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Harry Press —
Goddard

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LAUNCH VEHICLE SYSTEM REQUIREMENTS

AND RESTRAINTS FOR

THE NIMBUS C PROJECT

NIM57-D

Approved:

Harry Press
Nimbus Project Manager

Approved:

Edward A. Rothenberg
Agena Coordinator

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The enclosure has been revised to reflect LeRC comments presented in the reference and is distributed in accordance with the consolidated LeRC and GSFC distribution list. Appropriate revision necessitated by interface agreements reached during the Nimbus April 7-8, 1965 meeting at LMSC, Sunnyvale will be incorporated at a later date.

Edward A. Rothenberg

Edward A. Rothenberg
Agena Coordinator

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CONTENTS

Page

Page

ILLUSTRATIONS

TABLES

SECTION I

GENERAL

1.1 SCOPE

This document defines the technical requirements and restraints imposed by the Nimbus C spacecraft and spacecraft adapter upon the booster, booster adapter, Agena B vehicle, shroud, associated AGE, launch complex, and range.

1.2 PURPOSE

The purpose of this document is to set forth the technical requirements necessary to accomplish Nimbus project objectives, to effect formal scheduling and reporting of launch vehicle system engineering support, and to effect technical coordination between the various agencies involved in carrying out the Nimbus C program. These agencies are:

- Goddard Space Flight Center (GSFC), Greenbelt, Maryland - Project Management and Spacecraft Development Center
- Lewis Research Center (LeRC), Cleveland, Ohio - Vehicle Systems Management and Vehicle Development Center
- Air Force Space Systems Division (AFSSD), Los Angeles, California
- Lockheed Missiles and Space Company (LMSC), Sunnyvale, California
- Douglas Aircraft Company (DAC), Santa Monica, California, and Tulsa, Oklahoma
- General Electric Company (GE) Spacecraft Department, Valley Forge, Pennsylvania

1.3 MISSION OBJECTIVES

The mission objective of the Nimbus program is to demonstrate spacecraft development and techniques for global atmospheric observations useful for meteorological research, weather forecasting, and for rapid transmission of the collected data. The Nimbus contributes further by providing basic data leading to a better understanding of atmospheric phenomena.

1.3.1 <u>Spacecraft System Objectives</u>

More specific objectives of the Nimbus C spacecraft which are related to demonstration of spacecraft development and techniques for global atmospheric observations and which represent an outgrowth from the Nimbus A flight are:

A. New sensory systems

- Medium-resolution infrared radiometer (MRIR) - 5 channels, digital, radiation balance experiment

- High-resolution infrared radiometer (HRIR) - Direct readout

B. Extend sensory data coverage (advanced vidicon camera system (AVCS), HRIR)

- Global

- Extended time

- Higher flight altitude

C. Technological developments

- Improve solar array drive

- Improve day/night switch

- Improve attitude control

- More versatile clock

- Improve APT

- Provide real local time readout of HRIR

1.3.2 Launch Vehicle System Objectives

Attainment of spacecraft system objectives depends upon successful achievement of specific launch-vehicle system objectives:

- Proper Agena/spacecraft attitude position rates, and velocity in space as achieved by the LV-2A vehicle

- Proper protection of the spacecraft in a controlled environment from adverse pressure and heating on the pad and through the launch phase

- Proper LV-2A/Agena separation

- Proper jettisoning of the nose shroud
- Achievement of the required transfer orbit within specified tolerances
- Maintaining proper Agena vehicle attitude following booster separation
- Achievement of the required final injection conditions at second burnout within the prescribed orbit dispersions
- Proper Agena pitch-up from the local horizontal, and maintenance of Agena stabilization in attitude through spacecraft separation, all within prescribed injection conditions
- Achievement of Agena functions applicable to firing spacecraft separation squibs and subsequent Agena retro-maneuver

1.4 DEFINITION OF SPACECRAFT SYSTEM

Figure 1-1 shows the general assembly of the spacecraft, spacecraft adapter, and shroud. Figure 1-2 shows the coordinate system of spacecraft/adapter and launch vehicle (TAT booster). The spacecraft adapter configuration, to assure the proper position of a 1700-Mc window in the adapter for a straight view to the spacecraft preparation and telemetry area, is predicated on the range layout shown in Figure 1-3. Figure 1-4 shows the general arrangement of the spacecraft adapter.

1.4.1 Nimbus Spacecraft

The configuration of the spacecraft, provided by GSFC, is primarily a lower sensory-ring structure attached by truss supports to an upper housing containing the controls and solar paddles. The spacecraft consists of two primary sets of systems: basic spacecraft systems, and sensory systems.

1.4.1.1 Spacecraft Basic Systems

A. Structure. A hexagon-shaped upper section containing solar-array drive and attitude-control subsystems provides unobstructed exposed mounting for the sun sensors, horizon scanners, control nozzles, and command antenna. The solar-array paddles attach to control shafts projecting from the controls housing.

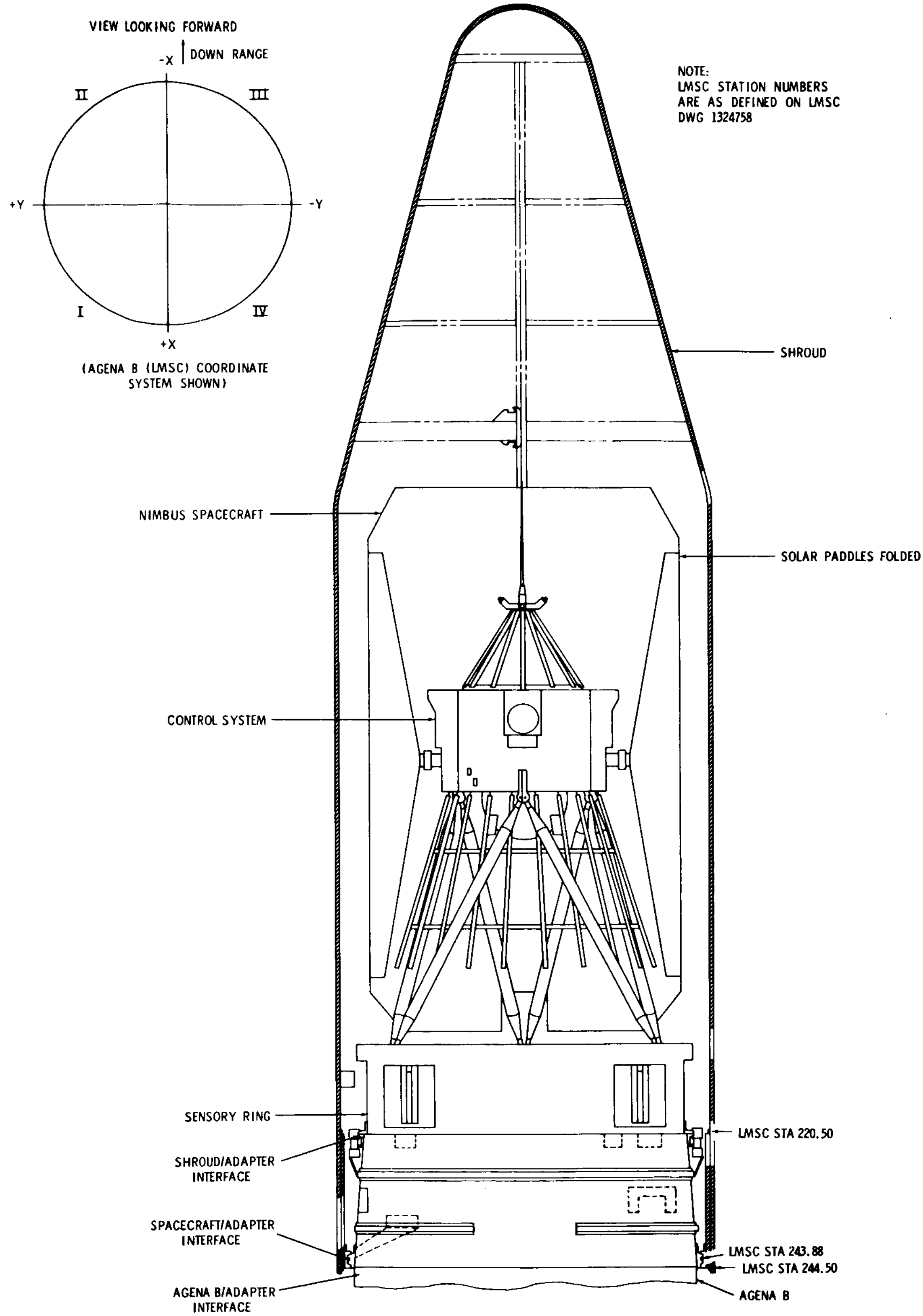

Figure 1-1 – Spacecraft-to-Agena Interface Equipment Requirements (Schematic)

