III. LAUNCH VEHICLE DESCRIPTION

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The Thorad-Agena is a two-stage launch vehicle consisting of a Thorad first-stage and an Agena second-stage, connected by a booster adapter. The composite vehicle (fig. III-1) including the shroud and the booster adapter is about 33 meters (109 ft) long. The total weight at lift-off is approximately 91 625 kilograms (202 000 lbm). Figure III-2 shows the Thorad-Agena lift-off with Nimbus III.

The Thorad (fig. III-3) stage consists of a long-tank Thor and three Castor II solid-propellant rocket motors located 120^{o} apart and attached to the long-tank Thor near the aft end. The long-tank Thor is 21.4 meters (70.3 ft) long and is 2.4 meters (8 ft) in diameter, except for the conical forward section which tapers to a diameter of about 1.6 meters (5.3 ft). The Thorad is approximately 4.3 meters (14 ft) longer than Thors previously used resulting in approximately 50 percent greater propellant tank volume. The additional propellant provides for an increased main engine thrust duration of approximately 72 seconds. The solid-propellant rocket motors are each about 7 meters (24 ft) long and are 0.8 meter (2.5 ft) in diameter with a conical forward end. The Thorad is powered by a main engine with a sea-level rated thrust of 756×10^3 newtons (170 000 lbf), two vernier engines with a total sea-level rated thrust of 89×10^2 newtons (2000 lbf) and the three solid-propellant rocket motors with a total sea-level rated thrust of 696×10^3 newtons (156 450 lbf). The total impulse of these solid-propellant rockets is approximately 3829×10^3 newton-seconds (861×10^3 lbf-sec) greater than the total impulse of the solid-propellant rocket motors previously used on the Thrust Augmented Thor vehicle. The propellants for the Thorad main engine and the vernier engines are liquid oxygen and high grade kerosene. The propellant for the solid-propellant rocket motors is basically a solid grain of polybutadiene acrylic acid and ammonium perchlorate. The vernier engines, the main engine, and the solid-propellant rocket motors are ignited in sequence prior to lift-off. The fixed-nozzle solid-propellant rocket motors burn for approximately 39 seconds. They are jettisoned at T + 102 seconds in order to insure that the cases for the solid propellant impact in a safe area (water impact). The Thorad main-engine thrusts until the desired velocity for the planned suborbital ellipse is achieved as determined by the radio-guidance system, or until propellant depletion. During powered flight, the Thorad main engine is gimbaled for pitch and yaw control, and the vernier engines are gimbaled for roll control. After Thorad main engine cutoff, the vernier engines continue to thrust for 9 seconds to

provide for vehicle attitude control and for fine trajectory corrections. After vernier engine cutoff, the Thorad is severed from the Agena by the firing of a Mild Detonating Fuse system located on the forward end of the booster adapter. The firing of a retrorocket system, mounted on the booster adapter, then separates the Thorad with booster adapter from the Agena.

The second stage Agena and the shroud protecting the Nimbus III spacecraft are shown in figure III-4. The diameter of the Agena is 1.52 meters (5 ft), and the length of the Agena and shroud is about 12 meters (40 ft). The Agena engine has a rated vacuum thrust of 71.17×10^3 newtons (16 000 lbf). This engine uses unsymmetrical dimethylhydrazine and inhibited red fuming nitric acid as propellants. During powered flight, pitch and yaw control are provided by gimbaling the Agena engine, and roll control is provided by a cold gas (mixture of nitrogen and tetrafluoromethane) attitude control system. During periods of nonpowered flight, pitch, yaw, and roll control are provided by the cold-gas system. The cold-gas attitude control system is also used to perform a 75° pitchup maneuver prior to Nimbus III separation and a coning (combined yaw and roll) maneuver subsequent to Nimbus III separation. For this mission a cold-gas retrothrust system provided the impulse (two separate thrust periods) required to perturb the Agena orbit after the coning maneuver. A fiber glass laminate clamshell shroud was used to provide environmental protection for the spacecraft during ascent. This shroud was jettisoned approximately 10 seconds after Agena engine first start. The Nimbus III is shown in figure III-5.

The Thorad used for the Nimbus III mission provided approximately 20 percent more payload capability than was provided by the Thrust Augmented Thor used for previous NASA missions.

