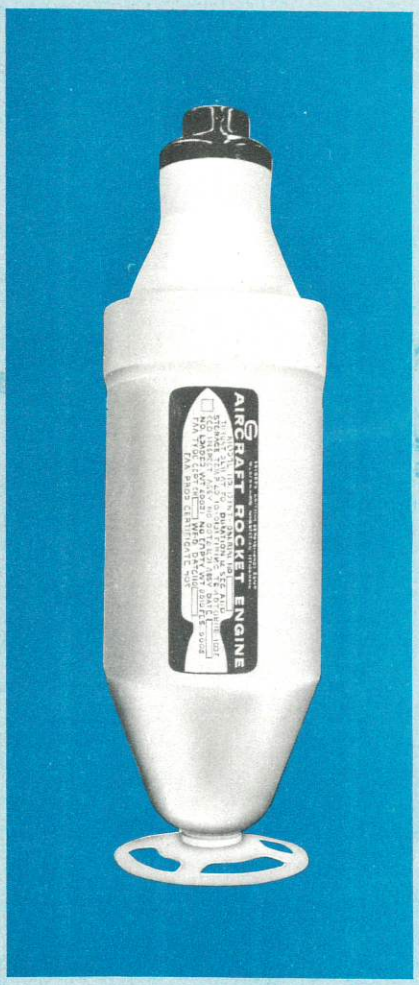
15 KS-1000-A1 AIRCRAFT ROCKET ENGINE

STM-159 October 1963 (supersedes report no. 997)



OPERATION & SERVICE INSTRUCTIONS

AEROJET GENERAL TIRE GENERAL

AEROJET-GENERAL CORPORATION

SOLID ROCKET PLANT • SACRAMENTO CALIFORNIA

STM–159

(SUPERSEDES REPORT NO. 997)

15KS-1000-A1 AIRCRAFT ROCKET ENGINE

OPERATION AND SERVICE INSTRUCTIONS

OCTOBER 1963

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Manufacturer's Warranty

The following warranties are made in lieu of all other warranties, express or implied, and of all other obligations or liabilities on the part of the manufacturer which neither assumes nor authorizes any other liability in connection with the sale of 15KS-1000-A1 rocket engines:

1. For a period of 90 days following sale thereof, the manufacturer warrants that each such engine sold by it to an original purchaser shall be free from defects of materials and workmanship.

2. Should defects in materials or workmanship be discovered by such purchaser, it shall return the engine to the manufacturer at its plant at Sacramento, California, transportation charges prepaid.

3. Should defects of materials or workmanship appear on receipt and inspection by the manufacturer at its plant, the manufacturer's obligation under the warranty shall be limited to making good at its factory any part or parts thereof which shall be found defective.

This warranty does not apply to any engine which has been repaired or altered outside manufacturer's factory in any way, or which has been subject to misuse, negligence or accident, and shall apply only when the engine has been maintained in accordance with the manufacturer's currently applicable instructions.

The manufacturer reserves the right to revise, change or modify the whole or any part of the construction of the 15KS-1000-A1 rocket engines without incurring any obligation in connection with engines previously sold.

The manufacturer shall, in no event, be obligated in an amount in excess of the purchase price of the 15KS-1000-A1 rocket engine.

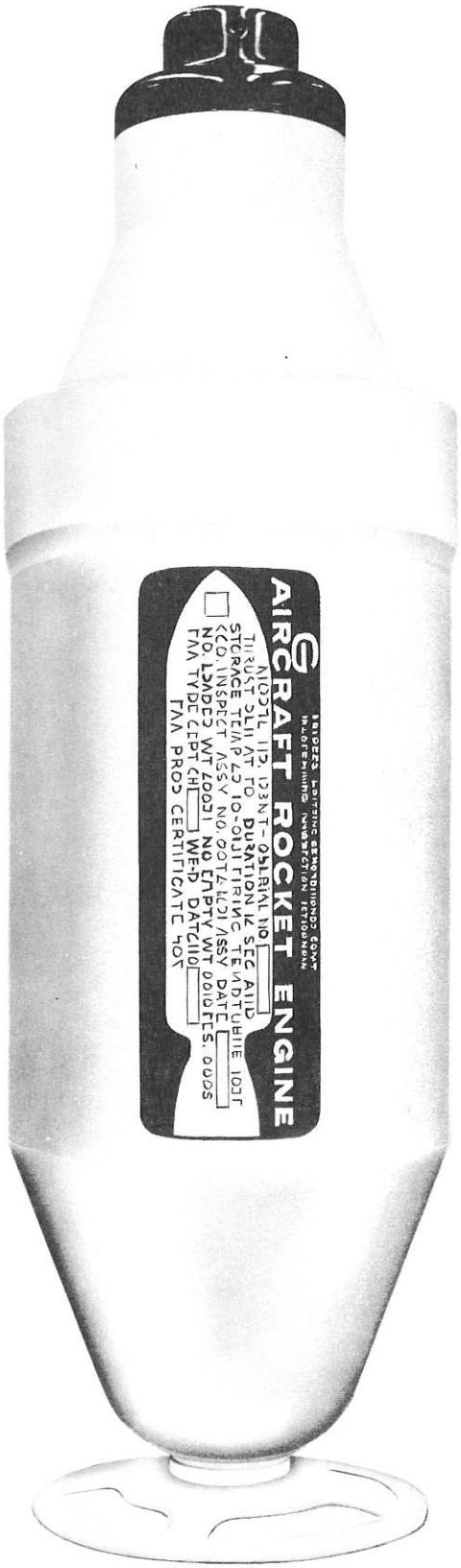

Figure 1-1. 15KS-1000-A1 Aircraft Rocket Engine

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SECTION I

INTRODUCTION

1-1. GENERAL

1-2. SCOPE OF MANUAL. This manual contains instructions for operation, service, inspection, storage, handling, and shipment of the 15KS-1000-A1 aircraft rocket engine manufactured by the Aerojet-General Corporation, Sacramento, California, U.S.A., in accordance with the manufacturer's specification and Federal Aviation Agency Engine Type Certificate No. 249 and Aircraft Rocket Engine Specification No. E-249.

1-3. PURPOSE OF EQUIPMENT. The 15KS-1000-A1 rocket engine is designed to provide standby thrust for any takeoff, flight, landing, or emergency conditions wherein short duration thrust increases may be required. Limitations on the gross weight, payload, and range of an aircraft imposed by such factors as runway length, air temperature, and runway elevation may be greatly reduced by the installation of standby rocket power. The 15KS-1000-A1 rocket engine may be used for jet-assisted takeoffs (JATO) in many military and special civil applications.

1-4. MODEL DESIGNATION. The model designation, 15KS-1000-A1, and the term "JATO" are interpreted as follows:

JATO - jet-assisted takeoff
15 - nominal duration of thrust, in seconds
K - type of propellant
S - solid-propellant grain
1000 - nominal thrust rating, in pounds
A1 - Model

SECTION II

DESCRIPTION

2-1. GENERAL

2-2. The 15KS-1000-A1 rocket engine, consists of a steel pressure vessel containing a solid propellant (or grain). An igniter assembly is provided at the forward end of the unit and the aft end contains the exhaust nozzle as well as a safety pressure release assembly. Attachment to the aircraft is accomplished by two welded steel lug assemblies designed for 3-point mounting. Principal dimensions of the rocket engine are shown in figure 2-1.

2-3. DETAILED

2-4. PRINCIPAL COMPONENTS. The 15KS-1000-A1 rocket engine, figure 2-2, consists of a thermosetting plastic base propellant grain, a chamber assembly and an aft cap assembly which is secured by a retaining ring and retaining ring clips. Together, the chamber assembly and aft cap assembly make up the pressure vessel and contain the slotted solid propellant (propellant grain). The propellant grain is supported by sponge rubber grain spacers and aft cap and forward felts. A plastic T-shaped insulating boot and gas-flow baffle is inserted outside the propellant burning inhibitor and projects into the bore of the propellant. A plastic deflector cone is fitted over the aft end of the propellant. The aft-cap assembly houses the nozzle assembly. The aft cap assembly also contains a pressure-release diaphragm which is an annular ring of fourteen small ports. The igniter assembly is inserted into the threaded boss on the forward end of the chamber assembly. Two mounting assemblies are welded to the chamber assembly for attachment to the aircraft. A handle stand is located on the forward end of the chamber assembly for convenience in handling and vertical storage, and should be removed before flight for external installations, and if desired, for submerged installations.

