NF-104
file

EXTRACT FROM T.O. 1F-104A-1-2 (REVISED)

ZOOM MISSION

The following procedures should be followed during a typical zoom mission:

TAKEOFF

WARNING

Due to heavy gross weight all takeoffs in fully serviced AST should be made with maximum thrust. Due to tire limitations, downwind takeoffs are not recommended.

CAUTION

Nosewheel shimmy is serious due to heavy nosewheel loading. Take appropriate action depending on speed and runway available if encountered on takeoff roll.

Normal takeoff is accomplished as shown in Figure 2-4 of T.O. 1F-104A-1, using maximum thrust (full afterburner) except for the following:

At 90 KIAS move control stick aft to relieve nose gear until nosewheel lift-off begins. Due to forward center of gravity nosewheel lift-off is initially slow. When nosewheel lift-off begins, partially release back stick and continue to fly airplane off the ground. At a takeoff gross weight of approximately 22,000 pounds (fully serviced) nosewheel lift-off will occur at approximately 185 KIAS with takeoff at about 210 KIAS. (See Appendix for takeoff data.) Any attempt to rotate rapidly at main gear lift-off will result in high angle of attack (indicated by stick shaker) and decreased performance and should be avoided. Move wing flap lever to UP at 260 KIAS or above. Raising flaps below 260 KIAS may result in stick shaker actuation. Continue acceleration at maximum thrust to 400 KIAS, then retard throttle slowly to military power while monitoring nozzle position for proper operation.

CLIMB

After takeoff, continue acceleration in military power to 450 KIAS, climbing at this indicated speed until reaching an indicated Mach No. (IMN) of 0.86. Continue climbing at 0.86 IMN to desired altitude. During the climb complete the following checks:

1. Dampers - Check (RCS and Aero)

   a. RCS GN_2 - Check

   b. RCS GN_2 switch - ON

   c. RCS H_2O_2 pressure - 520-560 psi

   d. All Aero dampers - OFF

   e. RCS dampers - Check. Turn each damper on separately, pulse aircraft, then turn OFF.

   f. Aero dampers - Check and leave ON.

   g. Manual RCS control - Check in each Axis.

WARNING

Should manual or damper malfunction occur during RCS checks, abort zoom mission

2. Aero shaker - Check

3. Monitor α bar and gross α during shaker check.

4. Monitor H_2O_2 temperature.

TURNAROUND

1. Instrumentation and Tape Recorder - ON

2. Rocket throttle - READY

3. Rocket - Bleed for one minute minimum, then Bleed switch - OFF.

4. Oxygen quantity and pressure - Check.

5. Cabin altitude - Check.

6. Fuel - Check.

Proceed so as to arrive at the point for starting acceleration (as previously computed) at 35,000 feet on the inbound zoom heading.

ACCELERATION

MACH .9

1. Rocket Bleed - Check OFF.

2. Afterburner - MAX

3. Rocket Throttle - FIRE

4. Rocket chamber pressure - Check (580-600 psi).

CAUTION

Rocket ignition is normally smooth and little acceleration is felt by the pilot. Should a hard ignition or unstable burning occur, the throttle should be returned to ARM and the flight aborted. Unstable rocket burning is indicated by large chamber pressure fluctuations.

WARNING

If unstable rocket operation occurs followed by low chamber pressure (500 to 550 psi), move rocket throttle to OFF to vent the tank and stop JP-4 flow to the rocket engine. Abort the flight. (Refer to Section III, Turbopump Failure.)

MACH 1.4

1. Rocket Throttle - READY

2. Min fuel switch - ON (light on)

3. Cockpit nitrogen switch - ON

4. Cockpit nitrogen pressure - 3000 psi minimum.

5. RCS damper switch guards - UP (switches - STANDBY)

6. APC switch - CUTOUT

7. Bypass Flaps - OPEN (1.5 Mach)

8. Oxygen and Cabin Pressure - Recheck

PRE-PULL MACH (.1 Mach prior to pull Mach Number)

1. AARS - Set pitch to zero

2. Angle of attack (α) - Check

3. Rocket Throttle - FIRE

4. Rocket Chamber Pressure - 580-600 psi.

CAUTION

Rocket engine light-off should not be accomplished with less than 1200 pounds of fuel remaining. Fuel lean shutdown of the rocket engine can cause major damage.