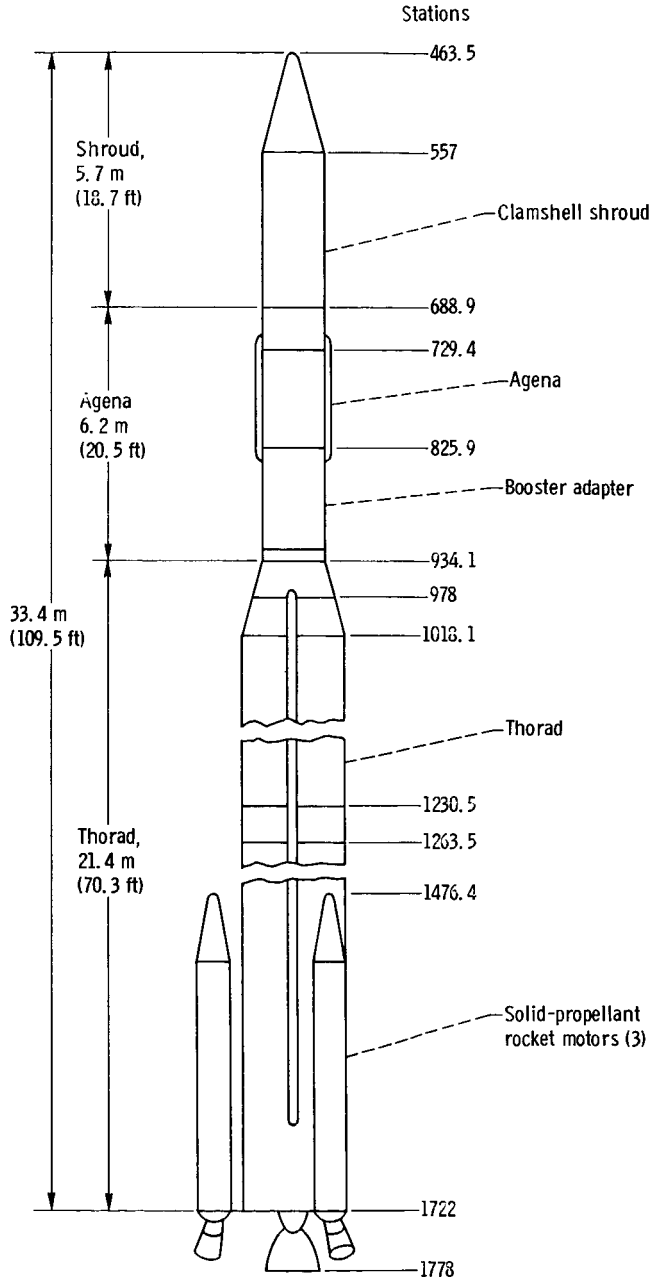

Figure III-1. - Composite space vehicle, Nimbus III.

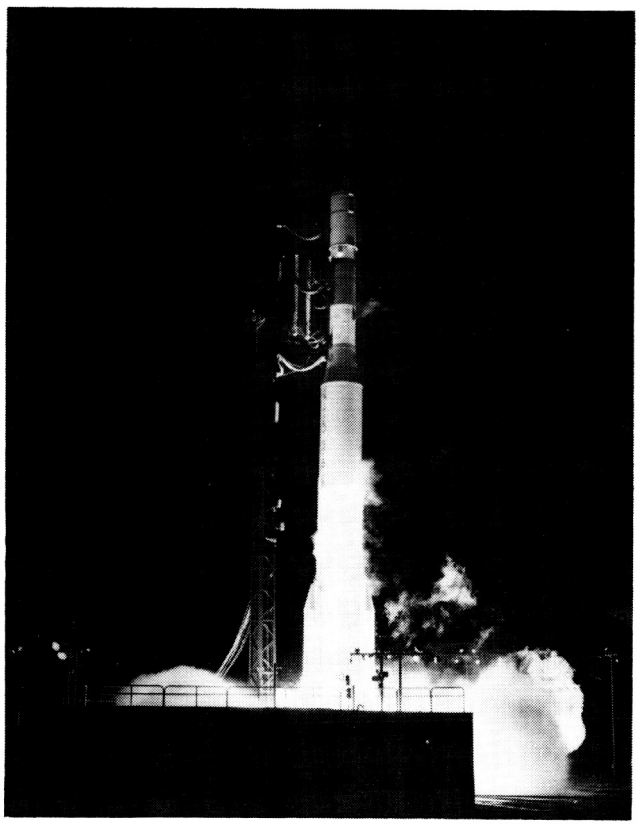

Figure III-2. - Thorad-Agena lift-off with nimbus III.