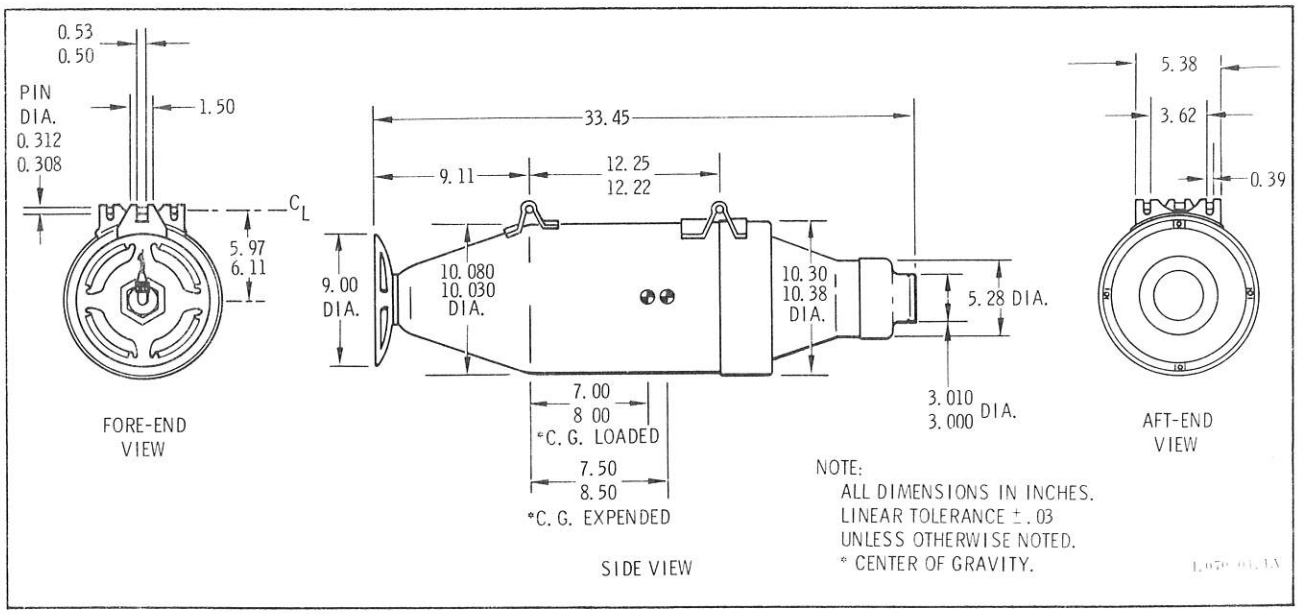

Figure 2-1. 15KS-1000-A1 Aircraft Rocket Engine, Principal Dimensions

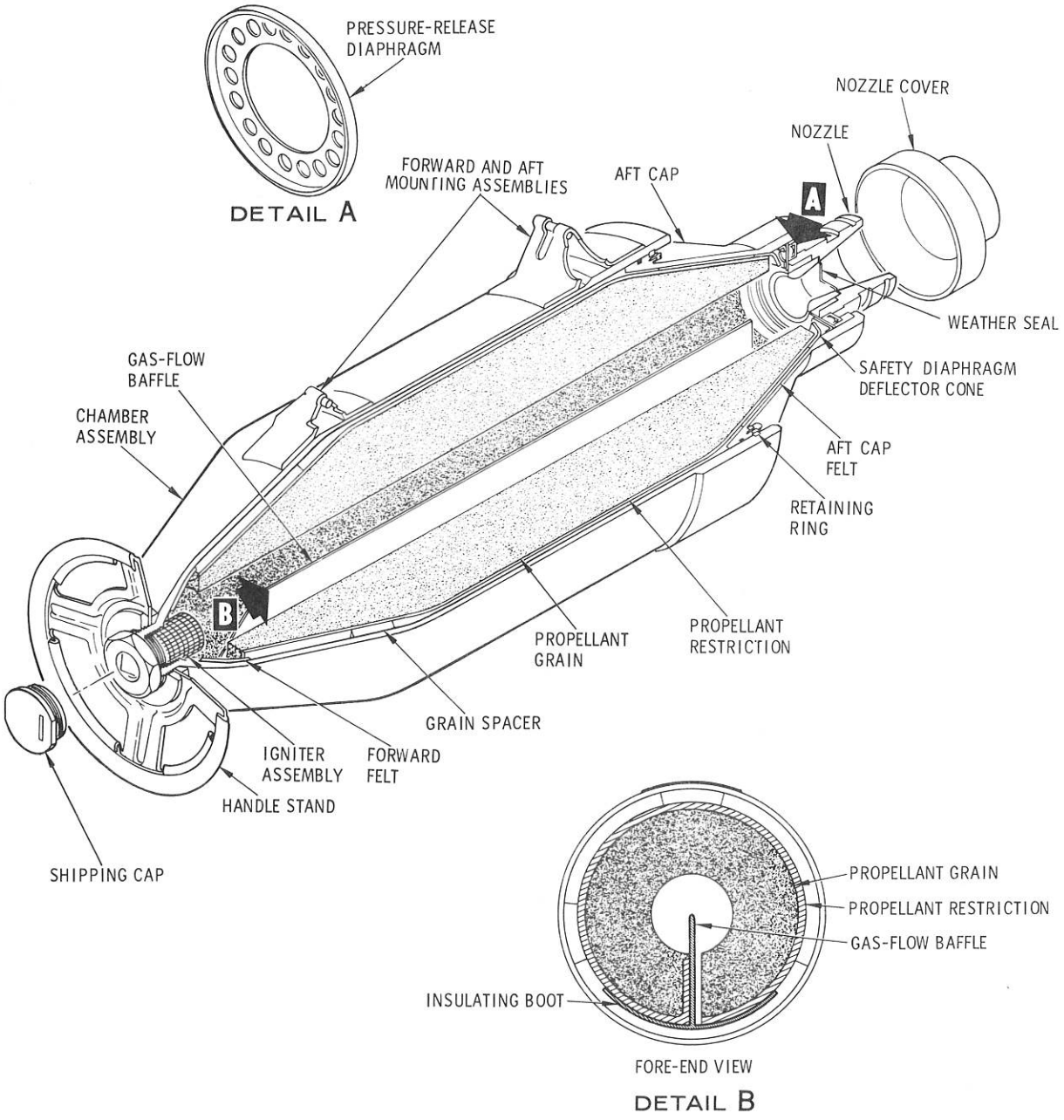

Figure 2-2. 15KS-1000-A1 Aircraft Rocket Engine, Cutaway View

SECTION III

OPERATION

3-1. OPERATING LIMITATIONS

3-2. TEMPERATURES. Operating and storage temperatures should be maintained between -65 to +140° F (-53.9 to +60°C). A JATO engine which has been stored at temperatures outside the specified range may suffer damage which cannot be found by the inspection outlined in Appendix A; therefore, any engine subjected to temperatures outside the specified values must not be used.

3-3. ALTITUDE. The 15KS-1000-A1 JATO igniter should not be exposed to altitudes above 35,000 feet.

3-4. VIBRATION. Prolonged or extreme vibration beyond that encountered in normal operation may be harmful to the engine.

3-5. STORAGE LIFE. The 15KS-1000-A1 JATO engine may be stored for a maximum of four years from date stenciled on the engine chamber.

3-6. OPERATING LIFE. The JATO engine is designed to be carried on the aircraft ready for use for a period of 750 hours of logged flight time or 18 months whichever first occurs. Engines approaching the above limitation should be used for flight training or demonstration purposes. This serves to maintain pilot proficiency, and eliminates the necessity for ground disposal of the propellant and igniter.

3-7. IGNITION PROCESS

3-8. The 15KS-1000-A1 aircraft rocket engine is ignited by current from the aircraft electrical system. Actuation of a switch by the pilot permits electrical current to energize the igniter glow plug and ignite the initiator material surrounding it. The initiator material in turn ignites the igniter pellets. The heat and pressure generated by the burning of these pellets ignite the propellant and simultaneously bring the unit to its normal operating pressure. The whole ignition process from actuation of the switch to development of full thrust requires a maximum of 0.5 seconds. In spite of the rapidity of the ignition process, the thrust is developed smoothly and without impact.

3-9. THRUST CHARACTERISTICS

3-10. DEVELOPMENT OF THRUST. The burning of the propellant creates pressure within the chamber and the exhaust gases released under pressure at high velocity through the nozzle create thrust. Pressure within the chamber and the resultant thrust developed are functions of the propellant burning area and burning rate. The propellant design of this rocket engine is such that a relatively constant burning area is maintained throughout engine operation. The propellant burns on the surfaces of the internal bore and one side of the slot. Normally, for a given propellant temperature, the pressure and thrust will remain

substantially constant throughout the operation of the rocket engine. Typical performance curves for the rocket engine, showing chamber pressure and thrust vs duration, are shown in figure 3-1. As shown on the thrust curve, the cessation of thrust at the end of burning is smooth and immediate.

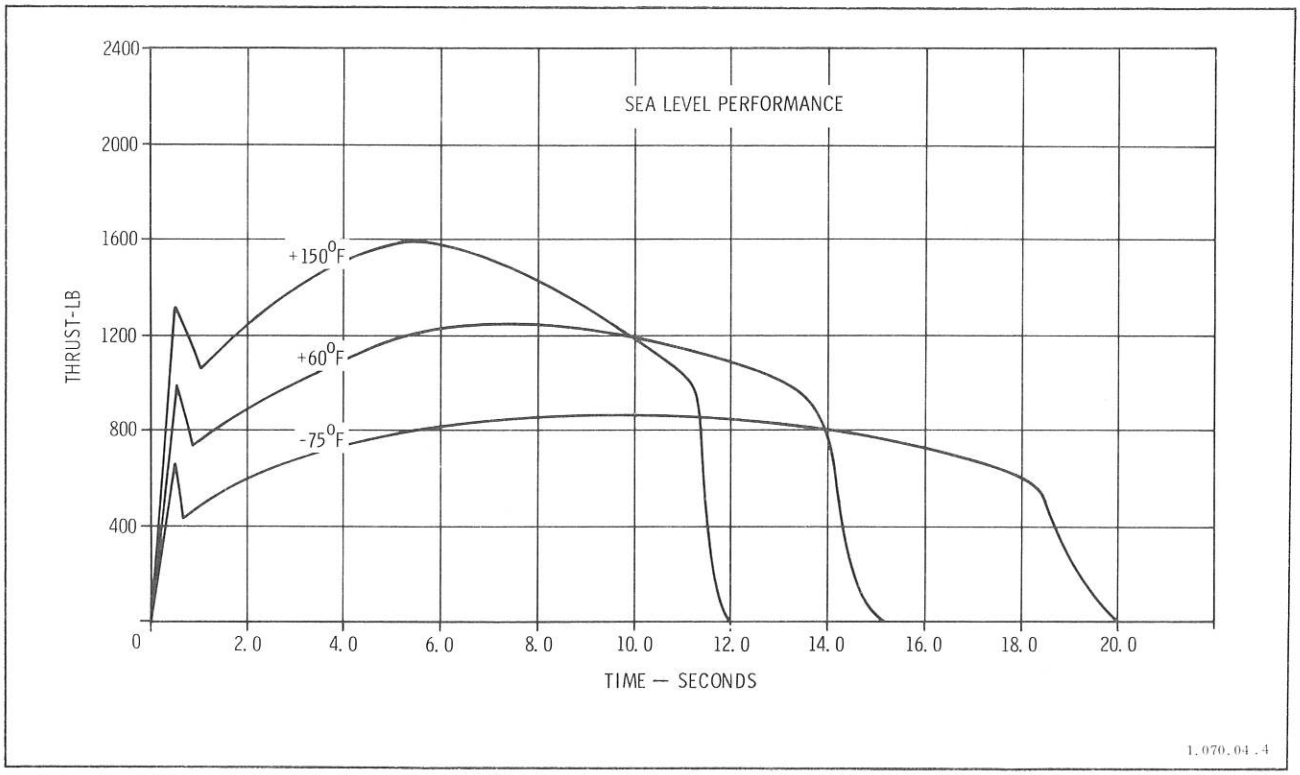

Figure 3-1. Typical Chamber Pressure and Thrust vs Duration

3-11. EFFECTS OF PROPELLANT TEMPERATURE ON THRUST. The propellant will burn more rapidly at higher propellant temperatures because less time is required to bring the propellant surface to ignition temperature. The higher burning rate will result in a higher pressure, higher thrust, and shorter duration. Since less energy is used in bringing the propellant to ignition temperature, the total impulse (product of thrust times duration) will be somewhat higher in higher-temperature propellants. Figure 3-2 shows the effects of propellant temperature on thrust and duration and the variation limits which may be experienced. Generally, the total impulse for a given propellant temperature will fall in a fairly constant range despite these variations, because higher thrusts will usually be related to shorter durations and lower thrusts to longer durations. The propellant temperature (the controlling factor) is not necessarily the same as the ambient temperature at the time of ignition. A considerable period of time is required at an ambient temperature to bring the propellant to a new temperature level. Consequently, the propellant temperature will be generally related to the average temperature to which it has been exposed for the previous period of 12 to 24 hours, depending on the extent of temperature change.