PULL UP

Pull up at prebriefed Mach number (not to exceed 2.15 IMN or 155°C CIT, whichever occurs first) to prebriefed pitch angle (θ).

WARNING

Pitch angle shall not exceed that which will result in a minimum dynamic pressure of 20 psi for the conditions under which the flight is conducted. Under no conditions will the pitch angle be flown in excess of 50 degrees indicated nor will the flight path be maintained at an angle greater than 50 degrees.

WARNING

Do not retrim airplane longitudinally after pullup is begun.

ZOOM

1. Maintain desired pitch angle and maintain J-79 EGT within limits. (Refer to T.O. 1F-104A-1.)

CAUTION

EGT may rise to limits at altitudes as low as 55,000 feet. If this should occur, it must be recorded in aircraft form 781.

2. Monitor chamber pressure and cabin altitude.

3. At 63,000 feet or at 625°C EGT maximum - Retard throttle to MILITARY.

4. At 80,000 feet or at 610°C maximum - Move J-79 throttle to OFF.

CAUTION

Should EGT limits be reached before altitudes indicated in steps 3 or 4, make appropriate entry in aircraft form 781.

5. Angle of attack - Maintain desired pitch angle until alpha bar of AARS drops to reference airplane. (This will result in alpha equal to the present null angle of attack of 8 degrees.) Maintain angle of attack by flying reference airplane toward alpha bar.

WARNING

Angle of attack must never exceed 11 degrees. Excessive angle of attack may result in pitchup which can lead to a flat spin. Successful recovery from an F-104 flat spin has never been reported.

6. At Rocket engine burnout - Rocket throttle to ARM. Rocket engine automatic shutdown is indicated by two or three thrust surges as H_2O_2 is depleted. The throttle can be moved to ARM any time after burnout.

CAUTION

Do not move the rocket throttle to OFF as cooling JP-4 flow to the turbopump will cease, resulting in pump damage.

7. At 90,000 feet (or after J-79 shutdown), RCS damper switches - ON

NOTE

Do not activate the RCS damper system during the acceleration prior to entering a zoom because the reaction control exhaust gases may disturb the boundary layer forward of the engine air inlet ducts, resulting in increased drag and possible unstable J-79 jet engine operation. Below 90,000 feet dampers are ineffective and waste RCS H_2O_2.

8. Manual RCS - USE OVER THE TOP.

WARNING

Abrupt pitch changes should be avoided. Excessive pitch rate (either direction) creates gyroscopic coupling which may result in loss of control and subsequent spinning. Use of RCS pitch control and full stabilizer deflection simultaneously can create excessive pitch rate.

NOTE

RCS damper and RCS manual control may activate the stick shaker when the nose left yaw thruster fires.

9. Angle of attack - maintain (8 degrees).

10. Speed brakes - OUT when the nose drops below the horizon.

REENTRY

1. Rocket throttle - ARM

   a. Bleed switch - ON

2. Below 60,000 feet

   a. START switches - START.

   b. Throttle - MILITARY.

CAUTION

Monitor fuel flow and EGT during start.

   c. RPM - Monitor to 100% then retard to IDLE.

WARNING

3. Turn towards high key for X-15 approach.

   a. Speed brakes - Closed (if required).

4. Min fuel switch - OFF.

5. Bypass Flaps - CLOSED.

6. APC - ON.

7. Cockpit nitrogen switch - OFF.

8. RCS H_2O_2 - JETTISON.

   a. RCS nitrogen switch - OFF when system is empty.

   b. RCS jettison switch - OFF.

9. Cabin Pressure - DUMP below 10,000 feet.

PRE-LANDING

1. Fuel - Check

Make a full stop landing from a X-15 or SFO approach if fuel dictates.

