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DISCOVERER

DETAILED TEST OBJECTIVES

NUMBER 4

CONTRACT AF 04 (647)-97

LMSD-6155-4 23 MARCH 1959

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DISCOVERER

DETAILED TEST OBJECTIVES

NUMBER 4

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An approved document

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Missiles and Space Division
Sunnyvale, California

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FOREWORD

This document, a requirement of Contract AF 04(647)-181, has been prepared by the Flight Test Planning Department (61-41) as a working document in support of the flight test of Discoverer 1020 and SM-75 booster 174.

CONCURRENCE

Information contained in this D. T. O. which pertains to the SM-75 booster has been furnished, and consequently agreed to, by Douglas Aircraft Co.

DOUGLAS AIRCRAFT COMPANY

for R. L. Johnson
Chief Missiles Engineer

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SECTION 1
TEST PLAN

1.1 GENERAL

The Detailed Test Objectives presented in this document define test plans for the flight test of the Discoverer satellite, Serial 2205-1020, and its associated system. It is intended as an authoritative planning document for use of the Flight Test Working Group, System Test Working Group, and all launch base, tracking station, and recovery personnel in planning Discoverer flight test operations.

The Discoverer earth satellite will utilize a modified Thor IRBM booster. The overall objectives of the program are to establish an orbital capability of the Discoverer/Thor and to effect the recovery of an aeromedical capsule form orbit.

In this flight, the configuration will include an instrumented aeromedical capsule and orbital command, control, and sequencing capable of effecting capsule re-entry. In addition, operational support will include capsule recovery by air-snatch and/or surface recovery techniques.

1.2 CONFIGURATION

The Discoverer satellite vehicle, XA Model 2205, Serial 1020, utilizing a cylindrical flared-skirt structural adapter, will be mated to the modified Thor booster, SM-75, Serial 174. The detailed configuration is presented in Section 3, and a weight breakdown is included as Appendix B.

1.3 LAUNCH DATA

This Discoverer test flight will be launched from Vandenberg Air Force Base (VAFB) launch complex SM-75-3, Pad No. 4. Target launch time for this flight is 11:15 a.m., P.S.T. The booster will be programmed in roll 1° 19' 6.14", from the pad attitude azimuth of 181° 28' 53.86" to the flight departure azimuth of 182° 48'. In addition to the launch complex, support for this flight will include the following facilities, listed by location:

a. Vandenberg Air Force Base
   (1) Launch and boost phase engineering and documentary optics
   (2) A thor telemetry receiving station
   (3) An exit and orbit telemetry receiving and radar tracking and command station

b. NAMTC, Pt. Mugu: An exit telemetry receiving, tracking, and command station (responsibility for metric optics at VAFB)

c. Telemetry Ship: An exit telemetry receiving station located 1200 nautical miles downrange beneath the nominal trajectory

d. Alaska: Two orbital telemetry receiving, tracking and command stations located on Kodiak and Annette Islands

e. Hawaii: An orbital telemetry receiving and tracking station at Kaena Point, Hawaiian Control Center at Hickam AFB on Oahu Island, and associated Recovery Force

f. Palo Alto: An orbital position and acquisition computer and Development Control Center.

1.4 OVERALL OPERATIONS SEQUENCE

1.4.1 System Control

The Development Control Center in Palo Alto will exercise overall control of the Discoverer System by coordinating and directing the launch and orbital phase activities of the launch base and tracking stations.

1.4.2 Prelaunch Operations

Vehicle prelaunch preparation and countdown will be coordinated by LMSD Vandenberg Control (located in the LMSD administrative area), which will alert all supporting facilities to an impending launch, provide countdown status information, and announce liftoff. The AFBMD Launch Controller will have direct control over all checkout operations performed at the launch pad.

1.4.3 Exit Tracking and Command

Following liftoff, the Vandenberg telemetry and tracking station and the Vandenberg auxiliary station at NAMTC (Pt. Mugu) will record exit telemetry and tracking data. In addition, the Pt. Mugu station will transmit commands to regulate the times for orbit engine ignition and cutoff at the appropriate time during the vehicle coast period.

1.4.4 Telemetry Ship

The downrange instrumentation ship will record telemetry data during the coast, orbit injection, and reorientation phases of flight. This ship will be located within the range limitations of the onboard tri-helix antennas to permit telemetry reception during vehicle pitchover. Recorded data will be returned from the ship to Van Nuys by a C-119 aircraft using air pickup techniques.

1.4.5 Orbit Operations

During its orbital life, telemetering and tracking data will be gathered by the Alaskan, Hawaiian, and Vandenberg AFB stations. The tracking data will be transmitted to the Palo Alto Development Control Center for orbit profile computation.

1.4.6 Recovery Operations

Operational support will include recovery of the biomedical capsule in the Hawaiian area on the 17th orbit pass. Detailed flight sequencing is contained in Sections 4, 5, and 6, and detailed information regarding data processing at each station is presented in Section 7.

SECTION 2
TEST OBJECTIVES

2.1 DEFINITIONS

2.1.1 Primary Flight Test Objectives

A primary objective is one for which a test flight is undertaken and must not, therefore, be compromised by any discernable inadequacy of airborne or ground equipment. Any malfunction of test vehicle or weapon system equipment constitutes grounds for holding, recycling, or terminating the launch countdown. In addition, any tendency toward malfunction of equipment, deterioration of weather conditions, or change of range status that could in any manner jeopardize the accomplishment of a primary objective is sufficient justification to delay the test.

2.1.2 Secondary Flight Test Objectives

A secondary objective is one which is of vital concern to the research and development of the weapon system but not of vital concern to the attainment of a primary objective. If the accomplishment of any secondary objective appears to be in jeopardy at any time prior to initiation of the booster automatic launch sequence, the countdown may be held or recycled to resolve the difficulty.

2.1.3 Tertiary Flight Test Objectives

A tertiary objective is one which contributes to design research, environmental research, associated projects, or other supporting engineering efforts. There shall be no delay, hold or recycling of a countdown to assure the accomplishment of a tertiary objective. However, schedule rearrangements, which in the opinion of the Flight Test Controller can be tolerated and favor the achievement of tertiary objectives, are desirable.

2.1.4 Launch Decision

The final authority for the execution of the launch command is vested in the AFBMD Launch Controller, and it is his responsibility to make all decisions where primary, secondary, and tertiary objectives are concerned during the conduct of a launch countdown.

2.2 PRIMARY TEST OBJECTIVES

The primary objective of this test flight is to place in orbit a Discoverer earth satellite which contains a biomedical capsule capable of returning test data while on orbit and of re-entry, on command, to be recovered for direct examination. To achieve this objective, Discoverer subsystems must demonstrate their ability to perform properly the functions given below.

2.2.1 Ground Support Equipment

The launch monitor and control equipment, checkout equipment, and ground handling and servicing equipment must provide adequate support and checkout required for launch of the Discoverer. In addition, adequate launch support must be provided as required by the biomedical recovery capsule prior to and including launch of the Discoverer.

2.2.2 Thor Booster

The Thor booster system must launch, control and separate from the Discoverer vehicle with at least the minimum performance specified in design documents. The Thor autopilot must demonstrate its ability to control the vehicle combination to the separation point within an acceptable degree of accuracy (plus or minus 4° in flight path angle).

2.2.3 Discoverer Airframe and Adapter

The Discoverer airframe must demonstrate its ability to withstand control system perturbations and flight environment.

2.2.4 Discoverer Propulsion System

The Discoverer propulsion system must demonstrate the following:

a. Ignition of the engine (Bell Model No. 8048) in a vacuum
b. Ability of the rocket engine to provide the total impulse required to attain orbital velocity
c. Proper propellant utilization.

2.2.5 Discoverer APU System

The Discoverer auxiliary power unit must demonstrate acceptable performance of its components, especially batteries and inverters.

2.2.6 Discoverer Guidance and Control System

The Discoverer guidance and control system must demonstrate the ability of its components to:

a. Derive the time to initiate orbital boost and the velocity to be gained during orbital boost using the Reeves computation equipment

b. Initiate and terminate orbital boost at the proper time

c. Maintain proper vehicle orientation during the coast, orbital boost and orbiting phases until the ejection of the BRC (including proper function of the Subsystem D computer, inertial reference package, horizon scanner, pneumatic control system, and hydraulic control system).

2.2.7 Discoverer Telemetry, Tracking and Command Equipment

Airborne and ground telemetry, tracking, and command systems must demonstrate the ability of their components to:

a. Satisfactorily monitor all primary vehicle functions (Thor and Discoverer) and produce adequate ground telemetry records of these functions

b. Properly receive, act upon, and verify all ground-space commands, and ensure that no false commands are acted upon

c. Send the command to adjust the Subsystem D timer to initiate and terminate orbital boost and to initiate capsule recovery at the proper time

d. Determine an ephemeris of orbit sufficiently accurate to assure acquisition on each succeeding intercept and to allow the vehicle timer to be adjusted with sufficient accuracy to program the required vehicle functions.

2.2.8 Recovery System

The Discoverer recovery system must demonstrate:

a. The ability of the Biomedical Recovery Capsule (BRC) components to obtain and transmit data on the physiological functions of the test specimens

b. Compatibility of the BRC with the satellite in its ascent, orbit and ejection for recovery

c. Compatibility and suitability of the related surface and airborne recovery system components and techniques.

2.3 PRIMARY DATA

The telemetry instrumentation schedule is presented in Appendix C. The primary telemetry data are indicated with a "P". Launch phase electronic and optical tracking data obtained from the Vandenberg AFB Tracking Station and the Vandenberg Auxiliary Station at Pt. Mugu and orbit tracking data for the establishment of an orbit profile are primary data. The launch phase tracking data in conjunction with the launch phase telemetry data will form the basis of the vehicle performance analysis through orbit injection. Station locations and functions are contained in Section 7.

All records of the Recovery Operation will be considered primary data and as such will be returned to Palo Alto for evaluation. See Section 7 for a discussion of test data handling.

2.4 SECONDARY TEST OBJECTIVES

The secondary flight test objectives are to test and evaluate the following:

a. Satellite systems and structure and their effective functional interrelationships

b. Temperatures at sufficient locations on the vehicle so that the heat-flow patterns established in theoretical design can be verified and the temperature environment for later flights established

c. Interstation communications network

d. Acquisition of the satellite at any one station by means other than radar, and orbit prediction with only azimuth and elevation information for any given intercept

e. Aerodynamic integrity of the Discoverer/Thor combination within the limit of optical tracking capability.

2.5 SECONDARY DATA

The secondary telemetry data is that data not indicated as primary by "P" in Appendix C.

Vehicle orbit life tracking data in excess of that required to establish the orbit profile will be considered as secondary data. Station location and functions are contained in Section 7.

2.6 TERTIARY TEST OBJECTIVES

Tertiary flight test objectives are to test and evaluate the crew proficiency and ground equipment design from the human engineering point of view.

SECTION 3
CONFIGURATION

3.1 DISCOVERER SYSTEM CONFIGURATION

3.1.1 Launch Base

Precountdown preparations at VAFB will be performed by LMSD, AFBAD, AFSAM, DAC, and SAC (pad and range safety and support) personnel to insure readiness for launch. The readiness of the combined Discoverer/Thor configuration for countdown will be determined by the successful completion of the Thor All Systems and Dual Propellant Load Tests and the Discoverer Countdown System Test. Concurrently, the BRC will be brought to the flight-ready condition by the aeromedical checkout crew. LMSD-420930 delineates the integration of the BRC Subsystem into VAFB operations. After mating, the Discoverer/Thor combination will await the start of launch activities in the SM-75 shelter. Weather forecasts for determination of launch feasibility will be supplied daily to LMSD Vandenberg Control by the SAC weather group. This information will be transmitted to Palo Alto. Detailed weather requirements are discussed in LMSD-414370.

Thor instrumentation and airborne range safety equipment will be checked, installed, and maintained by DAC under the cognizance of Aerojet and SAC IRSS personnel. This equipment is described in detail in Aerojet-General Corporation Report No. 1449.

Range clearance for flight will be determined by the SAC Range Safety Officer.

3.1.2 Tracking Station Activities

Stations at VAFB and Kaena Point, Oahu, T. H., will receive telemetry data with an automatic tracking TLM-18 antenna. These stations (and all other stations) will also employ tri-helix antennas. All telemetry data will be magnetically recorded. For telemetry details see Section 7.

Exit and orbital positions will be plotted and recorded through the Reeves VERLORT tracking radars located at VAFB, NAMTC, Annette, Chiniak, and Kaena Point. For details of these operations see Sections 4.1 and 5.1.

3.1.3 Telemetry Ship

The telemetry ship will be stationed at a latitude of 14° 45.4' N and a longitude of 121° 47.6' W. This location will place the ship 1200 nautical miles downrange of the launch pad and in the vertical plane which contains the nominal trajectory.

3.1.4 Palo Alto Development Control Center

The DCC at Lockheed Building 204, Palo Alto, will be equipped with the necessary communications equipment, plot boards, and status boards for the overall direction of flight test operations. The center will be supported by an LMSD computer (UNIVAC 1103AF) with backup from a second 1103, which, with the necessary data transmission equipment, will process tracking data and generate command and acquisition data.

The DCC will be operated by a staff of LMSD personnel and by a BMD representative assigned as System Test Controller. The Center will perform the following functions:

a. Overall direction and control of Discoverer flight test operations

b. Administrative and technical tracking station coordination and direction

c. Maintenance of weather status charts at the various stations and in the recovery area.

3.1.5 Hawaiian Control Center

The Hawaiian Control Center (HCC) at Hickam Air Force Base, Oahu, T.H., will control the deployment of all elements of the Recovery Force. The HCC will effect independent control over the following functions:

a. Definition of search mode

b. Cancellation of recovery effort based on local exigencies that affect Recovery Force safety

c. Designation of Recovery Force Controller

d. Assumption of recovery operation functions of DCC in the event of communications loss with the DCC.

For other command functions, the option is exercised by the DCC, with the HCC ensuring execution of the commands.

3.2 THOR BOOSTER

The booster will consist of a modified SM-75 (Thor) ballistic missile (Serial DM-18-174) with configuration and design specifications identical to those presented in LMSD-6155-1. Refer to Appendixes A-2, A-3, B-3, C-2, D-2, and E for detailed booster parameters.

3.3 DISCOVERER SATELLITE

The configuration of the Discoverer Serial 2205-1020 incorporates a Mark-I recoverable Biomedical Research Capsule. The structure and equipments peculiar to this vehicle are as outlined below.

3.3.1 Airframe

The Discoverer airframe is distinguished as to sections as the nose cone, the forward mid-body (which includes the forward equipment rack), the aft mid-body, the aft equipment rack, and the adapter. The nose cone comprises two sections: the forward being vendor-fabricated and comprising the major portion of the Biomedical Research Capsule (see Para. 3.3.6); and the aft being LMSD-fabricated and housing certain of the BRC equipment. The airframe of Discoverer 1020 is four inches longer than that of Discoverer 1022, as shown in Appendix A-1.

3.3.2 Propulsion System

The propulsion system consists of the XLR 81-BA-5 rocket engine with a single thrust chamber, a turbine pump assembly, and an engine mount; the propellants; the ullage control rockets; and the gas pressurization supply. The thrust chamber extends 6 inches further aft to MS 481.0, TS 70.1 than does the JP-4 engine of Discoverer 1022. Design parameters include:

a. Propellants: fuel UDMH (MIL-F-25604A)
   oxidizer IRFNA (Type III, MIL-M-7245C)

b. Propellants loaded: fuel 1861 pounds
   oxidizer 4779 pounds

c. Propellant pressures at turbine pump inlet: 48.5 psia

d. Pressurizing gas: helium at 3000 psia

e. Thrust chamber pressure: 487 psia

f. Thrust: 15,000 pounds (at altitude)

g. Exhaust nozzle expansion ratio: 20:1

h. Specific impulse: 277 lb-sec/lb (minimum)

i. Probable burn time: 120 seconds.

3.3.3 Auxiliary Power System

The basic power source consists of three silver peroxide-zinc batteries. Conversion of the basic power to vehicle system equipments operations is: (a) by a Type I voltage regulator to 28.3 plus or minus two percent volts dc; (b) by a Type I (rectifier) power supply to 28.3 plus or minus two percent volts dc; (c) by a transistor-oscillator Type IA inverter with a load limit assembly to 115 plus or minus 1.0 percent volts ac, 3 phase, 400 plus or minus 0.02 percent cps; (d) by a transistor-oscillator Type IVB inverter with a load limit assembly to 115 plus or minus 5.0 percent volts ac, 1 phase, 2000 plus or minus 1.0 percent.

3.3.4 Guidance and Control System

The guidance and control system, consisting of the guidance sybsystem and the flight control subsystem, includes equipment used for attitude and directional control from separation to establishment on orbit of the vehicle in the planned attitude and altitude for initiation of BRC ejection during the orbiting phase.

3.3.4.1 Guidance Subsystem. The guidance subsystem includes: (a) the inertial reverence package (IRP) which establishes pitch, yaw, and roll attitude references from the vehicle attitude at separation and supplies signals, modified in certain instances by signals from the SS/D sequence timer, to the electronics subsystem to effect and to maintain planned attitudes at planned times from the beginning of the coast phase through the ejection of the BRC during the orbit phase; (b) the horizon scanner (Detroit Controls Corporation-fabricated) which establishes vertical and horizontal references during the coast and the orbit phases until the ejection of the BRC and supplies signals proportionate to the vehicle deviations therefrom to the IRP; (c) the computer which sends programmed signals (see Appendix F) to start or stop vehicle equipment operations during the coast, orbital boost, and reorientation phases and at the BRC ejection period of the orbit phase and which, by means of its integrator supplies the orbital rocket engine shutdown command during the orbital boost phase.

3.3.4.2 Flight Control Subsystem. The hydraulic flight control subsystem for Discoverer 1020 functions as on 1018. The pneumatic flight control subsystem will be in use during orbit life until capsule ejection. To achieve the increased impulse required of this flight in reorienting and stabilizing the satellite on orbit and for the recovery capsule ejection, a mixture of Freon-14 and nitrogen will again be used as the pneumatic control impulse gas.

3.3.5 Communications System

Airborne communications equipment for Discoverer 1020 consists primarily of (1) an S-band beacon transponder, (2) a telemeter instrumentation system, (3) a VHF acquisition transmitter, and (4) an elementary timer.

Operation of the beacon and telemeter system, controlled by the H timer, is cyclic, with on periods coinciding with passes over tracking stations, radio commands to the beacon set and adjust the cyclic spacings. A command to clear the timer memory sets the maximum period between turn-on for two consecutive passes of 96-3/4 minutes each. This period can be shortened by commands in 15-second steps to a maximum of 31 steps; this gives a minimum period of 89 minutes.

If readout is not completed before the end of the fixed 17-minute on-period, the H timer can be reset to 12 minutes-to-go; this process can be repeated until readout is completed or the reception limit is passed. In order to receive data during passes with maximum reception duration, the timer cycle is preset for readout on orbits 1 and 2 in the southerly direction, 7 through 10 in the northerly direction, and 15 through 18 in the southerly direction. Readouts are not scheduled for passes with short reception periods in order to conserve power for more profitable operating periods.

3. 3. 6 Biomedical Capsule System

This Discoverer subsystem consists of the re-entry capsule, which includes a re-entry shield and structure. The thrust cone assembly is mounted to the aft end of this structure. This assembly is an orbit ejection system consisting of thrust rocket, stabilization spin rockets, instrumentation, and structural components. Mounted in the forward end of the shield cavity is the biomedical recovery capsule (BRC), which contains the life cell and the recovery system. The entire subsystem weighs 195 pounds and is pictured in Appendix A-1.

3. 3. 6. 1 Life Cell. The life cell is provisioned to supply adequate food and water and to maintain required environmental and respiratory conditions for its four rodent passengers. In addition, components measure essential animal reactions during the mission. The respiration system and nutrient supply have sufficient capacity to sustain the animals for a total of 52 hours, which includes 16 hours of pre-launch confinement, 27 hours on orbit, 4 hours of search and recovery, and a 5-hour contingency to be used in countdown holds (if necessary) or in recovery search.

3. 3. 6. 2 Recovery System. The recovery system is designed to establish location of the BRC and to aid in air-snatch recovery. In addition, the design provides for flotation and location if water recovery becomes necessary. Components of the recovery system include:

a. Parachute, metalized to provide a radar target of 65 square feet, checkerboarded with orange panels to aid in visual location

b. Aluminum chaff, a one-pound package producing a radar target of 2400 square feet

c. VHF beacon, transmitting on 232. 4 mc with peak power of 15 watts, repetition rate of 1000 pps, pulse width of 29 microseconds, and average power of 640 milliwatts

d. Resculite, high intensity light flashes at 1. 5 second intervals

e. Dye marker, powdered aluminum slurry dissolved after water impact.

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SECTION 4
FLIGHT PLAN (PART 1 - LAUNCH PHASE)

4.1 SEQUENCE OF EVENTS - CHECKOUT TO VEHICLE REORIENTATION

4.1.1 Hangar Checkout

4.1.1.1 Thor. After it is received, the booster will undergo the following hangar checkout operations:

a. Modification of configuration in the DAC Receiving, Inspection and Maintenance (RIM) Building
b. Checkout with missile subsystems checkout trailer and supplementary checkout trailer
c. Checkout of destruct system
d. Transportation to the LMSD Missile Assembly Building
e. Installation of adapter
f. Check with LMSD simulator
g. Mating with LMSD second stage (fit check)
h. Check of destruct system
i. Check for interface problems and removal of Discoverer
j. Transportation to launch area.

4.1.1.2 Discoverer. The Discoverer flight test vehicle, 2205-1020, will have undergone thorough ground testing on the component, subsystem, and system level prior to delivery to the Santa Cruz Test Base. At SCTB a static firing systems run will be successfully completed prior to delivery of the Discoverer to Vandenberg Air Force Base. The biomedical recovery capsule will be handled separately however, until its mating to the satellite vehicle.

Upon arrival at VAFB, the Discoverer will be unloaded at the Missile Assembly Building (MAB). Subsequent to receiving inspection, the vehicle will undergo a four-day preparation for subsystem checks, conducted in the following manner:

a. All existing shortages will be installed
b. All mandatory E. O.'s left open will be worked off
c. A wiring continuity check (SS/A) will be completed
d. A vehicle-adapter fit check will be conducted.

Detailed subsystem checks will be performed as for previous vehicles with the exception that Subsystem L (BRC) handling will be added. Integration of Subsystem L into ground checkout and countdown procedures is detailed in LMSD-420930, 30 January 1959. Highlights of BRC handling are as follows (days are approximate):

a. BRC arrives at VAFB, X-1 month
b. Receiving inspection and dissassembly for component tests, X-28 days
c. BRC to medical van, X-16 days
d. Weight and balance, X-14 days
e. BRC to MAB for assembly and systems checkout, X-12 days
f. Final checks and life cell loaded, X-6 days
g. Final weight and balance checks, X-2 days
h. Transportation to pad aboard BRC van, X-1 day
i. Satellite - BRC mating, during countdown

4.1.2 Launch Pad Checkout

4.1.2.1 Thor. Pad checkout will consist of the following:

a. Electrical and hydraulic re-check
b. Re-check with Discoverer 1020 mated

c. Interface re-check (electrical and mechanical)
d. Check of destruct system
e. Mock countdowns
f. T-2- and T-1-day checks.

The ground support equipment part of the DAC operations can be found in DAC Drawing No. 7692043, Section 5.0 through 5.4. LMSD will tie into the DAC electrical J-box for sequence operation of the Discoverer umbilical ejection. ACSP guidance and GE nose cone checkouts will not be performed.

4.1.2.2 Discoverer. Approximately fifteen days are scheduled for the pad operations up to initiation of launch procedures. These operations are as presented in LMSD-6155-2.

4.1.3 Launch Countdown

4.1.3.1 T-1 Day. T-1-day checks will be brief functional tests lasting only a few hours. The destruct systems will be installed. A relief crew will finish any final preparations and will conduct pre-countdown operations. Pre-countdown will comprise a two-hour period.

4.1.3.2 Countdown. The launch countdown will be initiated prior to dawn to provide the maximum possible daylight for operations. For this flight it is desirable to carry out all procedures under optimum conditions, and it is highly desirable to ensure photographic coverage. Time of launch and countdown span will become of paramount importance on this flight because of the necessity for daylight recovery operations.

The countdown will be conducted according to the integrated countdown manual prepared by the VAFB FTWG. The time sequence portion of the countdown will be approximately 300 minutes duration.

4.1.4 Boost Phase of Flight

The test vehicle will be launched vertically. At liftoff, a limit switch will be closed after the booster's first three inches of flight. This limit switch will initiate the "liftoff" signal, which will be transmitted from the blockhouse to the Vandenberg Control Center and Tracking Station and will cross-reference all flight test data (see Section 7). The booster will be programmed in roll 1° 19'6.14" from the pad attitude azimuth of 181° 28'53.86" to the flight path(departure) azimuth of 182° 48', during its vertical flight.

Vertical flight will continue for 10 seconds, and a zero-lift trajectory will subsequently be programmed in pitch until the separation attitude is attained (see Appendix E). At this time, a constant attitude trajectory will be programmed and will be maintained through Thor main engine cutoff and vernier engine burning.

The Thor boost phase extends for 157 seconds, nominally, first-stage main engine cutoff occurring on depletion of propellant. The vernier engines will be started prior to liftoff and will continue for 9 seconds after main engine cutoff.

4.1.5 Separation

At 161 seconds after launch, the first sequence signal will come from the Subsystem D computer, which will be the signal for uncaging the inertial reference gyros and for starting the Subsystem H timer. Ten seconds later, 171 seconds after launch, the "D" computer will initiate the signals for firing the explosive separation bolts, activiting the pneumatic control system and igniting the retrorockets on the adapter. The vehicles will then stage.

4.1.6 Reorientation

After separation, the Discoverer satellite vehicle will be programmed to pitch to the horizontal. The horizon scanner will then be activated to correct roll errors, and its shroud will be ejected. After the vehicle reaches local horizontal, vehicle attitude will be under horizon scanner control until the start of orbital boost. This will ensure a local horizontal attitude during orbital injection. During orbital boost, vehicle orientation will be determined by the inertial reference package (IRP) as previously corrected by the horizon scanner.

At approximately 165 seconds after launch, the position of the vehicle will be determined from the VERLORT radar at NAMTC, Pt. Mugu, which will track the vehicle beacon throughout the ascent phase. The position of this radar is 34° 6' 40" N latitude, 119° 7' 23" W latitude. Second and third position determinations will be made 40 and 80 seconds later. The first pair of positions will be plotted on a board for evaluation by the human computation team, and the second pair (first and third readings) will be evaluated automatically by the Reeves computer. This Reeves equipment will then automatically initiate a command to the vehicle to set the proper engine start-time and velocity-to-be-gained.

Engine thrust will be terminated by a signal from the Subsystem D integrator after the proper velocity is gained, at which time the hydraulic system will be shut down and the propellant tanks vented. The vehicle will then be turned in yaw 180° at 40°/min by the pneumatic control system, which will be activated in pitch and yaw just prior to orbital boost termination. The helium tanks will be vented simultaneously with the command to yaw around. The Subsystem D computer's functional sequence is shown in Appendix F.

4.2 SYSTEM OPERATIONS

4.2.1 System Operations Control

The system countdown for Discoverer Weapon System launch operations will commence six days prior to launch and will encompass final pre-flight checkout, countdown, launch, and vehicle flight to the limit of telemetry ship reception. System control during the launch phase is divided into three echelons of responsibility as follows:

a. Development Control Center. The System Test Director at the DCC, Palo Alto, will exercise overall direction of the LMSD Vandenberg Control Center (VCC) activities and the aircraft pickup of telemetry data. He will also direct and coordinate the prelaunch preparations of the Palo Alto Computer and of the Vandenberg, Hawaii, Annette, and Chiniak tracking stations (See Figure 4-1) for the block diagram of this control.)

b. Vandenberg Control Center. The Vandenberg Test Director at the LMSD VCC will exercise overall direction of the launch area activities and will direct and coordinate (1) prelaunch preparations of the instrumentation ship, (2) Pt. Mugu tracking, and (3) Vandenberg tracking station (launch tracking only).

c. Blockhouse. The Launch Controller will direct and coordinate the Discoverer/Thor checkout and countdown conducted on the launch pad.

4.2.2 Launch Criteria

Launch criteria are established on the basis of their effect upon primary and secondary objectives (see Section 2), range safety, and overall system operability.

4.2.2.1 Pad Conditions. All missile conditions affecting primary objectives will be reported satisfactory prior to launch by blockhouse personnel to Launch Controller. Blockhouse personnel will also report satisfactory those conditions affecting secondary objectives prior to the time of initiation of the DAC automatic sequencer (T-15 minutes).

4.2.2.2 Photographic Equipment A sufficient number of tracking and highspeed sequential cameras must be reported "ready" prior to launch to give the Launch Controller confidence that adequate photographic data will be gathered.

4.2.2.3 Weather Conditions. The following weather and atmospheric data represent the conditions under which the Discoverer may be launched:

a. Weather Minimums:
   (1) Cloud coverage: clear to 2/10
   (2) Visibility: vertical, unlimited; horizontal, 8 miles
   (3) Precipitation: none
   (4) Surface winds. 0-20 knots (any direction)
   (5) Winds aloft: specified in the firing table, Appendix G

b. Atmospheric Conditions: For a more lengthy discussion of weather conditions see LMSD-414370.

c. Recovery Area: Weather forecasts for the recovery area must be favorable for the projected time of recovery as determined from data supplied to the DCC.

In order to determine the probable effect of weather upon a forthcoming launch, forecasts for the VAFB area will be supplied to the Test Director at the Vandenberg Control Center in accordance with Table 4-1. These forecasts, and a subsequent report of conditions at the time of launch, will later become vital launch data (see Section 7).

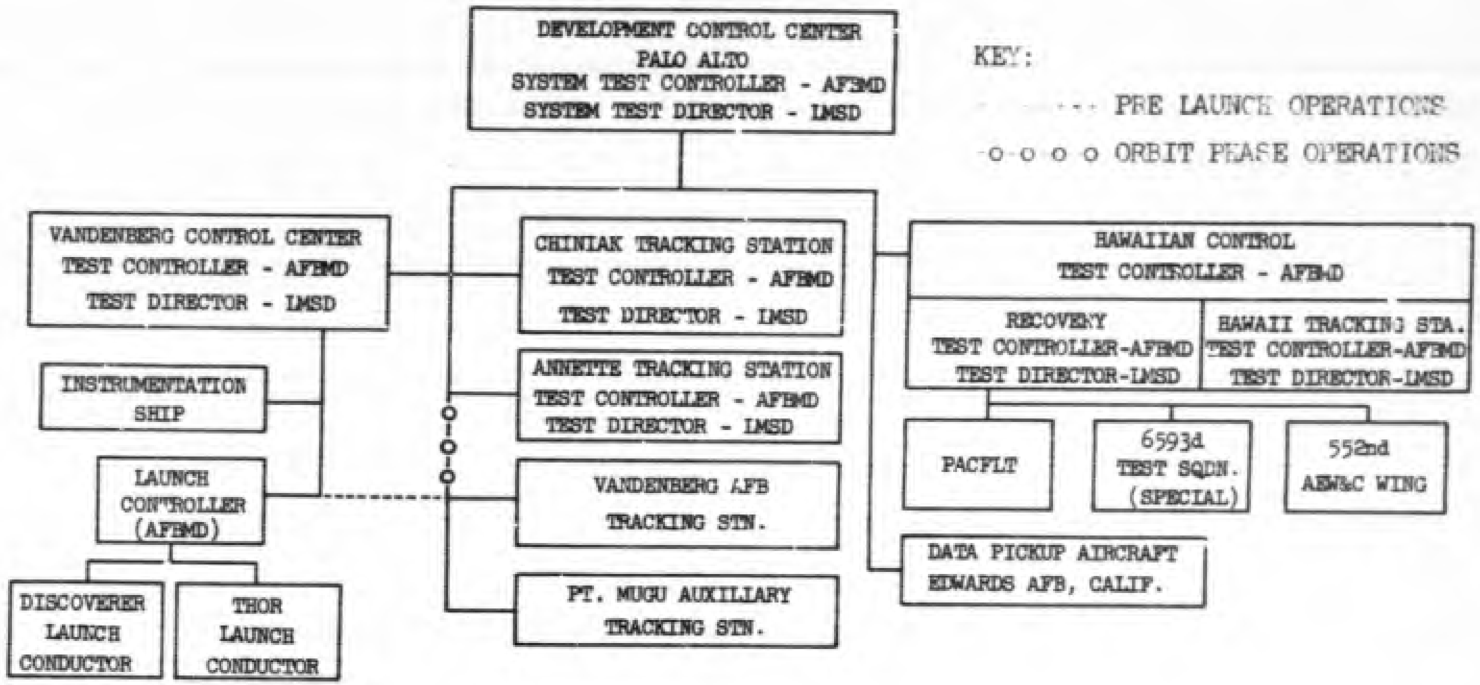

Fig. 4-1 Discoverer Test Operations Control

TABLE 4-1

Weather Forecast Requirements
Vandenberg Air Force Base

When Required	Parameters	Critical Elements
F-3 days	1. Precipitation	1. Precipitation in excess of trace
F-2 days	2. Surface Wind	2. Surface wind in excess of 20 knots
F-1 day T-12 hours	3. Winds Aloft	3. Winds aloft in excess of those listed in firing tables to be supplied by LMSD
T-6 hours	4. Visibilities	4. Visibility less than 8 miles
T-3 hours T-1 hour	5. Cloud Coverage	5. Cloud coverage in excess 2/10

4.2.2.4 Range Clearance. The Range Safety Officer will issue range clearance on the basis of operability of range safety electronic tracking and plotting equipment, visual sky-screen communications, and the readiness of the range. This clearance will be issued to the Test Controller at Vandenberg Control Center and will be revokable at any time for sufficient cause.

