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FACILITIES PLAN

NASA PROJECT APOLLO
TEST LAUNCH VEHICLE - LITTLE JOE II [redacted]

CLASSIFICATION CHANGE

TO = UNCLASSIFIED CONFIDENTIAL

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NASA PROJECT APOLLO

TEST LAUNCH VEHICLE - LITTLE JOE II [redacted]

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INTRODUCTION

This plan presents General Dynamics/Convair's complete facility requirements for developing, manufacturing and preparing the test launch vehicle for operation at a selected test site. The plan is prepared in accordance with Paragraph 4.5.3.1.2 of the NASA Statement of Work.

The Facilities Plan consists of three sections. Each section describes in detail one of the three primary facilities requirements:

1. Test Laboratories - The laboratories required to develop and confirm design information.

2. Manufacturing - The areas and equipment required to produce the launch vehicles and launcher.

3. Test Base - The facilities required to receive, assemble, check out and operate the launch vehicles.

1. TEST LABORATORY FACILITIES

Test facilities to be employed in the Little Joe II program are described in the paragraphs below. Only facilities or parts of facilities applicable to the program are listed. All facilities described are General Dynamics/Convair or General Dynamics/Astronautics property. No Government-owned test facilities within the Convair plant are contemplated for use during this program. Existing laboratory facilities are adequate for completion of test requirements within the program schedule. No new facilities or new subcontractor facilities will be required.

1.1 STRUCTURES LABORATORY

Structure, development and design verification tests will be performed in the Structures Laboratory. Universal load machines are to be used for load tests on joint and buckling load specimens. A hydraulic load programmer is available for the compression panel load tests.

1.2 MATERIALS AND PROCESSES LABORATORIES

The Materials and Processes Laboratories are equipped with the following facilities for manufacturing process control, quality control and reliability testing:

1.2.1 Mechanical Section

The Mechanical Section is equipped to test the tensile, compressive, flexural, shear and bearing properties of materials. A creep testing facility is available for conventional creep measurement as well as cyclic and flexural creep measurement.

1.2.2 Thermal Properties Laboratory

The Convair Thermal Properties Laboratory is equipped to determine thermal conductivity, thermal diffusivity, thermal expansion, emissivity, heat of reaction, and ablation properties.

1.2.3 Chemical Section

The Chemical Section consists of a well-equipped chemical laboratory for standard analysis and is equipped with such specialized equipment as nuclear magnetic resonance measuring equipment and a time-of-flight mass spectrometer.

1.3 COMPUTERS

1.3.1 Analog Computer Facility

The Analog Computer Facility consists of six major and four minor computing stations, total of 444 operational amplifiers, and 230 nonlinear computing units including multipliers, resolvers, function generators and comparators. The computer is capable of conducting studies of heat flow characteristics, control system responses, stability characteristics and flight performance.

1.3.2 Digital Computer Facility

This facility includes a large, high-speed computer, two medium-size computers and various supporting tabulating machines. An IBM EDP-7090 computer (32,768-word core storage and access time of 2.18 microseconds) is operated in the peripheral (off-line) mode with two data channels, fourteen tape units on line, and card-to-tape, tape-to-card equipment as peripheral support. Off-line tape-to-print is provided by a SC-5230 printer capable of printing 3,800 lines per minute. Two IBM 1620 solid-state, medium-size computers with 20,000 characters of memory and card input-output are also available.

1.4 STANDARDS AND TEST EQUIPMENT LABORATORIES

The Standards and Test Equipment Laboratories are service laboratories responsible for calibration of all standards and test equipment. All test equipment used during this program will be calibrated periodically against standards having certification directly traceable to the National Bureau of Standards. The calibration period for all equipment is called out automatically by an IBM schedule. The laboratory divisions include:

a. Electrical Calibration - AC and dc measuring equipment.

b. Mechanical Calibration - Pressure, force, viscosity, vacuum, vibration, and acceleration.

c. Physical Calibration - Mass, length, temperature, and light.

d. Electronic Equipment Calibration.

1.5 ELECTRICAL AND ELECTRONICS LABORATORY

The Electrical and Electronics Laboratory is equipped with multiple power sources and standard and specialized equipment to perform the following:

a. Evaluation of electronic and electrical components.

b. Evaluation of system operational characteristics, stability, and reliability.

c. Life cycling of components over a wide range of temperature, frequency and voltage.

d. Generation and control of typical switching transients.

