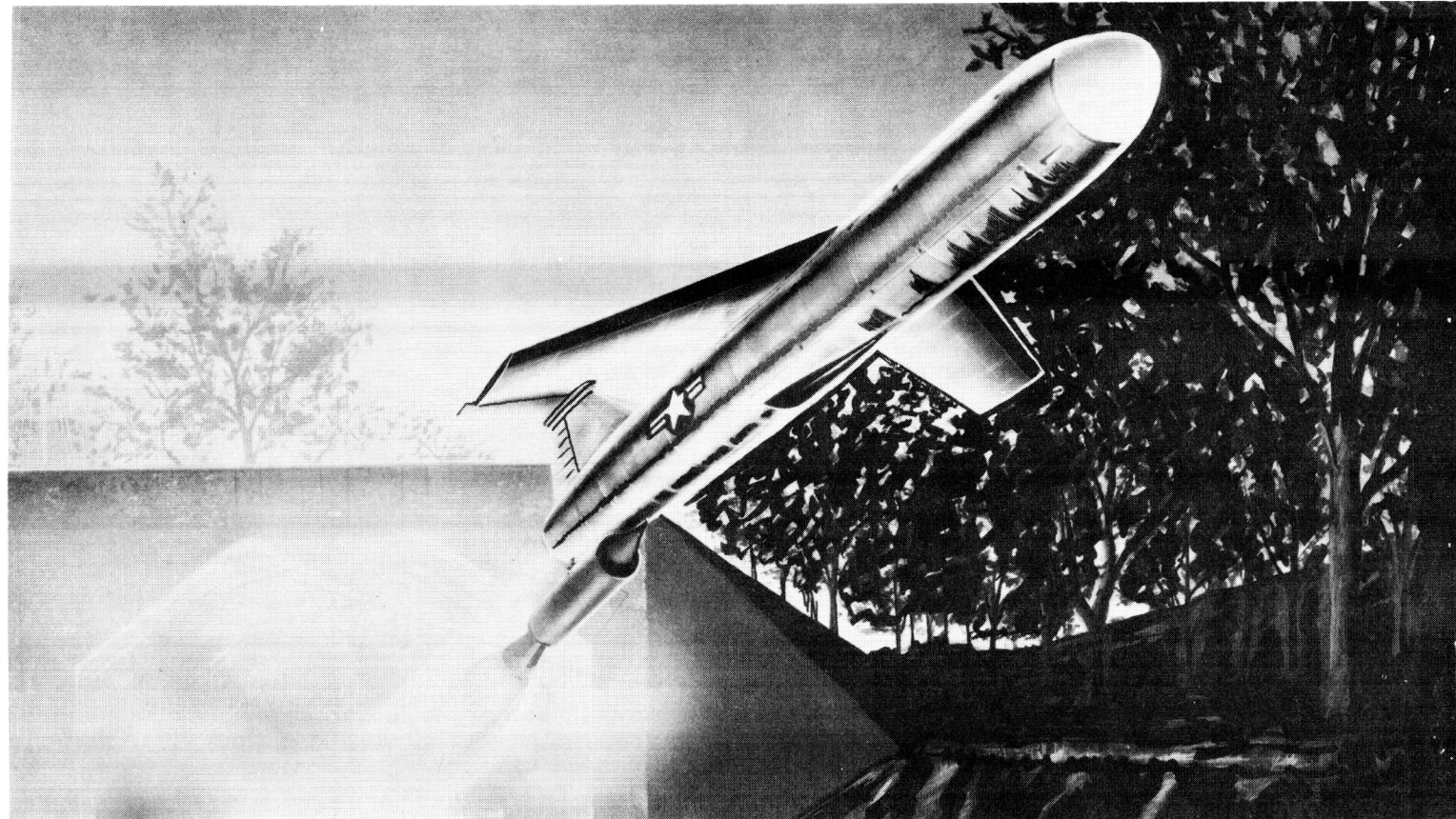


UNCLASSIFIED

CG  
MACE B/char



## *Standard Missile Characteristics*

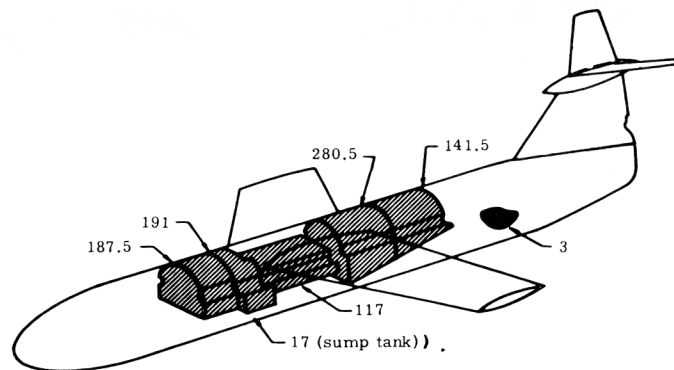
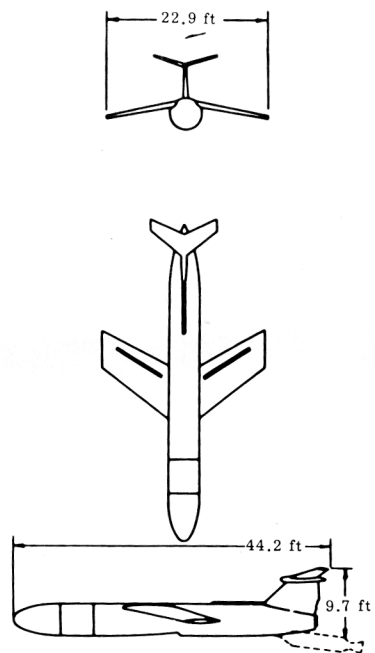
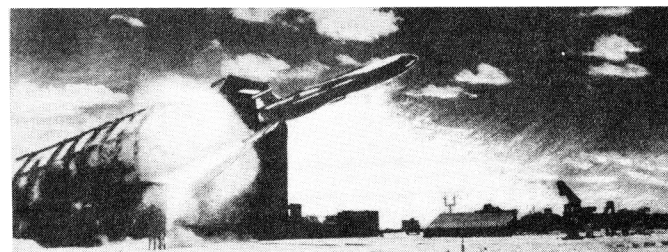
BY AUTHORITY OF  
