DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR ARMAMENT CENTER (AFMC)
EGLIN AIR FORCE BASE, FLORIDA

14 December 1998

AFDTC/IMDF
207 W. D Ave, Suite 214
Eglin AFB FL 32542-6852

Mr. John Greenewald, Jr.
[redacted]

Dear Mr. Greenewald

This is an interim response to your 13 June 1998 Freedom of Information Act request referred to this agency by the Air Force Pentagon FOIA Office, addressed To the Office of the Under Secretary of Defense, Defense Technical Information Center, Ft Belvoir VA, requesting a copy of document AD B972873, entitled "Operational Suitability Test of the Labs Computer, dated 19 November 1953.

After careful review, we have determined that the Air Force portions of the document are releasable to you under the Act and are being provided at Attachment 2.

The document also contained pages that were previously classified as Restricted Data Atomic Energy Act 1996, by the Department of Energy (DOE). In accordance with current Air Force guidance DOE must review those portions marked Restricted Data for release determination. Once their review is concluded, we will advise you as to their releasability and any cost incurred for processing your request.

This letter does not constitute a partial denial. Once a final decision is made regarding the rest of the requested records, we will notify you. Case number assigned to this request is DT 99-017; please refer to this number when referencing this request.

Sincerely

DENISE L. KING
FOIA Manager

Attachments:
1. Your Ltr, 13 Jun 98
2. Releasable Records

UNCLASSIFIED

AD-B972 873

Air Proving Ground Command

NOTICE
There has been a classification change to this document. It is the responsibility of the recipient to promptly remark it to indicate this change.

Final Report

TEST CONDUCTED
AT
EGLIN A.F.B. FLORIDA

94-01098

PROJECT NO. APG/TAT/83-A

SUBJECT: OPERATIONAL SUITABILITY TEST OF THE LABS COMPUTER

DATE 19 NOVEMBER 1953 COPY NO. 1? OF 250

THIS DOCUMENT CONSISTS OF 59 PAGES

[redacted]
Security Information

UNCLASSIFIED

NOTICE
There has been a classification
change to this document.
It is the responsibility of the recipient to
promptly remark it to indicate this change.

"This document contains information affecting the National defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."

NOTICE
There has been a classification
change to this document.
It is the responsibility of the recipient to
promptly remark it to indicate this change.

RETAIN OR DESTROY IN ACCORDANCE WITH AFR 205-1. DO NOT RETURN.

NOTICE

Distribution of this report or disclosure of data contained herein will not be made without prior approval of the Commander, Air Proving Ground Command.

DISTRIBUTION LIST

Address	No. of Copies
Commander, AF Special Weapons Center, Kirtland AFB, New Mexico	1
Commander, Detachment 1, Headquarters AFOTC, Kirtland AFB, New Mexico	1
Commander, 20th Fighter-Bomber Wing, APO 120, c/o Postmaster, New York, New York	4
Commander, 49th Fighter-Bomber Wing, APO 970, c/o Postmaster, San Francisco, California	4
Commander, WADC, Wright-Patterson AFB, Ohio	2
Commander, WADC, ATTN: WCLGT, Wright-Patterson AFB, Ohio	1
Commander, ARDC, P.O. Box 1395, Baltimore, Maryland	2
Commander, SAC, Offutt AFB, Nebraska	2
Commander, 40th Air Division, Turner AFB, Georgia	8
Commander, 42nd Air Division, Bergstrom AFB, Texas	8
Commander, USAFE, APO 633, c/o Postmaster, New York New York	2
Commander, 405th Fighter-Bomber Wing, Langley AFB, Virginia	4
Commander, 9th Fighter-Bomber Squadron, APO 970, c/o Postmaster, San Francisco, California	1
AF Development Field Representative, APGC	1
War Plans Division, D/Plans, DCS/O, ATTN: AF Plans Branch	1
Dir/Procurement and Production Engineering, Office, DCS/Materiel	1
Operations Analysis Division, DCS/O	1
Commander, TAC, Langley AFB, Virginia	4
Commander, ADC, Ent AFB, Colorado Springs, Colorado	1

Distribution List (Cont'd)

Address	No. of Copies
Tactical Air Division, AFOTC, Eglin AFB, Florida	4
Commander, 13th Air Force, ATTN: D/O, APO 74, c/o Postmaster, San Francisco, California	1
Commander, 8th Air Force, ATTN: D/O, Carswell AFB, Fort Worth, Texas	1
Commander, 4th Air Force, Hamilton AFB, California	1
Commander, 9th Air Force, Pope AFB, Fort Bragg, North Carolina	1
Commander, 49th Air Division, APO 22, c/o Postmaster, New York, New York	3
Operations Evaluation Group, Office, Chief of Naval Operations (OP-374), Navy Department, Washington 25, D. C.	1
The Rand Corporation, ATTN: Dr. J. L. Hult, 1500 Fourth Street, Santa Monica, California	1
Instrumentation Laboratory, M.I.T., 68 Albany Street, Cambridge, Massachusetts	1
Commander, 12th Air Force (ADVON), APO 61, c/o Postmaster New York, New York	3
Commander, AF Special Weapons Center, ATTN: Chief, Technical Library Branch, Kirtland AFB, New Mexico	3
Commander, Naval Air Test Center (AT), USNAS, Patuxent River, Maryland	1
All Reports List, APGC	

TABLE OF CONTENTS

1. INTRODUCTION:

a. This test was conducted under authority contained in letter, Headquarters USAF, AFDRQ/TA-S, subject: "(Uncl) Assignment of Ryan Toss Computer Units to APGC for Test," dated 3 June 1952. A copy of this letter is included in Appendix A.

b. The LABS, short title for Low Altitude Bombing System, and formerly known as the Ryan Toss Computer, was developed to provide fighter aircraft with the capability of delivering atomic weapons from extremely low altitudes. The LABS consists of three (3) components: 1) a box containing an intervalometer, relays and other electrical equipment; 2) a dive and bank indicator; and 3) a free gyro. A time is preset in the intervalometer, and a release angle is preset in the gyro. The equipment weighs nine (9) pounds and occupies one-fifth (1/5) of a cubic foot. This test began with the prototype LABS installed in an F-84G airplane. When the production LABS became available, the equipment was changed and tests were completed with the production LABS. See Appendix C for a complete description of the equipment and its installation and operation. Figure No. 1, below, is a drawing of a typical LABS delivery.

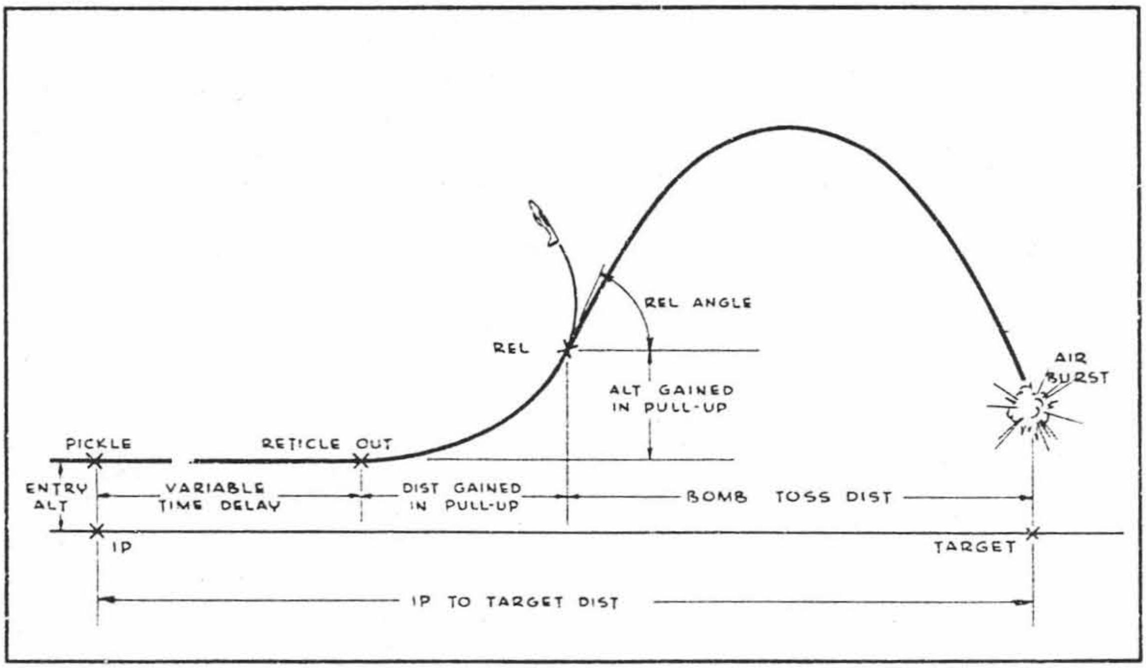


Figure No. 1

c. An interim letter report on this project was published on 6 November 1952, title, "(SECRET) Low Altitude Delivery of Atomic Weapons by Fighter-Bomber Type Aircraft." A final report was published on an allied test, Project No. APG/TAT/83-A-2, "(Uncl) Operational Suitability Test of Practice Bombs for LABS Toss Bombing Training," dated 4 August 1953. Another allied test, Project No. APG/TAT/83-A-1, "(Restr) Determination of Best Method of Fighter Low Altitude Delivery of Atomic Weapons," is now being conducted as a continuous study to investigate and evaluate other methods of low altitude delivery.

2. OBJECT: To determine the operational suitability of the LABS equipment for use in delivering atomic weapons from fighter aircraft under conditions of low ceiling and visibility. The investigations included a determination of obtainable accuracy, functional reliability, tactics and techniques, and training requirements.

3. OPERATIONAL ASPECTS:

a. Organizational Impact:

(1) Organizations equipped with the LABS will require no additional personnel for maintenance of LABS equipment over and above that normally required for a fighter-bomber wing. However, pilots who use the LABS equipment should be above average in experience and ability.

(2) In order to gain initial proficiency with the LABS, each pilot should toss a minimum of thirty (30) practice bombs. During this practice, the pilot must make a particular effort to be consistent in the pull-up maneuver. A minimum of three (3) hours should be spent practicing Immelman maneuvers under the hood, and this maneuver should be included in the instrument flight training with frequent proficiency checks. Since the pilot proficiency level is directly reflected in the results obtained, frequent practice in LABS procedure is mandatory. Navigation training flights should be made as frequently as possible and should be profile sorties against simulated targets at near maximum radius of action of the aircraft, navigating without use of radio aids. Ground training should cover all aspects of the LABS delivery with emphasis on navigation techniques and principal sources of error in techniques.

(3) No additional maintenance personnel will be required. Qualified technicians presently authorized to maintain the "A" Series GBR Sights and AN/APG-30 radar will be able to perform all organizational maintenance on the LABS equipment. One (1) week of OJT instruction under a qualified instructor should be sufficient to familiarize maintenance personnel with inspection techniques and maintenance procedures.

(4) No special equipment or facilities are required to maintain the LABS. It can be expected to give months of service with only frequent inspections and occasional leveling.

b. Capabilities and Limitations:

(1) The LABS equipment gives the fighter-bomber the capability of delivering atomic bombs accurately against almost any target within radius of action of the aircraft. When a LABS mission is flown as planned, eighty (80) per cent of the bombs delivered can be expected to fall within 1,000 feet of the desired bursting point and ninety-four (94) per cent within 1,500 feet. (Reference paragraph 3c, Appendix E.)

(2) The system can be used satisfactorily under marginal weather conditions. A ceiling of 1,000 feet and a visibility of five (5) miles is sufficient for the target area. However, weather conditions should be somewhat better in the area of the penetration (letdown) point, where the pilot must orient himself to start the bomb run. Two thousand (2,000) foot ceiling and five (5) to ten (10) miles visibility is considered the minimum for this area. The above weather minimums are suggested only as a guide, since these factors will be determined by the unit commander consistent with the experience level of his command.

(3) A maximum degree of security from detection and ground fire is provided by the delivery tactics common to this system. The low altitude, high speed approach makes the attacking aircraft a difficult target. In some cases, the distance from the target from which the bomb can be launched makes it unnecessary for the aircraft to fly over the target and its inner defenses.

(4) Escape of the aircraft from the bomb blast is easily accomplished with this type of delivery. An escape distance of 15,000 feet from a burst height of 2,000 feet can be achieved using a thirty-five (35) degree toss. This distance can be increased to more than 25,000 feet by using higher toss angles. (Reference paragraph 3d, Appendix E.)

(5) Intelligence will play a highly important role in the use of the LABS, since a geographic reference point for "pickling" (starting the sequence of events by depressing the bomb release button) the system must be available. This point, referred to herein as the "IP" (Initial Point), must be an easily recognized landmark which can be used to furnish a reference point to the pilot so that he can "pickle" at a known distance from the target. A large scale map or photograph of the area must be available so that the distance between IP and target can be accurately measured. Up-to-date photo-reconnaissance will be an invaluable aid to the pilot in locating and recognizing the target.

(6) The pilots selected to use this equipment must be above average in ability, and must receive special training. (Reference paragraph 3a(1) and (2).)

(7) Although navigation to and from the letdown point and/or target area is not peculiar to LABS operations, the basic investigations made during this test indicate that the lack of suitable automatic navigational equipment can limit complete realization of the LABS's inherent capabilities. It is believed that fighter navigational equipment under development will alleviate this problem.

c. Tactics and Techniques:

(1) The basic LABS technique requires the use of an IP, which is at a known distance from the target. The fighter-bomber passes over this point on a heading toward the target. As the aircraft passes over the IP, the pilot depresses the bomb button, holding it down throughout the maneuver. When the sight reticle disappears, the pilot executes a precise Immelman on instruments and the bomb is released at the preset gyro release angle. When the Immelman is complete, he dives to a lower altitude to assure maximum escape.

(2) The success of the mission will depend to a great extent upon the mission planner's decision on several variable factors. These factors include choice of IP, approach speed, approach altitude, and release angle. The correct solutions will vary considerably with the type of aircraft employed, type of target, type of terrain, enemy defenses, weather, type of bomb, etc. A complete analysis of these factors is presented in Appendix F.

(3) After the delivery conditions are decided upon, the penetration point is selected. This point should be a geographical reference point forty (40) to one hundred (100) miles from the target which can be easily recognized from the air when the pilot descends to low altitude. It could be a mountain, lake, river bend, or other outstanding terrain feature. It should be located away from population centers, if possible, to minimize the chance of alerting the target area. It can be located to one side of the target so that the enemy will not know the ultimate destination. At this point the pilot definitely establishes his position and navigates at low level to the IP, using intermediate check points, as available, so as to arrive at the IP with the proper airspeed, altitude, and heading in the direction of the target.

(4) The details of completing a normal profile sortie in a LABS-equipped F-84G carrying a Mark 7 bomb may be found in Appendices F and G.

(5) No attempt has been made to determine whether the fighter-bomber should proceed to the target alone, or whether it should be escorted or supported in some fashion. It is felt that these questions can be answered properly only after the complete tactical situation is known. Likewise, no specific method has been offered for navigating to the penetration point. However, information as to methods employed in the navigation phase of this project is contained in Appendices E and F.

(6) The use of a locally constructed automatic trim tab device throughout the test increased the effectiveness of the LABS delivery and proved valuable in training pilots. The use of this feature made possible consistent pull-ups to a constant acceleration and allowed the pilot more time for concentration on airspeed, altitude, heading, and attitude throughout the complete maneuver. This device is described in Appendix I.

