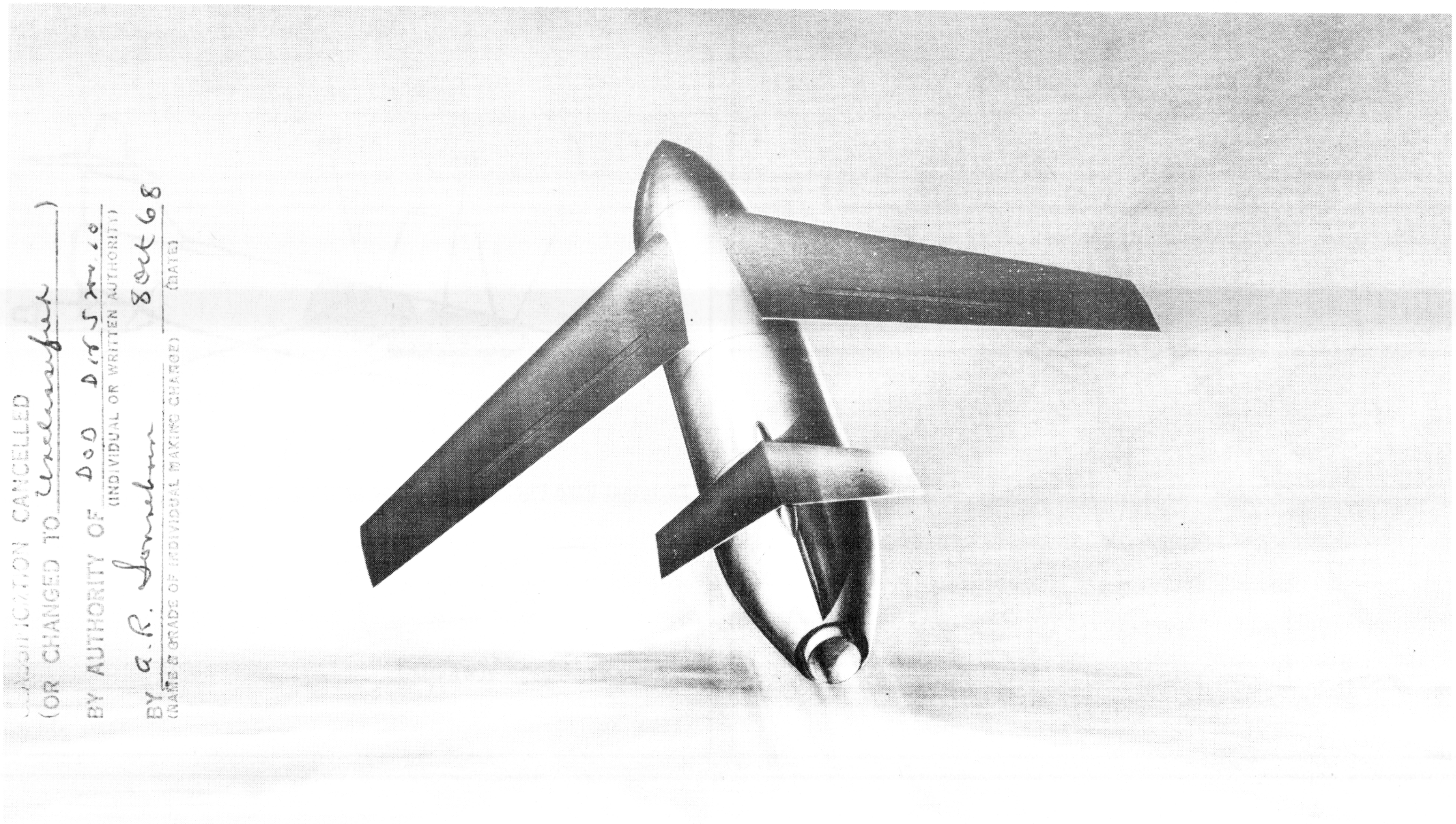


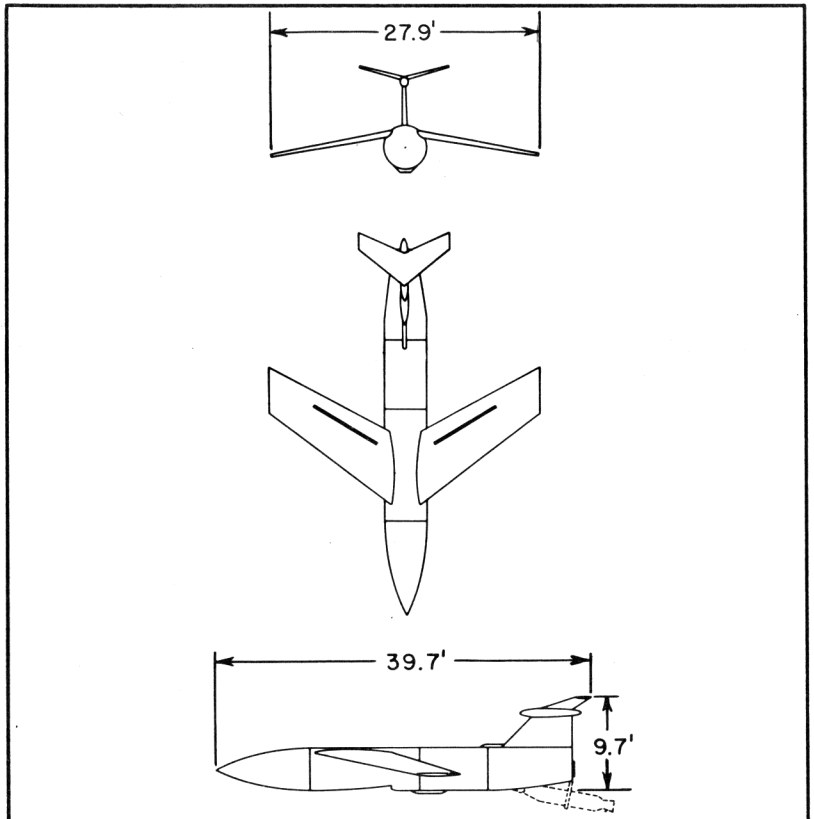
Standard Missile Characteristics

BY AUTHORITY OF
THE SECRETARY
OF THE AIR FORCE

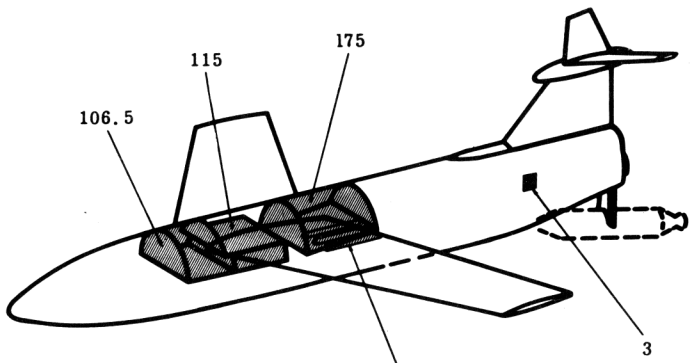
TM-61A & C
MATADOR
