JOHN F. KENNEDY
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ATLAS/CENTAUR-29

INTELSAT IV (F5)

FLASH FLIGHT REPORT

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INTELSAT IV (F5) FLASH FLIGHT REPORT (NASA)
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Prepared by
CENTAUR Operations Branch, KSC-ULO

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SUMMARY

ATLAS/CENTAUR-29 was launched from ETR Complex 36B, June 13, 1972, at 2153:04.100 GMT on a flight azimuth of 101 degrees. The ETR test number was 1240. The launch vehicle consisted of an ATLAS SLV-3C (S/N 5009C) first stage and a CENTAUR (S/N 26D) second stage. The spacecraft was INTELSAT IV (F-5).

The launch occurred at the opening of the window.

Indications are that the spacecraft was injected into the required transfer orbit and has achieved it's final orbit. All orbital parameters were extremely close to nominal.

A nominal apogee motor burn took place at 2101 EDT on June 14, 1972 at 124 degrees East longitude and the final duty station of the spacecraft will be at 62 degrees East longitude. A two week communications checkout was started on or about June 15, 1972.

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SECTION I
LAUNCH INFORMATION

A. MISSION OBJECTIVE

The INTELSAT IV(F5) spacecraft was the fourth of a series of fourth generation commercial satellites designed by the International Telecommunications Satellite (INTELSAT) Consortium to provide expanded worldwide telecommunications services. The INTELSAT Consortium is currently a 83 nation organization sponsoring the global communications network. The INTELSAT IV (F5) spacecraft was launched by an ATLAS SLV-3C first stage and a CENTAUR second stage vehicle designated ATLAS/CENTAUR-29.

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. Launch Vehicle.

a. ATLAS. The ATLAS stage (S/N 5009C) for the AC-29 mission was the SLV-3C. Propulsion of the ATLAS was provided by an MA-5 Rocketdyne engine group consisting of a booster engine with two thrust chambers, a sustainer engine, and two vernier engines. All are single-start, fixed-thrust, liquid propellant engines which provide a combined thrust of 403,383 pounds at liftoff. Liquid oxygen and RP-1 are used as propellants. The vernier engines are free to gimbal in the pitch plane only for roll control thrust during sustainer flight. The ATLAS autopilot system rolled the vehicle to the proper flight azimuth during the first 2 to 15 seconds of the flight after which the ATLAS autopilot system in conjunction with the CENTAUR guidance computer controlled the flight trajectory. The guidance steering was determined by prelaunch upper air wind soundings. The complete CENTAUR guidance system was enabled for trajectory control at 8 seconds after Booster Engine Cutoff (BECO). One lightweight telemetry package to monitor inflight performance and two Avco MK III command receivers for Range Safety purposes were aboard the ATLAS.

b. CENTAUR. The CENTAUR stage was S/N 26D. Flight trajectory was controlled by an improved Honeywell all-inertial guidance system which utilizes the main engines for thrust vector control, and an improved hydrogen peroxide system for attitude control. The hydrogen peroxide system also provided continuous propellant settlement during the coast phase. The main engines were the Pratt and Whitney production model RL10A3-3 improved performance type.

2. Spacecraft. The INTELSAT IV (F5) spacecraft is approximately 93 inches in diameter and 208 inches in overall height. The spacecraft is a rotor stabilized, earth-oriented platform, with the spinning section consisting of: a cylindrical solar cell array; positioning and orientation subsystems which include redundant radial and axial hydrazine thrusters that supply impulse for spacecraft spinup and station-keeping requirements; and a solid propellant apogee motor. The despun platform contains the communications repeaters, the

antennas, and the telemetry and command systems. Electrical power to operate the spacecraft is provided by 42,240 solar cells around its spinning drum shapped body. During solar eclipse periods, power is provided by two nickel cadmium batteries that are charged by a separate array of about 2,770 cells. A Bearing and Power Transfer Assembly acts as the rotary interface between the counter-rotating elements and permits power and signals to flow between the two sections.

The spacecraft weighed approximately 3,000 pounds at launch and about 1,600 pounds at apogee motor burnout. The spacecraft contains 12 transponders providing 12 television channels or from 3,000 to 9,000 telephone circuits (depending upon the mode of operation). The spacecraft has a design lifetime of seven years.

