(THIRD REVISION)

AIM-9B GUIDED MISSILE

(FORMERLY SIDEWINDER 1A)

DESCRIPTION AND OPERATION
(U)

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FOREWORD

Ordnance Pamphlet 2309 (Third Revision) describes the AIM-9B guided missile, gives the theory of operation, and covers handling, inspection, assembly, and stowage of the components.

This publication consists of four volumes.

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Chapter 1
DESCRIPTION

1-1 INTRODUCTION

The AIM-9B guided missile (formerly Sidewinder 1A) is a supersonic air-to-air homing missile employing passive infrared target detection, proportional-navigation guidance, and torque-balance control. It is launched from a rail launcher. The launcher contains a power supply, which furnishes standby power for the missile before firing, amplifies the missile signal for the pilot's earphones, and accomplishes the electrical functions necessary to fire the missile after the pilot pushes the firing button. The missile can be carried by high-speed fighter aircraft in attacks from a large portion of the after hemisphere, primarily against jet aircraft. Multiple-engine piston aircraft have been successfully attacked under ideal conditions.

None of the missile sections are to be repaired aboard ship or at any supply depot or forward field area. The missile is a simple, low-cost, reliable weapon without sacrifice of any functional performance requirements. Tactical sacrifices—in particular, restriction to fair-weather attacks from the tail cone—are inherent in the design.

1-2 MAJOR COMPONENTS

The AIM-9B missile has five major sections: Guidance and Control (G&C) Section Mk 1, Contact Fuze Mk 304, Warhead Mk 8, Influence Fuze Mk 303, and Rocket Motor Mk 15 or 17 with wings, figure 1-1. In final assembly of the missile, four forward movable control fins on the G&C section are in line with four rigid wings on the motor. The missile physical characteristics are as follows:

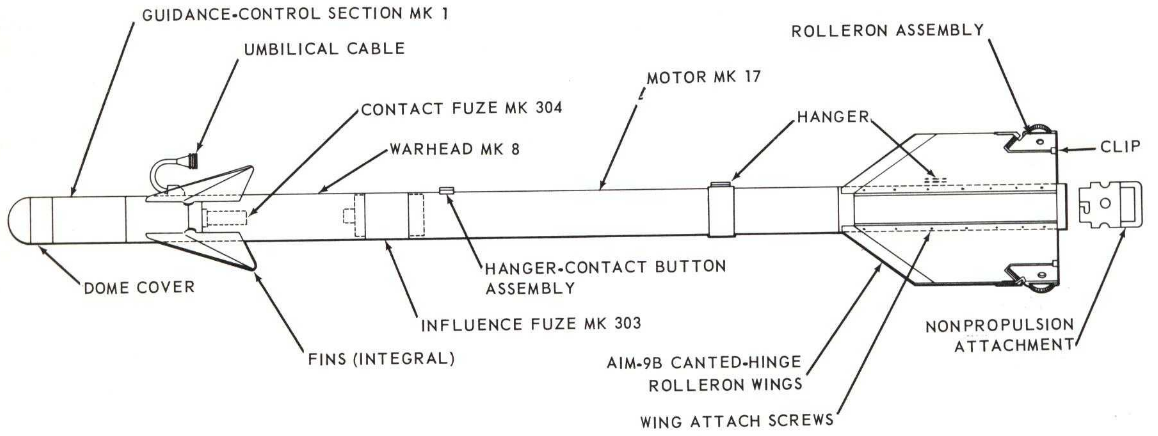


Figure 1-1. AIM-9B Guided Missile Components.

Length (in.)	111 1/2
Diameter (in.)	5
Fin span (in.)	15
Wing span (with rollerons) (in.)	22
Weight (lb)	160

Each section of the missile is assigned a mark and mod number. As functional or physical features of that section are modified, the mark and mod are changed accordingly. The mod number differences and the compatibility of the various sections are listed in tables A-1 and A-2, and aircraft-missile compatibility is listed in table A-3, appendix A. The five major sections are described in the following paragraphs.

1-2.1 GUIDANCE AND CONTROL SECTION. The G&C Section Mk 1 comprises the forward end of the missile. The nose of the G&C section is a glass dome, and toward the rear of the section are mounted four steering fins, figures 1-2 and 1-3. An umbilical cable and plug connector extend from the rear skin of the section. The G&C Section Mk 1 for the AIM-9B missile is 20 inches in length and 5 inches in diameter and weighs 36 pounds.

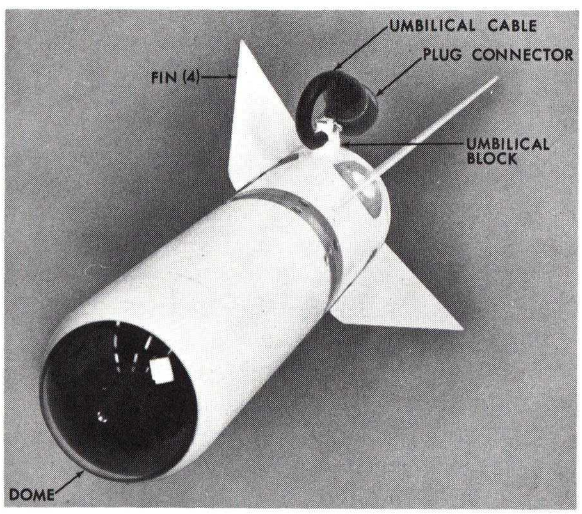


Figure 1-2. Guidance and Control Section, Front View.

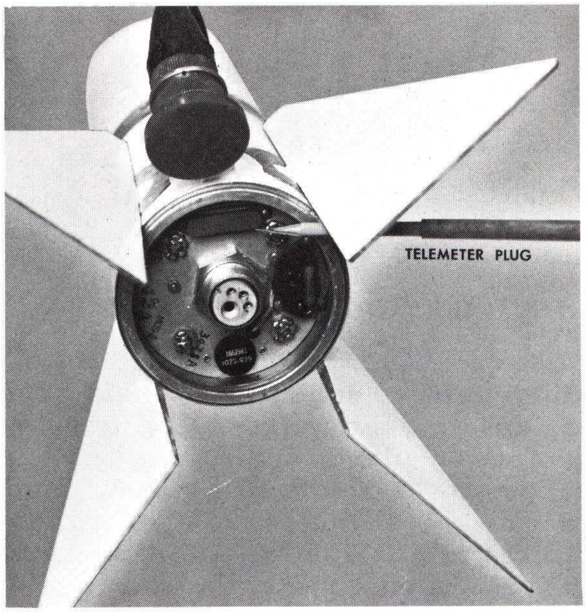


Figure 1-3. Guidance and Control Section, Rear View.

1-2.2 CONTACT FUZE. The Contact Fuze Mk 304, figure 1-4, is mounted

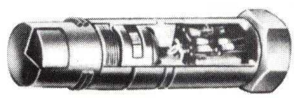


Figure 1-4. Contact Fuze

on the rear of the G&C section. The end containing the booster charge fits in the recess of the warhead section. The Mk 304 contact fuze, used in the AIM-9B missile, is 7 inches long, 1 1/2 inches in diameter, and weighs 1 1/2 pounds with booster installed.

