage, with two working engines built to earlier designs having already been successfully built and demonstrated.

Data gained from the analysis work performed on these prototypes has enabled progressive and significant improvements to be achieved in the areas of thrust-specific fuel consumption and power to weight ratio.




At the heart of the X-Jet's exceptional performance is a phenomenon which has been labeled "high magnitude combustion" (HMC).

While not a true detonation (the X-Jet is *not* a PDE) HMC results in the near simultaneous combustion of the entire air/fuel charge rather than the leisurely deflagration that normally results from single-point ignition.

The rapid rate of energy release that occurs in an HMC produces significantly higher peak combustion pressures than are normally obtained in a conventional pulsejet -- without the need for any kind of mechanically actuated post-combustion confinement.

As a result of this ultra-rapid combustion, the exhaust mass is accelerated to a far higher peak velocity and ejected from the engine more quickly. This produces a greater specific impulse per unit of fuel while also reducing the cycle time of the engine, thus allowing more power pulses per second and a subsequent increase in thrust.

The more rapid evacuation of the combustion chamber also means that less energy is lost by radiation and conduction to/through the chamber walls. In operation, the external temperature of the engine shroud does not exceed 120 degrees C.

Overall efficiency is further increased by entraining cold dense air which significantly boosts the engine's total mass-flow, thus increasing both thrust and efficiency. This bypass-flow produces an engine that effectively provides the same lean-burn operation as a turbojet, where far more air passes through the engine than just that needed to support combustion.

An additional benefit of this bypass flow is that the mean exhaust temperature of the engine is significantly reduced when compared to a conventional pulsejet. This is advantageous in military applications as it results in an engine with a far smaller off-aspect infrared signature.

The introduction of large amounts of cold, dense air also significantly reduces the noise level generated by the engine's pulsating combustion. Other noise-reduction techniques are currently being evaluated and the goal is to produce an engine with noise levels comparable to a conventional piston engine driving a propeller.

## Applications

Its low cost, high reliability and excellent durability make the X-Jet ideally suited to the next generation of unmanned aerial vehicles (UAVs), remotely piloted vehicles (RPVs) and low-cost cruise missiles that are poised to become the cornerstone of modern warfare.

Civilian applications include the provision of low-cost, high performance, high-reliability power units for ultralight, microlight and purpose-built light-aircraft, as well possible use as an add-on emergency thrust unit for existing light aircraft.

## Key Benefits

Perhaps the single largest benefit of the X-Jet design is its extremely low cost when compared to a conventional turbojet of similar size and power.

This cost advantage extends well beyond the initial purchase price since, unlike the turbojet, the X-Jet has no moving parts.

It is envisaged that routine maintenance on the X-Jet will consist solely of an inspection regime and the periodic pre-emptive replacement of low-cost hot-section components. This maintenance and servicing can be performed without the need for expensive test equipment, balancing rigs or other specialist apparatus and skills.

Another benefit of the X-Jet design is its high durability in adverse environments. Without delicate turbine blades or high-speed bearings, the X-Jet is capable of operating continuously in conditions that would cause the rapid, premature failure of a turbojet. This includes environments such as those where foreign object ingestion is likely.

The low cost and unique operating characteristics of the X-Jet also make multi-engine installations a viable option for even the smallest craft. This has the further advantage that it then allows engines to be stopped and started in a manner that ensures individual engines are operated at optimum efficiency levels over the greatest range of airspeeds and climb/cruise rates.

The attractiveness of multi-engine operation is enhanced further by the fact that X-Jet engines have a very low parasitic drag, near-instant throttle response, and can be restarted at any time while in flight -- simply by the application of fuel and spark.

A low component count and the simplicity of construction also means that X-Jet engines can be economically designed and built to specific customer requirements. Instead of being forced to build a craft around whatever engine is available, it becomes practical to design the engine to match the requirements and capabilities of the airframe.

## Summary

The pulsejet is an engine that has been largely neglected since the mid-part of last century.

Although much effort and funding has been poured into pulse detonation engines (PDEs), a complex and yet to be perfected supersonic pulsejet engine, designers and engineers have so far largely ignored the middle ground which the X-Jet directly addresses.

By applying advanced thinking and 21$^{st}$-century design, modeling and constructional techniques to the problem of producing a high-efficiency pulsejet engine, the developers of the X-Jet have succeeded in producing a product which effectively bridges the gap between the inefficient pulsejet engines of yesterday and the long-promised super-sonic engines of the future.

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