

Set-up procedure and Start-up procedure for a my KJ66

I wrote this to help give beginners an idea of a typical set-up for a KJ66, I don't give this information as the definitive answer to the meaning of life but just a simple guide to give some basic ideas, if you find any mistakes then I apologise now.

The KJ66 has a single stage centrifugal compressor as used in car turbochargers, an annular combustion chamber with 6 reverse flow fuel burners and an axial turbine, the basic engine weighs in the region of 2 to 3 LBS and has a rotational speed of 30,000 RPM @ idle and between 100,000 and 120,000 @Max RPM, these figures vary according to the accuracy of balance of the engine.

Some of the things you will need are:

Fire extinguisher, Electronic speed controller, propane/butane gas can or brazing can for silver soldering, electric motor with coupling and on/off switch or suitable blower fan, Radio control gear, ignition source of some kind, suitable test bench to strap the engine to, it's a good idea to have this securely fixed down. Pressure gauge reading 0 to 3 BAR or 0 to 30PSI

Some basics

The KJ66 uses a speed controller from an electric flight aircraft to power the fuel pump and vary the speed of the fuel pump, when you increase the fuel flow to a gas turbine the engine RPM increases.

The KJ66 uses small injector pipes for its burner tubes, these do not atomise the liquid fuel so the engine uses a flammable gas to preheat these burner tubes before the liquid fuel is sent into the engine, you'll need a can of propane or butane or propane/butane mix, this is used for starting the engine only, once the engine is heated and then running on liquid fuel this preheat gas is disconnected.

This gas is fed into the combustion chamber and ignited, there is then a flame inside the combustion chamber that is heating the burner tubes, when liquid fuel touches the insides of these burner tubes it vaporises into an ignitable gas.

The KJ66 is spooled and started up using either an electric motor driving the spinner on the front of the compressor or a blower fan/compressed air to blow the compressor round, either way is ok.

I use a blower to start my engine, this is a fan heater blower from a car, I have modified this with a nozzle to accelerate the air which is a plastic pop bottle and use 2X 12v batteries in series to give 24volts to power this blower.

To lubricate a KJ66, oil I pumped to the bearings, I use 6 to 8% two stroke oil which is mixed with the fuel (paraffin/kerosene/JET A1/white spirit) in the fuel line there is a T-junction that splits the fuel pipe in two, one pipe goes to the injector pipes and the other goes to the oil inlet pipe to feed the bearings tis fuel/oil mix,

After the bearings this fuel/oil is passed back into the engine to burn.

Setup

Ensure all fixtures and fittings are secured in place, a fuel pipe disconnecting and spraying you or the engine with neat fuel is NOT a good thing to have happen!

Ensure that the test bench is held down, a KJ66 or any other engine has enough power to topple a bench over.

Has the fuel got oil in?

Has the fuel been filtered? Any little piece of grit etc will block fuel and oil lines, it only takes a split second of fuel/oil starvation and a bearing fails.

Are all batteries charged?

Are all spectators clear of the engine? This is probably one of the most important safety issues that I can state here:

When (if) a turbine disintegrates the shrapnel goes in a direction perpendicular to the rotation of the turbine, so anyone standing in the plane of rotation when (if) it shreds a blade or worse has a disc separation/disintegration may get those hot metal parts stuck in them, even if the engine is at idle speed the engine is still running fast enough for these parts to become a major hazard! **YOU HAVE BEEN WARNED! NO ONE** stands inline of the turbine.

FACT: a KJ66 at idle speed is doing around 30,000 RPM and at max is doing in the region of 100,000 to 110,000 RPM

120,000 RPM if the owner has balls of steel and the rotor is well balanced!

ROTOR: when the rotor is mentioned this means the moving part of the turbine, this is the compressor, shaft and turbine, these parts combined form the rotor, these parts are tightened together and rotate as one. The bearings supports the rotor.

I have seen video footage of an engine that did have a disc explode and the only way I can describe what I saw was 'BLOODY TERRIFYING!' there was a sound similar to a rifle shot and objects were seen to impact against a wooden fence.