4.2.2.5 System Operability. Prior to launch, the operability of all LMSD tracking stations will be verified through the Vandenberg Control Center, and through the Development Control Center in the case of the Hawaiian and Alaskan stations.

4.2.3 Liftoff Tone Transmission

Missile liftoff will be signalled by a 1-kc tone generated in the blockhouse via a Douglas-supplied liftoff limit switch. This tone will be heard in the blockhouse, at the Vandenberg VHF receiving building (where it will be recorded in real time), and at the Vandenberg Control Center. From the VCC the signal will go out via the inter-station communications network to all stations, including the telemetry ship. The time of liftoff will be read from the recording at Vandenberg Tracking Station and will be sent to the Computer at Palo Alto to initiate orbit computations.

4.2.4 Real-Time Monitoring and Command Transmission

The time of occurrence of three additional events will be used as initial computer information. They are: (1) Thor main engine chamber pressure decay; (2) Discoverer engine ignition, and (3) Discoverer engine burnout. These events will be recorded in real time on oscillographs at the Vandenberg tracking station, Pt. Mugu, and on the telemetry ship. Main engine cutoff time will be sent from VCC via 60-wpm teletype. Burnout time will be sent from the telemetry ship to VCC via the single sideband link, and from there to DCC via 60-wpm teletype.

Information pertaining to real-time telemetry data recorded on the CEC oscillographs at the Hawaiian and Alaskan tracking stations are listed in Section 8 of the STD, LMSD-414760-3. Section 7 of this report (LMSD-6155-4) contains information regarding real-time TLM data being monitored at Vandenberg AFB, Pt. Mugu, and TLM ship tracking stations.

4.3 INSTRUMENTATION

Landline instrumentation is recorded in Appendix D-1 for Discoverer instrumentation and Appendix D-2 for Thor instrumentation.

Complete telemetry schedules are included as Appendix C, and Thor and Discoverer telemetry data are discussed in Sections 7.1.1 and 7.2.1.

Optical engineering sequential instrumentation and documentary coverage is supplied by the Air Force Lookout Mountain Laboratory and is included in Section 7.2.4.1.

Metric Optical instrumentation is furnished by five Mobile Optical Tracking Units supplied by the Pacific Missile Range, NAMTC, and located as shown in Table 7-5.

An integrated paint pattern for optical roll determination has been developed for the Discoverer/Thor combination. It is shown in Appendix A-3. The specific paint pattern for Thor No. 174 is shown on DAC Drawing Number 5790961. The paint pattern for Discoverer No. 1020 is shown on LMSD Drawing Number 1023717

Radar tracking data is discussed in Section 7.2.1.

SECTION 5
FLIGHT PLAN (PART II - ORBIT LIFE)

5.1 SEQUENCE OF OPERATIONS

5.1.1 Nominal Orbit Profile

The projected orbit injection location has been computed as 23.92° N and 121.24° W, based on an injection altitude at perigee of 140 statute miles. The elapsed time from launch to injection should be 398.5 seconds. The orbit has a nominal 0.04 eccentricity, and the nodal period has been calculated as 94.54 minutes with a corresponding total regression rate of 23.699° per orbit pass. The azimuth heading at injection should be 183.18° east of north, yielding an orbit plane inclination angle of 90° with respect to the equatorial plane. The apogee altitude is 482 statute miles for the nominal case, and the mean orbit altitude is 311 statute miles. A map of nominal orbit tracks is provided in Appendix E.

5.1.2 Variations in Profile

Deviations in launch azimuth will have no significant effect upon low-latitude station acquisition locations but may change those of high latitude considerably since a change in azimuth will give essentially a one-to-one change in the highest latitude reached. Variations in period resulting from orbital energy altitude variations will affect acquisition data only slightly on early passes, but the error will be cumulative on succeeding passes, as shown on the orbit traces maps in Appendix E.

5.1.3 Acquisition and Tracking Sequence

Tracking and telemetry receiving stations and their locations are:

a. Vandenberg AFB: Lat. 34° 47' 23" N; Long. 120° 30' 15" W
b. Kaena Point, Oahu, T.H.: Lat. 21° 34' 16" N; Long. 158° 18' 51" W.
c. Davidson's Point, Annette Island, Alaska: Lat. 54° 59' 50" N; Long. 131° 36' 11" W.
d. Chiniak AFB, Kodiak Island, Alaska: Lat. 57° 35' 54" N; Long. 152° 10' 33" W.

Approximate acquisition times and contact durations for each of the stations are shown in Appendix E and in Table 5-1. They are based upon a 1000-statute mile VERLORT reception range and upon the nominal orbit path.

Orbital passes 1 and 2, and 15 through 17 will be within reception range of one or more stations in the southbound direction. Orbits 7 through 10 will be within range during the northbound pass. One orbit pass is defined as the circuit from crossing the equator in a southerly direction to crossing the equator again in a southerly direction. The ascent pass begins with launch and ends when the vehicle, for the first time, crosses the equator in a southerly direction. The first pass is the next complete revolution, and so on.

Accurate acquisition time, heading, elevation, and range predictions will be generated by the Lockheed UNIVAC 1103AF computer at Palo Alto and will be transmitted to each station. These predictions will be based upon the nominal launch data and will be corrected by tracking data inputs from the tracking stations when acquisition is made. Tracking data inputs to the computer will be weighted double to phase old data out of the orbit calculations as rapidly as possible.

Until acquistion, tracking and telemeter ground antennas will be searched about a position computed by a Milgo Computer in the tracking station system. The VERLORT, to which the telemetry antennas are slaved, will then lock on the satellite.

A Reeves computer at each tracking station will provide emergency carryover orbit prediction to direct antennas in the projected orbit path if the Milgo computer fails or if temporary loss of the tracking signal occurs.

5. 2 SYSTEM OPERATIONS

5. 2. 1 Communications

Communication networks are a vital part of the overall system. Rapid and accurate data transmission is essential for completing timely acquisition predictions and initiating correction commands for control of the vehicle. A System Communications Chart, Figure 5-1, shows the data and command teletype and the voice circuits provided for operation of the system.

Teletype circuits, capable of 100 words per minute, will connect each tracking station to the computer for transmission of VERLORT X, Y, H, and T data as soon as it is received. The same circuit will be utilized to transmit telemetry and doppler tracking data from each station and to return acquisition and vehicle command data from the central computer to each station.

Telemetry and doppler tracking data will be handled on a secondary priority basis and normally will not be transmitted until a lull in activity, when orbit passes are beyond the range of the station. VERLORT tracking data will be checked for suitability upon receipt at the computer area. If necessary, retransmission of data will be requested.

5. 2. 2 Control

Overall control of system operations is vested in the Development Control Center (DCC) at Palo Alto. The DCC will receive milestone reports from each station and will initiate individual station operations, in the proper sequence, for integration with the activities of other stations and with satellite functions.

5. 3 INSTRUMENTATION

5. 3. 1 Tracking Data

Primary orbital tracking data will be obtained from the VERLORT radars at the four stations listed in Section 5. 2. 1 and will be transmitted to the computer in Palo Alto, where up-to-date orbital calculations will be made. Orbit path and acquisition data will then be provided for each of the stations. Plotting boards at each tracking station will present both station tracking data and computer orbit data in cartesian coordinates. Secondary tracking data will be obtained from the positioning of the TLM-18 antenna (Vandenberg and Hawaii) and from doppler range measurements. These data will be punched in teletype tape and transmitted following the transmission of radar data.

5. 3. 2 Telemetry Data

The satellite instrumentation configuration for the orbit life phase is identical to that listed in Appendix C-1, with the exception that channels 1, 2, 6, 7, 8, 9, 13, 17, and 18 are turned off 417 seconds after launch, leaving channels 4, 5, 10, 11, 12, 14, 15, 16 only. Telemetry operations, together with the S-band beacon, is controlled by the Subsystem H timer as described in Section 3. On this flight there will be a tape recorder in the BRC only. Flight data from the satellite will be obtained only from the portions of the orbits which are within reception range of the tracking stations except for biomedical data recovered with the BRC. Telemetry antennas will be slaved to radar antennas for proper orientation during the tracking period. Telemetry data will be recorded on magnetic tape and flown to Palo Alto by commercial or military air transportation. Details of telemetry data handling are presented in Section 7.

TABLE 5-1

Tracking Station Acquisition Times

Pass	Station	Acquisition Time (Min)	Fadeout Time (Min)	Total Time (Min)
Launch	VAFB	Launch	7.7	7.7
1	Chiniak	88.6	95.9	7.3
	Annette	90.4	96.0	5.6
	Kaena Pt.	100.1	104.7	4.6
2	Chiniak	183.4	189.7	6.3
	Kaena Pt.	193.6	198.8	5.2
8	VAFB	727.5	734.8	7.3
	Annette	733.0	740.1	7.1
	Chiniak	738.2	738.2	
9	Kaena Pt.	820.2	824.8	4.6
	Chiniak	830.7	835.5	4.8
	Annette	831.0	834.6	3.6
10	Kaena Pt.	913.6	919.3	5.7
	Chiniak	923.6	930.6	6.0
15	Annette	1413.5	1418.1	6.6
	VAFB	1418.2	1425.5	7.3
16	Chiniak	1507.0	1513.6	6.6
	Annette	1507.4	1514.6	7.2
	Kaena Pt.	1519.5		
17	Chiniak	1601.4	1608.2	6.8
	Kaena Pt.	1610.6	1618.0	7.4

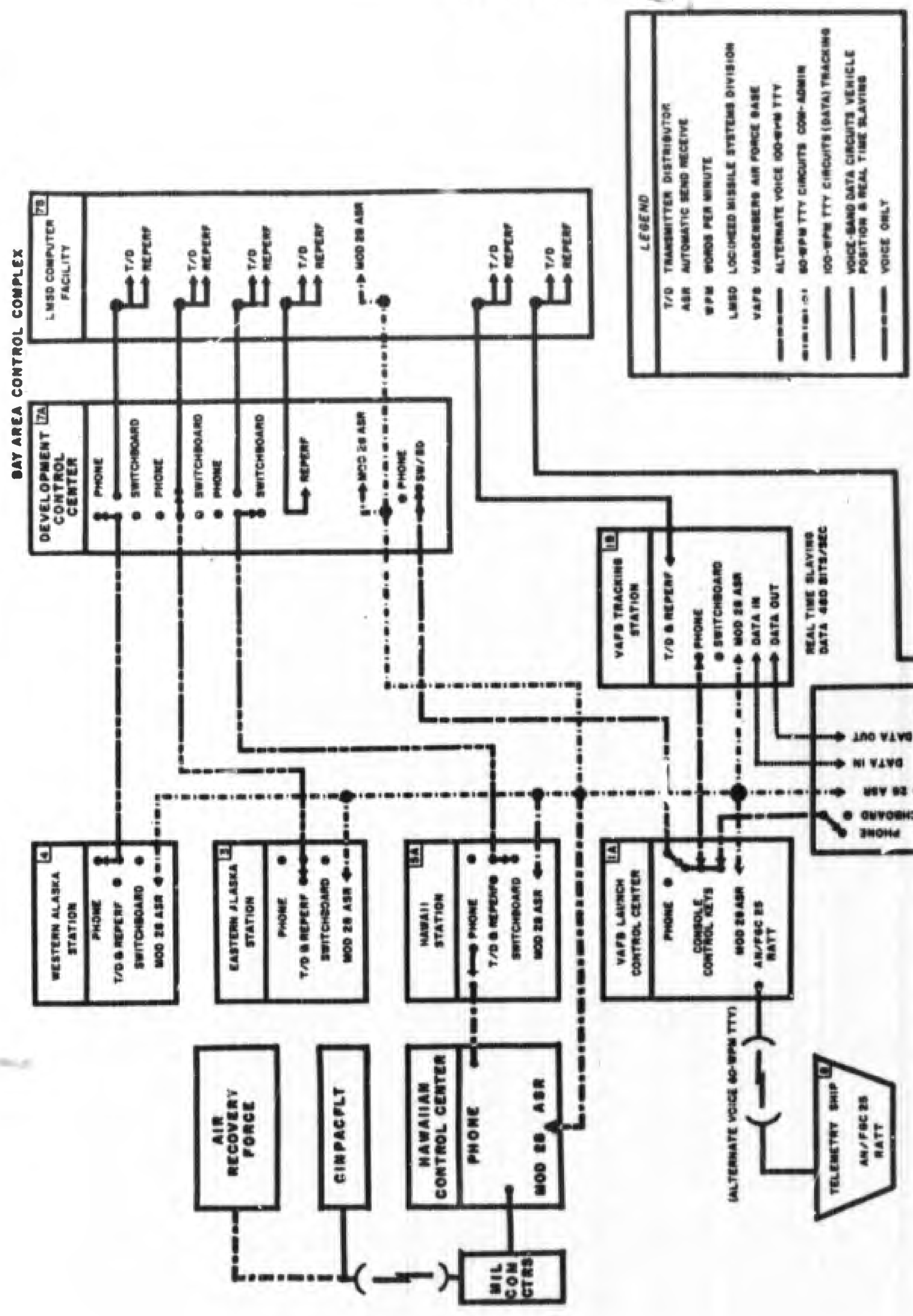

Fig. 5-1 Discoverer System Communications

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SECTION 6
FLIGHT PLAN (PART III - RECOVERY)

6.1 INTRODUCTION

It is a primary objective of this flight to recover a biomedical payload ejected from orbit on the 17th pass. The recovery capsule is placed on a re-entry trajectory utilizing a programmed retro-rocket system. At approximately 55,000 feet a parachute is deployed, aluminum chaff is dispensed, and the recovery beacon starts to transmit. RC-121 aircraft detect the chaff and vector C-119 aircraft to the appropriate azimuth. The C-119's, utilizing VHF direction finders, home on the recovery beacon to accomplish capsule intercept at 14,000 feet. As soon as visual contact is made the C-119's attempt to air-snatch the capsule-parachute combination. If the C-119's do not effect recovery before the capsule reaches 1000 feet, the capsule will be allowed to impact on the water. At this point, ships equipped with direction finders will locate and retrieve the capsule.

The sections below will describe the recovery force, indicate the sequence of events during the recovery cycle, and disclose the plans for Recovery Force deployment, control and instrumentation. All recovery forces will be located and moved in conjunction with alpha-numeric plot board at HCC.

6.2 CONFIGURATION

For the recovery from orbit which climaxes the satellite's flight, only two stations will be able to continue active tracking. These two stations are Chiniak and Annette, with Chiniak being designated as the prime station due to its ability to acquire the vehicle first. In the event of

Chiniak's inability to perform the function of the prime station, Annette will assume the responsibility.

6.2.1 Tracking and Command Stations

Both Alaskan tracking stations have a VERLORT radar and a tri-helix antenna for tracking equipment. This gives them the capabilities of acquiring and tracking the vehicle, receiving telemetry and doppler data, and issuing recovery commands. The BRC recovery effort is planned to take place on the 17th orbital pass over the Hawaii area. In order to accomplish this, the command must be given on the previous pass. Since Chiniak will be able to acquire the vehicle first on both the 16th and 17th passes, it will perform the function of the command station. These commands will adjust and reset the orbit timer within the vehicle. Then, when the timer runs out on the 17th pass, it will initiate the sequence to release the capsule.

6.2.2 Recovery Force

A Recovery Force will be based at Hawaii under direction of the Hawaiian Control Center (HCC) for the purpose of conducting the search for the descending capsule in the predicted area of impact. The force will consist of 3 destroyers at Pearl Harbor, 9 C-119J pickup aircraft, and 3 RC-121 radar search aircraft. The radar search aircraft will be equipped with APS-20/45 radar to detect the entrance of the BRC into the earth's atmosphere when chaff is dispersed at 50,000 feet. The destroyers and pickup aircraft will be equipped with a direction finding system that will permit them to home in on the capsule's VHF beacon. The pickup aircraft will also have the necessary gear to accomplish an air-recovery pickup after the parachute-borne capsule is visually located.

6.3 SEQUENCE OF EVENTS

This sequence covers the period from the 16th pass over Alaska until the BRC is delivered to Air Force Bioastronautics Directorate (AFBAD) personnel.

6.3.1 Recovery Command

When Chiniak contacts the satellite on its 16th pass, the Subsystem H elementary timer is reset by ground command at a latitude computed and directed by the DCC. This causes the Subsystem H timer to run out on the 17th pass at the proper latitude to begin the re-entry sequence as determined by the DCC. When the Subsystem H timer runs out, it restarts Subsystem D guidance computer which commands the remainder of the sequence on orbit.

6.3.2 Separation Sequence

The first step in the separation sequence is the activation of the horizon scanner for five minutes to stabilize the vehicle. Then the horizon scanner is turned off and a signal torques the pitch gyro (and in turn the gas jets pitch the vehicle) down at a rate of 40°/min. After 82 seconds the vehicle is in the correct position for re-entry firing (60° down from the horizontal), and the gyro torquing signal is returned to 4°/min. When reorientation is complete, the computer initiates the Subsystem L transfer circuits disconnecting the capsule from the vehicle power supply. The capsule is then ejected by a set of compressed springs.

6.3.3 Re-entry Thrust

The capsule's propulsion programmer then fires the spin-up rockets and, one second later, the main retro-rocket. After ten seconds the retro-rocket burns out and the de-spin rockets fire to de-spin the capsule. The propulsion programmer next fires the electrical disconnect squibs and explosive bolts which release the burned out propulsion system from the capsule. With the burnout of the retro-rocket, the capsule is on descent trajectory, which carries it to the re-entry area as shown in Appendix E.

6.3.4 Parachute Deployment

As the capsule reaches a deceleration of 5 g's, an accelerometer starts a timer which runs until an altitude of 55,000 feet is reached. Timer run-out turns on the VHF beacon and the flashing light, deploys the pilot and main parachutes and chaff, and after four seconds, cuts the main chute reefing line. After chute deployment, the descent rate drops with increasing atmospheric density from 45 feet/sec initially to 20 ft/sec at sea level.

6.3.5 Recovery Sequence

While the capsule is descending, the chaff and/or the silvered parachute are detected by the APS-20/45 radars on one of the RC121D aircraft. The RC121D then directs the closest C-119J aircraft toward the capsule. The C-119J is assisted by its own direction-finding equipment and homes on the capsule's VHF beacon until it makes visual contact. The C-119J will then attempt an aerial recovery of the capsule. The first attempt will be made at an altitude of 14,000 feet. If the C-119J misses on the first attempt it will have time to make at least six more recovery passes before the capsule impacts in the ocean. Upon successful aerial recovery, the capsule becomes the responsibility of a representative of AFBAD while the C-119J returns to the Hawaiian Control Center. If aerial recovery is unsuccessful, the capsule will be detected and located by means of its VHF beacon after water impact.

Visual contact will be assisted by the flashing light and the aluminum slurry dye marker, which is released on contact with the water. If a C-119J locates the capsule in the water, it will drop a flare and/or a VHF beacon buoy to mark the position and aid the ships in locating the capsule. Should surface recovery become necessary, the capsule will be turned over to the AFBAD representative aboard ship and returned to the Hawaiian Control Center

6.4 SYSTEM OPERATION

The Hawaiian Control Center (HCC), located at Hickam AFB, Oahu, T.H. is under the control of the DCC. The System Test Controller will evaluate the Discoverer system status and, based on vehicle checkout and weather predictions, order the Recovery Force plan into operation. It is anticipated that this plan will be put into operation approximately seven days prior to launch to permit DCC to alert the 552nd AEW Wing (RC-121D) and HCC to alert the recovery forces in the Hawaiian area of the impending recovery operations.

6.4.1 Briefing

The RC-121D's will depart the ZI for Hawaii at least 48 hours before the anticipated launch time. This will allow adequate time for the ocean flight and permit aircraft and electronic gear checks at Hickam AFB after their arrival. The crews of the RC-121D's, C-119J's and destroyers will be briefed 24 hours prior to scheduled launch time regarding the plan and details of the recovery operation. During the briefing, the HCC will designate departure times, impact area and rendezvous time.

6.4.2 Ship Departure

Immediately after the briefing, the three destroyers will depart for the recovery area. Based on a ship speed of 20 knots, the destroyers will be at the center of the recovery area in 20 hours. The recovery area is shown in detail in Appendix E, Figures E-18 and E-19.

6.4.3 Force Status

Eighteen hours before scheduled launch, the HCC will check the status of the Recovery Force to determine proper operation. The crews of the nine C-119J's will check out the air snatch equipment and the DF, and the crews of the four RC-121's will check out the radars. HCC will radio and obtain a status report from the destroyers. The status of the Recovery Force will be relayed to the DCC and, based on system evaluation, the System Test Controller will proceed with the scheduled launching or make changes as required. Should the launching be delayed, the HCC will be notified, and in turn it will notify the pilots of the C-119J's and RC-121's of the change in schedule. The destroyers will be notified of the delay and will continue at reduced speed (12 to 15 knots, to conserve fuel) to the recovery area. If the launching is delayed beyond 72 hours, provision for re-fueling will be necessary.

6.4.4 Communications and Weather Checks

Communication checks to HCC will be part of the system countdown. At T-1 hour, a weather report from the destroyers at the impact area and the local weather will be relayed to DCC. The Recovery Force status will also be included in this report.

6.4.5 Impact Area Prediction

After the launching, approximately two hours will be required to acquire the vehicles at Alaska, calculate the orbit ephemeris and the impact area. This impact area will be relayed to HCC which will command the ships to their proper positions. If the predicted impact area is a considerable distance from that originally planned, cruise rates and headings will be calculated and relayed to the ships. Based on information from each tracking station, the orbit ephemeris and impact area will be up-dated until 12 hours before the Estimated Time of Parachute Deployment (ETPD) when the last tracking data will be available.

6.4.6 Aircraft Flight Plan

Nine hours before the ETPD the aircraft will be pre-flighted and checked out. Six hours before ETPD, the pilots will be briefed. At four and one-half hours before ETPD, the aircraft will take off for the impact area. Aboard the lead RC-121 will be a Controller who will direct the operation. The aircraft and ships will be at their designated locations in the impact area one hour before ETPD. Communication and time checks will be conducted between the aircraft and destroyers as they rendezvous prior to taking up their assigned positions. The C-119's will fly at 14,000 feet and maintain constant communication with the RC-121's flying at 10,000 feet. The flight pattern has been planned to place the aircraft at midpoints of straight flight legs at ETPD-30 minutes, ETPD-15 minutes, and ETPD-0 minutes. At these points, the RC-121 aircraft are positioned so that an area of optimum radar return overlaps the impact area. Also, half of the C-119J aircraft will be heading downrange while the others will be flying uprange, thus completely covering the impact area with DF equipment. The search mode will begin at ETPD-30 minutes and will be at optimum operation at ETPD-7 minutes to ETPD+7 minutes which is the straight line of the flight pattern.

6.4.7 Air Recovery Operations

At 50,000 feet the parachute will deploy, releasing the chaff. The beacon and flashing light will also begin operating. The RC-121's will search and should acquire the chaff as the first radar return. Upon receiving the first radar return, the Controller will notify the nearest C-119J and proceed to vector the C-119J pilot into an interception flight. The C-119J pilot will follow the RC-121 vectoring, and use the DF for homing. All returns from the Recovery Force radars and direction finders will be verified as soon as possible. DF acquisitions by the C-119J aircraft will be plotted to verify that only one intersect point exists. DF returns will also be checked against radar returns of the RC-121 aircraft. The maximum capability of the aircraft and ships will be used to verify the returns. If after verification, bogeys signals still appear to exist, the airborne Controller will direct a systematic visual search for the source of each signal. This procedure will probably require a period in excess of air search time available and thus the search will enter the water search mode.

6.4.8 Capsule Disposition

Should the vectoring be successful and the C-119J sight the BRC, the air recovery will be attempted. Should the recovery be successful, the C-119J recovering the BRC will return to Hawaii at maximum speed. One RC-121 and two C-119J's will fly to intercept the C-119J with the BRC and accompany it to Hawaii. The destroyers will return to Hawaii as directed by HCC.

6.4.9 Surface Recovery

Should the air recovery be unsuccessful after sighting the BRC, the C-119J's will circle the area of water impact and drop marker buoys while the Controller vectors the destroyers into position to effect recovery.

6.5 INSTRUMENTATION

6.5.1 Telemetry

When the vehicle is over Chiniak on orbital pass 17, the BRC viability sensors, numbers 3 and 2, will be read in real time to ascertain the condition of the specimens before orbit ejection. As the satellite vehicle, minus the BRC, comes into range of the Hawaiian tracking station, telemetry will be recorded, indicating the previous capsule disconnection. See Appendix C-1 for a complete telemetry schedule. Tape-recorded instrumentation will also be recovered with the BRC.

6.5.2 Recovery Aircraft Instrumentation

6.5.2.1 RC-121 Aircraft. The RC-121 aircraft is equipped with the APS-20/45 radar acquisition and tracking system. The primary radar (APS-20) is instrumented to provide photographic coverage of the radarscope presentation. Performance parameters of both radars will be periodically logged.

6.5.2.2 C-119 Aircraft. The C-119 aircraft have electronic direction-finding equipment for homing on the capsule beacon signal.

6.5.3 Surface Vessel Instrumentation

Instrumentation of surface vessels is similar to that of the C-119's, described in the preceding paragraph.

6. 5. 4 Hawaiian Control Center

The HCC contains a large-scale plotting board used to present the relative location of all the Recovery Force ships and aircraft. The board has a coded alpha-numeric grid coordinate system to satisfy security requirements concerning recovery force deployment. Back-lighted boards reflect the status of recovery and direction-finding equipments. The HCC is linked to all associated functions by means of a communication network consisting of telephone, teletype, voice "hot lines," MHF, HF, UHF, VHF voice, CW, and RATT circuits.

SECTION 7
TEST DATA

Raw test data and films generated as a result of this flight test of Discoverer 1020 and Thor booster 174 are required as listed below. Each item listed will be correlated with LMSD timing and will be clearly identified as to source, content, test number, and date. Other items not listed but which are pertinent to test results will be included in written reports in accordance with Section 8 of this DTO.

Because of the many individual pieces of information which must be assembled within a short period of time, every effort will be made to deliver each item of data within the time specified. Deviations resulting from conditions arising during or subsequent to conduct of the flight will be coordinated through the Palo Alto Development Control Center.

Douglas and Lockheed will designate data couriers as necessary to facilitate transmission of test data to either DAC, LMSD, the Flight Test Working Group (FTWG) or AFBMD (Inglewood) in accordance with the requirements specified herein. Data items not hand-carried by designated couriers will be transmitted via registered airmail. Mailing addresses of the five recipients are as follows:

a. Douglas Aircraft Company
   Santa Monica Division
   Missiles Engineering, DM-18 Project Office
   Attention: O. E. Nemitz, A-260
   3000 Ocean Park Boulevard
   Santa Monica, California

b. Douglas Aircraft Company
A31 Location
Vandenberg AFB
Attention: L. J. Messersmith

c. Lockheed Aircraft Corporation
Missiles and Space Division
Test Management and Operations, Bldg. 204
Attn: L. F. Morgan, Dept. 61-44
3251 Hanover Street
Palo Alto, California

d. Chief
Air Force Ballistic Missile Division
Vandenberg AFB Field Office, WS-117L Project
Attention: FTWG, Lt. Col. W. F. Heisler
Vandenberg Air Force Base, California

e. Commander
Air Force Bassistic Missile Division
Air Research and Development Command
Attention: WDZW, Col. H. L. Evans
Air Force Unit Post Office
Los Angeles 45, California

7.1 LAUNCH DATA REQUIREMENTS

7.1.1 Launch Telemetry

Launch telemetry data requirements are listed in Table 7-1. The requirements for magnetic tapes, given in Item 1.1 of Table 7-1, assure satisfactory reception and recording of Thor telemetry at both the Air Force telemetry van and the LMSD tracking stations. In the event recording at one station is unsatisfactory. the other station will provide the necessary duplicate copy. The data described in Items 1.2 and 1.6 need not be better than plus or minus 5 percent of the bandwidth. These records will be appropriately annotated by ground station personnel to facilitate interpretation.

7.1.1.1 Real-Time Telemetry Recording -- VAFB and Pt. Mugu Tracking Stations. The following parameters will be recorded on the CEC oscillographs at the VAFB and Pt. Mugu tracking stations during the launch phase at a rate between one and four inches per second.

Oscillograph Number 1

Measurement Number	Measurement	Approximate Trace Deflection (Inches)
H64	Beacon Verification No. 1 (Channel 16-3)	0.4
H65	Beacon Verification No. 2 (Channel 16-5)	0.4
H66	Beacon Verification No. 3 (Channel 16-7)	0.4
H67	Beacon Verification No. 4 (Channel 16-9)	0.4
H70	Timer Synchronization (Channel 16-16)	0.4
H75	Beacon Signal Level (Channel 16-18)	1.4
—	Thor Main Engine Chamber Pressure (Thor Channel 12)	1.0
A28	Vehicle Separation Monitor (Channel 6)	2.0
B6	Combustion Chamber Pressure No. 1 (Channel 13)	2.0
A10	Longitudinal Acceleration (Channel 9)	2.0
—	Lift-off Signal	0.4
—	System Time	0.2

Oscillograph Number 2

Measurement Number	Measurement	Approximate Trace Deflection (Inches)
D85	SS/D Timer Monitor (Channel 15-3)	0.4
L2	Animal Compartment Temperature (Channel 15-6)	1.4
D16	Pitch Gyro (Channel 15-11)	1.4
D57	Velocity (Channel 15-17	4.0
L9	Viability Sensor No. 4 (Channel 15-18)	1.4
D18	Yaw Gyro (Channel 15-19)	1.4
L1	Animal Compartment Pressure (Channel 15-21)	1.4
D37	Horizon Scanner-Pitch (Channel 15-22)	1.4
L7	Viability Sensor No. 2 (Channel 5)	1.4
L8	Viability Sensor No. 3 (Channel 11)	1.4
--	System Time	0.2
--	Received Signal Strength (Discoverer)	1.4

7.1.1.2 Real-Time Telemetry Recording - T/M Ship. The following parameters will be recorded on the CEC oscillograph in the T/M ship ground station:

Oscillograph - Telemetry Ship

Measurement Numbers	Measurement	Approximate Trace Deflection (Inches)
L6	Viability Sensor No. 1 (Channel 4)	1.4
L7	Viability Sensor No. 2 (Channel 5)	1.4
A10	Longitudinal Acceleration (switched off at 417 seconds) (Channel 9)	2.0
L8	Viability Sensor No. 3 (Channel 11)	1.4
B6	Combustion Chamber Pressure (switched off at 417 seconds) (Channel 13)	2.0
SD 125	Longitudinal Vibration (until switch) (Channel 18)	1.4
L6	Viability Sensor No. 1 (after switch) (Channel 18)	1.4
--	System Time	0.2
--	Received Signal Strength, Forward Antenna	1.4
--	Received Signal Strength, Aft Antenna	1.4

7.1.2 Launch Tracking Data

Tracking data acquired by VAFB and Point Mugu during launch and ascent-to-loss-of-signal are required as shown in Table 7-2.

7.1.3 Photographic Requirements

Documentary and engineering sequential photographic coverage of launch and early boost will be provided in accordance with Tables 7-3, 7-4, and 7-9. Selected quick-look motion picture and still prints, as determined by the FTWG at VAFB, will be made available to DAC (VAFB), LMSD (PA), and FTWG, VAFB within 24 hours after firing. One work print each of all engineering sequential films will be delivered to the FTWG, AFBMD (Inglewood), DAC (SM), and LMSD (PA) within 74 hours after firing. One master or otherwise reproducible print of all documentary films will also be delivered to each of the above reporting areas within 98 hours after firing. Transmittal will be by courier or sent by registered airmail. All engineering sequential motion picture prints will be 16-mm.

7.1.4 Metric Optics

Films resulting from metric optics instrumentation are required as shown in Table 7-5. Within 52 hours following the test, four positive prints of all exposed metric film will be distributed as follows:

a. One positive print each to DAC (VAFB) and to FTWG (VAFB)
b. Two positive prints to LMSD (PA).

Metric optics data requirements are listed in Table 7-6. Quick-look data as listed will be distributed as follows:

a. One copy to the FTWG (VAFB)
b. Two copies to DAC (VAFB)
c. Three copies to LMSD (PA)

This quick-look data will also include X, Y, Z, and V_r space position data for the last few available points. Twelve copies of the final smoothed data, as listed, will be distributed by courier or registered mail as follows:

a. Three copies each to AFBMD (Inglewood), FTWG, DAC (VAFB), and LMSD (PA).

7.1.5 Launch Weather Data

Launch weather data requirements are listed in Table 7-7. Copies of these data are required within 48 hours after firing for distribution of two copies each to DAC (VAFB), and one copy each to the FTWG (VAFB) and LMSD (PA).

7.1.6 Blockhouse Landline Data

The originals of all blockhouse quick-look landline recordings (analog) of Discoverer functions monitored during countdown and launch operations will be supplied to LMSD (PA) within eight hours after firing. Necessary calibration information in the form of overlays or annotation will accompany the records.

7.1.7 Voice Communications Tapes

One copy each of magnetic tape recordings of voice communications recorded at the Vandenberg Control and the Blockhouse during countdown and launch operations will be furnished to LMSD (PA) within 24 hours after firing.

7.1.8 Radiation Monitoring

A written statement form Range Interference Control concerning the results of radiation monitoring during countdown and launch will be transmitted to DAC (VAFB), LMSD (PA), and the FTWG within four hours after firing.

7.1.9 Range Safety

One copy of each of the Range Safety Chart or Recording is required within eight hours after firing.

7.1.10 Servicing Notes

Final lift-off weight and balance data, alignment data, and instrumentation schedules for the Discoverer/Thor combination will be supplied to DAC (SM), LMSD (PA), and to FTWG (VAFB) within eight hours after firing.