The INTELSAT IV (F5) spacecraft was built by Hughes Aircraft Company (HAC) for the Communications Satellite Corporation (COMSAT), who functions as manager on behalf of the INTELSAT Consortium.

3. Nose Fairing. The INTELSAT IV (F5) nose fairing was a conical-cylindrical shroud incorporating a cork thermal barrier and a spring jettison system. The nose fairing extended approximately 11 feet above the top of the spacecraft to the bottom of the interstage adapter and was retained around the spacecraft until after CENTAUR engine start to protect the spacecraft during flight through the atmosphere and from ATLAS retrorocket exhaust.

SECTION II
FLIGHT PERFORMANCE

A. SPACECRAFT

All INTELSAT IV (F5) systems were nominal during the launch phase as indicated by the telemetry signals received. Data received at the spacecraft ground station from Carnarvon indicated that the spacecraft performed nominally. All other telemetry data received were within parameters.

The INTELSAT IV (F5) apogee motor was fired at 2101 EDT on June 14, 1972 during the third apogee near 124 degrees East longitude. The firing was successful and placed the spacecraft on a synchronous orbit with a westward drift of 4 degrees a day. Checkout of the communications system commenced on June 15, 1972.

B. RANGE SAFETY AND TRAJECTORY

The Range Safety plots during the flight were nominal. The flight azimuth was 101 degrees, using pitch program 103 and yaw program 0. The flight appeared to be nominal and on time during all phases. The IIP for BECO and SECO also appeared to fall as predicted. The CENTAUR stage passed through the African protective line on time. The Range Safety Officer sent SAFE at T+619.9 seconds. Guidance payload orbital parameters are presented in table 1.

Table 1. Guidance Payload Orbital Parameters

Parameter	Nominal	Actual
Epoch time	-	1728.11 seconds
Eccentricity (no units)	.718814	.718789
Inclination (deg)	26.9985	26.9958
Period (min)	640.1529	639.9458
Apogee (nm)	22,835.17	22,829.92
Perigee (nm)	3,735.67	3,735.20
Apogee height (nm)	19,391.24	19,385.99
Perigee height (nm)	291.74	291.27
Semimajor axis (nm)	13,285.42	13,282.56
Longitude of ascending node (deg)	164.3710	164.3242
C_3 km ^{2}/sec ^{2}	- 16.20027	- 16.20376

C. GUIDANCE

The countdown of MGS-42 and Computer 034 commenced on F-1 day in order to stabilize the v-accelerometer bias term (dg). After the normal 2 hour warm-up, three successive calibrations were made on the v-accelerometer bias term. The shift from the previous reading was (-75 micro-g's) out of the re-calibration specification; however, the next 2 Delta's (23 and 22 micro-g's) indicated that the bias term was trending towards its stable operating point. The system was powered down following the third calibration.

On launch day MGS-42 and computer 034 countdown was nominal (dg shift was 23 micro-g's). Pitch program 103 and yaw program 0 were loaded and verified along with the J-constants at nominal time.

Preliminary analysis of telemetry data indicates that the guidance system performed satisfactorily during flight.

D. CONTROL SYSTEM

1. General. The transients that occurred at liftoff were similar to those experienced on previous flights. The maximum transients at this time were pitch rate of 1.50 degrees/second peak-to-peak and a roll rate of 1.35 degrees/second peak-to-peak. A preliminary review of the data indicates that the vehicle was rolled to an azimuth of 101.78 degrees. The error is less than 1 percent of the programmed command. Maximum Q region was reached at approximately T+82 seconds and required an engine displacement of 2.64 degrees for B1 pitch and 2.64 degrees for B2 pitch, while the B1 yaw engine deflection was 2.16 degrees and B2 yaw engine deflection was 2.16 degrees.

At T+160.1 seconds, guidance steering to the ATLAS was enabled by the programmer (BECO +8 seconds). The initial commands resulted in sustainer engine deflections in pitch of 0.40 degree and in yaw of minus 0.64 degree.

The oscillations in pitch and yaw during insulation panel jettison were comparable to previous flights and caused no significant vehicle motion. The rates imparted to the CENTAUR at ATLAS/CENTAUR separation were not unusual, with the highest pitch rate observed being 0.43 degree/second peak-to-peak. Transients at CENTAUR main engine start were minus 1.30 degrees/second in pitch, minus 0.40 degree/second in yaw, and minus 1.11 degrees/second in roll.