1-2.3 WARHEAD. The section of the missile immediately aft of the contact fuze and G&C section is the warhead, figure 1-5. The warhead is designated the Mk 8. The 25-pound warhead consists of approximately 14 1/2 pounds of metal and 10 1/2 pounds of explosive. The warhead is attached to the G&C section by four clamps secured with Allen-head screws. The warhead can be detonated by either the contact or the influence fuze. Warheads with a

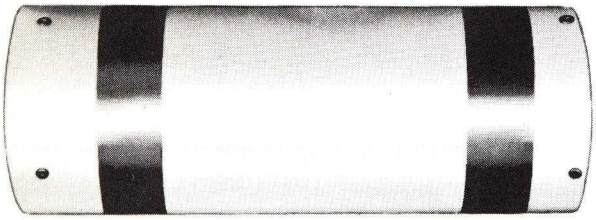


Figure 1-5. Warhead.

neoprene rubber gasket under the loading port are designated as Mk 8 Mod 3. The rubber gasket provides an effective seal against the possibility of explosive exudation during extended high-speed flights.

1-2.4 INFLUENCE FUZE. The Influence Fuze Mk 303, figure 1-6, is

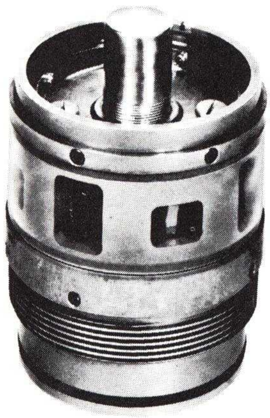


Figure 1-6. Influence Fuze.

mounted between the warhead and the rocket motor. The complete fuze is 6 4/5 inches long, 5 inches in diameter, and weighs approximately 6 1/2 pounds. It occupies 3 1/10 inches of the missile skin, and the booster extends forward into the center of the warhead. In final assembly aboard ship, the fuze and warhead are attached by four internal clamps (in the aft end of the warhead) secured with Allen-head screws. The aft end of the influence fuze has a tapered Acme male thread for closure to the rocket motor. Some of the influence fuzes had a slot cut in the threads for a nylon locking strip. A soft rubber slot filler has been adopted instead of the nylon strip in the fuzes with slots. A new rubber slot filler, if required, and a new O-ring are used each time the influence fuze is assembled to the rocket motor.

1-2.5 MOTOR AND WINGS. Just aft of the influence fuze is the rocket motor, figure 1-7. The forward end of the motor has a tapered Acme female thread for attachment of the influence fuze. The motor is approximately 75 inches long, 5 inches in diameter, and weighs about 80 pounds. The motor tube has four wing-mounting channels, which are extruded integral with the tube (see figure 1-7). In final assembly, wings with rollerons are clamped into these channels, each by means of five prestarted assembly screws. If required, a caging clip is available for wings. Rolleron clips for straight-hinge rollerons are shown in

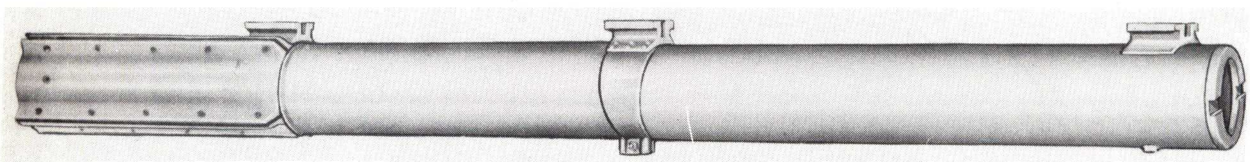


Figure 1-7. Rocket Motor.

figure 1-8. A caging clip for the canted-hinge rollerons is shown in figure 1-9. This caging clip supplements the caging pin for extra security when missiles are flown on F-4B or F-8E aircraft. The Mk 15 Mod 2 and

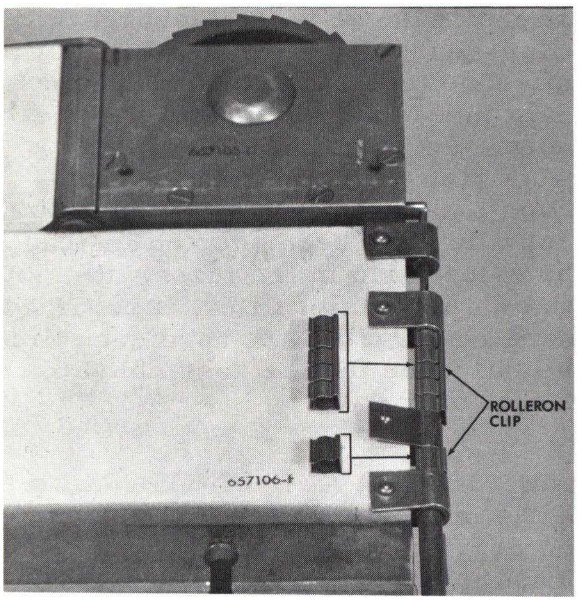


Figure 1-8. Straight-Hinge Rolleron Clip in Place on Wing.

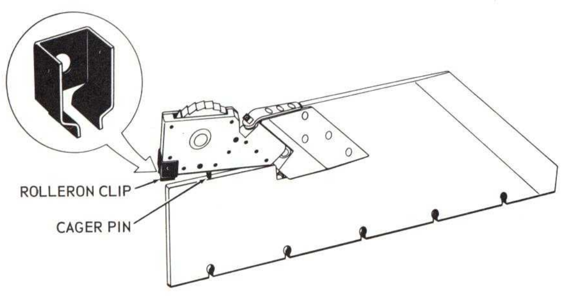


Figure 1-9. Caging Clip in Place on Canted-Hinge Rolleron.

Mk 17 Mod 5 motors are HERO SAFE. They are so designated by a special 2-inch color-coded band around the motor tube just aft of the forward hanger. The band has two brown strips that enclose a white strip. These HERO SAFE motors have contact buttons with plastic caps that cover the tops of the buttons, figure 1-10. These caps are an integral part of the HERO fix and should not be scraped.

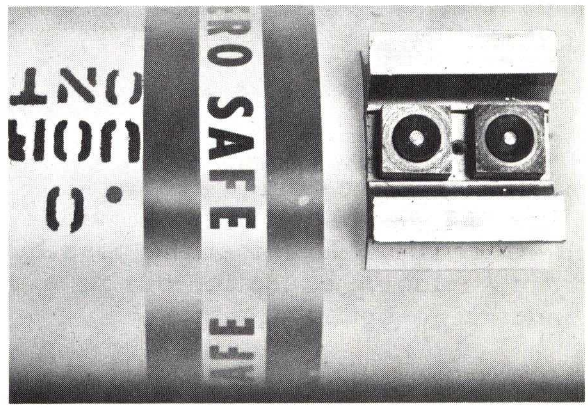


Figure 1-10. Mk 17 Mod 5 Motor Firing-Contact Buttons With Plastic Caps.

1-2.6 NONPROPULSION ATTACHMENT. A nonpropulsion attachment (NPA), figure 1-11, is attached, by

Figure 1-11. Nonpropulsion Attachment.

means of a bayonet-type connector, to the nozzle end of the rocket motor during assembly. An O-ring must be in place to retain the NPA in the motor tube.

NOTE: It is recommended that the NPA be removed immediately before the missile is loaded on the aircraft launcher.

1-2.7 PROTECTIVE DOME COVER. The protective dome cover, figure 1-12, is to be over the glass dome of the G&C section when it is out of the container. The dome cover is not to be removed until the missile is on the aircraft and the aircraft is ready for takeoff.