4. <u>COLLECTIVE ANALYSIS</u>:

a. The recent development of atomic weapons that can be carried by fighter aircraft has created the requirement for accurate delivery systems which can be used under all weather conditions. Since present delivery methods employing the "A" Series Sights require high ceilings and good visibilities, it is essential that low altitude methods and equipments continue being developed under high priorities.

b. The LABS-equipped fighter-bomber should be considered in determining the force requirement necessary for attacking a target which is sufficiently important to warrant the use of an atomic weapon. It cannot be overlooked that the use of the LABS may be seriously limited in some cases because of the requirement for using geographic reference points for "pickling." A continuous study of ways or means to eliminate this requirement is being made under Project No. APG/TAT/83-A-1, "(Restr) Determination of the Best Method for Low Altitude Delivery of Atomic Weapons by Fighter Aircraft."

c. As a delivery method the LABS must be compared with the "A" Series Sights and with the early model BT-9 which was recently tested under Project No. APG/TAT/93-A (reference paragraph 5, Appendix B). The "A" Series Sights and the BT-9 have several common disadvantages: 1) the inability to readily escape the bomb effects; 2) the requirement for 15,000 to 20,000 foot ceilings; and 3) the vulnerability to anti-aircraft fire during the bomb run. The BT-9 in its present configuration installed in an F-84E or G aircraft was found operationally unsuitable for atomic weapon delivery because of gyro bank angle, computer solution, and aircraft performance limitations. Although it is anticipated that the production BT-9 will correct at least some of these deficiencies, further testing will be required to determine its suitability. Therefore, at the present time, the LABS-equipped fighter-bomber offers the best method for delivering atomic weapons by fighter-bomber aircraft within its radius of action.

d. The LABS can be placed in use with a minimum of effort. Retrofit of tactical aircraft can be accomplished in the field, if kits and complete instructions are furnished. The logistic support required is minor since the unit is small and does not have to be replaced frequently. Maintenance personnel will require little additional training. Special pilot training can be accomplished within the organization. It should not require more than one (1) month to completely train selected pilots within a wing, if adequate bombing ranges are available. The requirement that the pilots who are to use this equipment be above average in experience and ability is not necessarily peculiar to the LABS delivery system, since all atomic-capable organizations already require highly qualified aircrew personnel.

e. The nature of the tactics employed in the use of the LABS makes detection, interception, and defense extremely difficult. The likelihood of detecting and intercepting a lone jet fighter aircraft is considerably less than for a bomber or formations. Ground observer detection, after the aircraft has descended to enter the bombing run, may be too late to be effective. Effective anti-aircraft defense against the low level attack is difficult at best. If the enemy is eventually able to counter the LABS attack by building better radars and anti-aircraft weapons, his defenses can still be saturated by the use of numerous conventional penetration fighter sorties, each simulating an atomic attack. The effect of a barrage balloon type defense was not considered during this test, but this hazard could seriously compromise this type of attack.

f. Summary: (The LABS provides the fighter-bomber with the means for delivering atomic weapons accurately in marginal weather.) It is the best available system for making an atomic attack against any target with fighter-bomber aircraft. However, its use will require good target information, highly qualified pilots, and the target area must provide good geographical reference points. Defense against the LABS attack will be extremely difficult, and can only be countered to a certain degree.

5. CONCLUSIONS:

a. The LABS equipment is operationally suitable for providing a method of effective low altitude delivery of atomic weapons by fighter aircraft.

b. The effectiveness of the LABS method for atomic weapon delivery is noticeably increased if highly qualified and trained crews are used.

c. The utility of the LABS when using an IP is limited by the necessity for using a visual geographic reference point to obtain range.

d. Navigation to and from the target can be accomplished with sufficient effectiveness to indicate that continued exploitation and utilization of the LABS is warranted.

e. The effectiveness of the LABS is increased by the use of an automatic trim tab device.

6. RECOMMENDATIONS: It is recommended that:

a. The LABS be utilized for low altitude fighter-bomber delivery of atomic weapons.

b. Only pilots who are above average in experience and ability be assigned to LABS-equipped organizations.

c. Research and development be continued in an effort to find a satisfactory means of using the LABS without obtaining range from any geographical reference point other than the target.

d. Research and development be continued to provide suitable (navigational equipment for fighter-bomber aircraft.)

e. Research and development be undertaken to provide an automatic device for standardizing the pull-up in the LABS maneuver.

PATRICK W. TIMBERLAKE
Major General, USAF
Commander

C O P Y

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
Washington 25, D. C.

AFDRQ-TA-S

3 June 1952

SUBJECT: (Uncl) Assignment of "Ryan Toss Computer" Units to APGC for Test

TO: Commanding General
Air Proving Ground Command
Eglin Air Force Base
Florida

1. Reference is made to your 9 May 1952 letter, subject "(Secret Restricted Data) Low Altitude Delivery of Atomic Weapons by Fighter-Bomber Type Aircraft" and your 20 May letter, subject, "Assignment of Low Altitude Bombing System Computers to APGC." This headquarters is fully aware of the importance and urgency of developing a capability for low altitude delivery of Atomic Weapons by fighter aircraft.

2. The LABS Computer developed at WADC and known as the "Ryan Toss Computer" has been proposed as an interim solution. Immediate action was taken by this headquarters to procure component parts for the assembly of ten (10) units for test purposes. Tactical Air Command has recommended that the two (2) computers originally scheduled for test within TAC should be sent directly to APGC. Headquarters USAF has concured in this recommendation and ARDC has advised this headquarters that two (2) Ryan Toss Computers will be assigned directly to APGC for test.

3. This letter will serve as authority to conduct tests to explore tactics and techniques using the Ryan Toss Computer in conjunction with the A-series sights in low altitude toss bombing missions.

4. Action is being taken by this headquarters to provide the required timer installation within the bombs to make the weapon compatible with this low altitude toss technique.

5. This computer is intended for interim use in the F-84G Aircraft of the 20th Fighter-Bomber Wing and as part of the project carries a priority of 1A.

6. Direct communication with WADC is authorized with information copies of correspondence to Headquarters ARDC and Headquarters USAF.

BY COMMAND OF THE CHIEF OF STAFF:

/s/ Edwin A. Russell, Jr.
/t/ DORR E. NEWTON, JR.
Colonel, USAF
Chief, (Tactical Air Division)
Directorate of Requirements

RELATED TESTS

1. Project No. APG/TAT/83-A, Interim Letter Report, "(SECRET) Low Altitude Delivery of Atomic Weapons by Fighter-Bomber Type Aircraft," dated 6 November 1952.

2. Project No. APG/TAT/83-A-1, "(SECRET) Determination of Best Method of Fighter Low Altitude Special Weapons Delivery."

3. Project No. APG/TAT/83-A-2, Final Report, "(Uncl) Operational Suitability Test of Practice Bombs for LABS Computer Toss Bombing," dated 4 August 1953.

4. Project No. APG/TAT/131-A, "(Uncl) Operational Suitability Test of Mark-76 Practice Bomb for LABS Training."

5. Project No. APG/TAT/93-A, Final Report, "(Uncl) Operational Suitability Test of the BT-9 Toss Bombing Computer," dated 1 October 1953.

6. Project No. APG/TAB/15-A, Final Report, "(Uncl) Operational Suitability Test of the F-84E Aircraft for High Altitude Dive Bombing," dated 19 May 1952.

7. Project No. APG/TAB/75-A-2, Final Report, "(Uncl) Detection and Tracking of F-84 and B-45 Aircraft at High Altitudes by AN/FPS-3 Radar," dated 19 April 1952.

8. Project No. APG/SAS/98-A, Final Report, "(Uncl) Evaluation of Celestial Navigation for Fighter Pilots," not yet published.

9. Project No. APG/TAB/17-A, Final Report, "(Uncl) Operational Suitability Test of Jet Navigational Equipment," dated 12 September 1952.

10. Project No. 1496---5, "(Conf) Investigation and Evaluation of Minimum Altitude Navigation on Strategic and Tactical Type Missions," dated 9 February 1950.

DESCRIPTION, INSTALLATION, AND OPERATION

1. Description: The production type LABS is manufactured by Minneapolis Honeywell and was designed to provide a low altitude bombing capability for fighter-bomber aircraft with atomic weapons. Essentially, the LABS is comprised of the following components:

a. A Cageable Vertical Gyro: This is a free gyro in pitch, but will tumble at eighty-five (85) degrees bank. It is fitted with an electrical caging mechanism capable of accomplishing the caging cycle in approximately ten (10) seconds. A movable, calibrated sector switch is mounted on the pitch axis to energize the bombing circuit of the aircraft when the pitch attitude of the aircraft matches the preset angle of the gyro. This sector switch is preset by an adjusting screw at the top of the gyro case. A window in the top of the case enables the preset angle to be seen. Indicating potentiometers mounted in the gyro send signals to the pitch and roll indicator in the cockpit to show the aircraft attitude.

b. Relay Box: The relay box contains an adjustable intervalometer, transformer, five (5) relays, and two (2) pitch and roll indicator calibration potentiometers. A dial on the top of the box allows the intervalometer to be preset to measure time lapses up to twenty-four (24) seconds in increments of 0.2 seconds. The transformer provides the required voltage to the gyro erection motors. The calibration potentiometers are used to center the pointer of the pitch and roll indicator. The five relays provide the necessary signals to operate the complete system.

c. Pitch and Roll Indicator: This instrument is a modified Weston dual indicating meter which indicates to the pilot the attitude of the aircraft.

d. Control Switches: Three (3) switches are provided on the aircraft instrument panel: 1) power switch (LABS/A-7); 2) caging switch (Cage-Normal); and 3) starting switch (Computer Start "On-Off").

2. Installation in the F-84G:

a. The LABS Gyro and Relay Box are installed in the upper rear section of the gun deck and are mounted on an inverted "L" shape bracket which is supplied with the installation kit. The upper end of the bracket is over the gunsight amplifier and is bolted to the aircraft bulkhead (Station 87). The lower end of the bracket is forward of the sight amplifier and is bolted to the gunsight converter mount. The data case must be removed. The gyro is shock mounted and the relay box is mounted in the vertical portion of the bracket. (See Figure No. 2, below.)

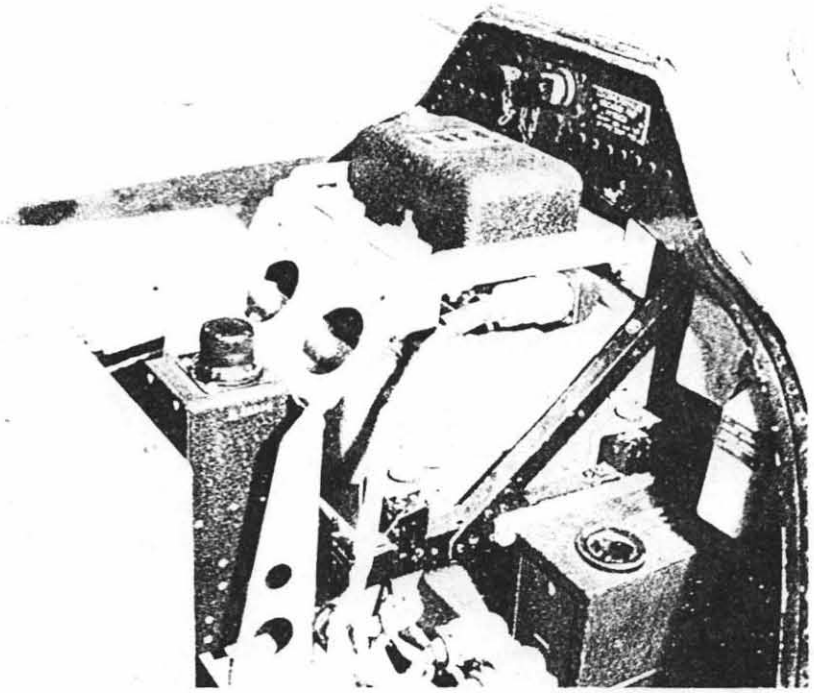


Figure No. 2 - LABS Installation in F-84G

b. The LABS indicator, power switch, starting switch, and caging switch are mounted on the left center portion of the gunsight control panel in the cockpit. (See Figure No. 3, below.) It should be noted that the flight instruments in the cockpit have been regrouped slightly. This consisted of exchanging the position of the attitude gyro and the radio compass indicator. This change grouped the attitude gyro, accelerometer, and LABS indicator in a vertical alignment which made it much easier for the pilot to accomplish a wings-level pull-up at constant acceleration (G's). This arrangement proved very satisfactory and required a minimum of relocation of the various instruments.

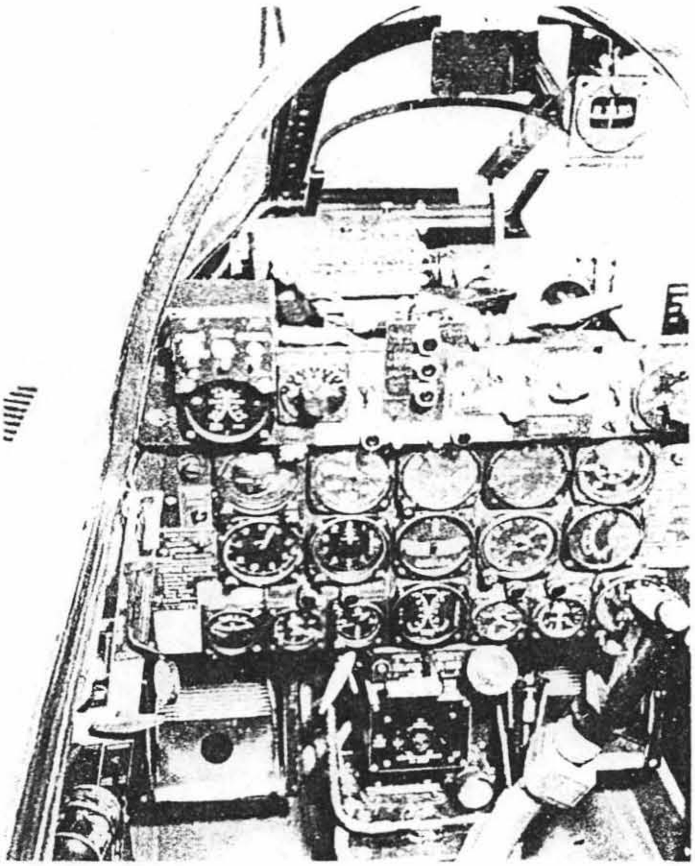


Figure No. 3 - LABS Cockpit Controls in F-84G

c. Power to the LABS is supplied from the aircraft twenty-eight (28) volt DC system and 115 volt, 400 cycle, three (3) phase inverter. The LABS units are integrated with the "A" Series gunsight reticle lamp circuit and the bomb release button.

3. Operation: The LABS is extremely simple to operate. When the aircraft engine is started and the inverters are operating, place the "LABS/A-7" switch to the "LABS" position, supplying power to the LABS system. Then place the "Computer Start" switch to the "On" position, energizing the LABS gyro. When the gyro has attained full speed, uncage the gyro. This is normally done before taxiing out for take-off. The LABS indicator is used as a reference to insure that the gyro is operating properly. The LABS may be operated continuously until the bomb(s) have been dropped. It may then be turned off by caging the gyro, switching off the "Computer Start" switch, and placing the "LABS/A-7" switch to

the "A-7" position. The LABS may also remain in operation throughout the entire mission, providing the above shutdown procedure is followed prior to stopping the aircraft engine.

a. If the pilot desires to abort the bombing run at any time prior to release, computer action may be stopped by releasing the bomb button. If this occurs, the system must be recycled by momentarily turning the "Computer Start" switch to "Off" and then back to "On". The system is then ready for another bombing run.

b. If the gyro is tumbled by exceeding eighty-five (85) degrees of bank, the pilot should place the "Caged-Normal" switch to the "Caged" position for a minimum of ten (10) seconds, then return it to the "Normal" position while in straight and level flight.

TEST PROCEDURES

1. Physical testing was divided into four (4) general phases as follows:

a. Phase One: Preliminary investigation and familiarization. Approximately thirty (30) sorties were flown during this phase for developing data, correcting instrumentation problems, familiarization with LABS equipment, etc. This phase supplied a basis for further experimentation in techniques and procedures for the remainder of the test.

b. Phase Two: This period was a concentrated effort on release angles of 60 and 45 degrees which were more likely to be used with the available radar fuzing. However, some sorties were flown with release angles of 30 and 35 degrees. All missions throughout this phase were conducted using the prototype LABS.

c. Phase Three: The test was expanded to include additional sorties at 35, 45, 60, 75, and 90 degrees using the production type LABS which had been installed in the same test aircraft. Approximately seventy (70) sorties were completed using three (3) pilots on each of the release angles. These sorties were all conducted on a land range which had suitable targets and IP's.

d. Phase Four: The test program was amended to include a navigational phase during which thirty-nine (39) sorties were flown to investigate the basic problems incidental to this type of operation. The procedure involved was as follows: 1) select an unfamiliar target; 2) locate a suitable IP from existing maps or target photographs; 3) fly to a penetration point by dead reckoning and pilotage only, penetrating weather if necessary; 4) navigate to the IP and perform a simulated attack; and 5) return to the base. Four (4) full external fuel tanks were carried all the way on eight (8) sorties. Six (6) sorties were flown using B-47 aircraft to simulate the range capabilities of future fighter aircraft. Radio aids were not used except in emergencies or when weather conditions made it necessary to comply with Air Traffic Control. Scoring on the first ten (10) sorties was accomplished when possible by assessing photographs taken from a 35mm camera mounted in the autopilot well of the aircraft pointing straight down. The remaining missions were analyzed from the pilot reports. Complete data cards were kept and the pilots' views were recorded. A total of eighteen (18) pilots, selected at random, were used to fly the sorties on this phase. Each pilot used a different IP and target on each mission. The missions were made more difficult by the lack of target photographs and target maps.