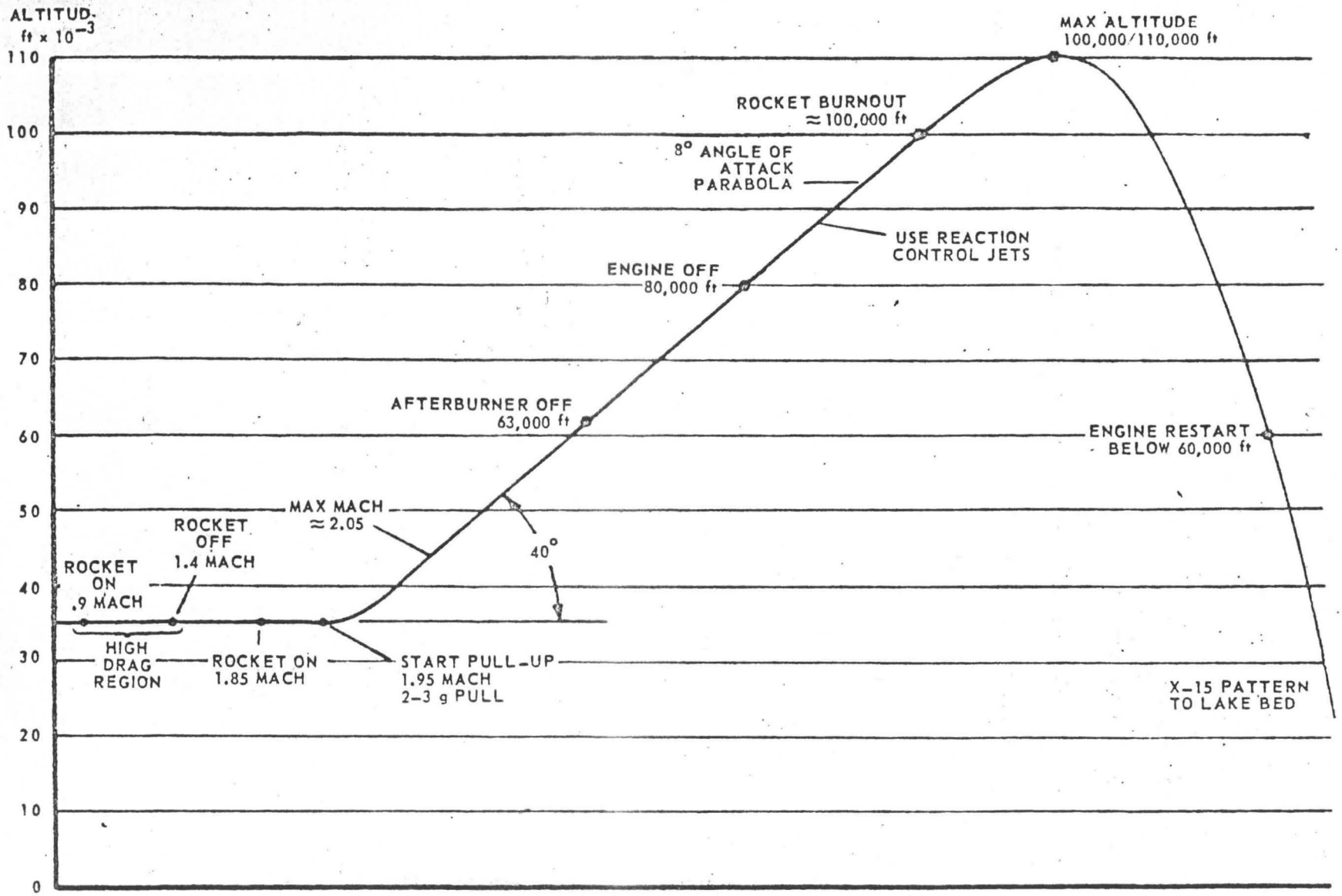
2. Plan to roll out to the end of the runway.