The rates generated from the nose fairing jettison occurred for a duration of three seconds. The highest rate was in pitch at minus 1.84 degrees/second while roll was 0.60 degree/second and yaw was 0.60 degree/second.

A small limit cycle was observed in the pitch channel during the first main engine burning time. The pitch rate was 0.54 degree/second peak-to-peak. Data from downrange indicated a stable vehicle throughout the coast period, second powered phase, and spacecraft separation.

2. ATLAS Propellant Utilization (PU). Matched set 114 was the propellant utilization set installed on the ATLAS for this flight. After the Error Demodulator Output (EDO) lockout was disabled at T+13 seconds, the sustainer engine fuel valve responded properly (open) to the indicated EDO voltage. The valve remained open until just prior to BECO when it started to move to a closed position. During the sustainer phase, the EDO showed a lox excess for most of the burn and the valve was in a position between closed and nominal occasionally going to the closed limit stop. At SECO minus 11.4 seconds the valve was at the closed limit.

The fuel and lox ports uncovered at SECO minus 8.4 and SECO minus 7.4 seconds respectively indicating satisfactory residuals at SECO.

E. RANGE SAFETY COMMANDS

The Range Safety Command (RSC) system data during flight indicated nominal operation with sufficient signal levels to respond to command if required. No commands were received or generated except RF disable. RF disable was received at 624 seconds from the Grand Turk station. RSC transmitter coverage is presented in table 2.

Table 2. Range Safety Command Transmitter Coverage

Event	Time in Seconds
Mainland RSC carrier on	T-1890
Mainland RSC carrier off	T+261
Station 3 RSC carrier on	T+261
Station 3 RSC carrier off	T+476
Station 7 RSC carrier on	T+475
Station 7 RSC carrier off	T+598.5
Station 91 RSC carrier on	T+597.5
Station 91 RSC carrier off	T+638.5
ATLAS RSC no. 1 AGC - AD7V - 80%	T-0
ATLAS RSC No. 2 AGC - AD4V - 87%	T-0
CENTAUR RSC No. 1 AGC - CD98V - 72%	T-0
CENTAUR RSC No. 2 AGC - CD99V - 70%	T-0

F. RF SYSTEMS

The C-band system performance was nominal (table 3). The frequency was stabilized, and the coded beacon afforded excellent tracking data. The system maintained adequate power. Refer to table 4 for radar station coverage.

Table 3. C-Band Transponder Range Readouts

Parameter	SP-106-Van	1.16 Radar
Beacon interrogation frequency (MHz)	.33	nominal
Beacon transponder frequency (MHz)	0.9	-0.5
Beacon delay (ms)	2.23	2.38
Pulse width (ms)	0.48	0.45
Range jitter (ms)	0.045	0
Countdown (%)	0	0
Recovery (ms)	46.5	-
Sensitivity (dbm)	-77.2	-77
Power (dbm)	67.6	56
Coding (ms)	0.01	-0.1
Time (GMT)	1950	2040
Condition	GO	GO

Table 4. AC-29 C-Band Radar Coverage

Station Radar	Auto Beacon Coverage (seconds)	Auto Skin Track (seconds)
1.16	0-380	-
19.18	12-62/65-102/104-379/381-547	62-65/102-104/379-381
0.18	275-557	25-275
3.13	84-95/249-273	-
7.18	205-661	-
67.16	248-530	-
67.18	278-704	-
91.18	389-795	-
12.16	1165-1718	-
	1742-1760	

G. MECHANICAL SYSTEMS

1. ATLAS Mechanical. All ATLAS mechanical systems operated satisfactorily. Propulsion system performance parameters were near predicted values. Total booster engine burn time was 153.3 seconds and sustainer burn time was 240.3 seconds, based on the total time engine chamber pressures were greater than 90 percent of the expected values. These burn times are shorter than expected, indicating slightly higher than predicted engine performance. A lox depletion shutdown of the sustainer occurred as expected, with SECO being generated by the propellant depletion pressure switches. During the booster phase, one of the ATLAS thrust section temperature monitors (AA745T ambient at sustainer fuel pump) indicated that some localized heating was taking place. The temperature looked normal until approximately T+90 seconds when a change in temperature rise rate was evident. At BECO, AA745T was indicating 214 degrees F. This same localized temperature rise until BECO was noted during the AC-28 flight.