MARTIN

ONE J33-A-37
ALLISON

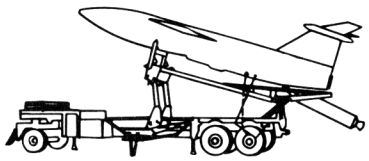
4 SEP 56



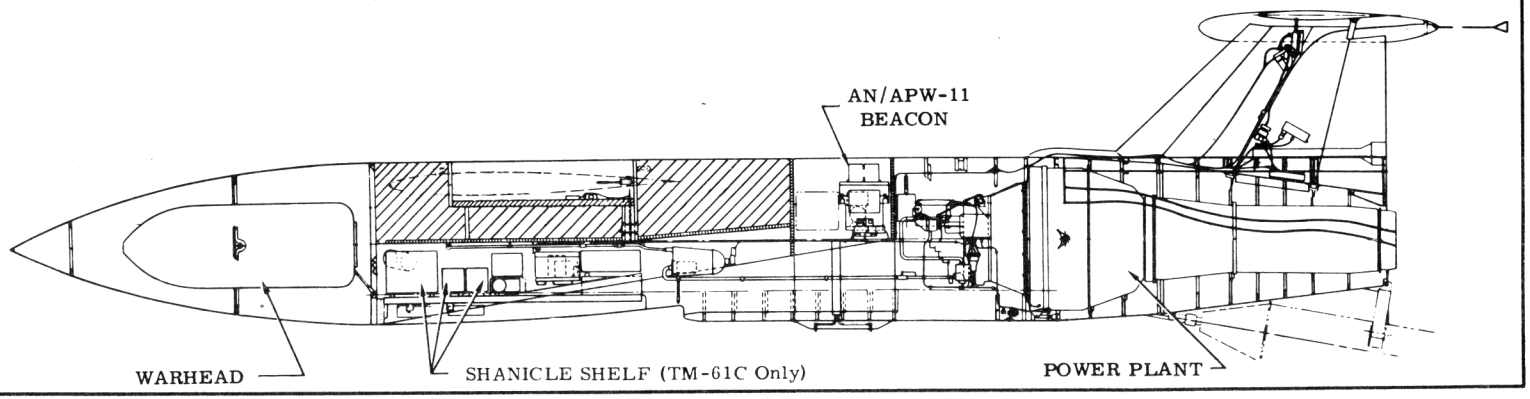
Wing Area . . . . . 176.719 sq ft
Aspect Ratio. 4.406
Wing Section 63-A-008
M.A.C. . . . . 77.583 in



