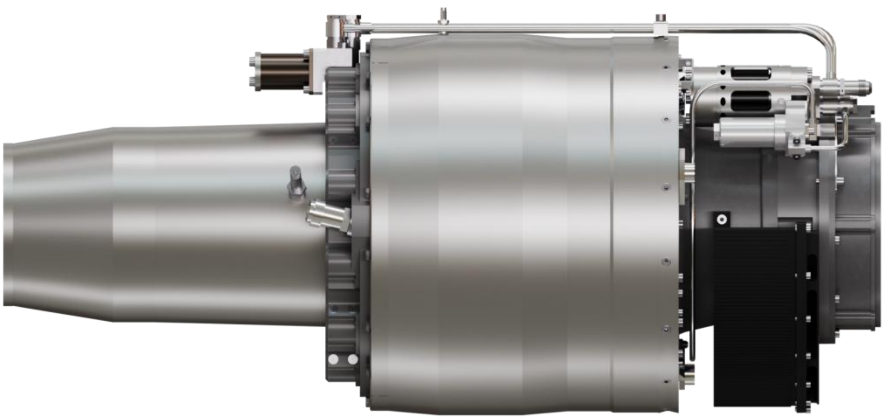
BPS-150 aerojet engine

Technical Use and Maintenance Manual



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1 Scope of Application

This document primarily describes the operation and maintenance of the BPS-150 turbojet engine (hereinafter referred to as the "Engine").

2 Reference Standards

GJB241A-2010 General Specification for Aero Turbojet and Turbofan Engines

GJB 5100-2002 General Specification for Turbojet and Turbofan Engines for Unmanned Aerial Vehicles

GJB 3186-1999 General Technical Requirements for Aircraft Engine Piping Systems

GJB 4053-2000 General Specification for Aircraft Engine Digital Electronic Control Systems

GJB 243A-2004 Flight Test Requirements for Aircraft Gas Turbine Powerplants

GJB 269A-2000 General Specification for Aircraft Rolling Bearings

GB/T 4240-1993 Stainless Steel Wire

GB 6537-2006 No. 3 Jet Fuel

GJB 1263-1991 Synthetic Lubricants for Aircraft Turbine Engines

HB 0-2-2002 Locking Methods for Threaded Connections and Pin Connections

3 Engine System Composition

The composition of the engine system is shown in Table 1.

Table 1 Engine System Composition

No.	Item Name	Quantity Per Set	Remarks
	Engine Unit	1	
	ECU	1	Powered by 24~28VDC, installed on the engine unit and tested OK.
	Igniter Assembly	1	
	Electric Fuel Pump	1	Installed on the engine unit and tested OK.
	Starter-Generator	1	
	Fuel Quick-Disconnect Coupling	1	Optional
	Solenoid Valve	1	Optional

4 Basic Dimensions of the Engine System

The basic dimensions of the BPS-150 engine system are shown in Table 2. The corresponding outline dimensions of the engine unit are shown in Figure 1.

Table 2 BPS-150 Engine System Basic Dimensions

Name	Dimension	Remarks
Engine Casing Diameter	ϕ272 mm±1 mm	
Engine Length	625 mm±2.5 mm	customizable
Engine Dry Weight	≤17.6 kg	Including ECU and accessories
Record of engine mass weighing (excluding battery and communication converter module):		

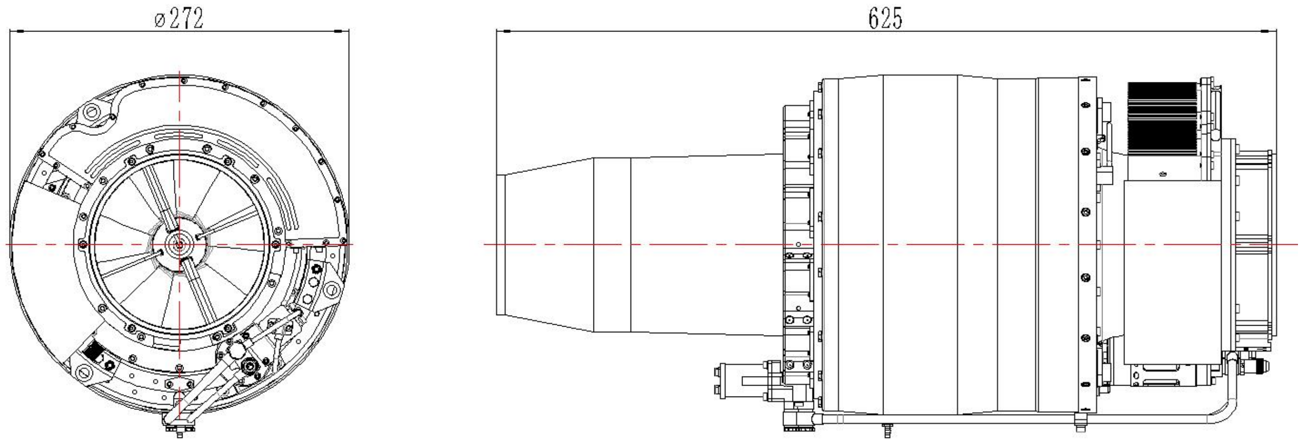


Figure 1 Engine Outline Dimensions Drawing

5 Engine Performance

Atmospheric Pressure 101.325kPa, Atmospheric Temperature 15°C, Altitude 0 meters:

Item	Parameter	Remarks
Overspeed Thrust (Emergency)	155daN	
Rated Thrust	150daN	
Ground Idle Thrust	<28daN	
Thrust-to-Weight Ratio	8.7	Calculated based on engine dry weight.
Maximum Airflow	Approximately 2.3 kg/s	
Ground Idle Speed	34000rpm	
Maximum Speed	55000rpm	
Overspeed	≤56500rpm	
Tolerable Deviation in Stable Mode	±350rpm	
Maximum Exhaust Temperature	<830℃	
SFC at Maximum Thrust	1.24Kg/daN·h	
SFC at Ground Idle	2.1Kg/daN·h	
Maximum Secondary Air Flow	28g/s	

6 General Safety Requirements for Operation

This document should be read carefully before operating the engine to understand the safety precautions and operational requirements.

6.1 Test Environment

Perform a sufficient number of start tests in a clean space under good external conditions for the engine, until the engine can start and run normally. If the test environment is poor, with airborne objects, etc., a filter screen or other dust/sand protection measures must be installed in front of the aircraft air intake to prevent foreign objects from entering the engine and damaging rotating components such as the centrifugal impeller.

6.2 Hazard Zone

Under no circumstances should the engine be started if any personnel are within the hazard zone shown in Figure 2.

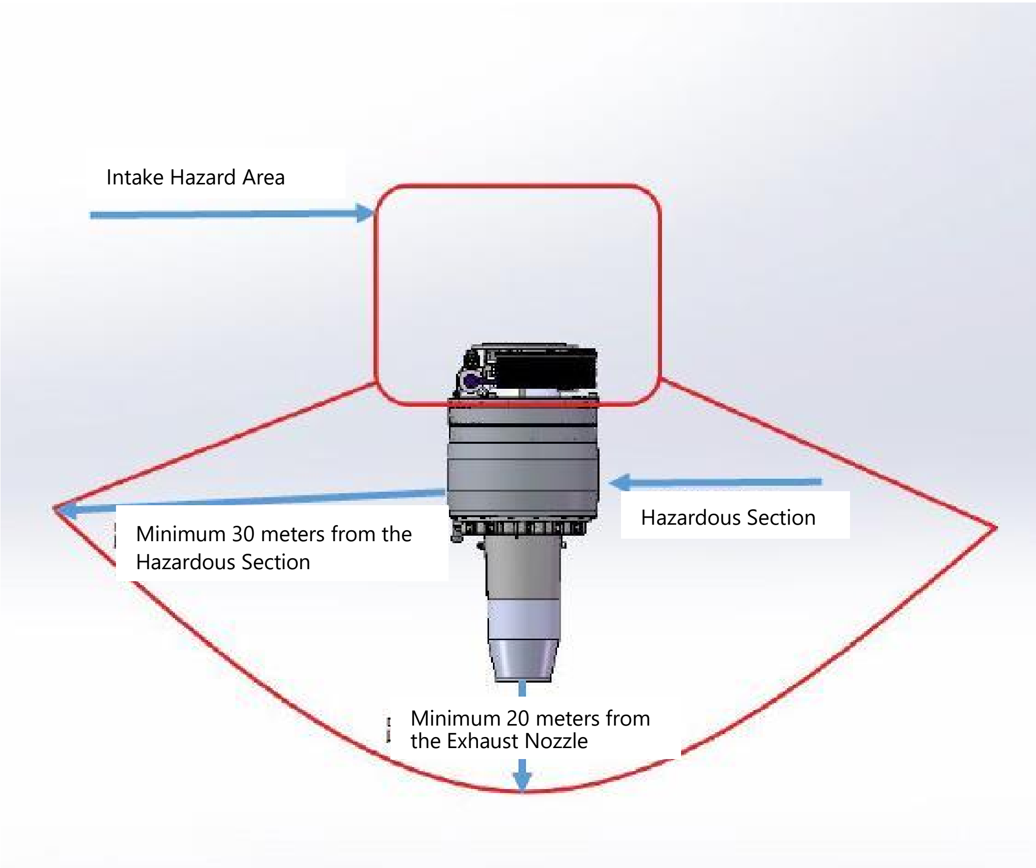


Figure 2 Minimum Engine Hazard Zone

6.3 Fire Extinguisher and Its Usage Requirements

Use a carbon dioxide (CO_2) fire extinguisher. Ensure the extinguisher is operational and placed within easy reach. Extinguish the fire after the engine is stopped. It is prohibited to extinguish the fire from the air intake.

6.4 Noise

Turbojet engines primarily produce high-frequency noise. Prolonged exposure to this noise may damage the operator's hearing. Therefore, wear hearing protection devices when operating the engine.