3-12. ALTITUDE EFFECTS ON THRUST. Because of the decrease in atmospheric pressure, the performance of this rocket engine improves slightly with a constant temperature as the altitude increases.

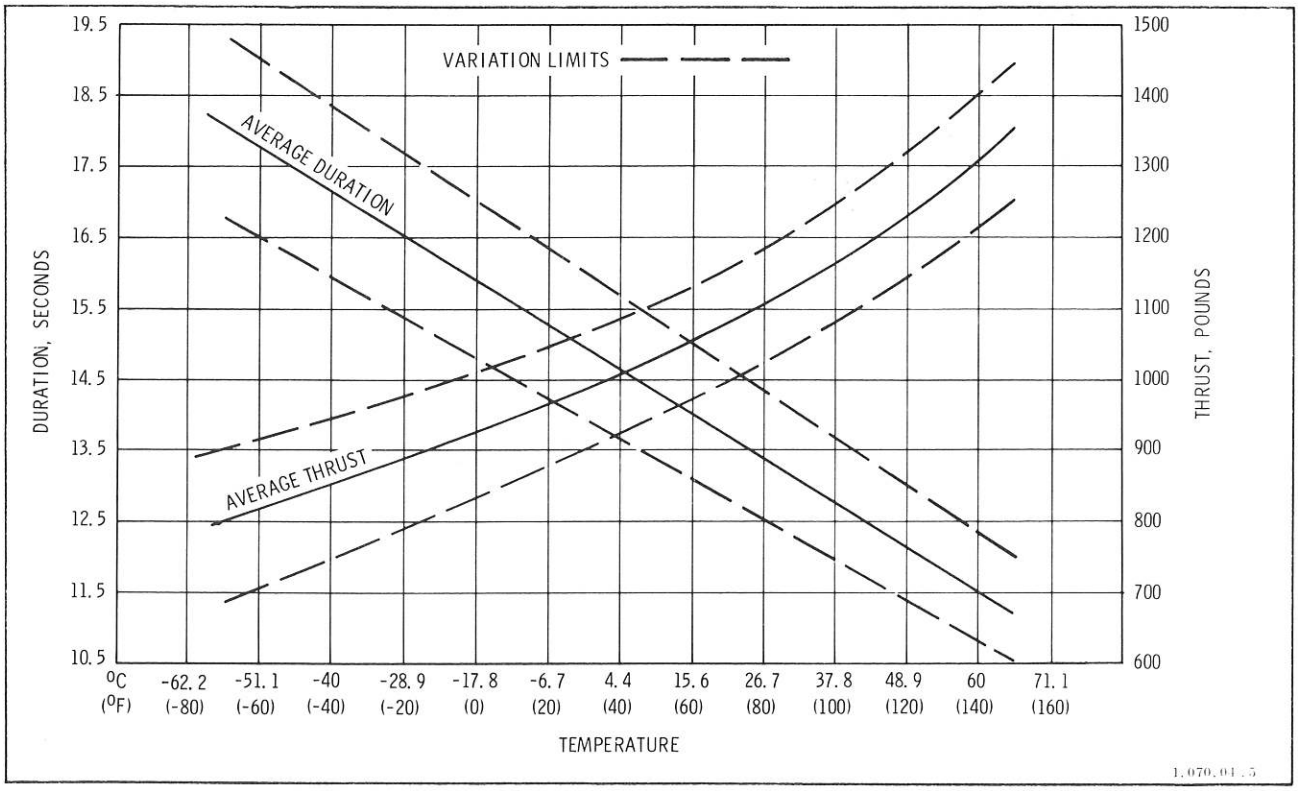

Figure 3-2. Propellant Temperature Effects on Thrust and Duration

The propellant incorporates its own oxidizer, and therefore the burning rate is the same at higher altitudes. However, the velocity of the exhaust gases increases at higher altitudes as shown in figure 3-3 because the pressure differential (inside vs outside pressure) is greater at lower atmospheric pressures. The effects of altitude and higher temperatures on rocket engines are opposite but not as great as those on air-breathing engines.

3-13. RATED AND ACTUAL THRUSTS AND IMPULSES. The 15KS-1000-A1 is rated at 1000 lb thrust for 15 seconds. The actual thrust and duration closely approximates the rated values when fired at sea level with a propellant temperature of 35°F (+1.7°C). Additional thrust, durations and total impulses are as follows:

THRUSTS AND IMPULSES

Temperature	Thrust	Duration	Total Impulse
-65° F	815 lbs	18 sec	14670 lbs
+60° F	1062 lbs	14 sec	14868 lbs
+140° F	1320 lbs	11.5 sec	15180 lbs

3-14. COMPARATIVE PERFORMANCE. Figures 3-4 and 3-5 have been included to provide approximate means for comparing the effects on aircraft performance of the 15KS-1000-A1 rocket engine with that of a typical reciprocating engine-propeller combination. The curves of reciprocating engine-propeller performance are not exact for any given installation, but can be considered to be typical for aircraft in the multi engine 200 m.p.h. category.