Terminal Dive Fuel 4.8 gal (three bottles)



Fuel (Gal) Oil (Gal)



POWER PLANT

Nr. & Model . . . . . (1) J33-A-37
Mfr . . . . . Allison
Engine Spec Nr. 318-C
Type . . . . . Centrifugal
Length . . . . . 159.5"
Diameter . . . . . 49.3"
Weight (dry) . . . . . 1790 lb

BOOSTER

Nr. & Model . . . . . (1) T-50
Mfr . . . . . Picatinny Arsenal
Engine Spec Nr. . . . . ---
Weight (loaded) . . . . . 1675 lb

ENGINE RATINGS

S. L. Static	LB	-	RPM	-	MIN
Max:	4600	-	11,750	-	5
Mil:	——	-	——	-	——
Nor:	4600	-	11,750	-	Cont

BOOSTER

S. L. Static	LB	-	SEC
Nominal:	57,000	-	2.4

Mission and Description

Navy Equivalent: None Mfr's Model: ---

The TM-61A and TM-61C are surface launched tactical missiles. The principal mission of these vehicles is the destruction of surface targets while under the direction of automatic guidance.

The configuration and aerodynamic characteristics of both vehicles are essentially identical. The Matador has a shoulder-type, swept wing and a "T" type tail. Use of honeycomb structures has made the construction of thin smooth contour surfaces for both the wing and tail possible. The fuselage is of monocoque construction with a flush type air inlet. The warhead is located in the nose section, while the guidance equipment is in the fuselage center section. The power plant is installed in the aft section of the vehicle and the automatically ejected booster rocket is installed externally in this section.

Lateral control is maintained by finger type spoilers located on the upper surface of the wing. An all movable stabilizer is employed for pitch control. The control system is of the electrical-hydraulic type. It is composed essentially of a Martin unattended gyro type stabilized autopilot whose principal of operation lies in the utilization of signals from displacement gyros and control surface position feedback. This system stabilizes the missile in pitch, roll and yaw. In addition, acceleration, climb and cruise phases are programmed and heading is adjusted in accordance with guidance signals. The guidance signals are furnished to the control system from either audio-modulated sources from AN/MSQ-1-AN/APW-11A radar or corrected commands from airborne SHANICLE equipment.

The significant difference of the TM-61C version from the TM-61A is the addition of SHANICLE hyperbolic mid-course guidance system equipment. The airborne components for the SHANICLE equipment are installed on a shelf in the fuselage center section.

Development

Matador Project Initiated . . . . . Aug 45
First flight (XSSM-A-1) . . . . . 19 Jan 49
TM-61A (MARC Guidance). 133 launched Nov 52 to Jul 55 (flights continuing)
TM-61A-1st USAF launch . . . . . Mar 53
YTM-61C (Operational Suitability Testing). 9 launched 14 Oct 54 to Oct 55
TM-61C-1st launch . . . . . Jan 56

WEIGHTS

Loading	Lb
Empty	9203(A)
Design	12,748
Launch	13,593(A)
1st Motion	13,462
Terminal	9334

(A) Actual

FUEL

Location	Nr. Tanks	Gal
Fus, Ctr	3	396.5
Fus, Ctr (Dive Tanks)	3	4.8
Fus, Ctr (Sump)	1	3.5
		Total 404.8