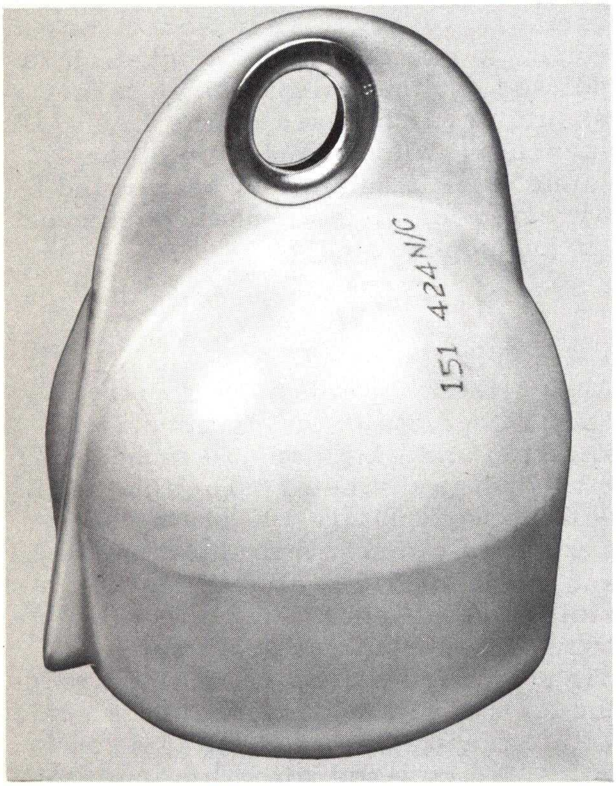


Figure 1-12. Protective Dome Cover.

1-2.8 PROTECTIVE COVER FOR INFLUENCE FUZE. The protective cover, figure 1-13, for the influence fuze is wrapped around the fuze and remains in place until the aircraft is ready for takeoff.

Figure 1-13. Protective Influence Fuze Cover.

1-3 TRAINING COMPONENTS

1-3.1 DUMMY MISSILES. Four types of dummy missiles, available for captive flight and training, are described in the following paragraphs.

1-3.1.1 Type I. Type I dummy missile is for use in missile assembly and handling drills, and for use as a captive dummy missile in aircraft-missile performance tests. It consists of the G&C section (Type I) with plastic seeker head, spring-loaded fins for "free-streaming" within aircraft local airflow, wiring harness with all connectors (but no wiring), and weight and center of gravity approximating a live G&C section. The other components (influence fuze, contact fuze, warhead, and rocket motor with wings) are inert.

1-3.1.2 Type II. Type II dummy missile is intended for evaluation of aircraft-missile separation tests and is designed for unguided firings. It consists of a G&C section (Type II) with a gas generator grain assembly with dummy pistons, a thermal time-delay relay (replacing the turbogenerator of a live G&C section), special purpose wiring harness arranged to actuate the thermal time-delay relay and the motor squib only, and weight and center of gravity approximating a live G&C section. The other components are an inert influence fuze, inert contact fuze, and inert warhead, but a live Rocket Motor Mk 15 or Mk 17 with wings.

1-3.1.3 Type III. Type III dummy missile (weighted) is used in captive flight tests and other training where an active seeker is required, but where the servo gas generator is not to be activated. It consists of a live G&C section Mk 1, with a molded umbilical cable. The other components are an inert influence fuze, inert contact fuze, inert warhead, inert rocket motor (wings optional), and an umbilical servo bypass adapter (FSN Z1420-676-4689).

1-3.1.4 Type IV. Type IV missile (unweighted) can be used instead of Type III and costs less. Either can be used where an active seeker is required, but where the servo generator is not to be activated. It has a live G&C section Mk 1 with a molded umbilical cable, unweighted adapter (BUWEPS dwg 1517438) replaces the influence fuze and the warhead, unweighted motor (inert and without wings), and umbilical servo bypass adapter (FSN Z1420-676-4689).

1-3.2 EXERCISE WARHEAD. The Exercise Warhead Mk 2 is a cylinder 13 1/2 inches long, 5 inches in diameter, and weighs 25 1/2 pounds. It is fuzed at both ends. At the forward end, a well, 6 inches deep, is provided for the contact fuze which is attached to the G&C section. At the aft end, a shallow well is provided for the influence fuze booster. The exercise warhead is attached to the G&C section and to the influence fuze in the same manner as the live warhead.

1-3.3 TARGET ROCKET MK 26. The Target Rocket Mk 26 is no longer carried in Navy inventory. Instead, towed targets with infrared augmentation and/or maneuverable drones are used. However, the Air Force continues to use this target rocket. It is pointed out that this 5.0-inch target should never be used on the LAU-7/A launcher. When carried on other launchers, it should not be carried in arrested landings. It shall be expended or jettisoned in flight.

1-3.4 TRACKING FLARE MK 21 AND MK 33. The Tracking Flare Mk 21 consists of an aluminum tube and stud and measures 10 inches long by 1 inch in diameter. The tube is filled with approximately 100 grams of pyrotechnic mixture in the forward end and about 10 grams of ignition material in the aft end. The flare will burn for approximately 25 seconds. Eight ignition holes are drilled around the aft end of the flare, which is sealed with a plastic cap, and the ignition holes are covered with aluminum foil tape. The aft end of the flare is then coated with a purple lacquer.

The Target Flare Mk 33, which will ultimately replace the Mk 21 tracking flare, is similar to the Mk 21 but is of improved design. The case is of steel rather than aluminum. The physical dimensions and the method of installation of both flares are identical. The flare will burn for approximately 60 seconds.

The tracking flares, as packaged, include a 1/4-inch socket-head capscrew which is used to hold the flare to the rocket motor. The channel ring has four tapped holes, which fit the capscrews. Each flare is held to a capscrew, which fits through the flare and into the channel ring on the motor body.

1-4 LAUNCHERS

1-4.1 AERO 3A LAUNCHER. The AIM-9B missile is launched from an Aero 3A launcher, figure 1-14. The physical characteristics of the launcher are as follows:

Length (in.)	84.2
Height (in.)	4.9
Width (in.)	2.6
Weight (lb)	50 (with self-contained power supply)

An electric power supply for the missile is located inside the launcher, between the two pylon attach points. It weighs approximately 12 pounds. The unit is encapsulated in a plastic material and is generally nonrepairable at the operational level. The launcher power supply furnishes both standby and firing power to the missile and provides amplification of the missile signal. It receives 400-cps, 115-volt power and 28-volt DC power from the aircraft, and furnishes B+ power, heater power, filament power, and firing power to the missile. It also amplifies the missile signal for the pilot's earphones by means of a two-tube, push-pull class A audio amplifier. Four relays in the power supply, used in firing and jettisoning the missile, provide safety in the form of multiple openings in the firing circuits.

The Aero 3A launcher shall have an unloading stirrup installed in accordance with Aircraft Armament Change No. 200. The stirrup prevents shearing of the umbilical block during missile unloading.

A launcher dust-cap protector shall be placed on the power supply receptacle whenever a launcher is removed from the aircraft (see Armament Material Bulletin No. 274). NAVAER 11-75-504, Aero 3A Missile Launchers and Pylon Assemblies, gives additional details on this launcher.