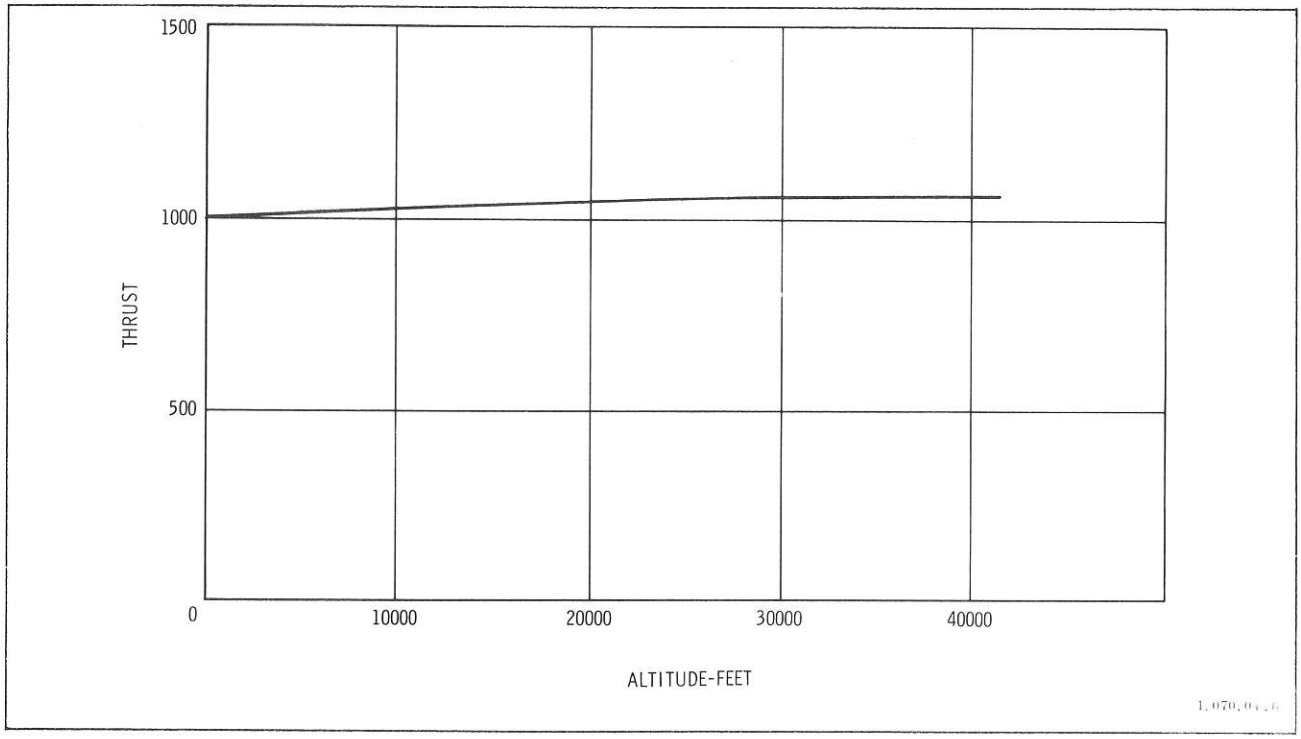

Figure 3-3. Effect of Altitude on Thrust

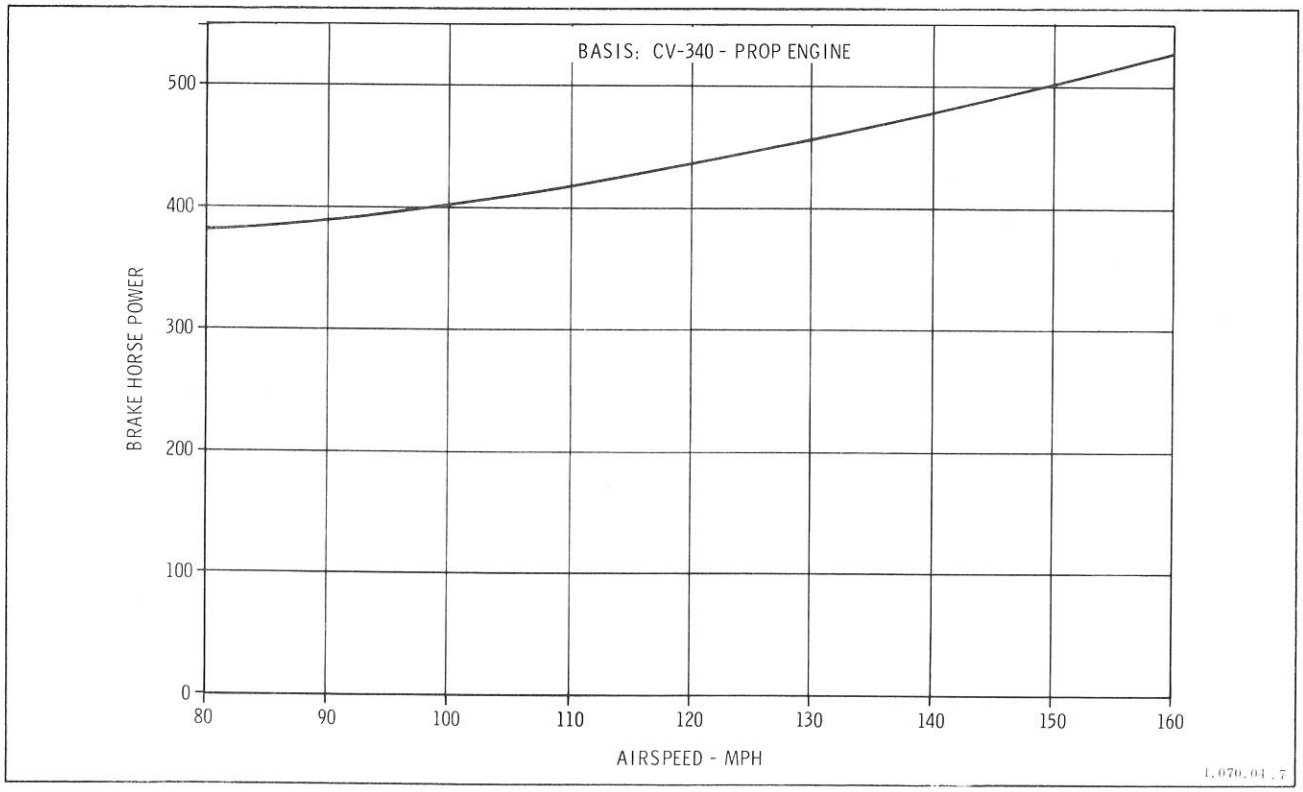

Figure 3-4. Equivalent Brake Horsepower of Single 15KS-1000-A1 Rocket Engine (Assuming Typical Convair 340 Type Engine-Propeller Performance)

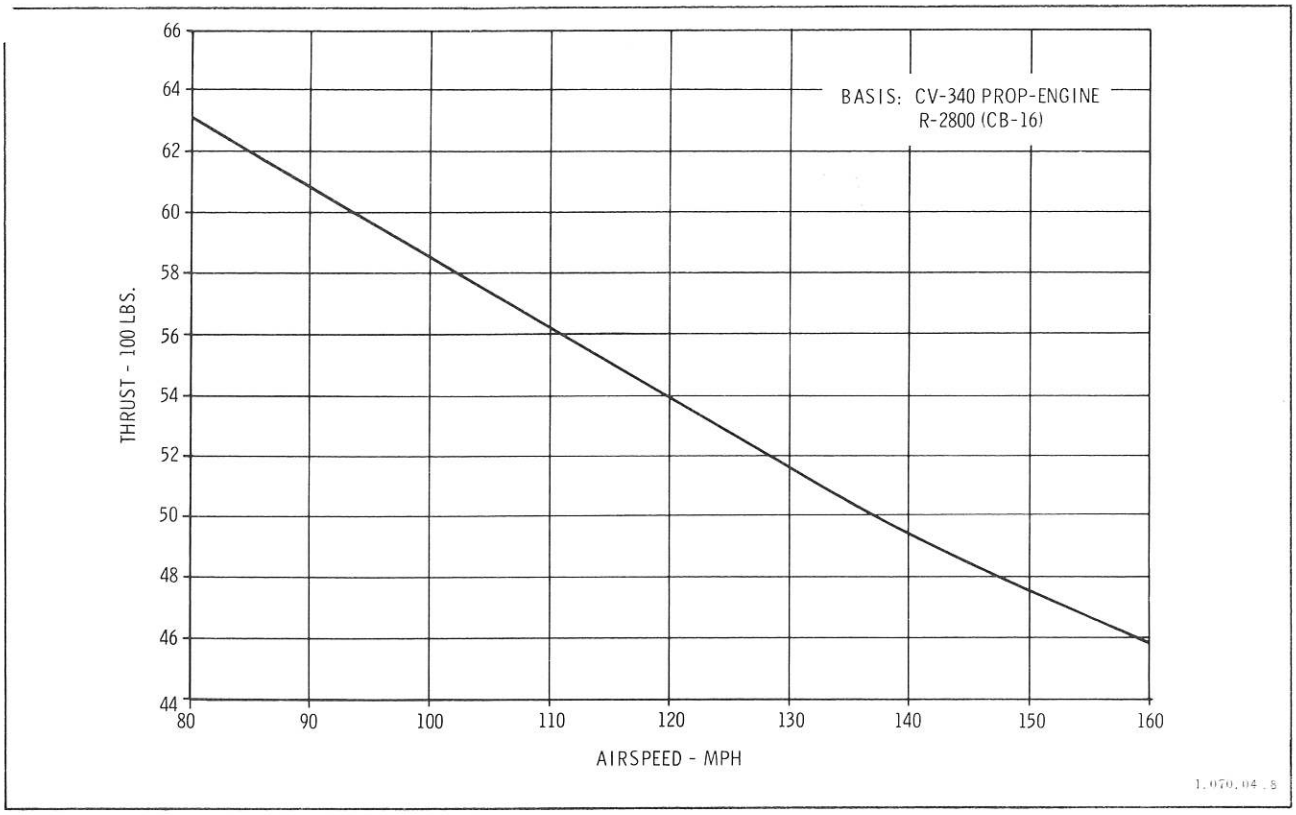

Figure 3-5. Thrust of Typical 2400 Brake Horsepower Aircraft Engine-Propeller Combination at Sea Level (Computed from Typical R-2800, CB-16, Engines in Convair 340 Type Aircraft)

3-15. EXHAUST NOISE AND APPEARANCE. The rocket engine operation is characterized by a noise similar to a small turbojet engine. The exhaust flame is bright blue with a column of hot gases beyond the visible flame pattern similar to that of a turbojet. No smoke is visible except when relative humidity is 80 percent or greater. Burning of internal residue such as rubber and felt grain spacers will normally result in a puff of black smoke at the end of burning which may be noticeable to observers outside the aircraft. In some cases, residual material may continue to burn slowly for 2 or 3 minutes, producing a small licking flame at the exhaust nozzle.

3-16. OPERATIONAL RELIABILITY

3-17. The 15KS-1000-A1 aircraft rocket engine has been designed to provide the utmost reliability under the extremes of operation listed in Federal Aviation Agency Aircraft Rocket Engine Specification E-249. This reliability has been demonstrated in the qualification and air-serviceability tests conducted for the F.A.A. certification of this engine.

3-18. To ensure maximum reliability in the rocket engine ignition circuit and to guard against inadvertent ignition, specific requirements for the electrical system are established in the manufacturer's design criteria for installation of this rocket engine (Aerojet-General Report No. 981). Items recommended to ensure reliability of ignition circuits are as follows:

a. The installation of a circuit-checking instrument in the cockpit to permit preflight checks of the circuits.

b. Individual circuits from main bus to each rocket engine.

c. Individual circuit-breakers for each circuit.

d. Heavy-duty arming and ignition switches.

e. Arming-indicator lights.

3-19. As safeguards against inadvertent ignition, incorporation of the following features are recommended:

a. A key-locking arming switch with key removable in the open position only.

b. Warning lights showing when rockets are armed.

c. Spring-return firing switches to preclude leaving switch on.

d. Readily opened circuit-breakers.

e. Circuits controlled by the airplane master switch.

f. Shielded and insulated wiring with shielding grounded at one end only to preclude induction loops.

g. Isolation of wiring to reduce possibility of shorting or induction from other circuits.

3-20. PRESSURE-RELEASE DIAPHRAGM ACTUATION. The diaphragm assembly is designed to provide the chamber with a safety valve to relieve excessive pressures resulting from mishandling or exposure to abnormal conditions or in the event of nozzle blockage. If a pressure diaphragm assembly should be actuated, forward thrust will continue, however, its magnitude and duration may vary. Actuation of the diaphragm assembly has never occurred in the operation of approximately 200,000 15KS-1000-A1 rocket engines in civil and military service.

3-20. NON-IGNITION. The ignition reliability of these rocket engines is such that ignition failure is highly unlikely. Any failure which might occur probably would be caused by a fault in the electrical circuit. In such an event, if an immediate check of the electrical circuit fails to reveal an open element, the balance of the investigation should be approached with caution; the non-ignition inspection instructions in Section IV should be followed. Until such investigation is completed or the igniter lead is disconnected, all persons should be kept away from the rocket-engine exhaust area except as may be necessary momentarily in leaving the airplane.

3-21. FORCED LANDINGS. In addition to their primary purpose as a source of stand-by power in the event of power loss during takeoff, the JATO engines may be used to advantage during landings resulting from power losses en route. They may permit the selection of a more advantageous landing spot or provide the necessary reserve power for a go-around after a missed approach. However, it is recommended that belly-mounted units be fired, if practicable, prior to a wheels-up landing. Wheels-up landings have been made with belly-mounted units which have not been fired and no ignition has occurred even though the entire aircraft weight has been supported by the rocket engine, demonstrating the insulating and abrasive resistance qualities of the chambers.

SECTION IV

INSPECTION

Note

If the rocket engine is rejected for any reason, please notify your nearest distributor or Product Marketing, Department 4000, Aerojet-General Corporation, P.O. Box 1947, Sacramento, California, for instructions on correction or disposition.

4-1. GENERAL

4-2. INSPECTION INTERVALS. The 15KS-1000-A1 aircraft rocket engine should be inspected at the following times and intervals (for convenience in inspection, an inspection check list is included as Appendix A to this manual):

a. Upon receipt, for shipping damage.

b. Prior to installation, for handling or storage damage.

c. Immediately after installation, if installation is not accomplished under the cognizance of inspection personnel.

d. After every 100 flight hours.

e. Just before use for training purposes, at end of life limitation.

f. In the event of an operating problem.

4-3. PERSONNEL. Inspections shall be accomplished only by personnel approved by the manufacturer.

4-4. TOOLS AND TEST EQUIPMENT REQUIRED FOR INSPECTION OR SERVICE. A flashlight insulated against external sparking, a 2.5-in. open-end or crescent wrench, and a pair of short-nosed pliers are the only tools required for inspection, however, a standard low-cost tool kit is available from manufacturer which will facilitate inspections.