Grade JP-4
Specification MIL-F-5624

OIL

Fus, Aft 3
Grade 1010
Specification MIL-O-6081

DIMENSIONS

Wing
Span . . . . . 27.9'
Incidence . . . . . 0°
Cathedral . . . . . 10°
Sweepback (25% Chord) . . . 35°
Length . . . . . 39.7'
Height . . . . . 9.7'

GUIDANCE

(a) INITIAL: Fixed bias pitch control plus programmed Air Speed control
(b) MID-COURSE: MARC (AN/MSQ-1 radar track; AN/APW-11A airborne beacon)(TM-61A)---MARC plus SHANICLE hyperbolic (TM-61C)
(c) Programmed, semi-ballistic, zero-g dive

CONTROL
see Mission and Description block

CEP*
Design . . . . . 1500 ft
TM-61A(at 165 n. mi.) . . . 2700 ft
TM-61C(at 165 n. mi.) . . . 1750 ft
*Varies with range and guidance orientation.

LAUNCHING

Launched from a mobile, "zero-length" launcher with solid rocket boost.

WARHEAD

Type . . . . . General Purpose or Special
Weight (lb) 3000

FUZE
General Purpose . T1400 or T1402
or
Special . . . . Airburst or Impact

Electric Motor employed for arming any of above type fuzes.

Loading and Performance — Typical Mission

CONDITIONS ①		DESIGN MISSION
		1
LAUNCH WEIGHT	(lb)	13,593
Fuel (JP-4 6.5 lb/gal)	(lb)	2632
Payload	(lb)	3000
Wing loading	(lb sq/ft)	77
Launching Distance	(ft)	0
Launching Time	(sec)	2.4
Initial Rate of Climb	(ft/min)	4900
Initial Cruise Altitude	(ft)	43,049
Time to Climb to Cruise Altitude	(min)	23
Climb Distance	(n. mi)	157
CRUISE ZONE		
Cruising Mach No./Speed	(M/kn)	.89/512
Distance	(n. mi)	443
Final Altitude	(ft)	44,200
TERMINAL		
Gross Weight	(lb)	9334
Terminal Altitude	(ft)	44,200
Distance	(n. mi)	6.6
Time to descend to SL	(sec)	61
Max Rate of Gyro Precession in Pushover	(Deg/Sec)	3
Impact Speed ②③	(Mach)	.97
Total Range ④⑤⑥	(n. mi)	600
Total Mission Time	(hr)	1.25

NOTES

FORMULA

Pre-launch: Missile count down takes place at the launch site. External power is turned on for the last few minutes for check-out of controls and guidance. At X minus three minutes the engine is started and kept at idle (60% rpm) until X minus 30 seconds. Full military power is applied for the final 30 seconds of count-down.
Launch: The missile is launched from a zero-length launcher. Longitudinal control is maintained by a fixed bias pitch controller. When airspeed reaches 183 knots, an airspeed switch closes, introducing an airspeed system. Launch bias fades out over a period of approximately 100 seconds and an airspeed loop with a climb-cruise bias phase in. Directional gyro guides the missile in this phase.
Climb-Cruise: By the end of airspeed control change-over, the missile is at an altitude of about 5000 feet. Airspeed in climb is controlled by a fixed-reference dynamic pressure of 220 pounds per square foot. Since the system is non-integrating, the airspeed exceeds the fixed-reference figure up to approximately 44,000 feet, which is the trim altitude reached near end of mission. Overall guidance of the missile is assumed by either the MARC or SHANICLE systems during this phase of the mission.
Terminal Dive: A transonic dive to target begins at a dump point indicated by the mid-course guidance system. Gyro precession varies so that lift will average zero throughout dive. An accelerometer loop senses and corrects for any divations from the prescribed zero-lift trajectory. At dive initiation the throttles reduced to idle, but a barometric override delays engine response until an altitude of approximately 15,000 feet is reached.