1.6 THERMODYNAMICS LABORATORIES

Heat transfer to the fin base and evaluation of the material selected for protection against recirculation heat flux will be accomplished in the Thermodynamics Laboratories. Small scale RPI-O_2 rocket motors firing at pressure altitudes up to 130,000 feet are available for these tests.

2. MANUFACTURING FACILITY REQUIREMENTS

2.1 GENERAL

All necessary buildings, utilities, yard space, machine tools, hand tools, material handling equipment, quality control facilities, tool manufacturing capabilities, manufacturing control competence, cost and schedule control are available to produce the launch vehicles and GSE without additional capital equipment or need for government-furnished equipment. (See Figure 2.)

Some rearrangement of the present manufacturing assembly area will be necessary. Compressed air, electrical utilities and wooden holding cradles (for one afterbody, one forebody and four fins) will be supplied. Expense-type items will be furnished from existing sources with the exception of a plywood standing shield around the launcher welding area.

The machines, equipment and capabilities for manufacture of the test launch vehicle, launcher and associated GSE are included in the facility items breakdown in the following paragraphs.

2.2 MACHINE SHOP

A full range of machine tools is available to accomplish "hog out" or precision-finish machining to close tolerances. Machine equipment includes jig borers and drills, a broaching machine, and grinders.

A battery of lathes is available including automatic, engine, turret, gap and tracer lathes. Milling capabilities are supported by plain and overarm horizontals ranging from hand types to a Number 6 Cincinnati mill with a 20 x 104-inch table surface. Vertical mills range from a 12 x 52 1/2-inch table to a 20 x 104-inch table size.

Profile milling machinery includes Rockford, Sandstrom and Arrow equipment. One tape-controlled profile mill and a "Milwaukee-Matic" with an 18 x 18-inch pallet and 24 x 20 x 16-inch travel are available.

Polishing and burring may be accomplished by hand or by barrel tumbling. All finished machined details will be inspected for quality in a precision inspection area equipped to check to specification tolerances.

2.3 SHEET METAL SHOP

The sheet metal shop is equipped to form, roll, bend, blank, pierce, notch, trim, route saw, drill, joggle, punch, spin or shear to manufacture details for this program. Forming is accomplished on drop hammers, hydropresses or by impact with a rubber pad. Roll forming is available with Yoder form rolls, pinch rolls, bead and sheet rolls of various sizes and capacities. Blanking, pierce and notch operations are possible on available fabricators and punch presses. Trimming operations are carried out on table saws, radial arm saws, pin routers, overarm routers, band saws and shears. Stretch-formed parts will be made on Hufford, Erco and Cyril Bath machines of up to 75-ton capacity. Multi-punching of material up to 20 feet in length is possible using existing machines. Bending machine capacities range from 18-inch to 14-foot beds and up to 197 tons.

2.4 ASSEMBLY

Assembly will be performed in the Experimental Factory. Facilities required for subassembly and assembly operations to complete the launch vehicle and launcher are available and will be used in conjunction with the necessary manufacturing aids. No capital equipment or GFE will be required. Manufacturing aids required include:

a. Approximately 40 compressed air outlets and 40 electrical outlets plus the necessary supply lines.

b. One 14 x 20-foot wooden holding cradle for the vehicle forebody.

c. One 14 x 11-foot wooden holding cradle for the vehicle afterbody.

d. Four 3 x 26-foot wooden holding cradles for fin storage.

e. Approximately 150 lineal feet of quarter-inch plywood, eight feet wide, will be necessary for the welding shield around the launcher construction area.

Work stands, racks, cabinets, tables and other items classified as expense equipment will be supplied from existing sources and modified as necessary.

All types of welding equipment are available for use on the launch vehicle and launcher. Capacities of the arc, heliarc, butt, spot and seam welders range from 0.001-inch foil to heavy plate, tubing and pipe.