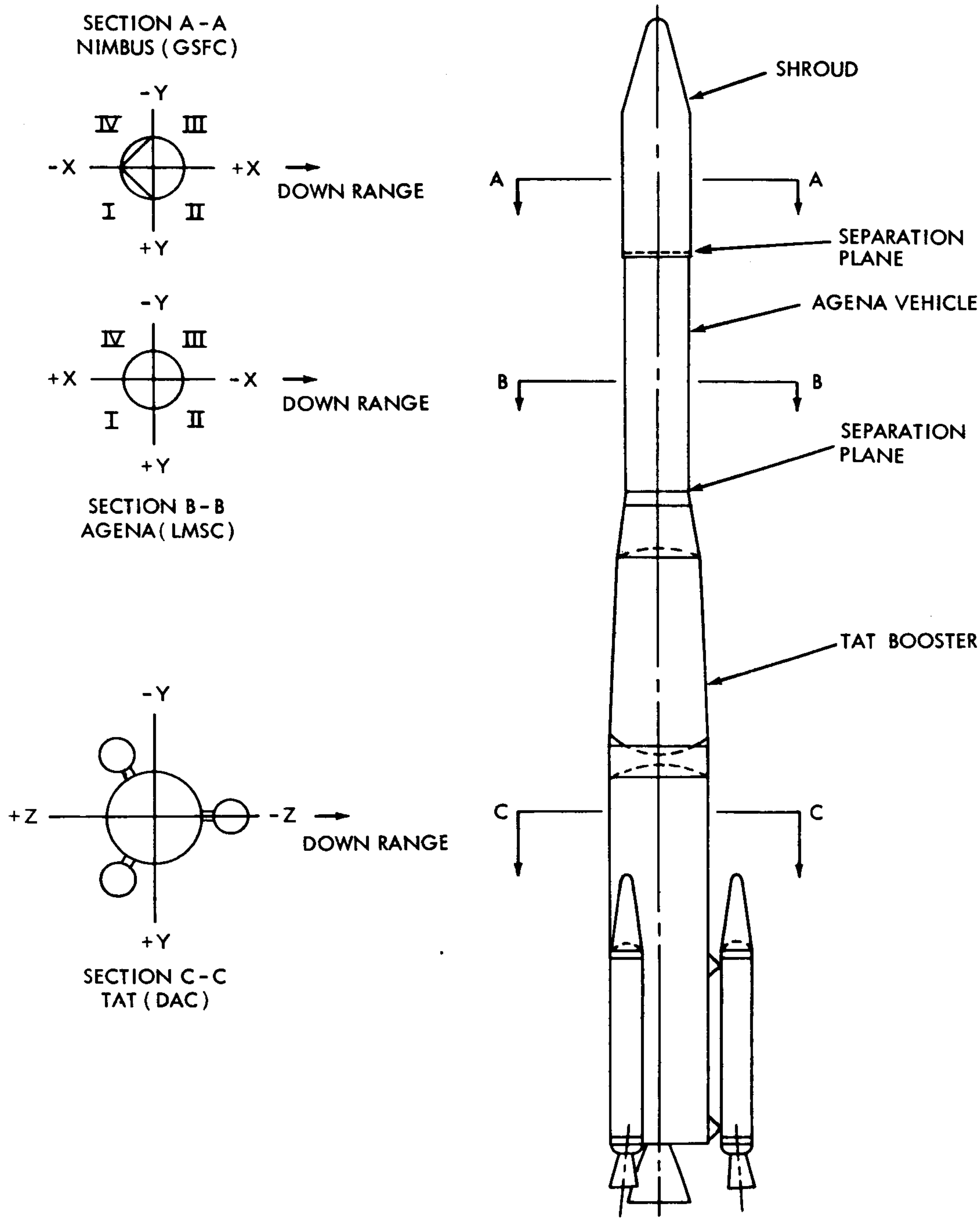

Figure 1-2 – Nimbus/Agena/TAT Coordinate Axis System

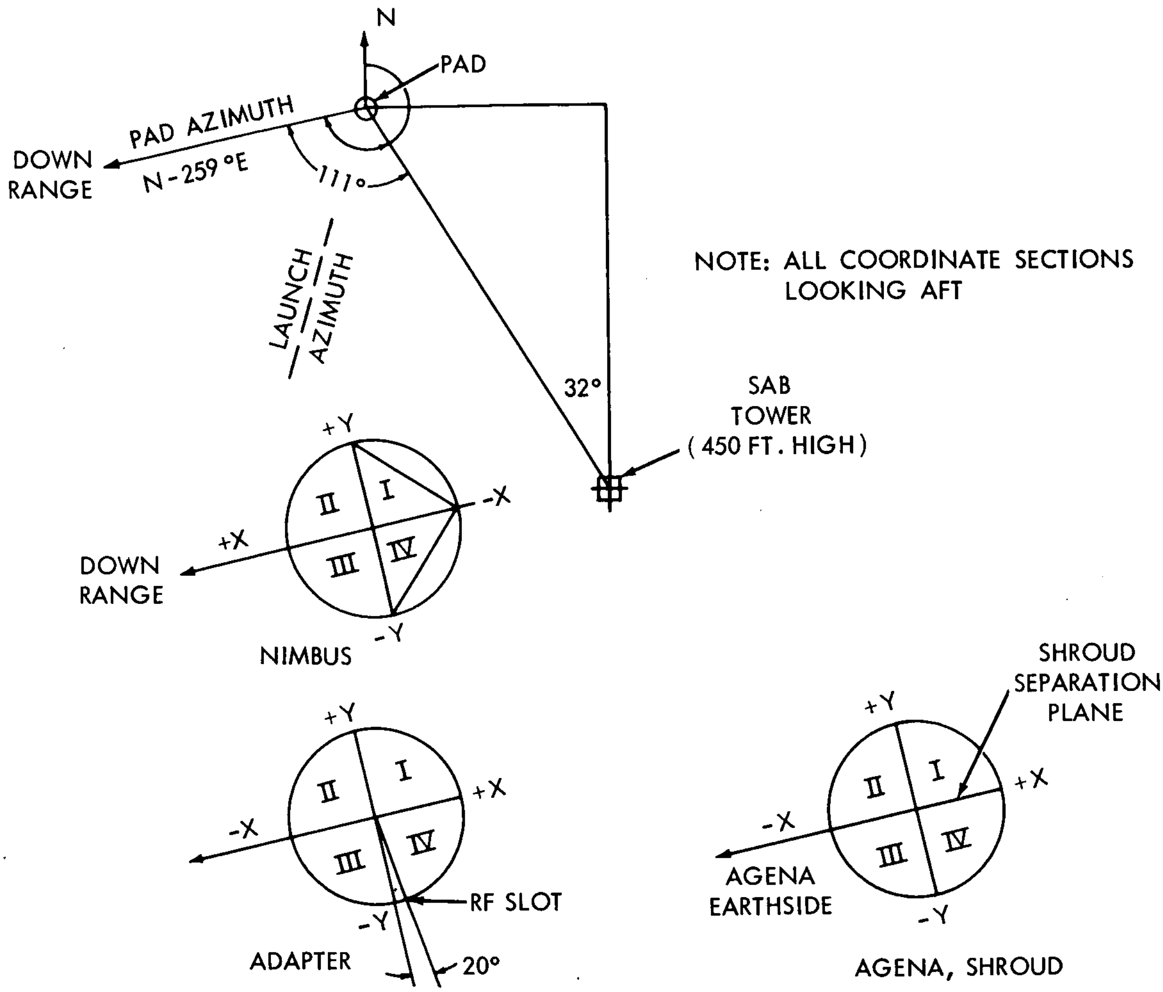

Figure 1-3 – Range Layout: Nimbus on Pad Checkout

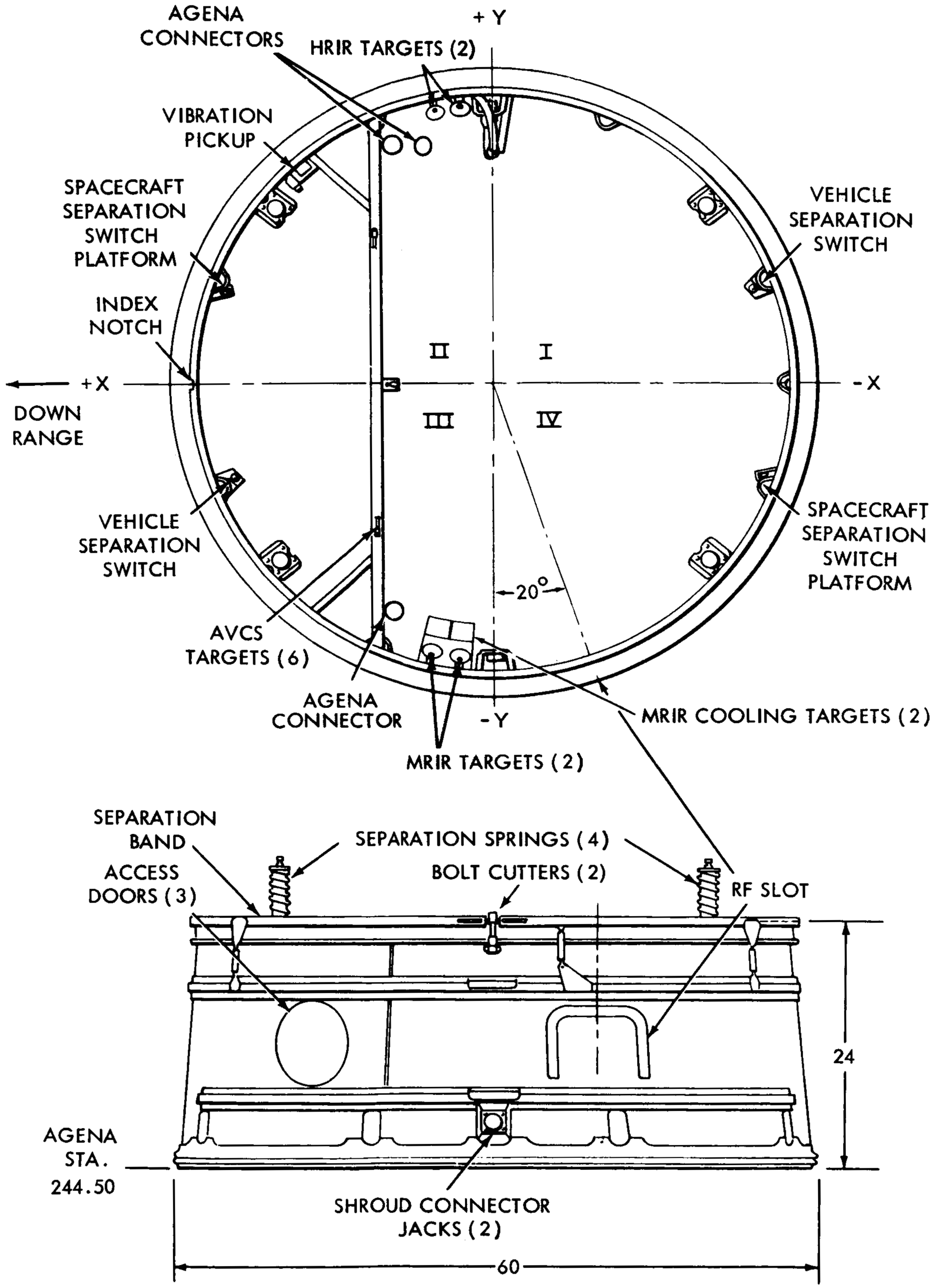

Figure 1-4 – Spacecraft Adapter General Arrangement

The control housing is attached to the sensory ring by a truss structure consisting of six members knee-mounted in laterally adjustable sockets. The truss structure, attached to three joints on both the upper and lower housing, provides the critical alignment required between the control system and sensor equipment.

The sensory ring is a hollow circular-section torus composed of 18 rectangular module bays and V-shaped separators. A box (truss) beam structure attached to the inner wall of the torus provides accessible mounting for the television cameras, recorders, and VHF antennas. The modular bays house the electronic equipment and battery packs. The lower surface of the torus provides mounting space for the infrared radiometers.

B. Thermal Control. A combination of active and passive thermal-control techniques provides acceptable average temperatures through the spacecraft. With the exception of the solar paddles, an average equilibrium temperature of approximately 25°C is maintained. The Nimbus configuration provides thermal separation and permits independent thermal control for each major segment of the spacecraft: solar paddles, sensory ring, and control system.

C. Attitude Control. The stabilization and control subsystem uses horizon scanners, a sun sensor, and a rate gyro as sensors, and reaction wheels and gas jets as torque generators. Major components of the attitude and control subsystem are:

- Horizon sensors and associated equipment for pitch and roll attitude control
- Yaw attitude-control loop, including a coarse sun sensor for emergency initial stabilization relative to the sun, and a gyro for initial stabilization and for maintaining the roll axis in the orbital plane
- Solar-array control loop for keeping the solar paddles oriented toward the sun
- Programmer for timing and sequencing of automatic stabilization procedures and ground-command control operation

Auxiliary components such as telemetry conversion circuits, power regulatory supplies, and a gas subsystem (for storing and controlling gas flow) complete the control package.

D. Power Supply. A solar conversion power supply delivering -24.5 volts regulated within ±2 percent is provided to meet the requirements of the experiments and spacecraft subsystems. Major components of the supply are an array of two 3-by 8-foot silicon solar-cell paddles, nickel/cadmium storage batteries, and regulating and protective devices. Maximum solar-array output is 465 watts. Regulated power available for spacecraft use is approximately 200 watts.

E. Command Clock. Absolute time relates atmospheric information obtained by the sensory systems to geography. This function is performed by a crystal-stabilized oscillator. An 800-kc aged crystal, sealed in glass and maintained at a constant temperature by a heating coil, provides an accurate timing reference. This time can be reset whenever necessary.

F. Command Capability. The Nimbus command subsystem consists primarily of a dual 149.52-Mc command receiver and a command decoder. Operating in conjunction with the clock subsystem, the command circuitry is capable of receiving and storing ground commands at the rate of one per second. A whip antenna located on top of the control housing serves the command subsystem. Binary-coded ground commands provide the following functions:

- Component switching and power control for experiments and spacecraft subsystems
- Power management
- Stabilization program backup and yaw axis control
- Interrogation
- Changing modes of operation of the communications and data handling systems
- Redundancy selection
- Time reset

G. Telemetry. The Nimbus uses a pulse-code-modulated (PCM) telemetry subsystem to gather housekeeping information from all subsystems. The PCM subsystem consists of two independent units:

an "A" unit which handles real-time and stored telemetry data of 542 channels, and a "B" unit which handles direct telemetry data of 128 channels for real-time transmission only. The stored telemetry data are recorded on tape during a complete orbit and are played back upon ground command. The real-time data are not stored on tape but are transmitted directly upon ground command. All data are gathered by the telemetry system in analog form, converted into digital form, and transmitted by 136.5-Mc transmitter through four antennas located on the outer area of the sensory ring. The "A" telemetry system stores 4000 words of data per minute, transmitting approximately 375,000 words of data in 3.6 minutes.

1.4.1.2 Spacecraft Sensory Systems

A. Advanced Vidicon Camera Subsystem (AVCS). The AVCS consists primarily of a bank of three synchronized TV cameras and a magnetic tape-recording system to obtain pictures during daylight. The three TV cameras deployed in a fan-like array produce a three-segment composite picture 107 degrees by 37 degrees, providing the lateral field-of-view (with 2 degrees overlap at the equator) necessary to cover the 27-degree rotation of the earth between spacecraft passes; the 27-degree rotation of the earth produces approximately 1620 nautical miles of arc at the equator. Pictures are taken every 91 seconds with storage capability for 1-1/2 orbits of data.

B. Automatic Picture Transmission (APT) Subsystem. The APT subsystem provides wide-angle daytime cloudcover pictures in real time. The equipment employs the same basic principles as the AVCS: i.e., a vidicon camera arrangement using earth rotation and spacecraft orbital period as the coverage mechanism. However, in contrast to the AVCS, which stores pictures during the orbit and reads them out only at command and acquisition (CDA) sites, the APT subsystem takes and transmits pictures in real time for local ground-station readout. The vidicon is similar to the AVCS equipment except for the addition of a polystyrene layer to provide image-storage capability. Capability exists to read out HRIR data in direct mode through the APT transmitter and modulator at night.