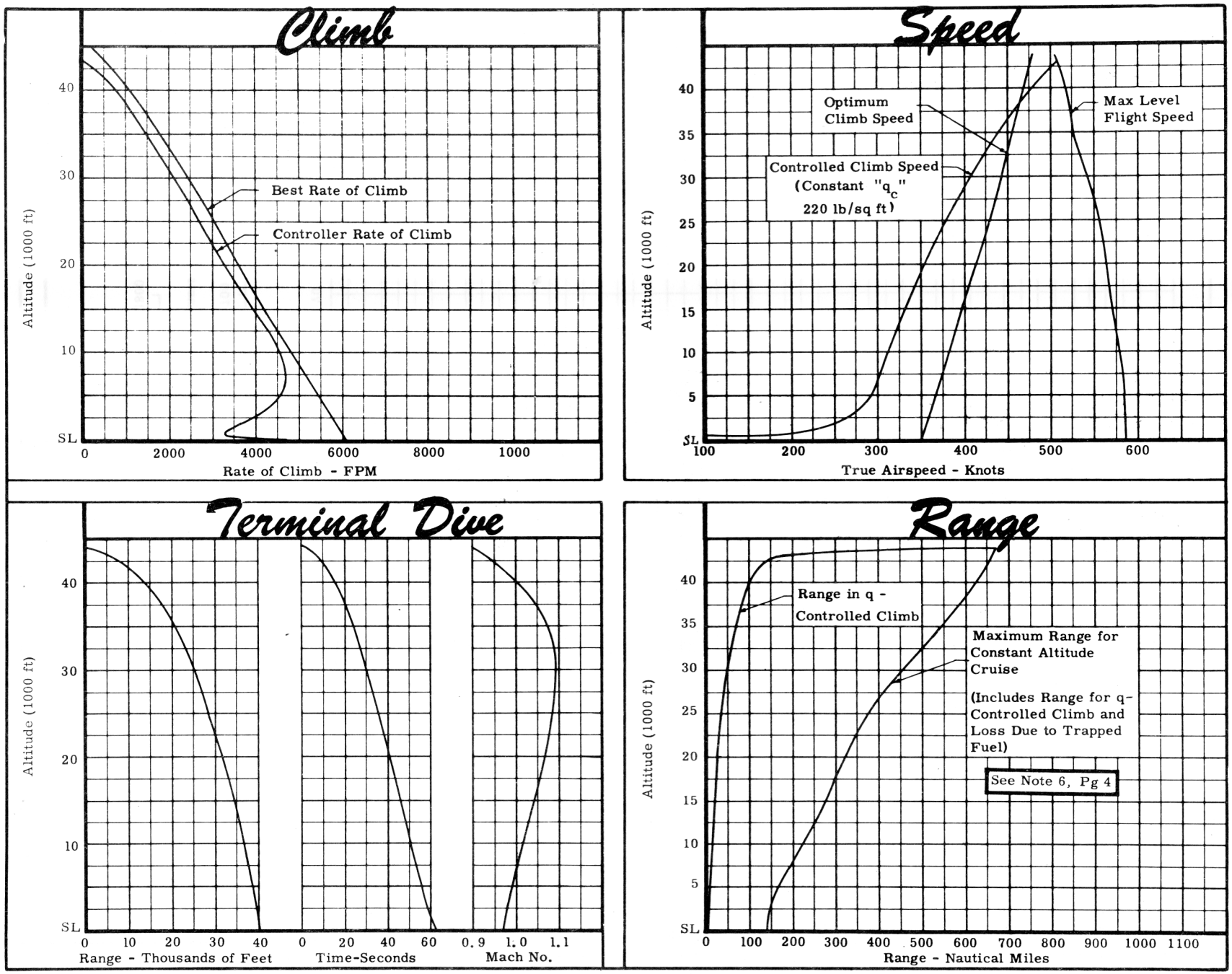
PERFORMANCE BASIS:
Calculated data based on Wind Tunnel data and Preliminary Flight Tests.

PERFORMANCE REFERENCE:
Glenn L. Martin Engineering Report 7371 dtd 15 Jun 1955.