THE SECRETARY  
OF THE AIR FORCE

# MGM-13B

**MACE**  
**Martin**

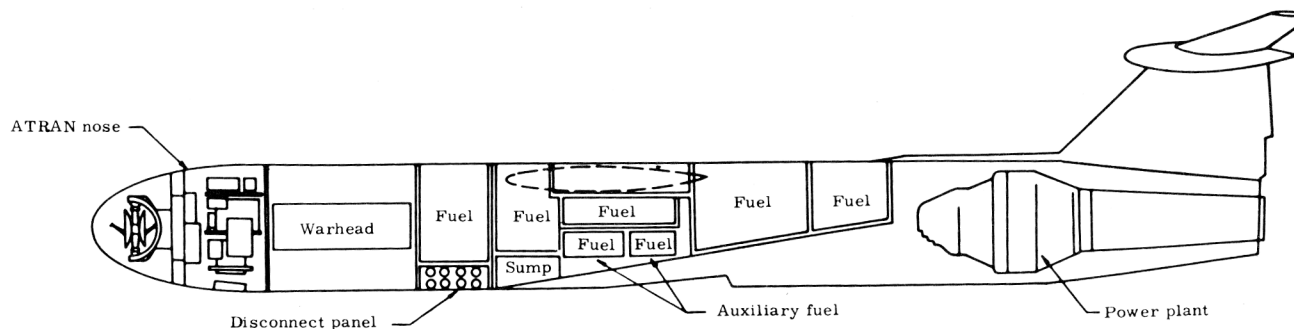
ONE J33-A-41  
ALL ISON

Wing Area . . . . .	151.5 sq ft	Wing section . . . . .	63-A-008
Aspect ratio . . . . .	3.461	MAC . . . . .	80.389 in.