C. High-Resolution Infrared Radiometer (HRIR) Subsystem. The HRIR is designed to produce high-resolution cloudcover pictures of the dark side of the earth. In contrast to television, the HRIR forms no image; the detector only integrates the energy received from the target. Cloudcover pictures are composed as follows: A rotating scanning mirror causes the detector view to continuously sweep through a complete circle. The radiometer is located on the spacecraft so that the plane described by the optical axis is normal to the instantaneous velocity vector. The scan time of the mirror is selected to coincide with the time required for the spacecraft to advance to width of a picture element; the lines thus scan a continuous picture. The HRIR detects radiation in the 3.4- to 4.2-micron spectral region and has an angle of view of 8.5 by 10^{-3} radians. It achieves a 5.1-nautical-mile linear resolution at scan center (local vertical). The data are recorded on tape during orbit.

D. Medium-Resolution Infrared Radiometer (MRIR) Subsystem. The MRIR is a five-channel sensor providing measurements of terrestrial and reflected solar radiation in the ultraviolet, visible, and infrared regions of the spectrum. The MRIR, while not physically the same, employes the same basic principles as the HRIR: i.e., a scanning-mirror optic system with detectors at the focal point and mechanical lightbeam choppers. Each detector produces a signal reflecting the radiation intensity within the spectral band to which it is sensitive.

1.5 DOCUMENT REVISION

Additions, deletions, and corrections to this document shall be made as required by technical considerations and to maintain it in an accurate, up-to-date status. All changes shall be coordinated between, and approved by, GSFC and LeRC. Any corrections or additions to this document shall be forwarded in writing to the Goddard Space Flight Center, Attn: E. A. Rothenberg, Agena Coordinator, Code 623. Controlled distribution and revision notices shall be sent to the addressees listed in the distribution section of this document.

SECTION II

MISSION REQUIREMENTS AND RESTRAINTS

2.1 FLIGHT EVENTS

The Nimbus C will be launched from the Western Test Range aboard a thrust-augmented Thor (TAT)/Agena B vehicle combination into a 600-nautical-mile circular sun-synchronous orbit with the characteristic that north-bound equator crossings occur near local noon. The first stage of powered flight will be provided by the TAT booster and the second stage by the Agena B. The detailed programmed and commanded trajectory sequence of events, including the event of spacecraft separation, shall be provided by LMSC. That detailed sequence of events shall be submitted in accordance with the requirements of Table 6-1.

2.1.1 Spacecraft Flight Sequence of Events

With the exception of an Agena maneuver to separate the spacecraft (paragraph 2.1.2) and subsequent spacecraft separation, there are no in-flight spacecraft events which either affect the electrical interface or may interfere with the Agena operation. The spacecraft beacon is energized before lift-off and is not switched off during ascent. The primary and backup command source for spacecraft separation shall be the Agena SS/D timer. No commands can be executed by the spacecraft during the ascent portion of the flight.

2.1.2 Maneuvers Required Before Spacecraft Separation

Maneuver description:	Agena pitch-up
Purpose:	Achieve specified spacecraft separation attitude
Time:	Subsequent to Agena second burn and early enough to permit receipt of separation signal at Pretoria and at least one minute of spacecraft tracking 15 degrees above the horizon from Johannesburg, South Africa
Velocity:	No requirement on velocity change required in the maneuver

Agena attitude: (at instant of spacecraft separation)

Angular Requirement		Angular Tolerance	
Roll	0 degrees	Roll	± 5 degrees
Pitch	90 degrees	Pitch	±15 degrees
Yaw	0 degrees	Yaw	± 5 degrees

Rate Requirement		Rate Tolerance	
Roll	0 deg/sec	Roll	±0.3 deg/sec
Pitch	0 deg/sec	Pitch	±0.3 deg/sec
Yaw	0 deg/sec	Yaw	±0.3 deg/sec

After spacecraft separation, an Agena retro maneuver is required to assure a minimum miss distance of 500 feet between the Agena and spacecraft in all orbits throughout a 1-year period.

Agena attitude requirements at the instant of spacecraft separation are predicated on the ability of the spacecraft to achieve acceptable post-separation stabilization. The range of permissible Agena attitudes at the instant of spacecraft separation should not be considered independent of the requirements for acceptable post-separation distances between the spacecraft and Agena. From the viewpoint of acceptable post-separation distance and from experience gained from the Nimbus-A program, factors influencing separation distance such as pitch attitude of the Agena, delay between time of Agena shutdown and spacecraft separation to preclude adverse tail-off effects, orientation of Agena after separation, and forcible retro of the Agena should be carefully considered. Springs in the spacecraft adapter produced separation velocity of 4 feet per second relative to the Agena.

2.2 OPERATIONS REQUIREMENTS

2.2.1 Launch Conditions

a. Range of launch times: The Nimbus C mission requires a 600-nautical-mile circular sun-synchronous orbit with the characteristics that north-bound equator crossings occur within 32 minutes of local noon (Local mean solar time between 1128 and 1232 hours).

b. Launch date: First quarter of 1966

c. Launch period: Not applicable

d. Other restraints: None

2.2.2 Trajectory Requirements (Separable Spacecraft, Ascent Phase)

1. Inclination angle: The inclination of the orbit plane is defined by the requirement that the precession rate of the orbit plane shall match the apparent regression rate of the mean sun within 0.082 degrees per day.

2. Orbit eccentricity: Maximum acceptable apogee and perigee difference is 28 nautical miles.

3. Mean orbit altitude: 600^{+40}_{-20} nautical miles

4. Position of first perigee: No requirement

5. Time of first perigee: Consistent with launch window

6. Other controlled mission parameters: None

2.3 TRACKING, COMMUNICATIONS, AND CONTROL REQUIREMENTS
There are no Nimbus C program-peculiar requirements for acquisition of telemetry data disassociated from the requirements for data acquisition specified in paragraph 3.5. There are no requirements for launch vehicle commands and control communications with the spacecraft.

2.4 SPACECRAFT FLIGHT OPERATIONS AND COMMUNICATIONS
There are no launch vehicle system requirements for spacecraft data acquisition or processing.

SECTION III

DESIGN REQUIREMENTS AND RESTRAINTS

3.1 CONFIGURATION DEFINITIONS

3.1.1 Spacecraft

The general arrangement of the spacecraft is shown in Figure 3-1, which includes dimensions and gives locations and types of the principal equipment. Details which govern the interface design of the spacecraft shall be shown in the official mechanical interface drawing.

3.1.2 Spacecraft Support Structure (Adapter)

Figure 1-4 shows the general arrangement of the spacecraft adapter. The adapter, furnished by GSFC, shall be used to provide volume between the spacecraft and the Agena B forward equipment rack into which GSFC/GE-furnished spacecraft pre-launch test and calibration equipment is installed. It is the responsibility of GE/DAC to provide detailed design, construction, and acceptance testing of this adapter. GE shall provide and incorporate in interface design those devices necessary to effect spacecraft separation from the launch vehicle and effect a relative velocity of four $(4\,^{+.5}_{-0})$ feet per second between the spacecraft and its adapter. Design of this separation interface is a joint GSFC/GE/DCA undertaking. Details which govern the interface design shall be shown in the official mechanical interface drawing.

3.1.3 Aerodynamic Shroud

The general arrangement of the shroud is shown in Figure 1-1, which includes principal dimensions and access doors. Specific details shall be shown in the official mechanical interface drawings required by paragraph 3.1.4.2. Only one flight shroud need be provided for the Nimbus C program.

LMSC/DAC shall provide to GSFC an engineering model shroud to be used for mechanical clearance checks, RF transmission checks, and simulation of on-pad operational checks in accordance with the requirements of Table 6-1. This shroud need not be qualified flight hardware, but shall be identical within manufacturing and stack-up tolerances to Nimbus flight hardware in all aspects which affect: mechanical and electrical interfaces, ascertaining critical static clearances between shroud and spacecraft/adapter, results of RF transmission tests, access to spacecraft/adapter, and handling of the shroud system. In

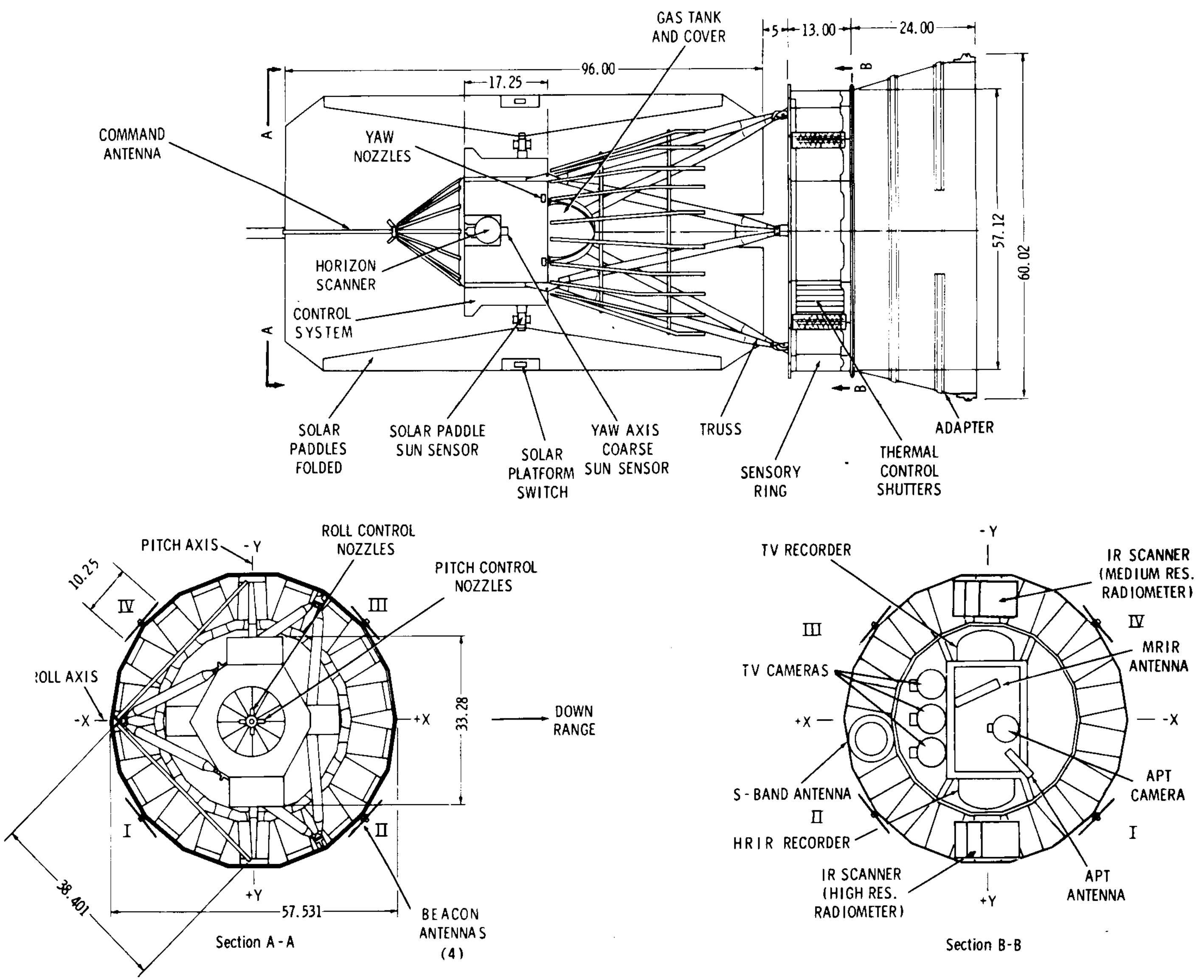

Figure 3-1 – Nimbus Spacecraft/Spacecraft Adapter satisfying this requirement, mock-up of shroud instrumentation is acceptable. Up-dating of the engineering model shroud provided to GSFC for the Nimbus A program is acceptable.

3.1.3.1 RF Transmissibility

Several RF communications links must be achieved between the spacecraft and the NASA telemetry area at WTR during the time the spacecraft is sitting on the vehicle at the launch pad and during part of the ascent phase. Spacecraft-system checkouts before launch are performed over the RF links only. To achieve transmissibility while the spacecraft is assembled to the Agena and while the shroud is in place, it is required that the shroud be RF-transparent. The configuration of the shroud provided for the Nimbus A program is considered acceptable for meeting this RF requirement.

The frequencies and powers of the transmitters used during checkout are given in Table 3-1. Only the 136-Mc cw 250-mw beacon is operative during ascent. All spacecraft transmitters and the command transmitter will be operated during the launch countdown.