7.2 ORBITAL DATA REQUIREMENTS

7.2.1 Radar and Telemetry Data

Radar and telemetry data recorded by each tracking station will be transmitted to LMSD (PA) in accordance with Table 7-8.

7.2.2 Voice Communications

Interstation communications will be recorded on magnetic tape by the Development Control Center during the launch and orbital phases of the test. One copy of these recordings will be made available to FTWG (PA) within 36 hours after firing.

7.3 RECOVERY DATA REQUIREMENTS

The following data will be transmitted to LMSD, Department 61-44 (PA) within 48 hours after termination of recovery operations.

7.3.1 Test Conditions

Test conditions at time of command-to-recover will be recorded as follows:

a. Surface and upper air weather conditions in recovery area
b. Recovery force deployment
c. Status of communications.

7.3.2 Acquisition Data

Data pertaining to the performance of the acquisition aids will be recorded as indicated below:

a. RC-121 and surface ship radar logs: chaff and silvered chute acquisition and tracking data
b. C-119 and surface ship DF logs: beacon acquisition and homing data
c. Aircraft and surface ship visual logs: acquisition data on the parachute, Rescuelites, dye markers, and capsule
d. Rate of descent and impact location data.

7.3.3 Recovery Data

The following data will be noted for each recovery or attempted recovery:

a. Aircraft or ship number executing recovery
b. Time of day
c. Capsule altitude (air snatch)
d. Observed condition of parachute
e. Cable payout (air snatch)
f. Contacts (air pickup poles, cabling, fuselages, ship hulls, grappling hooks, sharks, etc.).

7.3.4 Condition of Capsule and Specimen

Upon recovery, the following conditions will be noted based on a preliminary examination of the capsule and contents:

a. Extent of capsule damage
b. Condition of parachute
c. Condition of water seals
d. Condition of specimen

The Air Force Bioastronautics Directorate has assumed the responsibility for delivery of the onboard BRC tape recorder and intact tape to Holloman AFB and for the data reduction of the tape at their facility. Three copies of playback analog records, with appropriate calibration and annotations, and a preliminary analysis TWX report shall be transmitted by BAD to LMSD, Department 61-44 (PA) within 48 hours after completion of the recovery operation. Still photographs and motion pictures of the sequence of events involving opening and inspection of the recovery capsule, life cell, and animal cage shall be made by BAD. Two copies of this film shall be made available to LMSD, Department 61-44 (PA) within 48 hours after termination of recovery operation.

7.3.5 Operations Data

Recovery operations will be documented by motion picture and still photographic coverage as required. Still pictures of all significant items of equipment including capsules and parachutes after their recovery and return to HCC shall be made by LMSD (PA). A 16-mm motion picture coverage (32 frames/sec) shall be made of the aerial pickup operation by either fixed fore and aft looking cameras or by Air Force operated hand-held cameras. In addition, tape recordings of pertinent voice communications will be made at the HCC, aboard one of the naval recovery force contingent. RC-121 APS 20 and 45 radar scope pictures shall be obtained. A detailed log of recovery force deployment will be maintained at the HCC covering the period of time from the time of the command to recover to the termination of operations. Operations data required will also include copies of the regular (routine) logs maintained by the aircraft and ships. All such logs and photographic coverage shall be transmitted to LMSD, Department 61-44 (PA) within 48 hours following recovery.

TABLE 7-1
Launch Telemetry Data Requirements

ITEM	DESCRIPTION	TYPE	ORIGIN	DELIVERY SCHEDULE Routing	Location	Time Due	Resp
1.	Launch Telemetry Data IRRS T/M Van						
1.1	IRSS T/M Van Mag tape of 1st Stage	Orig	IMD	1	LMSD T/Sta	T+ 1/2	I MD
				2	5328	T+ 1	LMSD
				3	DAC VAFB	T+ 4	DAC
1.1.1	Dub of 1.1	Dub	LMSD T/Sta	1	VAFB T/M	T+ 1	LMSD
				2	5328	T+ 5	I MD
				3	DAC VAFB	T+ 6	DAC
1.1.2	Two Analogs from 1.1.1	2 Analogs	I MD	1	5328	T+5	I MD
1.1.3	Analog from 1.1.2	1 Analog	BMD	1	DAC VAFB	T+ 5	DAC
1.2	IRSS T/M Van Sig Real Time Analogs 1st Stage	Orig	I MD	1	5328	T+ 1/2	I MD
				2	DAC VAFB	T+ 4	DAC
1.4	LMSD T/Station LMSD T/M Mag Tape of Discoverer Tape A	Orig A	LMSD T/Sta	1	5328	T+ 2	LMSD
1.5	LMSD T/M Mag Tape of Discoverer Tape B	Orig B	LMSD T/Sta	2	LMSD (PA)	T+ 6	LMSD
				1	5328	T+ 2	LMSD
1.5.1	Dub of 1.5	Dub 2	LMSD	2	LMSD (PA)	T+ 6	LMSD
				1	5328	T+ 1	LMSD
1.5.2	Analog of 1.4 or 1.5 (1st Stage)	Analog	LMSD T/Sta	2	DAC VAFB	T+ 4	DAC
				1	DAC VAFB	T+ 12	LMSD
1.6	Real Time Analogs (Orbital Stage)	1 Set Analogs	LMSD T/Sta	1	5328	T+ 4	LMSD
1.6.1	Playback Analog Same As 1.6 (Orbital Stage)	Analog	LMSD T/Sta	2	LMSD (PA)	T+ 8	LMSD
				1	5328	T+ 6	LMSD
1.6.2	Playback Analog Same as 1.6 (Orbital Stage)	Analog	LMSD T/Sta	1	LMSD VAFB	T+ 4	LMSD
1.7	Sanborn Record Ch. 13 (1st Stage)	Orig	LMSD T/Sta	1	5328	T+ 1/2	LMSD
	Auxiliary T/Station Pt. Mugu						
1.8	Mugu T/M Mag Tape of Discoverer	Orig	LMSD Mugu	1	LMSD (PA)	T+ 8	LMSD
1.8.2	Analog from 1.8.1	Analog	LMSD Mugu	1	5328	T+ 6	LMSD
1.9	Mugu Real Time Analogs of Orbital Stage	Orig	LMSD Mugu	1	5328	T+ 6	LMSD
				1	5328	T+ 6	LMSD
1.10	DAC, Santa Monica 1st Stage T/M Playback Analog Kit	Copy	DAC(SM)	1	DAC VAFB	T+ 24	DAC
1.10.1	Copy of 1.10	Copy	DAC (SM)	2	5328	T+ 48	DAC
				1	LMSD (PA)	T+ 36	LMSD
1.11	LMSD, Palo Alto Orbital Stage T/M Playback Analog Kit	Copy	LMSD (PA)	1	5328	T+ 36	LMSD
1.11.1	1 Copy of 1.11	Copy	LMSD (PA)	1	DAC (SM)	T+ 36	DAC
1.11.2	4 Copies of 1.11	4 Copies	LMSD (PA)	1	LMSD VAFB	T+ 36	LMSD

TABLE 7-2
Launch Tracking Data Requirements

2.	Launch Tracking Data						
2.1	Punched Paper Tape of Verlort (LMSD T/Sta)	Orig	LMSD T/Sta	1	5328	T+2	LMSD
				2	LMSD (PA)	T+6	LMSD
2.1.1	Copy of 2.1	Copy	LMSD T/Sta	1	5328	T+4	LMSD
2.2	Punched Paper Tape of Ve-lort (Mugu)	Orig	LMSD Mugu	1	5328	T+6	LMSD
				2	LMSD (PA)	T+8	LMSD
2.2.1	Copy of 2.2	Copy	LMSD Mugu	1	5328	T+6	LMSD
2.3	Punched Paper Tape of TLM-18 LMSD T/Sta	Orig	LMSD T/Sta	1	5328	T+2	LMSD
				2	LMSD (PA)	T+6	LMSD
2.3.1	Copy of 2.3	Copy	LMSD T/Sta	1	5328	T+4	LMSD
2.4	Punched Paper Tape of Doppler	Orig	LMSD T/Sta	1	5328	T+2	LMSD
				2	LMSD (PA)	T+6	LMSD
2.5	Plotting Board Charts Verlort (1) VAFB Chart (2) VAFB of Mugu	Orig	LMSD T/Sta	1	LMSD VAFB (repro)	T+1/2	LMSD
				2	5328	T+1	LMSD
				3	LMSD (PA)	T+6	LMSD
	5 copies of 2.5 or one reproducible	5 copies or 1 Repro	LMSD Repro	1		T+1	
2.5.1	Five copies of 2.5 or one reproducible			2	DAC VAFB	T+1	DAC
2.5.2	1 copies of 2.5	1 copies	LMSD Repro	1	5328	T+1	LMSD
2.5.3	Plotting Board Charts of Verlort (Mugu) (1) Mugu Radar (2) Time to Fire	Orig	LMSD Mugu	1	LMSD VAFB (Repro)	T+2	LMSD
				2	5328	T+3	LMSD
				3	LMSD (PA)	T+6	LMSD
2.6.1	5 copies of 2.6 or one reproducible copy	5 copies or 1 repro	LMSD Repro	1	5328	T+3	LMSD
				2	DAC VAFB	T+6	DAC
2.6.2	1 copies of 2.6	1	LMSD	1	5328	T+3	LMSD
2.6.3	1 Copy of 2.6	1 copy	LMSD Repro	1	LMSD VAFB	T+3	LMSD
2.7	Plotting Board Charts TLM-18 LMSD T/Sta	Orig	LMSD T/Sta	1	LMSD VAFB (Repro)	T+1/2	LMSD
				2	5328	T+1	LMSD

TABLE 7-3
Documentary Film Requirements

ITEM NO	CAMERA POSITION	FILM SIZE	EMULSION	DURATION T-	T/	FPS	IMAGE TO FRAME RATIO	COVERAGE	SPEC INSTR.
5.1	J	35mm	ECN	A/R	LOV	24	O.S. &FS to fill 2/3 of frame	Tracking to limits of visability	
5.2	J	35mm	ECN	A/R	LOV	48	O.S. & F.S. to fill 2/3 of frame	Tracking to limits of visability	
5.3	K	35mm	ECN	A/R	LOV	24	O.S. & F.S. to fill 2/3 of frame	Tracking to limits Of visability	
5.4	K	35mm	ECN	A/R	LOV	48	O.S. & F.S. to fill 2/3 of frame	Tracking to limits of visability	
5.5	D	70mm	Ansco-chrome	55	55	10	O.S. & F.S. to fill 75% of frame	Lift-off	Use 5" Format
5.6	J	70mm	Ansco-chrome	55	LOV	10	O.S. & F.S. to fill 75% of frame	Tracking	Use 2-1/4 Format
5.7	D	4x5	Ektacolor S	N/A	N/A	N/A	O.S. & F.S. to 65% of frame	At Lift-off	Manually triggered by TV observation at liftoff
5.8	D	4x5	B & W	N/A	N/A	N/A	O.S. & F.S. to 65% of frame	At Lift-off	As above
5.9	E	4x5	Ektacolor S	N/A	N/A	N/A	O.S. & F.S. to 65% of frame	At Lift-off	As Above
5.10	E	4x5	B & W	N/A	N/A	N/A	As above	At Lift-off	As Above
5.11	MP alert	35mm	ECN	N/A		N/A	As directed by LMSD Photo coord.	As Directed	None
5.12	MP alert	35mm	ECN	N/A		N/A	As directed by LMSD Photo coord.	As Directed	None
5.13	Still alert	4x5	B&W & Color	N/A		N/A	As directed by DAC Photo coord.	As Directed	None
5.14	Still Alert	4x5	B & W & Color	N/A		N/A	As directed by DAC Photo coordinator	As Directed	None

TABLE 7-4
Engineering Sequential Film Requirements

O.S. - ORBITAL STAGE
F.S. - FIRST STAGE
ENGINEERING SURVEILLANCE

ITEM NO	CAM POS	FILM SIZE	EMUL	DURATIONS T-	T+	FPS	IMAGE TO FRAME RATIO	OPTIUM EXPOSURE AREA*	COVERAGE	SPEC INSTR.
4.1	A	16mm 1200'	Comm. Ektachrome	15M	5M	24	See coverage column	LOX Area & vehicle	To show LOX pipes w/veh in background	
4.2	B	16mm 1200'	Comm Ektachrome	15M	5M	24	See coverage column	Entire area	Surveillance	
4.3	B	16mm 400'	Comm Ektachrome	5S	5S	350	O.S. to occupy bottom 75% of	O.S. Umbilical connectons	Umb. disconnect and lift-off	
4.4	B	16mm 400'	Comm Ektachrome	5S	5S	350	O.S.-F.S. Thor bottom 75% frame	Entire vehicle	Lift-off	
4.5	C	16mm 1200'	Comm Ektachrome	15M	5M	24	O.S.-F.S. bottom 75% frame	Entire vehicle	Surveillance	
4.6	C	16mm 1200'	Tri-X	Reg	C/D-	75FPM	See coverage column	Vehicle & Pad area	Entire area (time study)	
4.7	C	16mm 400'	Comm. Ektachrome	5S	5S	300	O.S. bottom 75% of frame	S entry Umbilical connections	Disconnect & O.S. lift-off	
4.8	D	16mm 1200'	Comm. Ekatachrome	15M	5M	24	See coverage column	Vehicle & Pad area	Surveillance	
4.9	D	16mm 1200'	Tri-X	Beg-C/D-termination		75FPM	See coverage column	Vehicle & Pad area	Entire area (time study)	
4.10	E	16mm 1200'	Comm Ektachrome	15M	5M	24	See coverage column	Fueling area	Fueling area to missile	
4.11	E	16mm 400'	Comm Ektachrome	5S	15S	350	O.S.-F.S. bottom 75% of frame	Entire vehicle	Lift-off	
4.12	E	16mm 1200'	Tri-X	Beg C/D-termination		75FPM	See coverage column	Vehicle & Pad area	Entire area (time study)	
4.13	F	16mm 100'	Comm Ektachrome	5S	15S	200	See coverage column & spec. instructions	Vernier engine start	Vernier engine, base of missile, umbilical & lift - off	Poloroid filter to be used / 30° from Zenith to the right facing the missile from camera position
4.14	C	16mm 100'	Comm Ektachrome	5S	15S	200	Coverage column & spec instr	Turbine exhaust ignition	Launch arm #4 turbine exhaust, lift-off	Polaroid filter to be used / 30° from Zenith to the right facing the missile from camera
4.15	H	16mm 100'	Comm Ektachrome	5S	15S	200	See coverage column & spec.	Vernier engine #2	Vernier engine #2 lift-off	Polaroid filter to be used / 30° from Zenith to the right facing the missile from camera position
4.16	F	16mm	Comm Ektachrome	5S	30S	64	See coverage column	Base of F.S. & Launch Deck	F.S. Base & Launch Deck	Polaroid filter required

TABLE 7-5

Metric Optics Film Requirements

Item No.	Coverage*	Type Film	Time Interval	Frame Rate (FPS)	Image/Frame Ratio	Resolution	Camera Locations
5.1	4 Mobile Optical Tracking Units with 2 cameras each (MOTU's)	35-mm color 70-mm B/W	Lift-off to T+2 minutes	32	Best obtainable at 60,000 feet altitude		OT1, OT2, OT3, and OT4
5.2	One Recording Optical Tracking Instrument (ROTI or TPR)	35-mm color	Lift-off to T+4 minutes	64	Discoverer/Thor to occupy 75% of frame at lift-off	6-inch detail at lift-off	OT5

* These cameras are located at five optical tracking sites with approximate pad coordinates as follows:

Distance from Pad (feet)

	OT1	OT2	OT3	OT4	OT5
North	4000	11,700	(-)19,500	(-)41,200	Tranquillon
East	5300	38,200	14,100	22,100	Peak

Pad 4 Location

Latitude: 34° 45' 26.18" N
Longitude: 120° 37' 45.55" W

Pad 5 Location

Latitude: 34° 45' 22.15"
Longitude: 120° 37' 30.80"

All films to carry LMSD timing

TABLE 7-6

Metric Optics Data Requirement

Item	Description of Item	Data Source	Desired Coverage	Desired Accuracy	Sample Rate	Required Presentation*	Time Required
6.1	Space position data	Best Combination of Askania and MOTU photo-theodolite stations VAFB (PMR)	Lift-off to 5000 feet altitude and last available points	±1.0 mils	50 pt	Tabulation of X, Y, Z (feet) versus time from lift-off (sec)	T + 48 hr
			Lift-off to limit of tracking ability		4/sec		
6.2	Velocity data			7-degree smoothing		Tabulation of V_x, V_y, V_z, V_r (ft/sec) versus time from lift-off (sec)	T + 72 hr
6.3	Attitude data (pitch, roll, and yaw)	ROTI or TPR: Tranquillion Peak/PMR		±2 degree or best obtainable		Tabulation of Θ, ϕ, Ω (deg) versus time from lift-off (sec)	

* Coordinates: X, Y, Z, V_x, V_y, V_z, V_r: cartesian coordinates, earth axes (non-rotating), with origin at launch pad, position Z upwards along local gravitational vertical, positive X in direction of predicted launch azimuth, Y to complete right-hand system.

Θ, ϕ, Ω: Θ-angle between longitudinal axes and local horizontal, positive for pitch-up; ϕ-degree of rotation about longitudinal axes referenced to launch position, positive for clockwise roll; Ω-angle between the projection of the vehicle longitudinal axis on the horizontal plane and the projection of the velocity vector on the horizontal plane, positive for right yaw.

TABLE 7-7

Launch Weather Data Requirements

Item No.	Description of Item		Required Coverage	Desired Accuracy	Time of Observation	Required Presentation	Time Required
7.1	Surface Conditions	Pressure	Actual conditions at launch pad for each observation	±3 mb	T-12	Tabular	T + 46 hr
		Temperature		±1°C	T-4 and T+1 hr		
		Humidity		±10%			
		Wind Speed		±3.6 knots			
		Wind Direction		±10°			
		Visibility		±1000 ft			
7.2	Upper Air Conditions	Pressure*	Surface to 110,000 ft. or maximum capability of the weather station	±1.5 mb above 50,000 feet	Conditions prevailing at time of launch	Graphical presentation with all parameters correlated with tape-line altitude	T + 48 hr
		Temperature**		±1° C			
		Humidity**		Best obtainable			
		Wind Speed*		±3.6 knots			
		Wind Direction*		±10°			
		Density*		±0.6%			
		Cloud Cover		±10%		Noted	

* Data points required each 1000 feet of altitude

** Data points required each 1000 feet to 10,000 feet, each 2000 feet to 20,000 feet; each 5,000 feet above 20,000 feet

TABLE 7-8

Orbital Radar and Telemetry Data Requirements*

Tracking Station	Expected Coverage (Passes)	Time Required	Method of Delivery
VAFB and Pt. Mugu	8N	T + 15 hr	Courier
	15S	T + 30 hr	Lockheed Shuttle
Kaena Point	1S, 2S	T + 12 hr	Courier
	9N, 10N, 16S, 17S	T + 48 hr	Commercial Airline
Annette	1S	T + 18 hr	Courier
	8N, 9N, 15S, 16S	T + 48 hr	Commercial Airline
Chiniak	1S, 2S	T + 18 hr	Courier
	8N, 9N, 10N, 16S, 17S	T + 48 hr	Courier

*The following items of data from each tracking station will be transmitted to LMSD (PA) within the times specified:

a. Magnetic tape recordings of Discoverer telemeter receiver output
b. Discoverer telemetry signal strength records
c. Real time analog records of Discoverer telemetered functions
d. Punched paper tapes of radar and telemetry tracking data
e. Plotting board charts of radar and telemetry tracking data
f. Radar signal strength records

TABLE 7-9
Film Disposition Schedule

ITEM NUMBER	TYPE	DISPOSITION						Required data Delivery	Responsible Agency
		DAC/SM	DAC/VAFB	LMSD/PA via LMSD/VAFB	LMSD/VAFB	BMD/ING	BMD/VAFB		
4.1	W/P	1		1					
4.2	W/P	1		1				T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.3	W/P	1		1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.4	W/P	1		1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.5	W/P	1		1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.6	W/P			1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.7	W/P	1			1	1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.8	W/P	1		1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.9	W/ P	1		1		1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.10	W/P	1		1		1		T/ 74	1352 MPS
4.11	W/P	1		1				T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.12	W/P			1		1		T/ 74	1352 MPS
4.13	W/P	1						T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.14	W/P	1				1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.15	W/P	1				1		T/ 74	1352 MPS
	Master					1		T/ 74	1352 MPS
4.16	W/P	1				1		T/ 74	1352 MPS
	Master							T/ 74	1352 MPS
5.1	W/P	1		1		1		T/ 96	1352 MPS
	Master					1		T/ 96	1352 MPS
5.2	W/P	1		1		1		T/ 96	1352 MPS
5.3	W/P	1		1				T/ 96	1352 MPS
	Master					1		T/ 96	1352 MPS
5.4	W/P	1		1		1		T/ 96	1352 MPS
5.5	Selected origor duplicate frames		4	4		4		T/ 96	1352 MPS
5.6	Selected origor duplicate frames		4	4		4		T/ 96	1352 MPS
5.7	Duplicate Color Transparancy		1	1		1		T/ 96	1352 MPS
5.8	B & W 8x10 SWG		10		10	10	10	T/ 96	1352 MPS
	B & W Dup Neg		1	1		1		T/ 96	1352 MPS
5.9	Duplicate color Transparancy		1	1		1		T/ 96	1352 MPS
5.10	B & W 8x10 SWG		10		10	10	10	T/ 96	1352 MPS
	B & W Dup Negq		1	1		1		T/ 96	1352 MPS

5.11 thru 5.14 Acquisition, collection & disposition is the responsibility of VAFB-DAC, LMSD, & BMD Photographic Coordination Personnel with "as designated" delivery times dependant on type, nature, & urgency of requirement.

Quick Look Data will be designated by FTWG at Post Launch Critique Q. L. Data Disposition will be determined by Chairman, FTWG.

All Items Motion picture printing will be determined by BMD, DAC, & LMSD Photographic Personnel. This determination will be based upon usuable and informative material contained in original processed film data.

TABLE 7-10
Additional Data Requirements

ITEM	DESCRIPTION	TYPE	ORIGIN	DELIVERY SCHEDULE Routing	Location	Time Due	Resp
6.	Range Safety						
6.1	Range Safety Plotting Board Charts	3 copies	IMD	1	5328	T/ 1	IMD
6.1.1	Range Safety Plotting Board Charts	Copy	BMD	1	DAC VAFB	T/ 1	D..C
6.1.2	Range Safety Plotting Board Charts	Copy	BMD	1	LMSD (PA)	T/ 6	LMSD
6.2	Real Time FR W-2 UHF Commands	2 Copy	IMD	1	5328	T/ 2	IMD
6.2.1	Real Time FR W-2 UHF Commands	Copy	BMD	1	LMSD (PA)	T/ 6	LMSD
6.3	Range Safety Voice Tapes	Orig or copy	IMD	1	As requested	T/ 2	IMD
6.3.1	Range Safety Voice Tapes	Copy	IMD	1	by FTWG	T/ 8	LMSD
6.4	Other Range Safety Tracking	Copy	IMD	1	5328	T/ 4	IMD
7.	Communications						
7.1	PACC/VCC Voice Tapes	Orig or copy	LMSD	1	5328	T/ 2	LMSD
	PACC/VCC Voice Tapes		BMD	2	LMSD (PA)	T/ 24	LMSD
7.2	LMSD Blockhouse Voice Tapes	Orig or copy	LMSD	1	5328	T/ 4	LMSD
	LMSD Blockhouse Voice Tapes		BMD	2	LMSD (PA)	T/ 24	LMSD
7.3	Blockhouse Land Line Recordings Real Time	Orig	LMSD (B/H)	1 1	5328	T/ 2	LMSD
				2	LMSD (PA)	T/ 6	LMSD
8.	Weather						
8.1	Weather Data	4 copies	IMD	1	5328	T/96	IMD
8.1.1	1 Copy of 8.1	copy	BMD	1	LMSD(PA)	T/100	LMSD
8.1.2	2 copies of 8.1	2 copies	BMD	1	DAC VAFB	T/100	DAC
9.	Miscellaneous						
9.1	Radiation Monitoring records (written)	3 copies	IMD	1	5328	T/ 4	I MD
9.1.1	1 copy of 9.1	copy	BMD	1	LMSD (PA)	T/ 8	LMSD
9.1.2	1 copy of 9.1	copy	BMD	1	DAC VAFB	T/ 8	DAC
9.2	Servicing Notes LMSD	Orig	LMSD	1	LMSD PA	T/ 4	LMSD
9.2.1	Copy of 9.2	Copy	LMSD	2	5328	T/ 8	LMSD
9.3	Servicing Notes DAC	Orig	DAC VAFB	1	5328	T/ 4	DAC
9.3.1	Copy of 9.3	Copy	DAC VAFB	1	DAC (SM)	T/ 4	DAC
9.3.2	Copy fof 9.3	Copy	DAC (VAFB	1	LMSD (PA)	T/ 8	LMSD
9.4	Instrumentation Schedule LMSD	Orig	LMSD	1	5328	T/ 4	LMSD
				2	LMSD (PA)	T/ 8	LMSD
9.5	Instrumentation Schedule DAC	Orig	DAC	1	5328	T/ 4	DAC
9.5.1	Instrumentation Schedule DAC	Copy	DAC	1	LMSD (PA)	T/ 8	LMSD

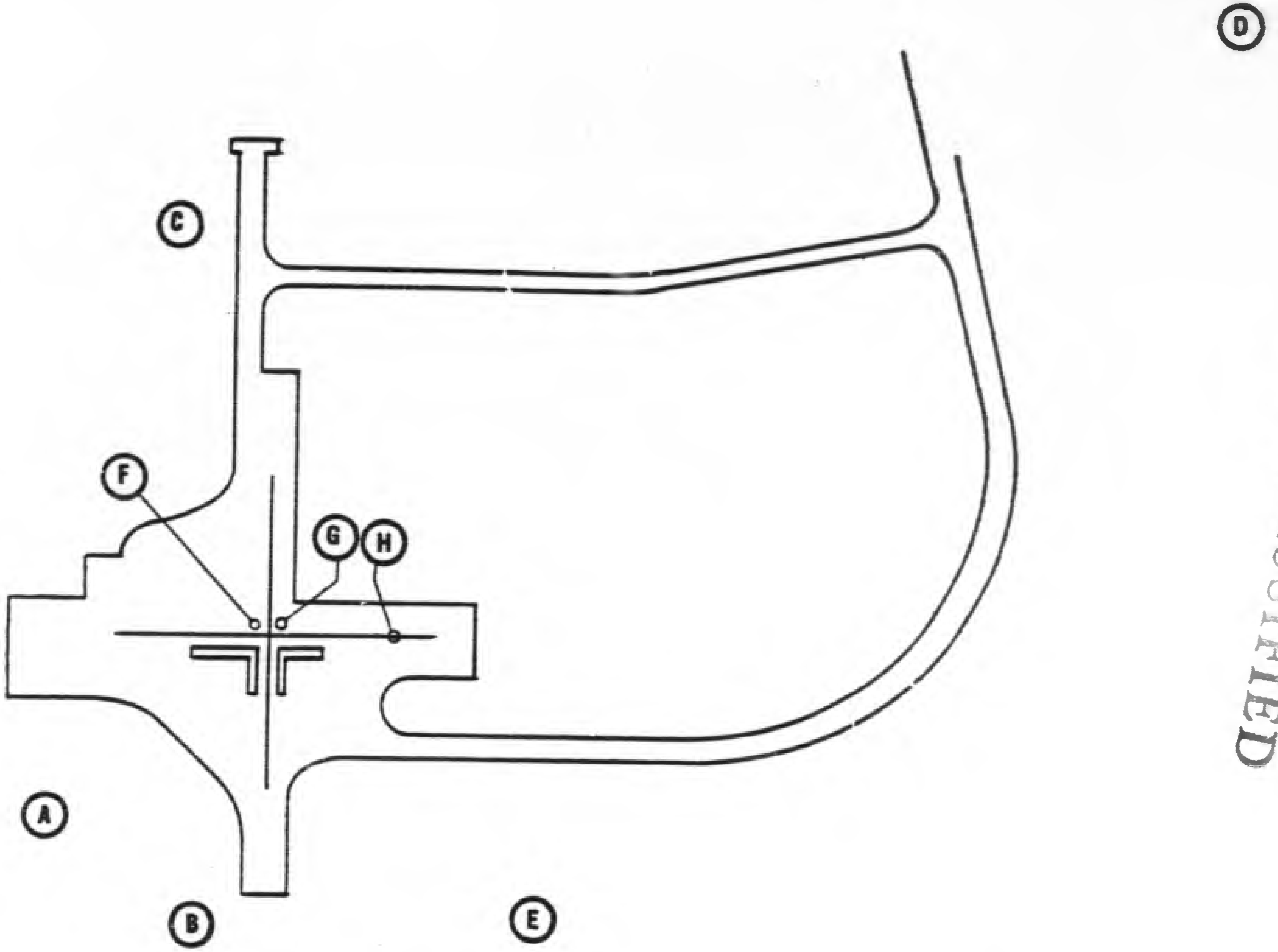

FIGURE 7-1 - LAUNCH COMPLEX SM-75-3 PAD 4 WITH CAMERA LOCATIONS

SECTION 8
TEST REPORTS

Test Reports which are required for official distribution are listed in Table 8-1. In addition, field reports describing actual test support activities and equipment operation will be required from all stations. The content and format of these reports are given below.

8.1 LAUNCH REPORTS

The Flight Test Working Group at VAFB will prepare and transmit the following reports to BMD(WDZW)with distribution as shown in Table 8-1.

8.1.1 Flash Report

A flash report briefly describing launch operations and results will be transmitted via TWX.

8.1.2 Follow-on Launch Report

A follow-on report giving a more complete description of launch operations and flight results will be transmitted via TWX after a preliminary review of raw launch data.

8.1.3 Final Launch Report

This report will provide a formal documentation and FTWG evaluation of launch operations and results, including the pertinent launch data.

8.2 DOUGLAS THOR REPORTS

8.2.1 Douglas Quick-Look Report

A quick-look report containing the results of a preliminary review of Thor launch data at Santa Monica, with particular emphasis upon indicated problem areas, will be transmitted via TWX.

8.2.2 Final Douglas Flight Test Report

This report will provide a preliminary analysis of Thor equipment operation and performance during countdown, launch, and flight and will encompass all factors involving possible modification of equipment, plans, or procedures on future tests.

8.3 DISCOVERER REPORTS

8.3.1 Preliminary Flight Information TWX

This report will contain a brief description of flight operations and results based on the flash report of Item 8.1.1 and the latest inputs from the remote tracking stations.

8.3.2 Preliminary System Test Report

This report will be based upon system quick-look evaluation at Palo Alto, the follow-on launch report (Item 8.1.2), the Douglas quick-look report (Item 8.2.1), and internal LMSD reports from the tracking stations and the Development Control Center. The report will include a brief summary of test results, a complete account of test conduct, and a preliminary operational evaluation of the flight in terms of the achievement of test objectives, problems encountered, and overall system performance.

8.3.3 Final Flight Test Report

This report will be based upon a complete analysis of boost and orbital trajectory and Discoverer subsystems performance. The report will contain an analysis of all factors involving possible hardware refinement or test procedures and will provide a complete documentation of the flight, including test data.

8.3.4 System Test Evaluation Report

This report will be based upon all test information previously published. The report will contain a final operational evaluation of overall system performance and will make specific recommendations regarding possible program re-direction.

8.4 TRACKING STATION REPORTS

All tracking stations will report on the operation of their equipment via TWX to the Development Control Center (DCC) within 36 hours following launch or within four hours after any premature termination of the test.

8.5 HAWAIIAN CONTROL CENTER REPORT

The HCC will transmit a commentary on test results to the DCC via the voice link immediately after termination of recovery operations. This will be followed by a more complete report to be transmitted via TWX within eight hours. In addition, each major contingent of the Recovery Force will prepare a written report describing the operation of equipment, actual procedures used, and pertinent observations. These reports will be furnished to the HCC, which will complete a preliminary recovery test report for formal transmission to the DCC within 48 hours after termination of recovery operations.