2. In order to provide suitable data for evaluation of the LABS, both a water range and a land range were used as test sites since four (4) phototheodolite stations were in position and available. Two (2) of the stations were used to track the aircraft until bomb impact and two (2) to track the bomb from release to impact. The recording devices at these stations were synchronized to allow correlation of the data obtained. A single point IP was used on the water range, while the IP on the land range was a road perpendicular to the line of flight.

3. The airborne instrumentation consisted of a flight recorder with an altimeter, attitude gyro, accelerometer, airspeed indicator, clock, and four (4) tel-lites. The tel-lites were used to indicate "pickle," reticle out, and bomb release for each pylon shackle. Through electronic signals, operation of the tel-lites activated markers in the ground recording equipment. This allowed determination of the pilots' errors in "pickling" at the IP, and the altitude and distance gained from the point of initiating a pull-up to bomb release. The bombs used in the test were 500-pound M-64A1 bombs with M-128 high speed fins since the trajectories of these bombs most nearly approximate the trajectory of the Mark 7 bomb. After sufficient data had been recorded to provide a basis for analyzing errors, escape distances, etc., the airborne and ground instrumentation was discontinued with only the bomb impacts being scored.

4. A study of the available aircraft and bomb ballistic data resulted in the following conditions used throughout the test:

a. Bomb release angles of 30, 35, 45, 60, 75, and 90 degrees.

b. An acceleration of 3.5 to 5.0 G's with emphasis on 4.0.

c. An indicated airspeed of 475 to 525 mph.

5. During the first part of the test, using the prototype LABS, all pull-ups were made manually. However, when the production LABS was installed, an Automatic Trim Tab Device was incorporated into the system, allowing all pull-ups to be initiated automatically. The operation of this device is described in detail in Appendix I.

TEST RESULTS

The results obtained during the four (4) phases of the LABS Computer investigation are presented below:

1. Phase One - Preliminary Investigations: The results obtained from the preliminary investigation of airspeed errors, altimeter errors, and flight characteristics of the aircraft with a 230 gallon water-filled pylon tank are as follows:

a. The data obtained from the airspeed and altimeter calibration flights were reduced and are presented in Figures 4 and 5, below, in the form of correction charts. These charts are applicable only to the aircraft used in the tests, but are indicative of the magnitude and direction of errors in F-84G type aircraft. During the calibration flights of this phase, it was determined that level acceleration above 500 mph (true) is very slow, and that approximately 525 mph (true) was all that could be expected in a tactical situation where an instrument letdown had to be made at a low altitude followed by acceleration to bombing airspeed while navigating to the initial point (IP).

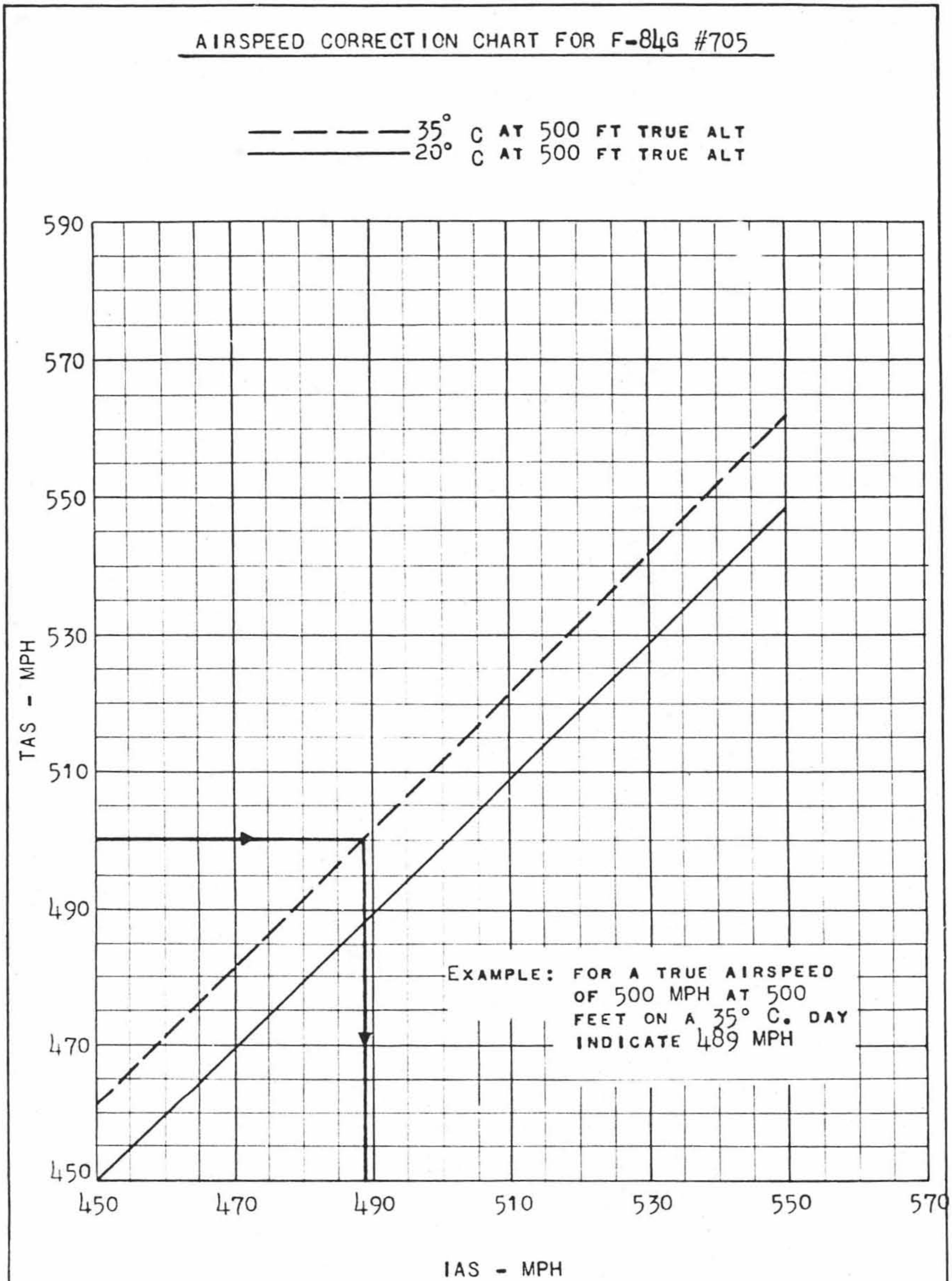

AIRSPEED CORRECTION CHART FOR F-84G #705
35° C AT 500 FT TRUE ALT
20° C AT 500 FT TRUE ALT
590
570
550
530
510
490
470
450
TAS - MPH
450
470
490
510
530
550
570
IAS - MPH
EXAMPLE: FOR A TRUE AIRSPEED OF 500 MPH AT 500 FEET ON A 35° C. DAY INDICATE 489 MPH

Figure No. 4

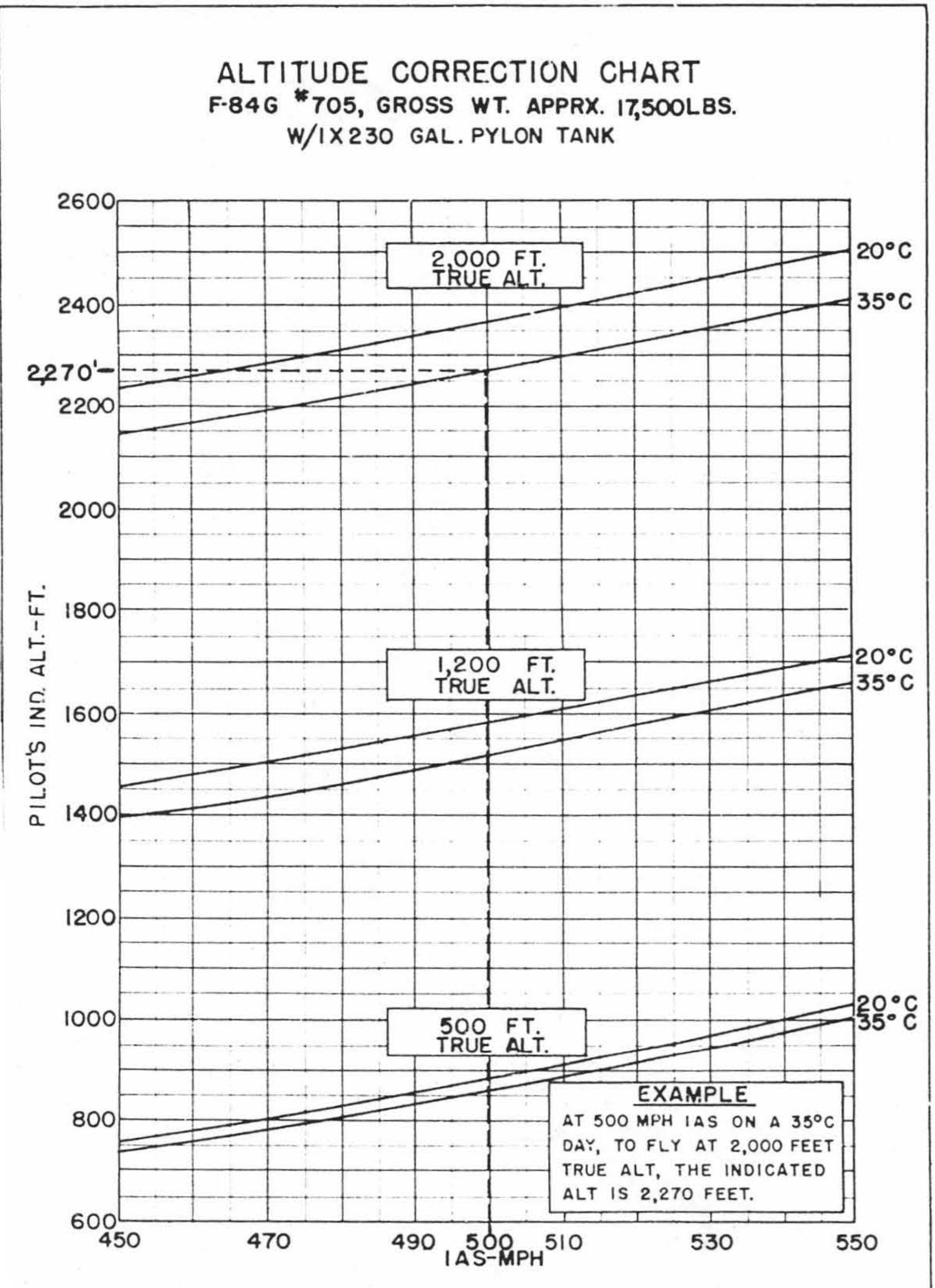

ALTITUDE CORRECTION CHART
F-84G #705, GROSS WT. APPRX. 17,500LBS.
W/1X230 GAL. PYLON TANK
2,000 FT. TRUE ALT.
1,200 FT. TRUE ALT.
500 FT. TRUE ALT.
20°C
35°C
2,270'
PILOT'S IND. ALT.-FT.
IAS-MPH
EXAMPLE
AT 500 MPH IAS ON A 35°C DAY, TO FLY AT 2,000 FEET TRUE ALT, THE INDICATED ALT IS 2,270 FEET.

Figure No. 5

b. With the aircraft carrying one (1) water-filled 230 gallon pylon tank to simulate a weapon, it was found that the aircraft flew in a skid which increased with airspeed. However, since a fuel tank would probably be carried on the other pylon for normal operation, the skid characteristic will arise only after the aircraft has dropped the pylon fuel tank.

c. The preliminary bomb tosses made during this phase indicated the general functional reliability of the LABS system insofar as the timer, reticle out, reticle on, and release mechanisms were concerned. It was found that the prototype LABS gyro would tumble readily and required approximately fifteen (15) minutes for re-erection. However, the production LABS has overcome this difficulty with a gyro caging mechanism which will erect the gyro in approximately ten (10) seconds.

2. Phase Two - Prototype LABS: The results of this phase of the test using the prototype LABS are shown in tabular form in Figure No. 6:

LAB INTERIM RESULTS

PROTOTYPE COMPUTER

WATER RANGE — SINGLE POINT IP

PILOT	ANGLE DEG	NO. BOMBS	REA (FT)	DEA (FT)	CEA (FT)	MPI RANGE (FT)	MPI DEFL (FT)	CEP (FT)	REMARKS
B	30	14	762	484	1017	408-S	475-L	792	
	30	14	613	637	947	274-S	637-L	716	CORRECTED TO "O" PICKLE ERROR
	30	14	616	191	648	291-S	191-L	562	CORRECTED TO "O" PICKLE & COURSE ERROR
B	60	13	1199	1787	2268	410-S	1472-L	1853	
	60	13	763	1715	2055	182-S	1493-L	1487	CORRECTED TO "O" PICKLE ERROR
	60	13	825	1095	1522	285-S	393-L	1385	CORRECTED TO "O" PICKLE & COURSE ERROR
F	60	7	989	1224	1751	606-S	407-L	1551	
	60	12	709	984	1354	456-O	631-L	1068	CORRECTED TO "O" PICKLE ERROR
	60	12	698	433	927	445-O	266-L	811	CORRECTED TO "O" PICKLE & COURSE ERROR
LAND RANGE — LINE IP									
ALL (F,H,J)	35	20	830	381	1000	666-S	142-R	824	
	45	8	568	711	1003	568-O	31-R	822	
	60	12	1217	567	1460	1217-O	168-R	829	

REA - AVERAGE RANGE ERROR
DEA - AVERAGE DEFLECTION ERROR
CEA - AVERAGE CIRCULAR ERROR
CEP - PROBABLE CIRCULAR ERROR

MPI - MEAN POINT OF IMPACT
S - SHORT
O - OVER
R - RIGHT
L - LEFT

Figure No. 6

The above data was included for two (2) reasons: 1) to present a comparison of the prototype LABS with the production model; and 2) to show the errors resulting from the use of a single point IP and flying a pre-determined course from IP to target. The results using the production LABS show a marked improvement as may be seen in the tables following this discussion. An analysis of errors was made following the completion of all missions on the water range and is as follows:

a. Pickle Errors: This error can be practically eliminated by using a line IP such as a road, river, edge of a lake, etc. The magnitude of the error using a single point IP varies directly with increases in altitude. For the missions shown above, the average pickle error at 500 feet approach altitude was 291 feet.

b. Course Error: This error is obviously caused by failure to correct for variation, compass deviation, and wind drift. These factors will apply only when the target is not visible when over the IP. A rule of thumb method of wind correction developed by trial and error is as follows:

(1) When tossing at angles of sixty (60) degrees and higher, double the wind correction necessary to maintain a true track on a line from IP to target.

(2) When tossing at angles less than sixty (60) degrees, use one and one-half (1-1/2) times the wind correction necessary to maintain a true track on a line from IP to target. Using these rules it is necessary, of course, to establish a drift correction prior to reaching the IP, then apply the extra correction just prior to the pull-up point.

c. Airspeed Error: This error will be difficult to eliminate entirely. It depends upon the pilot's ability to hold the desired airspeed, the correction of indicated to true airspeed, and the correction for wind effect to maintain the desired ground speed.

d. Altitude Error: This error is not significant for high angle releases, but becomes more important when low angle releases are made.

e. Pull-Up and Toss Error: Incorrect groundspeed or altitude at the pull-up point will cause proportionate errors in the distance covered during pull-up, release altitude, and bomb toss distance. If the wings are not held level during pull-up, the bomb is tossed at an angle to the desired course, resulting in large deflection errors. This error may be reduced by pilot training and the use of a more reliable attitude gyro or a more sensitive LABS indicator. The effect of small errors in "G" force during pull-up can be minimized as these errors tend to cancel out.