Portable power tools are located in the main tool crib and include hand drills of various drilling capacities and speeds, rivet hammers, rivet squeezers, torque-controlled impacting wrenches, nut setters and screwdrivers, belt and disk sanders, grinders, hot and cold dimpling equipment, air and power-feed drills, nibblers, shears, routers and similar equipment. Stationary riveting, drilling, sawing and grinding equipment is available within the Development and Modification Department where the major assembly work is to be completed.

2.5 MATERIAL HANDLING AND PACKAGING FACILITIES

Raw materials will be received and handled by existing Convair facilities. Facilities and equipment available include tractors, trailers of various configurations, Hysters, fork lifts, trucks, mobile cranes of 10- and 20-ton capacity and overhead cranes.

2.6 TOOLING FACILITIES

The widely diversified facilities of the Tooling Department include the

template shop, form block shop, plaster shop, tool and die shop, foundry, jigs and fixtures shop, and the tool grinding shop. These functions are equipped with precision drilling machines, jig borers (from No. 1 to the Pratt and Whitney No. 3E), mills up to the No. 6 Cincinnati, a 12-foot King vertical boring mill, a Lucas boring mill, and other equipment such as:

Horizontal and vertical grinders	Optical tooling
Jig mills	Electric and gas welders
Lathes	Pantograph pipe cutting machines
Slotters	Heat treat facilities
Elox grinders	Die grinding
Tool and cutter grinders	Plastics tooling equipment
Centerless grinder	Granite and steel surface tables
Internal grinders	Aluminum, lead and kirksite pots
External grinders	Sand blast equipment
Surface grinders	Woodworking machines
10- and 20-foot bed planers	Punching machines
Shapers	Painting equipment

2.7 QUALITY CONTROL FACILITIES

Quality control facilities are available to inspect and control the quality of raw stock, vendor furnished parts, standard parts and similar items from receipt of the item until final delivery to NASA. Receiving inspection will normally be conducted at the Rose Canyon material receiving area. Interim and final inspections will be conducted within the manufacturing departments, as well as within the tooling, fabrication, assembly, shipping and quality assurance functions. The quality control function is equipped with such facilities and equipment as:

Dielectric test analyzer	Compound sine plate
Barometer (to 50,000 feet)	Ac and dc load banks

Manometers (to 62 in. Hg)	Autocollimator
Magnetic charger	Bridge analyzer
Dead weight tester (to 3, 000 lb)	Phase angle meter
Pressure chamber	Inductance bridge
Hardness testers	Null detector
Tensile testing machines	Resistance bridge
Cup ductility test	Electrical counter
Bearing test machine	Capacitor analyzer
Binocular microscope	Current transformer
Ultrasonic test equipment	Digital voltmeter
Optical comparator	AC/DC converter meter
Leveling standard	Tube tester
Master alignment microscope	Audio oscillator
Jig transits	Sine wave oscillator
Master optical square	Cathode ray oscilloscope
Gage block comparator and amplifier	Comparison bridge
Profilometer	Industrial analyzer
Super micrometer	Vacuum tube analyzer
Thread lead checker	Electronic counter
Ponogmeter	Temperature chambers (-100° to 600° F)
Recorder oscillograph	Platen presses (to 50 tons)
Power sources	Analytical balance
Veri-drive	Dye penetrant inspection equipment
Shaker	Magano machine
Scales	Magnetic unit
Fatigue	Magnetic inspection unit
Tester	Demagnetizer
Pneumatic leak checker	Vibration console
Universal checking machines	Temperature test chambers

Quality control and inspection facilities will be used to review results in all phases of manufacturing, testing, and receiving.

2.8 MANUFACTURING CONTROL FACILITIES

Facilities are available to monitor, predict and report against scheduled completion dates for "detail parts fabrication complete" and "assembly complete" events. Blueprint control is a major function of this facility. Current work status reports will be compiled with the Friden Collectodata System and an IBM 705 computer. Existing stores methods and procedures of Kardex posting and stores locations will be used to maintain open stock in the manufacturing areas. High dollar value items will be maintained in, and distributed from, secured stores.

3. TEST BASE FACILITY REQUIREMENTS

Two broad areas of facilities and services will be required to support Convair activities at the launch site. One area covers the facilities and services to be furnished by the government. The remaining area deals with the contractor capital facilities required for field operations.