TABLE 8-1

Test Report

Report	Type	Time Req'd.	Responsibility	Installation Requiring Inputs	Receive Copies
Commentary	Voice Link	T-0 to T+15 min	Test Director (VAFB)	LC (DAC) LC (LMSD)	DCC (PA)
Flash	TWX	0-8 hr	BMD (VAFB)	FTWG (VAFB) DAC (VAFB) LMSD (VAFB)	BMD (WDZW) LMSD (61-44) LMSD (61-70) BMD (PA) DAC(SM)
FOLR	TWX	24-48 hr			
FLR	Pub.	7-14 days			
PRTR	TWX	48 hr from recovery	HCC	All recovery force elements	
DQLR	TWX	48 hr	DAC (SM)	DAC (SM)	BMD (WDZW) LMSD (61-44) LMSD (61-70) BMD (PA)
FDFTR	Pub.	30 days			
PFIT	TWX	2-8 hr	LMSD (PA)	DCC (PA) LMSD (VAFB) DAC (SM)	BMD (WDZW) BMD (PA) DAC (SM) BMD (VAFB)
PSTR	Pub.	5 days		Tracking Stations	
FFTR	Pub.	30 days			
STER	Pub.	45 days	BMD (PA)	STWG as required	BMD (WDZW) BMD (VAFB)

Code:

FOLR	Follow-on Launch Report
PRTR	Preliminary Recovery Test Report
FLR	Final Launch Report
DQLR	Douglas Quick-Look Report
FDFTR	Final Douglas Flight Test Report
PFIT	Preliminary Flight Information TWX
PSTR	Preliminary System Test Report
FFTR	Final Flight Test Report
STER	System Test Evaluation Report
Pub.	Published Formal Report
HCC	Hawaiian Control Center
SM	Santa Monica
PA	Palo Alto
LC	Launch Conductor
FTWG	Flight Test Work Group
STWG	Systems Test Work Group
DCC	Development Control Center

APPENDICES

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Appendix A-1

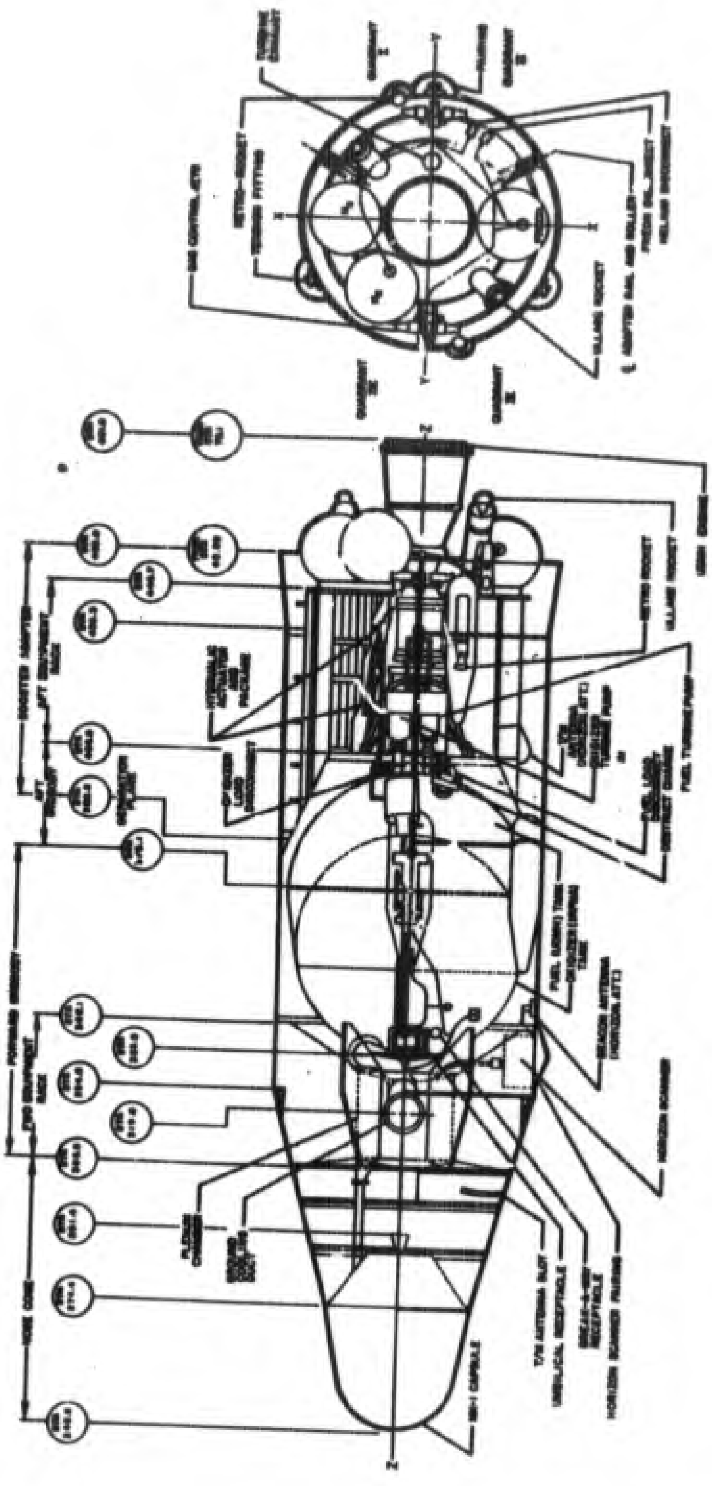
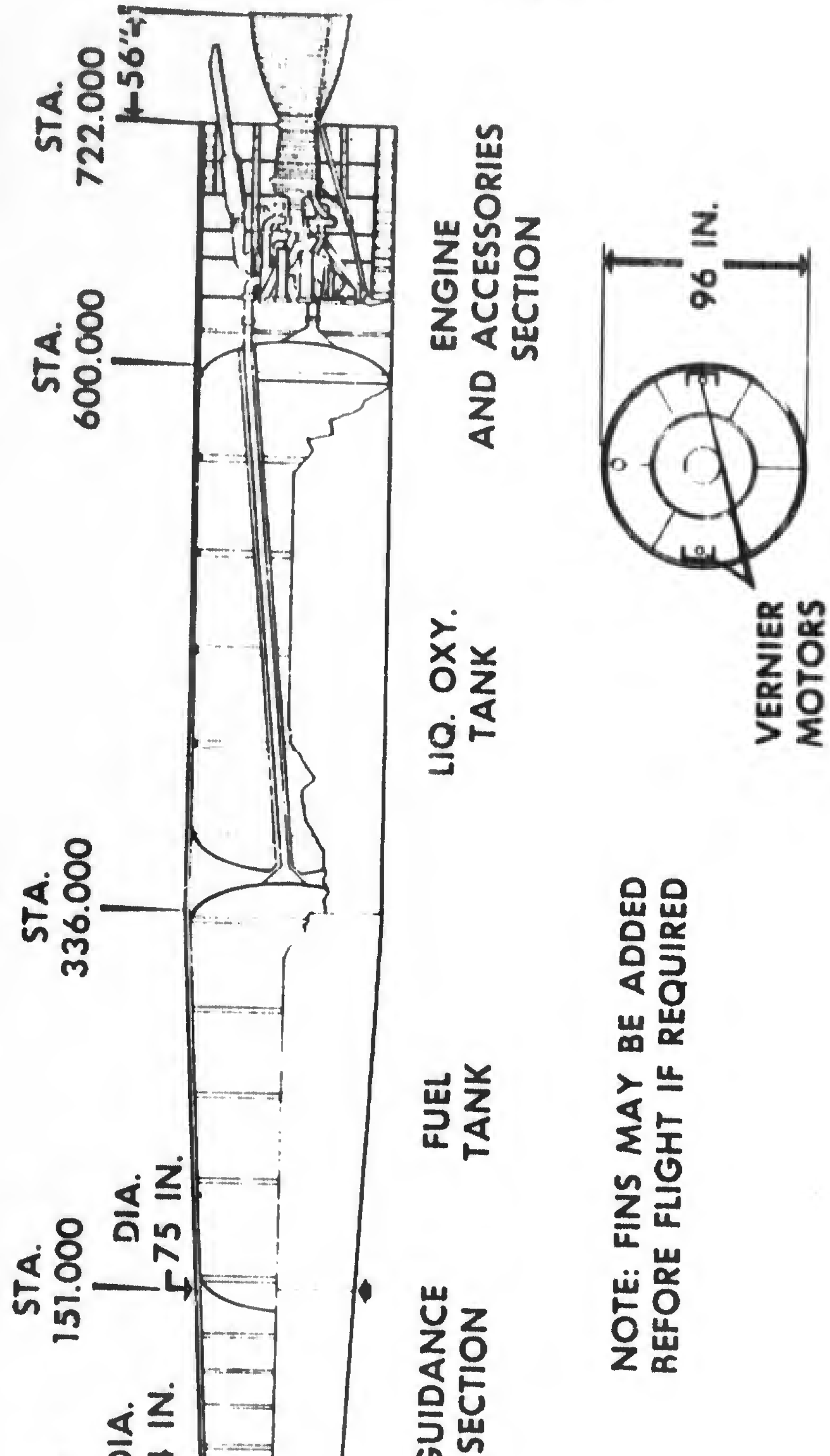


Fig. A-1 Discoverer Inboard Profile

APPENDIX A-2

DISCOVERER



NOTE: FINS MAY BE ADDED BEFORE FLIGHT IF REQUIRED

Fig. A-2 Thor (First Stage) Booster Inboard Profile

Appendix A-3

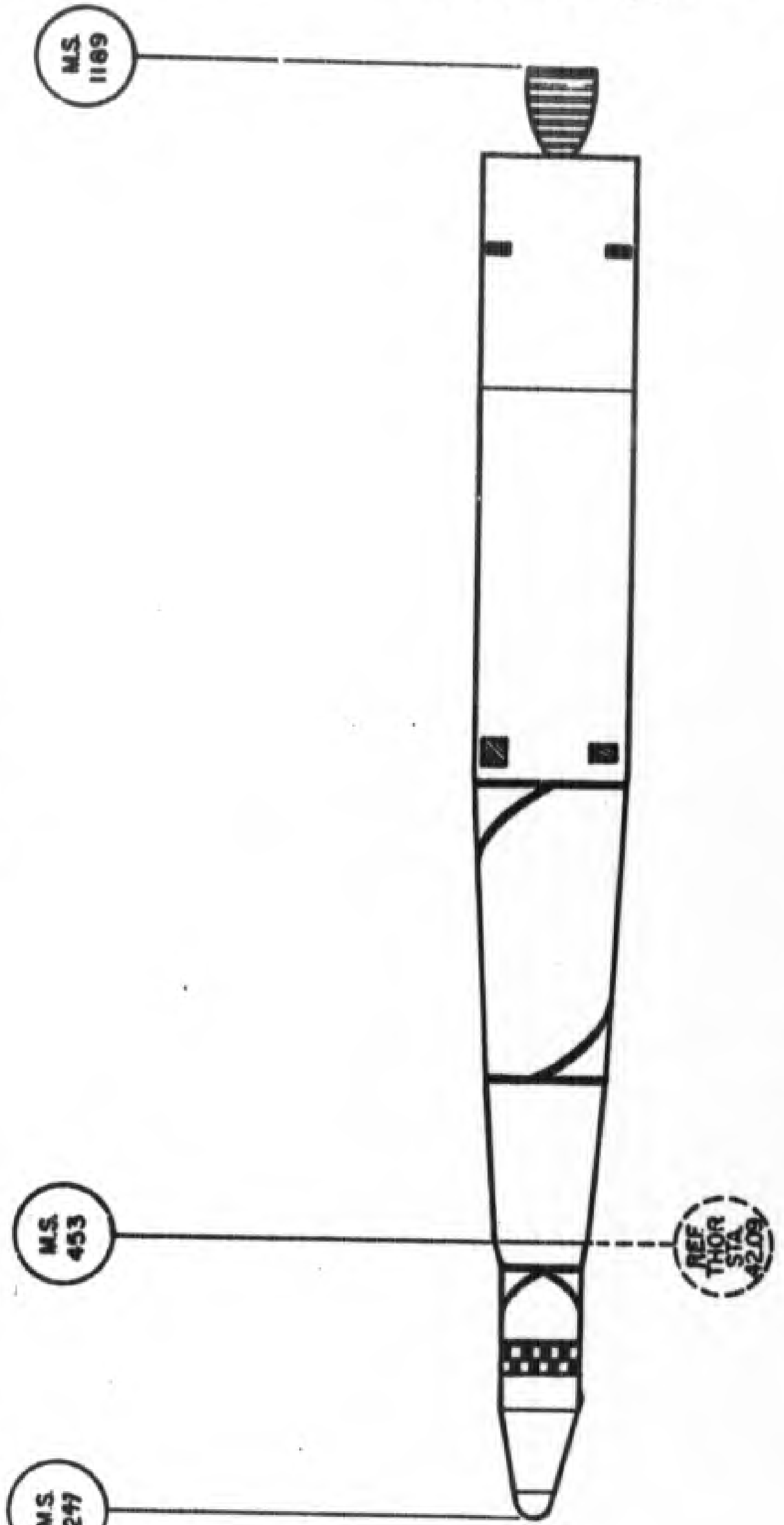


Fig. A-3 Discoverer/Thor Configuration, Paint Pattern

APPENDIX B-1

Detailed Weight Breakdown, Discoverer Serial 2205-1020

		Weight (lb)
WEIGHT EMPTY		1848
Propellants Loaded	Total	(6640)
Impulse		6527
Oxidizer Pre-Flow Expended		21
Trapped in Lines, Tanks and Engine		78
Residuals for Mixture Ratio		14
THOR PAYLOAD		8488
Less: Adapter and Attachments		-141
Retro Rockets		-16
Horizon Scanner Fairing		-2
SEPARATION WEIGHT		8329
Less: Control Gas Expended During Coast		-5
Ullage Control Rockets		-38
LAUNCH WEIGHT		8286
Less: Expendable Propellants		-6548
Control Gas Expended During Boost		-5
Engine Starting Charge		-1
Engine Nozzle Closure		-2
BURNOUT WEIGHT		1730
Less: Residual Propellants		-92
Helium Vented		-5
EMPTY WEIGHT ON ORBIT		1633

APPENDIX B-2

ESTIMATED INERTIA AND C. G. DATA (WEIGHT AND BALANCE) FOR DISCOVERER 1020/THOR 174

Condition	Weight Lbs	C. G. Location Inches			Moments of Inertia C. G. - Slug-Ft^2		
		z	x	y	I_{xx}	I_{yy}	I_{zz}
Launch	114,388	805.3	+0.02	+0.06	783,144	783,158	3620
Booster Burnout (1% P. U. -Lox)	17,551	656.7	+0.20	+0.26	393,159	393,173	2146
Thor Payload	8,488	364.3	+0.12	-0.07	2,007	2,021	164
Separation	8,329	363.2	+0.13	-0.07	1,868	1,884	139
Engine Ignition	8,286	362.7	+0.14	-0.07	1,787	1,803	135
Burnout	1,730	360.9	+0.47	-0.34	1,364	1,379	135
Operational (without residuals)	1,604	357.0	+0.70	-0.35	1,265	1,279	132

APPENDIX B-3

Thor Booster No. 174 Weight Breakdown

	Weight (Lb)	C. G. (Sta)
Dry Thor Booster	6,978	496.4
Trapped Propellant	614	621.1
Pressurization Gas	384	517.0
Unusable Lube Oil	44	651.5
Residual Propellant (1% Oxidizer)	982	609.1
Booster at Vernier Burnout (No Residuals)		
Booster at Vernier Burnout (1% Oxidizer Residuals)	9,002	518.8
Vernier Propellant Burned	61	649.0
Booster at Main Stage Burnout (1% Oxidizer Residuals)	9,063	519.7
Propellants Burned	96,612	421.2
Pressurization Gas Overboard	128	485.5
Vernier Propellant Overboard	13	449.0
Lube Oil Used	84	651.5
Booster Liftoff Weight	105,900	429.8

Note: Propellant values are based on engine calibration values, a nominal fuel density of 50.45 lb $/ft^3$, and a nominal liquid oxygen density of 71.38 lbs/ft^3.

APPENDIX C-1
TELEMETER INSTRUMENTATION SCHEDULE

VEHICLE NO. 2205-1020

T/M Package No. TSL-6

VEHICLE TRANSMITTER NO. 1	BUS
FREQUENCY (MC)	237.8
TRANSMITTER TYPE	1004390-637
R. F. AMPLIFIER TYPE	1060071-1

FINAL

INSTRUMENTATION SCHEDULE
(CONTINUOUS CHANNELS)

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020 TYPE ________ TRANSMITTER NO. 1

RDB CHAN. NO.	FREQUENCY-CPS −	C.F.	+	Meas. Name	Meas. No.	Freq. Resp.	Meas. Range	TYPE AND SERIAL PICKUP	OSC	LOC. OSC. P.U.	REMARKS
1	200 370	400	500 430	Turbine Speed	B35	4 cps	12,030 to 30,000 RPM	Supplied by Bell Aircraft		416	(Mod Bus)
2	518	560	602								
3	675	730	785	Not Used							
4	888	14 960	1,032	Viability Sensor #1	L6	14	0-4.5VDC		VCO UED TSO 200B	270	P
5	1,202	20 1,300	1,398	Viability Sensor #2	L7	20	0-4.5VDC		VCO UED TSO 200B	270	P
6	1,572	25 1,700	1,828	Vehicle Separation Mon. #3	A28	50cps	0-4" 0-6'	*	VCO UED TSO 200B	448	** P
7	2,127	35 2,300	2,473	Acceleration #2 (Ay)	A4	100cps	±3 G	S-A501 TCa	X1034394	409	DL-HG **
8	2,775	45 3,000	3,225	Normal Accel #2 (Ax)	A3	100cps	±3 G	S-A501 TCa	X1034394	409	DL-HG **
9	3,607	60 3,900	4,193	Longitudinal Accel (As)	A10	100cps	± 15 G	S-A501 TCa	X1034394	409	DL-HG ** P
10	4,995	80 5,400	5,805	Commutated Volt. (See Pg. 7 & 8)			Comm #3 "B" Ring	ASCOP TA00015 60 pt. 2 pole 1 RPS	VCO UED TSO	200B	
11	6,799	110 7,350	7,901	Viability Sensor #3	L8	0.5 sec	0-4.5VDC		VCO UED TSO 200B	270	
12	9,712	160 10,500	11,288	Commutated Temp. (See Pg. 3)			Comm. #1 A & B Ring	ASCOP B00027 30 pt. 5 RPS	VCO UED TSO 200B		
13	13,412	220 14,500	15,588	Combustion Chamb. Press #1	B6	200cps	0-700 PSIG	W-P 2041	X1034393	438	DL-LG ** P
14	20,350	330 22,000	23,650	Commutated Press (See Pg. 4)			Comm #2 C & D Ring	ASCOP B00028A 30 Pt., 10 RPS	X1034395		DL-LG Comm.
15	27,750	450 30,000	32,250	Comm. PSC & Volt. (See Pgs. 5 & 6)			Comm #1 C & D Ring	ASCOP B-00027 30 Pt., 5 RPS	TCO UED TSO 200B	0-5V	P
16	37,000	600 40,000	43,000	Commutated Volt. (See Pg. 9)			Comm #2 Ring "B"	ASCOP B00028A 30 Pt. 10 RPS	VCO UED TSO 200B		0-5VDC P
17	48,560	790 52,500	56,440	Comm. Volt. (See Pg. 10)			Comm #2 Ring "A"	ASCOP B00028A 30 Pt., 10 RPS	VCO UED TSO 200B	0-5V	**
18	64,750	1050 70,000	75,250	Longitudinal Vib. (Az)	SD125	2000cps	± 35 G	G-A321 AHT	VCO UED TSO 200B	315	Vib. Coupler 1031714

* Special Dev. item by Dept. 54-22
** On ascent only

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020

COMMUTATED CHANNEL NO. 12 TYPE COMM. ASCOP B00027 Comm. #1

COMM. UNIT Temp. COMM. RATE 30 Pt., 4 pole, 5 RPS

Ring "A" & "B" Ascent & Orbit

COMM POS.	Meas. Name	Meas NO.	CODE	Meas. Range	Volt Range	P.U. TYPE AND SERIAL NO.	FS
1	CAL 1/2						
2	Fuel Pump Inlet Temp.	B31		32-150°F	0-50MV	Model Cardinal B156-17	407
3	Env. Skin Temp. #4	SD42		2000°F	0-50MV	(C/A) LMSD T/C	221
4	Oxide Pump Inlet Temp.	B32		32-150°F	0-50MV	Model Cardinal B156-17	410
5	Gyro Block Temp.	D60		-100° to +200°F	0-50MV	R-BN-4	319
6	Env. Skin Temp. #5	SD43		2000°F	0-50MV	(C/A) LMSD T/C	253
7	Env. Skin Temp. #6	SD44		2000°F	0-50MV	(C/A) LMSD T/C	260
8	Guidance Electronics Temp.	D63		-100° to +200°F	0-50MV	R-BN-4	319
9	Env. Skin Temp. #15	SD65		-100° to +600°F	0-50MV	R-SN-1	445
10	Oxygen Bottle Press. #1	I4		0-7500PSIA	0-50MV		270
11	Nirtogen Gas Temp.	D94		30-185°F	0-50MV	Cardinal B-378-15	315
12	Telemeter Transmitter Temp.	H71		-100° to +200°F	0-50MV	R-BN-4	314
13	CAL (+)						
14	Env. Skin Temp. #9	SD47		-100° to +600°F	0-50MV	R-SN-1	365
15	Env. Skin Temp. #7	SD45		-100° to +600°F	0-50MV	R-SN-1	327
16	Env. Skin Temp. #8	SD46		-100° to +600°F	0-50MV	R-SN-1	350
17	Env. Skin Temp. #10	SD48		-100° to +600°F	0-50MV	R-SN-1	379
18	Env. Web Temp. #23	SD73		-100° to +200°F	0-50MV	R-BN-4	325
19	Env. Skin Temp. #16	SD66		-100° to +600°F	0-50MV	R-SN-1	338
20	He Sphere Compt. Temp.	SD103		-100°F to +600°F	0-50MV	R-SN-1	461
21	Horizon Scanner Temp.	D82		-100 to +200°F	0-50MV	R-BN-4	334
22	Env. 2000cps Inv. Temp	SD80		-100° to +200°F	0-50MV	R-BN-4	322
23	Env. FM Pkg. Temp. #26	SD81		-100° to +200°F	0-50MV	R-BN-4	318
24	Repeat Pos. #9						
25	Env. Web Temp. #29	SD85		-100° to +200°F	0-50MV	R-BN-4	325
26	T/C Ref. Temp.	SD49		-100° to +100°F	0-50MV	2 ea. R-BN-3 in series	321
27	CAL Z						
28	Sync)						
29	Sync) Resistance Therm. Ref. Volt						
30	Sync)						

* Transducer installed & supplied by G.E.

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020
COMMUTATED CHANNEL NO. 14 TYPE COMM. ASCOP B00028A Comm. #2
COMM. UNIT Press. COMM. RATE 30 Pt., 4 Pole 10RPS

COMM. POS.	Meas. Name	Meas NO.	CODE	Ring "C" & "D" Meas. Range	Volt Range	Ascent & Orbit P.U. TYPE AND SERIAL NO.	FS	REMARKS
1	CAL (1/2)							
2	Nitrogen Reg. Press.	D96		0-200 PSIG		W-P 2024	447	
3	Fwd. Compt. Press.	A74		0-20 PSIA		W-P 1503	333	
4	Gas Gen. Chamb. Press	B3		0-700 PSIG		W-P 2024	420	
5	Aft. Compt. Press.	A75		0-15 PSIA		W-P 1503	423	
6	Nitrogen Supply Press.	D95		0-4000 PSIG		W-P 2024	445	
7	Fuel Pump Inlet Press.	B1		0-120 PSIG		W-P 2024	407	
8	Comb. Chamber Press. #2	B10		0-20 PSIG		Pace (P210) *	438	F
9	Oxide Pump Inlet Press.	B2		0-120 PSIG		W-P 2041	410	
10	Hydraulic Press.	D1		0-4000 PSIG		W-P 1453	453	
11	Helium Supply Press.	B7		0-3200 PSIG		W-P 2024	448	
12	Repeat Pos. #3							
13	CAL (+)							
14	Repeat Pos. #6							
15	Repeat Pos. #2							
16	Repeat Pos. #8							
17	Repeat Pos. #10							
18	Repeat Pos. #9							
19	Repeat Pos. #4							
20	CAL (1/2)							
21	Repeat Pos. #3							
22	Repeat Pos. #7							
23	Repeat Pos. #5							
24	Repeat Pos. #9							
25	Repeat Pos. #11							
26	Repeat Pos. #6							
27	CAL (Z)							
28	Sync							
29	Sync							
30	Sync							

*700 PSIG Max.

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020
COMMUTATED CHANNEL NO. 15 TYPE COMM. ASCOP B00027 Comm. #1
COMM. UNIT PSC COMM. RATE 30 Pt., 4 Pole, 5 RPS
Ring "C" Ascent & Orbit

COMM POS.	Meas. Name	Meas NO.	CODE	Meas. Range	Volt Range	P.U. TYPE AND SERIAL NO.	FS	REMARKS
1	Yaw Rate - OTV A/P	D11		±10°/sec	±1.50VAC Input	Input to PSC	320	P
2	↓							
3	Roll Rate - OTV A/P	D12		±10°/sec	±1.50VAC Input	Input to PSC	320	P
4								
5	↓							
6	Pitch Rate - OTV A/P	D10		±10°/sec	±1.50VAC Input	Input to PSC	320	P
7								
8	↓							
9	Pitch Gyro	D16		±6°	±1.50VAC Input	Input to PSC	319	P
10								
11	↓							
12	Roll Gyro	D17		±6°	±1.50VAC Input	Input to PSC	319	
13								
14								
15	↓							
16	Yaw Gyro	D18		±6°	±1.50VAC Input	Input to PSC	319	
17								
18								
19	↓							
20	Horizon Scanner - Pitch	D37		±3°	±1.50VAC Input	Input to PSC	334	P
21								
22	↓							
23	Horizon Scanner - Roll	D39		±3°	±1.50VAC Input	Input to PSC	334	P
24								
25								
26	↓							
27	Yaw Rate - OTV A/P	D11		±10°/sec	±1.50VAC Input	Input to PSC	320	P
28								
29								
30	↓							

NOTE: All quantities on this page are Commutated into one common PSC

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205- [illegible]
COMMUTATED CHANNEL NO. 15 TYPE COMM. ASCOP B00027 Comm. #1
COMM. UNIT PSC & Volt COMM. RATE 30 Pt., 4 Pole, 5 RPS
Ring "D" Ascent & Orbit

COMM. POS.	Meas. Name	Meas NO.	CODE	Meas. Range	Volt Range	P.U. TYPE AND SERIAL NO.	FS	REMARKS
1	CAL (1/2)							
2	Yaw Rate - OTV A/P	D11	**	±10°/sec	±1.50VAC Input	PSC 1029774	320	P
3	SS/D Timer Monitor	D85		0-5VDC	0-5VDC	(TT)	319	P
4	Yaw Torque Signal	D59		0-3°	0-5VDC	Rectif.	319	
5	Roll Rate - OTV A/P	D12	**	±10°/sec	±1.50VAC Input	PSC 1029774	320	P
6	Animal Compt. Temp.	L2	*	40 to 90°F	0-5VDC		270	
7	Regulated Supply Volt (+)	C2		26-30 VDC	0-5VDC	Div.	315	P
8	Pitch Rate - OTV A/P	D10	**	±10°/sec	±1.50VAC Input	PSC 1029774	320	P
9	Relative Humidity Sensor	L3	*	20-100%	0-5VDC		270	
10	Reg. Supply Volt. (-)	C11		-26 to -30 VDC	0-5VDC	Div.	315	
11	Pitch Gyro	D16	**	±6°	±1.50VAC Input	PSC 1029774	319	P
12	Pitch Torque Signal	D41		1°/sec	0-5VDC	Rect.	319	
13	CAL (+)							
14	Repeat Pos. #3							
15	Roll Gyro	D17	**	±6°	±1.50VAC Input	PSC 1029774	319	
16	Repeat Pos. #6							
17	Velocity	D57		0-14,000' per sec.	0-5VDC	Rect.	319	
18	Viability Sensor #4	L9	*	0-4.5VDC	0-4.5VDC		270	
19	Yaw Gyro	D18	**	±6°	±1.50VAC Input	PSC 1029774	319	
20	6.3 VDC & Pod Sep. Mon.	L10		0 or 5 VDC	0 or 5 VDC		270	
21	Animal Compt. Press.	L1	*	0-15PSIA	0-4.5VDC		270	
22	Horizon Scanner - Pitch	D37	**	±3°	±1.50VAC Input	PSC 1029774	334	P
23	Repeat Pos. #9							
24	Fan Monitor	L11		0 or 5 VDC	0 or 5 VDC		270	
25	Repeat Pos. #10							
26	Horizon Scanner Roll	D39	**	±3°	±1.50VAC Input	PSC 1029774		P
27	CAL (Z)							
28	Sync							
29	Sync							
30	Sync							

** These meas. come from one common PSC
* Transducer installed & supplied by G.E.

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020
COMMUTATED CHANNEL NO. 10 TYPE COMM. ASCOP TA00015 Comm. #3
COMM. UNIT Volt COMM. RATE 60 Pt., 2 Pole, 1 RPS
Ring "B" Ascent & Orbit

COMM. POS.	Meas. Name	Meas. NO.	CODE	Meas. Range	Volt RANGE	P.U. TYPE AND SERIAL NO.	FS REMARKS
1	CAL (1/2)						
2	500K to Gnd						Res. in Vehicle (Sta. 365)
3	CAL (1/2)						
4	500K to Gnd						Res. in Vehicle (Sta. 365)
5	500K to Gnd						Res. in Vehicle (Sta.)
6	Equip. Beam Temp #5	SD89		-100° to +300°F	0-5VDC	R-BN-5	320
7	Equip. Beam Temp. #6	SD90		-100° to +300°F	0-5VDC	R-BN-5	320
8	Env. Web Temp. #34	SD68		-100° to +300°F	0-5VDC	R-BN-5	314
9	Env. Web Temp. #33	SD67		-100° to +300°F	0-5VDC	R-BN-5	320
10	Env. Web. Temp. #30	SD70		-100° to +300°F	0-5VDC	R-BN-5	316
11	Env. Web Temp. #31	SD71		-100° to +300°F	0-5VDC	R-BN-5	316
12	Env. Web Temp. #32	SD72		-100° to +300°F	0-5VDC	R-BN-5	318
13	Int. Skin Temp. #5	SD74		-100° to +300°F	0-5VDC	R-BN-5	326
14	Struct. Ring Temp. #1	SD75		-100° to +300°F	0-5VDC	R-BN-5	435
15	Battery case Temp.	C9		-100° to +300°F	0-5VDC	R-BN-5	315
16	500K to Gnd						
17	Int. Skin Temp. #6	SD82		-100° to +300°F	0-5VDC	R-BN-5	326
18	Equip. Beam Temp. #7	SD92		-100° to +300°F	0-5VDC	R-BN-5	320
19	Struct. Ring Temp. #2	SD76		-100° to +300°F	0-5VDC	R-BN-5	435
20	500K to Gnd.	D92					Res. in Vehicle (Sta. 365)
21	Gas Jet Command #1	D25		0-5VDC	0-5VDC		322
22	Gas Jet Command #2	D26		0-5VDC	0-5VDC		322
23	CAL (1/2)						
24	Gas Jet Command #4	D28		0-5VDC	0-5VDC		322
25	Gas Jet Command #5	D29		0-5VDC	0-5VDC		322
26	CAL (1/2)						
27	500K to Gnd.	D93					Res. in Vehicle (Sta. 365)
28	500K to Gnd.						Res. in Vehicle (Sta. 365)
29	CAL (+)						
30	500K to Gnd.						Res. in Vehicle (Sta. 365)

INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020

COMMUTATED CHANNEL NO. 10 TYPE COMM. ASCOP TA00015 Comm. #3

COMM. UNIT Volt COMM. RATE 60 Pt., 2 Pole, 1 RPS

COMM. POS.	Meas. Name	Meas. NO.	CODE	Ring "B" Meas. Range	Volt RANGE	Ascent & Orbit P.U. TYPE AND SERIAL NO.	FS	REMARKS
31	500K to Gnd							Res. in Vehicle (Sta.)
32	Res. Therm. Ref. Volt.#2	SD126		0-30VDC	0-5VDC	Div.		
33	500K to Gnd							Res. in Vehicle (Sta.)
34	500K to Gnd							
35	CAL (1/2)							
36	Gas Jet Command Sig. #3	D27		0-5VDC	0-5VDC		322	
37	500K to Gnd							
38	CAL (1/2)							
39	Gas Jet Command Sig. #6	D30		0-5VDC	0-5VDC		322	
40	500K to Gnd							
41	CAL (1/2)							
42	500K to Gnd							
43	500K to Gnd							
44	CAL (1/2)							
45	500K to Gnd							
46	500K to Gnd							
47	CAL (1/2)							
48	500K to Gnd							
49	500K to Gnd							
50	CAL (1/2)							
51	500K to Gnd							
52	500K to Gnd							
53	CAL (1/2)							
54	500K to Gnd							
55	500K to Gnd							
56	CAL (1/2)							
57	CAL (Z)							
58	Sync							
59	Sync							
60	Sync							

NOTE: Meas. listed on this page do not have a Meas. Name assigned.