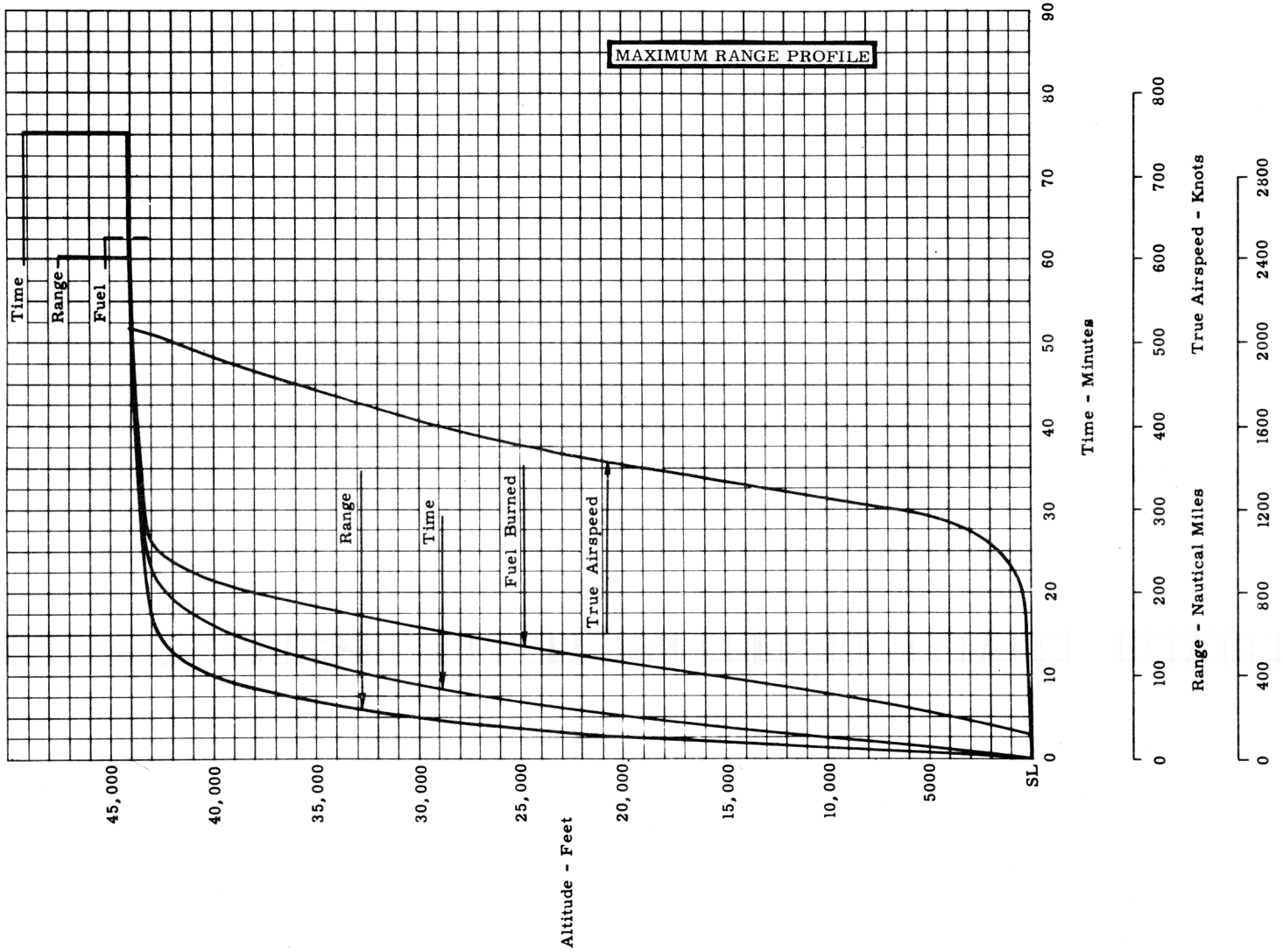
REVISION BASIS:
To combine TM-61A and TM-61C brochures, revise characteristics, and add performance data.

