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FOR RELEASE: TUESDAY AM'S
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PROJECT: TIROS I (Eye)

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NEWS NASA NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NASA TO LAUNCH

FIRST 'CARTWHEEL'

WEATHER SATELLITE

The National Aeronautics and Space Administration will launch a new version of its TIROS weather satellite no earlier than Jan. 19 from Cape Kennedy, Fla.

The new satellite, designated TIROS I (eye), will roll along its near-polar orbit much like a cartwheel. Cameras will view the Earth from its side or rim unlike cameras on earlier TIROS which pointed from the bottom of the satellite.

TIROS I is designed to roll at a rate of 10 revolutions a minute. Cameras in its rim will view the Earth once during each revolution permitting the photographing of the entire sunlit portion of the Earth daily.

If the launch is successful, the satellite will be designated TIROS IX. Nine consecutive NASA weather satellite launches have been successful. Of these, the eight earlier TIROS have snapped some 415,000 weather pictures of the Earth and the Nimbus I took 27,000 pictures.

The launch marks the first NASA attempt to place a satellite in near-polar sun-synchronous orbit from Cape Kennedy. TIROS I is scheduled to enter orbit over the Pacific Ocean about 300 miles west of Quito, Ecuador after its Delta launch vehicle has performed three dog-leg maneuvers.

The Delta launch vehicle, which has placed 25 NASA satellites in orbit, is programmed to put the 305-pound TIROS I into a circular orbit 460 statute miles high, inclined 81.6 degrees to the equator, and with an orbital period of 100 minutes.

Primary objective of the TIROS I research and development launching is to test the cartwheel configuration. It is the forerunner for the joint NASA and U. S. Weather Bureau operational weather satellite system called the TIROS Operational Satellite (TOS) system. The TOS program consists of six launches and is scheduled to begin next winter.

TIROS (Television Infrared Observation Satellite) is a weather satellite project of NASA's Office of Space Science and Applications. Technical direction is the responsibility of the Goddard Space Flight Center, Greenbelt, Md. The U.S. Weather Bureau receives all weather data from the satellite for distribution to the world-wide meteorological network.

BACKGROUND INFORMATION FOLLOWS

TECHNICAL BACKGROUND

TIROS I (eye) - Statistics

Spacecraft	Cylindrical, 18-sided polygon, 22 inches high and 42 inches diameter, weighing 305 pounds
Mission objectives	Test cartwheel configuration Increase Earth coverage from a satellite Increase frequency and accuracy of measurements Improve accuracy and resolution of television pictures Develop faster means for picture distribution
Launch Information:	
Vehicle	Three-stage Delta developing 170,000 pounds of thrust at liftoff
Launch Pad	Complex 17, Pad A at the Eastern Test Range, Cape Kennedy, Fla.
Date	No earlier than Jan. 19
Orbital Elements:	
Inclination	Near-polar and Sun synchronous, 81 degrees retrograde to the equator
Period	100 minutes
Orbit	Circular, 460 statute miles high

Velocity	Approximately 18,000 miles per hour
Cameras	Two, $\frac{1}{2}$-inch vidicons which take more than 400 pictures daily with a resolution of about two miles at picture center
Power System	9,100 solar cells (N on P) which convert sun energy to electrical energy to keep 63-nickel cadmium batteries charged
Tracking	Fifteen stations of the world-wide Space Tracking and Data Acquisition Network (STADAN) operated by the Goddard Space Flight Center
Command and Data Acquisition Stations	**Wallops Island, Va.** **Gilmore Creek, Alaska** **San Nicolas Island, Calif.**
Program management	Office of Meteorological Programs, Office of Space Science and Applications, NASA Headquarters
Project managment	Goddard Space Flight Center (Spacecraft, Launch vehicle and Launch Operations)

Major contractors:

Delta vehicle	Douglas Aircraft Co.
TIROS spacecraft	Radio Corp. of America

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THE FLIGHT PLAN

TIROS I will be the first NASA satellite ever shot into polar orbit from Cape Kennedy. Launch vehicle for the mission is the NASA-developed, three-stage Delta.

Delta will leave Complex 17, Pad A and must perform three precise "dog leg" maneuvers before it reaches its orbit injection point over the Pacific Ocean.

Launch is scheduled for 3 a.m. The launch window is about 45 minutes.

During first stage burning, from T plus 90 to T plus 130 seconds, a yaw right command from the guidance system will turn the vehicle to the right.

Six seconds after the second stage ignites, about 153 seconds after launch, the guidance system will send another yaw right command for six seconds. Also during the second stage burning a six-second pitch up command will nudge the nose upward.

When the second stage burns out and the 441-second coast period begins, Delta will perform its final maneuver. During this coast period the vehicle will be pitched down 47 degrees and yawed nose left eight degrees so the vehicle is in proper attitude for third stage ignition and injection.