The pressurization system performance was near normal with programmed pressurization system events occurring on time and at correct values. Tank pressures are shown in table 5. The lox and fuel tank pressure regulator performances were satisfactory. Additional ATLAS mechanical data are presented in table 6.

Table 5. ATLAS Tank Ullage Pressures

Time	Lox Tank Pressure (psia)	Fuel Tank Pressure (psia)
Internal (prior to shift)	46.8	82
Internal (following shift)	46.2	82
T+10 seconds	46.2	82
T+20 seconds	45.6	82
T+25 seconds (after pressure increase)	48.6	80
BECO	35.4	68
SECO	36.6	59

Table 6. ATLAS Mechanical Data at Liftoff Plus 10 Seconds

Measurement No.	Description	Units	Values
AP1P	B1 lox pump inlet pressure	psia	63
AP2P	B1 fuel pump inlet pressure	psia	77
AP60P	B1 chamber pressure	psia	604
AP84B	B1 pump speed	rpm	6,550
AP59P	B2 chamber pressure	psia	596
AP83B	B2 pump speed	rpm	6,423
AP100P	Booster gas generator chamber pressure	psia	584
AP26P	Booster lox reference regulator pressure	psia	745
AF125P	Booster pneumatic control regulator pressure	psia	780

Table 6. ATLAS Mechanical Data at Liftoff Plus 10 Seconds (Cont'd)

Measurement No.	Description	Units	Values
AH3P	Booster hydraulic pump discharge pressure	psia	3,045
AH224P	Booster hydraulic low pressure	psia	78
AF246P*	Booster helium bottles pressure	psia	3,325
AP56P	Sustainer lox pump inlet pressure	psia	70
AP55P	Sustainer fuel pump inlet pressure	psia	80
AP6P	Sustainer chamber pressure	psia	745
AP349B	Sustainer pump speed	rpm	10,414
AP330P	Sustainer fuel pump discharge pressure	psia	930
AP339P	Sustainer gas generator discharge pressure (at turbine)	psia	680 (noisy)
AP344P	Sustainer lox reference regulator pressure	psia	880
AF288P	Sustainer pneumatic (integrated start system) regulator pressure	psia	612
AH130P	Sustainer hydraulic pump discharge pressure	psia	2,975
AH601P	Sustainer hydraulic return pressure	psia	108
AP28P	Vernier number 1 chamber pressure	psia	268
AP29P	Vernier number 2 chamber pressure	psia	268

*At T-0

2. CENTAUR Mechanical. CENTAUR mechancial systems data reflect satisfactory performance. The steady-state values for C1 and C2 chamber pressures during first burn were 386 psia and 390 psia, respectively, based on realtime data. The CENTAUR first burn was normal, with a burn time of 366.6 seconds, based on chamber pressures greater than 80 percent of expected values. Second burn also appeared normal based on limited data, with the exception of a possible C-1 chamber pressure transducer malfunction during the start transient.

All hydrogen peroxide system temperatures appeared normal during the countdown and through first burn. Hydrogen peroxide (H202) system performance was satisfactory. Both LOX and LH2 boost pump H202 system parameters were near expected values during both first and second burn. The H202 engines maintained vehicle control and provided propellant settling forces throughout the coast phase.

CENTAUR hydraulic and pneumatic systems performance was nominal, and vehicle separation sequences appeared to be normal.

Table 7 provides some significant flight performance data.

Table 7. CENTAUR Mechanical Systems First Burn Steady-State Data*

Measurement No.	Description	Units	Expected	Actual
CF1P	Lox ullage pressure (at MES)	psia	40	40.9
CF3P	LH2 ullage pressure (at MES)	psia	20.5	22.1
CP46P	C1 thrust chamber pressure	psia	385	386
CP47P	C2 thrust chamber pressure	psia	385	390
CP51P	C1 lox pump inlet pressure	psia	62	61.5
CP52P	C1 fuel pump inlet pressure	psia	30	30.0
CP53P	C2 lox pump inlet pressure	psia	62	60
CP54P	C2 fuel pump inlet pressure	psia	30	31.5
CP1B	C1 pump speed	rpm	12,100	12,000
CP2B	C2 pump speed	rpm	12,100	12,450
CP15B	Lox boost pump speed	rpm	33,000	33,600
CP16B	LH2 boost pump speed	rpm	41,000	42,250
CP26P	Lox B/P turbine inlet pressure	psia	94	92.5