7 Installation Requirements

7.1 Pre-Installation Inspection

The engine system shall be inspected before installation. Installation may proceed only after confirming the engine system meets the following requirements.

a) The part numbers, quantities, and serial numbers of the engine and its components match the packing list.

b) The engine appearance is in good condition, with no dents or impact marks on the surface. The centrifugal impeller and turbine show no visible damage, cracks, or other surface defects upon visual inspection. The tailpipe shows no obvious deformation. The engine rotor rotates smoothly, without unusual noises, binding, or restriction.

c) All components are complete and in good appearance, with no rust, impact marks, or mechanical damage on the surfaces; cables have no breaks, insulation damage, or connector damage.

d) Fuel lines are clear and clean, with no signs of crushing, kinking, or scratching on the inner or outer walls.

e) The plastic plugs on the engine's fuel and air interfaces should be intact and should only be removed when connecting lines; the white caps on electrical connectors should be intact and should only be removed when connecting.

7.2 Installation Dimensions and Interfaces

7.2.1 Engine Unit Installation Interfaces

The engine unit installation interfaces are shown in Figure 3. The engine intake end is connected to the flight platform using 3 threaded ports.

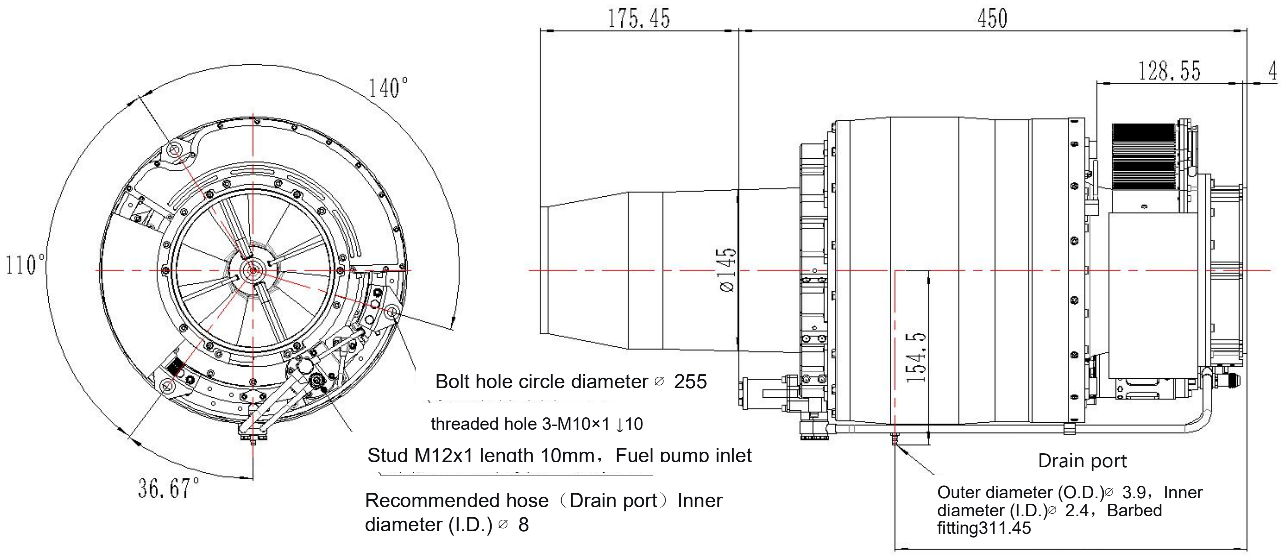


Figure 3 Engine Unit Interface Diagram

7.2.2 ECU Outline Dimensions and Interfaces

The ECU outline dimensions and interfaces are shown in Figure 4. Connect according to the labels on the physical interfaces during use. The 5-pin interface is the power interface, and the other interface is the communication interface.

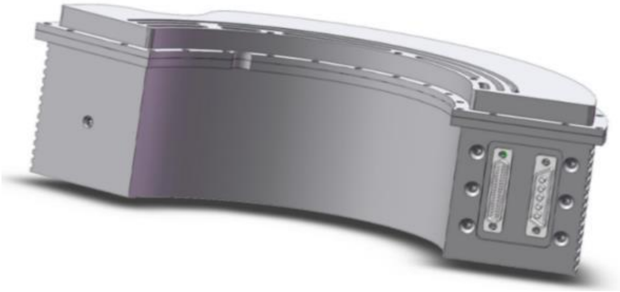


Figure 4 ECU Interface Schematic

7.3 Electrical Interfaces

7.3.1 ECU Operating Requirements

Operating Voltage: 24VDC ~ 28VDC; Note: Starting voltage must be not less than 24VDC.

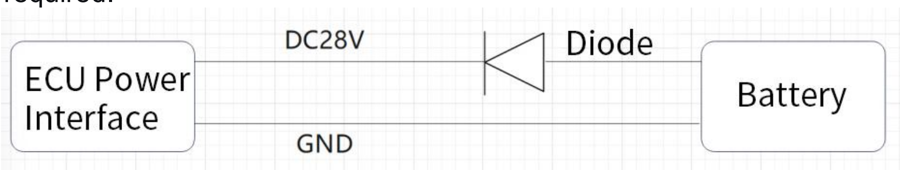
Operating Temperature: -40°C ~ 60°C;

Steady-State Operating Current: Not more than 10A;

Inrush Current: Not more than 30A.