NOTE

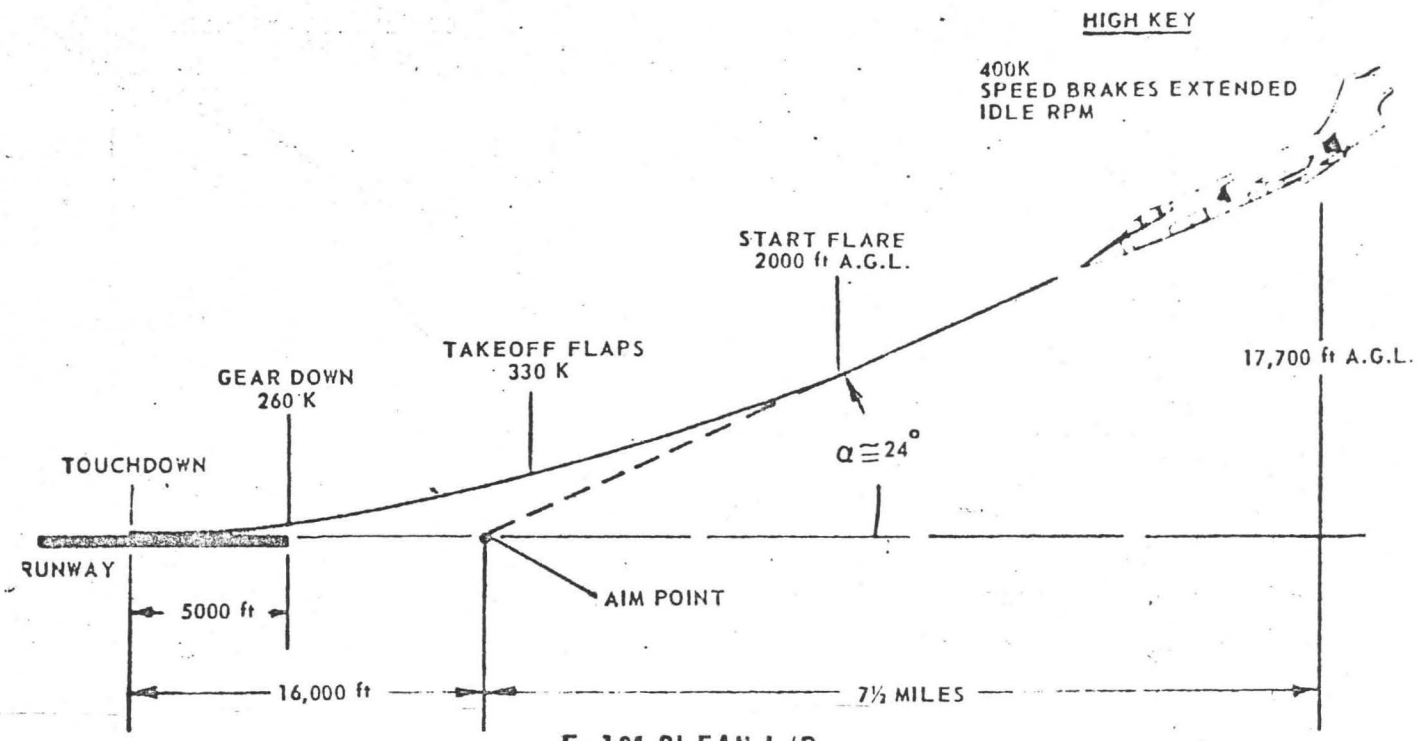
If the drag chute drogue gun is installed, use of the drag chute on the ground will damage the lower aft section. Therefore, use the drag chute only if necessary.

LANDING

Landing differs little from the standard F-104A and procedures listed in T.O. 1F-104A-1 apply with slight modifications described in Section VI (Flight Characteristics - Landing).