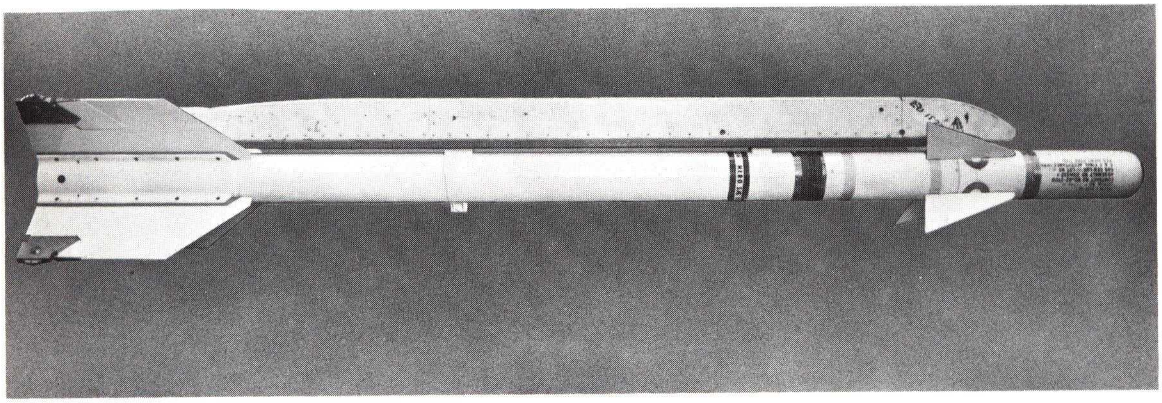


Figure 1-14. Aero 3A Launcher With Missile Attached.

The Aero 3A launcher detent tester (FSN RX-4920-075-8106-M558), figure 1-15, is a "pull through" tester for the Aero 3A launcher.

1-4.2 LAU-7/A LAUNCHER. The LAU-7/A launcher, figure 1-16, designed primarily for the AIM-9C and AIM-9D missiles, can be used to launch AIM-9B missiles. However, an electrical adapter (FSN VM-5935-885-9397-M588), Part no. 10001-1517359) is required to adapt the launcher electrically to the missile.

The physical characteristics of the LAU-7/A launcher are as follows:

Overall length (in.)	111
Height (in.)	5.5
Width (in.)	4
Weight (lb) (with power supply and empty gas receiver used for AIM-9D)	83

Complete details on operation and servicing of this launcher are given in NAVWEPS 11-75A-26.

1-5 ASSEMBLY, HANDLING, AND TESTING EQUIPMENT AND TOOLS

The equipment and tools required for the assembly, handling, and testing the AIM-9B missile, launchers, and aircraft are listed in the following paragraphs.

1-5.1 ASSEMBLY EQUIPMENT AND TOOLS. The assembly equipment and tools required are as follows:

AIM-9B Missile
- Assembly jig or stand
- Alignment jig
- End-closure clamp tool (for decanning G&C section)

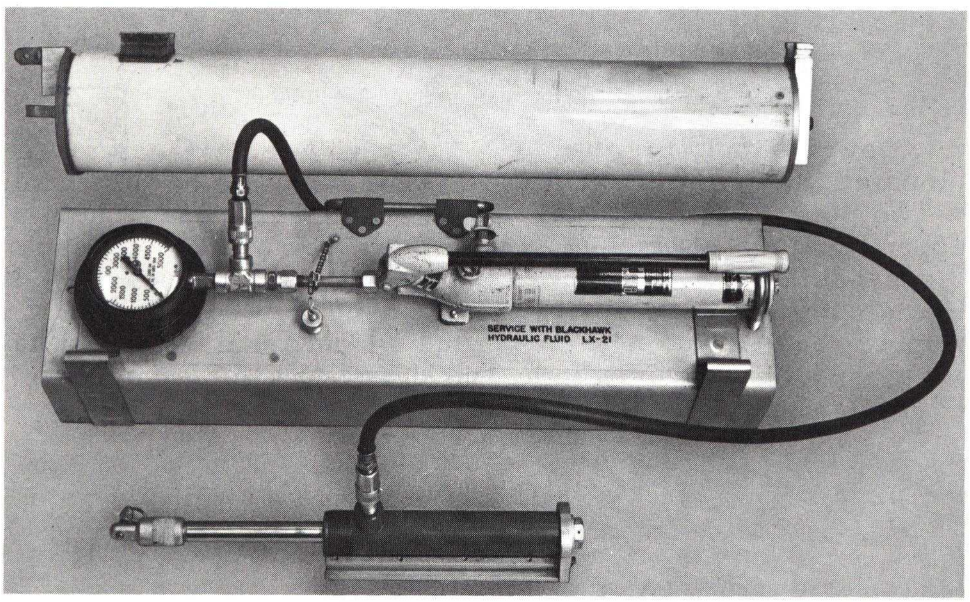


Figure 1-15. Aero 3A Launcher Detent Tester.

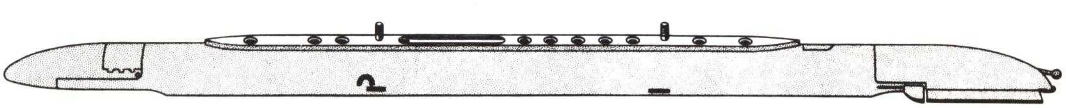


Figure 1-16. LAU-7/A Launcher.

Torque wrench kit
- Spanner torque wrench and tee torque wrench with socket-head-screw straight wrench, square-drive female wrench holder, hexagon socket setscrew, and spring pin
- 3-way wrench

Launchers
- 3A launcher
  - 3/8-inch Allen wrench
  - 7/32-inch Allen wrench
  - Dust cap
  - Launcher detent tester
- LAU-7/A launcher
  - Detent-wrench—safety pin
  - Dust cap

1-5.2 HANDLING EQUIPMENT. The following handling equipment is used in transporting the AIM-9B missile:

- Aero 12B bomb skid (short handles and extra-length handles)
- Aero 21A bomb skid
- Aero 30A vibration-isolation unit
- Aero 84A adapter
- Aero 8C-or Aero 8C-1 adapter
- Aero 9B package adapter

1-5.3 TEST EQUIPMENT. The following equipment is required in testing the launcher and aircraft:

- Guided Missile Launcher Test Set AN/ASM-11 or
- Guided Missile Launcher Test Set AN/ASM-20

1-6 REFERENCE DOCUMENTS

Documents covering the missile, launchers, and test equipment are given in table 1-1.

Table 1-1. List of Reference Documents

Identification	Date	Title
NAVAER 11-75A-504	15 Nov 1956	Aero 3A Missile Launchers and Pylon Assemblies; Operating and Servicing Instructions; Handbook
NAVWEPS 11-75A-26	1 May 1961	Guided Missile Launcher; Operating and Maintenance Instructions
NAVWEPS 16-1-529	1 July 1964	Radio Frequency Hazards Manual
NAVWEPS 16-30ASM-11-1	1 June 1964	Handbook; Operations and Maintenance Instructions, Test Set, Guided Missile Launcher AN/ASM-11
NAVWEPS 16-30ASM-20-1	15 Sept 1964	Test Set, Guided Missile Launcher AN/ASM-20; Operations and Servicing Instructions With IPB
NAVWEPS OD 12663	1 July 1964	Siderwinder 1A (AIM-9B), Performance Handbook
Aircraft Armament Change No. 200	22 Feb 1958	Aero 3A Guided Missile Launcher
Armament Material Bulletin No. 274	1 Oct 1960	Aero 3A Guided Missile Launcher Power Receptacle— Protector; Fabrication and Use
BUWEPS INSTR 8020.6B	8 Feb 1966	Accidents, Malfunctions, and Incidents Involving Non-Nuclear Explosive Ordnance and Materials.
BUWEPS INSTR 8810.2	7 Dec 1964	Air Launched Guided Missile Weapon System Performance Data Reports
BUWEPS INSTR 08810.1	14 June 1963	Air-Launched Missile Support

Chapter 2
OPERATION

2-1 GENERAL PRINCIPLES

A brief description of the general principles of operation of the system and of the sections of the missile is given in the following paragraphs. Aircraft-missile compatibility is listed in table A-3.