Table 7. CENTAUR Mechanical Systems First Burn Steady-State Data* (Cont'd)

Measurement No.	Description	Units	Expected	Actual
CP28P	LH2 B/P turbine inlet pressure	psia	97	97.5
CH1P	C1 hydraulic power package pressure	psia	1,150	1,170
CH3P	C2 hydraulic power package pressure	psia	1,150	1,200
CF8P	Engine control regulator output	psia	456	459
CF12P	H2O2 bottle pressure	psia	310	304
CF2P	Helium storage bottle	psia	3,100	3,115**

* Data taken at MES +90 seconds
** After burp

H. ELECTRICAL SYSTEMS

1. ATLAS Power System. The ATLAS missile power system supported the launch with no anomalies. The internal checks of the RSC, telemetry, and main power system during the minus count reflected acceptable load data and current profiles.

The ATLAS vehicle power was transferred to internal at T-2 minutes, yielding acceptable voltage and frequency. At T=0, the main battery voltage supplied to the inverter was 27.5 vdc, and inverter output was 115.3 vac at 402.1 Hz, as reflected on panel meters. The inverter operated well within the expected voltage and frequency limits throughout powered flight. The ATLAS current profile (AE1C) appeared nominal during the 58 amperes at T=0.

2. CENTAUR Power Systems. The CENTAUR power system consisted of a main vehicle battery, two RSC batteries, and two pyrotechnic batteries. The minus count internal checks afforded excellent load profile data on all batteries with the exception of the pyrotechnic batteries which are monitored for open circuit voltage only.

The CENTAUR main missile and the telemetry systems were cycled to internal at T-4 minutes, and the telemetry data reflect nominal operation. The CENTAUR current profile (CE1C) was available and afforded excellent data. The start sequence current profile was as expected. The nominal value was 52 amperes during powered flight, with a high of 62 amperes during MES.

Table 8 reflects T=0 values of CENTAUR Power Systems.

Table 8. CENTAUR Power Systems Values

System	Value
Inverter	
Frequency	400.0 Hz
Ø A	115.3 vac
Ø B	115.2 vac
Ø C	115.2 vac
Vechicle power	
Main missile battery	28.02 vdc
Main missle current	45 amps

3. AC-29 Flight Ordnance. The AC-29 flight ordnance were installed prior to the start of F-1 day and was the last task completed on F-1 day. All ordnance cirucits except the retrorockets and gas generator ignitors were resistance checked to insure system integrity. All ordnance functions were performed satisfactorily from ATLAS ignition to spacecraft separation, as reflected on both accelerometer and the telemetered functions.

4. CENTAUR Propellant Utilization. The CENTAUR PU system performed nominally during the countdown and flight. The slew rates at T-105 minutes were 9.3 degrees/second and 9.6 degrees/second for C1 and C2 servopositioners, respectively. The crossover point during tanking resulted in the following: LH2 = 2,532 pounds, lox = 12,550 pounds, or 5 (LH2) - lox = 110 pounds. The empty quantities were 72 pounds and 180 pounds while the full quantities were 3,874 pounds and 19,450 for LH2 and lox, respectively. These quantities include 508 pounds of lox for coast bias and -55.0 pounds for error bias.

I. SEQUENCE OF FLIGHT EVENTS

Table 9 lists the major flight events and the times they occurred for the AC-29 flight.

Table 9. Sequence of Flight Events

Mark Event	Time (seconds)
ATLAS BECO	T+152.1
ATLAS booster jettison	T+155.1
CENTAUR insulation panel jettison	T+197.1
ATLAS SECO/VECO	T+238.7
ATLAS/CENTAUR separation	T+241.6
CENTAUR MES 1	T+252.1
Jettison nose fairing	T+264.5
CENTAUR MECO 1	T+618.7
CENTAUR MES 2	T+1520.5
CENTAUR MECO 2	T+1593.3
Spacecraft separation	T+1726.9
CENTAUR turnaround	T+1733.9
Start CENTAUR blowdown	T+1896.9
End CENTAUR blowdown	T+2145.9
Power changeover	T+2198.4

Table 10 lists the release ladder functions and the times they occurred for the AC-29 launch.