3. Phase Three - Production LABS: The complete results of this phase are shown in the following charts and curves. These results have not been corrected for any errors whatsoever. It must be emphasized that this test was not conducted under controlled conditions and the majority of the releases were made with a direct crosswind of ten (10) to fifteen (15) knots. An interpretation of the chart and curves follows:

a. LABS Final Results with Production Model: (See Figure No. 7.) Three (3) experienced and qualified pilots were used to determine the data presented in this table. It should be noted that the CEP's of all three pilots generally are about the same. The one (1) exception is the sudden increase in the CEP's of pilot "F" at release angles of 75 and 90 degrees. These six (6) missions were flown on two (2) successive days and the pilot reported in his daily test reports that all pull-ups were made through scattered to broken clouds at 1,500 feet in turbulent air. The attitude gyro was also found to be precessing excessively and was replaced soon thereafter.

(1) The 90 degree releases using depressed sight ranging indicate a greater CEP than is desirable. This method is not considered satisfactory at this time due to the larger error in ranging encountered in turbulent air and the higher approach altitude required. Altitude becomes a critical factor using this method.

(2) All pull-ups during this phase of the test were made with the automatic trim tab device, except as noted. No significant increase in accuracy was obtained in comparison with the few manual pull-ups made since the test pilots were already experienced in this maneuver. However, the use of this device should be of great assistance in the training of new pilots for accuracy. The automatic trim feature also simplifies the escape Immelman since very little stick force is required.

LAB FINAL RESULTS

PRODUCTION COMPUTER — LAND RANGE

PILOT	RELEASE ANGLE DEG.	NO. BOMBS	REA (FT)	DEA (FT)	CEA (FT)	MPI RANGE (FT)	MPI DEFL. (FT)	CEP (FT)	REMARKS
ALL	35	22	595	147	637	486-O	83-R	416	
	45	17	510	348	669	109-O	0	590	
	60	20	512	394	733	333-S	216-R	628	
	60*	18	395	438	686	33-O	43-R	660	
	75	16	609	596	920	137-S	243-R	873	
	90	17	431	681	883	107-S	113-R	865	
F	35	10	667	148	695	667-O	69-R	355	
	45	6	390	430	653	387-O	60-R	500	
	60	10	532	330	727	242-S	264-R	651	
	60*	5	598	434	848	554-O	182-L	655	
	75	5	883	585	1076	261-S	59-L	1138	
	90**	6	450	961	1134	380-S	243-R	1048	
	90	13	639	1468	1681	345-S	1468-R	1051	
H	35	6	687	72	696	663-O	55-R	303	
	45	5	569	384	718	569-S	52-L	407	
	60	4	268	304	441	97-S	36-R	432	
	60*	8	234	267	426	176-S	232-L	318	
	75	5	424	522	796	330-O	298-R	725	
	90	6	384	366	586	21-O	184-L	603	
J	35	6	383	219	480	8-O	134-R	453	
	45	6	581	236	645	396-O	16-L	504	
	60	6	643	561	937	643-S	258-R	605	
	60*	5	449	716	938	153-S	706-R	613	
	75	6	537	666	893	423-S	449-R	680	
	90	5	465	725	938	67-O	383-R	881	

REA - AVERAGE RANGE ERROR
DEA - AVERAGE DEFLECTION ERROR
CEA - AVERAGE CIRCULAR ERROR
CEP - PROBABLE CIRCULAR ERROR

MPI - MEAN POINT OF IMPACT
S - SHORT
O - OVER
R - RIGHT
L - LEFT

*MANUAL PULL-UP

**DEPRESSED SIGHT RANGING

Figure No. 7

b. Pilot Accuracy Curves: (Figure No. 8.) These curves reflect the data in the preceeding table graphically. It will be noted that the CEP increases with a corresponding increase in the release angle.

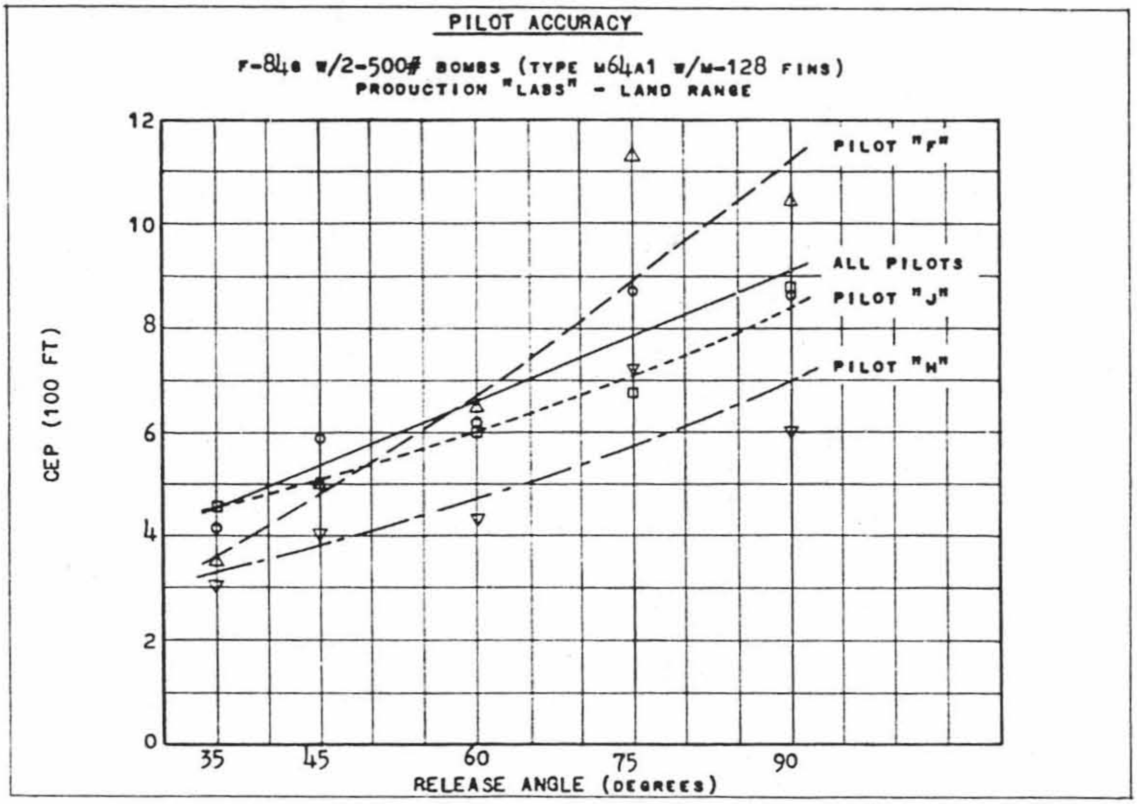


Figure No. 8

c. Percentage of Bombs Striking Within Certain Distance from Target: (Figure No. 9.) This curve shows that eighty (80) per cent of all bombs dropped fell within 1,000 feet of the target, ninety-four (94) per cent fell within 1,500 feet, and all bombs fell within 2,200 feet.

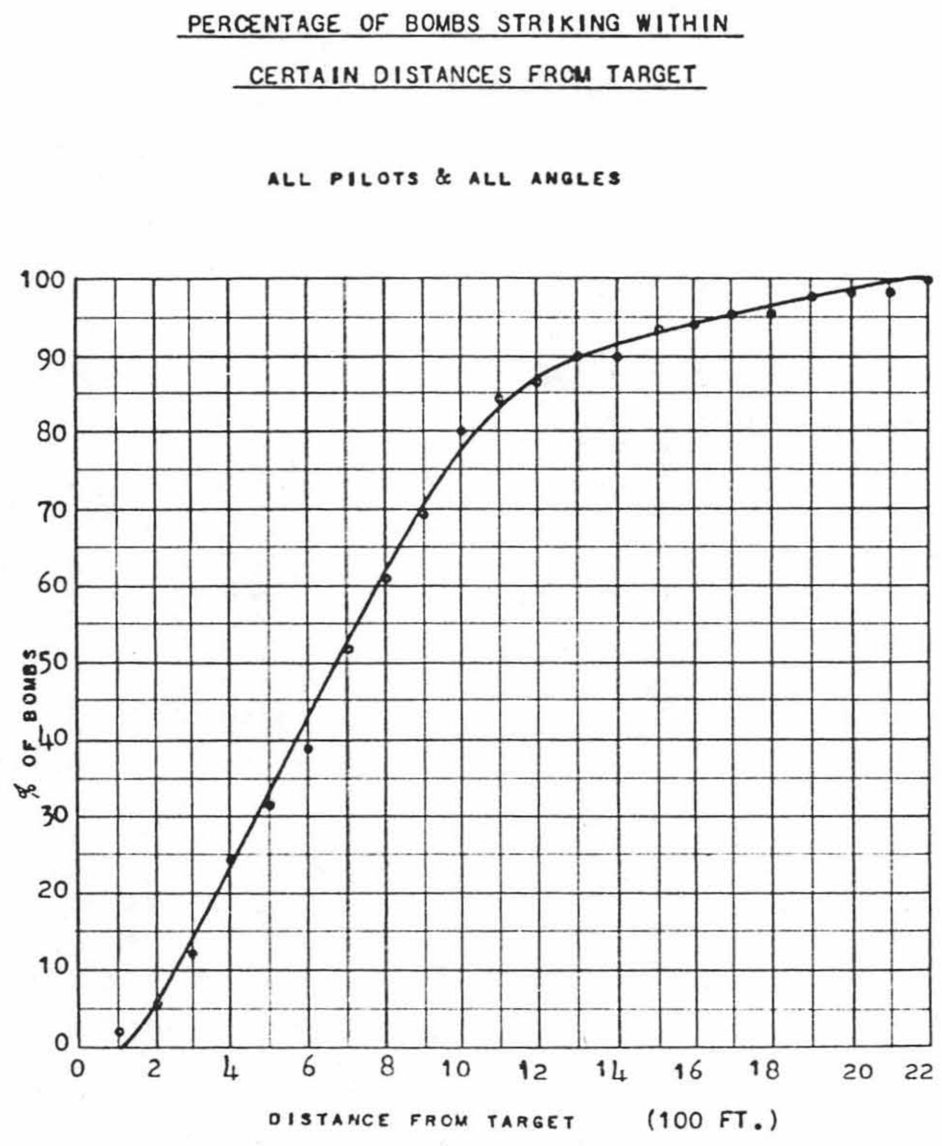


Figure No. 9

d. Escape Distance vs Release Angle: Two (2) separate graphs are presented. Figure No. 10 illustrates the actual escape distances obtained as measured by phototheodolites. Figure No. 11 shows the theoretical escape distances for all angles as obtained by plotting the bomb trajectory for each angle with an actual Immelman profile.

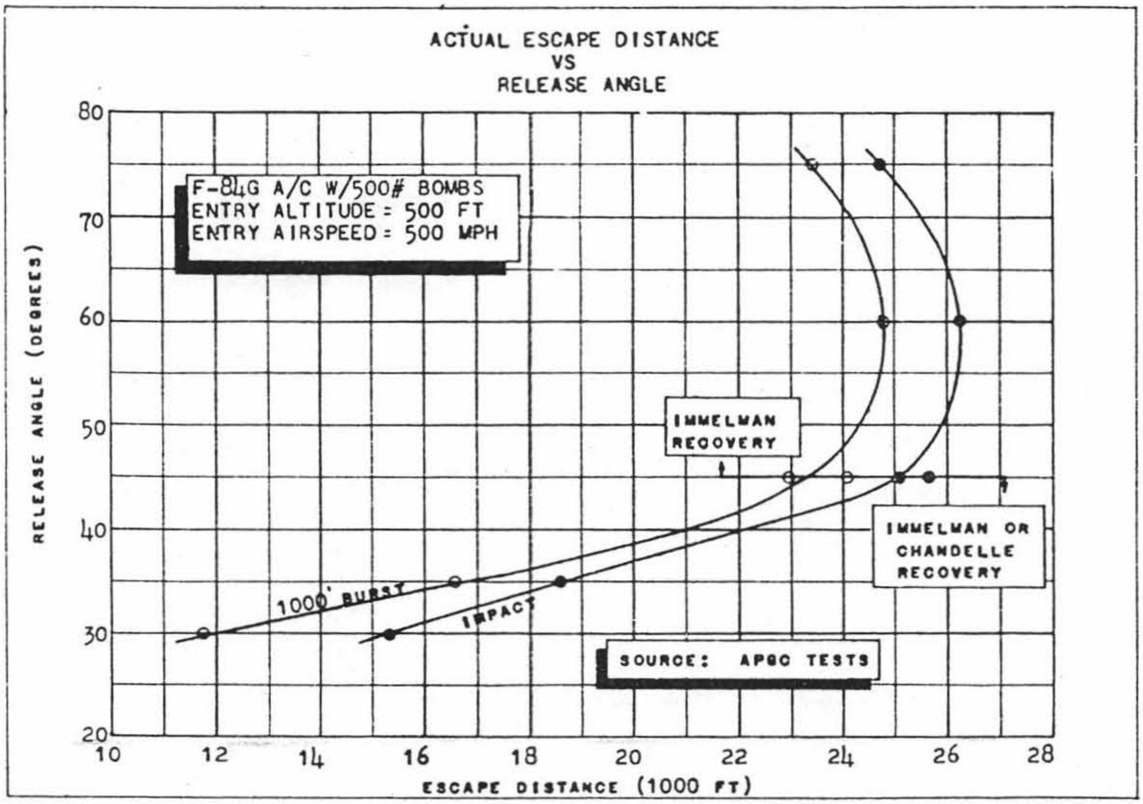


Figure No. 10

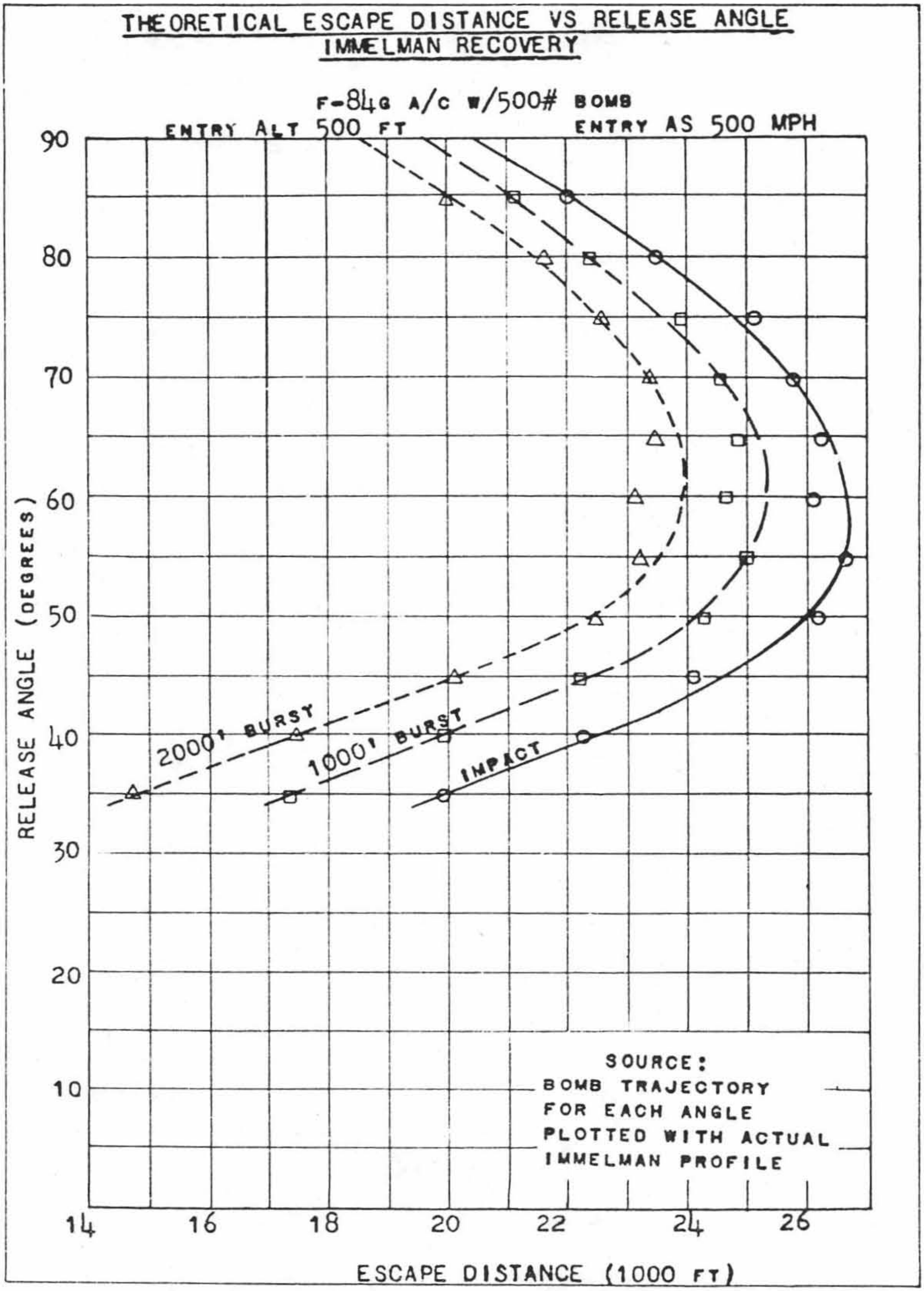


Figure No. 11
Appendix E, Page 12

4. Phase Four - Navigation:

a. The complete breakdown of sorties flown is as follows:

(1) Total Number of Sorties: 39.