3.1 GOVERNMENT FURNISHED TEST BASE FACILITIES AND SERVICES

Requirements outlined below are shown under the operation where first use occurs. The requirements are applicable, as necessary, to subsequent operational sequences.

3.1.1 Receiving Operations

3.1.1.1 Storage Space at Main Base Area

A 1500-square foot covered area will be required to store material prior to use at the shop facility and to house the spare launch vehicle. The most satisfactory storage area location would be immediately adjacent to a shop facility.

3.1.1.2 Access Route to Launcher Area

Adequate roadways are required to support trucks, cranes and other types of vehicles carrying loads up to 30,000 pounds.

3.1.2 Assembly Operations

3.1.2.1 Service Tower (Gantry)

3.1.2.1.1 Maintenance and operational services will be required for the gantry.

3.1.2.1.2 The following modifications to the gantry are essential:

3.1.2.1.2.1 Modify the traveling crane to extend longitudinal travel (travel parallel to the direction of tower movement) to 28 feet from the face of the tower. Provide lateral crane travel (travel perpendicular to longitudinal travel) of 3 1/2 feet each side of tower center.

Note

This crane must be capable of hoisting a total of 24,000 pounds, using either one or two hooks.

Provide working platforms at 15, 28, and 44 feet above ground level. The 15-foot level work platform will be used only for initial placement of the launch vehicle body on the launcher.

3.1.2.2 Launcher Area Hardstand Requirements

3.1.2.2.1 The launcher base footing will be required to react 200 KIPS distributed over a 36-square foot area.

3.1.2.2.2 The launcher rail footing will be required to react 50 KIPS on each track supporting the launcher. Two trucks will be used and will operate over 180 degrees of a circular segment dual track. The track rails will have a 25-foot mean radius about the launcher base. The chord between the trucks will be approximately 25 feet.

3.1.2.2.3 The area within 50 feet radius of the launcher must react loads from trucks, cranes and other mobile vehicles carrying or hoisting loads up to 30,000 pounds.

3.1.2.2.4 The surface area between the launcher base and launcher rail will be subjected to rocket gas impingement loads of 3,000 pounds per square foot.

3.1.2.3 Other Launcher Area Requirements

3.1.2.3.1 An electrical ground connection complex is necessary for zero potential gradient grounding of various electrical equipment and the launch vehicle (including the rocket motors and ignitors) during launch vehicle assembly and prelaunch checkout.

3.1.2.3.2 A minimum lighting level of 10-foot candles is required in and around the launcher area.

3.1.2.3.3 Undercover space in the vicinity of the launcher will be required to enclose the launcher motor controllers and a 100-terminal board. Wiring will be necessary to connect the control panel and a terminal board, respectively, in the blockhouse.

3.1.2.3.4 Launcher area utilities required include:

a. 110-volt, 60-cycle, 100-ampere, ac voltage.

b. 440-volt, 60-cycle, three-phase, ac voltage, 5% regulation, 35 kva.

c. 28 ± 4 volt dc power, 50-ampere service.

d. Shop air, 90 psi outlet pressure plumbed to several locations.

e. 300 gallon/minute water flow for five minutes.

3.1.2.4 Covered Storage Area at Launcher Site

3.1.2.4.1 Approximately 800 square feet will be the minimum area required to store hoisting slings, generators, and other miscellaneous equipment.

3.1.2.4.2 Electrical power (110-volt, 60-cycle, 50-ampere ac) must be available in this area.

3.1.2.5 Convair Office Facility in Main Base Area

3.1.2.5.1 Covered space requirements will be 1800 square feet.

3.1.2.5.2 Utilities required for this area include:

a. Telephones at desks.
b. Teletypewriter (provision for circuit).
c. 110-volt, 60-cycle, 100-ampere, ac voltage.
d. Drinking water.
e. Standard sanitary provisions.
f. Blackout curtains for conference room.