Table 3-1

Transmitters Requiring RF Transmissibility of Shroud

Nominal Frequency (Mc)	Power (watts)
136.5	0.25
136.9	5
137.2	1.5
149.52	5
1700	5

3.1.4 Composite Assembly

A drawing of both the spacecraft and spacecraft adapter is shown in Figure 3-1, which includes principal dimensions and interface connections. Composite assembly of spacecraft, adapter, and shroud attached to the Agena shall be shown in detail in the official mechanical and electrical interface drawings. The bases, scope, and associated schedule for the official mechanical and electrical interface drawings are presented in the following paragraphs.

3.1.4.1 Design Specification Control Drawings

GSFC/GE shall generate and maintain mechanical and electrical design specification control drawings for spacecraft and adapter. Initial distribution shall be in accordance with the requirements of Table 6-1. Revisions shall be furnished automatically to the recipients of the initial distribution. These drawings shall show engineering detail of interface hardware design to permit cross design and thermal studies with spacecraft/adapter, shroud, and Agena, including, but not limited to, the following:

- Identification, location, and orientation of electrical connectors, including connector pin assignments

- Identification, location, and orientation required for all spacecraft/adapter mechanical and electrical hardware access for mating or service when assembled with the launch-vehicle system

- Envelope of the spacecraft/adapter extremities, including adverse manufacturing assembly and alignment tolerances (no-load condition)

- Lateral load-deflection characteristics for cantilevered spacecraft/adapter in terms of inches deflection per unit static lateral acceleration (g)

- The designation, location, orientation, and dimensions of those elements of the spacecraft and adapter which are determined by GSFC/GE to be temperature-critical; designation of materials, surface coatings, absorptivities, emissivities, and, if not commonly available, material thermal properties. These data are required to permit LMSC performance of thermal response analyses specified in paragraph 4.3.3.

3.1.4.2 Official Mechanical and Electrical Interface Drawings

LMSC shall generate and maintain official mechanical and electrical interface drawings. Initial distribution shall be in accordance with the requirements of Table 6-1. Revisions shall be furnished automatically to the recipients of the initial distribution. The mechanical and electrical interface drawings shall show engineering details of interface hardware design to permit cross design studies with the spacecraft/ adapter, shroud, and Agena, including, but not limited to, the following:

- Identification, location, and orientation of electrical interface connectors including connector pin assignments; location, length, and size, where applicable, of conductors and connector pins which compose the blockhouse-to-Agena/adapter interface circuits

- Mechanical assembly dimensions and tolerances

- Tables of net clearances in critical locations between spacecraft/ adapter/shroud for critical loading conditions using static and dynamic deflections with a 1.25 factor of safety applied to all deflections. The shroud dimensions shall be based on the physical measurements of the shroud(s) to be used for the Nimbus C flight. The shroud dimensions shall account for such factors as the shroud insulation (and insulation fasteners), shroud instrumentation and any Nimbus C mission peculiar shroud modifications.

- Identification and location of all interface access ports in the shroud and the adapter

- Identification, location, and electrical wiring details of all Agena/ shroud circuits including instrumentation and separation equipment which require connections through the spacecraft adapter.

3.2 MASS AND STIFFNESS PROPERTIES

3.2.1 Mass Properties

Current weight for the spacecraft and adapter shall be reported by GSFC on or about the tenth day of each month. The GSFC monthly report is intended to permit LeRC assurance that correct values are used for trajectory guidance. The properties listed below are applicable for initial planning. Moment-of-inertia and center-of-gravity data shall be updated when significant changes occur.

Weight (estimated value)

Spacecraft 945 lb
Adapter 80 lb

Center-of-Gravity	Launch Configuration With Adapter (Paddles Folded)	Orbit Configuration Without Adapter (Paddles Open)
Along roll axis* (measured from pitch axis, inches)	-0.34	0.35
Along yaw axis, station	199.30	196.86
Along pitch axis (measured from roll axis, inches)	0.03	0.01
Moments-of-inertia (slug-in^2)		
I_{o_x} roll	34512	34295
I_{o_z} yaw	13637	14674
I_{o_y} pitch	33621	29811
Product of inertia (slug-in^2)		
Roll-yaw	901.5	-106.5
Roll-pitch	-35.5	-34.4
Yaw-pitch	-169.3	-178.1

3.2.2 Stiffness Properties

GSFC/GE shall provide the vibration modes for the cantilevered spacecraft/adapter, including lateral and longitudinal modes. All data supplied under this requirement shall be identified for Nimbus C use. Submittal of these data shall be in accordance with the requirements of Table 6-1.

3.3 MECHANICAL INTERFACE REQUIREMENTS

3.3.1 Alignment and Tolerance

There are no launch vehicle alignment tolerances imposed by the spacecraft/adapter beyond that presented in a subsequent section on matchmate. It shall be the responsibility of LeRC to inform GSFC of any spacecraft/adapter-Agena alignment necessary to assure acceptable flight characteristics of the launch vehicle.

3.3.2 Matchmate

A set of matched tools, shown pictorially in Figure 3-2, shall be used to achieve mating surfaces of the spacecraft adapter and the Agena vehicle. The matchmate tool furnished to LMSC for the Nimbus A mission shall be used for the Nimbus C mission.

The specification and procedures for initial surfacing of the spacecraft adapter and Agena vehicle using the matchmate tools shall be identical to those applicable to initial surfacing for the Nimbus A mission (LMSC Spec. M30086). LMSC shall issue the matchmate specifications and procedures for Nimbus C in accordance with the requirements of Table 6-1.

Following surfacing the spacecraft adapter and Agena using the matchmate tools, GE shall deliver the flight spacecraft adapter to LMSC to substantiate that all specifications for acceptable mate of flight hardware have been satisfied. An adapter stabilization fixture and spacecraft fixture simulating the Nimbus C spacecraft critical clearance points shall be used with the flight shroud during this matchmate of adapter and Agena. Any necessary modification to the Nimbus A adapter stabilization and spacecraft fixtures to make them representative of the Nimbus C spacecraft shall be accomplished by GE in accordance with Table 6-1. The stabilization fixture (GE Drawing 237R460-ST-1) shall include sufficient hardware to define the location of critical shroud/spacecraft/adapter clearance points and to permit checkout of spacecraft service functions which require shroud access doors. This matchmate of flight hardware and simulated spacecraft shall occur prior to the flight qualification testing of the Nimbus C spacecraft as set forth in Table 6-1.

The foregoing represents the total requirements for scheduled matchmate checks using the matchmate tools. An additional assessment of matchmate of the flight adapter and the Agena will be achieved when the prototype spacecraft is mated to the Agena during WTR prototype

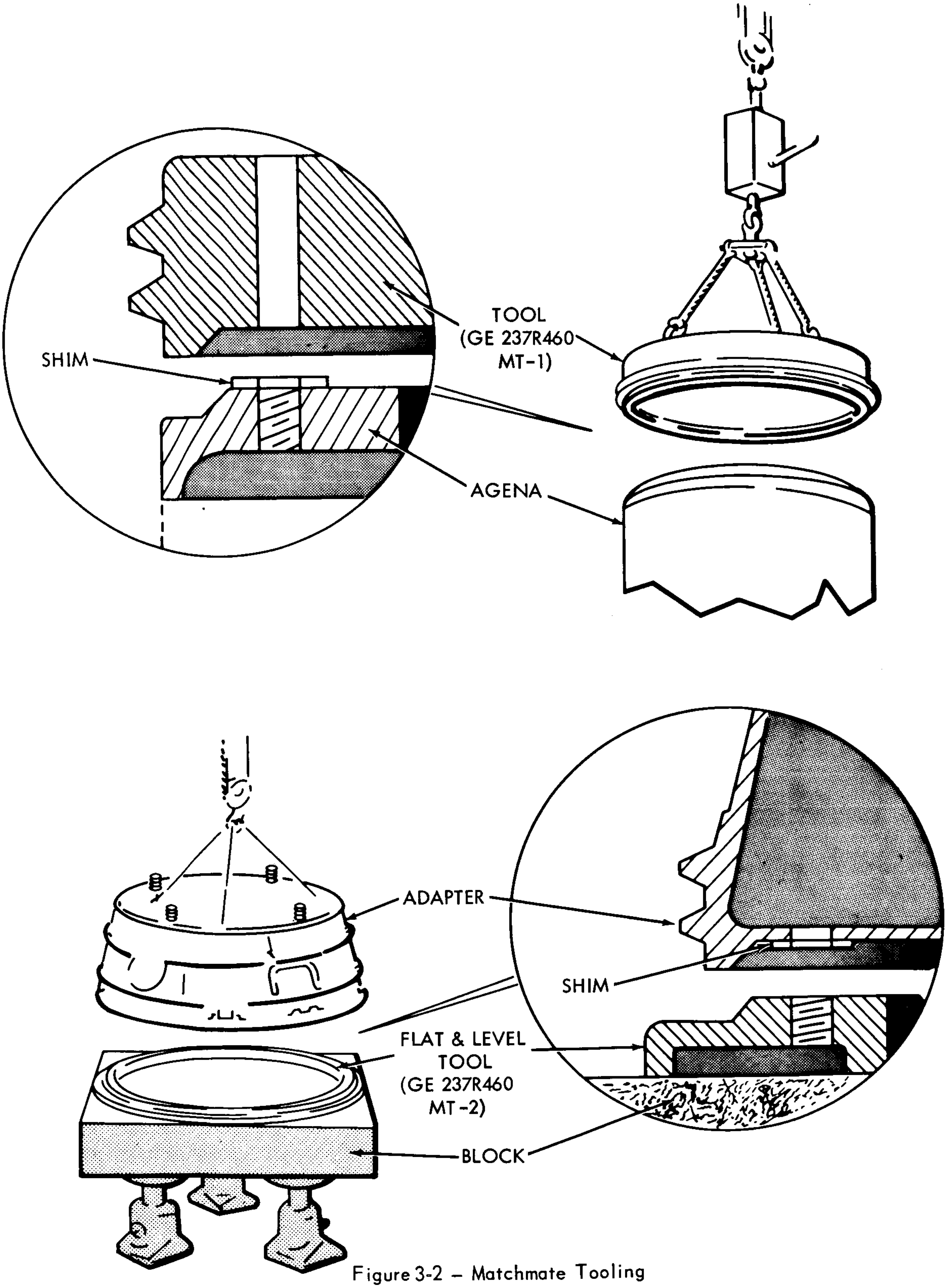

Figure 3-2 – Matchmate Tooling

spacecraft exercises. If gross mismatch between the prototype adapter and Agena are disclosed, check of the Agena with the MT-1 tool may be required. LeRC shall assure the availability of the MT-1 tool at WTR for such emergency. The spacecraft requirements for acceptable match between the adapter and the erected launch vehicle shall be as specified for the Nimbus A launch, that is, gaps in the Agena/adapter interface of up to 0.020 inches are acceptable from the standpoint of initial spacecraft stabilization provided bolt-pad clearance does not exceed lip clearance by more than 0.006 inches. If the 0.006 inch tolerance between bolt-pad and lip is exceeded, reshimming is indicated. The foregoing specification of acceptable gap during final mating of flight hardware at WTR shall not be construed as a relaxation of initial matchmate specification requirements which are considered necessary to achieve acceptable launch base final mating.

3.4 ELECTRICAL INTERFACE REQUIREMENTS

3.4.1 Spacecraft/Adapter

With the exception of spacecraft separation squib activation by the launch vehicle electrical system (paragraph 3.5.3), there are no launch-vehicle electrical-system requirements applicable to the spacecraft/adapter interface. There shall be no wires across the spacecraft separation plane and no electrical disconnect between the spacecraft and its adapter.

3.4.2 Spacecraft/Adapter/Launch Vehicle System

Specific engineering details of the electrical interface between the spacecraft system and the launch vehicle system shall be specified in the GSFC/GE design specification control drawings required by paragraph 3.1.4.1. There shall be one connector from spacecraft to shroud and two connectors from spacecraft adapter to shroud. These connectors shall be identical to that used for the Nimbus A Program. There shall be three connectors between the spacecraft adapter and the Agena. Table 3-2 lists applicable spacecraft functions and other electrical interface data.

3.5 ELECTRICAL REQUIREMENTS

3.5.1 Instrumentation

Table 3-3 lists telemetry and instrumentation requirements imposed on the Agena system by the spacecraft.