NOTE: 81.5-gal auxiliary fuel tanks may also be carried.

Fuel (Gal)
 ☆ Water Alcohol (Gal)
■ Oil (Gal)



**POWER PLANT**

Number and Model (1) . J33-A-41  
 Mfr . . . . . Allison  
 Engine Spec Nr. . . . . 380-A  
 Type . . . . . Centrifugal  
 Length . . . . . 159.5 in.  
 Diameter . . . . . 49.3 in.  
 Weight (dry) . . . . . 1738 lb

**BOOSTER**

Number and Model (1) . . M-16E3  
 Mfr . . . . . Thiokol Chemical Corp  
 Engine Spec Nr. . . . . SP-66-A-1  
 Weight (loaded) . . . . . 2910 lb

**ENGINE RATINGS**

**SEA LEVEL STATIC ENGINE RATINGS**

	(LB)	(RPM)	(MIN)
Maximum:	5200	12,150	30
Normal:	4600	11,750	Cont

**BOOSTER**

**SEA LEVEL STATIC**

	(lb)	(sec)
Nominal:	101,000	2.7
Total Impulse:	272,500	(lb/sec)

**DIMENSIONS**

Wing  
 Span . . . . . 22.9'  
 Incidence . . . . . 0°  
 Cathedral . . . . . 10°  
 Sweepback (25% chord) . . . . . 35°  
 Length . . . . . 44.2'  
 Height . . . . . 9.7'

*Mission and Description*

**ATRAN  
MISSION AND DESCRIPTION**

The MGM-13B Mace is an all-weather, surface-launched pilotless aircraft capable of delivering a nuclear warhead to a surface target. The Rapid Fire Multiple Launch (RFML) capability permits all alert missiles to be launched in approximately 10 minutes (reaction time by specification is 16.5 minutes).

The Mace features thin, swept-back wings, T-tail, flush air inlet, finger-type spoilers for lateral control, all-movable stabilizer for pitch control, honeycomb wing and tail construction, and a monocoque fuselage.

The missile is ground launched from hardened sites on zero-length launchers with thrust augmentation provided by a single solid-propellant booster rocket.

Guidance is provided by ATRAN (Automatic Terrain Recognition and Navigation). The range which can be traversed by this guidance system is in excess of the full fuel range.

Directional control is accomplished by comparing the missile's terrain clearance altitude (measured with a barometric sensor corrected with a radar altimeter) with terrain clearances, as well as appropriate altitude changes, programmed on the series of radar terrain maps carried aboard the missile.

Vulnerability to countermeasures, particularly enemy radar, is reduced by the low level approach and the relative immunity of ATRAN guidance to jamming.

First YMGM-13B (formerly YTM-61B) . . . . .	12 Oct 55
First successful synthetic film flight . . . . .	Apr 58
Production began . . . . .	May 58
End of R&D . . . . .	Apr 59
Squadron deployment . . . . .	Apr-May 59
Rapid Fire Multiple Launch (RFML) posture proved . . . . .	May 60
RFML incorporated tactically . . . . .	Oct 61

**GUIDANCE**

**SYSTEMS**

- (a) INITIAL: Programmed pitch and altitude control; automatic guidance programming to lock-on.
- (b) MIDCOURSE: ATRAN map-matching from lock-on to end of mission; requires live reconnaissance or map synthesis. Terrain clearance altitudes programmed on ATRAN map.
- (c) TERMINAL: None; missile detonation programmed at end of mission.

**CONTROL**

Autopilot  
 Guidance terminal accuracy CEP 1350 ft

**LAUNCHING**

**METHOD**

Ground launched from hardened sites. No catapult or runway is required. RATO booster is used.