(a) F-84 - 30.

(b) F-86 - 2.

(c) B-47 - 6.

(d) B-45 - 1.

(2) Number of Aborts: 6.

(a) Weather - 3.

(b) Failure to locate IP - 1.

(c) Failure to pass over IP on heading to target - 2.

(3) Number Altitude Penetrations: 30.

(4) Number Weather Penetrations: 22.

(5) Number Low Level Sorties (500 Feet): 9.

b. A total of eighteen (18) pilots were used to fly these sorties. The principal targets selected were cities and towns, airfields, and railroad yards. Target maps and photographs were available for only a small number of targets and sectional charts were used for the remainder. Pilot briefings were short and concise with minimum time allowed for target study. In spite of these conditions eighty-five (85) per cent of the sorties were accomplished successfully. Pilots reported that they were able to pass over the IP at 500 mph on a heading which would take them into the target. Some difficulties were experienced in navigating at 500 feet and 500 mph, but all pilots felt that with practice these difficulties could be overcome. It must be emphasized that these pilots, particularly the B-47 crews, were not proficient in low level navigation. The bomber pilots were all of the opinion that an autopilot would be a definite aid in navigating at low level. The following general statements were derived with the concurrence of the participating pilots:

(1) Dead reckoning at altitude to a target area within fighter radius of action is feasible.

(2) Dead reckoning combined with pilotage simplifies the navigation problem to the point where success is almost assured, commensurate with pilot ability.

(3) The use of celestial navigation will further assure the success of a mission.

(4) Weather penetration in the target area is feasible with ceilings of 1,500 to 2,000 feet and five (5) to ten (10) miles visibility.

(5) Low level navigation over areas similar to the southern states is relatively simple. However, over areas where there are few check points, such as in West Texas, time and distance flying is required.

(6) Marking the course lines in minutes instead of miles and using a navigation watch makes low level navigation much simpler.

(7) Using a prominent landmark toward which the letdown is made to low altitude enables the pilot to definitely locate his position while still forty (40) to one hundred (100) miles away from the target. From this point, low level navigation into the IP and target is relatively simple.

(8) Wherever possible, the last fifteen (15) to twenty (20) miles of the low level navigation to the IP should be on a straight line which passes over the IP on a heading to the target.

c. Analysis of Aborts:

(1) One (1) pilot failed to locate the IP or the target, which was at a distance of 505 nautical miles. Dead reckoning alone was used, penetrating on a river in the mountains of Virginia. The pilot searched for ten (10) minutes at low altitude but was unable to identify his position.

(2) One (1) pilot aborted the mission after descending from 30,000 feet to 500 feet in weather and failing to break out.

(3) Two (2) pilots aborted missions because of a line of severe thunderstorms.

(4) On two (2) missions one (1) pilot was unable to pass over the IP on a heading to the target on the first attempt. On one (1) mission the pilot did not see the IP when he passed over it. This IP was a ninety (90) degree railroad intersection in a draw. On the other mission the pilot was short of fuel due to adverse climb instructions in weather and was unable to orbit to definitely identify his position when he letdown at the penetration point. He passed over the target first, then circled back to make the bomb run over the IP.

d. The details of a simulated LABS bombing mission, including target study, navigation, etc., are presented in Appendices F and G.

MISSION PLANNING INFORMATION

1. Introduction: The purpose of this appendix is to present the factors to be considered and the procedure to be followed in planning a LABS mission against a representative target. The aircraft considered is a LABS-equipped F-84G. The type of weapon to be used and the related arming and fuzing is not included in detail, since these factors are constantly changing with new weapons and modifications. Nashville, Tennessee, was selected as a representative target because of the variety of strategic targets available and because it is located in hilly terrain. A target map (Figure No. 12) shows three (3) targets and IP's against which four (4) simulated bombing sorties were completed during the navigation phase of the project.

2. Required Planning Materials:

a. Bomb ballistic tables for toss bombing, aircraft pull-up tables, and aircraft angle of attack tables.

b. Maps, charts and photographs:

(1) 1:500,000 or smaller scale map and/or photo of similar scale for target information and distance measuring.

(2) 1:500,000 map for the low level attack course.

(3) En route charts as desired.

c. Cruise data on type aircraft. Four (4) sample profile missions are included for information and reference. (Figures No. 13 through 16.)

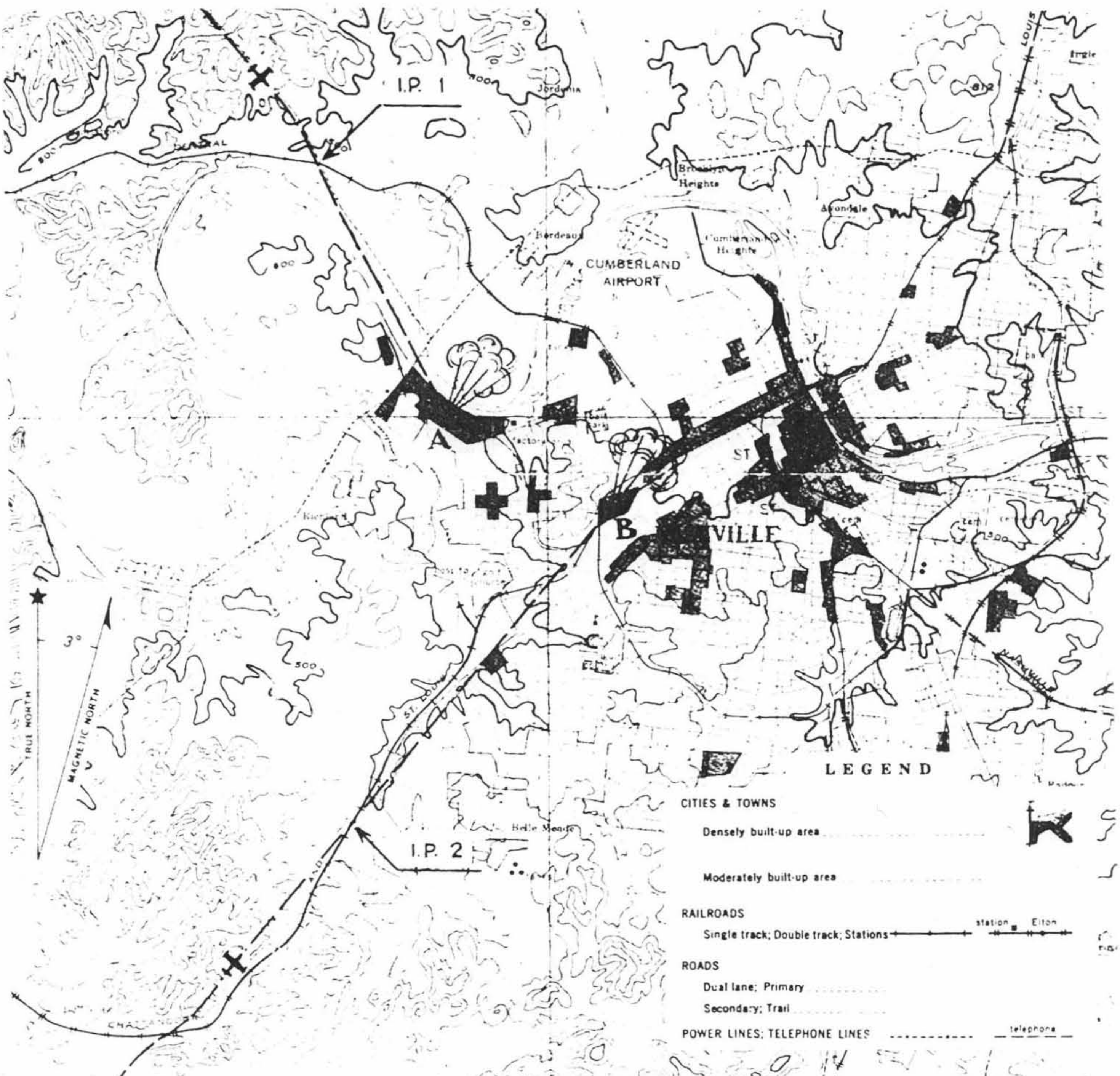
d. Weather Information:

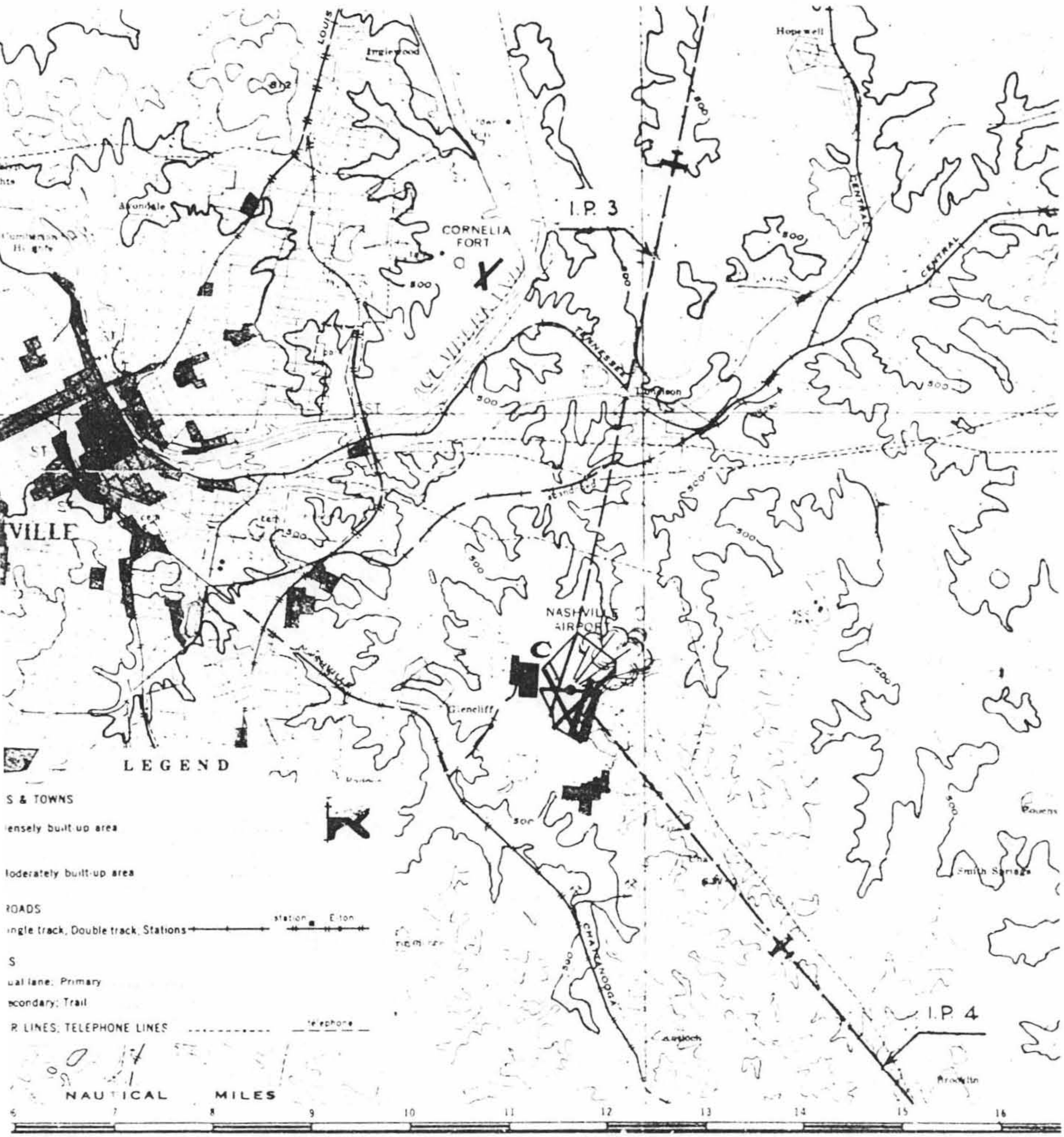
(1) High level winds and temperatures en route.

(2) Ceiling and visibility at target.

(3) Temperature and surface winds at target.

(4) Target pressure altitude.


I.P. 1
I.P. 2
CUMBERLAND
AIRPORT
Bordeaux
Heights
Avondale
Jordonia
A
B
VILLE
Belle Meade
3°
TRUE NORTH
MAGNETIC NORTH
500
LEGEND
CITIES & TOWNS
Densely built-up area
Moderately built-up area
RAILROADS
Single track; Double track; Stations
station
Elton
ROADS
Dual lane; Primary
Secondary; Trail
POWER LINES; TELEPHONE LINES
telephone
NAUTICAL MILES
1
0
1
2
3
4
5
6
7
8
9
10



Hopewell
Inglewood
LOUIS
I.P. 3
CORNELIA
FORT
CENTRAL
TENNESSEE
VILLE
NASHVILLE
AIRPORT
Glencliff
Smith Springs
CHATTANOOGA
I.P. 4
LEGEND
S & TOWNS
lensely built-up area
loderately built-up area
ROADS
ingle track, Double track, Stations
station
Elton
S
ual lane; Primary
econdary; Trail
R LINES; TELEPHONE LINES
telephone
NAUTICAL MILES
6
7
8
9
10
11
12
13
14
15
16

Figure No 12

3. Selection of the IP: The proper selection of an IP depends upon several variable factors:

a. The selected release angle of the LABS will determine a definite range span from the target within which the IP may be located (maximum distance from target - six (6) miles). Selection of the release angle is determined by the following:

(1) Type of fuzing to be employed.

(2) Desired accuracy of delivery.

(3) Escape distance required.

b. The type of terrain surrounding the target must be considered to determine from which direction the target should be approached.

c. The IP should be an easily recognized landmark such as a railroad crossing, river bridge or dam, coastline, lake, tower, etc.

d. The IP should, when possible, be located along or crossing a prominent checkpoint such as a railroad or highway to simplify navigation. The IP's shown on the map (Figure No. 12, Page 39) were selected to demonstrate the possibilities that exist and to show that they can be used successfully, as was determined during testing. IP-1 is simple since the pilot may navigate down a power line to intersect the railroad at the desired point. IP-2 is relatively difficult since the pilot must approach the railroad and highway intersection from open country and has only about twenty-five (25) seconds to identify it. IP-3 is simple since the pilot uses a prominent river bend and intersection and has sufficient warning of its approach. In this connection, small rivers should not be used since heavy foliage might obscure the river from the pilot's view at low level. IP-4 is difficult since the pilot must identify one (1) secondary road crossing out of many along a principal highway. This type of IP should be used only as a last resort since success is dependent upon precise low level navigation. Careful study of the target area should enable mission planners to locate suitable IP's in most areas.