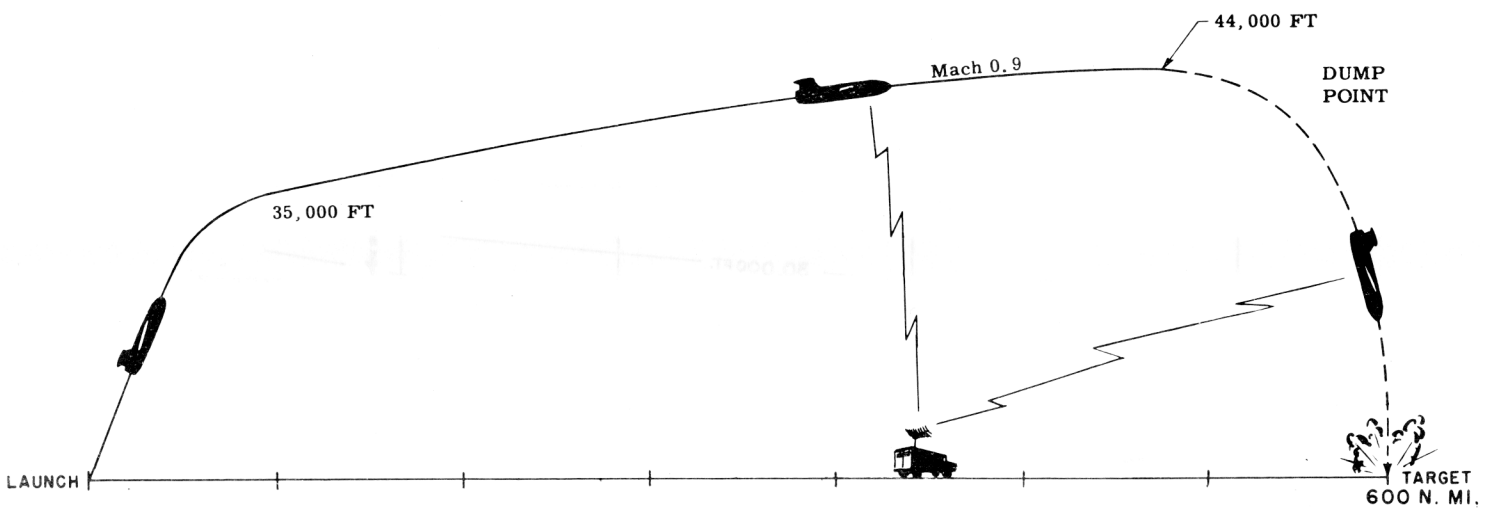
NOTES

① All phases of flight except terminal dive conducted at Military Power
② Min Idle (60%) Power
③ Max Mach Number in dive is 1.1-- Impact Angle approximately 71°.
④ Maximum Guidance Range using MARC equipment is limited to 175 n. mi.
⑤ Maximum Guidance Range using SHANICLE equipment is limited to 220 n. mi.
⑥ Range plot on page 5 presents an optimum std day range of 666 n. mi. compared with the 600 n. mi. specified value on pages 4 and 6. For planning purposes, 600 n. mi. should be used as range of the missile considering tolerances in the control system, etc would amount to a maximum of 10% of the optimum std day range of 666 n. mi.


Climb
Altitude (1000 ft)
40
30
20
10
SL
Best Rate of Climb
Controller Rate of Climb
0
2000
4000
6000
8000
1000
Rate of Climb - FPM
Speed
Altitude (1000 ft)
40
35
30
25
20
15
10
5
SL
Optimum Climb Speed
Max Level Flight Speed
Controlled Climb Speed (Constant "qc" 220 lb/sq ft)
100
200
300
400
500
600
True Airspeed - Knots
Terminal Dive
Altitude (1000 ft)
40
30
20
10
SL
0
10
20
30
40
Range - Thousands of Feet
0
20
40
60
Time-Seconds
0.9
1.0
1.1
Mach No.
Range
Altitude (1000 ft)
40
35
30
25
20
15
10
5
SL
Range in q - Controlled Climb
Maximum Range for Constant Altitude Cruise
(Includes Range for q-Controlled Climb and Loss Due to Trapped Fuel)
See Note 6, Pg 4
0
100
200
300
400
500
600
700
800
900
1000
1100
Range - Nautical Miles