2-1.1 PREFIRING AND POSTFIRING SEQUENCE OF EVENTS. The following describes the sequence of events before and after missile firing.

After engine turn-up, aircraft generator power is furnished to the launcher power supply which provides 400-cycle, 115-volt AC current, 28-volt DC power, and B+, heater, and filament power.

A missile signal is fed into the audio amplifier in the power supply. A gyro speed of 70 cps will continue as long as the aircraft power is on, or until the missile is fired. When the missile is loaded on the aircraft, a simplified preflight check is performed with the master armament switch OFF (see volume 4 of this publication for simplified preflight check).

After takeoff, the master armament switch is placed in the ARM position, the station selector is set for the correct station to be fired, and the weapon selector switch is on SIDEWINDER or ROCKETS position.

The AIM-9B missile is considered to be within range of the target if the pilot can see the target. The aircraft is considered to be within the firing envelope if, in addition to the pilot hearing the audio signal, the firing aircraft can track the target with less than 1.6 g at 40,000 feet or above, or with less than 2 g below 40,000 feet. (For additional information on the 2 g rule, see appendix B of this publication; and for complete firing envelope information, see NAVWEPS OD 12663.) Assuming all of the foregoing flight conditions are met, the pilot will fire the missile, keeping the firing button depressed until the missile leaves the aircraft.

On missile firing, the following sequence of events occurs:

Initial impulse fires the squib of the servo grain only. As the servo grain burns, gas pressure is built up and is distributed through a manifold to the turbogenerator and to the servo pistons within the drive cylinders.

When the turboalternator is rotating with sufficient velocity to generate enough power to operate the missile on internal supply, a relay in the launcher power supply is closed, and 28 volts of aircraft power is supplied through the relay to the two firing pins of the launcher. The time to effect this is 0.8 second, maximum. If the sequence is interrupted before the relay is closed, the servo grain will continue burning, but motor firing will not occur and the missile will not leave the launcher. Continued burning of the servo grain on the aircraft does not cause any safety in-flight hazard.

If the sequence described is uninterrupted, the firing power is delivered simultaneously to the firing squib of the rocket motor and to the thermal battery of the influence fuze. The missile will then leave the launcher.

During missile acceleration, both fuzes are mechanically armed between 480 and 840 feet of the firing aircraft. The influence fuze is electrically armed following motor burn-out approximately 2000 feet from the firing aircraft. Power to the contact fuze is furnished by the alternator of the G&C section. Power for the influence fuze is furnished by the thermal battery.

A disabling circuit prevents any turn signal from being sent to the steering servos for the first 0.5 second of flight. This prevents overcontrol of the missile at relatively slow speeds.

At firing, the caging coil and motor drive coils are disconnected; the gyro is then free to precess to its limits in any direction necessary to track the target. The gyro coasts with no power during maximum flight time of the missile. Maximum burning time of the servo grain and, therefore, maximum guided flight of the missile is approximately 20 seconds. The warhead is exploded either on contact with the target, or, in the case of a near miss, by action of the influence fuze.

If the missile does not pass close enough to the target for fuze action, the warhead is exploded (self-destruct action) approximately 24 seconds from time of launch by a mechanical timing device which is initiated at launch.

2-1.2 GUIDANCE AND CONTROL SECTION. The G&C section performs two primary operations. First, the missile optical system, which is a space-stabilized gyro, observes angular deviations between the gyro axis (also the optical axis) and the line of sight to the target. As the line of sight moves off the gyro axis, a signal is generated by the tracking loop which precesses the gyro axis toward the line of sight. Second, the signal generated by the tracking loop is used, by a phase detector, magnetic-amplifier, and pneumatic torque-balance servo combination, to deflect the fins to produce a missile-flight-line turning rate three to five times greater than the gyro-axis turning rate and in the same direction. By this means the missile is brought to an intercept course in the manner of conventional proportional navigation.

2-1.1.1 Details of Tracking Loop. The infrared radiation from a 4-degree solid-angle cone including the sky and target is imaged by the optical system upon a rotating reticle, figure 2-1. By referring to figure 2-2, it can be seen that the radiant energy is filtered as a visible light and then transmitted to the lead sulfide (PbS) cell, which is sensitive to infrared energy. The resistance of the PbS cell is changed by the total infrared flux falling upon the cell face, and the cell therefore generates an alternating signal voltage output proportional to the modulation of the total flux. The PbS cell responds to signal variation

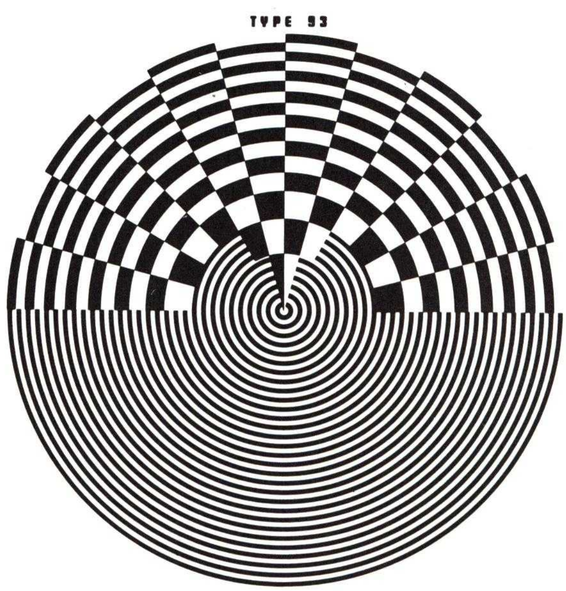
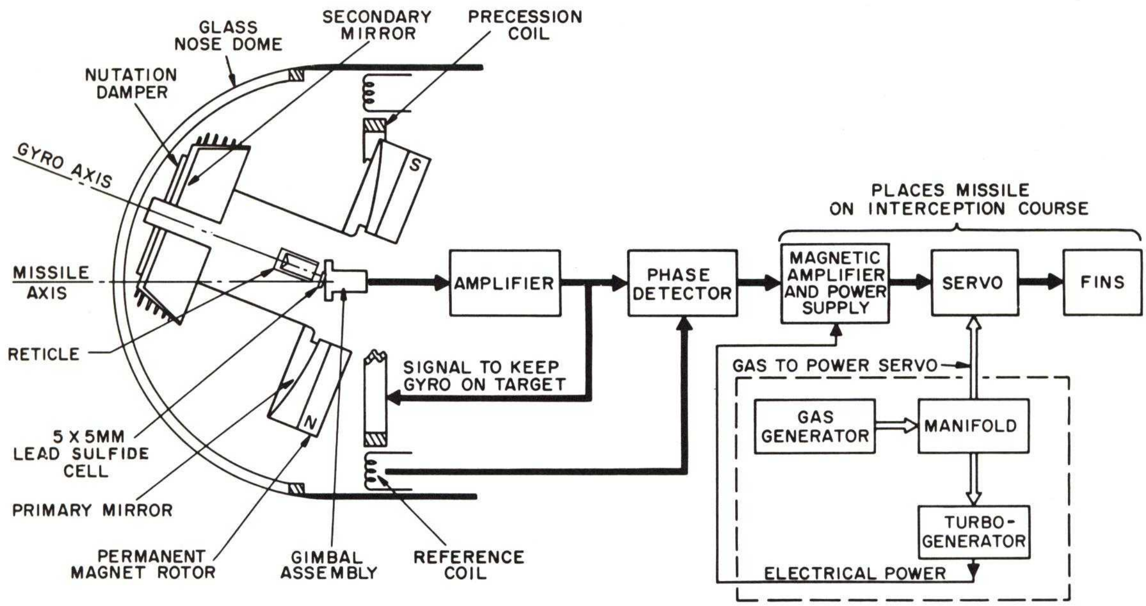


Figure 2-1. Typical AIM-9B Reticle Pattern.