3.1.2.5.3 The estimated type and quantity of office equipment and supplies required to be furnished by the test base facility are as follows:

Type of Equipment	Number Required
Desks, standard	16
Chairs, standard	16
Desks, secretary	4
Chairs, secretary	4
Tables, 2-drawer 5' x 3'	4
Drafting table	1
Drafting machine	1
File cabinets, 5-drawer	12
Calculators, Friden or equivalent	2
Adding machine, paper tape type	1
Typewriters, IBM electric type	4
Storage cabinets, 2-door 6' x 3'	2
Hat-coat racks	4
16mm movie projector (stop, reverse)	1
Film projector, slide	1

Type of Equipment	Number Required
Screen, film projection, 4' x 6'	1
Blackboard, 4' x 8'	1
Recordak	1
Office safe (fireproof, small)	1
Ditto machine, 8 1/2 x 11	1
Ozalid machine, 42" wide	1
Verifax machine, 8 1/2 x 11	1
Tables for reproduction equipment	3
Conference table (20-person capacity)	1
Conference chairs	20
Folding chairs	10
Desk lamps	5
Light table, tracing	1

3.1.2.6 Convair Shop Facility in Main Base Area

3.1.2.6.1 Covered space requirements will total approximately 2,000 square feet.

3.1.2.6.2 Utilities required are as follows:

a. 110-volt, 60-cycle, 100-ampere ac voltage.

Note

It is assumed that all shop equipment furnished under 3.1.2.6.3 will operate on this voltage.

b. Shop air, 90 psi outlet pressure plumbed to several locations.

3.1.2.6.3 The estimated types and quantities of shop equipment items to be furnished and maintained by the test base facility include:

Type of Equipment	Number Required
Grinder, 14-inch wheel size	1
Grinder, 6-inch wheel size	1
Arbor press, 30-inch throat	1
Bench vice, 6-inch jaw	2
Bench vice, 8-inch jaw, tripod mount	1
Work benches, 3' x 12' (2-drawer)	2
Metal shears, 48-inch capacity	1
Metal roll, 36-inch capacity	1
Metal shrinker	1
Oxy-acetylene welding equipment	1
Cutting torch	1
Metal turning lathe, 8-inch chuck	1
Drill press, pedestal, floor 1/2-inch chuck	1
28-volt dc battery charger	1
Metal brake, 48-inch capacity	1
Table saw, 10-inch, wood cutting	1
Band saw, Du all type, 17-inch capacity	1

3.1.3 Checkout Operations

3.1.3.1 Blockhouse Facilities

3.1.3.1.1 Installation and access space for one console approximately 2 x 2 x 6 feet will be required.

3.1.3.1.2 One terminal board with a minimum of 100 terminals and reasonable cableway access to console space specified in 3.1.3.1.1 will be required.

3.1.3.1.3 Two standard office desks and chairs and a space assignment for them are required.

3.1.3.2 Cables

3.1.3.2.1 Two 48-conductor cables, 12 gauge or equivalent, will be necessary between the launcher and blockhouse terminal boards.

3.1.3.3 Operational Participation

Test base personnel will be required to participate in the range safety system checkout. This will include direct supervision and installation inspection for any vehicle-borne, test-base-furnished components.

3.1.4 Launch Operations

3.1.4.1 Range Requirements

3.1.4.1.1 Local communications supporting launch vehicle assembly, checkout and operations will be required. Strategically located telephone and intercommunication installations will suffice for this purpose.

3.1.4.1.2 Data.

a. Launch vehicle space position versus time will be required from lift-off to impact.

b. Launch vehicle attitude versus time will be required from lift-off to impact.

c. Launch vehicle and selected payload test data versus time obtained via the telemetry system will be required.

d. Meterological data taken at approximately the launch time will be required.

e. Documentation and technical photography will be required. This includes both still and motion pictures, in black and white and/or color.

3.1.4.1.3 Recovery operations, at minimum, will consist of inspection of the impacted launch vehicle at the impact site. In event of an obvious or suspected failure, recovery operations may be extended to the physical recovery of selected components.

3.1.5 General

3.1.5.1 Mess Facilities

Contractor personnel will require test base mess facilities. Accommodations will be required for approximately 20 persons during periods of launcher installation, launch vehicle preparation and test operations. During intervening periods, accommodations will be required for three persons.

3.1.5.2 Heavy Equipment (Including Operational Maintenance)

a. One five-ton, mobile crane with 30-foot boom — for launch vehicle handling.

b. One ten-ton, mobile crane with 30-foot boom — for launcher installation.

c. One 10,000 pound capacity fork lift with 20-foot lift — for installation and removal of launcher access platform.

d. One standard duty, flatbed trailer and tractor — for moving launch vehicle omponents (on-call basis).

e. One standard duty fork lift — for loading and off-loading contractor-supported hardware (on-call basis).