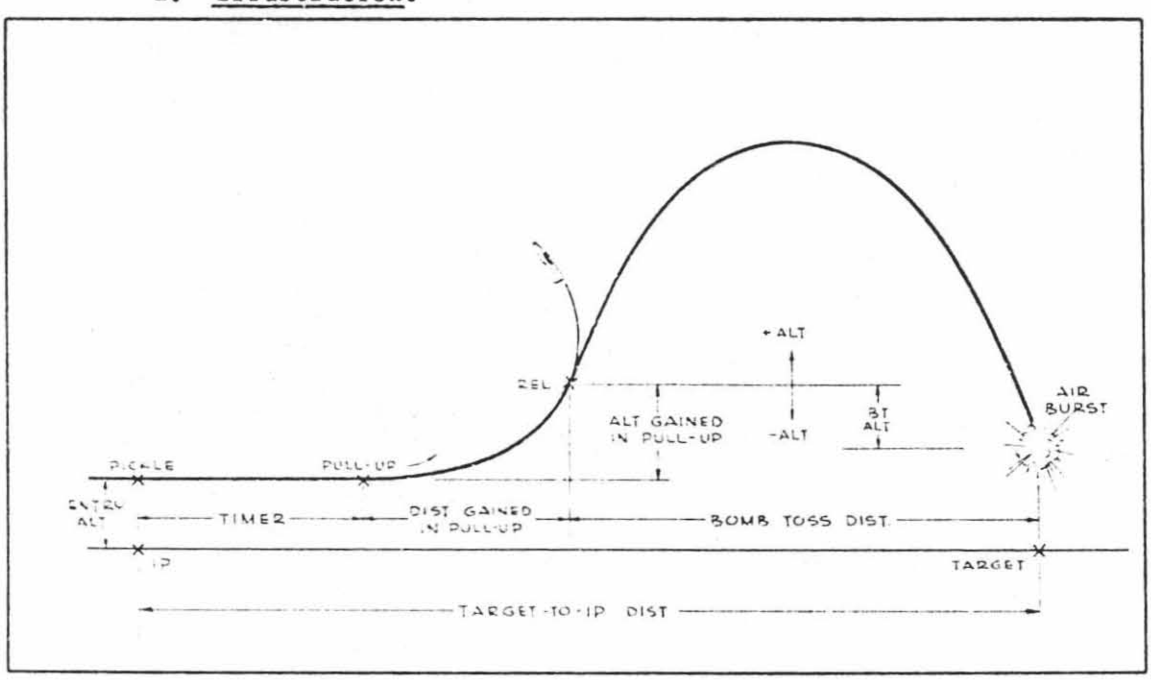
4. Selection of a Penetration Point: While determining an IP, it must be kept in mind that there should be a penetration point near the target area, into which the pilot can descend to lower altitudes, definitely identify his position, and then navigate to the IP and target. This might possibly be the first visible position fix since take-off and should not necessarily be a point, but rather an area, such as a lake, mountain, or some other prominent terrain

feature located within forty (40) to one hundred (100) miles of the target. It must be assumed that dead reckoning navigation will not provide pinpoint accuracy; consequently, the pilot should have some outstanding check point on which to position himself for the final run into the target. With positive identification several miles from the target and proper study of the low level route inbound to the target, the use of an IP becomes a less limiting factor. Letdown on the target itself is not advised for obvious reasons. Penetration into moderate sized cities is not advised since they are often difficult to definitely identify.

5. Map Preparation for Final Approach to Target: For navigation to the IP and target, a map with a scale no larger than 1:500,000 should be used. The final approach course from the penetration point to the IP should be marked off in minutes, such as seven and one-half (7-1/2) miles per minute for 450 mph. This speed will allow acceleration to bombing speed of 500 mph in two (2) minutes or less and the last two (2) minutes of the course line should be scaled accordingly. If the pilot desires, five (5) degree drift lines can be drawn on either side of the course line, using the IP as an apex. This feature is applicable when the final approach course is a straight line to the IP. In some cases it may be simpler to fly from point to point where there are good check points. In any case the final fifteen (15) to twenty (20) miles of the approach should be on a line with the IP and target so that only small corrections are necessary to pass over the IP on a heading to the target. The above procedure was used throughout the navigation phase of the project and was very successful.

6. Determination of LABS Settings:

a. Illustration:



b. After target data (target, IP, approach course, burst height, etc.) have been selected, determine the entry altitude above the target, entry airspeed, and desired bomb release angle. These are best determined from the situation expected at the time the mission is to be flown. Such factors as terrain features, target defense, etc., will have to be considered.

c. From the aircraft pull-up tables, for the proper "G" force pull-up, determine the distance gained in pull-up, altitude gained in pull-up, airspeed at release angle, and, for a time fuze started at the pickle point, time required to attain release angle after pull-up is started.

d. Determine release altitude by adding the altitude gained in pull-up to the entry altitude. Subtract the burst height from release altitude to determine altitude at which to enter bombing tables. If burst height is less than release altitude, bombing table altitude is negative (-). If burst height is greater than release altitude, bombing table altitude is positive (+).

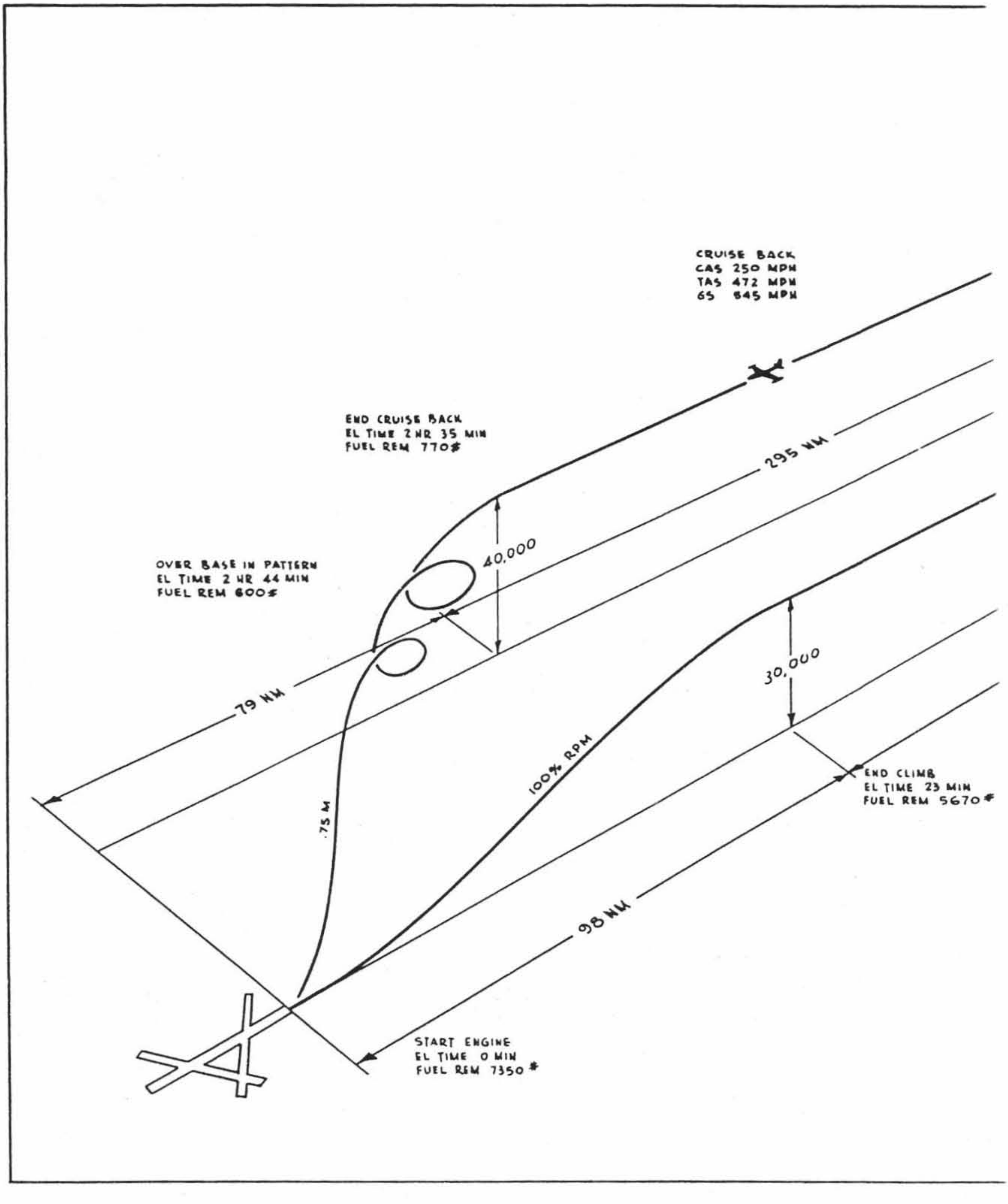
e. Enter bombing tables for correct release angle, release airspeed, and bombing table altitude to obtain bomb toss distance and, for a time fuze, time of flight.

f. Add bomb toss distance and distance gained in pull-up. Subtract this from target-to-IP distance and divide by entry ground speed to obtain LABS timer setting.

g. Obtain the aircraft angle of attack from the angle of attack versus airspeed chart on the "G" force curve at which the pull-up will be made. Add this angle algebraically to the release angle previously selected to obtain the angle to be set in the LABS gyro.

h. To determine the time setting at which the fuze is to be cut (if time option of the fuze is used), add the time of flight of the bomb, time of pull-up, and LABS timer setting for the fuze which is started at "pickle" point.

i. Set the LABS timer at the time determined in paragraph f, set the LABS gyro angle at the angle determined in paragraph g, and set the time fuze at the setting determined in paragraph h.


CRUISE BACK
CAS 250 MPH
TAS 472 MPH
GS 545 MPH
END CRUISE BACK
EL TIME 2 HR 35 MIN
FUEL REM 770#
295 NM
40,000
OVER BASE IN PATTERN
EL TIME 2 HR 44 MIN
FUEL REM 600#
79 NM
30,000
100% RPM
.75 M
END CLIMB
EL TIME 23 MIN
FUEL REM 5670#
98 NM
START ENGINE
EL TIME 0 MIN
FUEL REM 7350#

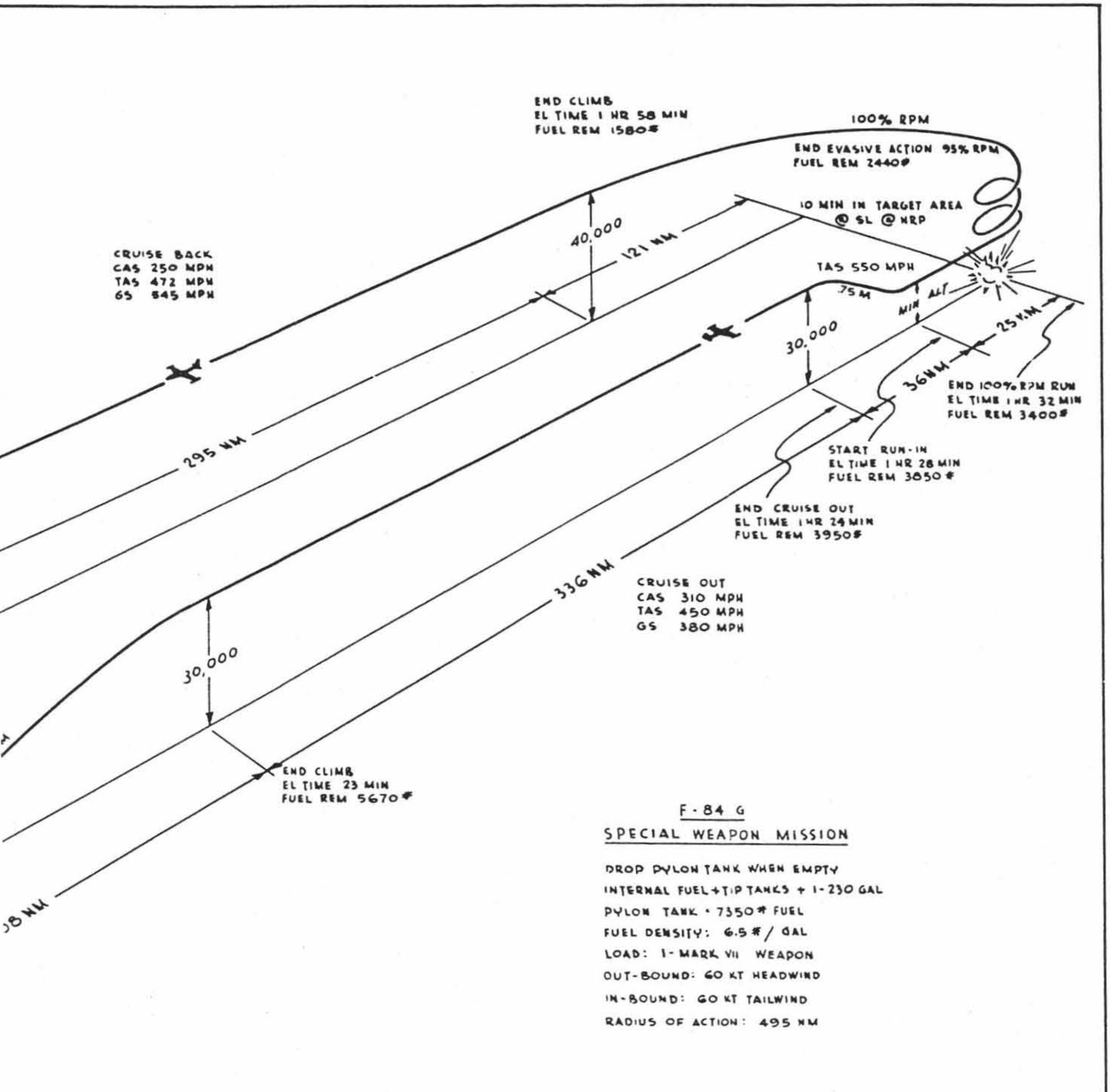
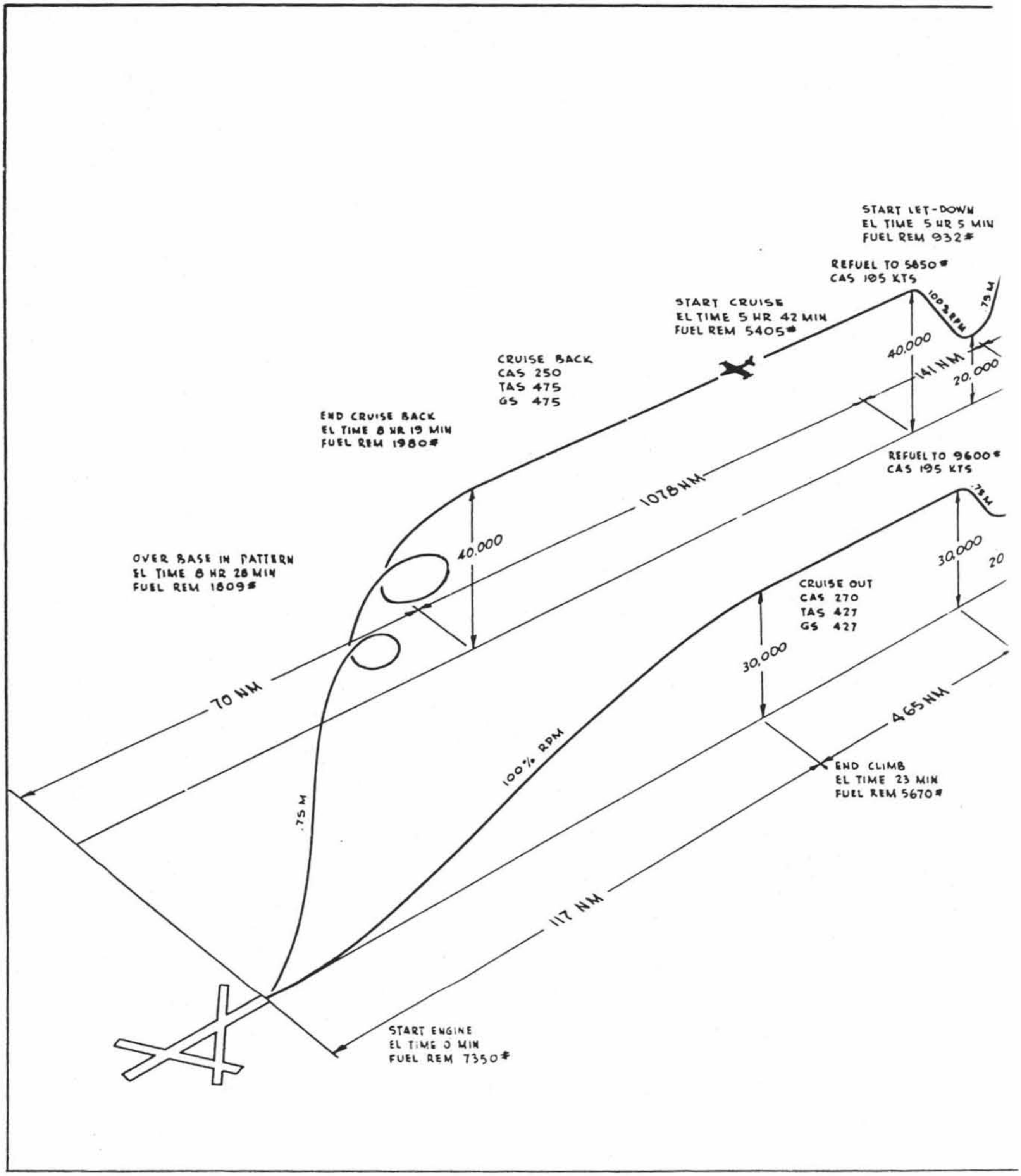
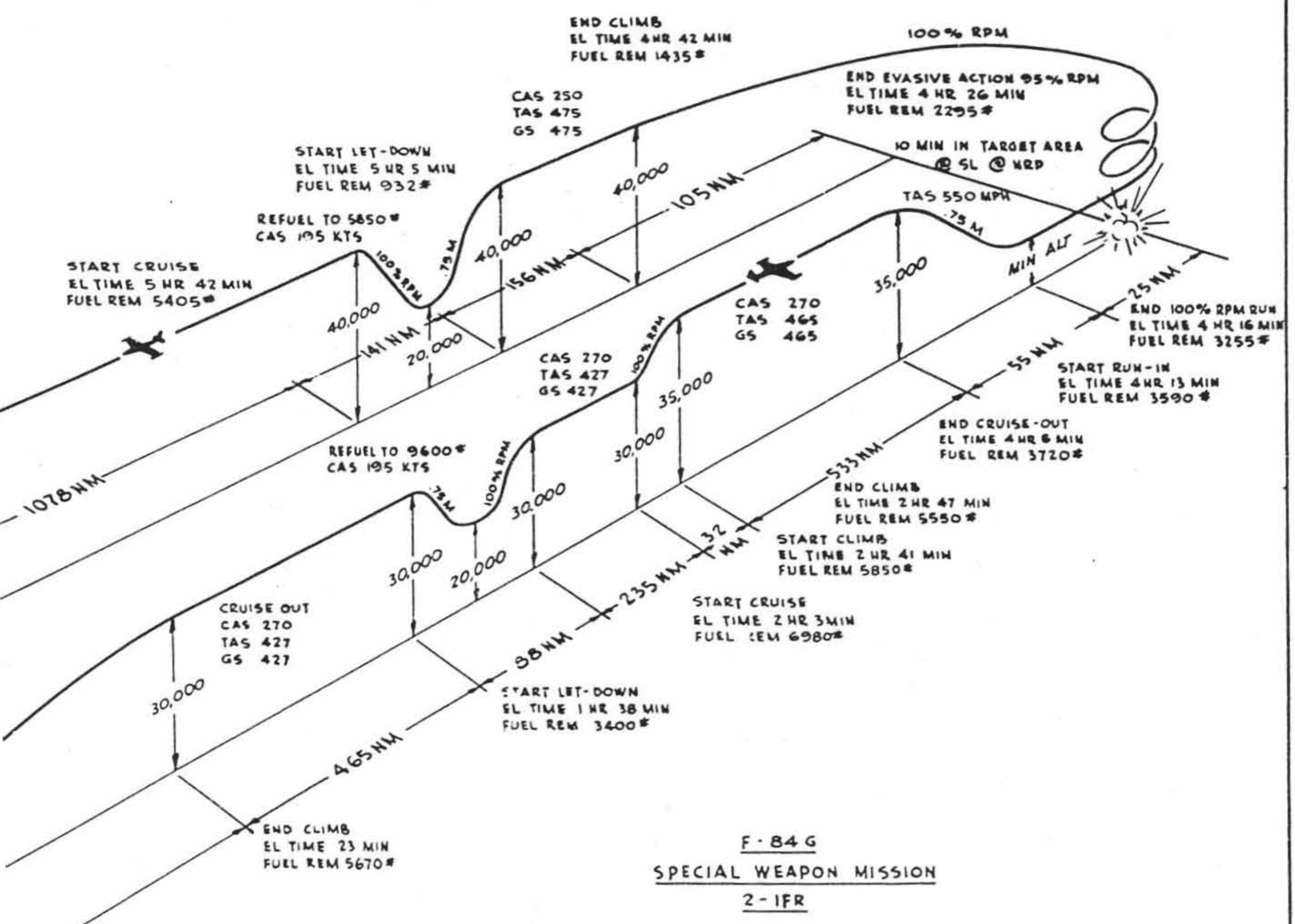