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INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020
COMMUTATED CHANNEL NO. 16 TYPE COMM. ASCOP B-00028A Comm. #2
COMM. UNIT Volt COMM. RATE 30 Pt., 4 Pole, 10 RPS
Ring "B" Ascent - Real & Visual Display

COMM. POS.	Meas.	Meas. NO.	CODE	Meas.	Volt RANGE	P.U. TYPE AND SERIAL NO.	REMARKS
1	CAL (1/2)						
2	T/M 250VDC	H77		0-250VDC	0-5VDC	Div.	314
3	Beacon Verification #1	H64		On-off	0-5VDC	Relay	324
4	+20V Reg. (VCO)	H78		0 to +20VDC	0-5VDC	Div.	314
5	Beacon Verification #2	H65		On-off	0-5VDC	Relay	324
6	T/M 6.3 VDC	H79		0 - 6.3 VDC	0-5VDC	Div.	314
7	Beacon Verification #3	H66		On-off	0-5VDC	Relay	324 P
8	T/M Regulator	H80		0 to -20 VDC	0-5VDC	Div.	314
9	Beacon Verification #4	H67		On-off	0-5VDC	Relay	324 P
10	Control Gas Shut Off Valve	D97	(D)	On-off	0-5VDC	Relay	446
11	Beacon Temp. #1	H74	*	0-185°	0-5VDC		324
12	T/M Volt. Regulator	H81		0-30VDC	0-5VDC	Div.	314
13	CAL (+)						
14	Repeat Pos. #3		(H)				
15	Battery Bus Voltage (+)	C1		23-31VDC	0-5VDC	Div.	315
16	Timer Synchronization	H70		On-off	0-5VDC	Div.	324
17	400 Cycle Pwr. Supply #1A	C3		110 to 120VAC	0-5VDC	Div.	326
18	Beacon Signal Level	H75		0-5VAC	0-5VDC	Rect.	324
19	400 Cycle Pwr. Supply #1C	C4		110 to 120VAC	0-5VDC	Rect.	327
20	Beacon Power Level	H76		0-5VAC	0-5VDC	Rect.	324
21	Roll Gyro Torque	D83		±20°/min	0-5VDC	Rect.	319
22	Repeat Pos. #7		(F) (H)				
23	Yaw Gyro Torque	D84		±50°/min	0-5VDC	Rect.	319
24	2000 Cycle Pwr. Supply	C7		110 to 120 VAC	0-5VDC	Rect.	318
25	Repeat Pos. #5						
26	Repeat Pos. #4						
27	CAL (Z)						
28	Sync						
29	Sync						
30	Sync						

* Instrument supplied by Philco

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INSTRUMENTATION SCHEDULE

FLIGHT NO. FTV-4 VEHICLE NO. 2205-1020
COMMUTATED CHANNEL NO. 17 TYPE COMM. ASCOP B-00028A Comm. #2
COMM. UNIT Volt COMM. RATE 30 Pt., 4 Pole, 10 RPS
Ring "A" Ascent

COMM. POS.	Meas. Name	Meas. NO.	CODE	Meas. Range	Volt RANGE	P.U. TYPE AND SERIAL NO.	FS REMARKS
1	CAL (1/2)						
2	Main Power Relay	B15		On-off	0-5VDC	Relay	328
3	Gas Gen. Igniter	B16		On-off	0-5VDC	Switch	424
4	Pitch Actuator Pos.	D43		±.72 in.	0-5VDC		319
5	Fuel Case Press. Switch	B17		On-off	0-5VDC	Switch	328
6	Gas Gen. Pilot Valve	B18		On-off	0-5VDC	Switch	328
7	Yaw Actuator Pos.	D44		±.72 in.	0-5VDC		319
8	Oxid Manifold Press. Sw.	B19		On-off	0-5VDC	Switch	328
9	Valve in Head Pilot Valve	B20		On-off	0-5VDC	Switch	328
10	Heater Cycle Monitor	D74		0-28VDC	0-5VDC	Div.	319
11	Thrust Chamber Press. Sw.	B21		On-off	0-5VDC	Switch	328
12	Shut down Relay	B22		On-off	0-5VDC	Switch	328
13	CAL (+)						
14	Roll Accelerometer	D58		0-15G	0-5VDC	Rect.	319
15	Explosive Bolts #1, 2, & 3	A80		0-5VDC	0-5VDC	(See next page) Step Function	404
16	Repeat Pos. #2						
17	Repeat Pos. #4						
18	Repeat Pos. #3						
19	Squib Monitors	B79		0-5VDC	0-5VDC	(See next page) Step Function	317
20	Repeat Pos. #5						
21	Repeat Pos. #6						
22	Repeat Pos. #7						
23	Repeat Pos. #8						
24	Repeat Pos. #9						
25	Separation Mon. Cal. #3	A87	*	0-5VDC	0-5VDC		448
26	Repeat Pos. #11						
27	CAL (Z)						
28	Sync						
29	Sync						
30	Sync						

* Special Dev. Item 54-22

TELL-TALE
A80 Explosive Bolts No. 1, 2, and 3

Bolts Not Fired	Voltage
1, 2, 3	2.14
1, 2	2.37
1, 3	2.61
1	2.98
2, 3	3.27
2	3.69
3	4.10
-	4.79

TELL-TALE
B79 Squib Monitors

Condition	Voltage
1	0.3
2	0.7
3	1.3
4	2.6
1 and 2	1.0
1 and 3	1.7
1 and 4	2.9
2 and 3	2.0
2 and 4	3.2
3 and 4	3.7
1, 2, and 3	2.3
1, 2, and 4	3.4
1, 3, and 4	4.0
2, 3, and 4	4.3
1, 2, 3, and 4	4.5

Condition

1. Fuel Tank Vent Valve Opened
2. Oxidizer Tank Vent Valve Opened
3. Helium By-pass Squib Opened
4. Helium Vent Squib Valve Opened

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APPENDIX C-2

Discoverer/Thor (Echo)
Telemetry System: PAM/FM/FM
Carrier Frequency 246. 3MC

RDB Channel & Commutated Channel	Parameter	Range **
15-1	Liquid Oxygen Pump Inlet Pressure	0-200 psia
15-2	Fuel Pump Inlet Pressure	0-200 psia
15-3	Main Engine Pitch Position	$\pm 8^{\circ}$
15-4	Main Engine Yaw Position	$\pm 8^{\circ}$
15-5	Yaw Attitude Error	$\pm 4^{\circ}$
15-6	Unassigned - Grd. in TM Set	---
15-7	V. E. #1 Pitch/Roll Position	$\pm 45^{\circ}$
15-8	V. E. #1 Yaw Position	-36° to 6°
15-9	V. E. #2 Pitch/Roll Position	$\pm 45^{\circ}$
15-10	V. E. #2 Yaw Position	$+6^{\circ}$ to $+36^{\circ}$
15-11	Actuator Potentiometer Positive	0-30 V
15-12	Pitch Attitude Error	$\pm 4^{\circ}$
15-13	Pitch Command	$\pm 1^{\circ}$/sec
15-14	Transducer Regulated 5 V Supply	5V ±0.055V
15-15	Instrumentation Ground	OV
15-16	Yaw Rate	$\pm 5^{\circ}$/sec
15-17	Roll Rate	$\pm 5^{\circ}$/sec
15-18	Unassigned - Grd. in TM Set	---
15-19	Unassigned - Grd. in TM Set	---
15-20	Yaw Attitude Error	$\pm 4^{\circ}$
15-21	Roll Attitude Error	$\pm 4^{\circ}$
15-22	Pitch Rate	$\pm 5^{\circ}$/sec
15-23	Actuator Potentiometer Negative	-30 to OV

APPENDIX C-2 (Continued)

RDB Channel & Commutated Channel	Parameter	Range **
15-24	△V. E. #1 Chamber Pressure	0-500 psia
15-25	△Gas Generator Liquid Oxygen Injector Pressure	0-800 psia
15-26	△Gas Generator Chamber Pressure	0-800 psia
15-27	△Main Engine Chamber Pressure	0-800 psia
15-28	Internal Calibrate of TM Set	0-5V
15-29	5 volt Framing Signal	5V
15-30 13	Sequential Event Channel - up to 4 events: MECO, VECO plus 2 low-level switche Lox and RP-1. If total exceeds 4, use 15-3, 15-6, 15-18, or 15-19.	0-5V: any one of 15 discrete steps
12	△Main Engine Chamber Pressure	0-800 psia
11	△Gas Generator Chamber Pressure	0-800 psia
9	△V. E. No. 1 Chamber Pressure	0-500 psia
10	△Gas Generator Liquid Oxygen Injector Pressure	0-800 psia

FM/FM RDB Channels are as follows:

9---------------------------- 3.9 KC ± 7.5%
10--------------------------- 5.4 KC ± 7.5%
11--------------------------- 7.35 KC ± 7.5%
12--------------------------- 10.5 KC ± 7.5%

APPENDIX C-2 (Continued)

13	14.5	KC ± 7.5%
14--------not used	22	KC ± 7.5%
15	30	KC ± 7.5%

** It is the responsibility of DACO Equipment Section to ascertain that correct networks and transducers are employed and that channel assignments and wiring are correct for the listed parameters and ranges.

Δ Wired on duplicate channels to increase the statistical probability of data return. Only one transducer is used.

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APPENDIX D-1

Discoverer Satellite, Serial 2205-1020 Landline Instrumentation

Function	Acceptance Limits
1. Control Rack	
Vehicle Bus Voltage	23 to 29.25V dc
Regulated +28V dc	27.8 to 28.8 V dc
Regulated -28 V dc	-27.8 to -28.8V ac
Vehicle Battery Voltage	23 to 29.25V ac
Inverter Voltage 2000 cps	109.25 to 120.75V ac
Inverter Voltage 400 cps, Three Phase (A, B, C)	112 to 117V ac
External 28V dc	27.8 to 28.8V dc
Inverter Frequency 2000 cps	1980 to 2020 cps
Inverter Frequency 400 cps	399.2 to 400.8 cps
Fuel Flow Indicator	Percent of Maximum
Fuel Flow Totalizer	Amount Transferred
Acid Flow Indicator	Percent of Maximum
Acid Flow Totalizer	Amount Transferred
Propellant Tank Differential Pressure	Acid or Fuel Over-Pressure
2. Propellant and Loading Rack	
Fuel Dump Status	Complete or in Progress
Acid Dump Status	Complete or in Progress
Fuel Dump Switch	On or Off
Acid Dump Switch	On or Off
Emergency Dump Switch	On or Off
He and N_2 Dump Switch	On or Off
He Tank No. 1 Temperature Recorded	$20^{\circ}F$ to $120^{\circ}F$
He Tank No. 2 Temperature Recorded	$20^{\circ}F$ to $120^{\circ}F$
N_2 Tank Temperature Recorded	$20^{\circ}F$ to $120^{\circ}F$
Fuel Tank Temperature No. 1 Recorded	$20^{\circ}F$ to $120^{\circ}F$
Fuel Tank Temperature No. 2 Recorded	$20^{\circ}F$ to $120^{\circ}F$
Acid Tank Temperature No. 1 Recorded	$20^{\circ}F$ to $120^{\circ}F$

Function	Acceptance Limits
Acid Tank Temperature No. 2 Recorded	20°F to 120°F
Fuel Fill Line Temperature Recorded	20°F to 120°F
Acid Fill Line Temperature Recorded	20°F to 120°F
He Tank Pressure Recorded	3000 to 3100 psi
N_2 Tank Pressure Recorded	0-3000 psi
Fuel Vent Pressure	0-75 psi
Acid Vent Pressure	0-75 psi
He Supply Pressure (2)	3200 to 6000 psi
N_2 Supply Pressure (2)	3200 to 6000 psi
300 psi Control Pressure, N_2	280 to 320 psi
100 psi Control Pressure, N_2	80 to 120 psi
Fuel Truck Tank Temperature	40°F ±5°F
Acid Truck Tank Temperature	40°F ±5°F
Cooling Air Inlet Temperature	50°F ±3°F
He Regulated Pressure (2)	63 ±3 psia Total
Umbilical No. 1 Drop Test	Indicator - On or Off
Umbilical No. 2 Drop Test	Indicator - On or Off
Emergency Dump Auto Pressure 65 psi Indicator	On or Off

3. Power Control Desk

Console Power 115V ac, 60~, Indicator	On or Off
Pad Electrical Trailer Power No. 1, Vehicle Indicator	On or Off
Vehicle 28V Load Bus Energized, Indicator	On or Off
Pad Electrical Trailer Power No. 2, GSE Indicator	On or Off

4. Propellant and Loading Status Desk

Air Conditioning	Connected or Disconnected
Umbilical Connection	Connected or Disconnected
Fuel Fill	Connected or Disconnected
Fuel Vent	Connected or Disconnected
Hi-pressure, He	Connected or Disconnected
Hi-pressure, N_2	Connected or Disconnected
Acid Fill	Connected or Disconnected
Acid Vent	Connected or Disconnected
Electricity	Connected or Disconnected

Function	Acceptance Limits
Acid Supply Tank Connected	Yes or No
Pneumatic Supply Tank Connected	Yes or No
Fuel Supply Tank Connected	Yes or No
He Supply to Load	On or Off
N_2 Supply to Load	On or Off
Fuel Pump Motor	On or Off
Acid Pump Motor	On or Off
Fuel Load Switch	On or Off
Acid Load Switch	On or Off
Safety Key (Pressurization)	In or Out
Fuel Tank Pressure Indicator	0 to 65 psig
Fuel Loading Status	In Progress or Complete
Acid Loading Status	In Progress or Complete

5. Guidance and Control

N_2 Valve Close Indicator	On or Off
Thermostat Monitor	On or Off
Pitch Gyro Position, Preamp. Output	0 to 10V ac
Yaw Gyro Position, Preamp. Output	0 to 10V ac
Timer Operation Indicator	On or Off
Pitch Spin Motor Monitor	0 to 1V ac
Roll Spin Motor Monitor	0 to 1V ac
Yaw Spin Motor Monitor	0 to 1V ac
Roll Accelerometer Motor 7V ac/g	0 to 7V ac
H/S Pitch Signal	0 to 1V ac
H/S Roll Signal	0 to 1V ac
Roll Gyro Position, Preamplifier	0 to 10V ac
Yaw Accelerometer 1V ac/g	0 to 1V ac
Heater Amplifier Cycling Indicator	On or Off
Pitch Actuator Position	0 to 5V ac
Yaw Actuator Position	0 to 5V ac
No. 1 Gas Valve Torque Motor	0 to 1V dc
No. 2 Gas Valve Torque Motor	0 to 1V dc
No. 3 Gas Valve Torque Motor	0 to 1V dc
No. 4 Gas Valve Torque Motor	0 to 1V dc
No. 5 Gas Valve Torque Motor	0 to 1V dc
No. 6 Gas Valve Torque Motor	0 to 1V dc
Integrator Resolver Output	0 to 10V ac
Integrator Velocity Output	0 to 10V ac
Guidance Block Temperature	
Guidance Electronics Temperature	

Function	Acceptance Limits
6. Ground-Space Communications (SS/H)	
Timer on Indicator	On or Off
Beacon Heater Monitor	On or Off
Beacon Plate Monitor	On or Off
Tone A Relay 2 Monitor	On or Off
Tone B Relay 4 Monitor	On or Off
Tone C Relay 6 Monitor	On or Off
Tone D Relay 8 Monitor	On or Off
Time Subcycle Monitor	On or Off
1/4 Minute Advance Monitor	On or Off
Timer Restart Indicator	On or Off
Timer Monitor Relay 4	On or Off
Beacon Regulator Power	0 to 28V dc
7. Telemetry	
Ledex Position Monitor	Position
8. Destruct System	
Safe-Arm Switch	Safe-Arm Indicators

APPENDIX D-2

Ground Monitored Parameters Discoverer/Thor (Echo)

System: Direct "Hard-Wire" Readout Via Safety Monitor Console (Presented on Meters)

No.		
1.	Main Liquid Oxygen Tank Pressure	0-100 psia
2.	Main Fuel Tank Pressure	0-100 psia
3.	High Pressure Helium Bottle Pressure	0-5000 psia
4.	Vernier Fuel (Start) Tank Pressure	0-1000 psia
5.	Vernier Liquid Oxygen (Start) Tank Pressure	0-1000 psia
6.	Gas Generator Liquid Oxygen Regulator Reference Pressure	0-1000 psia

Additionally, the GSE will monitor centered position of all engines.

PREPARED BY DHP
DATE 2/1/59
CHECKED BY

LOCKHEED AIRCRAFT CORPORATION
MISSILES SYSTEMS DIVISION

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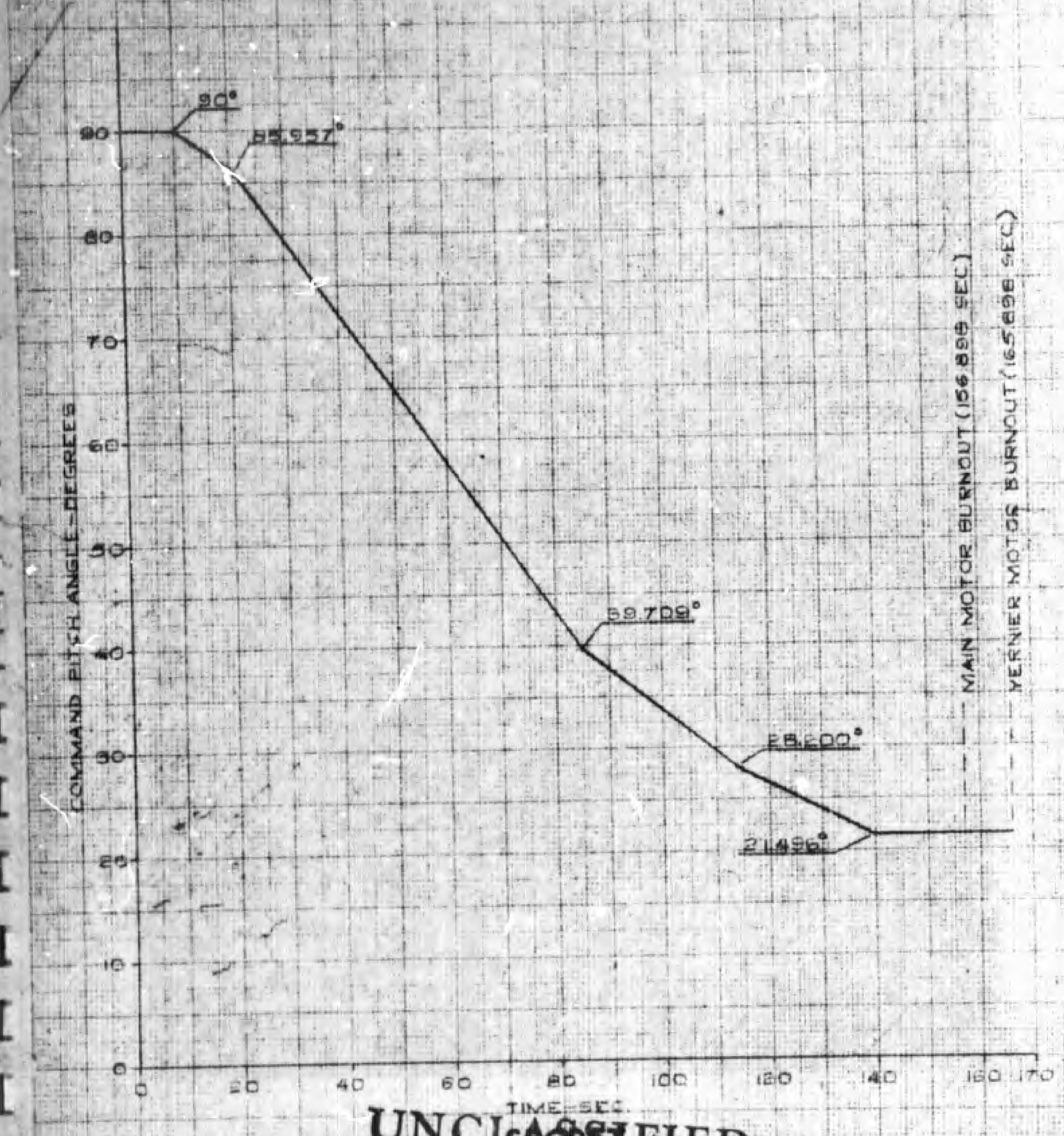
Fig. E-1 SM-75 COMMAND PITCH PROGRAM



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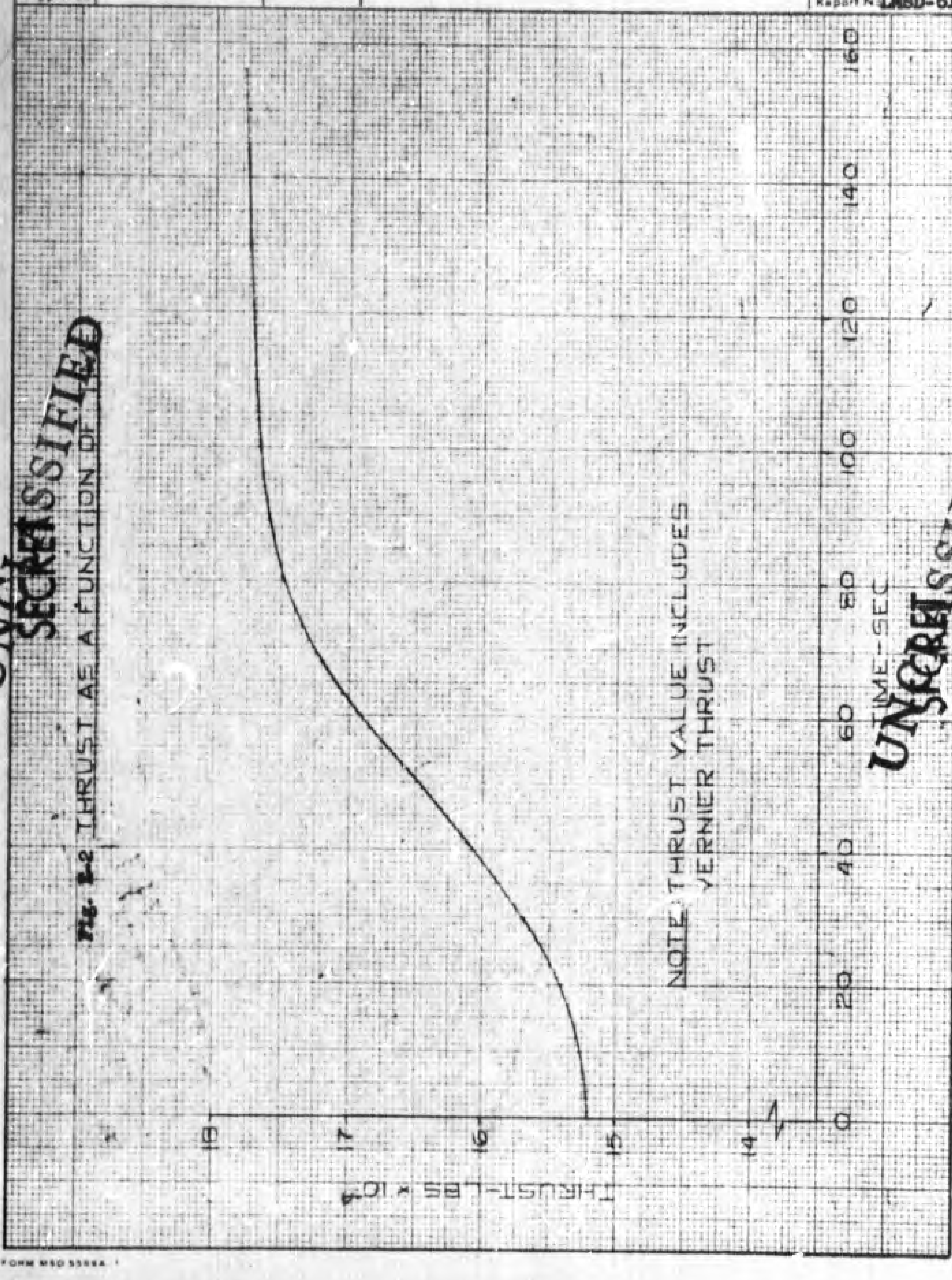
FORM LMSD 888A

TABLE E-1

Pitch Command Program, Thor Booster 174

Time (Sec)	Command Pitch Rates (Deg/Sec)
0-10	0
10-20	-0.31878
20-82	-0.74024
82-110	-0.45341
110-140	-0.25045
140-B.O.	0

Prepared	DUP	2/1/59	LOCKHEED AIRCRAFT CORPORATION MISSILE SYSTEMS DIVISION	E-3 Page	TEMP	PERM
Checked			TITLE	Model		
Approved				Report No. LMSD-6155-		



FORM MSD 5500A 1

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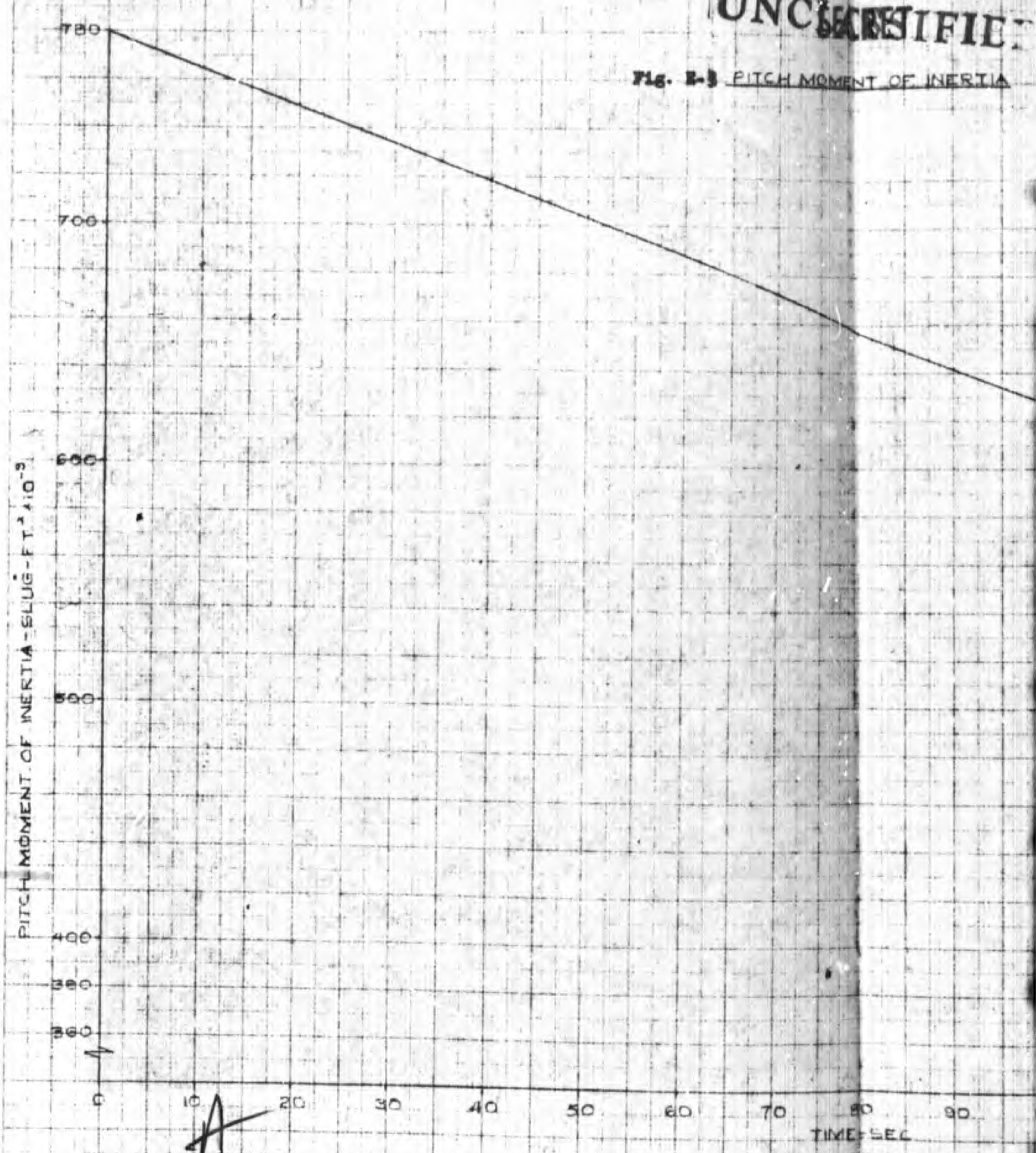
Fig. B-3 PITCH MOMENT OF INERTIA



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FORM MSD 838C

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PAGE B-5
MODEL
REPORT NO. LMSD-6155-

MOMENT OF INERTIA

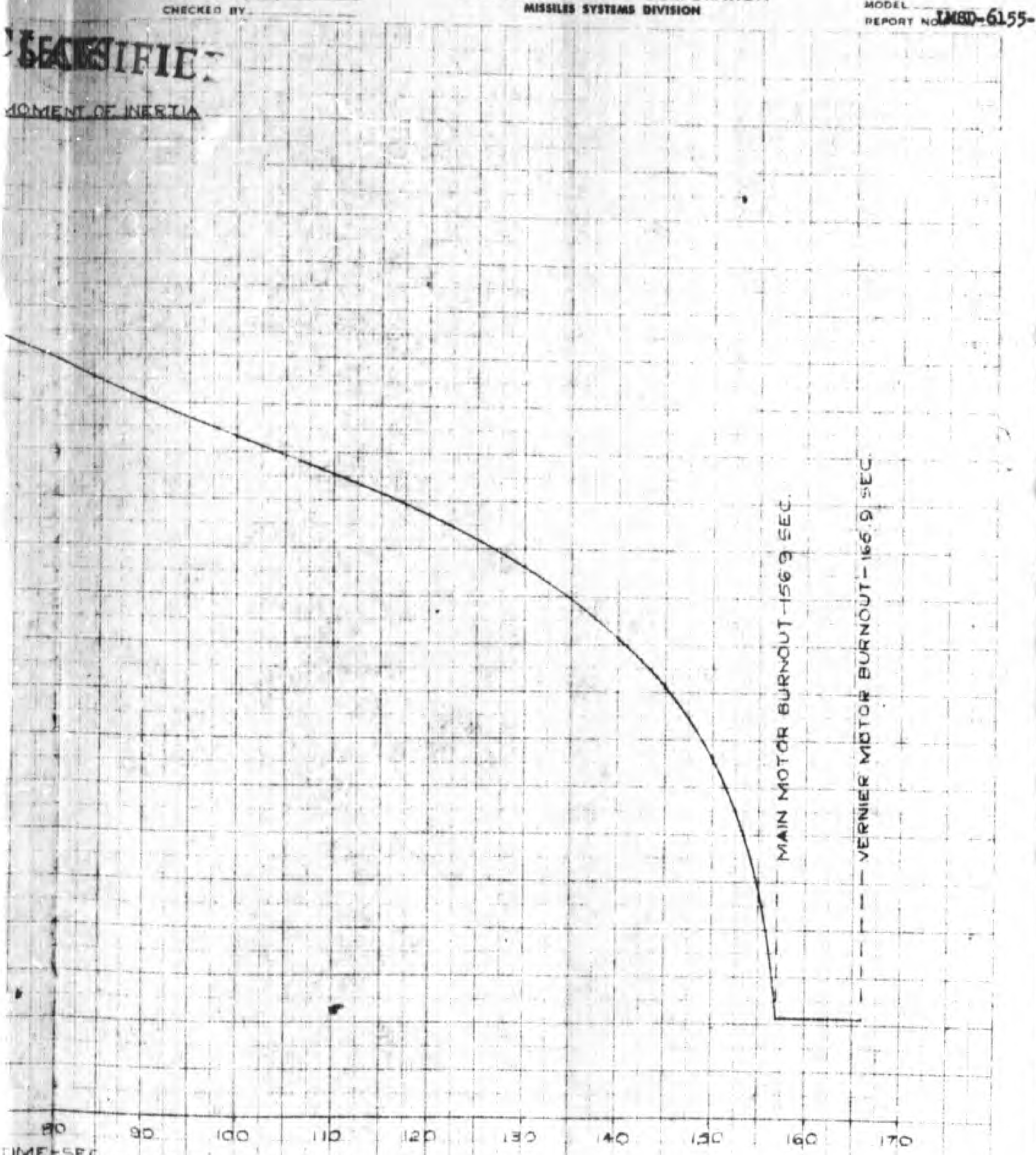

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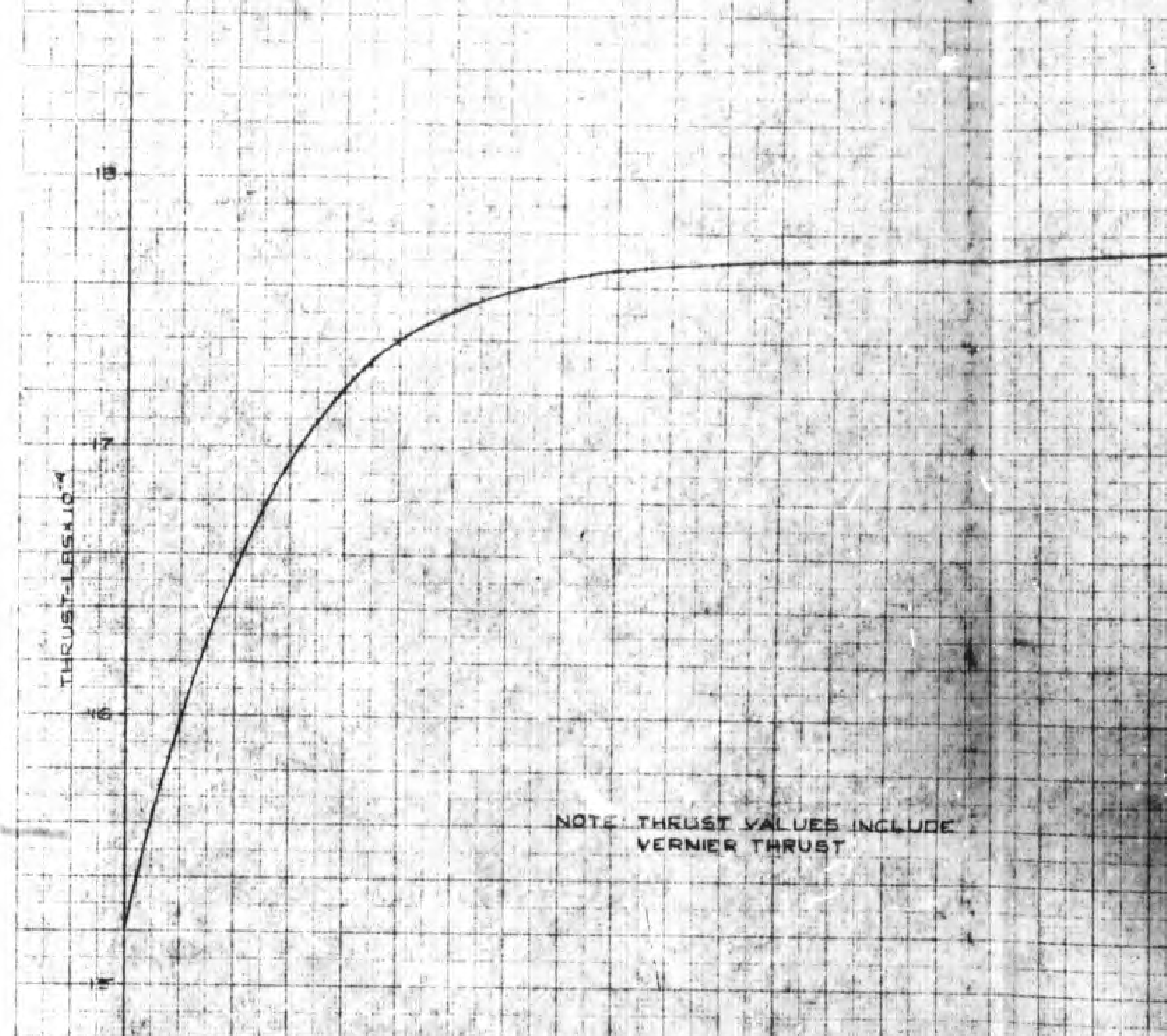
Fig. II-4 THRUST AS A FUNCTION O