NOTE: GYRO AXIS MAY BE OFFSET FROM MISSILE AXIS 0 TO 30 DEGREES

Figure 2-2. Tracking and Control Loops, Simplified.

with about a 300-microsecond time constant. As the target appears in the field of view, the target has, in general, a different total radiation as compared to the radiation from the sky background which has been blocked by the target. Thus, as the target image pops in and out of the transparent slits, a pulse signal is generated by the cell because of the change in total infrared flux introduced by the contrast of the target. The pulse signal is amplified and fed directly to precession coils concentric with the missile axis. By proper angular orientation between the reticle and a magnet carried on the gyro motor, a phasing compensation is introduced so that the gyro axis is automatically precessed properly in the direction of the line of sight. This method of precession is independent of the missile coordinate system, and the gyro will track properly even if the missile rolls.

The gyro-optical system of the G&C section has a set of internal gimbals, and the rotating optical assembly is supported by these gimbals. The gimbal system permits more positive mechanical decoupling of the gyro and optical assembly from the remainder of the missile. The PbS cell is mounted on the inner gimbal, which precesses with the optical elements, and is so positioned on the gimbal that the plane of the cell surface is always kept perpendicular to the optical axis. Because of this feature, a 5- x 5-mm cell is used. The leads from the cell extend through the center of the gimbal assembly. Since the inner gimbal and the cell do not spin with the rotor, no slip rings are necessary.

2-1.1.2 Details of Missile Control Loop. A simplified control loop, as well as tracking loop, is shown in figure 2-2. The target signal generated by the gyro tracking loop is fed from the electronic amplifier into two phase discriminators. Simultaneously, the rotating gyro magnet generates signals in the reference coils which are mixed, in the phase detectors, with the target signal. The resulting rectangular components of the target signal control the deflections of the two fin pairs. This result is achieved by pairs of push-pull magnetic amplifiers which control the currents in opposite pairs of solenoid valves of the servo. With this system, requirements for absolute roll-position control are eliminated from the missile, inasmuch as the reference coils roll rigidly together with the control fins.

The servo, figure 2-3, is powered by hot gas produced from a slow-burning, solid-propellant grain. The hot gas is fed into a manifold, which in turn supplies gas through four 0.019-inch metering orifices into four cylinders. Opposite fins are joined together by crossarms and are controlled by opposing pairs of pistons

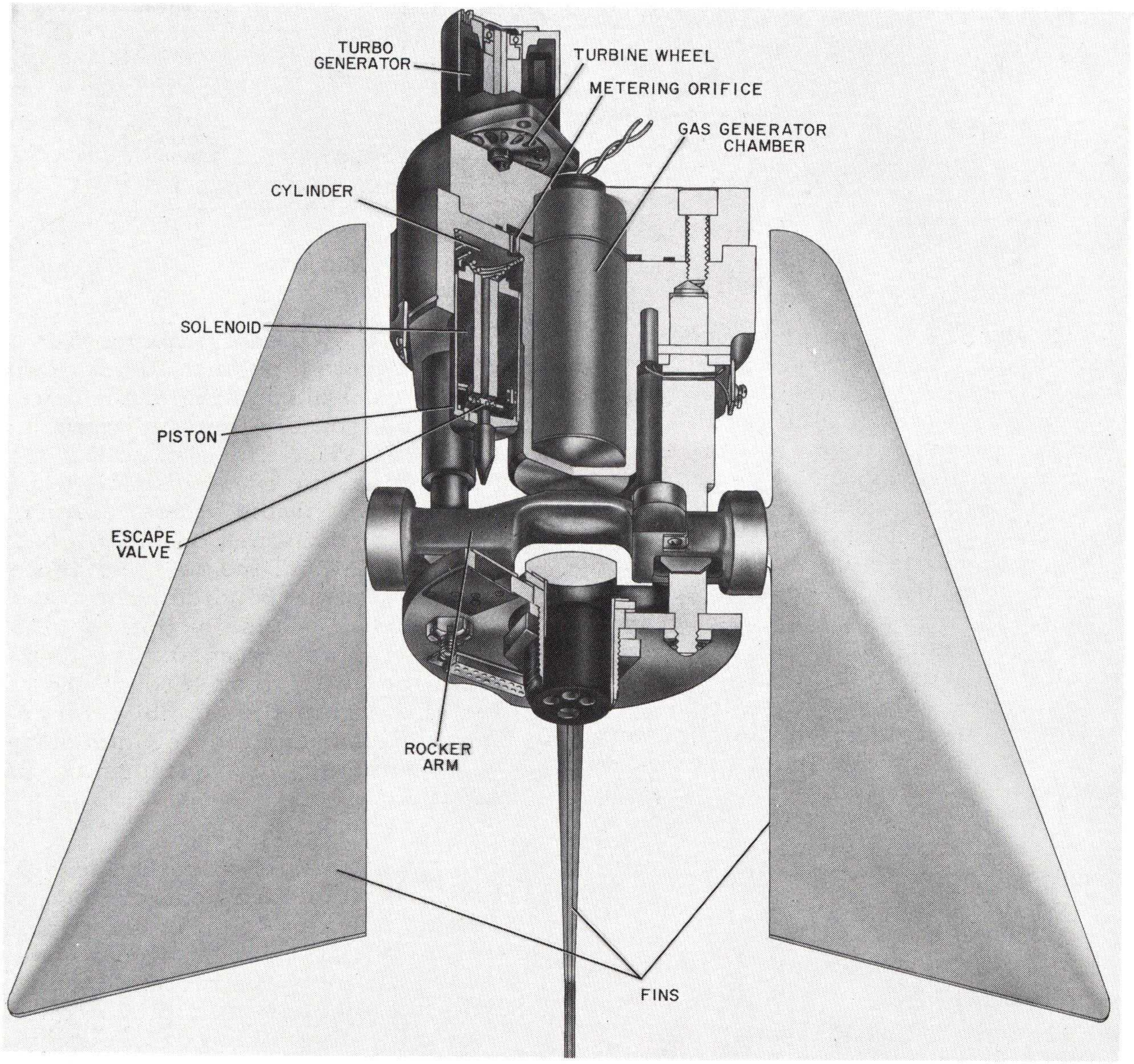


Figure 2-3. Pneumatic Control Servo and Turbogenerator.

in the cylinders. The piston pairs operate differentially in a push-pull arrangement. Gas flow through the metering orifices is sonic and remains constant, regardless of the pressure within the cylinders. Gas is permitted to escape from each cylinder through an orifice covered by a cup valve. The outlet orifice and valve are located in the piston, which also houses a solenoid coil. The valve is acted upon by a magnetic control force which is generated by the signal currents flowing in the solenoid. The magnetic force closes the valve and holds it closed until the gas flowing into the cylinder raises the pressure enough to open the valve and exhaust the cylinder. At equilibrium, the valve permits as much gas to flow out of the cylinder as flows into the cylinder. If the pressure in the cylinder is too low, the valve closes and remains closed until the pressure rises to its equilibrium value; if the pressure is too high, the valve opens and remains open until the pressure falls to its equilibrium value. Because of the push-pull arrangement of the pistons and differential currents in the opposite pairs of solenoids, the torque exerted by the pistons on the fins becomes a linear function, within limits, of the difference in the currents through the solenoids.