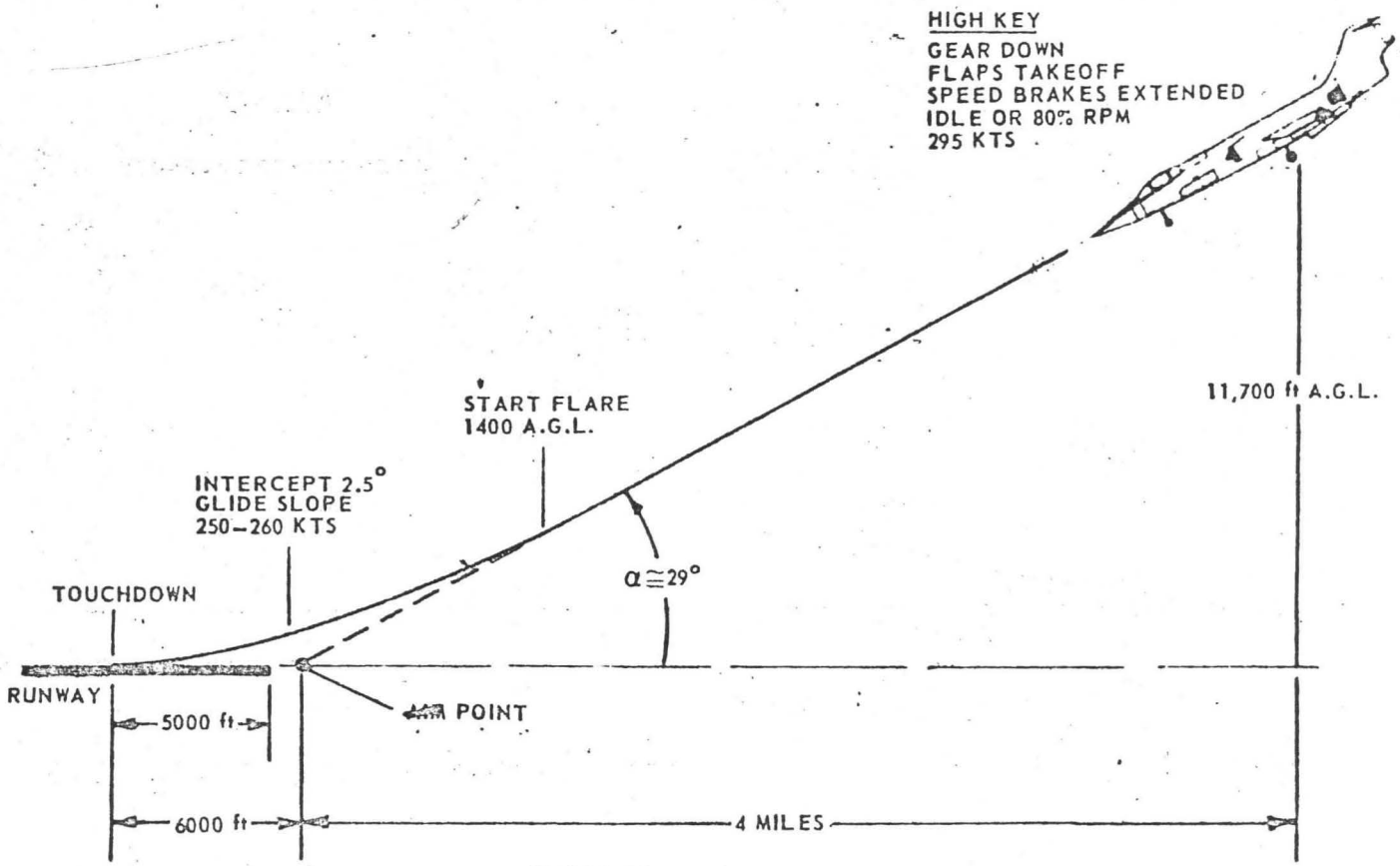
NF-104 ZOOM PROFILE



F-104 CLEAN L/D

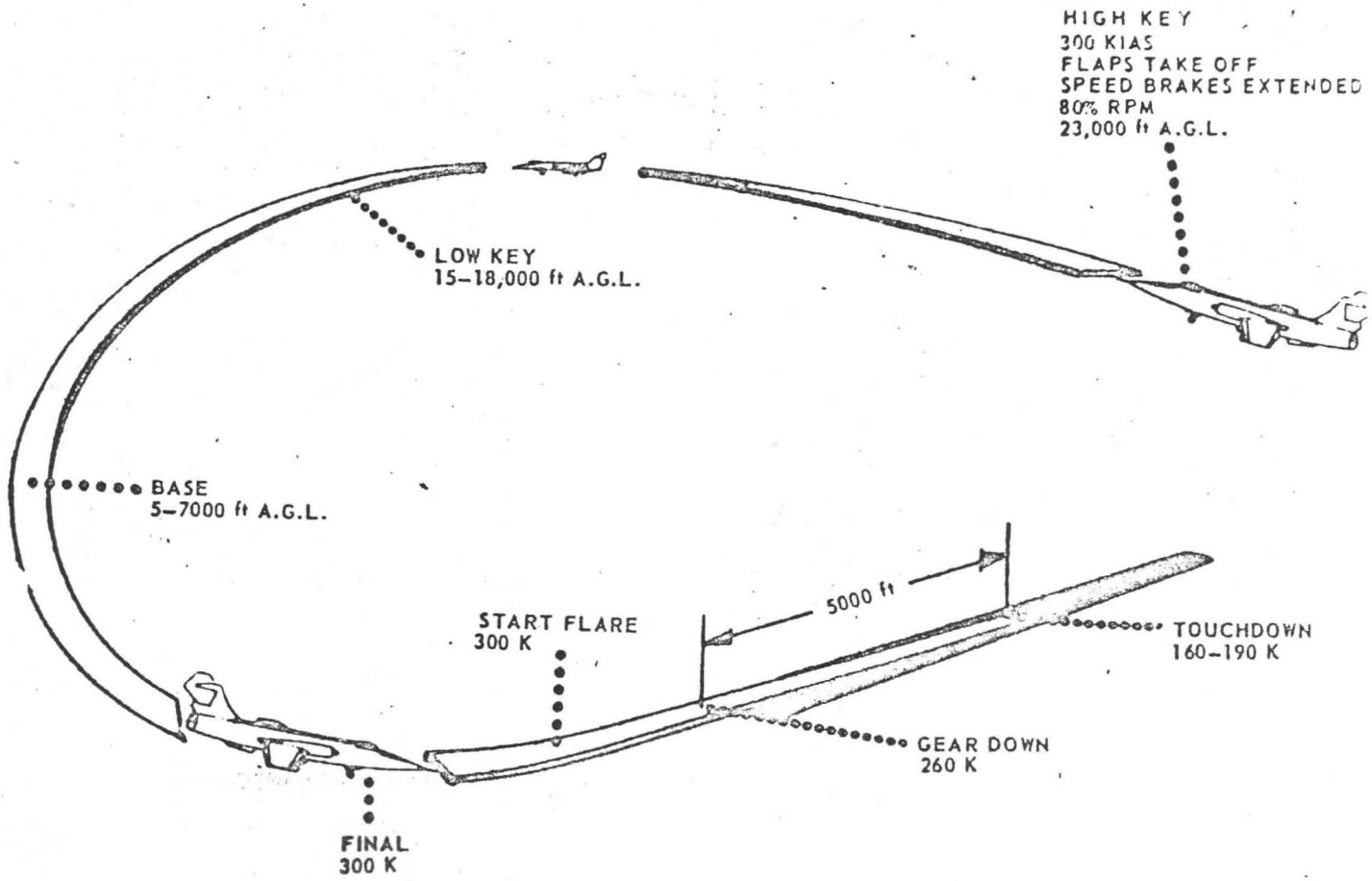
Figure 15