END CLIMB
EL TIME 1 HR 58 MIN
FUEL REM 1580#
100% RPM
END EVASIVE ACTION 95% RPM
FUEL REM 2440#
10 MIN IN TARGET AREA
@ SL @ NRP
40,000
121 NM
CRUISE BACK
CAS 250 MPH
TAS 472 MPH
GS 545 MPH
TAS 550 MPH
.75 M
MIN ALT
30,000
25 NM
36 NM
END 100% RPM RUN
EL TIME 1 HR 32 MIN
FUEL REM 3400#
295 NM
START RUN-IN
EL TIME 1 HR 28 MIN
FUEL REM 3850#
END CRUISE OUT
EL TIME 1 HR 24 MIN
FUEL REM 3950#
336 NM
CRUISE OUT
CAS 310 MPH
TAS 450 MPH
GS 380 MPH
30,000
END CLIMB
EL TIME 23 MIN
FUEL REM 5670#
F-84 G
SPECIAL WEAPON MISSION
DROP PYLON TANK WHEN EMPTY
INTERNAL FUEL + TIP TANKS + 1-230 GAL
PYLON TANK - 7350# FUEL
FUEL DENSITY: 6.5#/GAL
LOAD: 1-MARK VII WEAPON
OUT-BOUND: 60 KT HEADWIND
IN-BOUND: 60 KT TAILWIND
RADIUS OF ACTION: 495 NM

Figure No. 13


START LET-DOWN
EL TIME 5 HR 5 MIN
FUEL REM 932#
REFUEL TO 5850#
CAS 185 KTS
START CRUISE
EL TIME 5 HR 42 MIN
FUEL REM 5405#
CRUISE BACK
CAS 250
TAS 475
GS 475
END CRUISE BACK
EL TIME 8 HR 19 MIN
FUEL REM 1980#
40,000
141 NM
20,000
1078 NM
REFUEL TO 9600#
CAS 195 KTS
OVER BASE IN PATTERN
EL TIME 8 HR 28 MIN
FUEL REM 1809#
40,000
30,000
20
CRUISE OUT
CAS 270
TAS 427
GS 427
30,000
70 NM
465 NM
100% RPM
.75 M
END CLIMB
EL TIME 23 MIN
FUEL REM 5670#
117 NM
START ENGINE
EL TIME 0 MIN
FUEL REM 7350#

1



F-84G

SPECIAL WEAPON MISSION

2-IFR

DROP PYLON TANK WHEN EMPTIED 2ND TIME

INTERNAL FUEL + TIP TANKS + 1-230 GAL

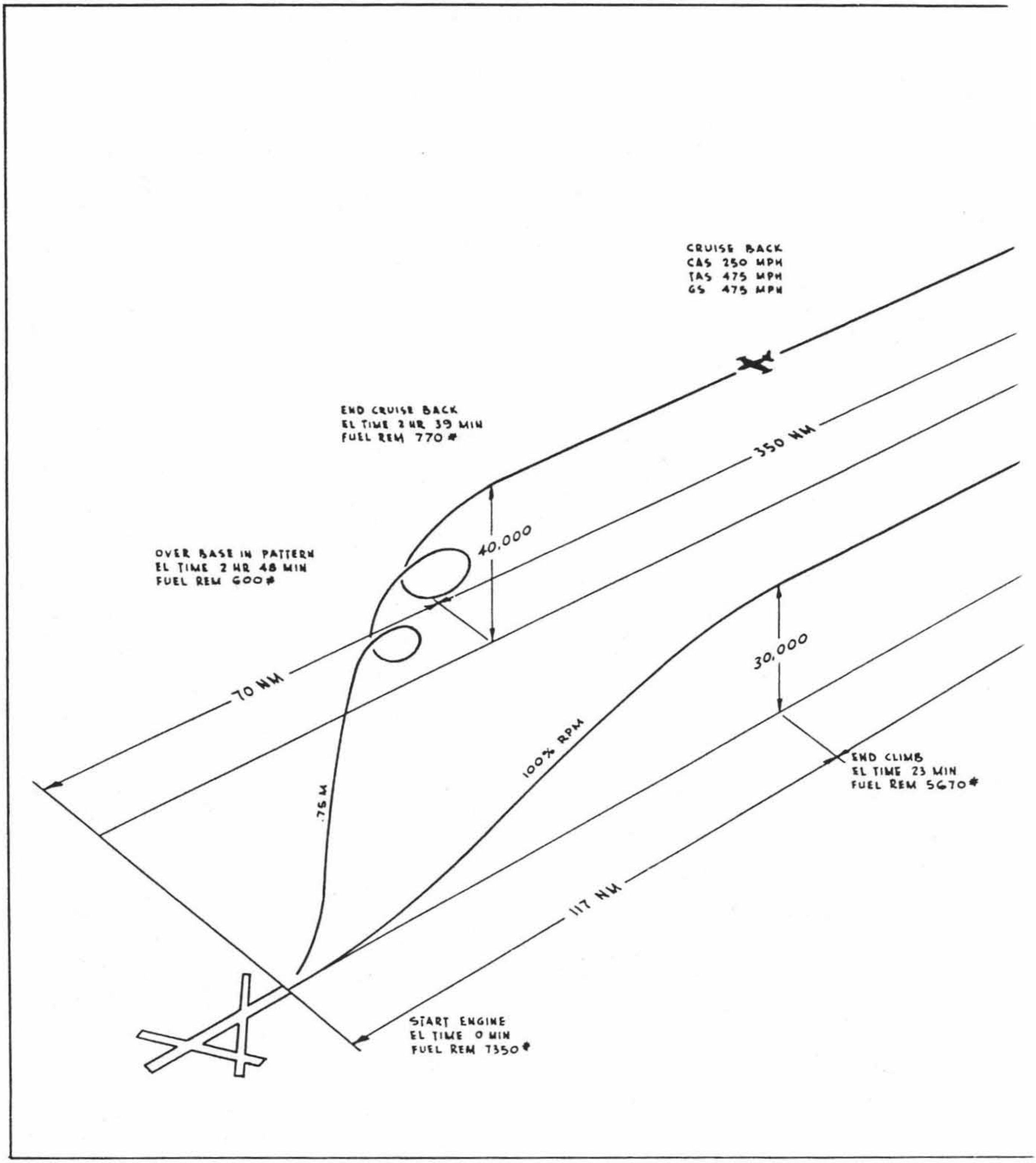
PYLON TANK = 7350# FUEL

FUEL DENSITY: 6.5#/GAL

LOAD: 1-MARK VII WEAPON

NO WIND CONDITION

RADIUS OF ACTION: 1782 NM


CRUISE BACK
CAS 250 MPH
TAS 475 MPH
GS 475 MPH
END CRUISE BACK
EL TIME 2 HR 39 MIN
FUEL REM 770 #
350 NM
40,000
OVER BASE IN PATTERN
EL TIME 2 HR 48 MIN
FUEL REM 600 #
30,000
70 NM
100% RPM
.75 M
END CLIMB
EL TIME 23 MIN
FUEL REM 5670 #
117 NM
START ENGINE
EL TIME 0 MIN
FUEL REM 7350 #
1

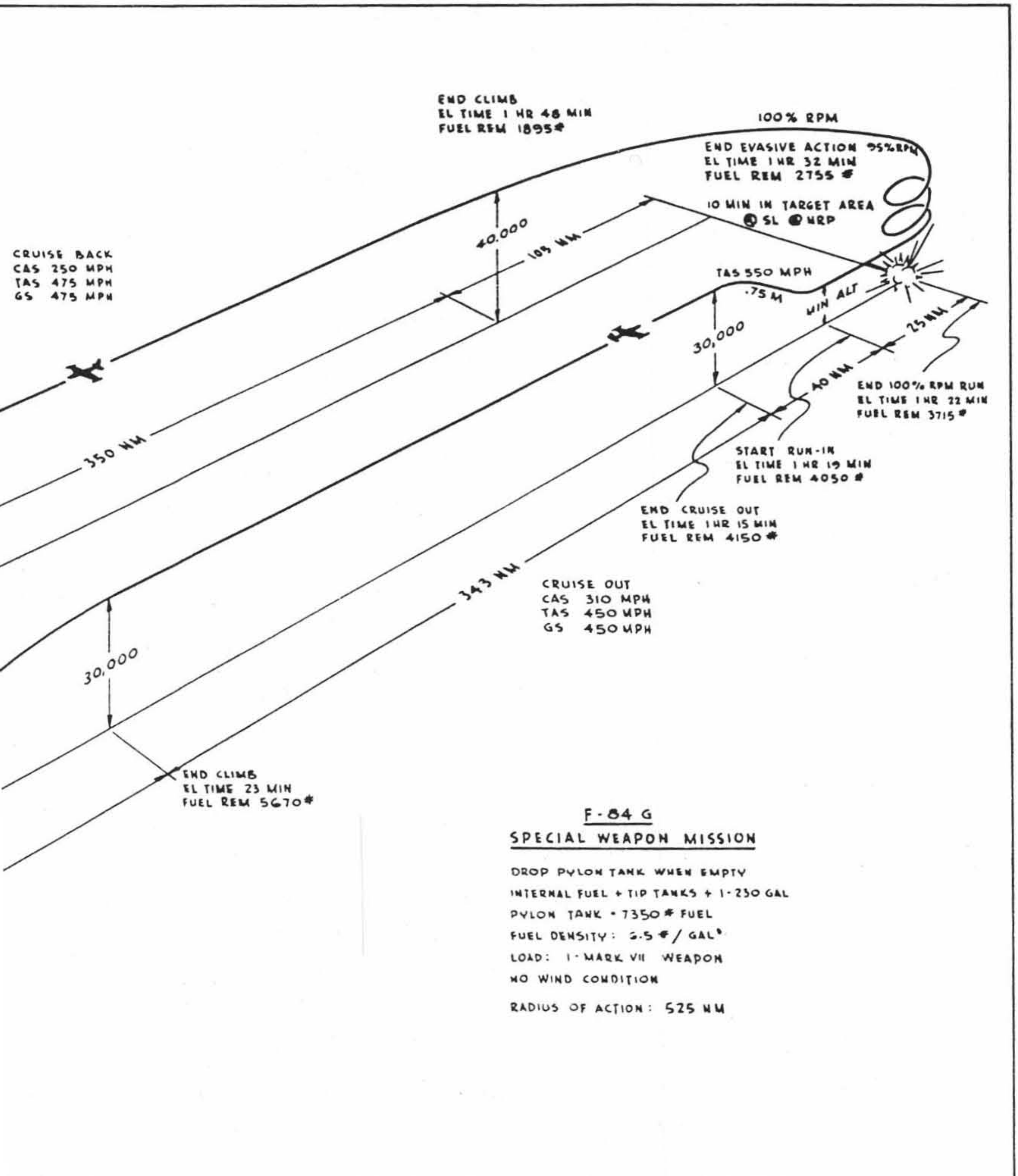
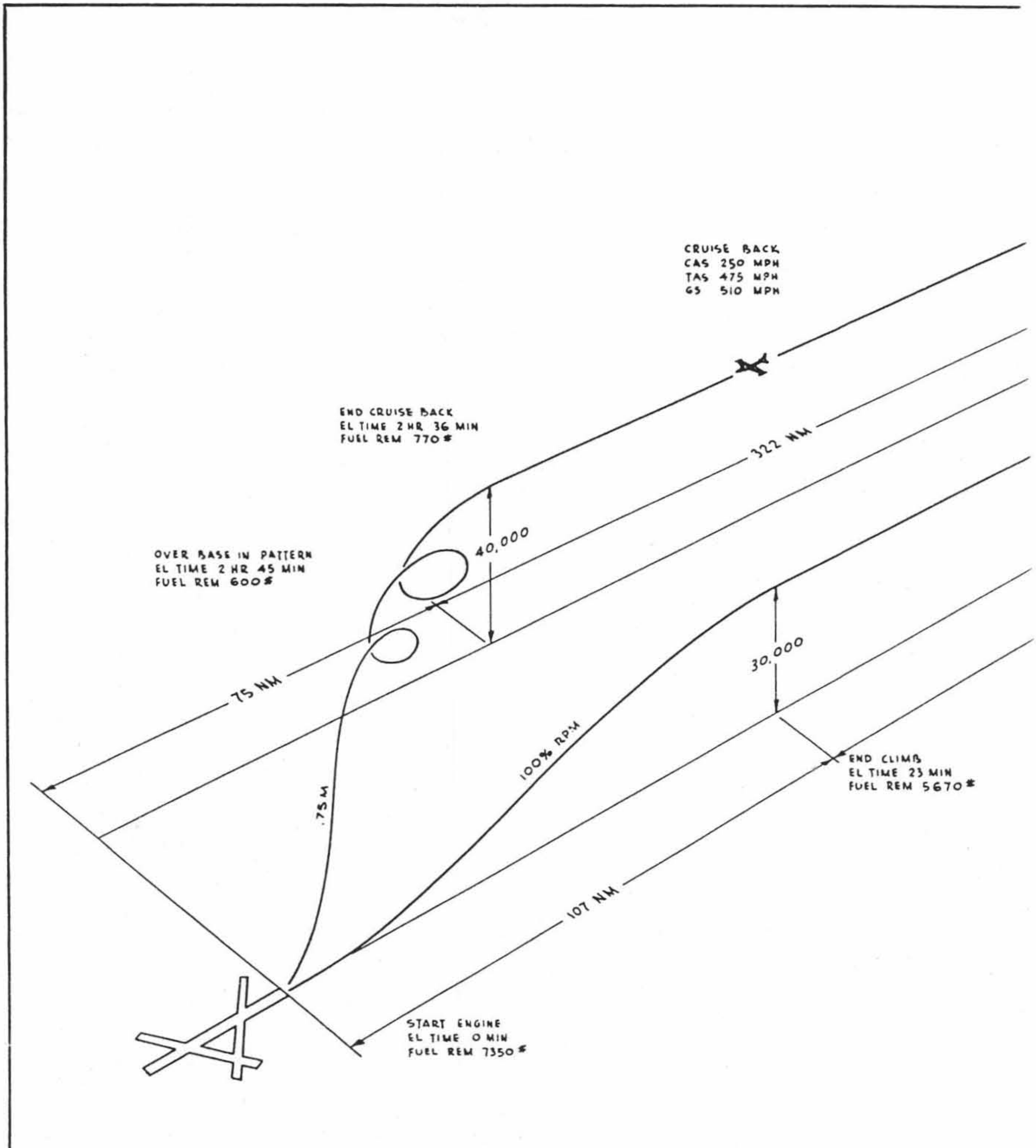