! Important Note:

The engine ECU's 24-28VDC power input port and its regulated 28V output share the same hardware interface. The regulated output interface does not have current limiting protection. When using a battery as the starting power source, the ECU power interface MUST NOT be connected directly to the battery (otherwise, it poses a safety hazard). A unidirectional output diode (rated for +30A) must be added on the battery side with proper heat dissipation. When using an AC/DC power supply for the ECU, such treatment is not required.



7.3.2 Engine Interface Specifications

1. Mechanical Interfaces: See Figure 3 for details.
2. Power Interface: ECU Power Interface JP2:

Figure 5 ECU Power Interface JP2

JP2 Definition

Connector Pin No.	Symbol	Signal Definition
A	DC+	GCS supply voltage 24-28V and regulated output 28V
B	DC-	GCS supply ground and regulated output GND

3. ECU Communication Interface: Input via a 9-pin aviation connector, as shown below:

Figure 6 ECU Communication Interface

Aviation Connector Interface Definition		
Connector Pin No.	Signal	Remarks
1	CAN_H	
2	CAN_L	
3	CAN Shield	
4	Fuel Pump Emergency Stop Control Signal	Shorting pins 4 and 5 triggers emergency stop; open circuit for normal operation.
5	Emergency Stop Signal GND	
6-9	/	Reserved/Backup

7.4 Communication Interface

The high-speed UAV Flight Control Computer (FCC) communicates with the BPS-160AW turbojet engine controller (CPSJ) via CAN2.0 bus: The FCC sends control commands to the engine; the engine replies to commands and periodically sends messages to the FCC.

7.4.1 Commands Sent from FCC to ECU

During ground testing, the FCC needs to read corresponding registers of the engine control unit (CPSJ). Reading data from the CPSJ is performed using a "request-reply" method. The FCC can identify the type of reply information based on the CAN ID and "Message Code" of the reply data frame.

7.4.1.1 Frame Format

The data format is as follows:

Table 3 Engine Total Operating Time Read Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	04	10	00	66	36				

The engine control unit (CPSJ) replies to the FCC via CAN bus with the data frame in Table 4.

Table 4 Engine Total Operating Time Read Reply Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D1	08	10	04	66	36	ab	cd	ef	gh

Data abcdefgh is an unsigned long integer (ULONG) representing the total operating time in seconds. The FCC sends the data frame in Table 5.

Table 5 Engine Cooling Write Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	05	10	0A	67	3F	00			

Table 6 Write Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	05	10	0A	67	3F	01			

The FCC sends the data frame in Table 7.

Table 7 Engine Cooling Write Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	05	10	0A	67	40	01			

During engine start, the FCC needs to write data to register number 60 of the engine control unit (CPSJ), implemented via a "request-reply" method. The FCC sends the data frame in Table 8 to the CPSJ via CAN bus.

Table 8 Engine Start Write Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	05	10	0A	67	3C	01			

During engine shutdown, the FCC needs to write data to register number 61 of the engine control unit (CPSJ).

Table 9 Engine Shutdown/Ground Operation Stop Write Request Data Frame (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	05	10	0A	67	3D	01			

The format for the FCC to send engine speed setting commands is according to Table 10.

Table 10 Engine Speed Setting Write Request Format (numbers in the table are in hexadecimal)

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
07	D0	08	10	02	67	64	ab	cd	ef	gh

The data contains 4 bytes (ab cd ef gh), representing a 32-bit floating-point number x (conforming to IEEE-745-1985, 1 sign bit, 23 mantissa bits, 8 exponent bits). This number ranges from 0 to 100, representing the set speed as a percentage of the full speed. The engine speed setpoint calculated by the FCC, *espc*, is a decimal. When sending the data frame in Table 17, use x = *espc* × 100% (default setting 56500). Note: The computer sends in big-endian mode.
$x = espc \times 100(\%)$
For example: Engine speed at 50% (42480000 HEX)

7.4.2 Commands Sent from ECU to FCC

7.4.2.1 Frame Format

The data format table is as follows:
The engine sends the message types in Table 11 to the CAN bus at a fixed frequency of 1.7 Hz.

Table 11 Information Sent Cyclically by the Engine (numbers in the table are in decimal)

No.	Message	CAN_ID	Send Freq.	Unit	Data Type (and its code)	Length
1	Inlet Air Temperature	200	1.4 Hz	°C	AS SHORT (06)	06
2	Exhaust Temperature	201	1.4 Hz	°C	AS SHORT (06)	06
3	Engine Speed	203	1.4 Hz	rpm	AS ULONG (04)	08
4	Detected Function Error	207	1.4 Hz		AS SHORT (06)	02

Data type explanations:
AS_SHORT – 2's complement short integer, 16-bit
AS_ULONG – Unsigned long integer, 32-bit
AS_USHORT – Unsigned short integer, 16-bit
AS_BSHORT – Each bit defines a discrete state, 16-bit
AS_FLOAT – Single-precision floating-point number, 32-bit, conforming to IEEE-745-1985
The message data frame has the format shown in Table 12.

Table 12 Cyclic Message Data Frame Format

CAN Header			CANAerospace Message							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
CAN ID		Length	Node ID	Data Type	Service Code	Message Code	Data			
			10							

The FCC can identify these messages via the CAN ID, then parse the data according to each message's data type. The content of Byte 5 and Byte 6 can be ignored. The value in Byte 4 corresponds to the data type code. The value in Byte 2 "Length" depends on the "Data Type" in Byte 4. The "Data Type (and its code)" and "Length" values for each message data frame are listed in Table 12.