4-5. An Aerojet-General S-3381A igniter circuit tester or equivalent is a necessary item of inspection equipment. The S-3381A tester is a three-in-one unit incorporating a sensitive 0- to 3-volt and 0- to 30-volt tester and a very sensitive resistance tester. This instrument may be safely used to check for residual or stray voltages and to check continuity of the ignition circuit, including the igniter. It may also be used to separately check the resistance of the igniter since its input (maximum of 0.015 amps) is considerably below the safe no-fire electrical energy (0.04 amps) established for the igniter. A Simpson volt-ohm-milliammeter, Model No. 260, or equivalent, may be used to check the ignition circuit for full system voltage or for stray or residual voltages. Other resistance meters will then be required to check resistance of the wiring harness, but not the resistance through the igniter. While the established value of safe no-fire energy provides a considerable safety margin, use of instruments for these purposes other than the S-3381A tester or the Aerojet-General cockpit-mounted circuitry test meter (3-033676) may be hazardous unless such instruments are approved by Aerojet-General for this purpose.

4-6. INSPECTION UPON RECEIPT

4-7. GENERAL. When the 15KS-1000-A1 aircraft rocket engine is received, inspect the shipping container for evidence of impact, punctures, tears, heat, or moisture absorption. Such evidence indicates the possibility of damage to the contents during handling or shipping.

4-8. CHAMBER ASSEMBLY. Inspect the chamber assembly for damage such as cracks, bends, or dents which may have occurred from rough handling. If evidence indicates that the rocket engine has been dropped, it must be rejected. Inspect the shipping plug in the igniter boss to ascertain that it is hand-tight. If the shipping plug is loose, broken or missing, perform the inspection presented in paragraph 4-13.

4-9. AFT CLOSURE AND NOZZLE ASSEMBLY. Check the aft closure and nozzle assembly for evidence of dents or damage to the nozzle or the safety-diaphragm assembly. If damage is found, the rocket engine must be rejected. Also check the weather seal in the nozzle exit cone to ensure that it is intact. During the installation of the weather seal, a line of glue will sometimes run across the seal, giving it the appearance of a crack. Light finger pressure on one side of the line will indicate whether the seal deflects as a unit or is actually cracked. If the weather seal is cracked, broken, or missing, the rocket engine must be rejected.

4-10. IGNITER CONTAINER. Inspect the igniter container for evidence of impact, looseness of the igniter in the container, or the presence of moisture. If any such conditions are apparent, perform the inspection presented in paragraph 4-16.

Note

If the above inspection shows the unit to be in satisfactory condition, the rocket engine and the igniter may be replaced in the shipping container for storage.

4-11. INSPECTION BEFORE ENGINE INSTALLATION

4-12. GENERAL. Before installation of the 15KS-1000-A1 aircraft rocket engine, inspect the unit as specified in paragraph 4-6; then perform the following additional inspection immediately prior to the installation.

4-13. CHAMBER INTERIOR

4-14. Remove the shipping plug from the igniter boss. Inspect the igniter boss threads for nicks or burrs which would interfere with the proper installation of the igniter assembly. The unit should be rejected if defects in the igniter boss are found.

4-15. Inspect the propellant by looking through the igniter port with the igniter or shipping plug removed. Check for cracks (irregular lines in the propellant) and evidence of foreign materials inside the unit. Also, check for leaching (formation of a gray crystalline or powdery formation on the inner bore). This is an indication of excessive moisture absorption by the propellant. If any irregular conditions are found, reject the unit.

Note

The edges of the propellant bore may be slightly chipped during the manufacturing process. Also, mandrel marks may be noted in the propellant bore. Neither of these phenomena are reason for rejection.

Note

Small areas of leaching, not to exceed 2 inches in diameter and 1/32-inch in thickness, are normal in the 15KS-1000-A1 rocket engine since it is not a hermetically sealed unit. Such areas are not cause for rejection. To date, there has been no case of engine rejection for leaching.

Note

The shipping plug should be replaced after inspection and should not be removed until the igniter assembly is ready to be installed.

4-16. IGNITER ASSEMBLY. Remove the igniter assembly from its container and inspect for nicks or dents resulting from dropping or mishandling. Check the plastic mudge coating of the igniter basket for perforations. Check the basket assembly for looseness in the igniter adapter. Inspect the threads on the igniter adapter for nicks or burrs which might prevent proper installation of the igniter assembly in the igniter boss. Check the igniter cable to ensure that it is intact. Remove the shorting plug from the connector and check to be sure the connector threads are not damaged. Sparingly lubricate Cannon plug connectors with Dow Corning DC-4 lubricant or equivalent using care to keep lubricant away from igniter basket and threads. If any irregularities are apparent, reject the igniter assembly.

CAUTION

The seal on the moisture-proof igniter container should not be broken for inspection unless there is evidence of damage. Inspection of the igniter is not performed until it is to be installed in the rocket engine.

4-17. Shake to check for loose igniter pellets. A clicking rattle is normal even in new igniters, especially when the rattle can be neutralized by shaking the igniter in a direction 90-degrees to that in which the rattle is noted. However, a "salt shaker" type rattle is cause for concern, and should be carefully investigated.

4-18. Inspect the igniter under normal lighting conditions (not bright sunlight or other glaring light) for indications of cracked or crushed pellets or a film of silvery powder on the inside of the mudge coating. Such a film would opaque the mudge and would indicate pellet attrition. Any of these conditions is cause for rejection. While the mudge basket covering is not transparent, the outlines of the tablet shaped pellets are normally visible.

CAUTION

Do not remove or re-tighten the igniter basket assembly.

4-19. INSPECTION AFTER ENGINE INSTALLATION

4-20. If the igniter is not installed in the presence of aircraft and engine inspectors, the inspection presented in paragraphs 4-13 and 4-16 should be repeated.

4-21. Prior to installing the igniter, make a careful check with the Aerojet-General Corporation S-3381A igniter circuit tester (or equivalent) to ensure that full electrical-system voltage is available for ignition of the rocket engine, and that there is no stray voltage in the line when the rocket-ignition switch is open. Current in the line may cause inadvertent ignition when the ignition wire is attached. Conversely, lack of proper voltage may prevent proper ignition. Also check the igniter resistance (resistance should be between 0.20 and 0.30 ohm). In making these checks, conform to the procedures in paragraphs 4-5 and 4-23.

4-22. INSPECTION AT 100 FLIGHT-HOUR INTERVALS

4-23. Perform the following procedure when checking the rocket-engine ignition circuits:

a. Make sure that the airplane master switch, the rocket-engine circuit breakers, and the rocket-engine arming switch are all open (off).

b. Disconnect the igniter cable from the igniter, and remove the igniter from the rocket engine.

c. If an S-3381A tester or other acceptable sensitive a-c/d-c voltmeter is available with a high-voltage range up to at least 30 volts and a very sensitive low-voltage range, check for full-system voltage and for residual or stray voltage. After the igniter is removed, connect the voltmeter between the igniter cable and one of the rocket-engine mounting lugs. Make full-system voltage checks by closing the rocket-ignition circuit while the meter is set in the high-voltage range. Residual or stray voltage should be checked with the meter set in the low-voltage range by opening the elements of the ignition circuit one at a time as follows: ignition switch, rocket-arming switch, and circuit breaker. These voltage checks should be repeated with all electrical equipment in the aircraft operating. No residual or stray voltage indication shall be tolerated in the ignition circuit.

CAUTION

Do not switch voltmeter to low-voltage range with the ignition circuit for the rocket engine closed. Damage to the voltmeter will result.

4-24. Inspect the rocket engine and igniter in accordance with instructions in paragraphs 4-13 and 4-16.

4-25. INSPECTION PRIOR TO USE FOR TRAINING PURPOSES

4-26. Just before using the rocket engine for pilot familiarization at the end of its life limitation, it should be inspected as covered under paragraph 4-22.

4-27. INSPECTION IN THE EVENT OF NON-IGNITION

4-28. If the engine does not ignite, the following inspection steps should be taken:

a. Check switches and circuit breakers to determine whether they are open. If they are not open or if the circuit breakers only are open, further investigation should be conducted as follows:

b. After checking the rocket ignition circuit, open the arming switch and circuit breaker. Open the airplane master switch after landing.

c. If the aircraft is equipped with a cockpit-mounted circuit-checking meter, make the normal circuit check. Other than normal resistance would indicate that trouble exists in the ignition switch in the aircraft. High or infinite (∞) resistance would indicate trouble downstream from the ignition switch. Lower-than-normal resistance might indicate a shorted ignition circuit or igniter glow plug.

d. Avoid the rocket-engine exhaust area for 15 minutes after ignition failure. This period of time will usually have transpired by the time the airplane is landed and returns to the line, but it should be kept in a clear area so that the rocket-engine nozzle is not directed toward other aircraft or buildings.

e. Approach the rocket engine from the side or front, disconnect igniter lead, and remove igniter.

f. Inspect the igniter for indication of its ignition, and also check the forward seal of the rocket engine for signs of heat. If the igniter has not fired, its resistance should be checked with an S-3381A tester. If the igniter resistance is higher than normal, reject the igniter. If the igniter resistance is normal, the problem is in the ignition circuit. The cause should be determined and corrected.

g. There is a remote possibility that the igniter could fire without igniting the rocket engine; therefore, check the rocket engine for the possibility of damage to the seals and indication of moisture absorption. After noting the results of such inspection, replace the shipping plug in the igniter port, seal the exhaust nozzle with tape to prevent entry of moisture, and remove the rocket engine from the aircraft.

SECTION V

INSTALLATION AND MAINTENANCE

5-1. GENERAL

5-2. HANDLING OF 15KS-1000-A1 AIRCRAFT ROCKET ENGINE. The handling precautions listed herein are principally intended to ensure operational reliability of the unit, which is extremely important in view of its intended purpose as an emergency power source. Paragraph 6-8 describes the care required in handling the rocket engine before proceeding with installation or maintenance of the unit.

5-3. INSTALLATION

5-4. PREPARATION FOR INSTALLATION OR MAINTENANCE

5-5. Before the rocket engines are installed, perform the procedures presented in paragraph 4-23 to determine that full-system voltage is available for ignition and that residual or stray voltages do not exist.

5-6. Before any installation or maintenance work is performed, check the airplane master switch and the arming switch and circuit breakers of the rocket engine ignition circuits to determine that they are open.