Table 3-2

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
1	-33-volt battery charging supply	Umbilical	Spacecraft	Twisted with #3 and shielded	33	7.0
2	-33-volt battery charging supply	Umbilical	Spacecraft	Twisted with #4 and shielded	33	7.0
3	-33-volt battery charging return	Umbilical	Spacecraft	Twisted with #1 and shielded	33	7.0
4	-33-volt battery charging return	Umbilical	Spacecraft	Twisted with #2 and shielded	33	7.0
5	Battery-charging voltage monitor (Pos.)	Umbilical	Spacecraft	None	33	.003
6	Battery-charging voltage monitor (Neg.)	Umbilical	Spacecraft	None	33	.003
7	Go-no-go target lamps supply (Pos.)	Umbilical	Adapter	Twisted with #8 and shielded	16.5	2.5

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
8	Go-no-go target lamps return (Neg.)	Umbilical	Adapter	Twisted with #7 and shielded	16.5	2.5
9	MRIR target lamps supply (Pos.)	Umbilical	Adapter	Twisted with #10 and shielded	24	.5
10	MRIR target lamps return (Neg.)	Umbilical	Adapter	Twisted with #9 and shielded	24	.5
11	MRIR target lamps return (Neg.)	Umbilical	Adapter	Twisted with #12 and shielded	24	.5
12	MRIR heating pad target return (Neg.)	Umbilical	Adapter	Twisted with #11 and shielded	24	.5
13	Controls scanner B target supply (Pos.)	Umbilical	Shroud	Twisted with #14 and shielded	24	4.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
14	Controls scanner B target return (Neg.)	Umbilical	Shroud	Twisted with #13 and shielded	24	4.0
15	Controls scanner B target supply (Pos.)	Umbilical	Shroud	Twisted with #16 and shielded	24	4.0
16	Controls scanner B target return (Neg.)	Umbilical	Shroud	Twisted with #15 and shielded	24	4.0
17	Controls scanner A target supply (Pos.)	Umbilical	Shroud	Twisted with #18 and shielded	24	2.0
18	Controls scanner A target return (Neg.)	Umbilical	Shroud	Twisted with #17 and shielded	24	4.0
19	Controls scanner A target supply (Pos.)	Umbilical	Shroud	Twisted with #20 and shielded	24	2.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
20	Controls scanner A target return (Neg.)	Adapter	Shroud	Twisted with #19 and shielded	24	2.0
21	-10-volt telemetry supply (Neg.)	Umbilical	Spacecraft	Twisted with #22 and shielded	10	.02
22	-10-volt telemetry return (Pos.)	Umbilical	Spacecraft	Twisted with #21 and shielded	10	.02
23	Gas tank temperature signal	Umbilical	Spacecraft	None	6	.001
24	Gas tank pressure signal	Umbilical	Spacecraft	None	6	.001
25	Gas manifold' pressure signal	Umbilical	Spacecraft	None	6	.001
26	Gyro liquid temperature signal	Umbilical	Spacecraft	None	6	.001
27	-24-volt gyro heater supply	Umbilical	Spacecraft	None	24	1.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
28	This connector terminates at the umbilical.					
29	-24-volt tank solenoid supply	Umbilical	Spacecraft	None	24	1.0
30	-24-volt pos. yaw solenoid supply	Umbilical	Spacecraft	None	24	1.0
31	-24-volt solenoids returns	Umbilical	Spacecraft	None	24	2.0
32	Umbilical isolator operate signal (Pos.)	Umbilical	Spacecraft	None	24	0.5
33	Command enable control (Pos.)	Umbilical	Spacecraft	None	24	.05
34	Spare	Umbilical	Spacecraft	None	24	1.0
35	Spare	Umbilical	Adapter	None	24	1.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
	Agena/Adapter/Spacecraft Nimbus Connections					
36	28-volt telemetry supply (Pos.)	Agena T/M	Spacecraft	Twisted with #37 and shielded	28	.3
37	28-volt telemetry return (Neg.)	Agena T/M	Spacecraft	Twisted with #36 and shielded	28	.3
38	Spacecraft roll-axis acceleration signal	Spacecraft	Agena T/M	Shielded	5.0	.1
39	Spacecraft pitch-axis acceleration signal	Spacecraft	Agena T/M	Shielded	5.0	.1
40	Spacecraft yaw axis acceleration signal	Spacecraft	Agena T/M	Shielded	5.0	.1
41	Spacecraft acceleration signal return	Spacecraft	Agena T/M	Shielded	5.0	.3

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
	Agena/Adapter/Spacecraft Nimbus Connections (continued)					
42	28-volt telemetry supply (Pos.)	Agena T/M	Adapter	Twisted with #43 and shielded	28	.1
43	28-volt telemetry return (Neg.)	Agena T/M	Adapter	Twisted with #42 and shielded	28	.1
44	Adapter pitch axis vibration signal	Adapter	Agena T/M	Shielded	5.0	.1
45	Spacecraft sep-aration signal supply	Agena T/M	Adapter	Twisted with #46 and shielded	5.0	.1
46	Spacecraft sep-aration signal return	Agena T/M	Adapter	Twisted with #45 and shielded	5.0	.1
47	Spacecraft sep-ration pyro supply	Agena S/Q timer	Adapter	Twisted with #48 and shielded	28	5.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
	Agena/Adapter/Spacecraft Nimbus Connections (continued)					
48	Spacecraft separation pyro return	Agena S/Q timer	Adapter	Twisted with #47 and shielded	28	5.0
49	Spacecraft separation pyro supply	Agena S/Q timer	Adapter	Twisted with #50 and shielded	28	5.0
50	Spacecraft separation pyro return	Agena S/Q timer	Adapter	Twisted with #49 and shielded	28	5.0
51	Spacecraft separation pyro supply	Agena S/Q timer	Adapter	Twisted with #52 and shielded	28	5.0
52	Spacecraft separation pyro return	Agena S/Q timer	Adapter	Twisted with #51 and shielded	28	5.0

Table 3-2 (continued)

Umbilical/Spacecraft Nimbus Connections

Conductor Number	Function	Origin	Termination	Shielding	Voltage	Current amp
	Agena/Adapter/Spacecraft Nimbus Connections (continued)					
53	Spacecraft separation pyro supply	Agena S/Q timer	Adapter	Twisted with #54 and shielded	28	5.0
54	Spacecraft separation pyro return	Agena S/Q timer	Adapter	Twisted with #53 and shielded	28	5.0

Table 3-3

Instrumentation

Type of Measurement	Frequency Response	Accuracy Required	Range of Measurement	T/M Coverage	Purpose	Classification	Location
Y-axis s/c accelerometer	Continuous 0-80 cps	±7%	0-5 vdc	Lift-off until shroud separation	Determine s/c loads	Mandatory	Spacecraft
X-axis s/c accelerometer	Continuous 0-110 cps	±7%	0-5 vdc	Lift-off until shroud separation	Determine s/c loads	Mandatory	Spacecraft
Z-axis s/c accelerometer	Continuous 0-160 cps	±7%	0-5 vdc	Lift-off until shroud separation	Determine s/c loads	Mandatory	Spacecraft
s/c adapter radial vibration	Continuous 20-2000 cps	±7%	0-5 vdc	Lift-off until s/c separation	Determine s/c adapter vibrations	Mandatory	Spacecraft adapter

3.5.2 Spacecraft Power to be Supplied by Launch Vehicle

Three accelerometers mounted on the spacecraft and one vibration transducer mounted in the spacecraft adapter require launch vehicle +28v regulated direct current. Power for the transducers on the spacecraft shall be supplied through the adapter/shroud/spacecraft circuit and interrupted at time of shroud separation. Power for the transducer in the spacecraft adapter is supplied directly through the adapter/Agena interface.

Four squibs employed at the spacecraft/adapter separation plane for separation of the spacecraft from its adapter shall be activated via launch vehicle switching. An impedance of 0.2 ohms, 28vdc, and a peak current of 5 amperes represents the nominal electrical requirements for each of the four squibs. Table 3-4 summarizes these requirements.

3.5.3 Switch Loading for Spacecraft Functions Activated by Launch Vehicle

There are no requirements for Agena programming of events in the spacecraft.

3.6 ENVIRONMENTAL REQUIREMENTS

3.6.1 Spacecraft Thermal Environment

Table 3-5 is a summary of spacecraft thermal critical components and associated thermal limits applicable during launch through injection. Bulk thermal limits between which the spacecraft must be maintained are 10°C (50°F) and 45°C (113°F). Data applicable to thermal response of spacecraft components together with designation of all thermal critical components shall be provided in accordance with the requirements of paragraph 3.1.4.1. Figure 3-1 presents general locations of certain thermal critical components. Items 1 through 7 of Table 3-1 will receive direct thermal radiation from the shroud during launch. The other components listed may be considered as not significantly affected by shroud heating.

Detailed time histories of spacecraft power dissipation are dependent on detailed spacecraft system test procedures which remain to be developed. However, an average power dissipation of 200 watts in the spacecraft/vehicle launch configuration throughout launch countdown (approximately 8-10 hours) is representative. Peak power dissipation of 420 watts over an interval of 30 minutes may result during on-pad checkout. A constant spacecraft power dissipation of 160 watts throughout the ascent trajectory is representative.

Table 3-4

Spacecraft Power Supplied by Vehicle

Spacecraft Function	+28v Unregulated		+28v Regulated	
	Load	Duty Cycle	Load	Duty Cycle
Spacecraft yaw axis acceleration			100 mil amp	Continuous until shroud separation
Spacecraft pitch axis acceleration			100 mil amp	Continuous until shroud separation
Spacecraft roll axis acceleration			100 mil amp	Continuous until shroud separation
Spacecraft separation pyrotechnics	20 amp (5 amp each)	1 sec. max.		
Spacecraft vibration (adapter)			100 mil amp	Continuous, not required after s/c separation

Table 3-5

Nimbus C Temperature-Critical Components

Description	Max. Temp. (°F)	Min. Temp. (°F)
1. Yaw axis coarse sun sensors	221	-58
2. Horizon scanner case & window	141	3
3. Stabilization & control system upper surface	300	Not critical
4. Solar array sun sensors	221	-58
5. Sensory subsystem, upper surface	300	Not critical
6. Separation devices (bolt cutters)	77	5
7. Beacon/PCM antenna	160	-23
8. Solar platform aluminum channels	140	-112
9. Solar platform	140	-112
10. Solar platform transition section	140	-112
11. Solar platform motor drive casing	140	23
12. Solar platform switch	140	23
13. Solar paddle latch line	140	23

3.6.2 On-Pad Spacecraft Cooling

The flight spacecraft will be mated to the Agena on R-4 day; R-0 day being the day of countdown initiation. At all times thereafter the spacecraft shall be provided a controlled environment.

Spacecraft thermal characteristics and the varying levels of electrical heat dissipation during on-pad checkout require air conditioning of the shroud at all times from shroud installation to lift-off. To permit control of spacecraft temperatures within the bulk temperature limits, air-conditioning shall be provided which will supply air to the shroud inlet and satisfy the following conditions:

- Temperature: variable ±2°F from 50°F to 75°F
- Flow rate: variable ±5 pounds per minute from 30 pounds per minute to a maximum of 60 pounds per minute
- Humidity: relative humidity not exceeding 45 percent
- Filtration: preclude passage of particles equal to or greater than 50 microns.

Environmental control of the gantry greenhouse interior shall be required to maintain an interior temperature of 60°F ±5° and an average relative humidity of 45 percent. Cracks and holes in the greenhouse exterior surfaces shall be closed. Portions of the greenhouse which may be opened and closed shall be sealed, when closed, to permit a positive differential pressure inside the greenhouse to be maintained with air-conditioning. Conditioned air supplied to the greenhouse interior shall be filtered to assure exclusion of 90 percent of all particles greater than 50 microns from that air.

3.6.3 Contamination Control

There shall be no contamination, within the limits specified below, of spacecraft sensors from ground cooling, pyrotechnic sources, vehicle fuel venting, material outgassing, or other launch vehicle system. Means shall be provided to seal the spacecraft adapter cavity from vehicle air-conditioning. Any retro or other maneuver of the Agena must be accomplished by means which assure non-contamination of the spacecraft.

It is required that optical transmission losses resulting from contamination shall not exceed 2%. This limit shall apply to all regions of the spectrum over which the system is sensitive. The contamination shall not cause wear or abrasion on any optic system. Within the solid particle limits established by shroud air-conditioning filtration requirements, contamination shall be limited to thin film coatings such as might result from condensation of products of outgassing. The various applicable spacecraft subsystems and regions of the spectrum over which they are sensitive are listed below:

TV cameras	480-850 millimicrons
HRIR	3.4-4.2 microns
MRIR	0.2-30.0 microns
Horizon sensors	12.0-18.0 microns
Solar cells	0.4-1.1 microns
Sun sensor	0.4-1.1 microns

3.6.4 Sterilization

There are no sterilization requirements applicable to the Nimbus C program.

3.6.5 Applied Loads

There are no requirements for shaped vehicle trajectory necessitated by spacecraft loads criteria.