3.1.5.3 Security

The test base will be required to provide area security in the industrial, launch complex and impact areas commensurate with the security requirements of this program.

3.1.5.4 Safety

3.1.5.4.1 Emergency medical services will be required for contractor personnel.

3.1.5.4.2 Damage control management and activities will be the responsibility of the test base.

3.1.5.4.3 Industrial safety procedures with respect to the handling and/or installation of ordnance and propellant items will be under the cognizance of the test base.

3.2 CONTRACTOR CAPITAL EQUIPMENT

To supplement the Government-furnished facilities and service requirements covered in Paragraph 3.1, Convair will provide the following capital facilities at the test base:

Type of Equipment	Number Required
Impact wrenches	2
Hand drill motors (air) - 1/4 in. chuck	6
Hand drill motors (air) - 1/2 in. chuck	1
Portable drill press magnetic base	1
Hand rivet gun and sets - 3x size	2
Hand rivet gun and sets - 4x size	1
Hand rivet bucking bars - standard sizes	6
Blind riveting equipment (cherry or equivalent)	1 set
Torque wrenches (size as required)	1 each
C - clamps - 6 in. and 8 in.	6 each
Clecos - 3/32, 5/32, and 3/16 (and tool)	2 doz. ea.
Files - various 6 in. and 8 in.	10 each
Drills (No. 50 through "F" and special sizes)	as req'd

Type of Equipment	Number Required
Reamers	as req'd
Countersinks	as req'd
Counterbores	as req'd
Special wrenches	as req'd
Hydraulic jacks, 1 ton	2
Hydraulic jacks, 2 ton	1
Air hoses	600 ft
Electric extension cord (J-box type)	150 ft
Lights (portable)	as req'd
Elephant stands	4
Racks for miscellaneous hardware and small parts	as req'd
General meters and checkout equipment	as req'd
Soldering irons	2
Terminals and terminal tools	as req'd

3.3 SCHEDULE

The schedule shown in Figure 1 indicates general time phasing for facility and services planning purposes. The second launch test vehicle under the contract will be added to this schedule when the launch date is established.