The servo is a torque-balance system capable of exerting up to 800 inch-pounds of control torque. The difference in solenoid currents causes a pressure unbalance in the affected cylinders. The fins are then deflected in the airstream until the servo torque is balanced by the opposing aerodynamic forces.

In such a control system, automatic altitude compensation is incorporated into the control loop of the missile without requiring programmed electronic-gain changes in the amplifier or fin position control. Because of the elimination of these two requirements, the problems of drift, gain calibration, and stability associated with DC amplifiers, pressure transducers, feedback control systems, etc., are not present in the torque-balance control system. Moreover, sensitivity of the control system to airframe elasticity is eliminated, since the fins naturally assume the angle relative to the airstream required to generate the called-for aerodynamic lift forces. Besides being highly reliable because of the small number of components required, this control system can be easily and cheaply manufactured in large numbers, by virtue of the relatively wide tolerances permissible on the various parts of the pneumatic servo as compared to the tolerances of corresponding components in a hydraulic servo.

2-1.1.3 Generator. The electrical generator, also shown in figure 2-3, is a small, efficient, high-frequency turboalternator driven by hot gas from the gas generator through the servo manifold. The voltage and frequency outputs of the generator are regulated by a passive-tuned regulating circuit. The high-frequency alternating generator power is used directly in the magnetic amplifier circuits and also is rectified to supply B+ and filament power for the electronic amplifier circuits. The generator supplies a total power of approximately 50 watts to the missile and has approximately 300 percent reserve capacity.

2-1.3 WARHEAD. The Warhead Mk 8 produces about 1300 high-velocity (6000 feet per second) fragments. The lethal radius of the warhead is about 30 feet. The fragments are capable of penetrating 3/8-inch steel plate at this radius. The warhead can be detonated by either the contact or influence fuze. A cutaway of the warhead and the contact fuze (with booster) is shown in figure 2-4.

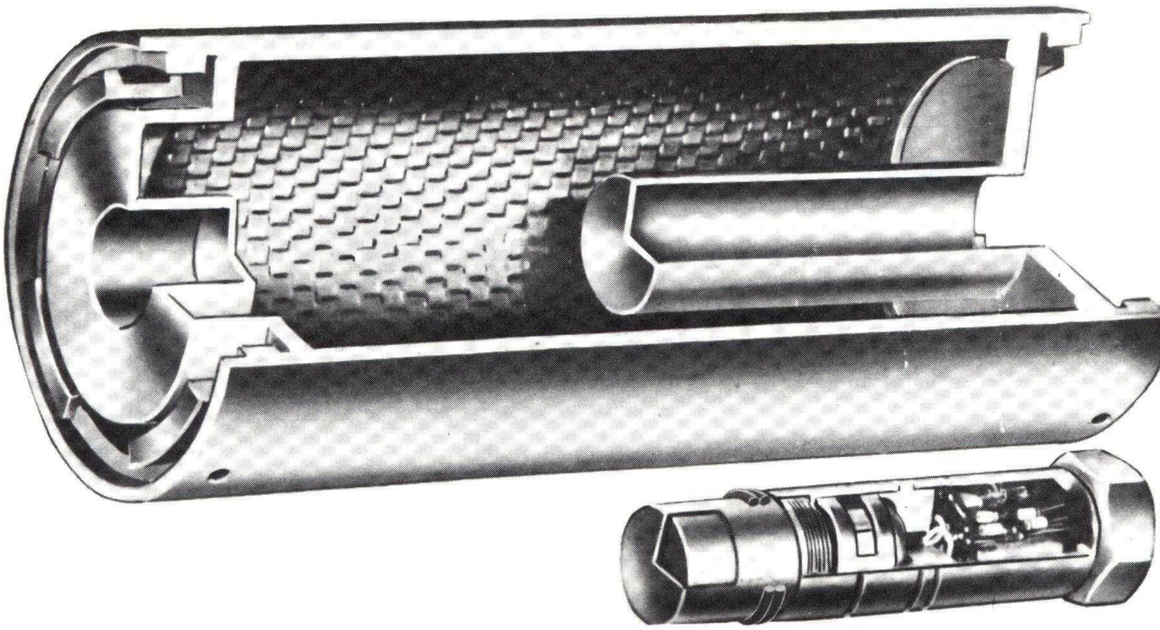


Figure 2-4. Warhead and Contact Fuze (With Booster), Cutaway.

The Mk 2 exercise warhead is similar in weight and configuration to the Mk 8 warhead and may be used against drones and target rockets.

2-1.4 CONTACT FUZE. The Mk 304 contact fuze with the Mk 35 Mod 0 booster is used in the AIM-9B missile. The Mod 2 is similar to the Mod 1 contact fuze in physical appearance, but it has a one-piece case design. Safety during handling and in use is assured by the incorporation of two different safety devices. The pyrotechnic firing train is interrupted by an escapement-type mechanism which can be armed only by a strong, prolonged acceleration. The contact fuze does not receive power until the turbogenerator within the missile has reached operating speed and until the safety short in the umbilical block has been broken by the missile launching.

The method of actuation of the contact fuze is by means of a piezoelectric (barium titanate) crystal. A crystal is mounted to each rocker arm of the G&C section. When the missile strikes the target, the shock to the rocker arm causes the crystal to generate a voltage. This voltage triggers the firing thyratron in the contact fuze, resulting in instantaneous detonation of the warhead.

2-1.5 INFLUENCE FUZE. A Mk 303 Mod 2 or Mod 3 influence fuze, containing a Mk 34 Mod 1 booster, is installed in the AIM-9B missile. The basic safety and arming device of this fuze consists of a mechanical arming section, which arms between 480 and 840 feet from the launch aircraft and an acceleration switch which initiates electrical arming of the fuze at motor burnout, approximately 2000 feet in front of the launch aircraft.

The power necessary to operate the influence fuze is supplied by a thermal battery internal to the fuze. The battery can supply no power until a firing pulse is transmitted from the aircraft launcher to the front contact button on the missile.

The influence fuze will function and detonate the warhead if the missile fails to make a direct hit on the target, but passes within 30 feet.

Neither fuze will mechanically arm if the missile malfunctions. Although the fuzes may be supplied with internal power, the basic mechanical safety and arming device will prevent arming of the missile while it is on the aircraft. The A-section internal power of the Mk 56 Mod 1 battery (in the Mk 303 fuze) expires after approximately 30 seconds, preventing operation of the firing circuit beyond this time even though the other battery sections last for a longer period of time. Fuzes involved in malfunctions should be labelled and returned to a Naval Weapon Station (NWS) since the battery is likely to have been expended.

2-1.6 MOTOR. The Rocket Motor Mk 15 or Mk 17 provides a nominal impulse of 8440 pound-seconds with a 2.2-second burning time at 70°F.

2-2 MISSILE PERFORMANCE

The missile performance under typical conditions is as follows:

Speed: The missile will be given an incremental speed of approximately Mach 1.5, depending upon the altitude, above that of the firing aircraft.

Range: 28,000 feet at 50,000-feet altitude at Mach 1.2 launch and Mach 0.9 target; 6000 feet at sea level at Mach 1.2 launch and Mach 0.9 target.