Atch 2



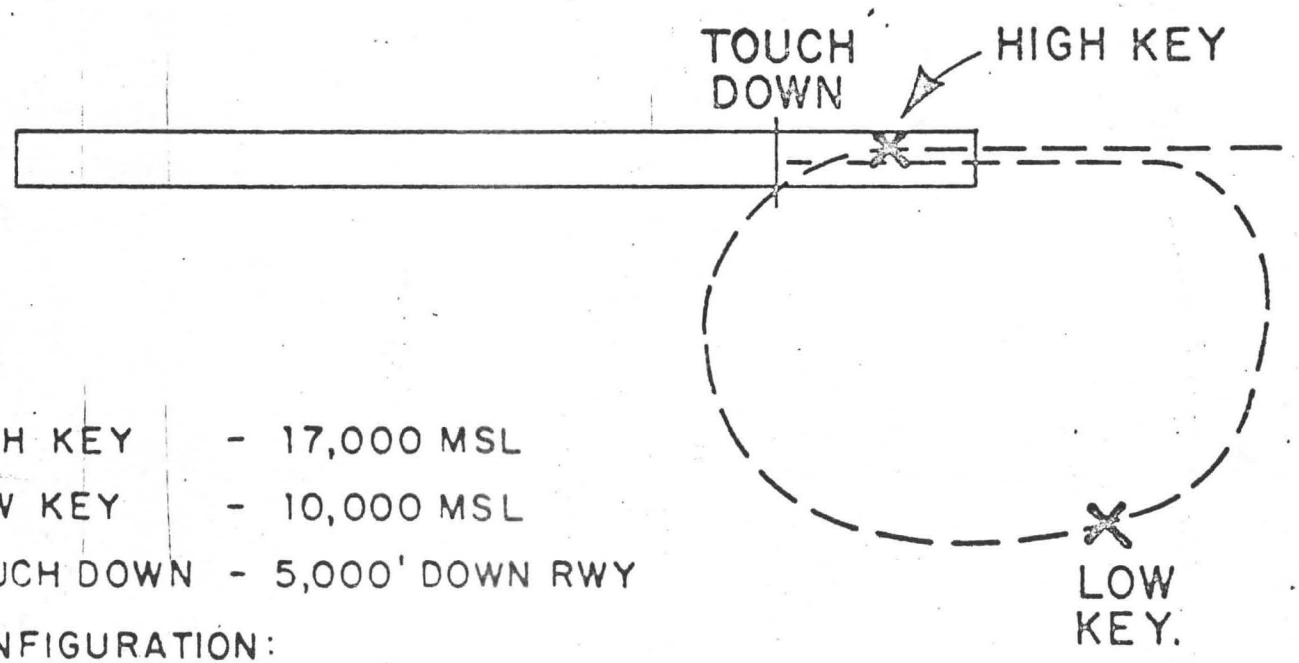
F-104 DIRTY L/D

Atch 2



SIMULATED X–15 PATTERN

STANDARD SFO