Table 1C. Release Ladder Functions

Event	Time (seconds)
Test conductor console start	T-12.329
Airborne purge flowing	T-12.199
Flight mode accepted	T-8.109
Engine tank pressurize	T-7.869
Insulation panel vent command	T-7.859
Insulation panel vent open	T-7.829
LH2 vent valve closed	T-7.789
Eject CENTAUR umbilicals	T-3.770
P402 ejected	T-3.709
P404 ejected	T-3.709
P403 ejected	T-3.709
P401 ejected	T-3.709
Second stage umbilicals ejected	T-2.979
Vernier flight lockin	T-2.959
Aft plate ejected	T-2.719
Booster flight lockin	T-2.059
Sustainer flight lockin	T-2.059
Main engine complete	T-.849
Prerelease C/O disarm	T-.839
Release	T-.770

Table 10. Release Ladder Functions (Cont'd)

Event	Time (seconds)
2-inch motion	21:53:04.100 GMT
600P4 ejected	T+.010
600P2 ejected	T+.010
600P3 ejected	T+.010
P4001 ejected	T+.020
600P5 ejected	T+.020
Umbilical boom upper boom solenoid	T+.020
P409 ejected	T+.020
Auxiliary 2-inch motion	T+.040
Umbilical boom lower boom solenoid	T+.280
8-inch motion	T+.300
600P1 ejected	T+.320

SECTION III
DATA ACQUISITION

A. TELEMETRY AND INSTRUMENTATION

The ATLAS/CENTAUR telemetry system operated with all parameters (with the exception of VCO 12), including RF center frequencies, commutator speeds, and Voltage Controlled Oscillator (VCO) deviations, well within their specified tolerances. The ATLAS 2215.5 MHz link had a signal strength of 1.0 k microvolts with a center frequency of 18.6 KHz below nominal at T-5 minutes. The CENTAUR 2202.5 MHz link had a signal strength of 950 microvolts with a center frequency 17.7 KHz above nominal. There were five discrepancies at this time according to available telemetry data.

1. VCO 12. This reading shifted down in frequency 7 percent at the high end and 8 percent at the low end.

2. CA80T Stagnation Point. This measurement indicated open at 2155:23 GMT, and a burned open thermo couple was the probable cause.

3. AH130P Sustainer Hydraulic Pump Discharge. This measurement indicated open at 2154:15 GMT. The measurement later came back to zero percent after SECO. A transducer failure is probably the cause of loss of data.

4. AM79A Missile Axial Acceleration Fine. This measurement is switched on at booster jettison. At this time, the measurement was inoperative and remained that way for the duration of the flight.

5. AU101A Axial Acceleration. This measurement showed no increase of acceleration at 2155:23 GMT.

The 2202.5 MHz link was received in Building AE in real time from Antigua by means of two wide band pairs and one voice/data circuit. The voice/data circuit contained VCO's 1 thru 7 while one wide band circuit contained VCO's 8 thru 16 and the other wide band circuit contained VCO 18. The data quality from Antigua was very good. There were seven VCO's containing data and one VCO with timing sent in realtime from Ascension (ETR). This data was transmitted in HF by ETR and also routed to the Space Flight Tracking Data Network (STDN) site on Ascension and returned to the Cape by satellite and voice data circuits. The guidance data from Ascension was transmitted by a 202 data modem on the combination of satellite and voice data circuits by ETR. The Ascension data quality was very good. The STDN participating stations were Bermuda, Johannesburg S.A., Tananarive, and Carnarvon. Tananarive is the only station that sent back in realtime. This data was of poor quality due to the 40 foot dish antenna not being available for launch. The power changeover mark event was seen from this station.

Refer to figure 1 for AC-29 telemetry coverage.