Table 13 Error Codes and Handling Methods

Value	Meaning	Error Handling Method
0	Normal	
1	Start did not reach idle within time limit	Shutdown procedure
2	Start speed below lower speed protection limit	Shutdown procedure
3	Overtemperature during operation	Derate speed procedure
4	Exceeded upper speed protection limit during operation	Shutdown procedure

7.5 Installation

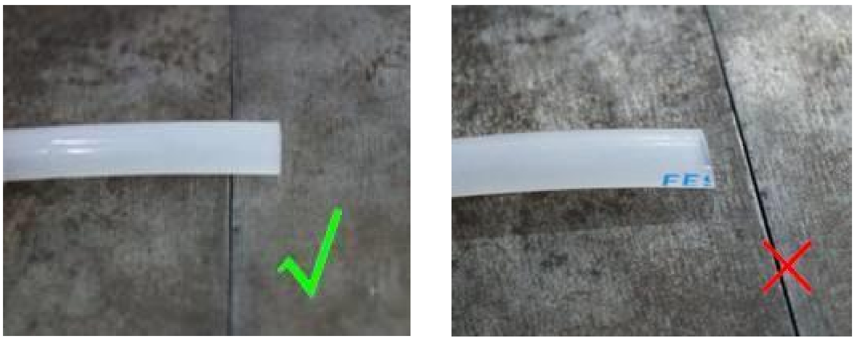
Live electrical work is prohibited during engine system installation. Disconnect power when connecting cables. This engine is ready for use after connecting the two electrical interfaces (communication and power) and one fuel line interface.

7.5.1 Fuel Line Installation

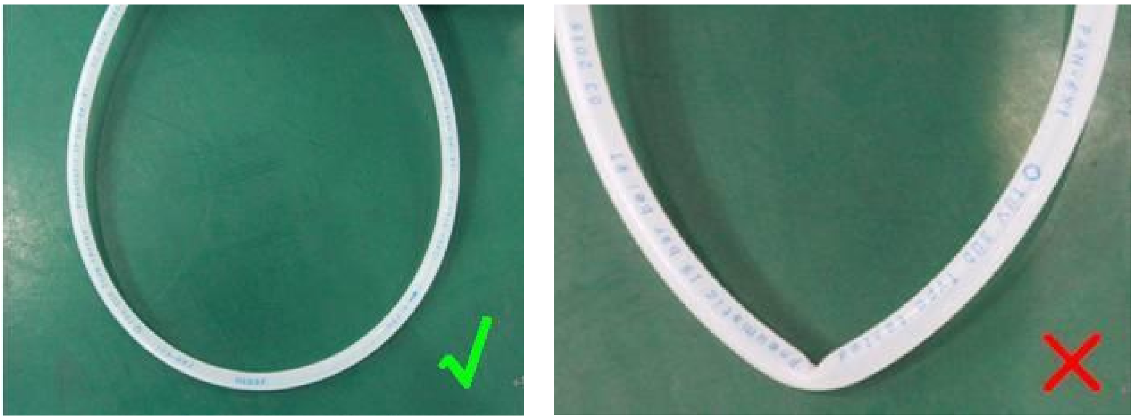
a) Connect the fuel tank directly to the fuel inlet.

b) Fuel lines should be routed below cables as much as possible to prevent fuel dripping onto cables during fuel line handling.

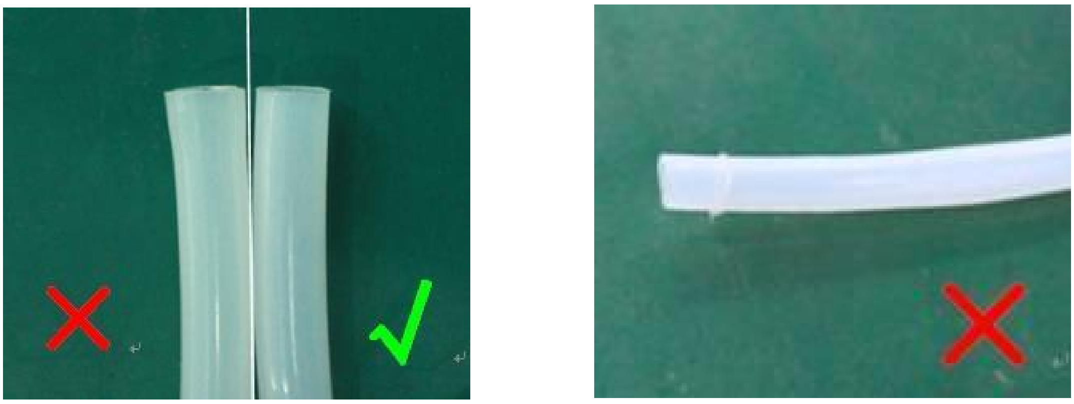
c) Determine the length and cut the fuel line according to the actual installation position of the components to prevent stretching or squeezing of the line. Use a dedicated tube cutter or utility knife to cut Festo hoses. The hose cut should be smooth (perpendicular to the tube wall). Do not kink the hose during installation. Fuel line connector positions must not be reused. After disassembly, use a new hose or cut off the hose end before reinstallation. See the figure below.