5-7. Before any work is performed on the rocket-engine installation or in its vicinity, the igniter leads and igniter should be removed.

CAUTION

Passengers or personnel must not linger or work in the area aft of the exhaust nozzles when the igniter leads are connected. Should the units be inadvertently actuated, exhaust gases of high temperature and velocity are emitted from the nozzle.

5-8. MOUNTING. Mount the 15KS-1000-A1 aircraft rocket engine on the aircraft as follows:

a. Remove paint or rust from the forward pin of the rocket-engine attaching lugs to ensure an adequate electrical ground for the ignition current. This serves as a secondary ground since the primary ground is normally accomplished through the ignition lead shielding.

b. Lift the rocket engine into position and attach it by its mounting lugs to the aircraft attachment fittings. Make certain that the engine is securely locked in position.

c. Recheck switches and circuit breakers (paragraph 5-6).

d. Remove the shipping plug and cap from the igniter port and nozzle of the chamber assembly.

e. Insert the igniter assembly in the igniter boss and tighten snugly with a hand

wrench; then secure the igniter with aircraft safety wire.

f. Connect the igniter lead to the cannon connectors on aircraft and igniter.

g. If the aircraft is equipped with a cockpit-mounted circuit-checking instrument, check to be sure that igniter resistance is normal. The meter should indicate a resistance of 0.25 to 0.75 ohm. Higher or lower resistance is an indication of an unsatisfactory circuit. However, the resistance indication of a given rocket engine igniter should be consistent, and indications for a given airplane should not vary more than 0.10 ohms for different rocket engines.

5-9. MAINTENANCE

5-10. MAINTENANCE OF IGNITION CIRCUITS

5-11. Little maintenance is required for ignition circuits installed in accordance with the procedures established by the rocket-engine manufacturer. Such installations should have more than adequate capacity and safeguards to provide for trouble-free operation. The following maintenance items are those which might be expected or are those precautions in maintenance which should be taken.

5-12. An increasing resistance reading on the cockpit-mounted circuit-checker is generally a sign of corrosion or foreign matter in the ignition switch, or corrosion or looseness of the igniter lead terminals. If readings do not return to normal after the igniter-lead terminals are cleaned and tightened, the wire attachments to the switches in the test circuit and the switches should be checked for deposits. If deposits are in the switches, actuating the switches a few times should return readings to normal. If such is the case, the switch should be removed and cleaned.

5-13. If switches or circuit breakers require replacement at any time, an item identical in all respects should be used as a replacement. Specific requirements have been established to ensure the proper types and capacities for the specific use involved. The ignition switches must be spring-return-type switches. If weakness or failure of the spring return is noted in the "ignition" position, the switch should be replaced immediately as a safeguard against inadvertent ignition.

5-14. If the Aerojet-General cockpit-mounted circuitry test meter will not "SET" (indicate infinity, ∞, when the checking circuit is open), a weak battery or corroded battery terminals are indicated. The battery terminals and contacts in the battery case should first be cleaned and then rechecked. If the condition persists, the battery should be replaced. Use of Mallory RM502R 1.34-volt mercury primary batteries or equivalent is recommended because they have longer life and less tendency for corrosion than other 1.5-volt cells. The polarity in some mercury cells is opposite to that found in other 1.5-volt cells. If the circuit checker needle pegs at the "OFF" end of the dial, the battery is installed incorrectly. In such a case, remove the battery, reverse and re-insert.

5-15. If any of the ignition-circuit wiring must be replaced, the following precautions must be taken: Use wiring identical to the wiring originally used in the installation and keep wiring isolated from the other electrical systems. Only insulated, shielded wire should be used in the ignition circuit, and the shielding should be grounded at one end only (a grounding point common to that of the shielding of the igniter lead). Electrical circuits for other items added to the aircraft after the rocket engines are installed should be kept isolated from the rocket-engine ignition circuits. These last two requirements are precautions to preclude inadvertent ignition by induced or stray volt-

ages from other circuits. The igniter lead shielding should be soldered or clamped to the sleeve of the Cannon connector which connects it to the igniter. This serves as the primary ground for the rocket engine.

CAUTION

Disconnect igniter leads before working on the aircraft electrical systems. This is a precaution against inadvertent rocket-engine ignition from shorting other systems to the rocket ignition system.

5-16. Check for battery-acid leakage in areas adjacent to the rocket-ignition wiring. The electrolytic action of acid on the aircraft skin might act as a battery, and possibly create enough current flow to energize the igniter glow plug or other electrical items in the aircraft if a closed circuit is established in some manner.

5-17. MAINTENANCE OF ROCKET ENGINE

5-18. Before operations involving heat, electricity or structural modifications are performed in the vicinity of the rocket engine installation, or before the aircraft is placed in long-term hangar storage or raised for landing gear removal or retraction tests, the rocket engines should be removed as follows:

a. Disconnect the igniter lead from the igniter and aircraft terminals.

b. Remove the igniter and return it to its shipping container. Seal the container with a suitable tape to preclude entry of moisture.

c. Insert the plastic shipping cap in the igniter boss.

d. Remove the rocket engine.

e. Store the rocket engine and igniter in accordance with the instructions in Section VI.

5-19. MAINTENANCE LIMITATIONS. The 15KS-1000-A1 aircraft rocket engine is expendable and may not be disassembled in the field. Therefore, maintenance is limited to the following:

a. Light rust may be removed from the chamber and the surface refinished for protection against further rusting. Light rust may be removed with steel wool or sandpaper.

CAUTION

While these rocket engines are far less sensitive to ignition than many other flammable materials commonly used in aircraft (such as gasoline), the same precautions should be used against inadvertent ignition. No torches, other heating or electrical devices, or impact tools should be used directly on the rocket engine or on the aircraft in the immediate vicinity of the rocket engine installation.

b. Removal of the igniter may be accomplished for inspection and maintenance of the rocket engine. However, if an igniter has fired and the rocket has not, do not replace the igniter and make a second firing attempt. The rocket engine should be removed as described in paragraph 5-18, and the nearest distributor or Product Marketing, Department 4000, Aerojet-General Corporation, P.O. Box 1947, Sacramento, California, should be advised.

5-20. POST-OPERATION MAINTENANCE. After operation of the aircraft rocket engine, the aircraft surfaces which have been exposed to the rocket-engine exhaust should be thoroughly washed down with water. This procedure will eliminate any danger of exhaust deposits resulting in corrosion of the aircraft skin.

SECTION VI

HANDLING, STORAGE, RESHIPMENT, AND DISPOSAL

6-1. I.C.C. SHIPPING AND STORAGE CLASSIFICATION

6-2. The interstate shipment and storage of the rocket engine is controlled by classifications established under Interstate Commerce Commission Regulations. Storage or transportation within states, counties, or municipalities falls under the state, county, or municipal laws or codes. When installed on an aircraft, the rocket engine is in the same category as any other F.A.A. certified aircraft engine.

6-3. The 15KS-1000-A1 aircraft rocket engine is packaged and marked for shipment and storage incidental to shipment as an "Aircraft Rocket Engine (commercial)" in compliance with Interstate Commerce Commission Regulations (in Canada, Board of Transport Commissioners Regulations). The shipping container for the rocket engine must carry this classification. While the characteristics of the rocket engine are far less critical than those of most items in this category, certain handling precautions must be taken. These handling considerations and the characteristics which prompt it are covered in subsequent paragraphs of this section.

6-4. The 15KS-1000-A1 aircraft rocket engine is defined by the Interstate Commerce Commission as a metal cylinder containing a mixture of chemicals capable of burning rapidly and producing considerable pressure. Under certain extremely rare combinations of conditions such as subjecting the unit to an intense fire or normal ignition after a severe breakup of the propellant, the propellant burning rate can increase sufficiently to create pressure beyond the design limits of the chamber. The conditions under which such excessive pressure might occur in storage or shipment are very unusual and of such nature that they would generally create considerably more damage than the burning or even than the rupture of the rocket-engine case.

6-5. The conditions under which overpressurization might occur are readily recognizable and may be easily avoided by following the simple inspection practices covered in Section IV of this manual, and the handling, storage, and shipping practices covered in this section of the manual.

6-6. ENVIRONMENTAL CHARACTERISTICS OF THE 15KS-1000-A1 AIRCRAFT ROCKET ENGINE

6-7. The behavior of this unit under very severe environmental conditions has been determined by extensive investigation. Operation of the unit was normal after extensive vibration, pressure and temperature cycling, dropping, and exposure to moisture. Additional research involved the exposure of individual units or clusters of units to intense fire after the units had been conditioned at high or low temperatures, and then dropped from a considerable height onto a hard surface. Other units were exposed to impact tests with high-explosive charges after similar temperature conditioning. Comparison with the characteristics of other commonly used aviation materials shows that these rocket engines can be handled, stored, and used safely under conditions which would be extremely hazardous for items such as gasoline or compressed flammable gases. The rocket engine has the following characteristics:

a. There is no appreciable deterioration of the propellant or the igniter during

the specified operation or storage life resulting from normal vibrations, temperature cycling, altitude cycling, or normal shocks.

b. Neither the propellant nor the igniter produces combustible vapors or gases which will ignite or explode on contact with sparks or flame.

c. The propellant and igniter are true rapid-burning flammable materials which do not detonate for propagate mass detonation when subjected to fire, shocks, or vibrations of severe nature.

d. Neither the propellant nor the igniter is susceptible to ignition from shock or vibrations resulting from normal or even relatively sever mishandling.

e. Because of their high auto-ignition temperatures, neither the propellant nor the igniter are susceptible to accidental ignition within the storage-temperature range.

f. Excessive pressures resulting in chamber rupture will occur only when the rocket engine is subjected to fire or normal ignition after severe breakdown of the propellant (such as might occur from heavy shock); when the rocket engine is subjected directly to intense fire such as a high-octane gasoline fire of considerable duration; or when the propellant grain is slowly heated so that a large mass of propellant approaches auto-ignition temperature at one time.

g. The propellant, when ignited in its chamber, burns with an intense flame for several seconds, and is extremely difficult to extinguish.

h. The auto-ignition temperatures of the igniter and the propellant of the rocket engine are 500°F and 550°F, respectively. During storage, the igniter is enclosed in a sealed metal container and surrounded by shock-absorbing materials which have a considerable insulating value. The propellant is encased in a steel chamber and surrounded by insulating materials capable of maintaining exterior chamber temperatures at a maximum of 600°F while operating with an interior combustion temperature of 3510°F. The rocket engine has been subjected to 1500°F bonfire tests for periods of five to seven minutes before igniting, demonstrating that the materials are also effective in insulating against heat entry. A considerably longer period is required for ignition of the igniter when sealed in its metal shipping container; however, sustained exposure of the rocket engine or the iginter to their respective auto-ignition temperatures might eventually cause ignition. Exposure of the rocket engine to temperatures beyond the established storage or operating limits for extended periods might result in damage to or deterioration of the propellant. Therefore, the unit must be protected from such exposure.

i. The rocket engines do not become propulsive with the igniter removed. With the igniter installed, the rocket engine will become propulsive.