3.6.6 Acoustic Noise

The Nimbus C project requires that the "wet pad" capability of WTR pad 75-1-1 be furnished to minimize the acoustic noise level.

3.6.7 Electromagnetic Environment

A. Conducted Interference. Spacecraft systems checkouts before launch are performed over RF links only. For spacecraft hard-wire umbilical circuits for functions such as battery charging, as specified in a subsequent section, there are no specific design requirements beyond usual acceptable launch pad electrical wiring practices. It shall be a joint spacecraft and vehicle system responsibility to monitor cognizant systems for interference caused by switching or RF transmission performed during scheduled integrated tests.

B. RFI Tests. During the mock countdown with the prototype spacecraft, the RFI test used for the Nimbus A program wherein tracking radars and spacecraft command transmitter are beamed at the spacecraft shall be repeated for the Nimbus C program. As in the Nimbus A program, spacecraft squibs shall be simulated during this test.

C. Radiated Interference. There is no Nimbus C radiating equipment other than spacecraft transmitters.

D. Spacecraft Transmitter Identification (Beacon). Table 3-6 provides identification of spacecraft transmitters.

E. Transmitter Frequency Spectra. Spacecraft transmitter spectra are not available for incorporation in this document. GSFC has no plans to obtain these data.

F. Spacecraft Wiring Design. Details of spacecraft wiring design applicable to interfaces with the vehicle system shall be provided in accordance with the requirements of paragraph 3.1.4.1. In general, the following information applicable to spacecraft design is provided:

- Ground system: multiple point
- Extent of conductor shielding used: power, signal, and pyrotechnics
- Ground return system employed: signal, power, pyrotechnic, and shields employ conductors, whereas equipment cases employ spacecraft structure.
- Electrical bonding: copper braid

G. Magnetic Materials. There are no spacecraft requirements for limitations on use of ferromagnetic material in vehicle structure.

H. Nuclear Radiation. There is no nuclear radiation from the spacecraft.

3.7 CLEARANCE REQUIREMENTS

3.7.1 Static Clearance

Determination of static clearance between the spacecraft, spacecraft adapter, and the shroud shall be in accordance with the requirements of paragraphs 3.1.4.1 and 3.1.4.2, and is intended to lead to determinations of clearances which properly account for both static and dynamic system deflections. The requirements for determination of clearances previously set forth are also intended to substantiate that no static or dynamic interference exists between the spacecraft/adapter and the shroud under any static or dynamic launch condition.

Table 3-6

Spacecraft Transmitter Identification

Make and Model	Measured Power	Antenna Type and Location	Operating Frequency	Bandwidth	Time of Transmission	Type of Modulation	Multiplication System
Hughes s/c unique	0.25 watts	4 quadra-loop in phased array s/c sensory ring	136.5 Mc	45 kc	Continuous during count-down and ascent	PCM/PM/AM	
General Electric s/c unique	5 watts	Spiral conical, s/c sen-sory ring	1700 to 1710 Mc	3 Mc	8 minutes during s/c ground checkout	FM/FM	24
United Electro-dynamics s/c unique	5 watts	Quadraloop s/c sen-sory ring	136.95 Mc	25 kc	10 minutes during s/c ground checkout	AM/FM	
Texas Instru-ments s/c unique	1.5 watts	Quadraloop s/c sen-sory ring	To be deter-mined; may be 137.2 or 273 Mc	100 kc	10 minutes during s/c ground checkout	FM	8

3.7.2 Dynamic Clearances

As outlined in paragraph 3.7.1, requirements have been specified for determination of static and dynamic clearances.

3.8 SEPARATION REQUIREMENTS AND RESTRAINTS

3.8.1 Shroud

There are no peculiar requirements or restraints. The shroud (including all components of the shroud system) shall not physically interfere or have other adverse affect on either the spacecraft/adapter or launch vehicle during or after shroud separation.

3.8.2 Spacecraft

No hardware items of the spacecraft adapter or vehicle system shall remain with the separated spacecraft.

SECTION IV

PROGRAM ANALYSIS, TEST AND DOCUMENTATION REQUIREMENTS

4.1 GENERAL

The requirements of this section are intended to satisfy project needs for technical information necessary for overall evaluation of the effects of vehicle-system characteristics, configuration, and schedules upon corresponding spacecraft technical considerations. It is clearly the responsibility of LeRC to coordinate the performance of vehicle system analyses and demonstration of vehicle system tests, to receive contractor documentation, and to forward that documentation and all related technical information to GSFC. In this respect, it shall be the responsibility of LeRC to assure that changes in vehicle-system characteristics, configuration, and schedules which affect the requirements of this document, or tests, analyses, and reports obligated in support of these requirements, are promptly reflected in document or test revisions, or proposal for revision, wherever applicable.

4.2 TEST REQUIREMENTS

4.2.1 General

Subsequent paragraphs of this section 4.2 presents test requirements which may be unique to the Nimbus C spacecraft. Other general test requirements which require joint GSFC and LeRC planning are to be included in an "Interface Plan and Schedule" as discussed in paragraph 4.3. The general tests considered applicable to Nimbus C include, but are not limited to, the following:

- Shroud separation tests: Required for Nimbus C shroud if shroud changes have been incorporated which affect test results obtained for Nimbus A

- Spacecraft/adapter/Agena/TAT electrical compatibility and all systems tests and detailed test procedures therefor: Applicable for either real or electrically simulated test components

- Spacecraft/adapter/Agena electrical continuity tests and detailed test procedures therefor: Applicable for either real or electrically simulated test components

- Spacecraft/adapter/Agena mechanical compatibility tests and detailed test procedures therefor: Applicable for either real or electrically simulated test components.

- Blockhouse-to-Agena umbilical wiring checkout

4.2.2 Rehearsal of Integrated Test Procedures at GE

Following initial integration of launch-base procedures involving coordinated launch vehicle and spacecraft system actions, a rehearsal at GE, Valley Forge, will be scheduled in accordance with Table 6-1 to evaluate procedures, acquaint spacecraft and launch base personnel with the applicable equipment and procedures, and to assess the schedule to be assigned to the last three days of launch activity.

The rehearsal, similar to that performed for Nimbus A, will involve a Nimbus spacecraft with its adapter, an Agena forward equipment rack, the engineering model shroud of paragraph 3.1.3, and associated handling equipment. Requirements for updating the engineering model shroud for such use as this rehearsal were set forth in paragraph 3.1.3. Similar requirements are set forth here for the Agena forward equipment rack; that is, it is required that LMSC accomplish all necessary modification to the Agena forward rack located at GE to assure complete representation of the flight Agena in all aspects which affect mechanical and electrical interface, and handling of the shroud system. Any necessary modifications to the GE forward equipment rack shall be accomplished in accordance with the schedule of Table 6-1.

Rehearsal with the foregoing equipment, performed by spacecraft and launch base personnel who will actually perform the tasks at the launch base, will be scheduled to include:

- Briefing and orientation of attendees

- Rehearsal of R-4 day pad activity, primarily spacecraft installation on the Agena

- Rehearsal of R-3 and R-2 day pad activity, primarily shroud installation and spacecraft checks

- Rehearsal of R-0, primarily evaluation of spacecraft in launch mode and concluded by overall review of rehearsal

Although launch base personnel such as the shroud installation crew and supervisory personnel for all integrated activity are encouraged to attend for the full rehearsal (approximately 4 days), their actual services could be limited to rehearsal of R-4 and R-3 if necessitated by other considerations. Participating agencies are: GSFC, GSFC/GE, GSFC/GLO, GE, LeRC, LeRC/LMSC, LMSC (Sunnyvale), LMSC (WTR), DAC (Tulsa), DAC (WTR), AF (WTR).

4.2.3 Spacecraft/Adapter/Shroud/Agena Electrical Interface Tests

Substantiation of acceptable electrical interface between the spacecraft and launch vehicle system requires certain interface electrical tests before launch. For the Nimbus C, these tests are outlined below:

(1) The Nimbus C flight adapter will be provided to LMSC Sunnyvale to participate in the matchmate of adapter to Agena. At the matchmate, and in addition to the mechanical mating process, an electrical check using the flight adapter, flight shroud and flight Agena will be performed. The purpose of this electrical test will be to check electrical continuity of applicable flight harnesses in the adapter, shroud, and Agena.

(2) The Nimbus C flight adapter and an electrical simulation of the spacecraft will be provided to LMSC Sunnyvale to participate in Agena systems tests which involve provision of electrical functions to or through the spacecraft/adapter configuration. The electrical spacecraft simulator used at WTR for the Nimbus A program will be updated for this test and includes provision for simulation of spacecraft electrical loads. The purpose of this test will be to check applicable flight harnesses and Agena functions for transmitting the required electrical power by proper commands.

(3) The spacecraft/adapter electrical simulator and the flight spacecraft/adapter will be provided at WTR to be used in vehicle compatibility and systems tests which involve provision of electrical functions to or through the spacecraft/adapter configuration. The purpose of these tests will be to essentially repeat the electrical checks of (2) above, to assure that no changes in wiring or no damage has occurred since performance of the LMSC Sunnyvale tests.

(4) After final mate of the flight spacecraft/adapter to the Agena, a continuity check of the spacecraft separation circuit will be

performed from the point of spacecraft separation squib connectors. It is planned that this test be performed identical to the corresponding test performed for Nimbus A. The purpose of this test is to check continuity of final mate of the separation circuit. Also after final mate, electrical checks of spacecraft functions supplied through the Agena umbilical will be performed in the same manner performed for Nimbus A. These include certification of such umbilical circuits as spacecraft battery charging, target light and scanner stimulator operation, and pneumatic system pressure and temperature operation.

4.2.4 RF Tests

Spacecraft RF-transmission tests with the gantry in place above the launch vehicle shall be made with spacecraft and shroud in place on the Agena. The purpose of this test shall be to substantiate acceptable signal strength reception at the Nimbus mobile ground station located at the spacecraft assembly building adequate for spacecraft subsystem ground equipment operation. An RF repeater capability on the gantry covering 136-137 Mc will be provided by GSFC/GLO for these tests. Spacecraft transmitter data are provided in Table 3-6.

4.3 ANALYSIS AND DOCUMENTATION REQUIREMENTS

4.3.1 Interface Plan and Schedule

LeRC shall prepare an "Interface Plan and Schedule" for all interface test and documentation requirements which involve GSFC/GE hardware, personnel, or technical information. This "Interface Plan and Schedule" shall define, where applicable, the objectives, general procedures, equipment, and schedules for each interface requirement. In addition to technical efforts outlined in paragraph 4.2.1, other areas of effort to be covered in this plan and which require joint GSFC and LeRC planning are:

- Spacecraft and shroud modal, thermal, and clearance analyses
- Integration of detailed launch base procedures, such as shroud installation procedures
- Launch plan documentation such as Program Requirements Documentation, Launch Operations Plan, and Countdown Manuals

The "Interface Plan and Schedule" shall include LeRC/LMSC requirements and schedules for GSFC/GE-furnished hardware, personnel, and technical information needed to implement any of the foregoing requirements. The initial issue of this plan and any subsequent revision necessitated by new or modified contractual test and documentation requirements shall be in accordance with the requirements of Table 6-1.

4.3.2 Launch Operations Plan
LeRC shall provide a Nimbus C launch operations plan to include organizational structure, resources, schedule of activities, and overall plans for the performance of prelaunch, launch, and flight operations up to Agena/Nimbus separation. This plan is required in accordance with the schedule of Table 6-1.

4.3.3 Thermal Analysis
GSFC/GE shall furnish to LeRC/LMSC thermal characteristics and allowable temperature for critical spacecraft elements (see paragraph 3.6.1) exposed to the thermal environment during ascent phase of the launch. Numerical values of only peak thermal response are required for those elements which exceed their thermal limits. For all other elements, a statement that the Nimbus C response does not exceed thermal limits will be acceptable. The ascent conditions applicable for this investigation shall be as specified for Nimbus A; that is, a shroud-on phase and a shroud-off phase covering the ascent from liftoff to spacecraft injection including the pitch-up maneuver. With the exception of the sensory ring, which will have an initial temperature of 70°F, initial temperature for all other spacecraft components at liftoff can be assumed to be 60°F. A qualitative assessment of the effect of the pitch-up maneuver on component temperatures will be acceptable.

An exception to the foregoing requirement for reporting only peak temperatures is the analysis of the solar paddles, transition section, hinge line, latching mechanism, and solar paddle channels. For analyses of these components, time histories for temperature distributions are required. Reference is made to LMSC report A377035, "Nimbus Spacecraft — Thermodynamic Analysis of Solar Paddles and Associated Structure," dated 10 September 1963 for method of analysis acceptable for Nimbus C. Incidence angles, thermal response properties, etc., should, of course, be compatible with Nimbus C launch conditions and thermal data provided in accordance with paragraph 3.1.4.1.