**TARGET ACCURACY**

SYSTEM CEP	
Guidance CEP	1310 feet
Weapon System CEP	1510 feet

**WEIGHTS\*\***

Loading	lb	LF (vert)	LF (horiz)
Prelaunch, gross (1)	18,569		
Launch (2)	18,418	1.01g	-7.50g
End of boost (3)	17,039	3.00g	-8.00g
Flight (SL) (4)	15,444	+3.80g	-3.2g
Fixed weight (5)	8904		
(1) Before start of engine:	15,595		
+2974 =	18,569 lb;		
(2) 151 lb of fuel used in warm-up, checkout and launch:	18,569 - 151 =		
	18,418 lb		
(3) Booster empty:	18,418 - 1379 =		
	17,039 lb;		
(4) After booster ejection:	17,039 -		
	1595 = 15,444 lb;		
(5) Total except fuel:	15,444 - 6540 =		
	8904 lb		

**F U E L**

Nr of tanks: . . . . .	7
Location . . . . .	Fuselage
Volume (gal): . . . . .	1029*
Grade . . . . .	JP-4
Specification . . . . .	MIL-F-5624

**O I L**

Nr of tanks . . . . .	3
Location . . . . .	Fuselage
Grade . . . . .	1010
Specification . . . . .	MIL-L-6081

\*Includes 81.5 gal of auxiliary fuel

**WAR HEAD**

Type . . . . .	MK-28
Weight Class . . . . .	1675 ± 50 lb

**FUSING**

1. Barometric switch for ballistic dive airburst
2. I. G. system for low level air burst.
3. Impact crystals for airburst backup or as a primary option

# Loading and Performance — Typical Mission

C O N D I T I O N S		M I S S I O N S			
		I	II	III	IV
PRELAUNCH WEIGHT (lb)		18,569	18,569	18,569	18,569
Fuel at 6.5 lb/gal/Oil (gal)		6691/3	6691/3	6691/3	6691/3
Warhead 1675 ± 50 lb		1675	1675	1675	1675
Booster weight (with change and sling) (lb)		2974	2974	2974	2974
LAUNCH					
Altitude at launch (ft)		0	0	5000	0
Captive launching distance (ft)		0	0	0	0
Distance to clear 50 ft obstacle (no wind) ① (ft)		180	180	210	180
Ground speed at end of boost (kn)		272	272	276	272
FLIGHT WEIGHT					
Fuel (lb)/Oil (gal)		15,444	15,444	15,444	15,444
Wing loading (lb/sq ft)		102.2	102.2	102.2	102.2
Stall speed (power only) (kn)		210	210	224	210
ACCELERATION CLIMB					
Engine speed (rpm)		12,150	12,150	12,150	12,150
Initial climb weight (lb)		15,444	15,444	15,444	15,444
Rate of climb at launch (fpm)		2200	2200	1835	2200
Altitude at end of climb (ft)		750	10,000	15,000	750
Cruise altitude (ft)		750	10,000	15,000	750
Time, launch to end of climb (min)		0.18	5.32	6.74	0.18
Distance, launch to end of climb (naut mi)		0.7	35.5	44.9	0.7
CRUISE					
Engine speed rpm(alt)		11,750(750')	11,750(10,000')	11,750(15,000')	11,280(750')
Initial cruise weight (lb)		15,422	15,009	14,976	15,422
Cruise Mach number (average)		0.738	0.790	0.814	0.713
Cruise true airspeed (average) (kn)		488	510	512	470
Time spent in cruise (min)		68.10	74.70	74.22	79.44
Distance covered in cruise (naut mi)		553.9	635	633.3	622.3
DESCENT					
Engine speed rpm(alt)		11,750(3000')	11,750(3000')	11,750(8000')	11,280(3000')
Initial weight (lb)		9244	9602	9514	9298
Average rate of descent or climb (fpm)		2110	1730	1360	2110
Time spent in descent or climb (min)		1.07	4.05	5.15	1.07
Distance covered in descent or climb (naut mi)		8.4	36.0	46.0	8.2
LEVEL CRUISE (TERMINAL PHASE)					
Engine speed rpm(alt)		11,750(3000')	11,750(3000')	11,750(8000')	11,280(3000')
Initial weight (lb)		9202	9277	9148	9216
Time spent in level cruise (min)		0.26	1.10	1.09	0.26
Distance covered in level cruise (naut mi)		2.0	10.0	10.0	2.0
TERMINAL PHASE/DIVE IMPACT					
Engine speed (rpm)		11,750	11,750	11,750	11,280
Time spent (min)		—	—	—	—
Distance covered (naut mi)		—	—	—	—
TACTICAL RANGE					
Total range (naut mi)		565	716.5	734.2	6332
Total mission time (min)		69.6	85.2	87.2	81.0
Total fuel burned (lb)		6400	6400	6400	6400