6-8. HANDLING PRECAUTIONS

6-9. When the 15KS-1000-A1 aircraft rocket engine is packaged for shipment, it will withstand the normal handling practices for aircraft, aircraft engines, and aircraft components. However, because the rocket engine has some characteristics which are different from those of the conventional aircraft engine, different handling is required in some respects. Handling instructions pertinent to the rocket engine (presented in the following procedure) should be followed closely to ensure the operational reliability required of a standby power source of this type.

a. Unpack the rocket engine and igniter, following closely the directions on the shipping container.

Note

Do not push on the aft cap assembly. If it is necessary to push the engine from the rear, apply the force only to the rear extension of the chamber wall.

b. Use care not to drop the rocket engine during handling. While the engine

is designed to withstand acceleration loads of 30 g along its length and 12 g across its diameter, such loads may be exceeded if the engine is dropped on a hard surface from even a low height. Damage to the propellant may increase the burning area and, hence, the pressure within the chamber to the extent of causing actuation of the excess pressure diaphragm ports or, in cases of severe propellant breakup, may result in damage to the rocket engine or the aircraft. A thick shock-absorbing blanket placed under the unit during installation is recommended.

c. Use care in handling the igniter during installation, removal, or inspection. The igniter is somewhat more sensitive to shocks than the rocket engine. Dropping the igniter can result in crushed or broken igniter pellets or damage to the protective seals around the pellets or initiator material. Pellet attrition may progress from the aircraft vibration to the point of causing a severe ignition shock when the igniter circuit is energized. Such ignition shock may result in actuation of the excess-pressure diaphragms or, in the case of severe attrition, in damage to the rocket engine or aircraft.

CAUTION

Any rocket engine which is dropped on a hard surface from height of one foot or more, or any igniter which has been dropped on a hard surface from any height, must be rejected. Such units must not be installed on an aircraft or ignited. Usually some evidence of an impact may be noted, such as dents, bends, or scratches on the chamber, or dents in the igniter basket. Such signs should make the items suspect of having been dropped. Lack of such signs in the case of a known droppage of a rocket engine or igniter is no guarantee that damage has not been sustained.

d. Protect the rocket engine and igniter from excessive bumping, jarring, and rolling while they are being transported. Padded transport cradles should be used, if available, when units have been removed from their shipping containers. If cradles are not available, place a shock absorbant pad in the cart or truck bed being used and block rocket engine and igniter containers to prevent rolling.

e. Protect the rocket engine and igniter from excessive heat and sources of sparks or electric current.

f. Do not install the igniter until the rocket engine is installed in the aircraft. Keep the shipping plug in place until ready for installation of the igniter. This will preclude the possibility of entry of moisture or foreign materials.

6-10. STORAGE

6-11. GENERAL

6-12. Storage of the 15KS-1000-A1 aircraft rocket engine and the igniter when not installed on the aircraft should conform to state, county, or local government codes, as applicable, for the storage of materials of its classification. These units are in the same general category as certain types of airplane flares which are in common commercial use. Therefore, the same authorities who have cognizance of flare-storage regulations will also have cognizance of the regulations governing storage of these units. When the rocket engines are installed on the aircraft, they are considered the same as any other F.A.A. certified aircraft engine. The considerations which should be observed in the storage of aircraft with rocket engines installed are covered in paragraph 6-17.

6-13. Prior to installation, the rocket engine and its igniter should be stored in the original shipping containers. These

containers comply with Interstate Commerce Commission specifications. The containers and shipping plugs should be retained for re-use in the event the units are returned to storage. The rocket engine container serves as an insulator from radiated heat but will burn when directly exposed to flame.

6-14. The plastic plug which seals the igniter-boss opening should remain installed during storage. This plug and the shipping cap over the nozzle, combined with the airspace and restriction coating around the propellant will delay heat absorption and ignition by a surrounding fire. Tests have indicated that the plastic plug and other seals melt before the propellant ignites. If the propellant does ignite first, the resultant pressure would eject the plug, the weather seal, and the shipping cap, providing exits for the gases.

6-15. The igniter is shipped in the same shipping container with the rocket engine but is sealed separately in an insulated, airtight metal container. An igniter sealed in its metal shipping container will normally require a longer period to reach its auto-ignition temperature from a surrounding heat source than will be required for the rocket engine. The burning period of the igniter is of such short duration that its inadvertent ignition would have little effect on time required for the rocket-engine propellant to reach auto-ignition temperature.

6-16. In the event that the rocket engine cannot be returned to storage in the original container, it should be stored (in any position) in a rack (preferably constructed of non-combustible material) which will not permit it to roll, fall, or come in contact with another rocket engine. The exhaust and igniter ports should be aligned away from other rocket engines. The igniter should be removed from the rocket engine and stored separately in a sealed moisture-proof container surrounded by shock-absorbing material. The igniter port of the rocket engine should be sealed with the shipping plug or waterproof tape.

6-17. STORAGE OF AIRCRAFT WITH ROCKET ENGINES INSTALLED

6-18. Generally, normal storage precautions are required for aircraft with rocket engines installed. However, some of these should be emphasized and a few special considerations should be taken.

a. A careful check should be made to ensure that the airplane master switch and the rocket-engine ignition-circuit arming switch and circuit breakers are open. If the aircraft is equipped with igniter-lead grounding connectors, the igniter leads should be disconnected from the ignition circuits and connected to the grounding leads.

b. Rocket engines should be removed from aircraft in long-term or major maintenance storage and should be stored in accordance with the instructions in paragraphs 6-13 and 6-14, as applicable.

c. Aircraft equipped with rocket engines should be restrained to prevent movement in the event of inadvertent ignition.

d. Insofar as possible, aircraft with rocket engines installed should be stored so that the rocket-engine exhausts are not directed toward other aircraft, and should be readily accessible for removal in the event of a fire in the hangar.

6-19. FIRE PREVENTION RECOMENDATIONS

6-20. Normal fire-prevention practices should be followed in the storage of rocket engines.

a. Avoid storage with easily ignited and flammable or combustible materials.

b. Store in areas constructed of non-combustible materials.

c. Avoid storage in areas wherein the collapse of floors during a fire might permit the rocket engines to fall.

d. Provide easy access to the storage area to permit fire-protection measures or removal of the units in the event fire threatens the area.

e. Provide adequate venting for storage area to permit release of pressure in the event of rocket ignition.

f. Water-deluging facilities are recommended for the storage area.

6-21. FIRE-FIGHTING RECOMENDATIONS

6-22. The following precautions are recommended for fighting fires in rocket engine storage area or in the event of inadvertent rocket ignition:

a. Clear the area of all persons not engaged in fighting the fire.

b. If possible, remove all rocket engines and aircraft equipped with rocket engines from the fire areas.

c. If rocket engines or aircraft equipped with rocket engines cannot be removed from the fire area, concentrate efforts on cooling the rocket engine to prevent its ignition.

d. Use water or foam to control any burning material in the vicinity of the rocket engine.

e. Do not attempt to extinguish ignited rocket engines. The propellant contains its own oxidizer and cannot be extinguished by normal smothering techniques. The only effective means of fighting the fire is by venting the storage area and confining the fire by flooding the surrounding area with water or foam.

f. Provide fire-fighting personnel with suitable respirator masks in case area ventilation cannot remove exhaust gases.

6-23. RESHIPMENT

6-24. The 15KS-1000-A1 aircraft rocket engine and igniter must be shipped in accordance with current Interstate Commerce Commission Regulations covering Aircraft Rocket Engine (commercial). The following specific requirements shall govern their shipment.

a. Individual units will be shipped in appropriate shipping containers meeting I.C.C. requirements. Each unit will be completely assembled except for the igniter, which will be enclosed in a separate, sealed, metal container housed in the shipping container. These containers should be retained for storage or reshipment.

b. Shipment of the rocket engines or igniters may be made only by carriers approved for transportation of this type of material. Approvals have been obtained for shipment of this class of material by rail freight, rail express, certain motor-freight carriers, and certain air-freight carriers.

c. The package should be marked in accordance with I.C.C. requirements. This should be the same as the markings on the packages received from the rocket-engine manufacturer. If these packages are not retained for any reason, the markings should be carfully noted for any reshipment. Proper marking instructions may also be obtained by contacting Product Marketing, Department 4000, Aerojet-General Corporation, P.O. Box 1947, Sacramento, California.

6-25. DISPOSAL OF REJECTED ROCKET ENGINES OR IGNITERS

6-26. The 15KS-1000-A1 aircraft rocket engine or igniter might be withdrawn from use in an unexpended condition due to damage or rejection. Because the propellant and igniter contain rapid-burning, high-energy materials, their disposal

must be accomplished with care by experienced or properly trained personnel only. The following precautions are to be taken in disposing of unexpended rocket engines or igniters.

a. The igniter is to be removed from the rocket engine (if possible) and the plastic shipping cap installed in its place.

b. Except as described in subparagraphs c., d., or e., a rocket engine or igniter which is not immediately disposable or which is awaiting further inspection to determine disposition, is to be returned to storage in accordance with the applicable provisions of paragraph 6-10.

c. If the rocket engine or igniter is so damaged as to preclude removal of the igniter by simply unscrewing it, the igniter shall remain installed. In such instances, proceed as follows:

1. Stand the rocket engine on the forward end.

2. Cut out the weather seal with a penknife.

3. Fill rocket engine with water.

4. Re-seal the nozzle with a cork or other suitable seal to retain the water during transportation to the disposal site, or during storage if immediate disposal is impossible.

d. If a rocket engine has been damaged by heavy impact, but the igniter can be removed, accomplish such removal and install the plastic shipping cap; then proceed as in subparagraph c.

e. Any igniter which has been damaged by heavy impact or dropping should be placed in a metal container. The container should be filled with water and sealed for transportation to the disposal site or for any storage required prior to disposal.

f. An unexpended rocket engine or igniter which is to be scrapped should be disposed of as soon as possible by dumping in a deep-water area approved by the cognizant government service for disposal of materials of this classification.

g. Propellant, igniter, igniter pellets, or initiator material shall not be disposed of by burning.

h. An unexpended rocket engine or igniter shall not be sold as scrap material.

i. An expended rocket engine or igniter may be treated as scrap material without special treatment, but flushing with water prior to disposal is recommended.

j. If disposal as outlined in subparagraph f. cannot be accomplished immediately, or in the event guidance is required in regard to any disposal problem, contact Product Marketing, Department 4000, Aerojet-General Corporation, P.O. Box 1947, Sacramento, California.