Is everything out of the way of the intake? If something gets ingested into the compressor it can write off an engine, and while I'm on the subject make sure no one puts their hand anywhere near the intake, one of my friends lost the tip of his middle finger by accident, it was gone in a millisecond!

He was removing the gas pipe and placed his middle finger in the intake by accident!!

The exhaust, make sure no one puts their hands near here, the temperature of a turbine running at idle is somewhere in the region of 500 deg C

Fuel tank filled?

Got a frequency that doesn't clash with anyone else? Or anyone else that's on the same frequency knows not to switch on? It'd be a shame to be testing at the flying sight and someone switches on the same channel and goes to full throttle when you weren't expecting it!

Gear switched on and checked? Everything connected?

Is the engine flooded? Its easy to do, if you travelled with full tanks there is a chance that fuel could've leaked past the pump into the engine so when you light the engine all this fuel is vaporised and there is a chance that the engine could run away. i.e. rev up and up and up and up until something gives.

Start up.

This isn't how everyone does it but this is how I do it.

Check and double check everything, especially fuel lines

Bring throttle stick and trim to fully down i.e. towards you

Switch on transmitter

Switch on speed controller and receiver

Slide the throttle trim slowly forward until fuel pump begins to hum then a little more until it begins to slowly pump fuel, watch as fuel reaches engine and disappears out of sight, wait about a second more, this should have primed the fuel lines pumping fuel almost all the way into the engine, the reason for doing this is so when you have lit the gas and are spooling the engine and begin to pump the fuel to the engine there is no delay in flare up, more of this in a minute.

Ok fuel lines primed, spectators out of the way and nothing small and loose near the intake.

Fireman briefed and at the ready?

There should be someone with a fire extinguisher ready to put out any fire that may arise, now you should let him know that there may be a few flames coming out the exhaust and that this does not give him the right to douse the engine in white powder or what ever you have to hand. Even a bucket of water is better than nothing! He should only extinguish the fire if it is the fuel tanks or anything else that is on fire .

Ok, I think we're ready, lets try a start

Turn on the gas (or ask your helper! And tell him/her to keep it upright else you'll have liquid gas in the engine and if this ignites then you have either a fireball or a rapidly accelerating engine)

So turn on the gas in the propane preheat bottle that is connected to the engine, spool the engine up for a second so that it is just turning over at about 1000 RPM and ignite the gas at the exhaust, I use a cigarette lighter but you may have followed the plans completely and use a glow plug that extends into the combustion chamber, if so connect this to a 2v battery, the propane preheat will now ignite with a pop and the flame should go into the engine, if it doesn't ignite then either the engine is spooling to high in which case let it spin down a little more and try again or there isn't enough gas so open the valve a little more you'll know when there is a flame there by the sound.

Now the gas has ignited spool the engine with what ever method you are using and begin to move the trim on the throttle stick SLOWLY to start the fuel pump running SLOWLY, I say slowly cos. if you pump too much fuel in too early then not all the fuel burns and you have a fireball of unburned fuel out the back.

When the fuel enters the engine you will hear it flare up and the engine revs will increase rapidly, keep moving the trim forward slowly and watch the pressure gauge that is connected to the case of the engine, this pressure gauge shows what the engine is doing,

So keep moving the trim forward while spooling the engine, when the gauge starts to show a pressure of about 1 or 2 PSI you should be able to disconnect the spool up device and the engine should keep running on its own, this will probably be its self sustain speed, you'll need to bring this speed up a little higher than this to its idle speed, a gas turbine won't accelerate very well from sustain speed to that is

why the idle speed is a little higher, you'll have to work this one out on your own, basically it'll speed up better at idle speed than sustain speed.

Now you can turn off and disconnect the preheat gas supply.

Your engine is now running,

To shut down its best to bring the engine to idle and stop the fuel pump, then attach the spool up device and keep the engine turning over to cool it down to prevent anything warping

All the details given here are given in good faith and you follow these at your own risk,

So you can't hold me responsible if it goes wrong!

WATCH THOSE EYEBROWS AND KEEP UP THE THRUST!