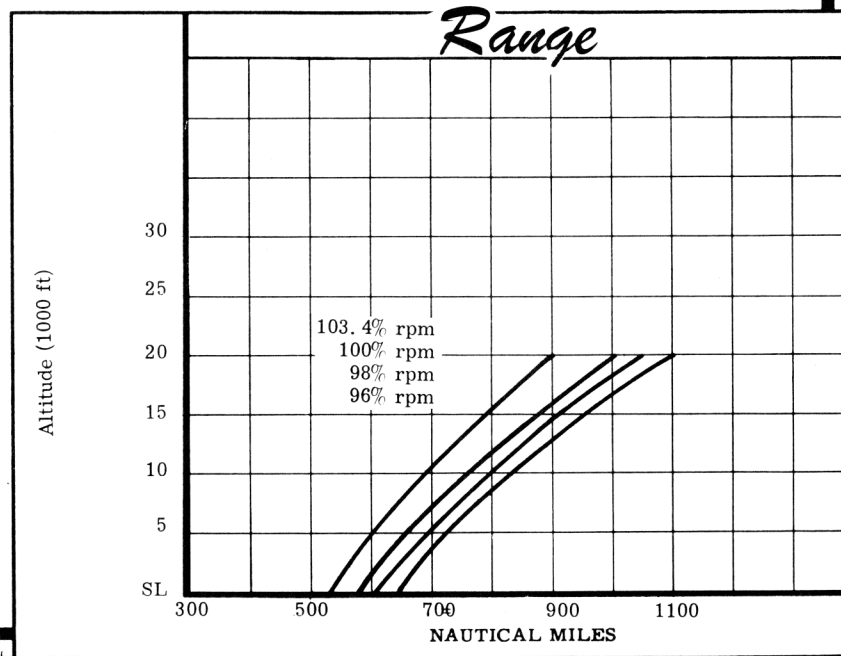
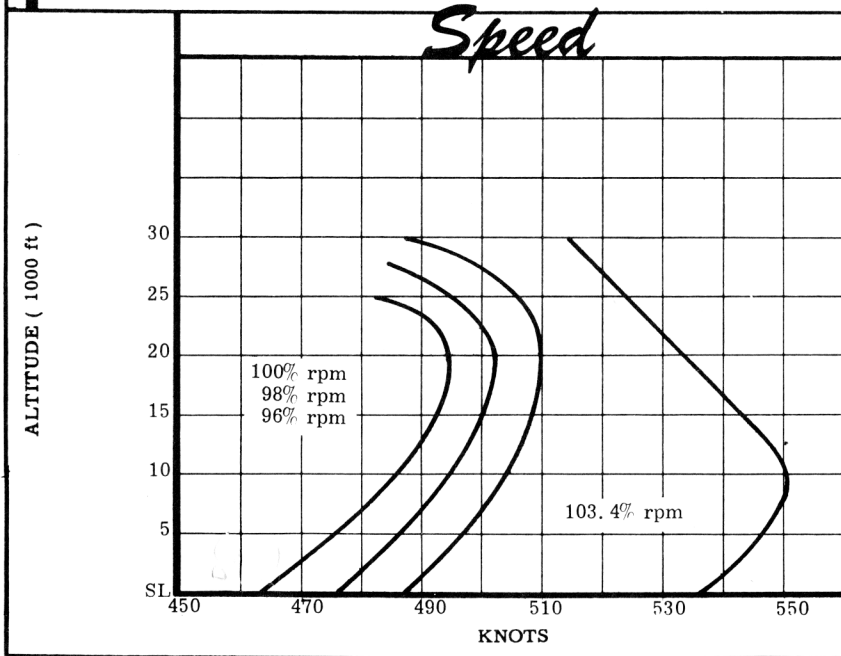
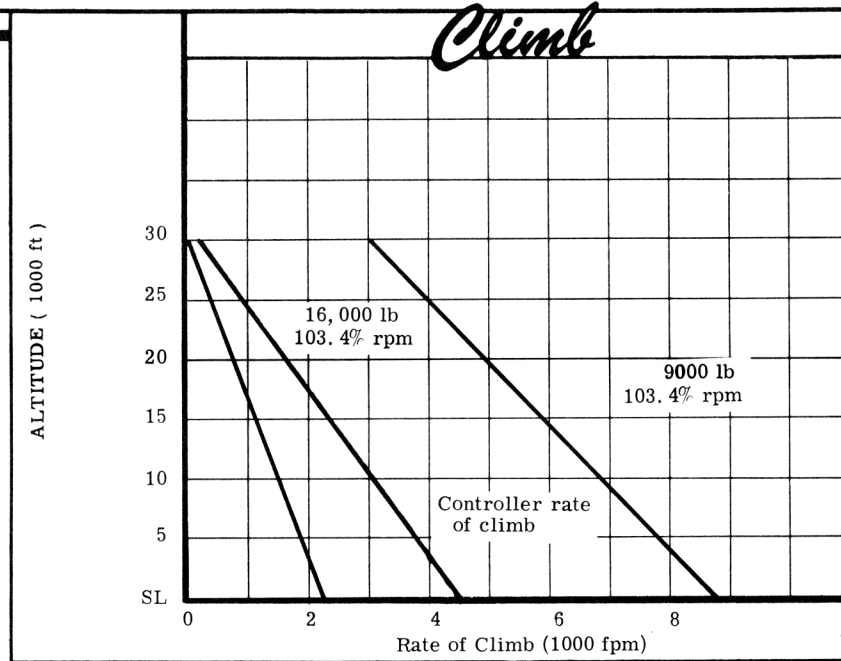