APPENDIX A
INSPECTION CHECK-OFF LIST

I. As received from factory, check items A-1 through A-5 and B-1 through B-3.

II. Before installation, check items A-1 through A-9, B-3 through B-8, and C-1 through C-5.

III. At 100-hour inspection periods, check items A-3 through A-13, B-3 through B-8, and C-4 through C-6.

General Note; Inspection Disposition:

(a) Reject

(b) Perform additional inspection

(c) Take corrective action

When more than one disposition letter follows an item, the seriousness of the condition will determine the necessary disposition.

A. ROCKET ENGINE CHAMBER AND SHIPPING CONTAINERS

1. Shipping crates or pallets for evidence of mishandling, dropping, immersion, excessive heat or vibration (a) . . . . . .

2. Plastic igniter port plug:
Missing (b & c). . . . . .Damaged (b & c). . . . . .Loose (c) . . . . . .

3. Evidence of dropping or impacts of other objects on rocket engine (a) . . . . .

4. Rust on engine chamber Heavy (a). . . . . Light (b & c) . . . . . .

5. Nozzle protecting cover
Missing (b & c). . . . . .Damaged (b & c). . . . . .Loose (b & c) . . .

6. Nozzle weather seal Broken or missing (a) . . . . . .

7. Nozzle retaining lugs and bolts
Damaged (a). . . . . Missing (a). . . . . .Loose (b & c) . . . . . .

8. Snap ring retaining clips and screws
Damaged (a). . . . . .Missing (a). . . . . Loose (c) . . . . . .

9. Damage to diaphragm protector visible through pressure release ports (a) . . . . . .

10. Loose pieces or foreign objects inside chamber (a) . . . . . .

CAUTION A safety flashlight is to be used for all interior inspection. Do not insert flashlight or other objects into chamber bore.

INSPECTION CHECK-OFF LIST (CONT)

11. Moisture or water inside chamber (a) . . . . . .

12. Cracks, chips or other damage to propellant grain (a) . . . . . .

Note Slight chipping of the sharp edge between the propellant bore and the ends normally occurs in processing and does not affect operation. Also, mandrel marks may be seen near the middle of the propellant bore.

13. Mounting lugs and pins bent or cracked (a) . . . . . .

B. IGNITER

1. Igniter loose in container (a or b) . . . . . .

2. Evidence of mishandling or dropping (a) . . . . . .

3. Rust on igniter or container (a or b or c) . . . . . .

Note Do not break seal on moisture-tight container for the above inspection until ready for installation unless evidence of damage is found.

4. Damage to igniter lead or terminals (a) . . . . . .

5. Evidence of moisture on igniter basket or pellet cover (a) . . . . . .

6. Looseness of igniter basket in igniter body (a) . . . . . .

CAUTION Do not remove or retighten basket assembly. In case of looseness, replace igniter in the shipping container and dispose of according to applicable service instructions.

7. Rupture or perforation of plastic bag covering pellets (a) . . . . . .

8. Rattling of pellets when igniter assembly is shaken (see 4-17.) (a) . . . . . .

9. Cracked or crushed pellets or attrition of pellets manifested by silvery powder on inside of plastic bag covering pellets (a) . . . . . .

C. AIRCRAFT INSTALLATION AND ELECTRICAL SYSTEM

1. Full system electrical voltage not available for firing (b & c) . . . . . .

2. Voltage remaining in line when switch is open (b & c) . . . . . .

INSPECTION CHECK-OFF LIST (CONT)

CAUTION A careful check for conditions 1 and 2 above should be conducted prior to installation of the igniter. Be sure that no voltage remains when switches are open. Current remaining in line when switches are open may cause inadvertent ignition when attaching the ignition wire. Conversely, lack of proper current may preclude ignition or cause ignition delays.

3. Ignition circuit continuity resistance abnormal after re-installing igniter (b & c) . . . . . .

4. Corrosion or foreign materials in the igniter lead connectors (c) . . . . . .

5. Alignment (b & c) . . . . . .

6. Security of attachment (b & c) . . . . . .

7. Damage to surrounding structure and protective shrouds (b & c) . . . . . .

8. After firing JATO, check aircraft surfaces aft of JATO for possibility of remaining deposits at skin joints, crevices, around rivets, etc. (c) . . . . . .

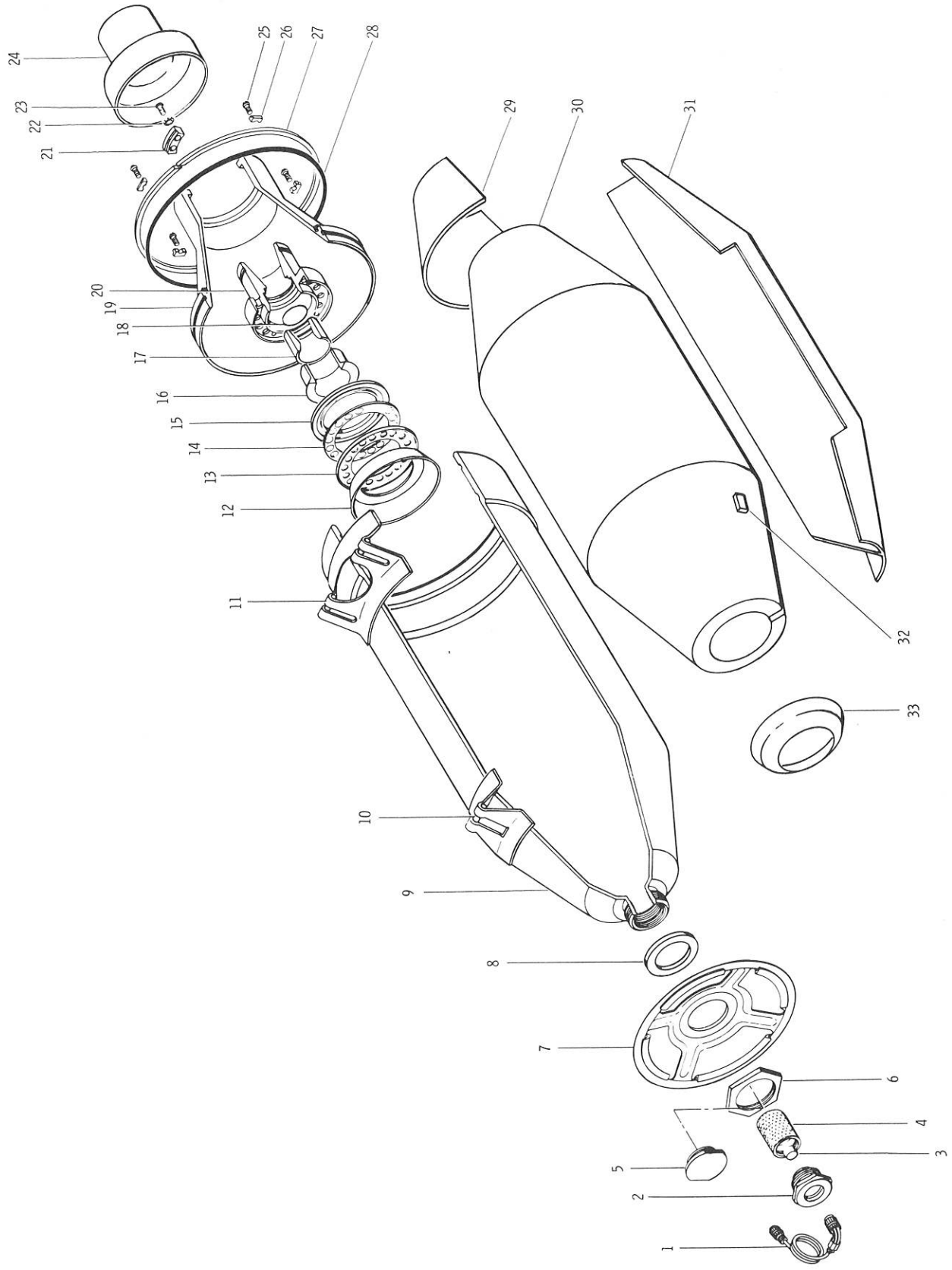

Figure 1. Disassembled View of 15KS-1000-A1 Aircraft Rocket Engine

APPENDIX B
ILLUSTRATED PARTS BREAKDOWN

Note

Parts cannot be purchased separately. This list is furnished for identification and inspection purposes only.

Index No.	Description	Units Per Assy
1	SQUIB ASSY, Igniter	1
2	ADAPTER, Igniter	1
3	CASE, Powder	1
4	BASKET ASSY, Igniter	1
5	CAP, Shipping	1
6	NUT, Handle	1
7	STAND, Handle	1
8	WASHER, Handle	1
9	CHAMBER ASSY	1
10	MOUNTING ASSY, Forward	1
11	MOUNTING ASSY, Aft	1
12	CONE, Safety, Diaphragm Deflector	1
13	RING, Aft Cap	1
14	DIAPHRAGM ASSY	1
15	WASHER, Diaphragm Insulating	1
16	RETAINER, Nozzle Insert	1
17	INSERT, Nozzle	1
18	SEAL, Weather	1
19	AFT CAP ASSY	1
20	BODY, Nozzle	1
21	LUG, Nozzle Retention	2
22	WASHER, Spring Lock	4
23	SCREW, Socket Head	4
24	COVER, Nozzle	1
25	SCREW	4
26	CLIP, Retaining Ring	4
27	RING, Aft Cap Retaining	1
28	SEAL, O-ring	1
29	FELT, Aft Cap	2
30	GRAIN, Propellant	1
31	BOOT AND BAFFLE, Insulating	1
32	SPACER, Grain (Sponge Rubber)	1
33	FELT, Forward	1

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SOLID ROCKET PLANT SACRAMENTO CALIFORNIA