

## 1.0 Introduction and Protocol Mandate

This document provides the official safety and emergency response protocols for the 40KG turbojet engine and serves as the authoritative guide for all personnel. Adherence to these protocols is mandatory to mitigate the inherent risks of micro-turbine operation, ensuring the safety of all individuals and the operational integrity of the equipment. All personnel must understand that turbines are fundamentally hazardous, and the operator assumes complete liability for all operational risks.

Turbines are inherently dangerous to run. The user assumes full responsibility for any damages or injury to themselves or to any bystanders. Our responsibility is explicitly limited to the motor and its internal workings.

**If you have any questions, do not run the turbine. If you are unsure about how to operate the unit, do not run the turbine.**

This protocol is comprehensive and applies to all phases of engine operation: setup, startup, normal operation, shutdown, and emergency response. These procedures are binding for all personnel associated with the engine's operation, including designated Operators and Ground Assistants. Safe and effective operation begins with a thorough understanding of the specific hazards associated with this powerful equipment.

## 2.0 Fundamental Safety Principles & Hazard Identification

A comprehensive understanding of the specific risks associated with the 40KG turbojet engine is the foundation of safe operation and effective risk mitigation. All personnel must be fully aware of the following primary hazards before commencing any operational activity.

- **Mechanical Failure Hazard** In the rare event of a catastrophic malfunction, there is a significant risk of high-velocity debris being expelled from the engine. This includes the potential for compressor blades to be ejected from the front intake and turbine blades from the rear exhaust. Such an event poses an extreme danger to personnel and equipment in the immediate vicinity.
- **Extreme Thermal Hazard** The engine's exhaust gases can reach temperatures of up to **1000°C**. Direct contact will cause severe, immediate burns to the skin. All personnel and equipment must remain clear of the exhaust path, and any objects susceptible to heat damage must be removed from the operational area.

- **Acoustic Hazard** The turbine produces excessive decibel levels of noise during operation. Prolonged or unprotected exposure can lead to permanent hearing damage. The use of appropriate industrial-grade ear protection is **mandatory** for all individuals in the operational area.
- **Chemical & Inhalation Hazard** Two primary chemical risks are present:

1. **Oil Toxicity:** The required turbine oil is poisonous. Direct contact with the mouth, eyes, or skin must be prevented. Always store turbine oil in a clearly marked container, safely out of reach of children.

2. **Exhaust Inhalation:** Turbine oil is a known carcinogen. Prolonged and repeated exposure to the engine's exhaust smoke can pose a long-term health hazard. Operations must be conducted in well-ventilated outdoor areas.

- **Loss of Control Hazard** The culmination of these risks is the potential for death or serious injury resulting from a loss of control of the turbine or the model in which it is installed. This underscores the critical importance of disciplined adherence to all safety protocols.

The effective management of these hazards depends on clearly defined roles and a strict adherence to assigned responsibilities.

### 3.0 Personnel Roles, Responsibilities, and Qualifications

Clear roles and responsibilities are critical for operational safety and accountability. This section defines the mandatory qualifications and duties for every individual involved in turbine operations. No one may participate in engine operation without meeting these requirements.

#### 3.1 Operator

- **Qualification:** Must be thoroughly versed in model jet turbine operation and be completely familiar with every section of the engine's operational manual.
- **Responsibility:** Assumes full and final responsibility for all risks associated with the operation, including any potential injury or damage to bystanders and property.
- **Responsibility:** If they are a first-time turbine user, they are required to engage the help of a seasoned pilot or experienced turbine mechanic to oversee their initial operations.

### 3.2 Ground Assistant

- **Qualification:** Must be a "qualified" assistant who is familiar with the operations of a micro-turbine.
- **Responsibility:** Required during all Start-Up procedures.
- **Responsibility:** Must fully understand their designated role and responsibilities *before* the engine start sequence is initiated.

### 3.3 Designated Fireman (Ground Assistant Role)

- **Responsibility:** Must be formally assigned the specific role of "fireman" prior to operation.
- **Responsibility:** Must be fully aware of the correct emergency response procedures in the event of a fire or other emergency.
- **Responsibility:** Must know the precise location of all fire extinguishers and be trained in their proper use.

### 3.4 Bystanders

- **Responsibility:** Must maintain a safe distance from the engine at all times. This is defined as a minimum of **10 meters (30 feet)** clear of the area to the side and rear of the engine.

These personnel must execute a rigorous pre-operational checklist to verify system and environmental safety before any engine start is attempted.

## 4.0 Pre-Operational Safety Checklist

This checklist is a non-negotiable procedure designed to verify the safety of the operational environment, the integrity of the equipment, and the readiness of personnel before powering on the engine. Each item must be verified by the Operator before every operational session.

### Environment & Setup Verification:

1. Confirm the engine is mounted securely in a test stand explicitly rated to handle the engine's full thrust.
2. Verify the test stand itself is properly weighted down and secured against movement.

3. Ensure operations are conducted outdoors. If operating in a garage, confirm the exhaust is routed directly and safely outdoors via a suitable pipe.