Maneuver capability: 2.7 g at 60,000 feet and missile speed of Mach 2.3; 4.2 g at 50,000 feet and missile speed of Mach 2.3; 10 g at sea level.

Effective control system: Time constant, 0.25 second (maximum)

Appendix A

MISSILE COMPONENT AND AIRCRAFT COMPATIBILITY

Table A-1. Identification and Modification Characteristics of G&C Section Mk 1

Mod No.	Description of Modification
0	None
1	1. Servo actuation time, 21 seconds 2. Gyro seeker gimbal bearing replaced spherical-type bearing 3. Launch disabling of 0.5 second
2	1. Barium titanate crystals replaced fin contact strip
3	1. Filter in servo cylinders
4	1. Three parallel resistors removed from magnetic amplifier power supply for load regulation 2. A single load resistor added to servo
5	1. Desiccant dehydrator 2. Positive dome retention
6	1. Modified precession amplifier-preamplifier (6222 tube, plastic housing) 2. Current regulating transformer 3. Modified seeker head with new backplate to accept new preamplifier 4. Mercury-thallium damper
7	1. New cell specification 2. Modified precession amplifier 3. Rearrangement of components of magnetic amplifier 4. New improved fulcrum bearing (GE only)
8	1. Incorporation of new servo containing skin-type exhaust valve (Philco RP-30), resistive network in wiring harness replaced current limiting XMFR (GE RP-34) and heat limiter, an itegral part of manifold plate 2. Magnetic amplifier circuit changed to improve disabling time (GE RP-33) [Note: Concurrent with mod change, but no effect on mod in itself.]
9	1. Rehabilitation of the Mods 1 and 2 to include the following: a. New gimbal assembly (NOTS RP-12) b. Positive dome retention and desiccant c. NOTS XS-200 AC generator d. Rocker arms with fin fuze crystals (on Mod 1 only) e. Harness includes resistive network f. Soft cager and photoelectric cell and glass damper g. Filament rectifier change h. New silicone rubber boots i. Lower temperature thermostatic switch

Table A-1. (Contd.)

Mod No.	Description of Modification
10	1. Rehabilitation of the Mod 3 to include the following: a. New gimbal assembly (NOTS RP-12) b. Positive dome retention and desiccant c. Piston pointer clips (Philco RP-29) d. NOTS XS-200 AC generator e. Harness modification includes resistive network f. Soft cager and photoelectric cell and glass damper g. Filament rectifier change h. New silicone rubber boots i. Lower temperature thermostatic switch
11	1. Rehabilitation of the Mods 4 and 5 to include the following: a. New gimbal assembly (NOTS RP-12) b. NOTS XS-200 AC generator c. Harness modification includes resistive network d. Piston pointer clips (Philco RP-29) e. Positive dome retention and desiccant on Mod 4 only f. Soft cager and photoelectric cell and glass damper g. Filament rectifier change h. New silicone rubber boots i. Lower temperature thermostatic switch
12	1. Rehabilitation of the Mod 6 or 7 with blade fulcrums in servo to include the following: a. New gimbal assembly (NOTS RP-12) b. NOTS XS-200 AC generator c. Resistive network replacing current limiting transformer d. Piston pointer clips (Philco RP-29) e. Soft cager and photoelectric cell f. Filament rectifier change g. New silicone rubber boots h. Lower temperature thermostatic switch
13	1. Rehabilitation of the Mod 6 or 7 with sleeve fulcrums in servo to include the same modifications as the Mod 12 above
14	1. Rehabilitation of the Mod 8 to include the following: a. New gimbal assembly (NOTS RP-12)
	New Production
14	Serial nos. G-21270 through G-35513
15	1. New PbS cell assenbly 2. New seeker backplate 3. New PI noise under vibration

Table A-2. Rocket Motor Mod Differences

Rocket Motor Mk 15	
Mod 0	Plain wings without rollerons
Mod 1	Canted-hinge rollerons
Mod 2	Canted-hinge rollerons and HERO fix
Rocket Motor Mk 17	
Mod 0	Plain wings without rollerons
Mod 1	Straight-hinge rollerons[a]
Mod 2	Inert or dummy motor
Mod 3	Canted-hinge rollerons
Mod 5	Canted-hinge rollerons and HERO fix

[a] For Mk 17 motors only.

Table A-3. Aircraft-Missile Compatibility

Aircraft	No. of Missiles
A-4	2
A-6	2
A-7	2
F-4B	4
F-8	2, 3, or 4 (depending on pylon used)

Appendix B

AIM-9B (SIDEWINDER 1A) 2-g RULE; ITS MEANING AND APPLICATION

Several misconceptions have arisen concerning the AIM-9B (Sidewinder 1A) 2-g rule. The rule was developed when the firing envelopes for this missile were determined (see NAVWEPS OD 12663).

The volume of space relative to a given target from which an attacker at a given speed can launch a kill is called the missile envelope. The size and shape of the envelope are determined once the two aircraft speeds and the altitude of the target are specified. A study of the envelopes showed that a pursuit-flying aircraft which was within the appropriate envelope was always pulling less than 2 g (below 40,000 feet) or 1.6 g (above 40,000 feet), and one which was pulling more than 2 g was almost always outside of the envelope boundary. This meant that a conservative or safe rule could be given to those pilots who had no envelope computers in their aircraft. Incidentally, the computers work on about the same principle since the aircraft radar cannot determine angle-off-the-tail directly either. The rule does not, of course, exactly fit the envelopes for all possible combinations of aircraft speeds and altitudes, but it represents a best, conservative compromise and should be regarded as such.

The following are among the more prevalent misconceptions that have been assumed to follow from the 2-g rule:

1. The AIM-9B (Sidewinder 1A) missile cannot pull more than 2 g (or 1.6 g above 40,000 feet altitude) in navigating to its target.

False. The missile can pull as much as 10 or 12 g, depending on altitude, etc. The 2-g rule has nothing to do with this.

2. The 2-g rule applies to all missiles of the Sidewinder family.

False. The 2-g rule is a device which was tailor-made to match the AIM-9B (Sidewinder 1A) performance envelope only.

3. The pilot must take care not to pull more than 2 g while flying an aircraft with an AIM-9B (Sidewinder 1A) missile aboard. If he does, the missile will be damaged or its performance adversely affected in some way.

False. The 2-g rule has nothing to do with the environment of the missile, except during the launching phase itself—nor has it anything to do with the structural capacity of the launcher, etc.

4. The missile must not be launched if the carrying aircraft is pulling more than 2 g (or 1.6 g at high altitudes). A missile launched under these conditions will always fail to reach and kill the target.

False. It is, indeed, possible to achieve a hit with the AIM-9B (Sidewinder 1A) while pulling a relatively large number of g's at launching. This is a kind of "shooting from the hip" that sometimes works, but it is not recommended for those who want to achieve good scores. This is because the high g's imply that the pilot is not tracking the target for very long in ascertaining the adequacy of the infrared signal. The best way to be sure of the signal is to track the target for a few seconds, thus flying a pursuit course. If the tracker is anywhere except dead astern of the target, he will have to pull some g's to fly the pursuit course. The farther he is from being dead astern (other things remaining equal), the more g's he will have to pull. In other words, there is a direct relationship between angle-off-the-tail and g's necessary to track. If the pursuer does not track, the entire relationship, which is the one on which the 2-g rule rests, collapses, and the 2-g rule is not applicable. The g's, in themselves, are nothing. It is the rough proportionality of g's to angle-off-the-tail while tracking that makes g's a factor in Sidewinder launching doctrine.

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