(a) Fuel Hose Cut Schematic



(b) Fuel Hose Bend Schematic



(c) Fuel Hose Reuse Schematic

Figure 5 Proper Fuel Hose Cutting and Usage Schematic

d) Fuel hoses longer than 100mm individually should be secured. During securing, avoid excessive squeezing of the hose, avoid causing significant scratches on the hose surface; avoid causing leaks at the hose-connector joint.

e) Before connecting the fuel line to the engine fuel inlet, purge air from the fuel line. Only after visually confirming no air bubbles in the line and no leakage at the connector joints, connect the fuel line to the engine fuel inlet.

7.5.2 Cable Installation

a) The ECU is already connected and securely fastened at the factory.

b) Electrical connection is complete after connecting the communication and power interfaces.

7.5.3 Engine Unit Installation

a) Before engine installation, remove the protective caps (or red cloth bags) from the intake casing and exhaust nozzle. Shake the engine body to confirm no foreign objects are inside before proceeding with installation. Take measures to prevent foreign object debris (FOD) during installation; if foreign objects enter the engine, clean them promptly.

b) Do not cause damage to the engine during installation.

c) Fasteners such as bolts and nuts shall be secured with anti-loosening measures as per the types shown in HB 0-2-2002.

7.6 Post-Installation Confirmation

The installation sequence of the engine, components, and piping shall be determined based on actual conditions. After the engine system installation is complete, perform an inspection and confirmation, ensuring the following requirements are met.
a) The engine system appearance is in good condition, with no obvious impact marks or surface defects/appearance damage affecting engine performance.
b) No parts, components, assemblies, or attachments are missing, incorrectly installed, or over-installed.
c) Cable connectors have good contact; piping is unobstructed, with good joint sealing; no misconnections or incorrect connections.
d) Fastener anti-loosening measures are in place; lockwire is tightly wound without kinks.
e) No loose wire ends, lockwire, or other foreign objects around the engine.
f) Quantity of spare parts, accessories, consumables, and tools is correct, with no missing items.
g) Perform a fuel flow test to observe if the flow direction in the inlet line is normal and if the connection positions are correct.

8 Engine Operational Requirements

8.1 Operating Conditions and Envelope

The engine operating conditions and envelope are detailed in Table 10.

Table 14 Engine Operating Conditions and Envelope

Operating Envelope	**Operating Altitude**	**0-10000m**
	Mach Number	**0Ma～0.9Ma**
Ground Start Envelope	Altitude	0-4000m
	Mach Number	0-0.3Ma
Windmill Start Envelope	Altitude	4000-6000m
	Mach Number	0.3-0.6Ma
Usage Range	Operating Temperature Range	-40℃~+60℃
	Relative Humidity	≤95%±3%
	Roll Angle Range	-35° ～35°
	Pitch Angle Range	-30° ～30°
	Compressor Operating Speed Range	34000r/min～56500r/min
	Ground Ignition Start Ambient Temperature Range	-20℃~+50℃

8.2 Permitted Fuels and Lubricants

8.2.1 Fuel

The fuel for the engine is a mixture of No. 3 jet fuel (GB6537-2006) and No. 4050 synthetic lubricant for aircraft turbine engines (GJB 1263-1991) (or equivalent specification).

Specifically:

When ambient temperature ≤ 10°C, the volumetric mixing ratio of jet fuel to lubricant is 40:1.

When ambient temperature > 10°C, the volumetric mixing ratio of jet fuel to lubricant is 20:1.

8.2.2 Lubricating Oil

The bearings of the engine gas generator are lubricated using the mixture described in section 8.2.1.

8.3 Fuel System Description

8.3.1 Fuel System

The internal fuel lines of this engine have been installed and tested. Only the fuel inlet needs to be connected to the mixed fuel tank during use.

8.3.2 Fuel Tank Requirements

The fuel is supplied from a single tank. It is recommended to use a rigid tank (temperature resistance 100°C). The tank outlet pressure must be between -20 kPa and 50 kPa to ensure normal engine operation.

8.3.3 Fuel Usage Instructions

a) The filled fuel/lubricant shall comply with section 8.2.1.
b) The fuel must be clean (it is recommended to prepare fresh mixture for each use) and must be filtered during fueling.
c) Disconnect power during fueling. It is strictly prohibited to fuel while the engine is operating.
Note: Before fueling, ensure the tank is clean, free of particles, plastic, or other solid foreign objects. The pump has strong suction capability and could clog fuel valves, engine nozzles, etc., affecting normal engine system operation.

8.4 Engine Ground Start

8.4.1 Individual Component Checks

8.4.1.1 Igniter Check

Perform the igniter check as needed. Method: Use the ground control station (or host computer) to turn on the igniter without supplying fuel, for 3-5 seconds. Touch the casing around the igniter (careful of burns). If the temperature increases, the igniter is normal.

8.4.1.3 Fuel Pump

Connect the fuel line (not to the engine), use the ground control station (or host computer) to turn on the fuel pump (low-speed operation) to purge air from the fuel line. Stop when no bubbles are visible in the line. After the check, connect the fuel line to the engine fuel inlet.