SUPPLEMENTAL





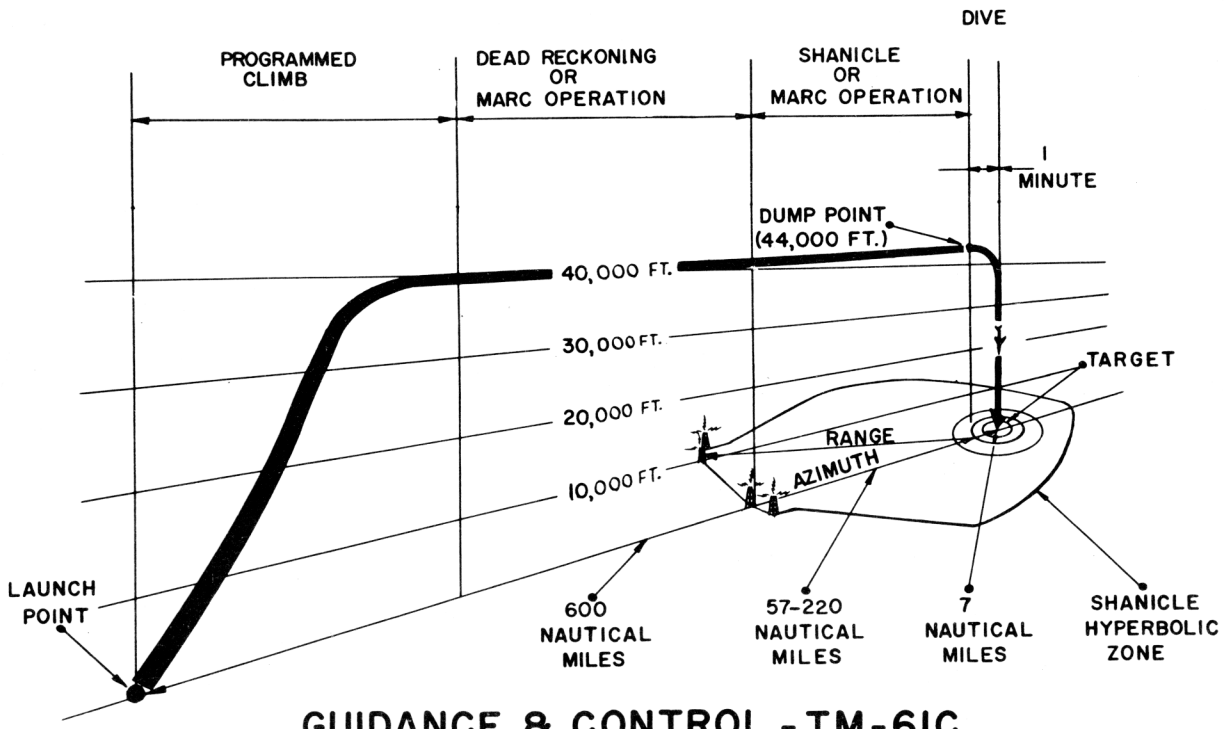
GUIDANCE AND CONTROL - TM-61A

LAUNCHING PHASE
The missile is launched from a zero-length launcher. Longitudinal control is maintained by a fixed bias pitch controller. When airspeed reaches 183 knots an airspeed control system is phased into operation. The missile climbs under programmed airspeed control to an indicated dynamic pressure of approximately 220 lb/sq ft. The airspeed control period lasts until radar contact with the MARC guidance equipment for mid-course flight.

MID-COURSE FLIGHT
The TM-61A utilizes the MARC guidance system (Ground Radar Set AN/MSQ-1 and airborne Radar Set AN/APW-11A) for mid-course guidance. The AN/MSQ-1 ground based mobile equipment tracks the missile through the use of the airborne AN/APW-11A beacon. In addition, proper commands are developed either automatically or manually in the MSQ-1 equipment and sent over the radar link to the beacon and thence to the flight control system in order to control position.

TERMINAL DIVE
A semi-ballistic transonic dive begins at the "dump" point predicted by the MARC mid-course guidance equipment. When "dump" is signaled, the terminal dive system produces signal voltages which cause the engine to be throttled to idle, the warhead to start its fuzing operation, and the fuel system to be switched to terminal dive condition. Gyro precession with accelerometer corrections assures that the zero-lift trajectory is maintained until impact.

NOTE: Line-of-sight limitations to microwave propagation restricts the TM-61A with MARC guidance to 175 nautical mile range ahead of the AN/MSQ-1 equipment.



GUIDANCE & CONTROL - TM-61C

LAUNCHING PHASE
The guidance mode for the launching phase is the same as for the TM-61A and lasts until a pre-determined point where one of three alternate mid-course guidance systems assumes control.

MID-COURSE PHASE
At the discretion of the launching agency, any one of three possible modes of mid-course guidance may be selected. The systems available are SHANICLE, MARC, or a combination of the two. If the SHANICLE hyperbolic system is employed for the mid-course, the missile is programmed into the SHANICLE zone. Four base stations (consisting of antenna towers and transmitting equipment) generate two families of LORAN-type constant-time differential hyperbolic signals; one family for azimuth guidance, and one family for range guidance. Airborne equipment measures the time of arrival of these signals and issues corrective commands to the controls in the missile. The missile is guided along the azimuth hyperbola until it crosses the intersecting range hyperbola, at which time the terminal dive is initiated. If the MARC system is selected, the missile is controlled from the ground based mobile transmitter until arrival at the dump point or may be flown into the SHANICLE zone where the SHANICLE system assumes control until terminal dive. While operating under SHANICLE guidance the missile emits no signal.

TERMINAL DIVE
The terminal dive phase is conducted in the same manner as the TM-61A.

REVISION BASIS: Data recoordinated this date.