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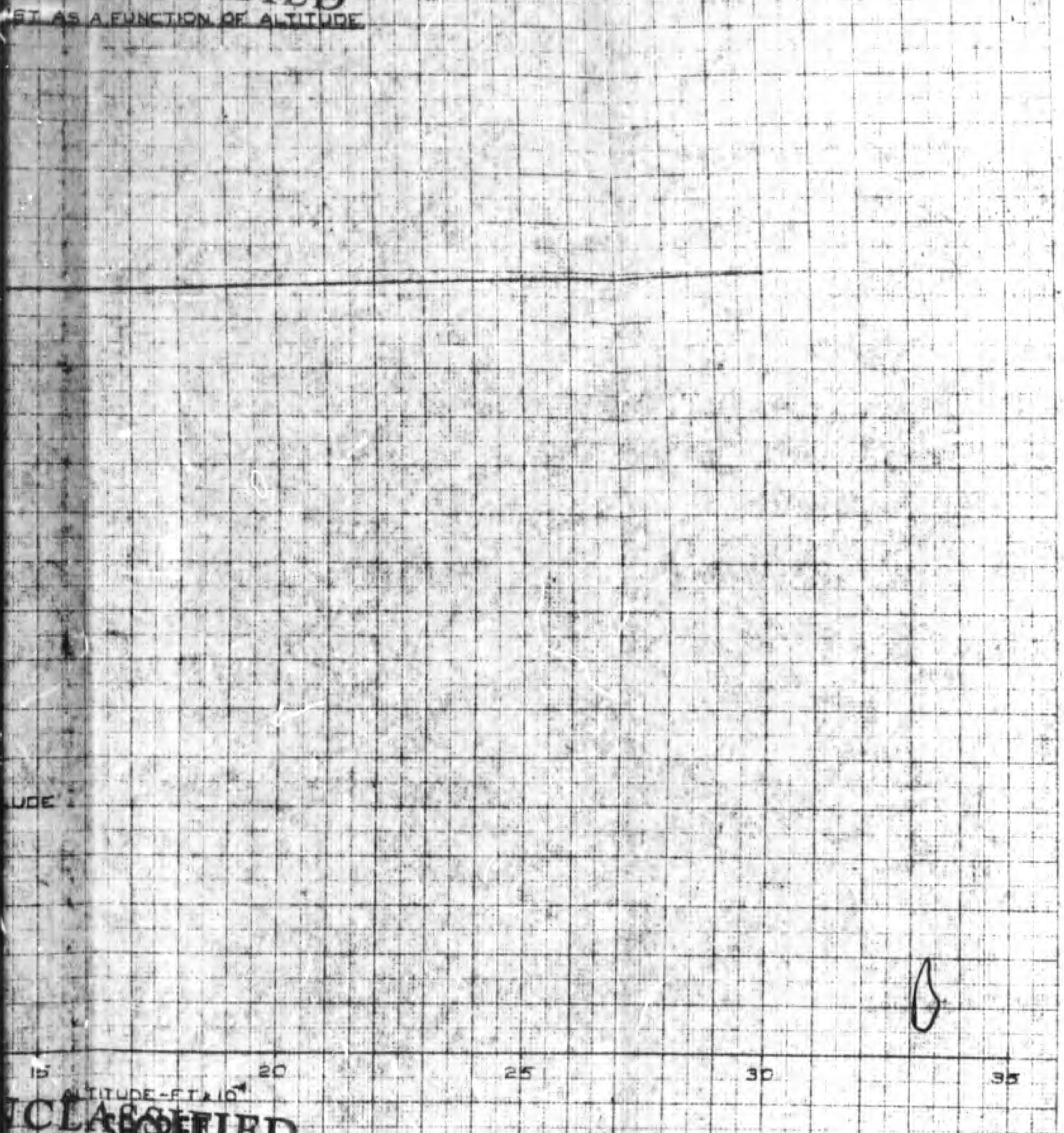

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PAGE E-6
MODEL
REPORT NO LMSD-6155-3

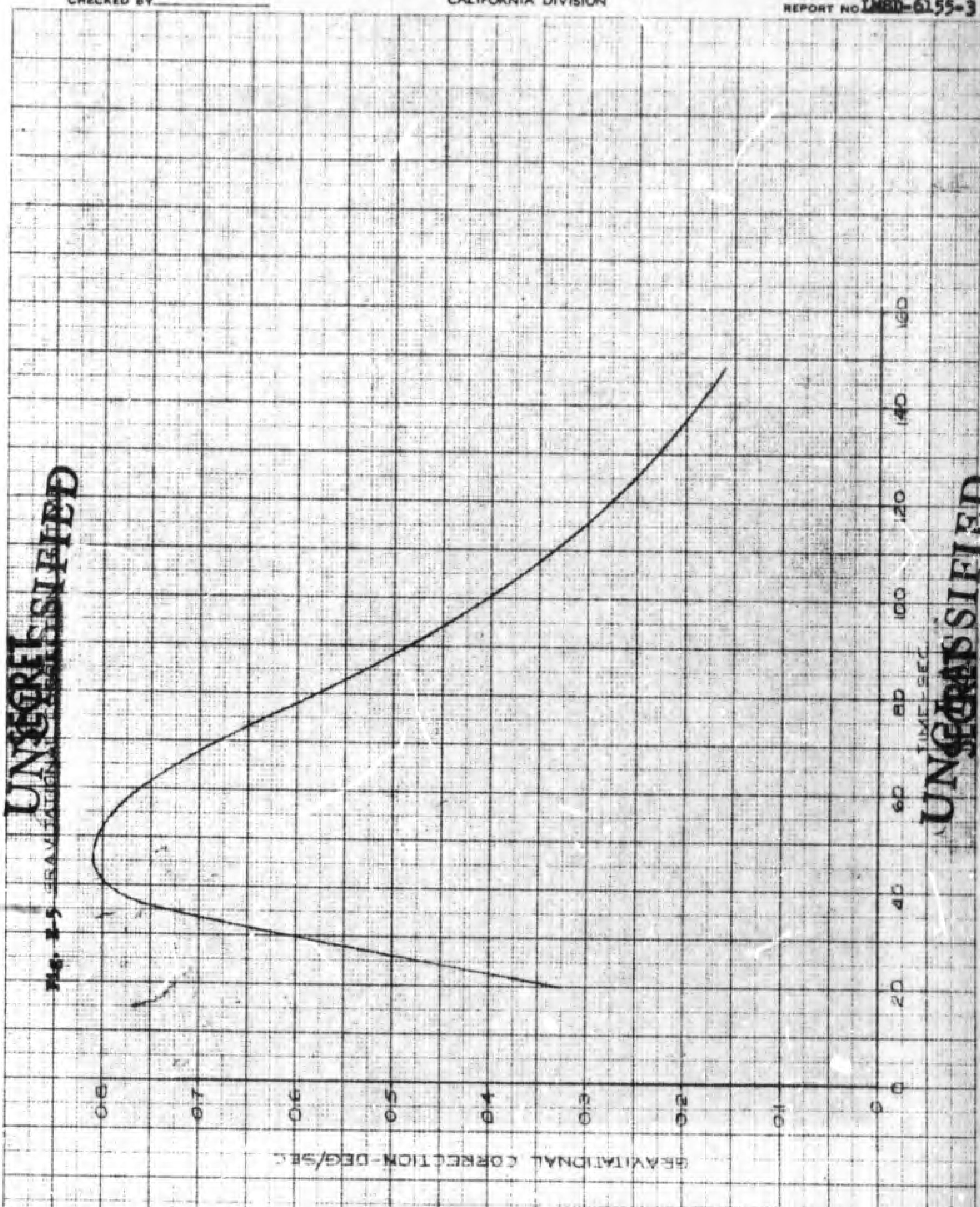

Fig. E-5 GRAVITATIONAL CORRECTION

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FORM 2278A

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Approved				Report No LMSD-61

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Fig. E-6 WEIGHT VS TIME
NOMINAL TRAJECTORY
SM75 BOOSTER FLIGHT

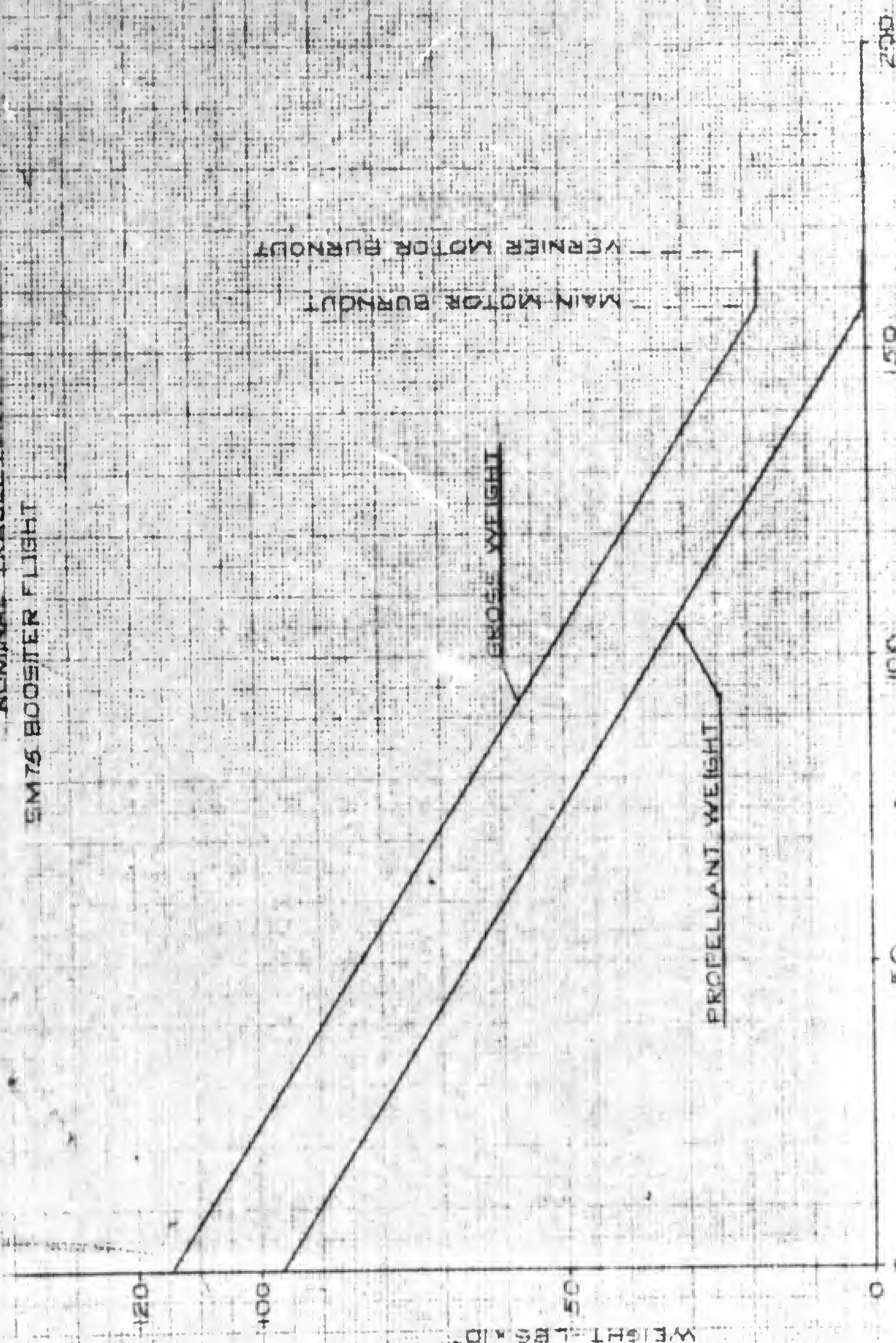

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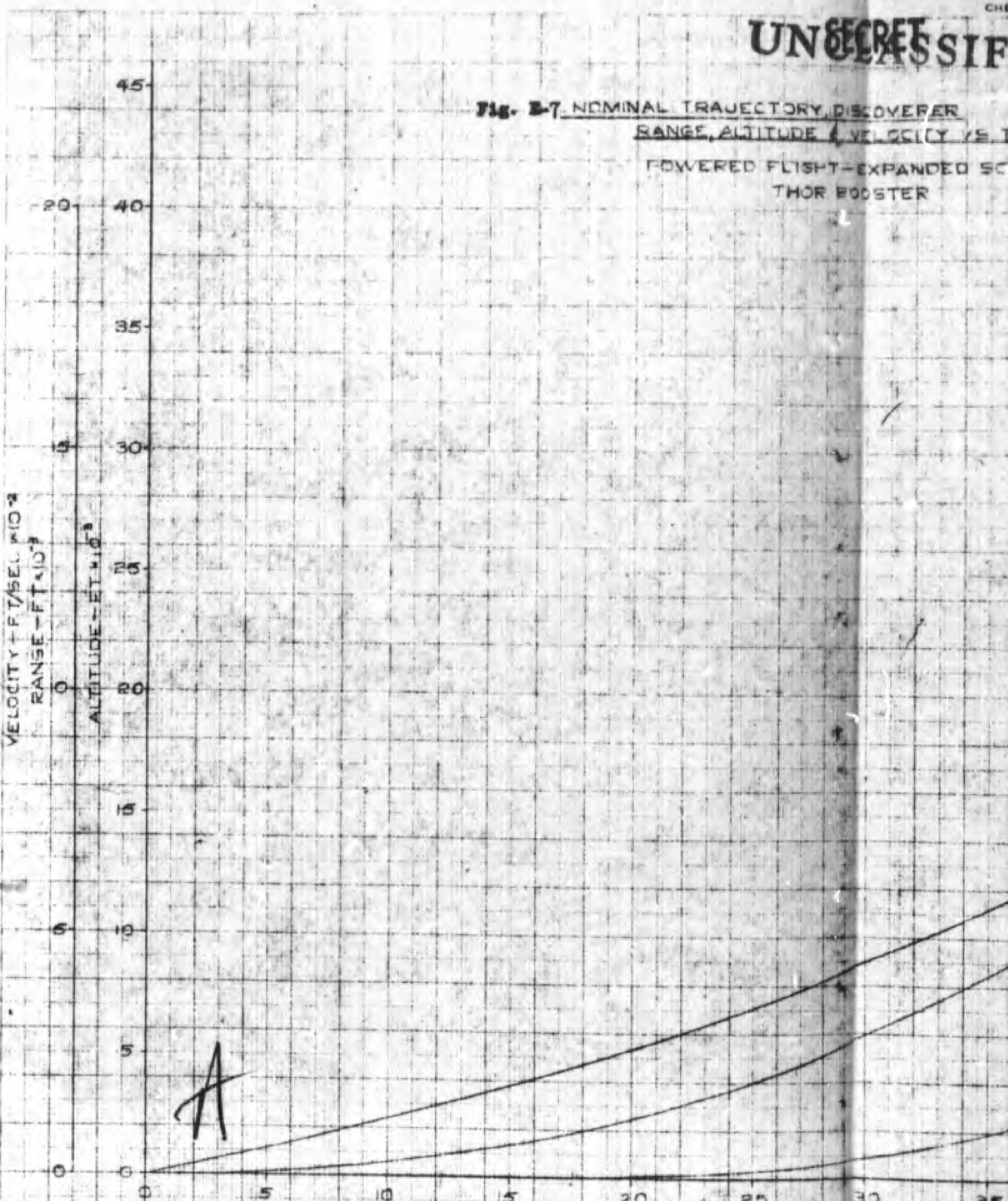
Fig. B-7 NOMINAL TRAJECTORY, DISCOVERER
RANGE, ALTITUDE & VELOCITY VS. T
POWERED FLIGHT—EXPANDED SC
THOR BOOSTER



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CTORY, DISCOVERER
ITUDE & VELOCITY VS TIME
FLIGHT — EXPANDED SCALE
THOR BOOSTER

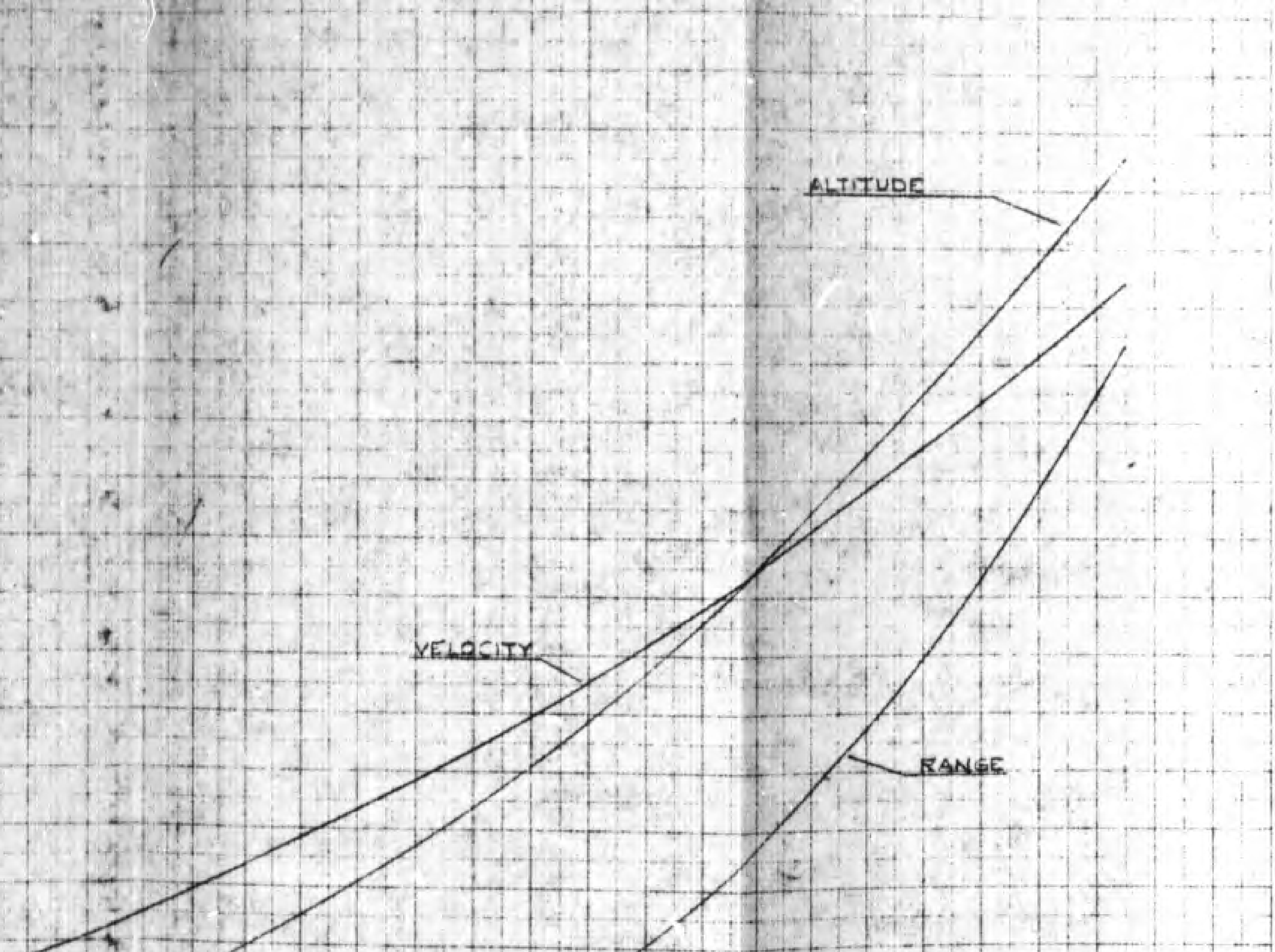

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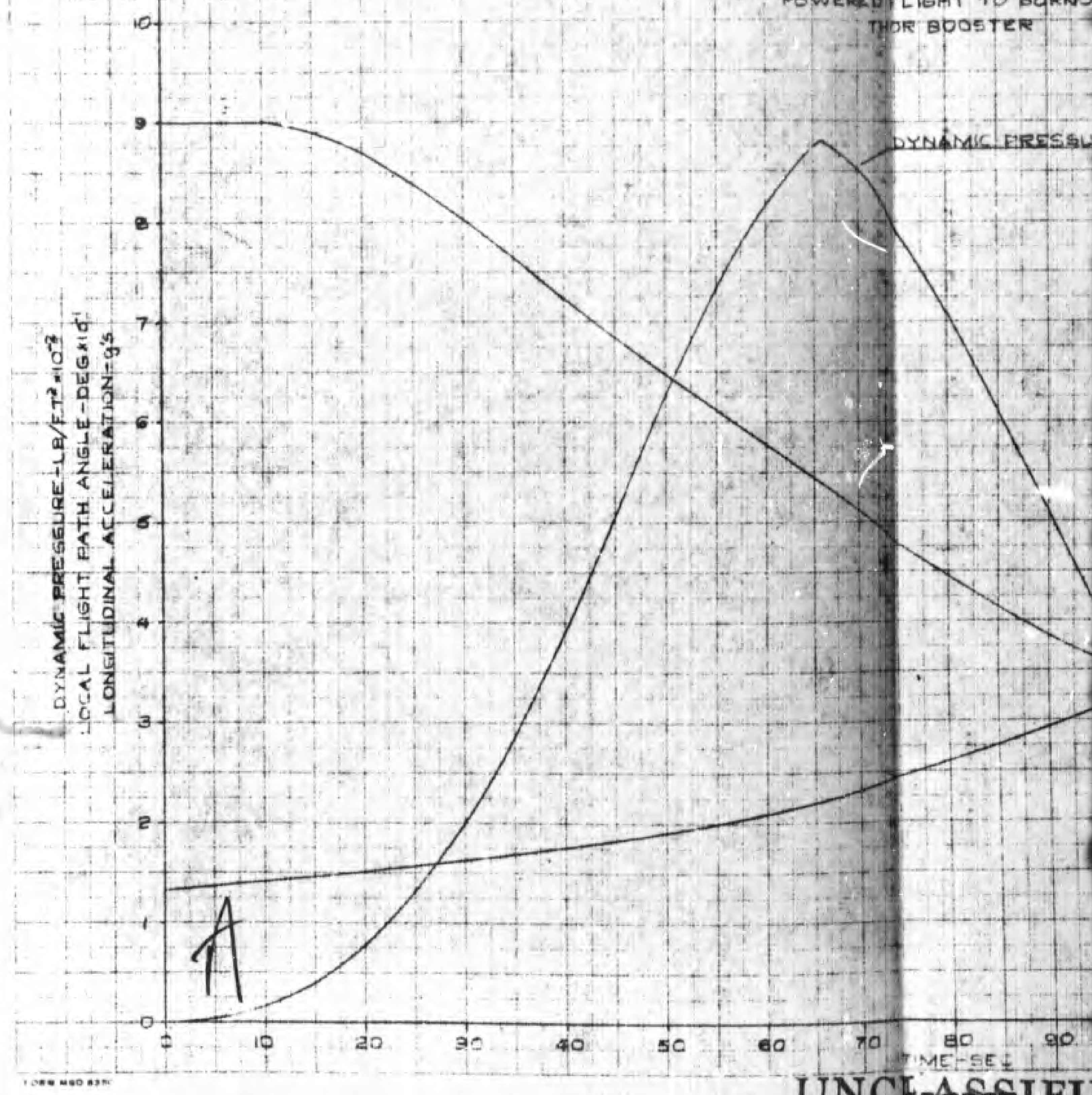
Fig. B-8 NOMINAL TRAJECTORY, DISCOVERER
DYNAMIC PRESSURE, LONGITUDINAL AC...
AND LOCAL FLIGHT PATH ANGLE
POWERED FLIGHT TO BURNO...
THOR BOOSTER



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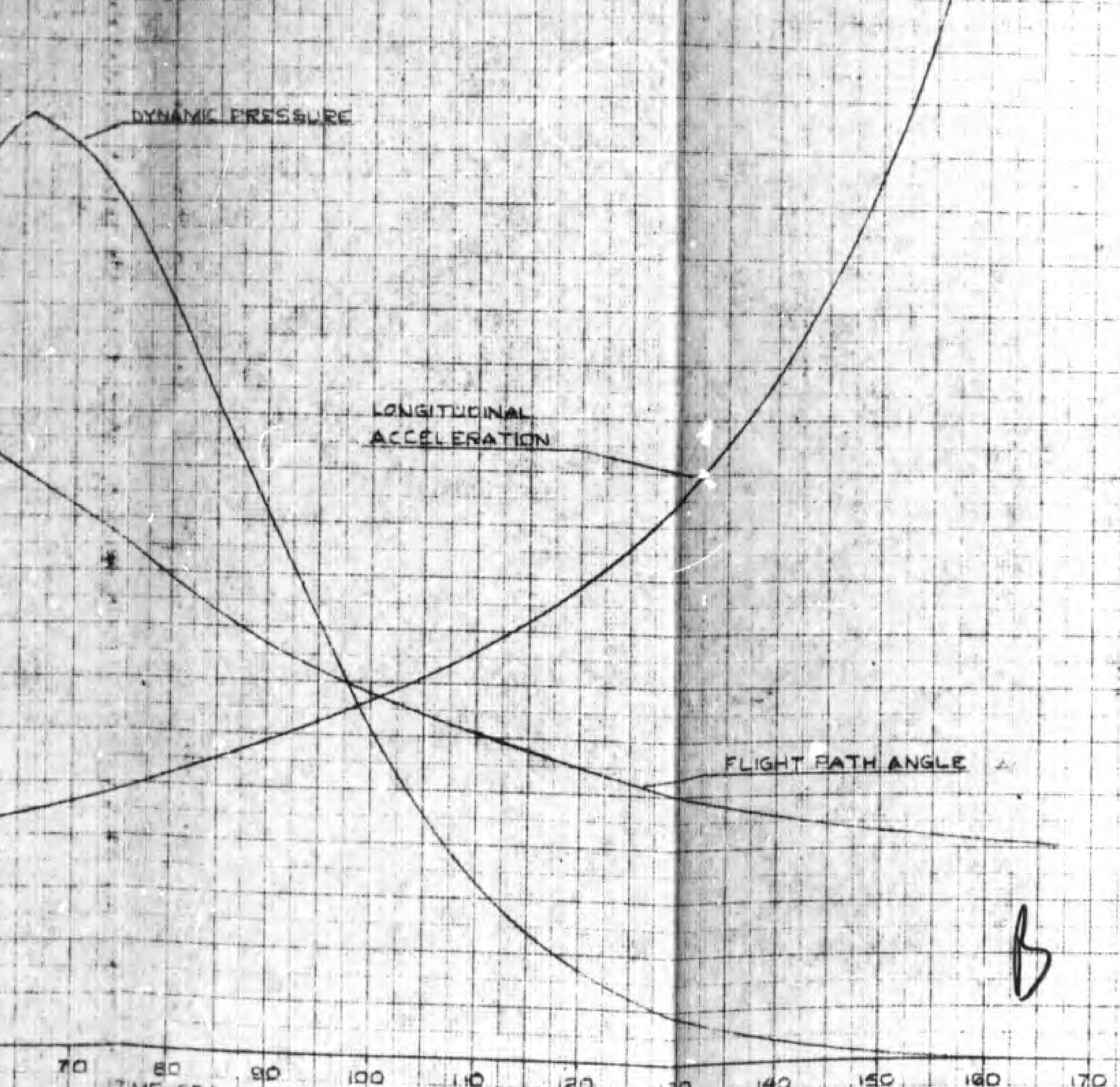
TRAJECTORY DISCOVERER
PRESSURE, LONGITUDINAL ACCELERATION
LOCAL FLIGHT PATH ANGLE VS. TIME

POWERED FLIGHT TO BURNOUT
THOR BOOSTER



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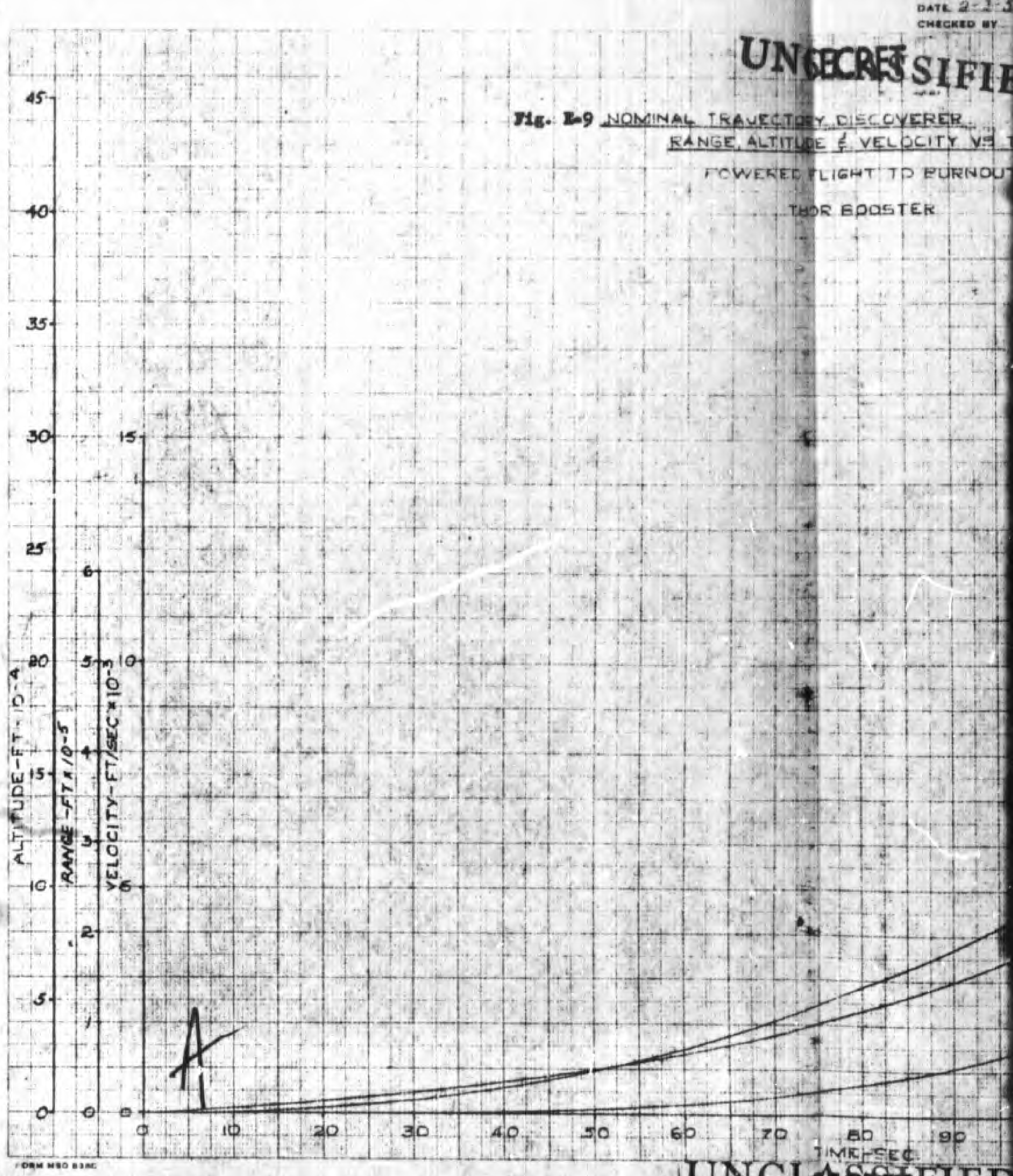

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...ORY: DISCOVERER
...UDE & VELOCITY VS TIME
... FLIGHT TO BURNOUT
...HOR BOOSTER

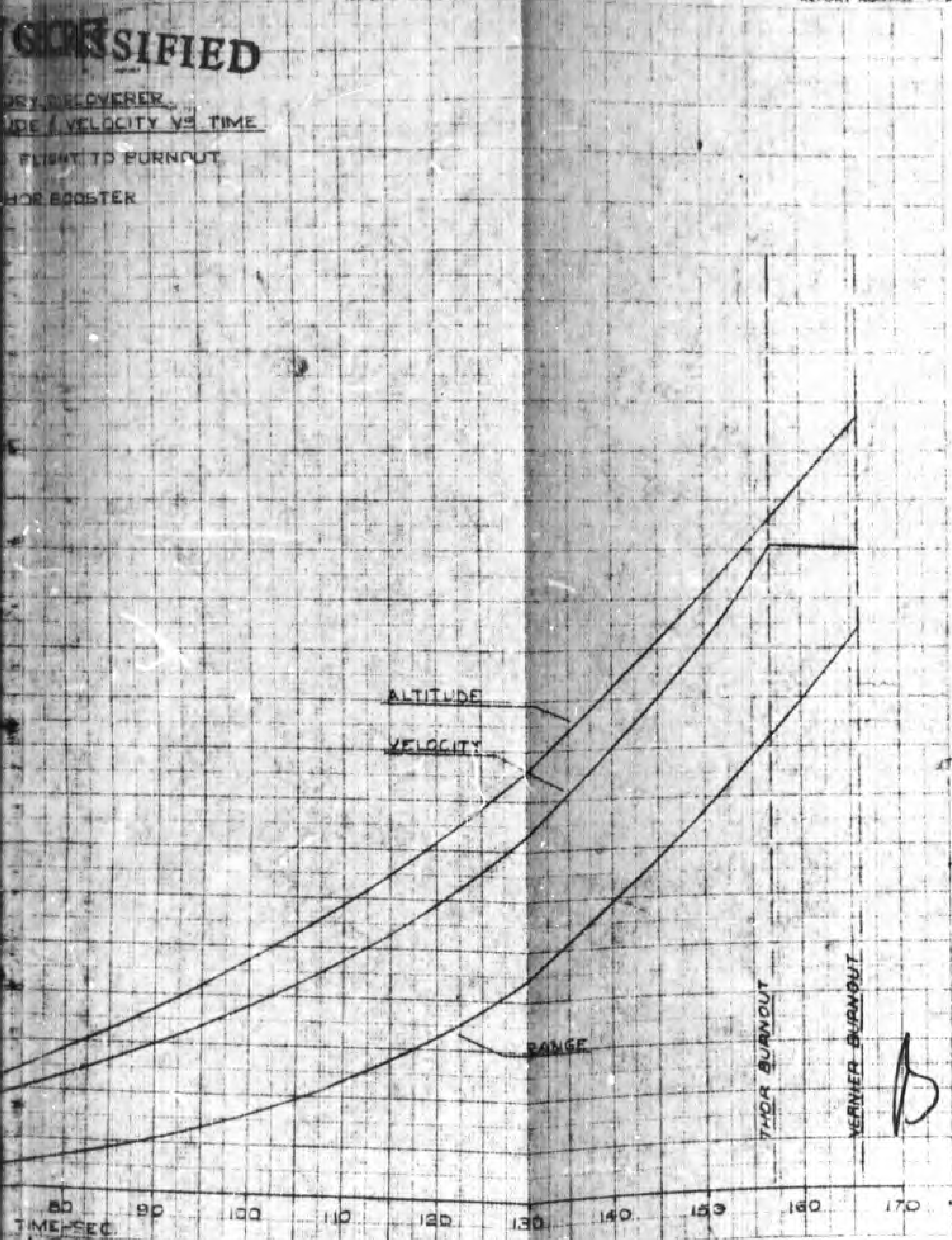

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TABLE E-2
Discoverer 1020 Nominal Trajectory