8.4.1.4 Speed Sensor, Temperature Sensor Check

If the speed and temperature readings on the ground control station (or host computer) are normal and reasonable, it indicates the speed and temperature sensors are working properly.

8.4.1.5 Safety Check

After individual component checks, confirm there are no cables or other foreign objects at the engine inlet, and no flammable or explosive materials near the engine. Have safety and firefighting equipment ready.
During field tests, there should be no personnel or other equipment within the engine's minimum hazard zone (see Figure 2 for details). During engine testing, high-frequency noise is generated; personnel involved should wear ear protection such as earmuffs.

8.4.2 Start

After the ground control station (or host computer) issues a "Start" command to the engine ECU, the ECU automatically controls the engine start process; manual operation is not required. The start process is complete when the engine speed stabilizes at idle (32000 r/min).
Note: If the engine fails to ignite on the first attempt, perform a cold purge on the engine unit before attempting another start. If the exhaust temperature during the previous start was above 60°C, purge until below 60°C before restarting. If the exhaust temperature was below 60°C, purge for 30 seconds before restarting to remove excess fuel and prevent overtemperature on the next start.

8.4.3 Test Run

After successful engine start, use the ground control station (or host computer) to send speed commands to the engine ECU for the test run. End the test by sending a "Stop" command to the ECU; the engine will stop.

8.4.3.1 Test Run Limitations

a) The engine maximum operating speed must not exceed 56500 r/min.

b) The exhaust temperature during stable operation at any condition point shall not exceed 830°C. The instantaneous temperature spike during start shall be less than 950°C.

8.4.3.2 Test Run Precautions

Execute an emergency stop if any of the following situations occur during the test run:

a) Hot Start/Hung Start: Increasing fuel flow does not increase the displayed speed, temperature rises, and the tailpipe exit shows a long flame (similar to start-up flame).

b) The engine consistently produces abnormal sounds at different speeds, such as "whistling" or "howling".

c) Continuous sparks appear at the engine exhaust nozzle.

d) Unexpected situations such as fire occur.

e) Other situations deemed by the test site technical supervisor as potentially endangering engine safety.

Note: In case of urgent situations requiring immediate engine stoppage, emergency stop can be activated.

8.4.4 Cooling

The engine requires cooling after shutdown:
a) During normal engine shutdown, the ECU will automatically control the starter motor to cool the engine until the exhaust temperature drops below 60°C.
b) During abnormal engine shutdown, after the engine stops, blow air through the intake duct to cool the engine until the exhaust temperature drops below 60°C.
c) Avoid burns during the engine cooling process.
Note: After engine shutdown and under cold purge conditions, a 15-minute interval is required before the next test run.

8.4.5 Test Run Fault Handling

a) If a test run is interrupted due to a fault not related to the engine unit itself, resume the test only after troubleshooting. If interrupted due to an engine unit fault or an emergency stop triggered by test run limitations, stop the test run, troubleshoot, then continue.
b) Test run faults should be resolved by specialized technical personnel.
c) For common possible engine faults and troubleshooting methods, refer to Appendix B.

8.5 In-Flight Operation

After the Flight Control System (FCS) starts the engine on the ground to 32000 r/min and stabilizes the speed for 1-2 minutes, the FCS can then control the engine's corresponding operating state (i.e., engine set thrust output percentage) to complete the flight mission.

8.6 Handling

a) Handle the engine and components carefully during movement, avoiding damage to external lines or components.
b) It is strictly prohibited to throw the engine or lift it by the head/tail structural parts. It is strictly prohibited to use sensors, cables, etc., to move the engine or for other purposes.

8.7 Transportation

a) The engine system shall be transported using a dedicated packing case. The engine shall be securely positioned and fastened within the case. The case should be lined with cushioning material to prevent damage during transport. The case must not be overloaded, inverted, or rolled. It shall be securely fastened within the transport vehicle.
b) When the engine is packed with the aircraft, the aircraft air intake should be covered, and the engine exhaust should be capped to prevent entry of foreign objects.

c) The engine system can be transported by rail, air, road, or sea. During rail transport, shunting operations are not allowed. During sea transport, pay attention to mold prevention, salt spray prevention, and water immersion.
d) The transport vehicle should be waterproof. The engine system is prohibited from being transported together with kerosene, gasoline, acids, alkalis, or other chemicals.

8.8 Storage

a) The engine system should be stored in its packing case.
b) For long-term storage, the warehouse should have facilities for protection against rain, moisture, mold, sand/dust, static electricity, explosion, lightning,
snakes, rodents, and should meet an environmental temperature range of -40°C to +60°C with relative humidity not exceeding 80%.
c) For temporary storage, the storage period generally should not exceed three months. The storage location should provide protection against rain and moisture.

9 Engine Life and Maintenance

9.1 Total Engine Life

The total engine life is approximately 30 hours or 200 starts or 3 years, whichever comes first.

9.2 Operation and Maintenance Records

The operating and maintenance unit shall keep records of the engine system's operation and maintenance. The records should include:
a) Engine test run records, including test speed, test duration, cumulative operating time, and whether it was normal.
b) Engine faults and repair details.
c) Replacement of components and ground equipment.