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If Delta performs as planned, TIROS I will be injected into orbit over the Pacific Ocean about 300 miles West of Quito, Ecuador (84 degrees West longitude, 0 degrees latitude).

During the first orbit the satellite will operate in much the same manner as the earlier TIROS spacecraft. It will be spin stabilized at about 10 rpm with the bottom of the spacecraft, or baseplate, looking at the Earth.

As TIROS starts it second orbit a gradual orientation maneuver, performed by ground controllers, begins to turn the satellite on its side into the cartwheel position. On command from the ground, electrical currents pass through a magnetic-attitude coil inside the spacecraft which turns the satellite on its side at a rate of approximately 10 degrees per orbit.

When the satellite is about half way on its side (45 degrees to the vertical plane of the Earth) the current will be reduced to about half so TIROS will turn five degrees each orbit.

Approximately 14 to 18 orbits, or 24 hours after launching, TIROS I should be turned on its side in the cartwheel attitude. After about 36 hours, project engineers will turn the two television cameras on to photograph the Earth. Two ½-inch vidicon cameras can take pictures at 32, 64, or 128-second intervals or more than 400 daily.

Pictures will be sent to TIROS ground stations on at least 10 of the 14 daily orbits. However, weather pictures can be recorded during three "blind" orbits (orbits which do not pass over one of the three TIROS ground stations) for playback on a later pass.

Spacecraft performance data as well as weather pictures will be sent to three ground stations called Command and Data Acquisition (CDA) stations. These stations are at Wallops Island, Va., San Nicolas Island off the California coast, and Gilmore Creek, Alaska.

POLAR, SUN-SYNCHRONOUS ORBIT

Complete coverage of the world's cloud cover, compared to about 25 per cent with earlier TIROS, will be possible due to a combination of the cartwheel configuration and an orbit which is polar and sun-synchronous.

In a sun-synchronous orbit the precession (westward drift) of the satellite is about one-degree daily, the same rate and direction as the Earth moves around the Sun.

Thus, the Sun is always behind TIROS so the satellite is in a favorable position to take pictures during all four seasons of the year.

TIROS SPACECRAFT

About the only likeness between TIROS I and its eight predecessors is the hat-box shaped structure. It is an 18-sided polygon which weighs 305 pounds, stands 22 inches high and measures 42 inches in diameter.

Some of the new components to undergo testing for the first time aboard TIROS are digital clocks, control system, horizon scanners, solid state commutators for telemetry and a new triggering system for the cameras.

The 9,100 solar cells mounted on the top and sides of the satellite structure have been changed from positive on negative (P on N) to negative on positive (N on P), which do not deteriorate as rapidly in the artificial radiation belt.

Protruding from the top of the satellite is an 18-inch receiving antenna which receives commands from data acquisition stations.

Four 22-inch transmitting whip antennas extend from the bottom of TIROS I, or the baseplate, which is made of .064-inch aluminum alloy. These equally spaced antennas transmit television pictures and telemetry information concerning the spacecraft temperature, pressure, battery charge levels, spin rate and other "housekeeping" data.

The two TV cameras are mounted 180 degrees apart on the rim of the satellite rather than in the bottom. This enables each camera to view the Earth once every six seconds as TIROS rolls along its orbit.

STABILIZATION AND CONTROL SUBSYSTEMS

Two dynamic control (DYCON) units in TIROS I control the satellite's spin rate, camera timing and magnetic attitude coil currents which steer TIROS to the cartwheel attitude and maintain it in that position.

Shortly before the burned out second stage of Delta separates from the third stage, the entire vehicle spins up to approximately 125 rpm.

To reduce the spin rate to 10 rpm, a timer triggers two weights attached to cables wrapped around the outside of the satellite. As the weights uncoil, they reduce the spin to the desired rate and then automatically drop away from the spacecraft.

The interaction between the Earth's magnetic field and magnetic material in the spacecraft causes a drag effect which reduces the spin rate making the satellite unstable.

To prevent this, TIROS I has two types of spin control systems -- a magnetic coil inside the spacecraft and small, solid propellant rockets for backup.

The magnetic coil is made of aluminum and measures 30 inches long and is tightly wrapped inside a rectangular spool in the spacecraft. The spin rate can be kept almost constant by sending small charges of electric current through the coil.

As a backup, five pairs of firecracker-size solid propellant rockets mounted on the rim of the spacecraft can be fired upon command from a ground station.

Each rocket motor develops an impulse of approximately 1.4 pounds per second, and when fired in pairs, can increase the spin rate by about three rpm.

Attitude Sensors

Two infrared horizon sensors arranged in a V configuration determine the satellite's attitude in space. The plane of the V contains the spin axis and the bisector of the angle between the optical axes is normal to the spin vector.