HIGH KEY - 17,000 MSL

LOW KEY - 10,000 MSL

TOUCH DOWN - 5,000' DOWN RWY

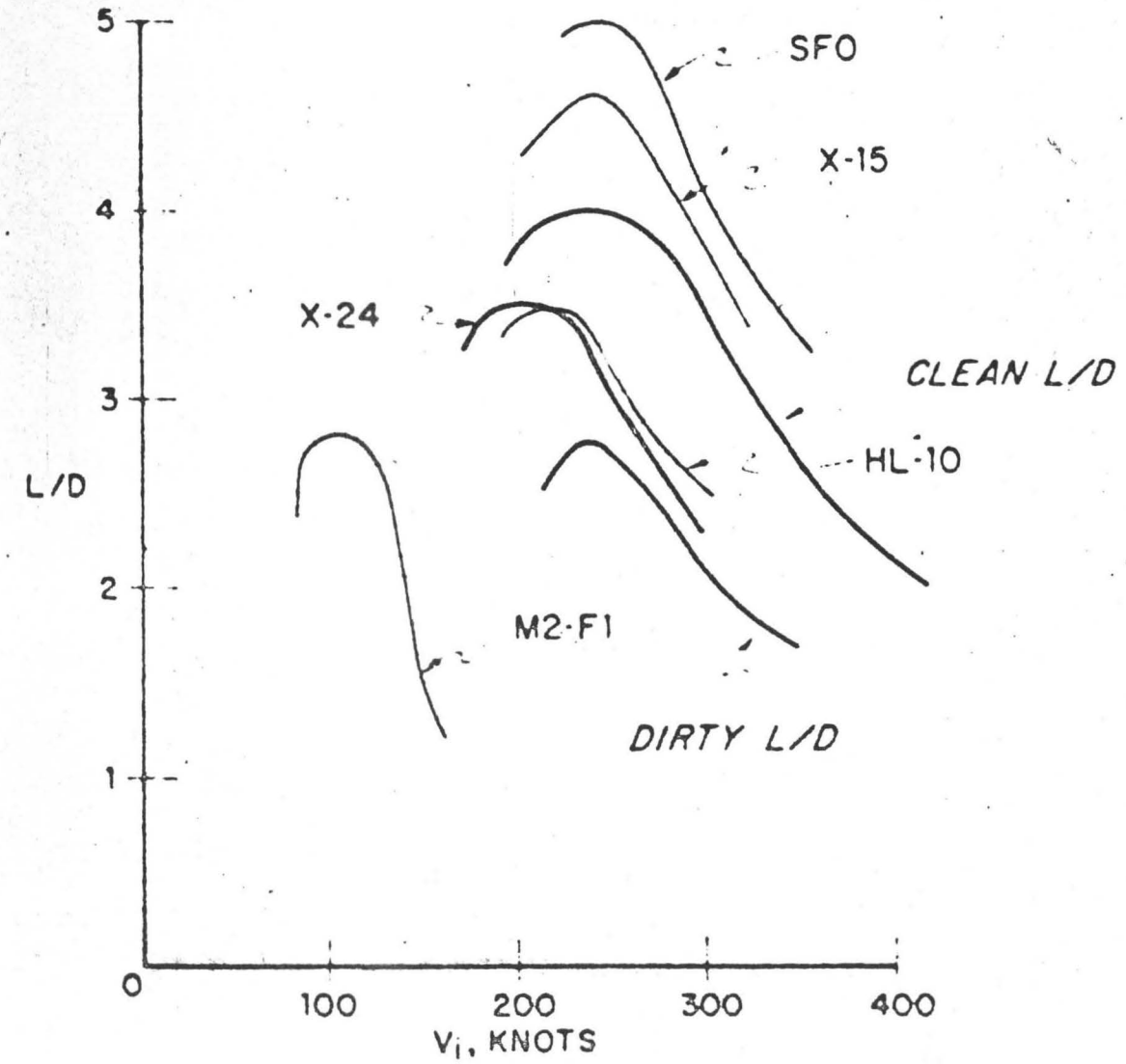
CONFIGURATION:

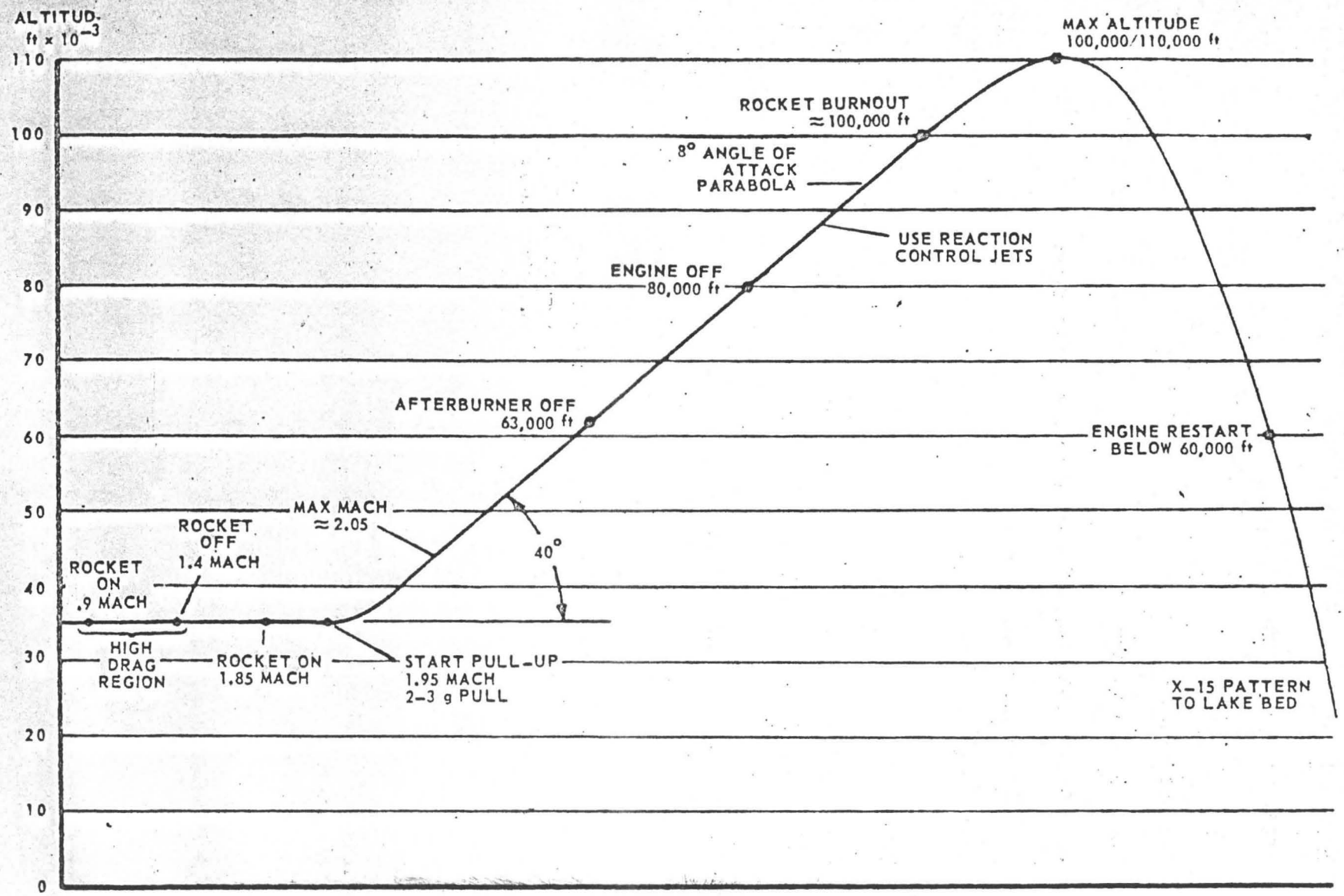
T.O. FLAPS, SPEED BRAKES, 82%

GLIDE SPEED 260 KTS +

L/D VERSUS INDICATED AIRSPEED

X-15, LIFTING BODIES and F-104





NF-104 ZOOM PROFILE