9.3 Replacement of Components

During engine operation, if a component fails and cannot be repaired, it must be replaced. If the engine is already installed on the aircraft and the component cannot be replaced on the aircraft, the engine must be removed from the aircraft for replacement.
Disconnect the engine system power before replacing components. After replacement, re-perform installation and inspection according to the relevant requirements in Section 6. Maintain a replacement record when components or ground equipment are replaced.
If the igniter, speed sensor, or temperature sensor need replacement, it must be performed by the engine manufacturer's specialized technical personnel, following these requirements:
a) After connecting the new igniter to the engine, connect it to the ECU. Use the ground control station (or host computer) to turn on the igniter. If clicking/pulsing sounds come from the igniter tip, it is working normally. After installation, confirm the igniter and the corresponding start fuel line interface are properly installed.
b) The temperature sensor should be inserted 2 cm ~ 4 cm into the tailpipe. If it does not wobble, the installation is correct.

9.4 Foreign Object Debris (FOD) Control

To ensure no foreign objects inside the engine and components, during handling, transportation, and storage, all engines and components must not be left open. If protective hose caps, screws, or front/rear caps (or cloth bags) are removed for work, they must be reinstalled immediately upon completion. If engine blade damage occurs due to foreign objects, the engine must be returned to the factory for repair.
10 Operation and Maintenance Tools
The tools required for engine system operation and maintenance are listed in Table 15.
Table 15 Engine Operation and Maintenance Tools

No.	Name	Specification	Quantity	Purpose
1	Open-End Wrench	6mm ~ 16mm	1 set	Loosening/tightening nuts, hex bolts
2	Utility Knife	100mm	1	Cutting hoses
3	Hex Key Set	1.5mm ~ 10mm	1 set	Loosening/tightening hex socket screws
4	Flathead Screwdriver	-	1	Loosening/tightening cable connectors

Note: The tools listed in Table 15 are to be provided by the user.

11 Safety Requirements

a) Except for activities like final assembly or maintenance, the engine's air, fuel, and electrical interfaces must not be left open.
b) During transportation after installation, fill the area around the engine with foam or other cushioning material.
c) Handle the engine carefully during transportation, handling, installation, and inspection to prevent damage to the engine or personal injury from impacts.
d) After the engine is started to idle, personnel are prohibited from standing within a 1-meter radius in front of the air intake, within 30 meters to the side of the engine, and within 20 meters behind the exhaust nozzle.
e) During operation and testing, it is strictly prohibited for foreign objects to enter the engine.
f) It is prohibited to run tests with the engine exhaust facing into the wind to prevent exhaust flow from burning the airframe.
g) The test site should have corresponding safety plans and emergency procedures, and be equipped with safety and firefighting equipment such as CO_2 fire extinguishers.
Appendix A Possible Engine Faults and Troubleshooting Methods

No.	Fault Phenomenon	Possible Causes	Troubleshooting Method
1	Engine ground start ignition fails, exhaust temperature shows no significant rise.	1. Start fuel supply abnormal. 1.1 Air not purged from the line. 1.3 Fuel pump operation abnormal. 1.4 Restrictor tube in start fuel line assembly clogged. 2. Igniter operation abnormal. 3. Temperature sensor operation abnormal.	1.1 Purge air from fuel system; open fuel line connectors in the start fuel circuit and drain fuel until no bubbles are present. 1.3 Use host computer to command fuel pump to supply fuel. Confirm normal fuel supply, then resume test. If start still fails, replace fuel pump. 1.4 If restrictor tube is confirmed clogged, replace start fuel line assembly. 2. Check igniter voltage input and troubleshoot accordingly. If internal igniter fault, replace igniter.
2	During engine ground start ignition, exhaust temp rises to a point then drops, ignition fails.	1. Main fuel supply abnormal; 1.1 Air not purged from line. 2. Engine fuel line assembly clogged.	1.1 Purge air from fuel system; open fuel line connectors in the start fuel circuit and drain fuel until no bubbles are present. 2. Return to factory for repair.
3	Fuel pump speed does not increase before engine speed reaches 56500 r/min.	1. Fuel filter clogged from prolonged use without cleaning. 2. Fuel leak at a line connector. 3. Fuel tank positioned too low, increasing pump load.	1. Clean fuel filter. 2. Inspect fuel system, replace/repair any leaks promptly; if not possible, return to factory. 3. Reduce vertical height of fuel tank appropriately, minimize height difference between fuel level and engine.

No.	Fault Phenomenon	Possible Causes	Troubleshooting Method
4	During test run, engine speed suddenly drops, fuel pump speed increases.	1. Excessive impurities in fuel clogging the filter.	1. Replace with clean fuel. 2. Return to factory for repair.
5	FCC can receive ECU data, but ECU does not respond to FCC commands.	1. ECU voltage too low. 2. ECU cable fault preventing receipt of FCC commands.	1. Measure ECU communication cable with a digital multimeter. If faulty, replace cable.
6	Engine components do not execute ECU commands.	Engine component cable connections loose.	Check if engine component cables are correctly and securely connected to ECU cables.
7	Overtemperature / Overspeed		Automatic hang-start shutdown protection.