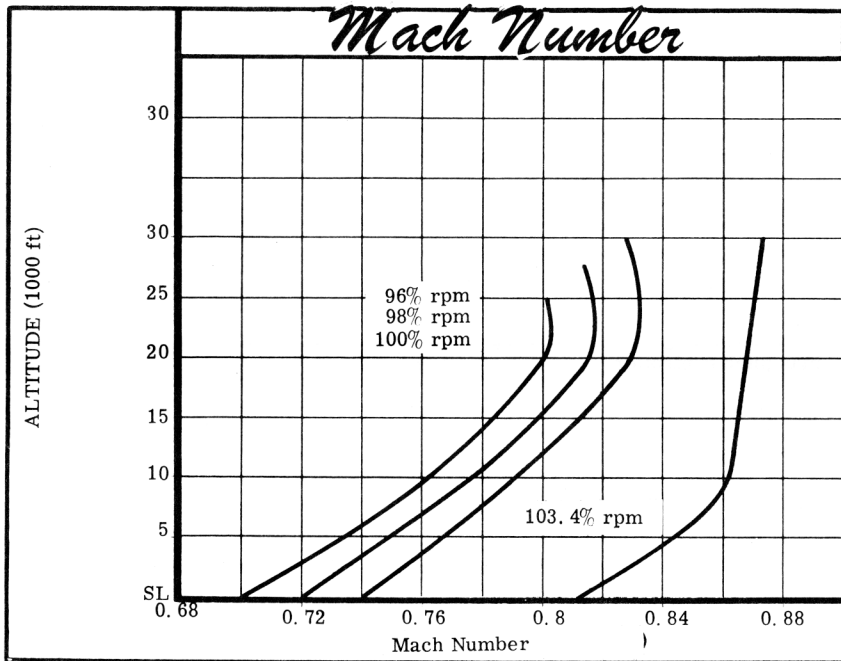
N  
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E  
S