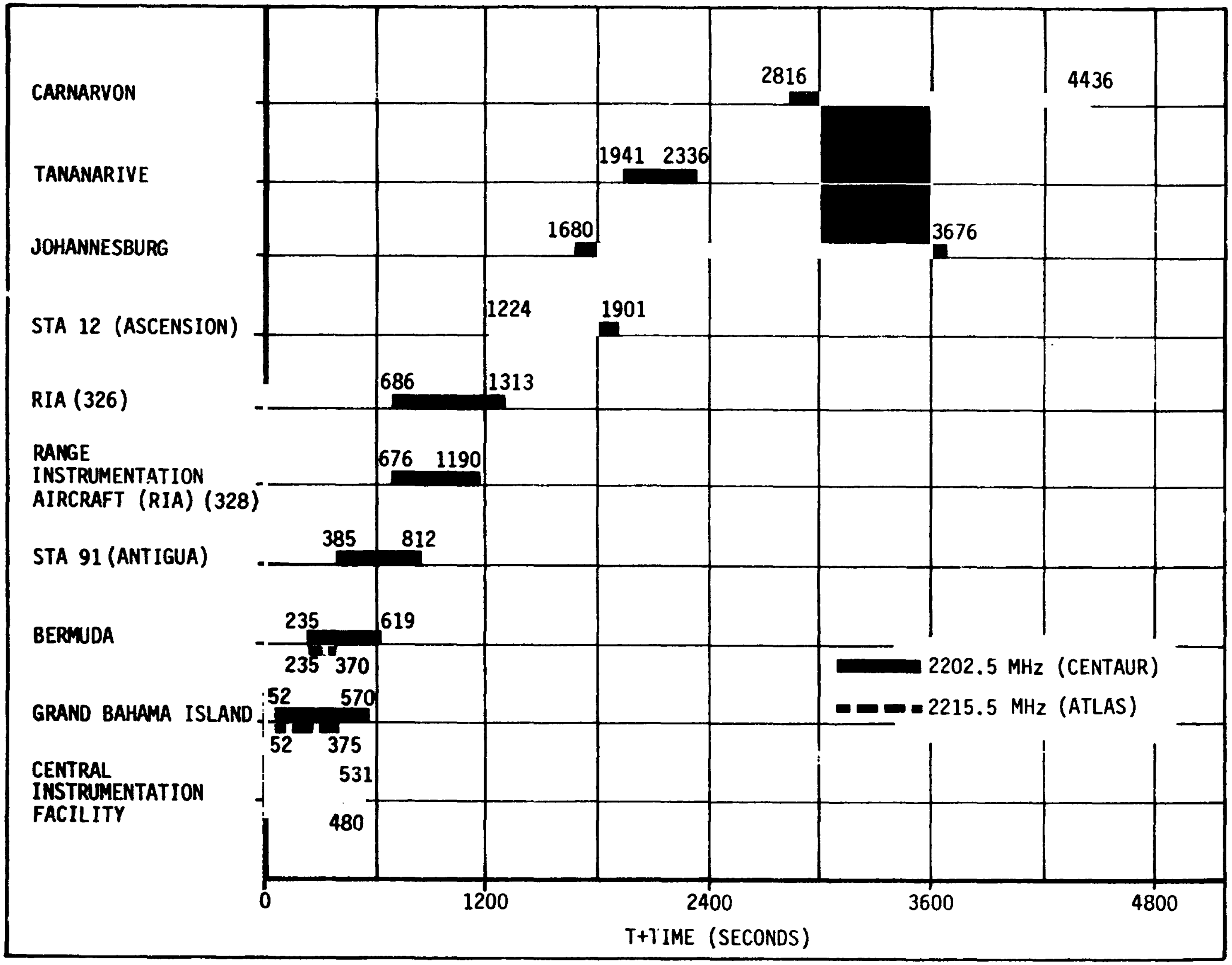

Figure 1. AC-29 Telemetry Coverage

B. OPTICS

This launch was supported by twenty-four engineering sequential cameras that provided coverage from T-4 minutes to T+10 minutes. Four of these cameras were of the long focal length type (ROTI-IGOR) that tracked from acquisition through LOV. Also included was a long range tracker (Patrick IGOR) that provided live TV for display and recording in Building AE and display on blockhouse monitors. An additional twenty-five documentary cameras recorded various launch operations.

SECTION IV
WEATHER AND PAD DAMAGE

A. WEATHER

Weather during the launch operation was nominal. At liftoff, the following weather parameters were recorded:

Temperature	80.2 degrees F
Relative humidity	73 percent
Visibility	10 miles
Dewpoint	71 degrees F
Surface winds	12 knots from 090 degrees with gusts to 17 knots
Clouds	3/10 stratocumulus at 1800 feet 3/10 cirrus clouds at 23,000 feet
Sea level atmospheric pressure	30.010 inches of mercury

B. PAD DAMAGE

No unusual pad damage was incurred.