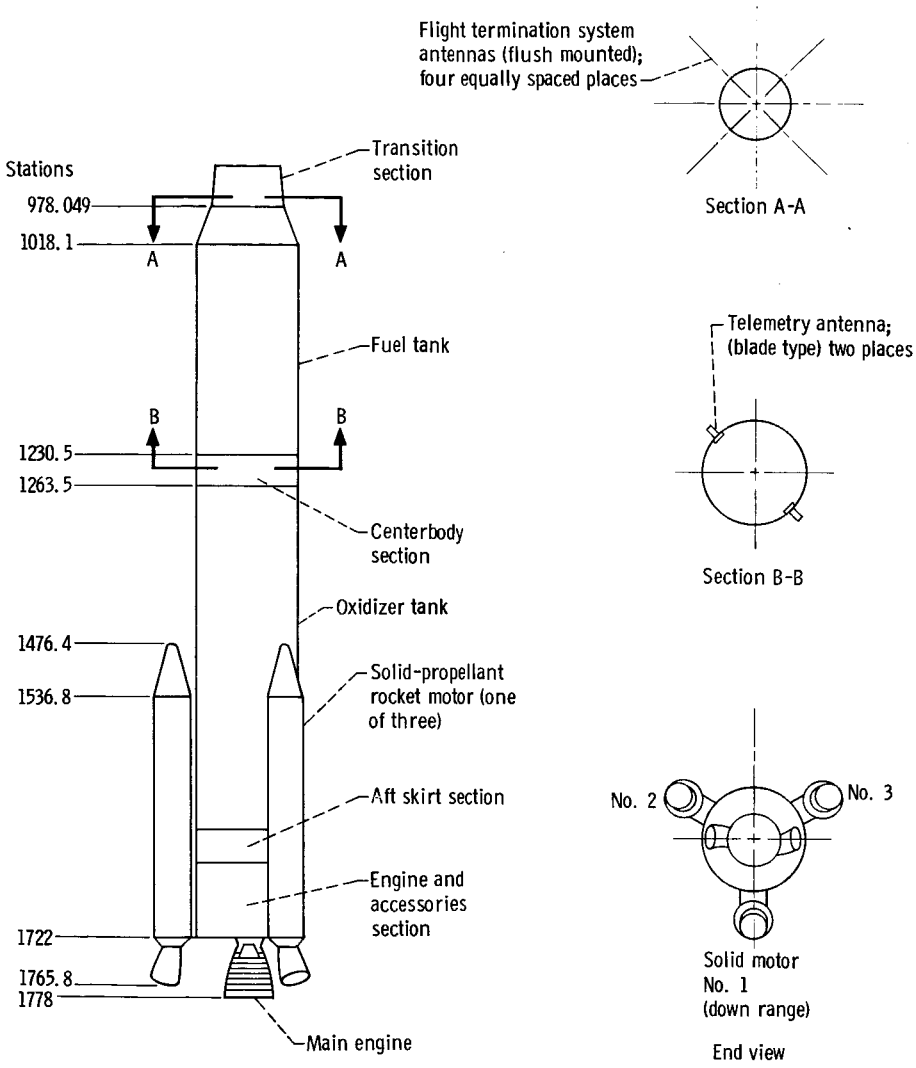

Figure III-3. - Thorad general configuration, Nimbus III.