With the exception of a relatively narrow sweep across the horizon scanner stimulator heater elements, the detector elements in the horizon scanners should not view surfaces having temperatures which exceed 250°F. It is required that any portion of the shroud, with the exception of scanner stimulators and associated brackets, viewed by the horizon scanners and which exceeds this temperature limit of 250°F be reported with details of critical location and temperature. If no critical areas of the shroud exists in this respect, a statement of that fact is desired.

Results of the thermal analysis shall be reported in accordance with the schedule of Table 6-1.

4.3.4 Shroud Clearances During Separation

LMSC shall provide an analysis which substantiates that the shroud will not collide with the Agena/spacecraft during or after shroud jettisoning. This analysis, applicable test data, and applicable data obtained during in-flight shroud separation (measurements of vehicle motions) shall supplement the shroud/Agena/spacecraft clearance values provided in accordance with paragraph 3.1.4.2. Clearance between shroud/Agena/spacecraft during in-flight separation shall reflect the effect of adverse Agena motions which are known or are likely to exist during shroud separation. Analyses and test performed for Nimbus A may be used for this substantiation where applicable. Substantiation required for Nimbus C shall be in accordance with the schedule of Table 6-1.

4.3.5 Contamination of Spacecraft Optics

LMSC shall assure that no changes have occurred in vehicle materials from those employed for Nimbus A which, if caused to outgas by launch environment, could exceed the contamination limits of paragraph 3.6.3. If such change has occurred, documentation shall be provided which describes the identity, specification, and environmental testing and test results for the material. Materials such as pyrotechnics, sealants, lubrication, thermal and electrical insulations, paints, chemical coatings, and cleaning compounds applicable in the shroud and spacecraft/adapter/Agena interface area are of primary concern. Any necessary documentation resulting from this requirement shall be submitted in accordance with the requirements of Table 6-1.

4.3.6 Monthly Weight Status Report

LMSC shall provide a monthly weight status which includes the information shown in Table 4-1. Spacecraft inputs shall be provided in accordance with the requirements of paragraph 3.2.1. The assessed values of line (A) result from an evaluation of launch vehicle mission capabilities by both spacecraft and vehicle systems.

Table 4-1

Format for NASA Satellite Weight Status Report

Mission		(1) Nominal Burnout Weight Capability	- (2) Performance Reserves	= (3) Agena Burnout Weight Capability	(4) Agena Burnout Weight (Less S/C support weight)	(5) S/C Weight	(6) S/C Support Weight	(7) Total Weight Margin
Nimbus	(A) Assessed value							
	(B) Current value							
	(C) Weight margin							

Notes:

(A) Assessed values of Agena burnout weight and spacecraft weight included weight-growth contingencies.

(B) Current values include no contingencies.

(C) For items (1) and (3), weight margin is positive if current value is greater than assessed value; i.e., (C) = (B) - (A).

(D) For items (2), (4), (5) and (6) weight margin is positive if current value is less than assessed value; i.e., (C) = (A) - (B).

(E) Total weight margin, item (7), is sum of algebraic weight margins for items (3), (4), (5), and (6).

4.3.7 Trajectory and Three Sigma Precision

The required orbit for the Nimbus C mission is defined in Section 2. LMSC shall provide the orbit three-sigma precision characteristics which can be achieved with the TAT/Agena B. Also required is the trajectory time history covering the phase from liftoff through the establishment of the required orbit. Trajectory calculations shall note the latitude, longitude, and time from liftoff at spacecraft injection. These data throughout the time of spacecraft first equator crossing are required in accordance with Table 6-1.

4.3.8 Flight Evaluation and Performance Data

Complete time histories of spacecraft environmental data reduced from the telemetry data, and post-flight reporting of the Agena attitude and rates at the time of spacecraft separation, are required in accordance with the schedule of Table 6-1.

4.3.9 Shroud Air Conditioning Capabilities

GSFC requires facilities in the blockhouse to monitor temperature and rate of airflow of the conditioned air supplied to the inlet into the shroud. To permit preparation of GSFC procedures for the use of these facilities, and to establish GSFC knowledge of the characteristics of the system it will be using for control of spacecraft temperatures, reports presenting a general description of the air conditioning facilities, sensor calibration curves, and system capabilities, within the limits of the air conditioning requirements specified in paragraph 3.6.2, shall be provided in accordance with the schedule of Table 6-1.

4.3.10 Loads Applied by Launch Vehicle

To accomplish spacecraft/adapter structural design without imposing restraints on the launch vehicle, LMSC shall recommend Nimbus C structural design criteria in terms of 2σ (sigma) load factor and vibration levels at the interface between the spacecraft adapter and the Agena applicable to the Agena-B/TAT vehicle. This recommendation shall be supported by an engineering report which describes the bases for the recommended design criteria, assumptions, and other engineering information necessary for understanding this criteria. These data shall be submitted in accordance with the requirements of Table 6-1.

4.3.11 Shroud Clearances Before Shroud Separation

In support of the requirements of Section III for LMSC determination of static and dynamic clearances between the shroud and spacecraft/adapter, it is required that LMSC provide a report which presents the derivation of the spacecraft/adapter/shroud clearances required by paragraph 3.1.4.2. This report shall present the derivation of final numerical clearances, vehicle and shroud dynamics data used in the analysis, and a table of references identifying the sources of data used. This report shall also include a brief engineering description of the test methods, equipment, and specimens used for obtaining experimental static or dynamic data. Preliminary and final versions of this report shall be submitted in accordance with the requirements of Table 6-1. It shall be the responsibility of LMSC to provide an engineering description of the Nimbus C shroud static and dynamic envelope if necessary for completion of the foregoing requirement.

4.3.12 Nimbus/Agena Pitch-Up and Retro-Maneuver

LMSC shall perform an analysis of the Nimbus C and Agena orbits applicable to the Nimbus C orbit conditions and launch data to establish the relation between Agena/spacecraft separation pitch attitude, subsequent safe separation distance between the Agena and spacecraft, and the effect of Agena retro-maneuvers on the separation distances. The purpose of this study is to determine a way to avoid collision between the Agena and spacecraft throughout an expected spacecraft orbit life of 12 months. Acceptable spacecraft/Agena separation distance is predicated upon the following conditions:

- The Nimbus spacecraft separation system providing a differential velocity between the spacecraft and Agena of 4 feet per second.

- Spacecraft separation following Agena second burnout is delayed until Agena tail-off has decayed to a level which does not adversely affect subsequent separation distances.

- The Agena remains more than 500 feet from the spacecraft following initial spacecraft stabilization.

Section II presents requirements for spacecraft orientation based on limitations of spacecraft stabilization. Results of this analysis shall be submitted in accordance with the requirements of Table 6-1.

SECTION V

LAUNCH BASE REQUIREMENTS AND RESTRAINTS

5.1 TRANSPORTATION AND HANDLING CRITERIA

5.1.1 General

Preceding sections of this document have specified requirements and restraints necessary primarily to assure physical compatibility of the spacecraft and its adapter with the launch-vehicle system. This section describes certain spacecraft criteria and associated launch operations criteria applicable to Nimbus launch base operations at the Western Test Range (WTR). These criteria are presented to permit launch-vehicle system planning of compatible criteria which may serve to minimize conflict or omissions in combined spacecraft and launch-vehicle operations plans as established by LeRC and GSFC/GLO. It is also intended that these criteria be reflected, where applicable, in launch base operations planning documentation required in support of the Nimbus program.

5.1.1.1 Spacecraft/Adapter Procedures

The spacecraft and adapter are assembled at the manufacturer's plant (GE) and shipped, maintained, and confidence-tested as an assembled unit. The spacecraft and adapter are not to be disassembled except as an emergency action.

Before the flight spacecraft arrives at WTR, a similarly configured prototype spacecraft/adapter assembly shall have been cycled through all handling, testing, mating with the launch vehicle, and mock countdown, using test procedures, equipment, and personnel applicable to operations with the flight spacecraft. This prototype spacecraft/adapter operation is intended to assure that all procedures, equipment, and personnel are fully qualified and available to produce a flight spacecraft operation with efficient and reliable results.

5.1.1.2 Electro-Explosive Devices

Two kinds of spacecraft electro-explosive devices must be considered during prelaunch and launch operations: (1) separation band bolt cutters and (2) cable cutters in the solar paddle unfold release mechanism. The configuration of the electro-explosive devices in each handling phase of operations is as follows:

- During transporting and shipping, the bolt-cutters are assembled to the spacecraft/adapter assembly armed but with shorting caps installed (adapter connectors protected for shipment); the cable-cutters are assembled to the spacecraft with pyro squibs installed with shorting caps (timer output to cutter disconnected for protection during shipping).

- During the RFI test and mock countdown with prototype spacecraft/adapter, the bolt-cutters are assembled to the spacecraft/adapter assembly, not armed, with shorting caps. Redundant parallel bolt-cutter assemblies are also installed, armed and electrically connected to the Agena firing circuits, in such a manner that firing cannot initiate spacecraft separation. During the mock countdown, the spacecraft configuration incorporates armed cable-cutters connected in normal manner; however, a protective mechanical device which clamps the solar paddles to the spacecraft support structure is installed for the mock countdown.

- During preparation for launch, the bolt-cutters will be checked and connected by GSFC and GE pyrotechnic technicians with GLO and LMSC pyrotechnic technicians monitoring the operation. The spacecraft cable-cutters will be checked and installed by GSFC and GE.

5.1.2 Vehicle System Requirements

The spacecraft assembled on its adapter will be delivered to WTR by GSFC/GE together with a spacecraft transportation dolly and a spacecraft protective cover. There are no launch vehicle system requirements for spacecraft environmental control during transport of the spacecraft. Handling of the spacecraft shall be the responsibility of the vehicle system personnel during hoisting and mating activities at the launch pad. Removal of the spacecraft from the spacecraft dolly and attachment of the slings shall be the responsibility of the GSFC/GE. A spacecraft-cover handling sling shall be furnished by GSFC/GE to permit attachment of hoisting gear to the spacecraft cover. Design of the spacecraft cover permits installation and removal with the same equipment used for installation and removal of the shroud.

5.2 UMBILICAL AND TEST PLUGS

5.2.1 Electrical Umbilical

The Nimbus C spacecraft requires 34 pins in the Agena electrical umbilical connector. Table 5-1 presents the assignment of spacecraft

Table 5-1

Blockhouse-to-Nimbus Umbilical Connections

Item	Function	Origin Blockhouse AGE-Connector and pin	AGE Connector Wire Size	Termination	Agena/Adapter Connector and Pin	Voltage (at spacecraft)	Current (amps)	Permissible Voltage Drop
1	-33-volt battery-charging supply (Neg.)	J101-R	8	Umbilical	9002-m	33.0	7.0	5.0
2	-33-volt battery-charging supply (Neg.)	J101-T	8	Umbilical	9002-k	33.0	7.0	5.0
3	-33-volt battery-charging supply (Pos.)	J101-X	4	Umbilical	9002-j	33.0	7.0	5.0
4	-33-volt battery-charging return (Pos.)	J101-X	4	Umbilical	9002-i	33.0	7.0	5.0
5	Battery-charging voltage monitor (Pos.)	J101-I	16	Umbilical	9002-g	33.0	.003	.05
6	Battery-charging voltage monitor (Neg.)	J101-K	16	Umbilical	9002-h	33.0	.003	.05
7	Go-No-Go target lamps supply (Neg.)	J101-U	12	Umbilical	9008-U	16.5	2.5	5.0
8	Go-No-Go target lamps return (Neg.)	J101-V	12	Umbilical	9008-V	16.5	2.5	5.0
9	MRIR target lamps supply (Pos.)	J105-K	16	Umbilical	9008-b	24.0	.5	5.0
10	MRIR target lamps return (Neg.)	J105-L	16	Umbilical	9008-c	24.0	.5	5.0

Table 5-1 (continued)

