Turbine Starting and Running

Always set-up and confirm the operation of your Auto-start installation on the test-stand, before installing into your model. This will help you to familiarize all components associated and the characteristics of different stages of turbine engine starting.

The present version of auto start uses only one channel for the entire engine functions:

To trigger the auto start cycle, the process is as follows:

- The user raises the trim. "Ready" will appear on the GSU screen. The trim and stick should be where the engine is supposedly to be to idle once running. If the trim is on "stop" position, "Trim low" will be read on the GSU.
- If throttle value is higher than idle, "StickLo!" will be read.
- When "Ready" is displayed, the user should cycle the stick to full power and back to idle in order to initiate the start sequence. *For F & G models, do not be alarmed by the starter motor engaging the rotor, this briefly actuates manual cool down*
- The glow-plug is powered and checked. Once hot, the starter is engaged at reduced power (soft start) and the gas valve is energized. If the glow test fail, a "Glow Bad" message is displayed, and if the starter fails to arrive a minimum RPM in 2 seconds, a "start bad" message is issued, and the auto start function aborted.
- When the rotor arrives at more than the "ignition max rpm" programmed parameter (default 4000 for K-80E), the starter is disconnected and the brake applied.
- When the rotor RPM falls below than the "ignition min. Rpm" parameter (default 3000), the starter is switched on again to raise the rotor speed to the "ignition max rpm" and the cycle is repeated until the gas ignites or the system times out after 30s.
- When the thermocouple register a increase of 100ºC in temperature meaning that the ignition have occurred, the starter is switched on immediately at reduced power, increasing this power accordingly to the real rotor rpm. At the same time the pump is switched on at "pump start point" power, and the fuel valve is opened.
- The engine begins to accelerate as soon as fuel begin to burn, and power of the pump is being increased through the time at "fuel ramp" slope. Once rotor RPM
arrives to the RPM set in “rpm switch off gas” parameter (usually set at 3/4 of the “starter off RPM”) the gas valve is closed, and when the RPM arrive at the predefined "starter off RPM" value, the starter is switched off and the brake applied to it. The engine continues to accelerate until idle RPM is reached. Now, the command of the turbine will be taken over by the transmitter.

**Turbine Stopping and Cooling**

- The user can finish the sequence at any moment, simply setting the trim to "off" position. If the engine was on "running" phase (above idle rpm), a cooling sequence will be triggered, cycling the starter motor until the EGT is below the minimum programmed temperature. This cooling sequence will be aborted if the trim is raised again.
- If the engine is hot (EGT higher than the minimum temperature) at the moment that the user triggers the auto start cycle, then the FADEC will begin a cooling cycle until the temperature is below 100C.

**Manual cool down:**

In the event if engine does not go into the cool down mode after the turbine shuts down or flames-out, the user can lower the trim, and advance throttle stick to trigger cooling from starter. Make sure you simulate the auto cooling sequence and monitor the real time temperature and do not leave motor running to longer than a couple of seconds.

Another option is to unplug reconnect power to ECU, this power cycle will enable ECU to recognize that the engine temperature is still higher than normal, and should engage auto cool down.
RUN Menus

Under this submenu, the parameters used for the engine during normal run can be modified. Note: Some of these menus parameters cannot be changed by user. It was factory set for best operation and to protect turbine. **Please do not change these values set by factory. This may void your warranty!**

**Full power speed:** On this screen you can set the RPM that the engine will run at 100% throttle. If the engine manufacturer has set a maximum limit, you will only be able to reduce the max RPM.

**Idle speed:** Set the RPM that the engine will run when the ECU receive IDLE Command. While the engine is running, the ECU will adjust the rotor speed accordingly the throttle position in a closed loop system.

**STOP speed:** Set the minimum RPM that the engine is allowed to run. The ECU will shut down the engine if the rotor speed is below this setting.

**Start/Min temperature:** Set the minimum temperature that the engine is allowed to run, and in manual start operation, sets the temperature from which the pump begin to run. 100 Celsius.

**Maximum temperature:** Set the maximum temperature that the engine is allowed to run. The ECU will reduce the acceleration rate if the EGT approaches to maximum and will reduce the pump power if necessary to keep the temperature below the maximum, but it don’t will cut the engine if the temperature is too high, it will try always to keep the engine running by reducing the fuel flow. 850 DEG C

**Acceleration delay:** Set the acceleration time on the engine. Higher the values, slower the acceleration. The real acceleration is calculated using a complex algorithm that take in to account this value, temperature, current RPM, commanded RPM, and the tendency of EGT and RPM.

**Deceleration delay:** Similar to the acceleration, but used during throttle down. Higher values mean slower deceleration.

**Stability delay:** When the engine is running at constant throttle setting, the ECU is adjusting continuously the pump power so that the rotor RPM mach exactly with the throttle signal. The speed of witch the ECU adjust the pump power is set by this...
parameter. A value of 100 usually is the best for all engines. A too low of a value can cause instability on the RPM.

**Pump Limit:** The ECU can give to the pump the full battery voltage, but in most cases the voltage needed for the pump is only a fraction of the full battery voltage. Limiting the pump give a much smoother control of the engine and prevents that the pump could receive excessive voltage in the case of a problem in the fuel circuit, a clogged filter for example. This excessive power will cause a high pressure on the circuit that can cause leaks or blown tubes. Modifying this parameter is similar to reducing the battery voltage, so the accel and decal times will be modified. The most ideal is to have the limit set at the lowest and still be able to reach full max RPM, run the engine, check and annotate the Pw of the pump displayed on the first screen when the engine is running at full power and then use this value as pump limit, increasing it in a 15%-20% to give a bit of margin for weak batteries and pump wear. Once the new value set, adjust the accel and decel delays for best engine handling.

**List of FADEC STATUS Message Codes**

Here is a list of possible messages shown on the data terminal screen and their meaning.

**TrimLow:** Indicates that the signal received from the transmitter corresponds to the lowered trim, that is to say, engine OFF.

**Ready:** Indicates that the engine is ready for starting, and that the transmitter signal corresponds to IDLE, (green LED lit)

**StickLo!:** This indicates that the throttle stick is in the IDLE position, the engine will not start with the stick in this position.

**Glow Test:** Verifying of glow plug

**StartOn:** Test of the starter

**Ignition:** Gas ignition phase.

**Preheat:** Phase of heating of the combustion chamber after detecting gas ignition.

**FuelRamp:** Phase of fuel acceleration until IDLE IS reached.