If the spin axis of the satellite is normal to an Earth radius the outputs of the sensors are identical. If a yaw error exists, there will be a roll error 90 degrees later in orbit because of the inertial rigidity of the spin vector.

This roll error is detectable as an inequality in the pulse durations of the two sensors.

Because accuracy is determined by the resolution and reliability of each of the data points, at least 10 minutes of roll error will be required in a given pass.

Television Cameras

The camera subsystems are two identical ½-inch vidicon cameras, similar to those carried on previous TIROS missions. They have a resolution of about two miles at picture center.

These cameras, mounted on the side of the spacecraft, are canted 26 degrees to each side of the plane of the satellite's rotation so they can view the Earth once every revolution (every six seconds). An on-board timer programs the cameras to take pictures only when the satellite is looking straight down at Earth.

The TV tube is a 500-scan line vidicon with a persistence that permits a two-second scan with less than 20 per cent degradation in picture quality.

Each wide angle camera, using 104-degree lenses, will nominally take 16 pictures per orbit at 128 second intervals providing nearly full dawn-to-dusk coverage. Each picture will cover a 550,000 square mile area. The interval can be decreased to 64 or even 32 seconds, thereby providing increased overlap of successive pictures if required.

TIROS I camera systems can send pictures directly to a commandand data acquisition station or store the photos on one of two tape recorders for readout when the satellite passes within a 1,500 mile radius of a ground station.

Television pictures transmitted from the spacecraft are reconstructed on special kinescopes at the ground station and are photographed by 35mm cameras.

Transmission time for a full orbit of pictures takes about three minutes and begins when the satellite receives a radio command from the ground.

Sufficient tape is provided in each of the two tape recorders for storing 48 picture frames at a speed of 50 inches per second. The tapes are erased immediately after playback and again just before recording.

Camera Triggering Subsystem

Because of the orientation of the cameras in relation to the spacecraft a new triggering system is required for TIROS I so pictures are taken only when the cameras are looking vertically at Earth.

Each of the cameras has two independent triggering systems, a Self-Computing Trigger system and a Spin-Synchronized Trigger system. A command from the ground will select which system is to be used.

The Self Computing-Trigger system is controlled by an on-board computer which predicts horizon crossings in advance to ready the cameras and tape recorders for an upcoming picture sequence.

The Spin-Synchronized Trigger system can operate only when the spacecraft is spinning precisely at 9.8 rpm. Horizon scanners determine the satellite's spin rate so the triggering system will turn the cameras and tape recorders on when the Earth is directly below.

Power Supply

The power supply delivers up to 2.2 amperes and consists of solar cells, storage batteries, voltage regulators and protective circuits.

Solar energy is converted to electricity by 9,100 N on P solar cells, 1 cm by 2 cm, attached to the top and sides of the spacecraft cover assembly. The cells are arranged in shingles of five series-connected cells.

Each cell has a bonded coat of fused silica to improve thermal emissivity and a vacuum-deposited anti-reflective coating, plus a 6mm shield to prevent radiation damage.

During the daylight orbits, the solar array power is fed directly to spacecraft subsystems. Current which is not required is used to charge 63 nickel-cadmium storage batteries which have a capacity of 295 watt-hours.

The batteries, connected in three parallel strings of 21 cells, supply spacecraft power during the nighttime.

Diodes in the solar cells prevent the storage batteries from discharging into the solar cells during orbital night.

DELTA LAUNCH VEHICLE

The Delta project management plus launch operations is under the direction of the Goddard Space Flight Center.

The Delta vehicle has the following general characteristics:

Height	90 feet
Maximum diameter	8 feet
Lift-off weight	about 57 tons

First stage: Modified Air Force Thor, produced by Douglas Aircraft Co.

Fuel:	Liquid (Kerosene with liquid oxygen as oxidizer)
Thrust:	170,000 pounds
Burning time:	about 2 minutes and 27 seconds
Weight:	more than 50 tons

Second stage: Aerojet General Corp., JA 10-118 propulsion system.

Fuel:	Liquid (UDMH and Inhibited Red Fuming Nitric Acid)
Thrust:	about 7,500 pounds
Burning time:	approximately 1 minute 40 seconds
Weight:	2½ tons

Third stage: **Allegany** Ballistics Laboratory X-258 motor

Fuel: Solid

Thrust: Approximately 5,700 pounds

Burning time: 26 seconds

Weight: 576 pounds

PROJECT OFFICIALS

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Radio Corp. of America:

Abraham Schnapf, TIROS Project Manager

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WEATHER SATELLITE RECORD

Satellite	Launch Date	Lifetime	Inclination	Pictures Taken
TIROS I	April 1, 1960	2½ mos.	48 degrees	22,952
TIROS II	Nov. 23, 1960	10 mos.	48 degrees	36,156
TIROS III	July 12, 1961	4½ mos.	48 degrees	35,033
TIROS IV	Feb. 8, 1962	4½ mos.	48 degrees	32,593
TIROS V	June 19, 1962	10½ mos.	58 degrees	58,226
TIROS VI	Sept. 18, 1962	13 mos.	58 degrees	66,674
TIROS VII	June 19, 1963	still operating	58 degrees	95,573*
TIROS VIII	Dec. 21, 1963	still operating	58 degrees	66,444*
NIMBUS I	Aug. 28, 1964	26 days	near polar/ 82 degrees	27,000
			Total pictures	440,631

*As of Mid-January

Eight TIROS storm trackers plus the Nimbus I weather observer have spotted almost every tropical storm and hurricane since 1960, enabling the Weather Bureau to issue more than 5,000 nephanalyses and 1,000 storm bulletins.

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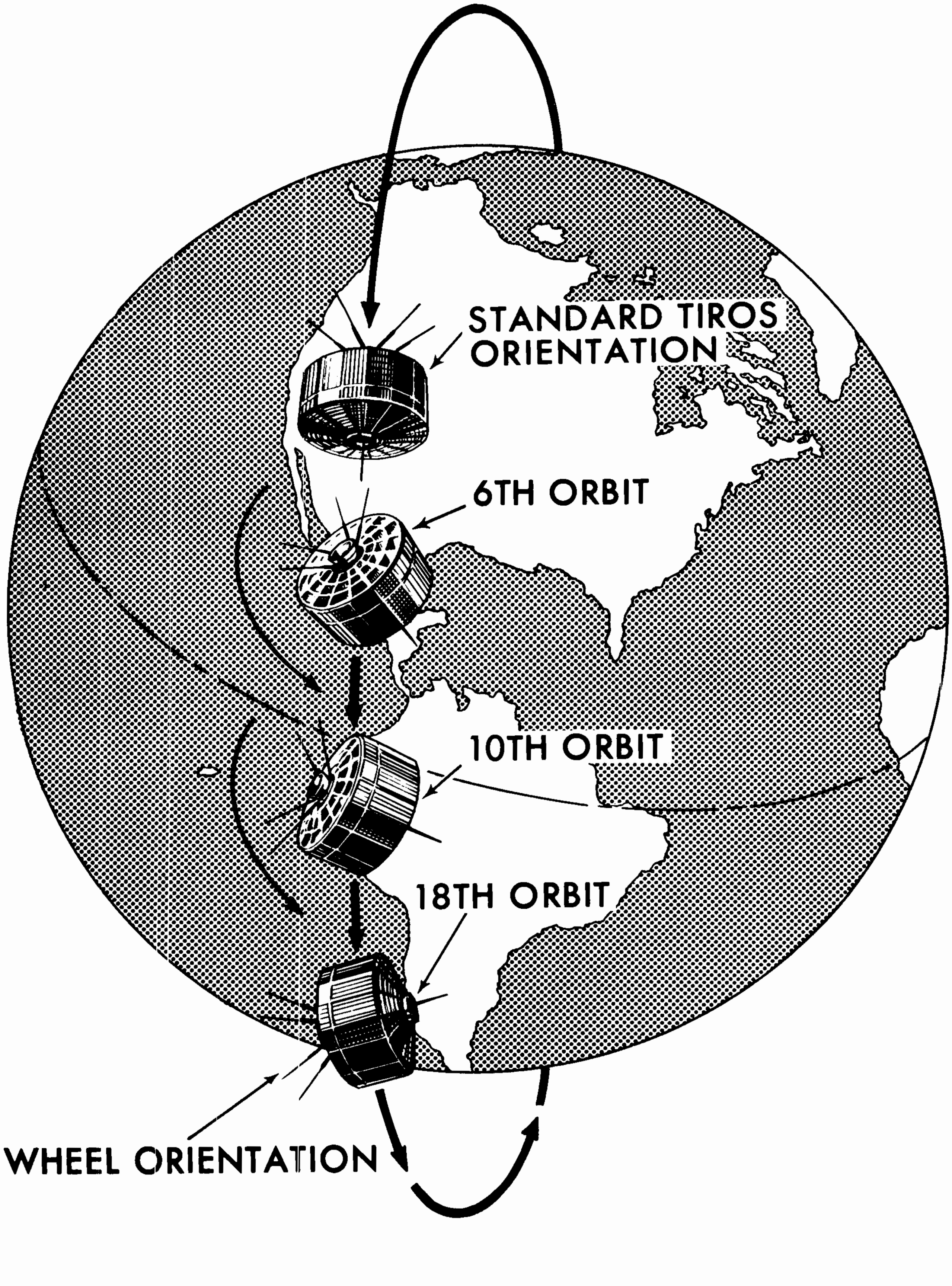
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18TH ORBIT
WHEEL ORIENTATION