① Normal booster alignment 0 ± 0.50 in. (on the Z axis) at cg.

**CONDITIONS:**

- (a) Performance Based on ICAO standard atmosphere.  
 (b) No fuel consumption loss to allow for service tolerance is considered

- (c) Range Mission description on page 6.  
 (d) Additional fuel table shown on page 6.



**N O T E S**

**FORMULA: MISSION I**

Climb from S. L. launch at max power 103.4% RPM to 750 ft for constant cruise. Engine retarded to normal power (100% RPM) for cruise. At end of cruise, climb at normal power (100% RPM) to 3000 ft, level off and cruise 2 nautical miles to terminal phase.

**FORMULA: MISSION II**

Climb from S. L. launch at max power (103.4% RPM) to 10,000 ft for constant cruise. Engine retarded to normal power (100% RPM) for cruise. At end of cruise, power settings remain at normal power to include descent to 3000 ft, level off and 10 nautical miles cruise to terminal phase.

**FORMULA MISSION III**

Climb from 5000 ft launch at max power (103.4% RPM) to 15,000 ft for constant cruise. Engine is retarded to normal power (100% RPM) for cruise. At end of cruise, power settings remain at normal power to include, descent to 8000 ft, level off and 10 nautical miles cruise to terminal phase.

**FORMULA MISSION IV**

Climb from S. L. launch at max power (103.4% RPM) to 750 ft for constant cruise. Engine retarded to normal power (96% RPM) for cruise. At end of cruise, power settings remain at normal power (96% RPM) to include climb to 3000 ft, level off and 2 nautical miles cruise to terminal phase

REVISION BASIS: To reflect downgrading of security classification and to indicate conversion to non-recoverable target (MQM-13A).

PRELAUNCH: Four mace missiles are maintained on alert by one fixed, central fire control center. The first missile can be launched in about 5 minutes, and all four missiles in about 10 minutes. A minimum of checks are performed immediately prior to launch; however, more extensive checks are made periodically. The engine is started at X minus 2 minutes for each missile and advanced to 60% RPM. Full power is applied during the final 30 seconds.

LAUNCH: During launch, the Mace is boosted by an M-16E3 solid propellant rocket from hardened sites on Zero-length launchers. This phase has a duration of 10 ± 4 seconds. Longitudinal control is maintained by a fixed bias pitch controller.

LAUNCH TO TRANSITION: Approximately 10 seconds after launch, a (125 second) launch bias fadeout is initiated, and a nulled altitude control is switched on.

The original reference altitude is then programmed to the desired command altitude at a programmed rate.

CRUISE: The missile can cruise at terrain clearance altitudes between 500 and 10,000 ft to a maximum of 25,000 ft MSL. The terrain clearance altitude to be flown is commanded on any desired ATRAN guidance map and is maintained by a barometric altitude sensor, which is corrected by a radar altimeter.

TERMINAL PHASE: The terminal phase of the ATRAN - guided mission is governed by commanding the desired warhead burst altitude into the last few ATRAN maps. The warhead burst altitude is programmed in advance of burst point to allow sufficient time for the missile to stabilize at desired altitude. When descending to burst altitude, approximately 10 nautical miles of range are required to stabilize at burst altitude; approximately 2 nautical miles are required when ascending to burst altitude.

FUEL USED (LB)

MISSION	LAUNCH PHASE	INITIAL CLIMB	CONSTANT CRUISE	FINAL CLIMB	DESCENT	LEVEL-OFF CRUISE	TERM
1	151	SL/750'	750'	750'/3000'		3000'	PROGRAMMED DETONATION
		22	6113	923		22	
2	151	SL/10,000'	10,000'		10,000'/3000'	3000'	
		435	5391		325	98	
3	151	5000/15,000'	15,000'		15,000'/8000'	3000'	
		468	5330		365	86	
4	151	SL/750'	750'	750'/3000'		3000'	
		22	6124	82		21	
TRAPPED & UNAVAILABLE FUEL - 44 GALLONS							