Small-Scale Turbo-Jet Engine

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BocaBearings

PROBAL DYNAMIC BALANCING

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Introduction

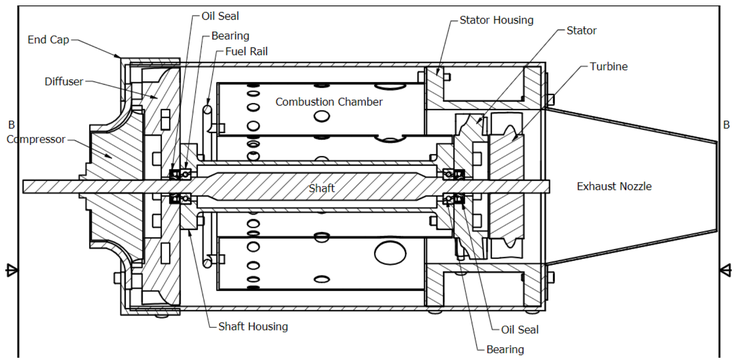
Turbojet engines have been used in aerospace applications for over 80 years to achieve high flight performance and power output. This design project's goal is to produce a working turbojet engine using materials and resources that the University provides, along with material anyone can buy from a hardware or hobby store.

Materials and Resources

The biggest resource to this project is the Mechanical Engineering machine shop underneath ME North and their staff. The shop also possesses a large materials room where most of our material was drawn from. For specific sized materials, online resources were used such as onlinemetals.com. The engine operates at very high rotational speeds so our team bought specialized bearings from Boca Bearings after receiving a sponsorship from them. Also because of the high rotational speed, accurate and precise balancing is needed. Probal Dynamic Balancing of Gainesville TX sponsored us and provided the balancing services for this project. Another huge resource on this project is a man we came in contact with named Chris who has had over a decade of experience in jet engine and other turbomachinery engineering. Chris devoted a lot of his time and effort to help this project achieve success. We as a team are very grateful for his assistance.

Design

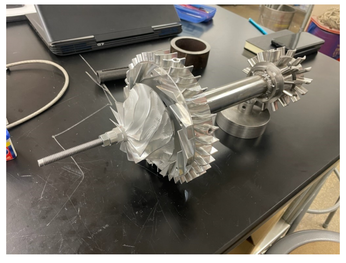
The engine was designed to use a centrifugal compressor from a turbocharger so the rest of the engine's size was based around this compressor rotor. The engine is fueled by propane, this was chosen for a simpler fuel system than compared to kerosene or other liquid fuels. The combustion chamber features a "can" design where air is directed to form a flame vortex in the primary zone for proper full combustion. The ignition system consists of a battery wired to a large capacitor, following a blinker relay and a spark plug to have rhythmic ignition during operation. All components were designed using Autodesk Inventor.



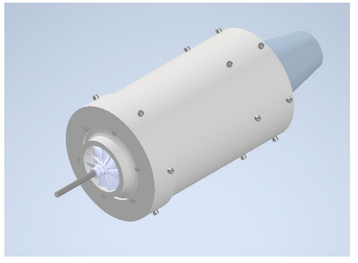
Cutaway of engine

Turbocharger compressor wheel

Full engine internals front

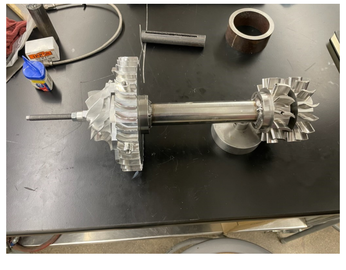


Rotation assembly front

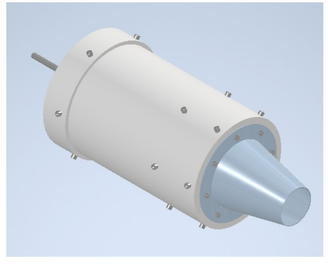


Complete assembly front

Full engine internals back



Rotation assembly side



Complete assembly back

Manufacturing

- Turning

The jet housing, shaft housing, stator housing, and other parts were machined on lathes for preparation and final manufacturing.

- Milling

Holes for fasteners in the jet housing, shaft housing, and stator housing were drilled using manual mills.

- CNC

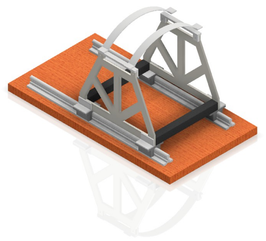
Complex shaped parts such as the stator, diffuser, turbine and shaft were machined using the CNC mill and lathe in the shop to achieve small tolerance dimensions.

- Welding/Rolling

The combustion chamber and exhaust nozzle were rolled and welded together using sheet metal rollers and the welding shop. Other parts were welded for assembly as well.

Test Bed

A test bed to mount the engine to, as well as measure performance was designed using steel structural beams and rails to allow for an attached spring gauge to measure thrust output. Internal engine temperature will be measured using thermocouples to ensure proper operation of the engine, and to avoid bearing seizure due to heat.



Test Procedure

The test procedure of the engine follows

1. Ensure safety in the area of operation
2. Spool up engine using airflow or mechanical means
3. Engage ignition system circuitry
4. Slowly open propane tank regulator until engine lights and is operating
5. Adjust engine speed using tank regulator and monitor temperatures and thrust using the test bed
6. Reduce engine power by closing gas regulator and let engine wind down to stop operations