END CLIMB
EL TIME 1 HR 48 MIN
FUEL REM 1895#
100% RPM
END EVASIVE ACTION 95%RPM
EL TIME 1 HR 32 MIN
FUEL REM 2755 #
10 MIN IN TARGET AREA
SL NRP
40,000
105 NM
CRUISE BACK
CAS 250 MPH
TAS 475 MPH
GS 475 MPH
TAS 550 MPH
.75 M
MIN ALT
30,000
25 NM
40 NM
END 100% RPM RUN
EL TIME 1 HR 22 MIN
FUEL REM 3715 #
350 NM
START RUN-IN
EL TIME 1 HR 19 MIN
FUEL REM 4050 #
END CRUISE OUT
EL TIME 1 HR 15 MIN
FUEL REM 4150 #
343 NM
CRUISE OUT
CAS 310 MPH
TAS 450 MPH
GS 450 MPH
30,000
END CLIMB
EL TIME 23 MIN
FUEL REM 5670#
F-84 G
SPECIAL WEAPON MISSION
DROP PYLON TANK WHEN EMPTY
INTERNAL FUEL + TIP TANKS + 1-230 GAL
PYLON TANK - 7350 # FUEL
FUEL DENSITY: 6.5 # / GAL
LOAD: 1-MARK VII WEAPON
NO WIND CONDITION
RADIUS OF ACTION: 525 NM

Figure No. 15



CRUISE BACK
CAS 250 MPH
TAS 475 MPH
GS 510 MPH
END CRUISE BACK
EL TIME 2 HR 36 MIN
FUEL REM 770 #
322 NM
OVER BASE IN PATTERN
EL TIME 2 HR 45 MIN
FUEL REM 600 #
40,000
30,000
75 NM
100% RPM
.75 M
END CLIMB
EL TIME 23 MIN
FUEL REM 5670 #
107 NM
START ENGINE
EL TIME 0 MIN
FUEL REM 7350 #

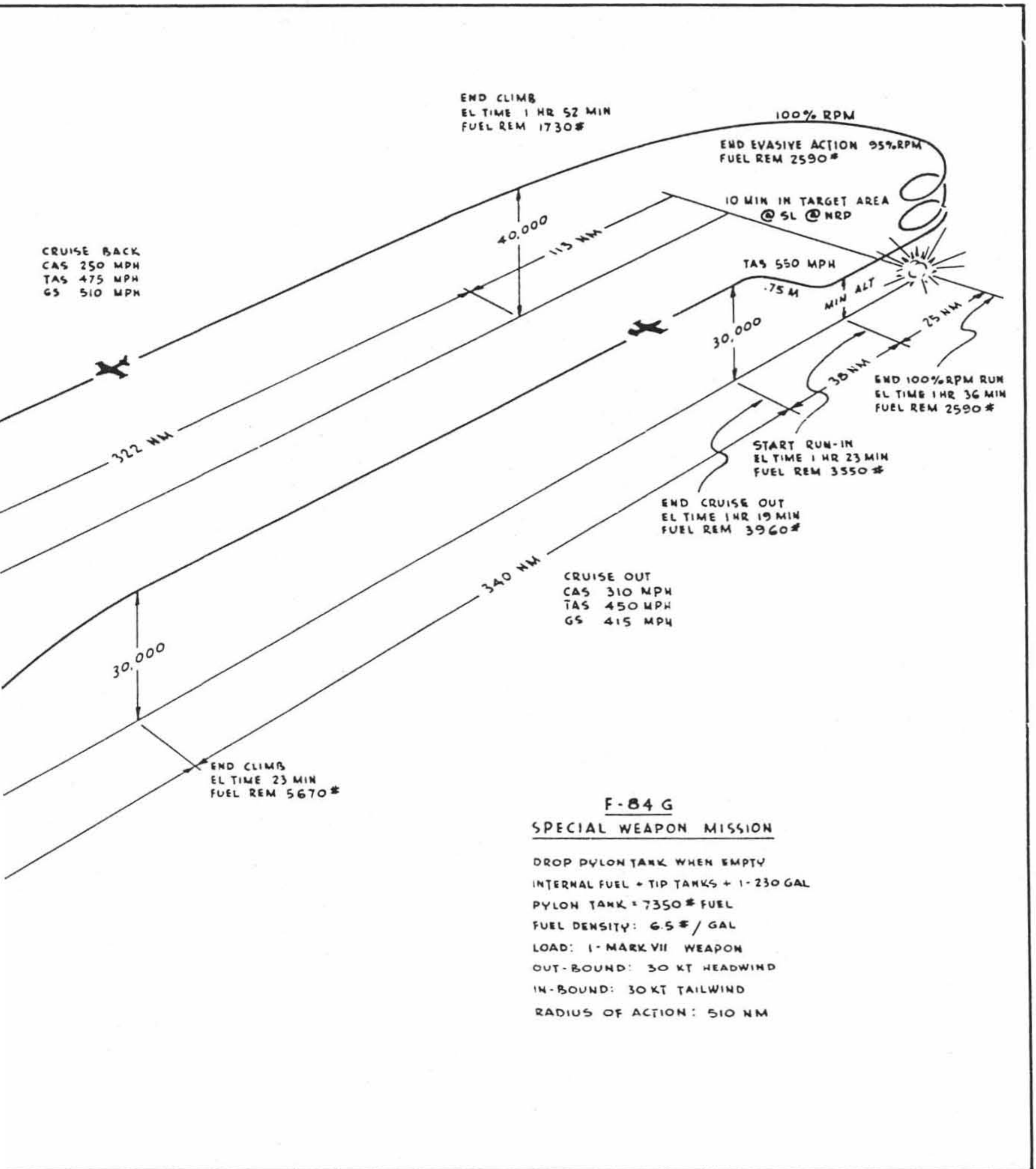

END CLIMB
EL TIME 1 HR 52 MIN
FUEL REM 1730#
100% RPM
END EVASIVE ACTION 95% RPM
FUEL REM 2590#
10 MIN IN TARGET AREA
@ SL @ NRP
CRUISE BACK
CAS 250 MPH
TAS 475 MPH
GS 510 MPH
40,000
113 NM
TAS 550 MPH
.75 M
MIN ALT
30,000
25 NM
38 NM
END 100% RPM RUN
EL TIME 1 HR 36 MIN
FUEL REM 2590#
322 NM
START RUN-IN
EL TIME 1 HR 23 MIN
FUEL REM 3550#
END CRUISE OUT
EL TIME 1 HR 19 MIN
FUEL REM 3960#
340 NM
CRUISE OUT
CAS 310 MPH
TAS 450 MPH
GS 415 MPH
30,000
END CLIMB
EL TIME 23 MIN
FUEL REM 5670#
F-84 G
SPECIAL WEAPON MISSION
DROP PYLON TANK WHEN EMPTY
INTERNAL FUEL + TIP TANKS + 1-230 GAL
PYLON TANK = 7350# FUEL
FUEL DENSITY: 6.5#/GAL
LOAD: 1-MARK VII WEAPON
OUT-BOUND: 30 KT HEADWIND
IN-BOUND: 30 KT TAILWIND
RADIUS OF ACTION: 510 NM

Figure No. 16

PILOT OPERATING PROCEDURES

1. Prior to Take-Off:

a. Set LABS release angle and timer delay.

b. Preflight the weapon.

c. After engine start and inverters are operating, place gunsight switch to "SIGHT-CAMERA" position, turn LABS power switch on, and turn computer start switch to "ON".

d. Bomb selector switch to "AUTOMATIC" position, other bomb switches "OFF".

e. Before taxiing out, uncage the LABS gyro.

2. The pilot's first indication that the system is operating is after take-off when the LABS indicator should show indications relative to the aircraft attitude.

3. The pilot proceeds on the mission, completing the weapon check list as required. If the gyro should tumble during the flight to the target, it can be erected in a maximum of ten (10) seconds by caging.

4. Prior to beginning the descent to the penetration point, the pilot should arm the weapon and complete the check list as required.

5. While navigating to the IP, the pilot should check his ETA closely to be prepared for the approach of the IP. When it is sighted, he should check his heading and maneuver to pass over the IP on a heading to the target. Over the IP the bomb button is depressed and held down throughout the maneuver. If the pilot discovers he is not lined up with the target after passing the IP, a correction of approximately ten (10) to fifteen (15) degrees may be made without severely impairing the accuracy of delivery.

6. When the reticle goes out after the preset time delay, the pilot starts a four (4) "G" pull-up, concentrating on the attitude gyro pointer and the accelerometer to maintain a wings-level attitude and constant "G" force. When the bomb is released, the sight reticle will reappear and remain on until the pilot releases the bomb button. The bombing run may be aborted at any time prior to bomb release by releasing the bomb button. If another run is then desired, the system must be recycled by turning the computer start switch to "OFF" and back to "ON".

7. Tests have shown that the best escape and evasion technique is to follow through with the Immelman until the attitude gyro shows a definite inverted nose-down attitude and the airspeed is increasing. A roll-out at this time with full power and a subsequent dive to near minimum altitude will obtain maximum escape distance.

8. When the bomb run has been completed and escape effected, the LABS system may be de-activated as follows:

a. Cage the gyro.

b. Turn computer start switch to "OFF".

c. Turn LABS power switch to "A-7" position.

MAINTENANCE PROCEDURES

1. General: The prototype LABS was out of commission for repairs on numerous occasions. The difficulty was primarily with the complicated system of erection of the gyro. The production LABS has not been out of commission at any time through the completion of this test. Since the original installation at Republic Aircraft Corporation, 23-27 March 1953, it has not been removed from the test aircraft. Over 300 automatic bomb releases at various angles have been made with this equipment without a malfunction. This remarkable record should indicate that the LABS can be considered reliable and simple to maintain when used properly.

2. Maintenance Procedures:

a. A daily preflight, when in use, by a competent technician is the only normal maintenance required for the LABS. This preflight consists of energizing the LABS circuit to see that the gyro is erecting and indicating properly. The reticle-out function of the intervalometer is also checked at this time. All connections should be checked periodically for secure fits and corrosion.

b. The LABS gyro is a sealed unit and should a malfunction occur, it must be returned to the manufacturer or depot for repairs.

c. Installation of the LABS does not affect in any way the routine maintenance required on an F-84G aircraft.

3. Publications: A Confidential technical order (TO 01-65BJE-51) has been prepared on the LABS containing instructions for installation. This TO does not include maintenance information and the only reference of this type at present is a handbook of service instructions compiled by Minneapolis Honeywell, which includes preflight and maintenance information. This handbook does not include specific instructions for leveling the LABS gyro and there is no leveling plate on either the gyro case or the mounting bracket on the production model tested. Therefore, the following procedure is recommended as an interim measure:

a. Using an external power unit, energize the LABS.

b. Cock the left bomb rack and set the bomb switches accordingly.

c. Without placing the aircraft on jacks, read the angle of the longitudinal level lugs with a gunner's quadrant.

d. Rotate the bomb release angle from a 20 degree pull-up angle setting back toward 0. Bomb release should occur as the angle on the gyro scale reads the same as the angle read on the gunner's quadrant.

e. Adjust the gyro on its frame with the forward leveling screws so that this condition is fulfilled.

f. Thus, for any angle set on the gyro scale, bomb release occurs as the aircraft level lugs make that same angle with the horizontal.

AUTOMATIC TRIM TAB DEVICE FOR USE WITH

LABS IN F-84G AIRCRAFT

1. General:

a. The F-84G trim tab motor is a split field DC motor. Energizing one field runs the motor in one direction to move the trim tab to the nose-up position. Energizing the other field runs the motor in the other direction to move the trim tab to the nose-down position. Each field is energized by a relay, the coil of which is energized by the trim tab selector switch on the control stick.

b. The Automatic Trim Tab Device was designed to use with the above system and the LABS. Its purpose is to operate the trim tab motor in the nose-up position for a selected number of seconds.

2. Details of Operation:

a. This device was constructed to use five (5) relays, a B-9A intervalometer and a selector switch (see attached wiring diagram, Figure No. 17). The selector switch selects a voltage from the pickle circuit or the reticle-out circuit. NOTE: This selector switch could be eliminated entirely from the device since normal operation of the LABS, utilizing an IP, would require only voltage from the reticle-out circuit. This switch was installed for test purposes to allow the pilot to by-pass the LABS intervalometer and receive an instantaneous pull-up when the bomb button was depressed. This procedure was used when making vertical bomb releases without the use of an IP and is included in Project No. APG/TAT/83-A-1, "(Restr) Determination of Best Method of Fighter Low Altitude Delivery of Atomic Weapons."

b. The voltage selected by the selector switch operates the coil of relay no. 6 through the normally closed contacts of relays no. 3 and no. 4. This voltage latches relay no. 6 starting the B-9A intervalometer and energizing the nose-up field of the elevator trim tab motor. The B-9A intervalometer runs a pre-selected number of seconds and gives out a pulse which energizes relay no. 7. This interrupts the latch circuit of relay no. 6 stopping the trim tab motor and turning off the B-9A intervalometer. Relay no. 6 may also be unlatched by relay no. 5. The purpose of relay no. 5 is to prevent both fields of the elevator trim tab motor from being energized at the same time, damaging the motor or preventing it from running in either direction. To do this, relay no. 5 is connected parallel to the nose-down relay of the aircraft system. If the nose-down position of the trim tab selector switch is actuated at any time and the Automatic Trim Tab Device is operating the motor in the nose-up position, relay no. 5 will unlatch relay no. 6, stopping the travel in the up position and allowing it to move down. In other words, the pilot can stop the pull-up action of the Automatic Trim Tab Device at any time by simply actuating the trim tab selector switch to the nose-down position.

c. Relay no. 3 is a delay pickup relay. Its purpose is to prevent relay no. 4 from opening its normally closed contacts too soon, giving relay no. 6 time to latch. The voltage will be continuous from the LABS once the reticle has been extinguished.

d. Relay no. 4 was included to break this circuit to prevent the Automatic Trim Tab Device from continually re-cycling and running the trim tab motor. Relay no. 4 latches open and prevents the Automatic Trim Tab Device from working any more until the LABS has been reset.

e. Relays no. 1 and no. 2 are part of the aircraft electrical system. These relays energize the elevator trim tab motor for nose-up and nose-down operation. All numbered wires are a part of the normal aircraft electrical system.

f. The B-9A intervalometer was used only because it is a stocked item. The Automatic Trim Tab Device could be made more compact if an intervalometer of smaller size and a range of only zero (0) to five (5) seconds was available.