#### **Emergency Equipment Readiness:**

1. Verify the immediate availability of at least one **CO2 extinguisher** and one **Class ABC extinguisher**.
2. Perform a daily inspection of all fire extinguishers to ensure they are fully charged and functional.

#### **Personal Protective Equipment (PPE) Mandate:**

1. Confirm all personnel in the immediate vicinity are equipped with and are wearing appropriate **ear protection**.

#### **Electrical System Integrity Check:**

1. **CRITICAL:** Quadruple-check the polarity of the LiPo battery connection to the Engine Control Unit (ECU). Reversing polarity will instantly destroy the ECU and is not covered by the warranty.
2. **CRITICAL:** Confirm the engine cable is connected to the ECU port labeled "motor" and the pump cable is connected to the port labeled "pump." Mixing these connections will damage the pump, may destroy the ECU, and will produce white smoke from the pump.

#### **Fuel System Integrity Check:**

1. For first-time engine use, confirm that the fuel lines have been fully primed using the "test pump" function in the GSU to purge all air from the system.
2. Inspect all fuel line connections. Ensure all tubing is secured to non-festo connections using 20-gauge stainless steel wire.
3. Verify the fuel shut-off valve is accessible to the Operator and is currently in the "off" position.

Once all checklist items are positively verified, the Operator may proceed with the Standard Operating Procedures for engine startup.

#### **5.0 Standard Operating Procedures (SOPs)**

These SOPs provide the exact, sequential steps for starting, operating, and shutting down the 40KG engine under normal conditions. Any deviation from these procedures can result in severe engine damage, pose a significant safety risk, and will void the manufacturer's warranty.

### 5.1 Engine Startup Protocol

1. Perform a final walk-around inspection of the motor stand and all connections.
2. Turn the fuel valve to the **ON** position.
3. Turn on power to the receiver and observe the Ground Support Unit (GSU) as it starts and syncs with the motor.
4. Turn on power to the Radio Controller. Listen for the audible sync tune confirming the link with the engine.
5. Raise the throttle trim to **100%**. On the GSU, observe the ECU status switch from **stop** to **ready**.
6. Initiate the start sequence by raising the throttle stick to **full**, then immediately lowering it to its **minimum** position.
7. Monitor the GSU display as the ECU automatically proceeds through the **Ignition**, **Preheat**, and **Fuelramp** phases.
8. For first-time use only, follow the on-screen GSU prompts to "raise stick to high" and "lower stick" to allow the ECU to train itself to the motor.

### 5.2 Engine Shutdown & Cooling Protocol

**WARNING:** Always observe proper shutdown and cooling of the turbine. Failure to observe proper shutdown by not properly cooling the unit will render damage and will void the warranty.

1. Lower the throttle stick to its **minimum** position.
2. Lower the throttle trim to its **minimum** position.
3. Confirm that as the trim reaches its minimum threshold, the engine fuel supply is cut and the **automatic cool-down sequence** initiates. The starter motor will spin to circulate cooling air through the engine core.

4. Monitor the engine temperature on the GSU display. Wait for the temperature to fall to a safe level (e.g., 80°C).

5. **Only after the engine is cool**, turn the fuel valve to the **OFF** position.

6. Turn off power to the ECU/controller.

7. Turn off power to your radio transmitter.

While these SOPs cover normal operations, all personnel must be trained and prepared to execute emergency procedures at a moment's notice.

## 6.0 Emergency Response Procedures

In the event of a malfunction, immediate and correct action is critical to prevent injury and catastrophic equipment damage. This section provides clear, non-negotiable response plans for critical emergencies. These procedures must be memorized by all operational personnel.

### 6.1 Engine Fire (Startup or Operation)

1. The Designated Fireman shall immediately retrieve the **CO2 extinguisher**.

2. Apply the CO2 extinguishing agent directly to the motor fire to extinguish the flames.

3. **WARNING:** Use a Class ABC dry chemical extinguisher **ONLY** as a last resort. Its use will cause heavy damage to the turbine, requiring a complete disassembly and cleaning. The use of a dry chemical extinguisher **will void the warranty**.

### 6.2 Radio Signal Loss (Failsafe Event)

1. Upon loss of radio signal, the pre-programmed radio failsafe will activate, and the engine will enter the state set by the operator during setup (e.g., shutdown).

2. **CRITICAL NOTE:** Following a failsafe event or a flameout, the ECU **will not** automatically enter a cool-down sequence. This is because the ECU has no way of knowing the status of the motor, whether from a flameout, crash, or other cause.

3. Once the situation is stabilized, if the engine is hot, the Operator must manually cool the motor. This is done by navigating to the GSU **Test function menu** and activating the **Test Starter** function to circulate air.

### 6.3 Uncontrolled Shutdown / Flameout

1. Immediately ensure all personnel are in a safe position and assess the status of the engine from a distance.
2. Do not attempt an immediate restart.
3. If the engine is hot, initiate a manual cooling cycle using the **Test Starter** function in the GSU, as described in the Failsafe procedure.
4. Once the engine is fully cool, the Operator must perform a full systems inspection to identify the cause of the shutdown before another start is attempted.

Mastery of these normal and emergency protocols is the hallmark of a professional and responsible operator.