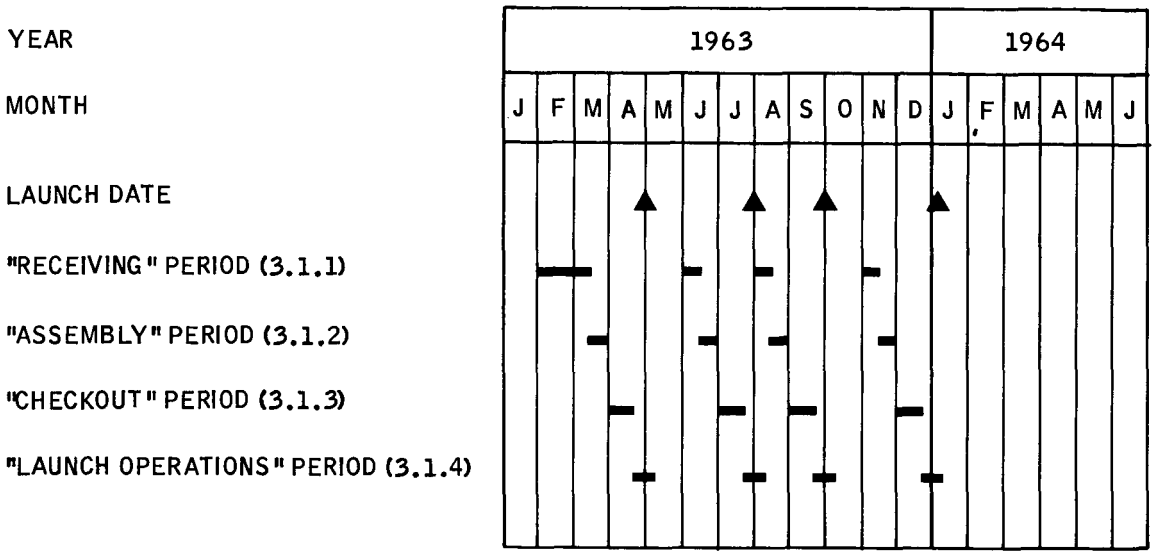

Figure 1. FACILITIES AND SERVICES SCHEDULE

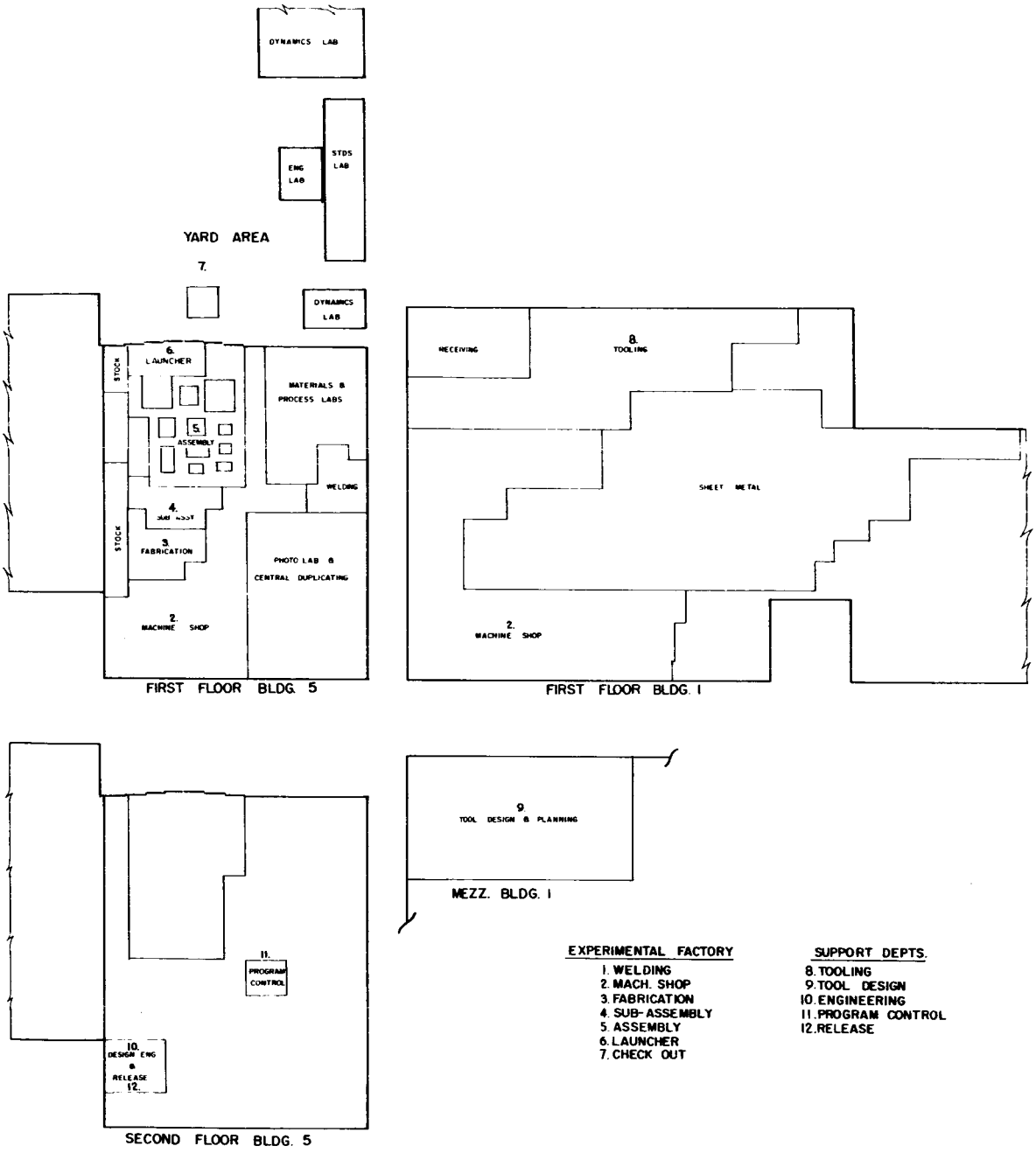

Figure 2. BLOCK PLAN LAYOUT