Nominal Trajectory Tabulation Discoverer
Number 3 - Azimuth Launch Angle 132.8°

Time Sec	X Ft	Y Ft	Z Ft	Ẋ Ft/Sec	Ẏ Ft/Sec	Ż Ft/Sec	γ Deg	V Ft/Sec	A_x Ft/Sec²	R Ft	h Ft
0	0	0	0	0	0	0	90.00	0	42.7	0	0
2	0	22	0	0	22	0	90.00	22	43.1	0	22
4	0	87	0	0	44	0	90.00	44	43.6	0	87
6	0	199	0	0	68	0	90.00	68	44.1	0	199
8	0	359	0	0	92	0	90.00	92	44.7	0	359
10	0	570	0	0	118	0	90.00	118	45.2	0	570
12	0	833	0	0	145	0	89.89	145	45.8	0	832
14	2	1152	0	0	173	0	89.46	173	46.4	2	1152
16	7	1527	-1	2	202	0	88.84	202	47.0	7	1527
18	19	1962	-2	4	233	0	88.11	233	47.7	19	1962
20	39	2459	-3	8	265	-1	87.33	265	48.3	39	2459
22	69	3021	-5	12	298	-1	86.43	298	49.0	69	3021
24	115	3650	-8	19	332	-1	85.23	333	49.8	115	3650
26	182	4349	-11	28	367	-1	83.84	369	50.5	182	4349
28	276	5120	-16	40	404	-2	82.32	407	51.3	276	5119
30	402	5965	-23	54	442	-3	80.71	447	52.1	402	5965
32	567	6887	-32	72	481	-5	79.05	489	53.0	567	6887
34	776	7888	-42	93	521	-6	77.36	534	53.9	776	7888
36	1036	8970	-54	117	562	-7	75.67	580	54.8	1035	8970
38	1352	10136	-69	143	604	-8	74.00	629	55.8	1351	10136
40	1731	11388	-85	173	648	-9	72.35	680	56.7	1730	11388
42	2179	12727	-109	206	692	-11	70.72	733	57.7	2177	12727
44	2702	14157	-133	242	738	-13	69.13	790	58.7	2700	14157
46	3306	15679	-163	281	784	-15	67.56	848	59.7	3304	15679
48	3999	17294	-196	324	831	-17	66.04	910	60.6	3996	17293
50	4787	19005	-234	370	879	-19	64.54	974	61.4	4782	19005
52	5676	20811	-276	419	927	-22	63.06	1040	61.9	5670	20811
54	6673	22711	-323	471	974	-25	61.60	1107	62.7	6666	22712
56	7785	24707	-376	527	1022	-28	60.17	1178	63.9	7776	24709
58	9020	26799	-433	586	1070	-31	58.74	1252	65.1	9003	26801
60	10385	28988	-498	649	1119	-35	57.33	1329	66.3	10371	28990
62	11891	31274	-574	717	1167	-39	55.93	1409	67.7	11874	31277
64	13547	33658	-656	790	1216	-43	54.53	1493	69.1	13525	33662
66	15361	36139	-744	867	1265	-45	53.13	1581	70.5	15335	36144
68	17345	38718	-836	949	1314	-45	51.73	1673	72.1	17313	38725
70	19510	41394	-986	1036	1362	-40	50.43	1769	73.7	19471	41403
72	21866	44166	-1057	1129	1410	-25	48.95	1870	75.4	21820	44177
74	24425	47033	-1097	1228	1457	1	47.57	1974	77.0	24370	47047
76	27198	49994	-1067	1332	1504	23	46.20	2083	78.8	27133	50011
78	30197	53047	-998	1442	1549	42	44.84	2197	80.7	30120	53068
80	33433	56189	-898	1558	1594	57	43.49	2316	82.5	33344	56216
82	36920	59420	-794	1680	1637	70	42.16	2439	84.5	36815	59453
84	40669	62737	-652	1808	1680	81	40.87	2567	86.4	40547	62776
86	44688	66141	-492	1941	1725	91	39.70	2701	88.5	44547	66189
88	48984	69638	-303	2078	1772	101	38.62	2839	90.6	48821	69695
90	53565	73231	-107	2219	1820	109	37.60	2983	92.8	53375	73299
92	58442	76921	-113	2364	1870	117	36.64	3133	95.1	58227	77002
94	63623	80709	349	2514	1919	125	35.72	3287	97.4	63373	80806
96	69122	84597	605	2669	1969	132	34.83	3446	99.8	68842	84711
98	74947	88585	890	2830	2019	139	33.97	3614	102.3	74630	88719

TABLE E-2 (Continued)

Nominal Trajectory Tabulation Discoverer
Number 3 - Azimuth Launch Angle 182.8°

Time Sec	X Ft	Y Ft	Z Ft	$\dot{X}$ Ft/Sec	$\dot{Y}$ Ft/Sec	$\dot{Z}$ Ft/Sec	γ Deg	V Ft/Sec	A_x Ft/Sec^2	R Ft	h Ft
100	81113	92673	1147	3170	2069	145	33.13	3785	105.0	80754	92830
102	87631	96862	1432	3349	2119	151	32.32	3963	107.7	87226	97045
104	94514	101150	1718	3535	2169	156	31.53	4148	110.5	94058	101363
106	101776	105539	2036	3728	2219	161	30.76	4338	113.4	101263	105786
108	1094[illegible]	110027	2345	3928	2269	166	30.01	4536	116.5	108855	110312
110	117492	114613	2667	4136	2318	170	29.27	4740	119.7	116848	114942
112	125975	119299	3012	4349	2368	174	28.56	4952	123.1	125257	119677
114	134893	124086	3370	4571	2419	179	27.89	5171	126.6	134094	124519
116	144262	128977	3721	4799	2472	185	27.25	5398	130.3	143373	129473
118	154095	133976	4125	5035	2527	190	26.65	5634	134.2	153108	134541
120	164409	139086	4466	5280	2583	196	26.07	5878	138.4	163316	139729
122	175220	144310	4872	5533	2641	202	25.51	6131	142.8	174012	145041
124	186547	149651	5236	5795	2701	209	24.[illegible]	6394	147.4	185213	150480
126	198407	155115	5641	6067	2762	216	24.48	6666	152.3	196937	156051
128	210822	160702	6065	6349	2826	223	23.99	6950	157.6	209203	161759
130	223812	166418	6501	6643	2891	232	23.51	7244	163.3	222032	167609
132	237401	172266	6965	6948	2958	240	23.06	7551	169.3	235446	173606
134	251613	178251	7464	7266	3027	249	22.61	7871	175.9	2[illegible]9469	179756
136	266474	184376	7976	7598	3099	259	22.19	8205	182.9	264125	186064
138	282013	190648	8511	7944	3173	270	21.77	8554	190.5	279442	192537
140	298261	197070	9071	8306	3250	280	21.36	8919	198.8	295449	199182
142	315250	203648	9644	8686	3330	290	20.97	9302	207.7	312178	206008
144	333015	210395	10240	9082	3418	301	20.62	9704	217.5	329662	213027
146	351592	217323	10890	9498	3512	312	20.92	10127	228.3	347934	220256
148	371022	224450	11550	9935	3615	322	19.99	10572	240.2	367034	227715
150	391348	231790	12130	10395	3727	332	19.72	11043	253.3	387002	235422
152	412620	239365	12960	10881	3849	342	19.48	11542	268.0	407886	243400
154	434893	247193	13723	11396	3981	353	19.25	12072	284.3	429738	251673
156	458227	255298	14437	11944	4126	363	19.06	12636	302.8	452614	260271
158	482692	263707	15150	12578	4285	372	18.88	13240	323.8	476581	269222
158.7443	492091	266917	15466	12756	4348	375	18.82	13476	3.702	485785	272648
160	506200	272400	16000	12759	4310	381	18.67	13467	3.7	501500	278400
162	533850	281000	16780	12764	4250	390	18.41	13453	3.7	526650	287750
164	560000	289600	17510	12770	4189	398	18.16	13439	3.7	555300	297000
166	586000	298000	18190	12775	4127	406	17.90	13426	3.7	576000	306000
167.7443	607000	304840	18800	12780	4079	412	17.70	13415	3.7	598100	313540

REMARKS:

1. X,Y,Z are Earth Fixed, Right Handed, Cartesian Coordinate System, with Origin at the Launch Pad, and X Positive Downrange, Y Positive Upward, and Z Positive to the Right.

2. Flight Path Angle, γ, is Referenced to the X-Z Plane Described Above.

3. Range, R, is Range on the Surface of the Earth.

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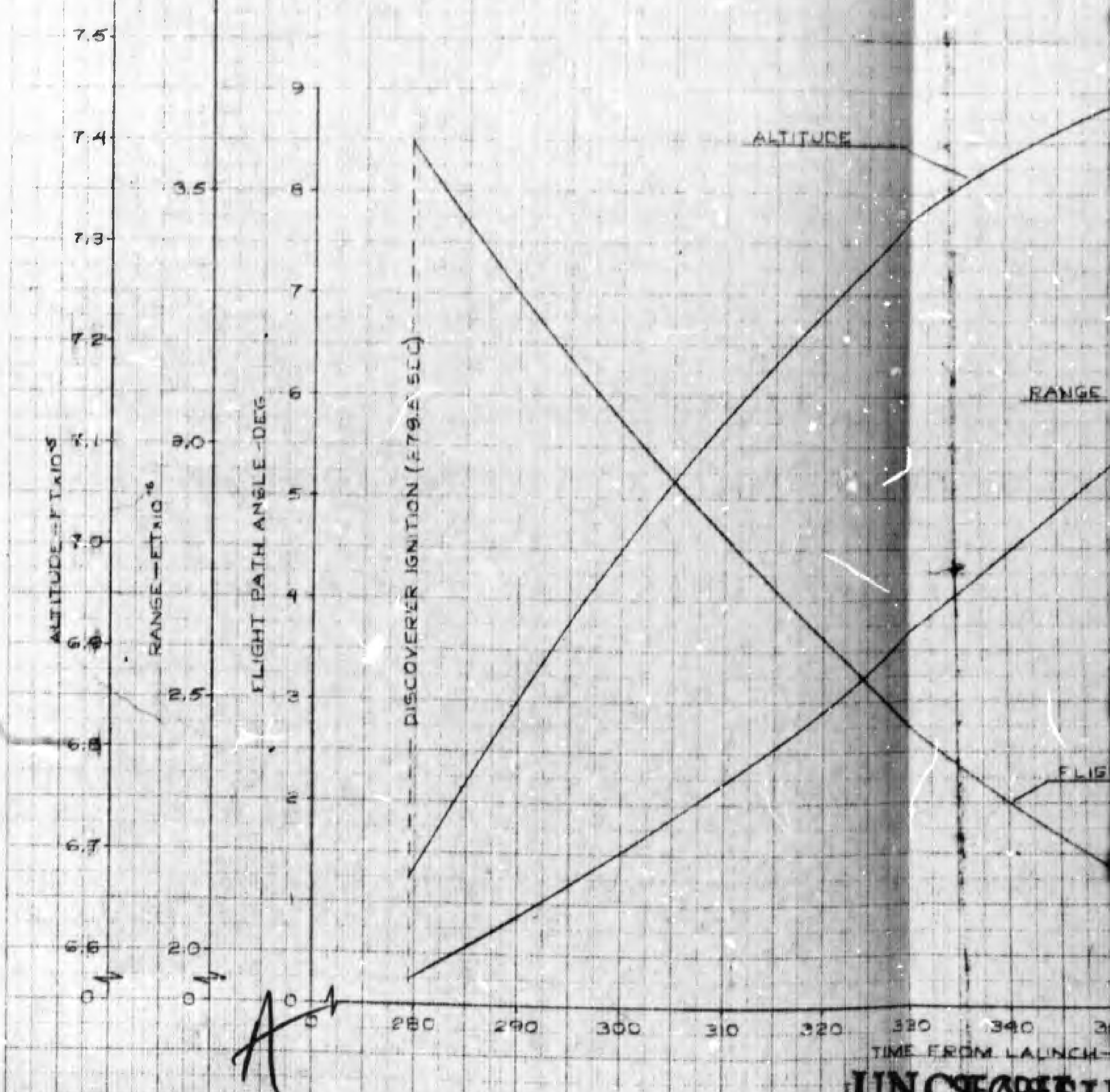
Fig. E-10 ORBIT BOOST TRAJEC
ALTITUDE, RANGE AND F
PATH ANGLE VS. TIM



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E-10 ORBITAL BOOST TRAJECTORY, ALTITUDE, RANGE AND FLIGHT PATH ANGLE VS. TIME

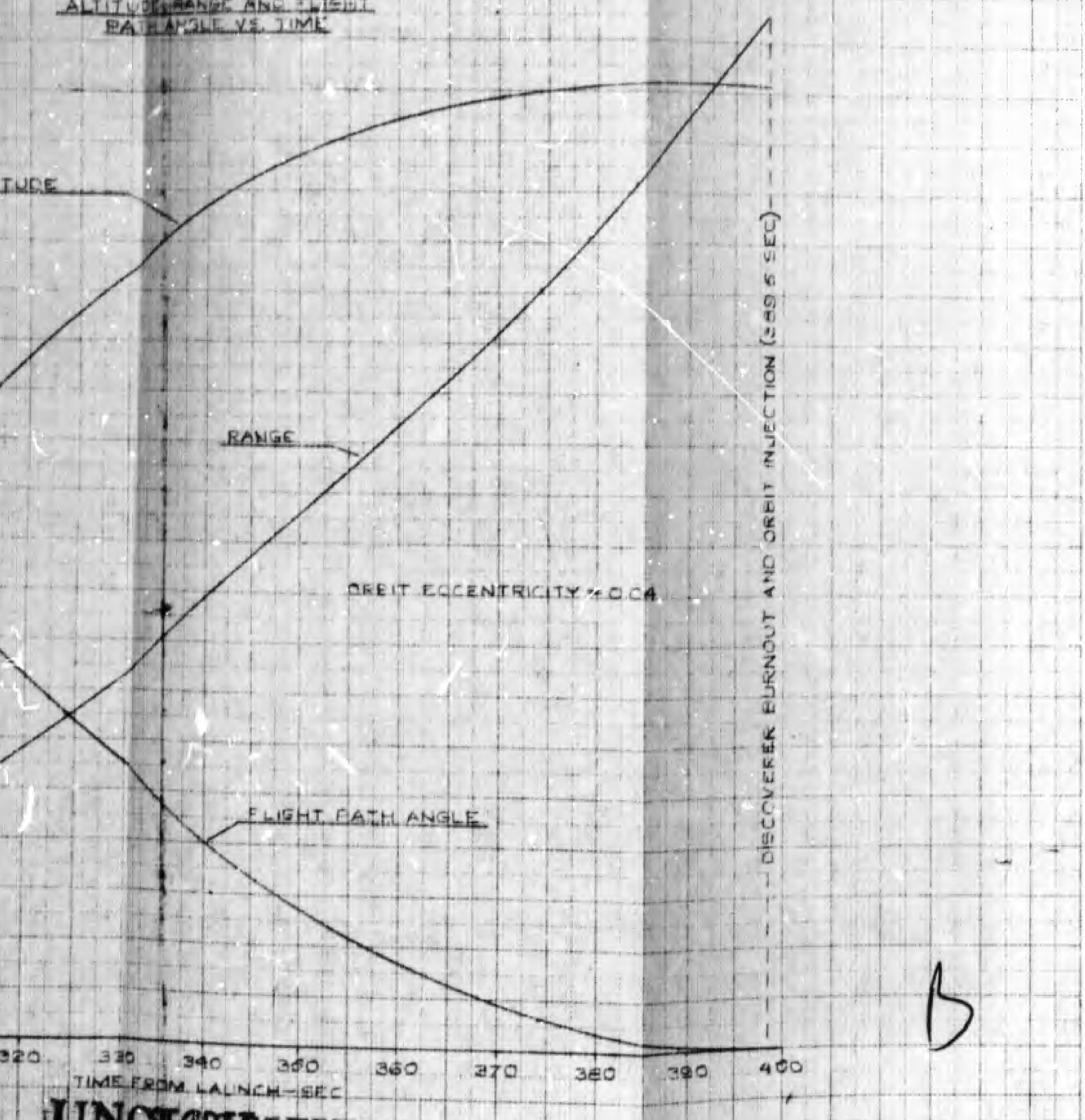

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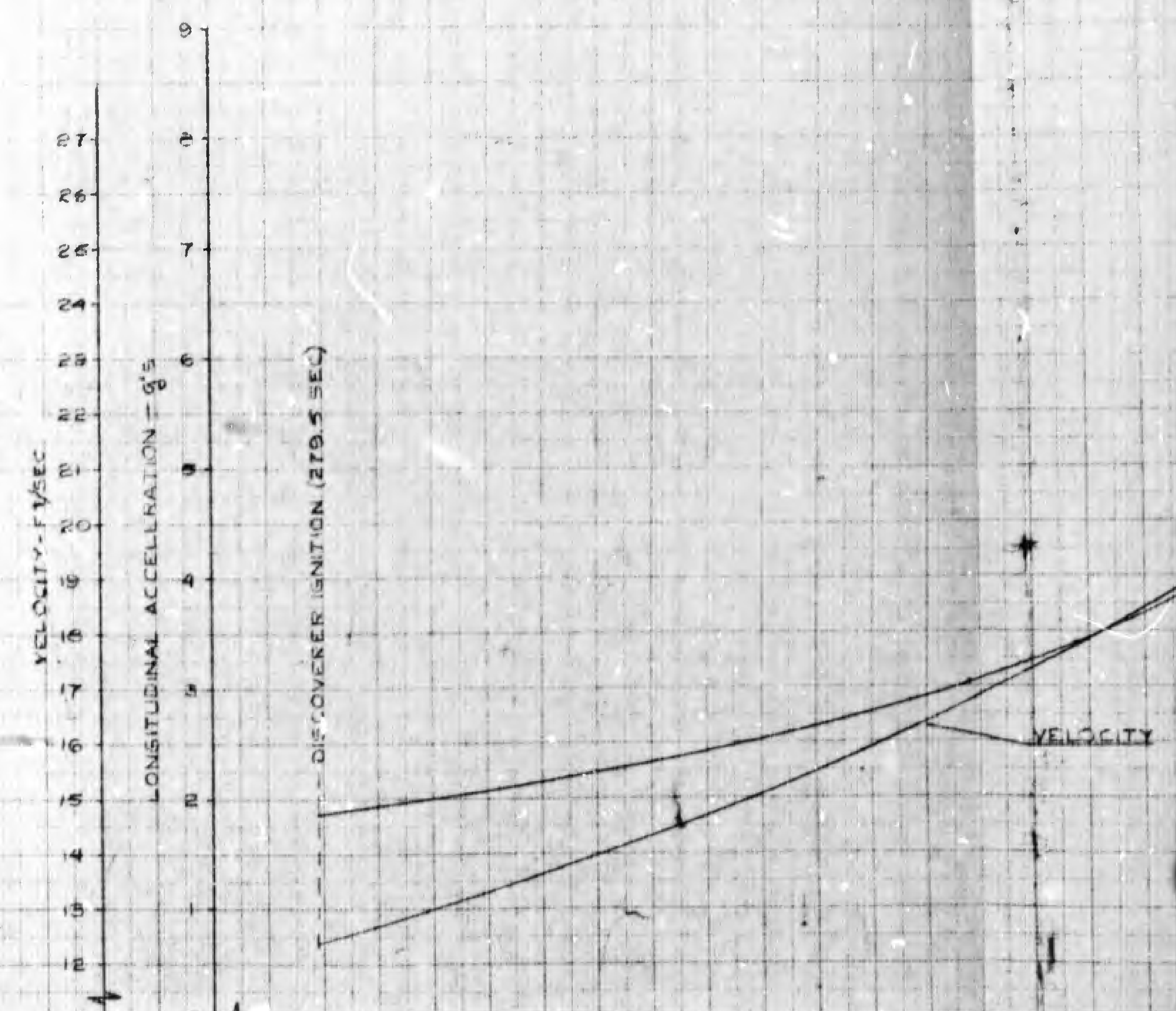
Fig. E-11 ORBITAL BOOST TRAJECTORY LONGITUDINAL ACCELERATION AND ALTITUDE VS. TIME



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...L BOOST TRAJECTORY
...UDINAL ACCELERATION
... ALTITUDE VS TIME

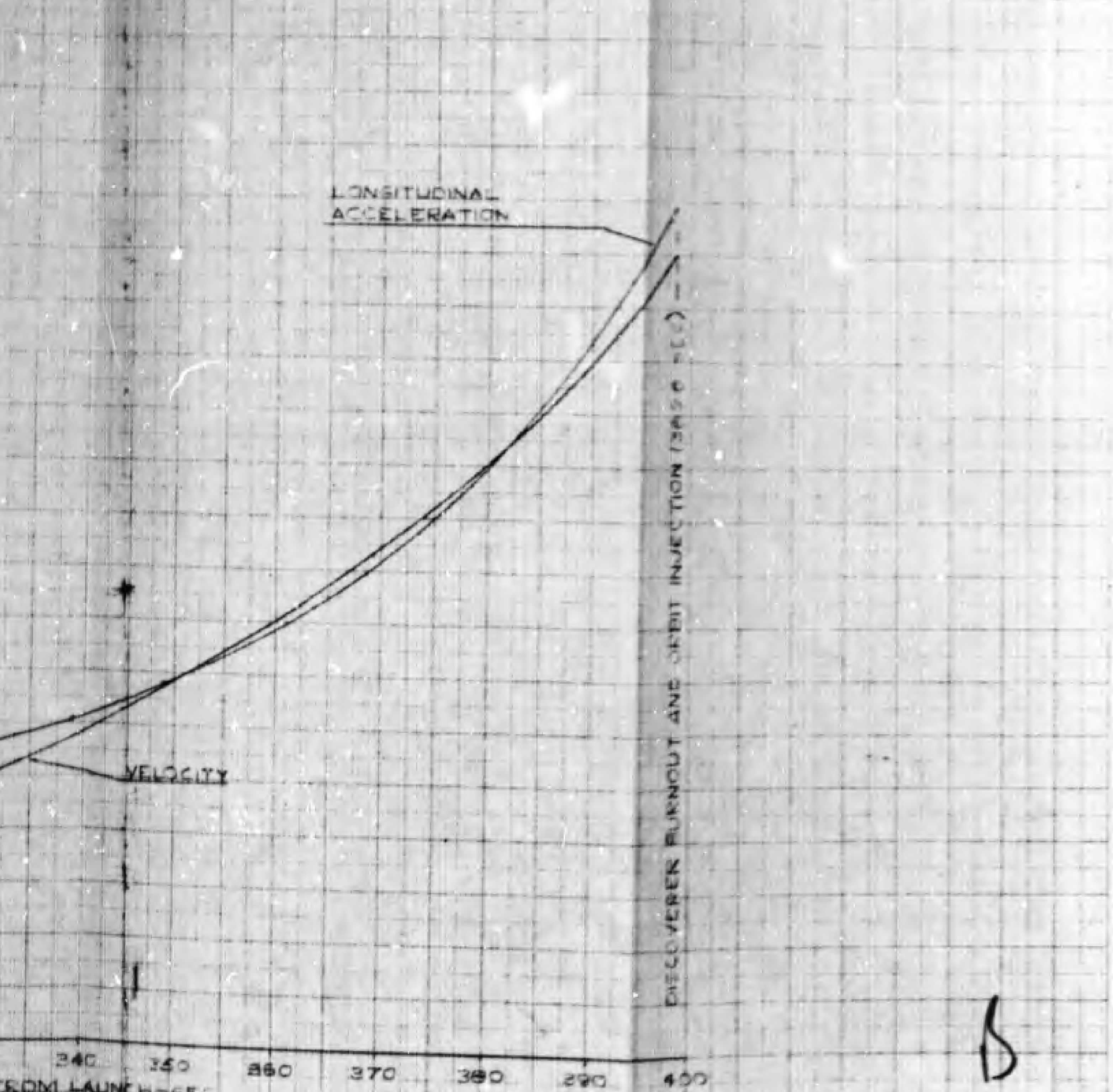

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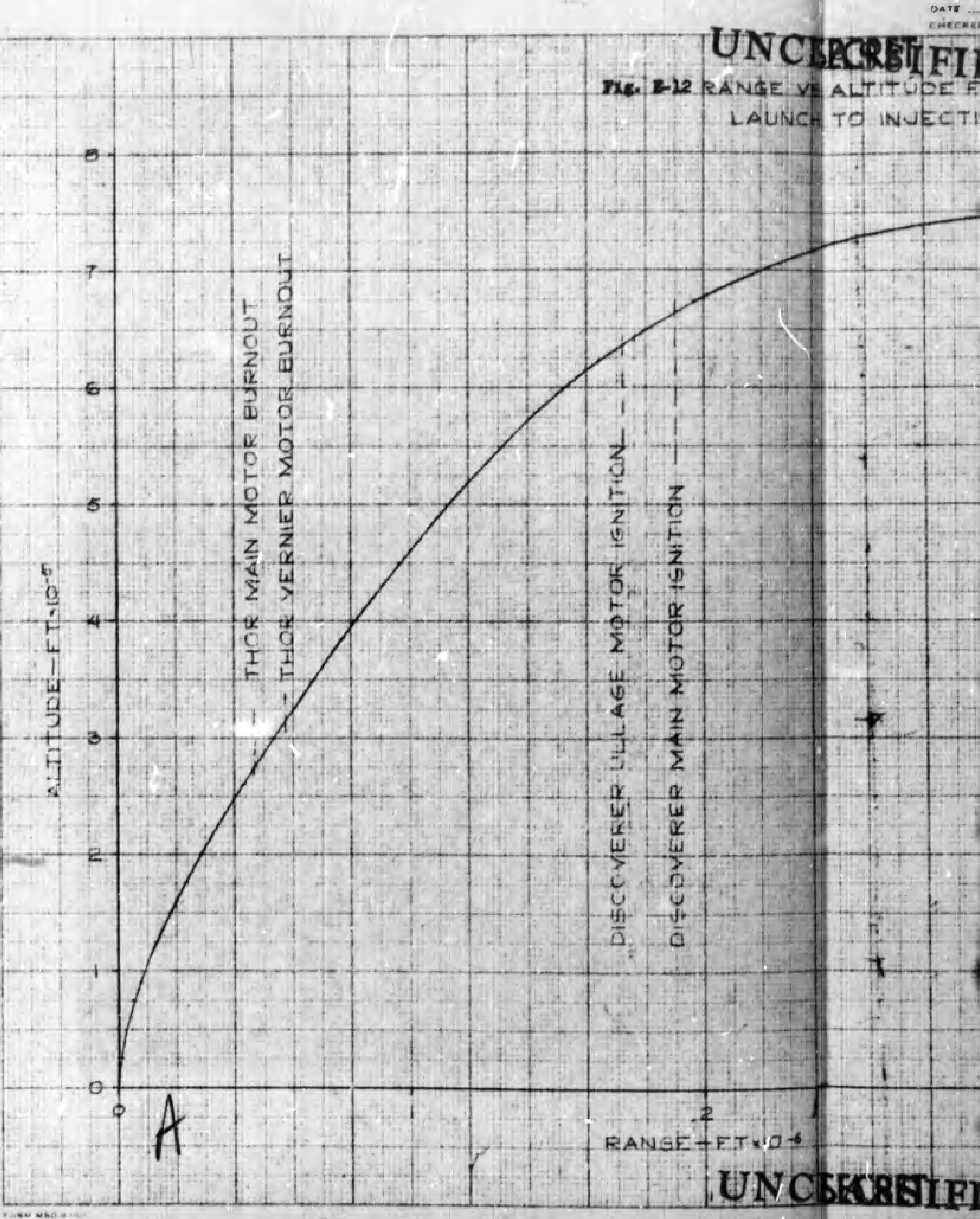
Fig. B-12 RANGE VS ALTITUDE F
LAUNCH TO INJECTI



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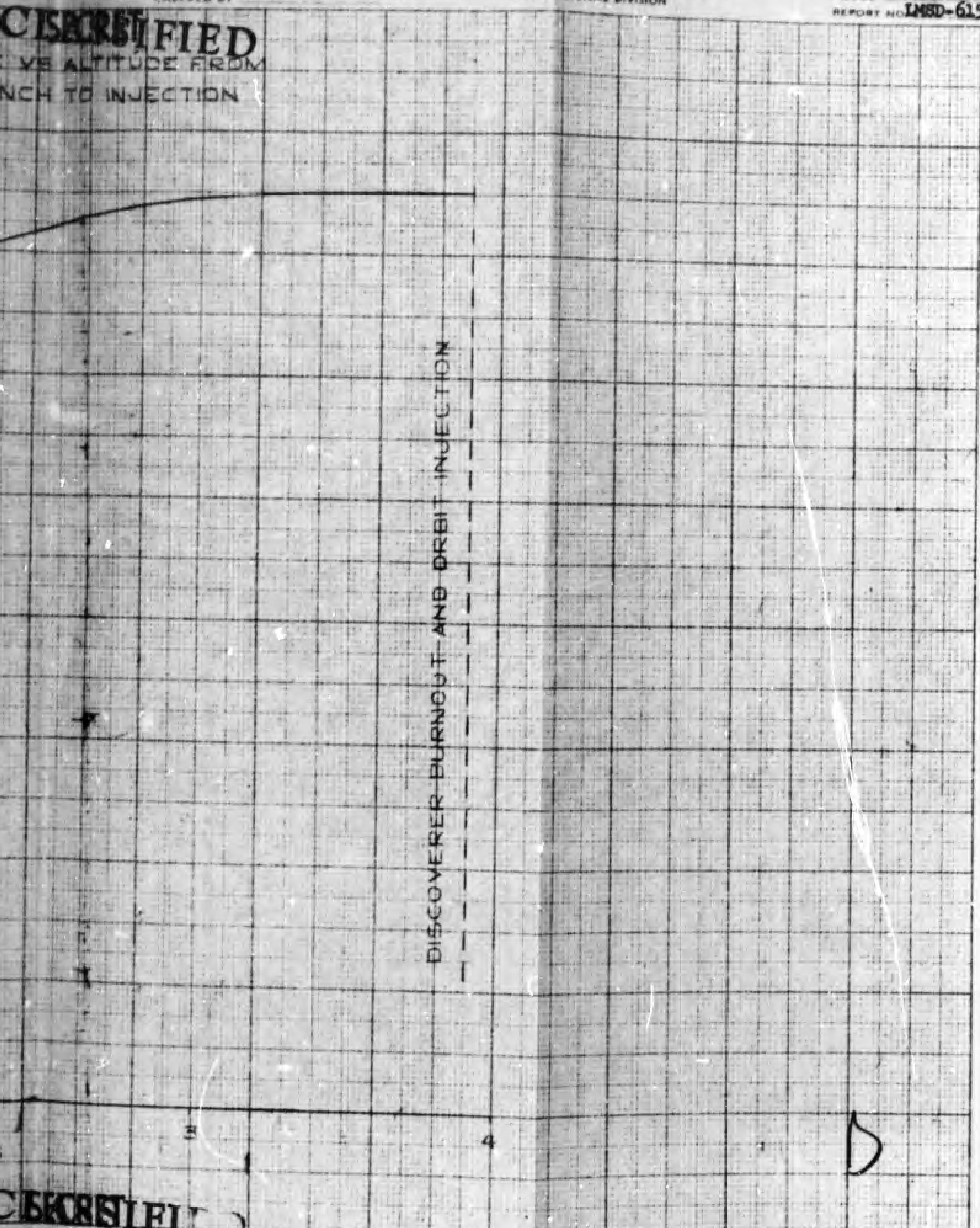
VS ALTITUDE FROM
NCH TO INJECTION
DISCOVERER BURNOUT AND ORBIT INJECTION
3
4