Blockhouse-to-Nimbus Umbilical Connections

Item	Function	Origin Blockhouse AGE-Connector and pin	AGE Connector Wire Size	Termination	Agena/Adapter Connector and Pin	Voltage (at spacecraft)	Current (amps)	Permissible Voltage Drop
11	MRIR heating pad target supply (Pos.)	J105-M	16	Umbilical	9008-Y	24.0	.5	3.0
12	MRIR heating pad target return (Neg.)	J105-N	16	Umbilical	9008-Z	24.0	.5	3.0
13	Controls scanner B1 target supply (Pos.)	J101-R	10	Umbilical	9002-w	24.0	4.0	5.0
14	Controls scanner B2 target supply (Pos.)	J105-E	10	Umbilical	9002-u	24.0	4.0	5.0
15	Controls scanner B1 target return (Neg.)	J105-C	10	Umbilical	9002-v	24.0	4.0	5.0
16	Controls scanner B2 target return (Neg.)	J105-G	10	Umbilical	9001-C	24.0	4.0	5.0
17	Controls scanner A1 target supply (Pos.)	J105-F	12	Umbilical	9002-n	24.0	2.0	5.0
18	Controls scanner A2 target return (Neg.)	J105-J	10	Umbilical	9001-v	24.0	4.0	5.0
19	Controls scanner A2 target supply (Pos.)	J105-H	12	Umbilical	9001-w	24.0	2.0	5.0
21	-10-volt telemetry supply (Neg.)	J3-E	16	Umbilical	9002-f	10.0	.02	.05
22	-10-volt telemetry return (Pos.)	J3-F	16	Umbilical	9002-e	10.0	.02	.05

Table 5-1 (continued)

Blockhouse-to-Nimbus Umbilical Connections

Item	Function	Origin Blockhouse AGE-Connector and pin	AGE Connector Wire Size	Termination	Agena/Adapter Connector and Pin	Voltage (at spacecraft)	Current (amps)	Permissible Voltage Drop
23	Gas tank temperature signal (Neg.)	J3-R	16	Umbilical	9002-c	6.0	.001	.05
24	Gas tank pressure signal (Neg.)	J3-D	16	Umbilical	9002-b	6.0	.001	.05
25	Gas manifold pressure signal (Neg.)	J3-G	16	Umbilical	9002-a	6.0	.001	.05
26	Gyro liquid temperature signal (Neg.)	J3-N	16	Umbilical	9002-d	6.0	.001	.05
27	-24-volt gyro heater supply (Neg.)	J3-S	16	Umbilical	9002-Z	24.0	1.0	5.0
28	-24-volt gyro heater return (Pos.)	J3-P	16	Flag Plate		24.0	1.0	5.0
29	-24-volt tank solenoid supply (Neg.)	J3-P	16	Umbilical	9002-Y	24.0	1.0	5.0
30	-24-volt positive yaw solenoid supply (Neg.)	J3-K	16	Umbilical	9002-X	24.0	1.0	5.0
31	-24-volt solenoids return (Pos.)	J3-T	14	Umbilical	9002-V	24.0	2.0	5.0
32	Umbilical isolator operate signal (Pos.)	J3-L	16	Umbilical	9002-W	24.0	.5	5.0
33	Command enable control (Pos.)	J105-Q	16	Umbilical	9002-p	24.0	.05	5.0
34	Spare	J105-P	16	Umbilical	9002-r	24.0	1.0	5.0
35	Spare	J105-B	16	Umbilical	9002-q	24.0	1.0	5.0

umbilical functions and associated technical data. These circuits, with the exception of circuits 7, 8, and 9 through 18, pass from the umbilical connector through the Agena and the adapter to the shroud, thence to the spacecraft. Circuits 7, 8, and 9 through 12 terminate in the adapter. Circuits 13 through 18 terminate in the shroud. There are no shielding requirements for the circuits listed in Table 5-1. All circuits are dc and resistive, have a continuous duty cycle, and are monitored from the blockhouse. All AGE is GSFC-furnished, and all circuits listed in Table 5-1 are mandatory.

5.2.2 Electrical Test Plugs

Breakout plugs must be used in all trouble shooting tests through flight connectors which mate with the spacecraft/adapter.

5.2.3 Pressurized Gas Loading Umbilicals

No requirements for pressurized gas loading umbilicals.

5.2.4 Propellant Loading Umbilicals

No requirements for propellant loading umbilicals.

5.2.5 Parasitic Coupler and Reradiating Antennas

No requirements for parasitic coupler and reradiating antennas.

5.3 LAUNCH BASE SEQUENCING

5.3.1 Spacecraft Assembly Building Operations

Although firm scheduling and tests applicable to Nimbus C are yet to be formulated, Table 5-2 presents comparable data from the Nimbus A operations and is included herein as generally applicable to Nimbus C operations. Table 5-2 reflects use of both a prototype and a flight spacecraft and is applicable to Nimbus C in that respect.

5.3.2 Pad Checkout

As in paragraph 5.3.1, operations and schedule from Nimbus A operations are presented in Table 5-3 as generally applicable to Nimbus C operations. Table 5-3 also reflects use of prototype and flight spacecraft.

5.3.3 Countdown Activity

Firm countdown activity for Nimbus C is yet to be formulated. A guide to typical countdown activity which can be expected for Nimbus C may be found in LMSC document 226338-A, "Nimbus Countdown Manual, LV-2/01/399/6201," Second Edition, dated 10 August 1964.

Table 5-2

Typical Spacecraft Assembly Building Operations

Item	Operation	Time
1	Prototype spacecraft at VAFB	R-27
2	Evaluation of transportation and handling effects on prototype	R-27 to R-18
3	Data review and prototype status evaluation	R-18
4	Alignment of springs and mate to prototype adapter, mount on test and cal dolly	R-17
5	RF link, controls, go/no-go, and sensory ring confidence checks	R-16 to R-15
6	Visual inspection, charge pneumatics, install humidity bag, install spacecraft covers, load prototype in van for transport to pad	R-15
7	Tow to launch pad	R-14
8	Flight spacecraft/adapter at VAFB	R-10
9	Post-shipping verification of flight spacecraft	R-9
10	Flight spacecraft alignment and leak check	R-8
11	Matchmate tool check with flight spacecraft and battery conditioning	R-7
12	Conditioning of flight spacecraft batteries	R-6
13	Flight spacecraft check; launch preparation	R-5
14	Tow flight spacecraft to pad	R-4

Table 5-3

Typical Spacecraft Pad Checkout

Item	Operation	Time
1	Prototype arrival at pad	R-14
2	Mate prototype to Agena and conduct RF link checks	R-14
3	Mock R-3 day activities with prototype	R-13
4	Mock R-2 day activities with prototype	R-12
5	Mock countdown (R-0 day activities plus RFI checks with prototype)	R-11
6	Exercise gantry to spacecraft gas-charging equipment	R-11
7	Demate prototype and return to SAB	R-10
8	Flight spacecraft/adapter arrival at pad and mate to Agena	R-4
9	Shroud and pyro installation, spacecraft checks	R-3
10	Shroud final installation and spacecraft confidence test	R-2
11	TAT solid installation and alignment	R-1
12	Countdown initiation	R-0

5.3.4 Combined Launch Base Test Operations

An integrated activities schedule of launch base operations involving combined TAT, Agena, launch pad and spacecraft activities is required. This schedule shall be prepared jointly by vehicle and spacecraft system personnel and shall present an itemized daily schedule of launch vehicle and spacecraft system tasks identified by task title, starting and completion times, identification of applicable written procedure, and designation of agency having responsibility for action. The integrated activities schedule shall reflect planning covering the period from arrival of the prototype spacecraft at WTR through the day of launch of the flight spacecraft. Scheduling of all spacecraft system support and participation in combined launch base activities shall be based on an 8-hour day and 5-day work week for spacecraft system personnel with the exception of the last week of activity which may involve consecutive 7-day spacecraft system support.

5.3.5 Pad Cabling Requirements

Table 5-1 presents applicable Nimbus C cabling requirements from blockhouse consoles to spacecraft adapter. GSFC will place three standard relay racks, 24 inches wide, 28 inches deep, and 82-1/2 inches high in the blockhouse. Pad cabling shall terminate at these racks, or consoles. These racks will contain battery-charging controls, calibration and test equipment controls, and monitoring equipment for remote charging or dump of the pressure vessel in the spacecraft control system. Availability of approximately 5-kw, 110v, 60-cycle, single-phase power will be required at these control racks.

Cabling for pad validation tests, electrical compatibility tests, and all systems tests shall be provided in accordance with GE Drawing 245E709, "System Assembly Nimbus Blockhouse to Pad Test (AGE/PMR)." Cabling indicated on this drawing by phantom lines shall be supplied by LMSC. A revision to GE Drawing 245E709 applicable to Nimbus C shall be furnished in accordance with the requirements of Table 6-1.

LMSC shall provide a pad umbilical wiring diagram which presents wiring details of spacecraft umbilical circuits provided from the blockhouse junction to the umbilical plug in the Agena. The diagram shall include such information as wire sizes, length of wires, designation of spacecraft pins inthe umbilical plug, and all other electrical details pertinent to evaluation and calibration of spacecraft blockhouse consoles. These data shall be provided in accordance with the requirements of Table 6-1.

SECTION VI

SCHEDULES

6.1 GENERAL

To facilitate coordination, and achievement of overall mission schedules, an interface schedule shall be prepared jointly by GSFC and LeRC for inclusion in the "Interface Plan and Schedule" required in paragraph 4.3.1. Pending the coordination of that schedule, the requirements of Table 6-1 shall apply. The interface schedule shall be compatible with the official overall program schedules.

Table 6-1

Nimbus C Interface Requirements Schedule

Reference Paragraph	Requirement	Distri-bution	Schedule	Action By	Agency Responsible
2.1	Sequence of events, Nimbus C	II	10 mo. B/L*	LMSC	LeRC
3.1.3	Engineering model shroud	III	6 mo. B/L	LMSC	LeRC
3.1.4.1	Spacecraft/adapter design specification control drawing	I	9 mo. B/L	GE/DAC	GSFC
3.1.4.2	Official mechanical and electrical interface drawing	III	6 mo. B/L	LMSC	LeRC
3.2.2	Spacecraft/adapter stiffness properties	I	11 mo. B/L	GE	GSFC
3.3.2	Matchmate specification and procedures	III	9 mo. B/L	LMSC	LeRC
3.3.2	Ship flight spacecraft adapter to LMSC for matchmate test		7 mo. B/L	GE	GSFC
3.3.2	Update Nimbus adapter stabilization fixture		8 mo. B/L	GE	GSFC
3.3.2	Matchmate tests at LMSC		6 mo. B/L	LMSC	LeRC

Table 6-1 (continued)

Nimbus C Interface Requirements Schedule

Reference Paragraph	Requirement	Distribution	Schedule	Action By	Agency Responsible
4.3.9	Shroud air conditioning description report	III	5 mo. B/L	LMSC	LeRC
4.2.2	Rehearsal of integrated pad procedures at GE		5 mo. B/L	GE	GSFC
4.2.2	Flight-equivalent Agena forward rack (Up-dating)	III	6 mo. B/L	LMSC	LeRC
4.2.3	Flight adapter for Agena Sunnyvale systems test		4 mo. B/L	GE	GSFC
4.3.1	Interface plan and schedule	II	10 mo. B/L	LMSC	LeRC
4.3.2	Launch operations plan	II	6 mo. B/L	LeRC	LeRC
4.3.3	Spacecraft/adapter thermal response analysis	III	6 mo. B/L	LMSC	LeRC
4.3.4	Shroud clearances during separation	III	4 mo. B/L	LMSC	LeRC
4.3.5	Investigation of spacecraft optic contamination	III	6 mo. B/L	LMSC	LeRC

Table 6-1 (continued)

Nimbus C Interface Requirements Schedule

Reference Paragraph	Requirement	Distri-bution	Schedule	Action By	Agency Responsible
4.3.7	Trajectory and three sigma precisions	II	10 mo. B/L	LMSC	LeRC
4.3.8	Time histories of flight environmental data	III	4 mo. after Launch	LMSC	LeRC
4.3.8	Postflight report of Agena attitude and rates	II	45 days after Launch	LMSC	LeRC
4.3.9	Shroud airconditioning data	III	1 mo. B/L	LMSC	LeRC
4.3.10	Loads applied by launch vehicle	II	10 mo. B/L	LMSC	LeRC
4.3.11	Preliminary shroud clearance report (shroud-on)	III	4 mo. B/L	LMSC	LeRC
4.3.11	Final shroud clearance report (shroud-on)	III	2 mo. B/L	LMSC	LeRC
4.3.12	Nimbus/Agena pitch-up and retro maneuver	II	9 mo. B/L	LMSC	LeRC

Table 6-1 (continued)

Nimbus C Interface Requirements Schedule

Reference Paragraph	Requirement	Distri-bution	Schedule	Action By	Agency Responsible
5.3.5	Specification drawing, Nimbus C pad electrical test cables	I	11 mo. B/L	GE	GSFC
5.3.5	Blockhouse-to-umbilical wiring diagram	III	3 mo. B/L	LMSC	LeRC

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*B/L = Before scheduled launch

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