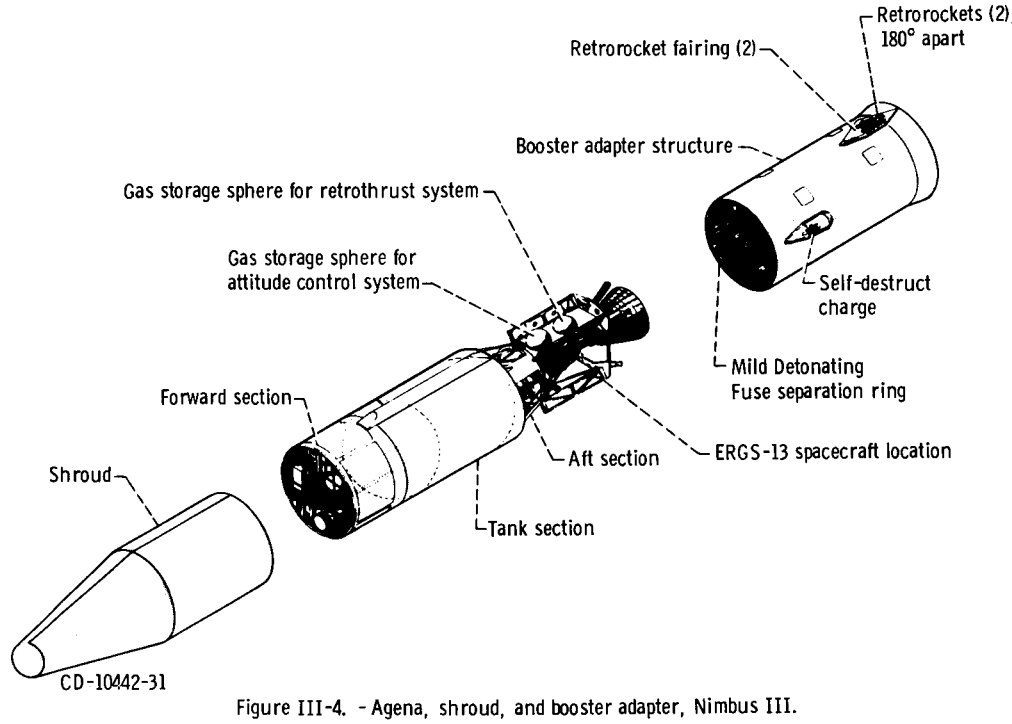

Figure III-4. - Agena, shroud, and booster adapter, Nimbus III.

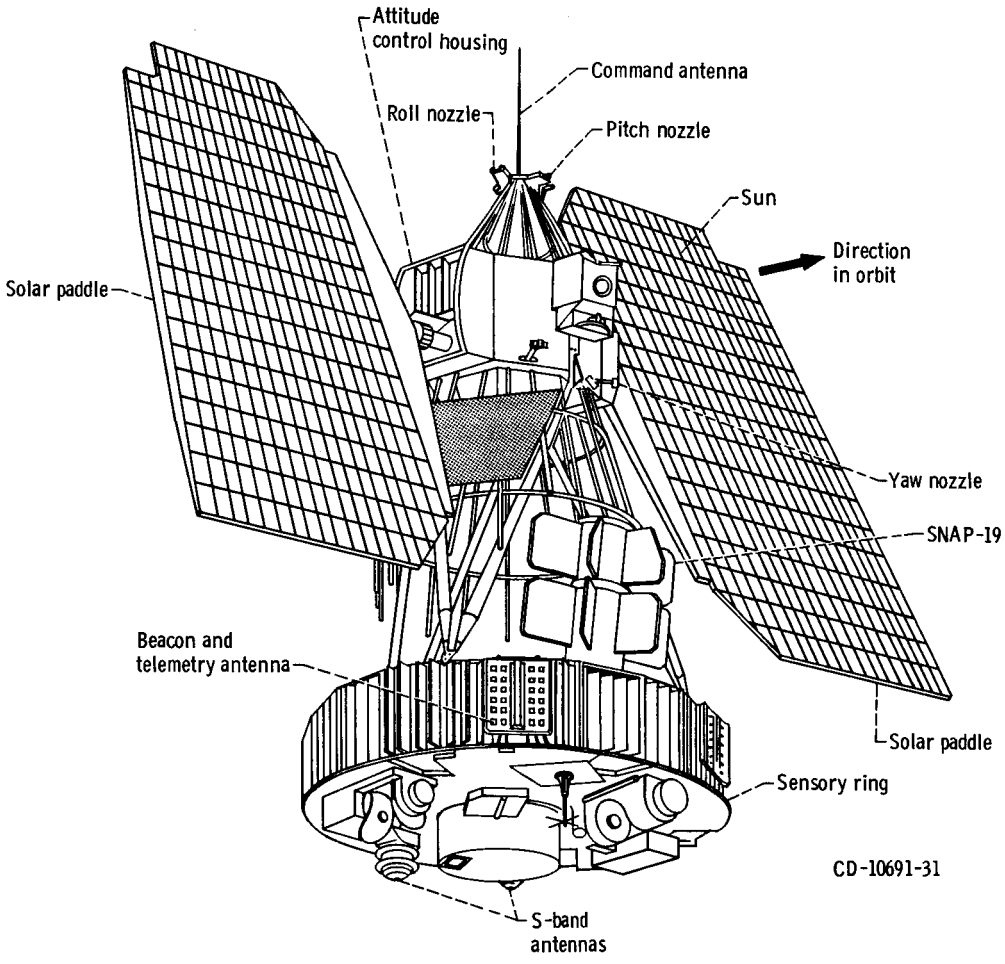

Figure III-5. - Nimbus III spacecraft in deployed configuration.