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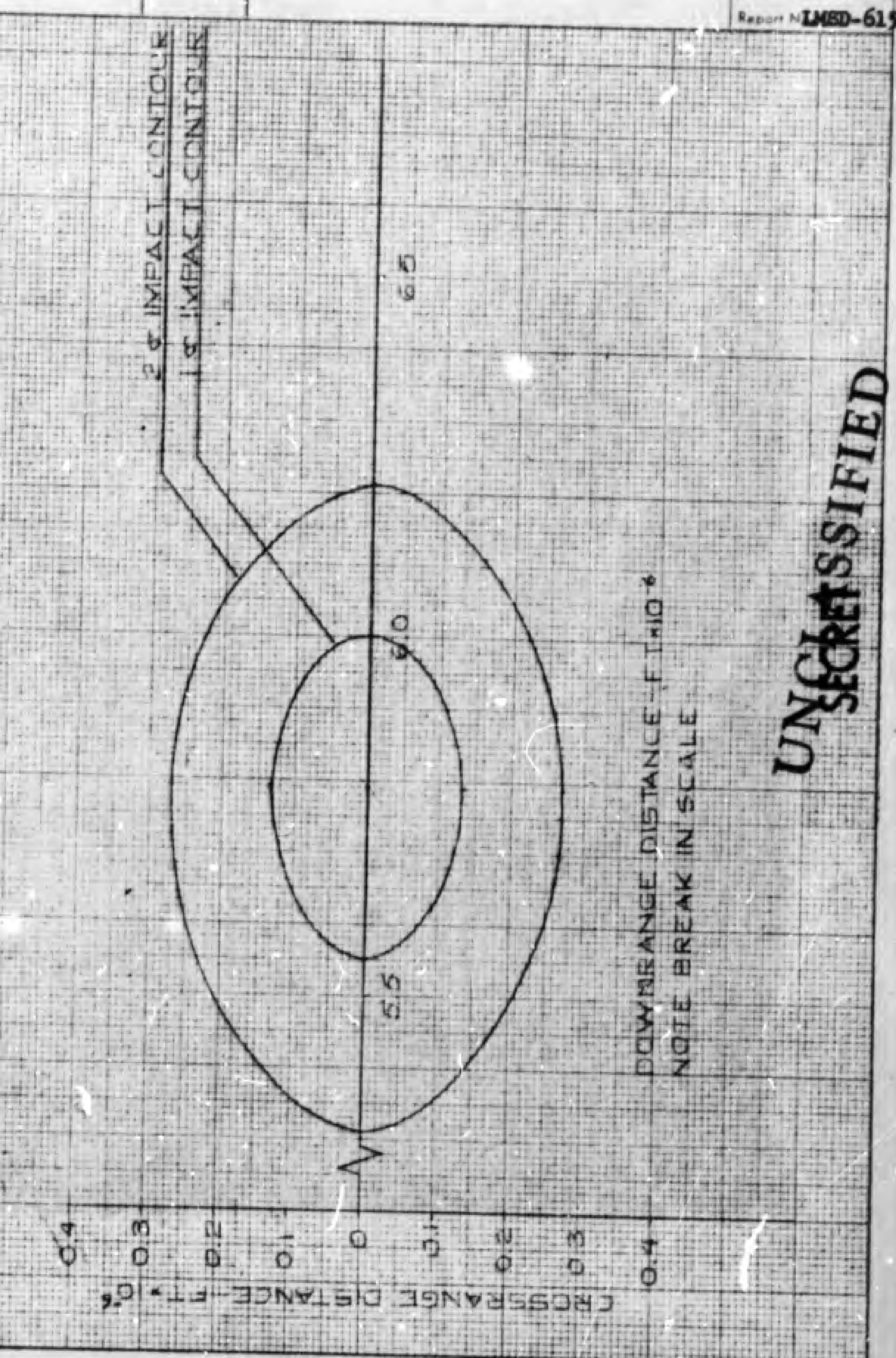

Fig. E-13 SM-75 IMPACT DISPERSION CONTOURS

DISCOVERER

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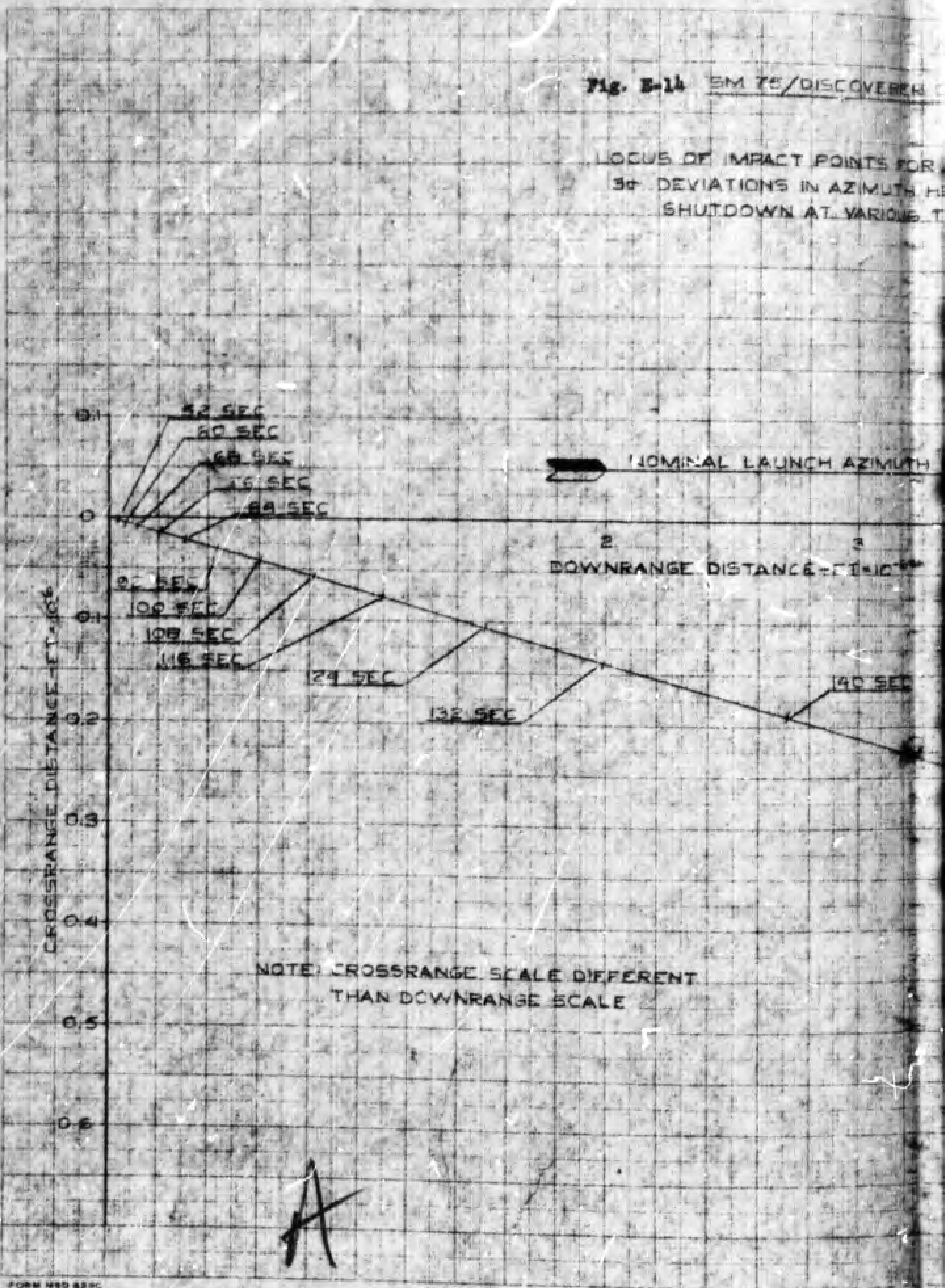
Fig. E-14 SM 75/DISCOVERER
LOCUS OF IMPACT POINTS FOR
3σ DEVIATIONS IN AZIMUTH HE
SHUTDOWN AT VARIOUS TI
NOMINAL LAUNCH AZIMUTH
52 SEC
60 SEC
68 SEC
76 SEC
84 SEC
92 SEC
100 SEC
108 SEC
116 SEC
124 SEC
132 SEC
140 SEC
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
2
3
DOWNRANGE DISTANCE
CROSSRANGE DISTANCE
NOTE: CROSSRANGE SCALE DIFFERENT THAN DOWNRANGE SCALE

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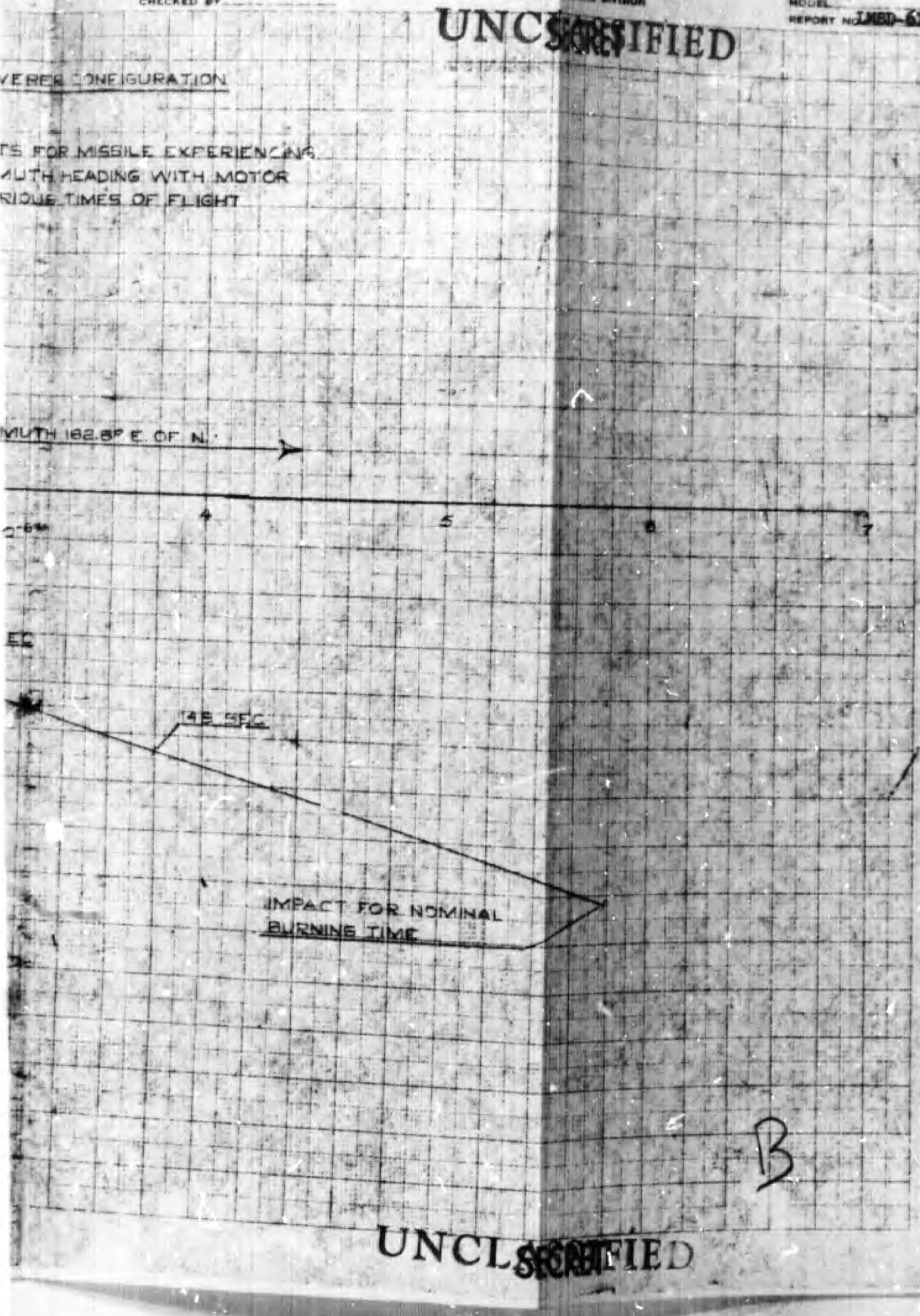

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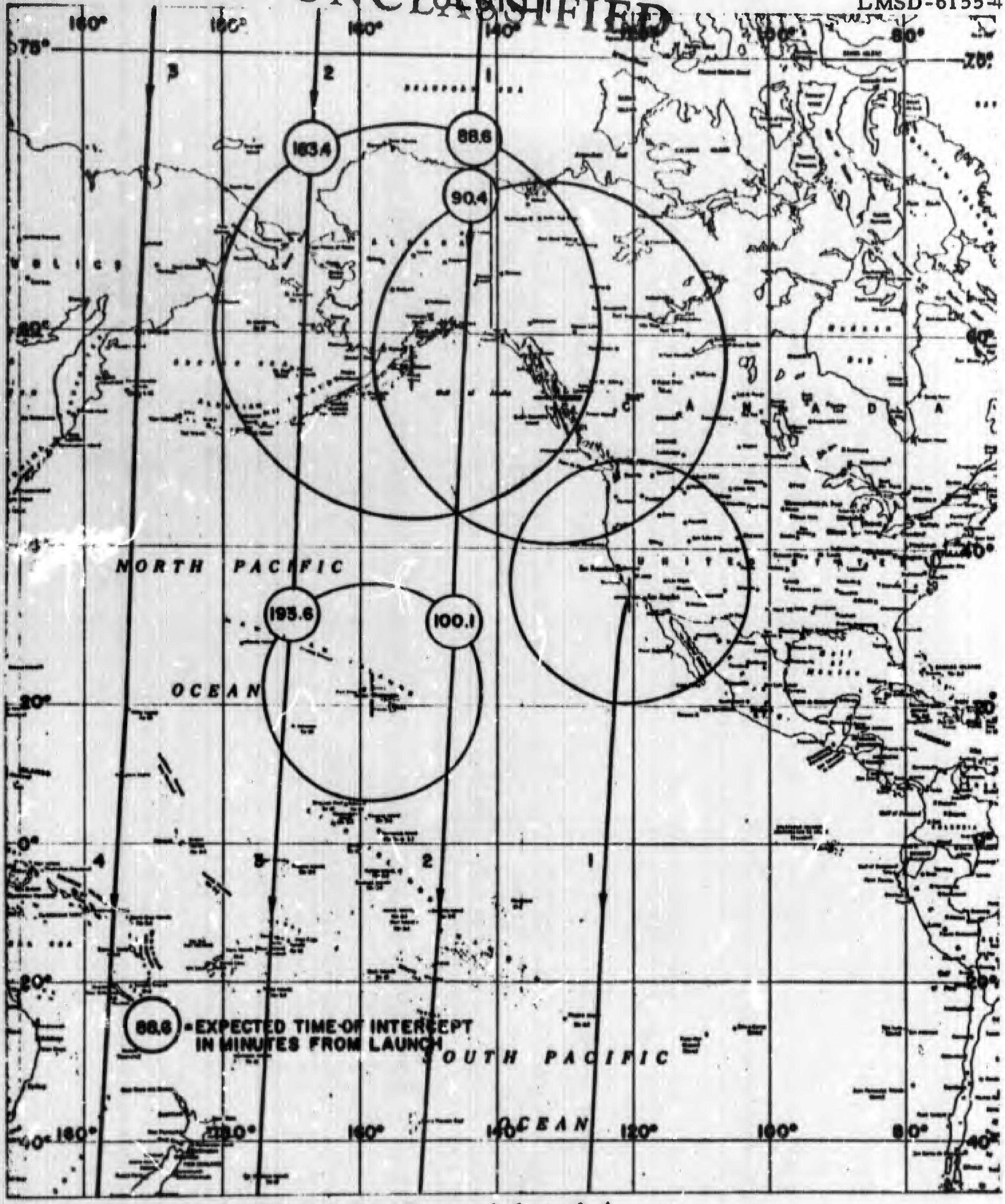


Fig. E-15 Nominal Orbit Tracks, Passes 1 through 4

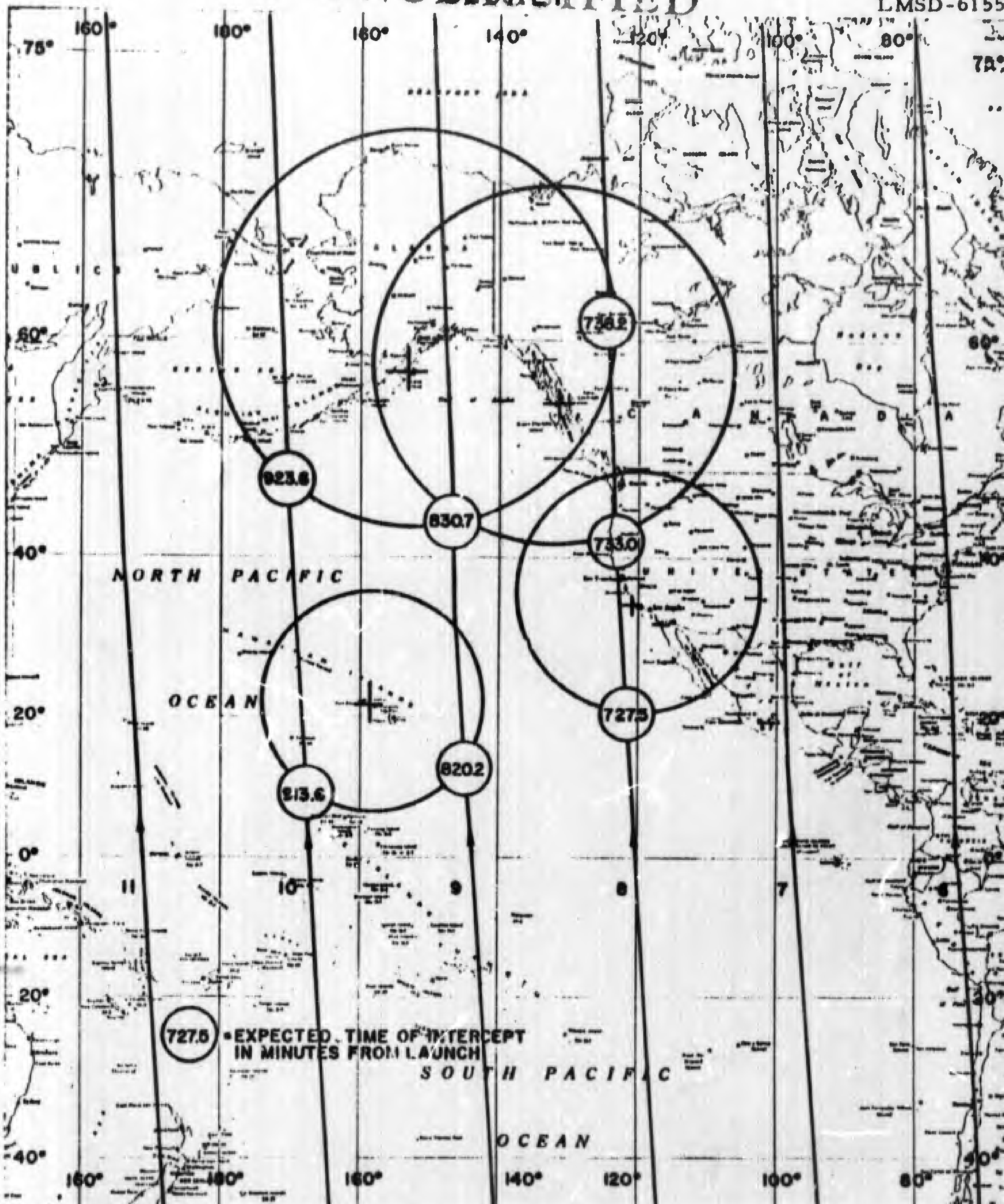


Fig. E-16 Nominal Orbit Tracks, Passes 6 Through 11

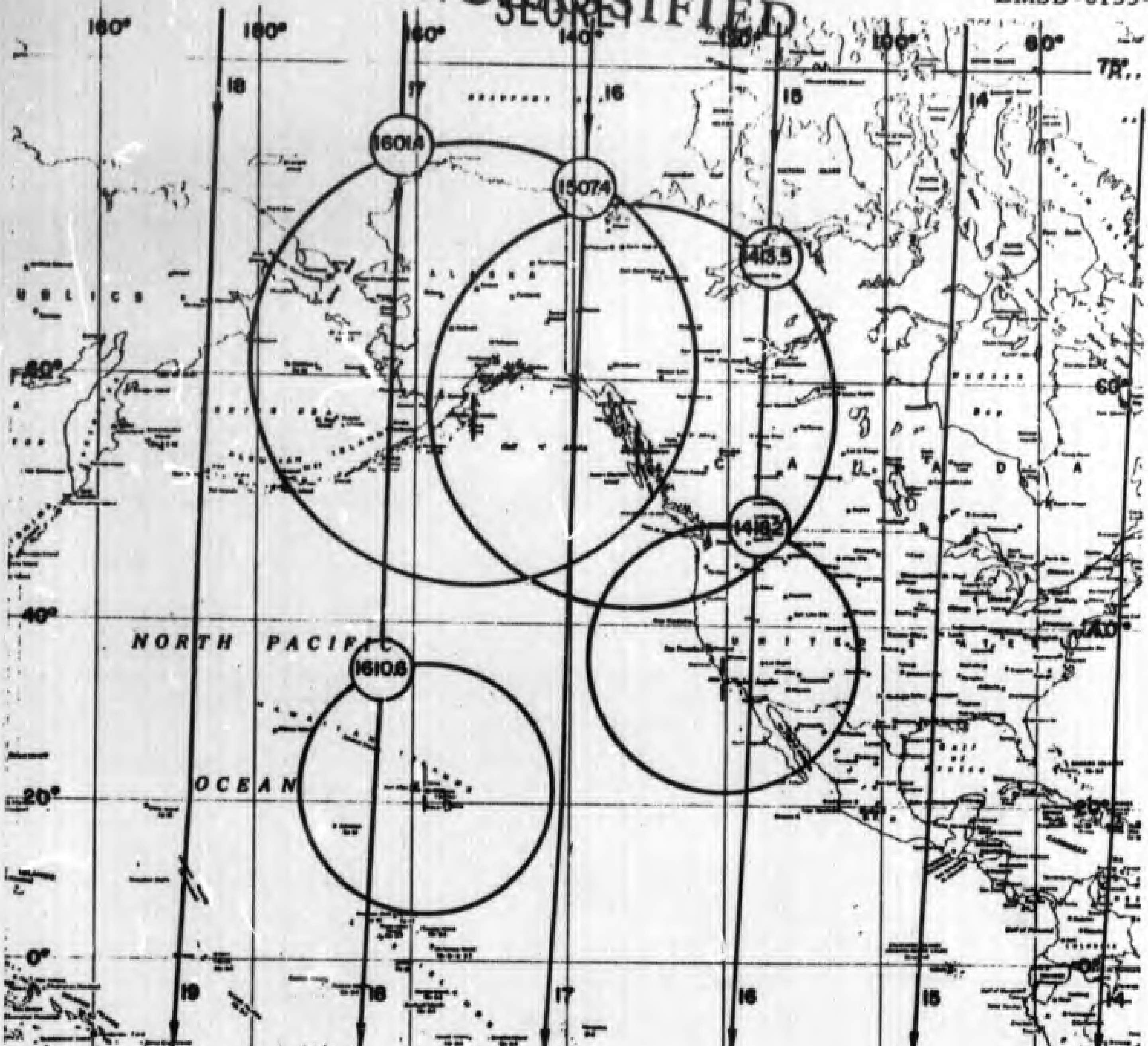


Fig. E-17 Nominal Orbit Tracks, Passes 14 Through 19

Fig. E-18

DUMP-TO-IMPACT RE-ENTRY RANGES

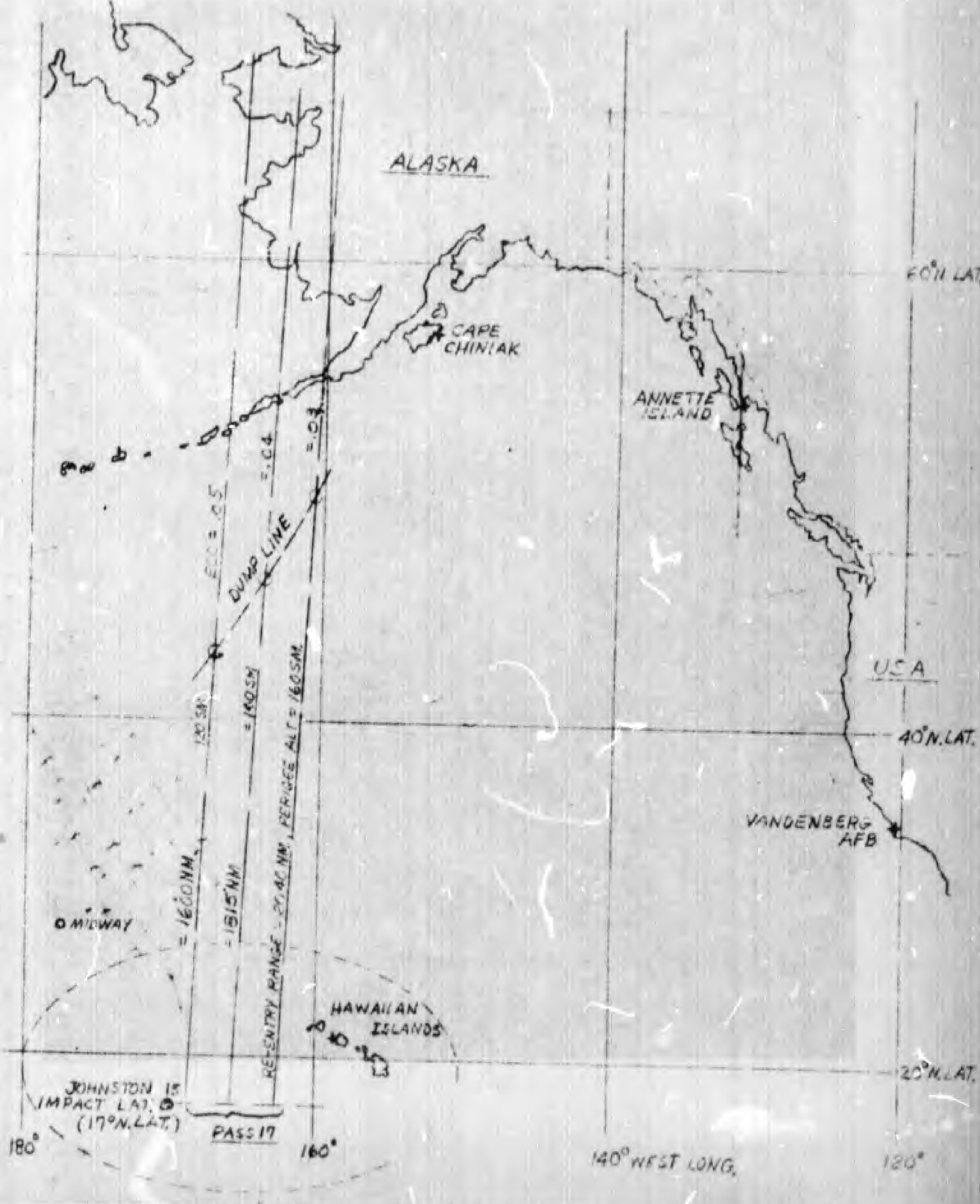
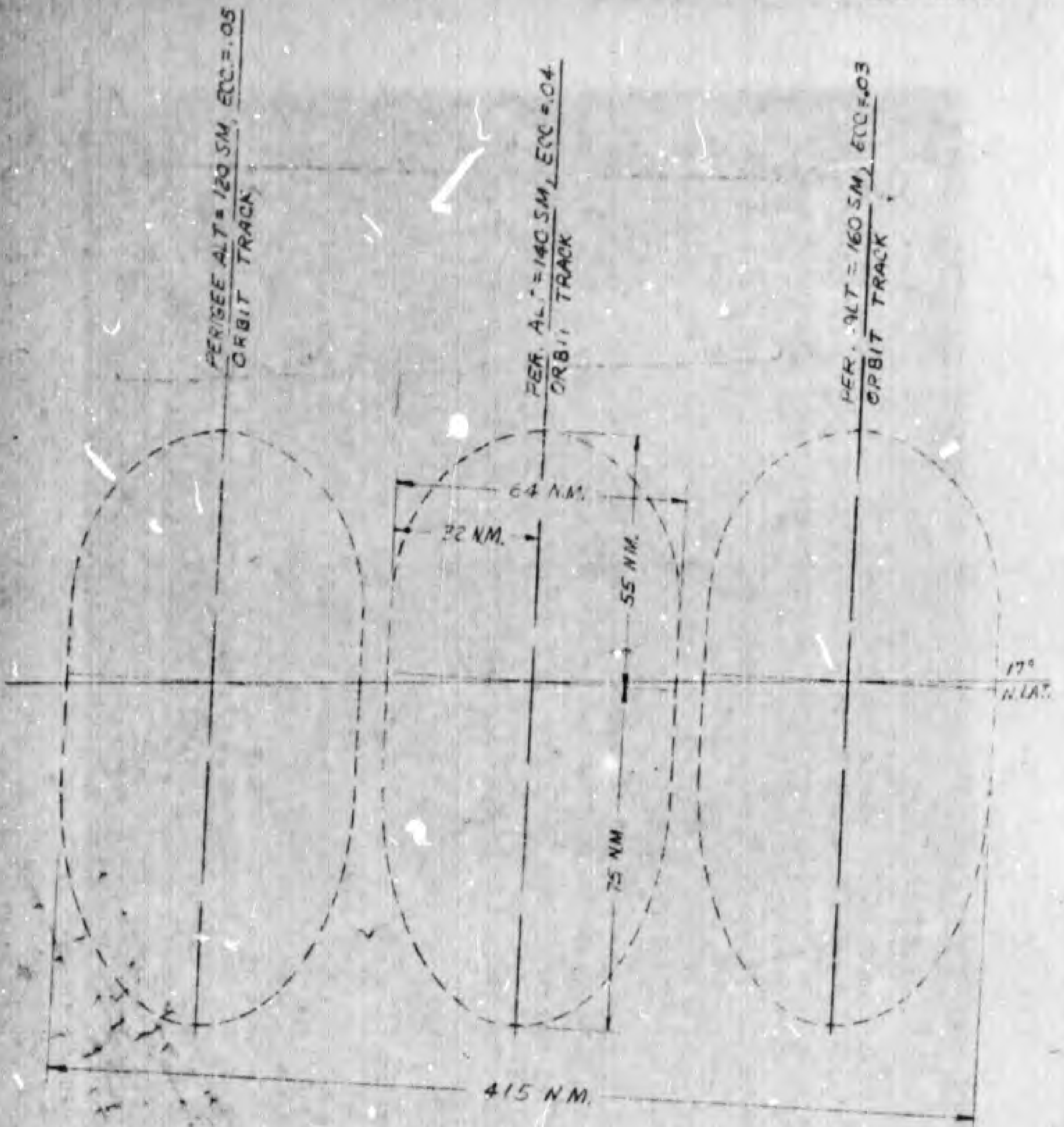


Fig. E-19

TYPICAL E.R.C. RANGE DISPERSIONS



APPENDIX F

SS/D SEQUENCE FOR DISCOVERER VEHICLE SERIAL 2205-1018

SS/D Switch Number	Mfg Switch Number	Time (sec): Nominal Time From Launch	Time (sec): Computer Running Time	Switch: NC	Switch: NO	Signal Control Function
U-1	S2A	0	0		x	Timer reset
UMB Drop		0	0			Start timer
U1	S1A	0.35	0.35		x	Timer test
U1B	S4E	161	161	x		De-energize K30, 31, 32 (uncage gyros)
U1C	S4F	161	161	x		Destruct lockout safety switch
U2B	S1C	171	171		x	Vehicle roll control
C	D				x	Nitrogen valve
D	E				x	Fire explosive bolts
E	F				x	Fire explosive bolts
U2B	C	171	171	x		Spare
U3A&B	S3A&B	172	172		x	Fire retro-rockets (Parallelod)
C	C			x	x	Activate gas controls
D	D	172	172		x	Arm integrator correction circuit
U4A	S4A	178	178	x	x	Command 40°/min pitch rate
B	B			x	x	Arm roll H/S command
C	C			x		Integrator caging bypass network armed } Integrator setup for ground control signal
D	D			x		Turn off 28v to N_2 valve and to separation monitor } Integrator setup for ground control signal
C	C				x	Fire H/S cover squib
D	D	178	178		x	Fire H/S cover squib

APPENDIX F (Continued)

SS/D Switch Number	Mfg Switch Number	Time (sec) Nominal Time From Launch	Time (sec) Computer Running Time	Switch NC	Switch NO	Signal Control Function
D	D	284	264	x	x	Start thrust misalignment correction
Engine		284.6				Engine to 90° of thrust
U9A	S3E	304	284	x	x	Stop thrust misalignment correction
U9B	S3F	304	284	x		Stop pitch gyro offset correction (thrust misalignment)
U10A	S5E	395	375	x	x	Arm pneumatics (pitch and yaw)
B	F	395	375	x	x	Engine cutoff safety switch
In2A		400	-		x	Engine shut down
A		-	-	x		Disconnect accelerometer from integrator
B		400	-		x	Test isolation
EPS		400	-		x	Activate pneumatic controls (de-energize K28)
U4F	S12D	406	386		x	Start SS/H timer
U12A	S2B	409	389		x	Pulse latch K16 (connect H/S signal high)
A&B	B&C	-	-	x		Hydraulic controls shut down (paralleled)
D	E	-	-	x	x	Command +40°/min yaw rate
E	F	-	-	x	x	Command 0°/min pitch rate
B&C	C&D	-	-		x	Fire oxidizer, helium, and fuel vent valves (paralleled)
C	D			x		Remove first switch to K26, K27, and IRP gyro heaters
U14A	S7E	415	395	x	x	Calibrate T/M
B	F	-	-	x		De-energize K21 (minimize power consump)

APPENDIX F (Continued)

SS/D Switch Number	Mfg Switch Number	Time (sec)		Switch		Signal Control Function
		Nominal Time From Launch	Computer Running Time	NC	NO	
U20A	S12A	X+383.5	1277.5		x	Command total power shut down SS/D (K11, 12, 13, 14, K9)
B & C	B & C	X+383.5	1277.5		x	Command ejection of recovery capsule (paralleled)

Appendix G
Weather Flight Tables