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SECTION V
PRELAUNCH OPERATIONS

A. MILESTONES (LAUNCH VEHICLE)

The significant launch vehicle prelaunch milestones are presented in table 11.

Table 11. Launch Vehicle Prelaunch Milestones

Date	Event
2-4-72	CENTAUR (26D) arrived at ETR
2-10-72	ATLAS (5009C) arrived at ETR
3-7-72	ATLAS erected
3-8-72	CENTAUR erected
5-9-72	Terminal Countdown Demonstration
5-18-72	Flight Acceptanc Composite Test Number 1
6-2-72	Flight Acceptance Composite Test Number 2
6-8-72	Mated INTELSAT IV (F5) to CENTAUR
6-8-72	Composite Readiness Test
6-9-72	F-3 Day
6-10-72	F-2 Day
6-12-72	F-1 Day
6-13-72	Launch

B. SUMMARY OF MAJOR TESTS (LAUNCH VEHICLE)

1. Terminal Countdown Demonstration (TCD) May 9, 1972. The test nose fairing was installed the morning of May 8, 1972 subsequent to the removal of the ATLAS booster special instrumented separation bolts thus establishing a TCD configuration. RP-1 was tanked at 1500 GMT to flight levels followed by completion of electrical and mechanical tanking readiness procedure. The TCD began at 1115 GMT and proceeded as planned through the countdown to the 40 minute hold at T-10 minutes. During the 40 minute hold, severe weather warnings were issued and marginal environmental conditions predicted in the area about the time of the plus count. To insure ample time for completion of the plus count, detanking, and tower securing around the vehicle, the 40 minute hold was reduced so that upon the completion of all lockup and vent valve tests, the helium chilldown could be started and preparations made to pick up the count commensurate with the systems readiness report. The GN_2 heater blower in the vaporizer malfunctioned and this effect on the continuation of the test was evaluated and considered insignificant. Subsequent to determining vehicle readiness, the count was reinitiated and continued in accordance with the procedure. As the count proceeded, ATLAS boiloff valve locked indication was absent from the panel meter and the EA pens. Investigation in realtime revealed adequate tank pressures on the analog instrumentation verifying correct operation of the valve itself. The count was not held and continued through ATLAS airborne tanks cycling to internal pneumatics and successfully generating a cutoff when cycled to external. The start tanks were pressurized and vented and the safe guidance autopilot plus count was performed with a programmer start of 1441:59.4 GMT.

2. Flight Acceptance Composite Test (FACT) Number 1, May 18, 1972. The test was initiated and proceeded through the release sequence and plus count as planned. The programmer was in the armed configuration and all discretes were verified at their end function successfully with umbilicals ejected. No significant anomalies were reported in the post-test critique; however, the shuttle valve control LCS switch was manually operated and returned to normal position at the correct time. All systems were secured subsequent to the test.

3. Flight Acceptance Composite Test Number 2, June 2, 1972. This test was orginally planned for May 31, 1972 but was rescheduled to June 2, 1972 in order to incorporate new ATLAS autopilot components. A variation of a 40 millivolt magnitude was witnessed on the B-1 pitch feedback transducer during engine null checks. Investigation of the anomaly included special tests with the pitch and yaw actuators cross connected while monitoring the system for recurrence of the voltage variation with the engines at null. When the anomaly could not be made to re-appear, it was decided to changeout that portion of the autopilot system which could contribute to the cause of these variations. The changed components were the ATLAS autopilot servo, the ATLAS B-1 pitch actuator, and the GSE isolation amplifier. A series of replacement tests were performed on these new equipments yielding acceptable data and the system was again deemed within parameters. The components were sent to San Diego for failure analysis and the test was rescheduled for June 2, 1972.

The test began with a T=0 of 1500 GMT and proceeded through the release sequence, and plus count. The programmer was in the armed configuration and discretes were verified at their end function successfully with umbilicals ejected. There were two anomalies reported in the post-test critique. The ATLAS inverter frequency was 1/10 of a cycle low at internal. This was attributed to lower than normal voltage on the test ATLAS main missile battery. The burp pressure switch actuation test malfunctioned and was determined to be a function of the GSE pneumatic source. All systems were secured subsequent to the test.

4. Composite Readiness Test (CRT), June 8, 1972. Subsequent to spacecraft erection and securing, the CRT began on schedule. The test proceeded through the release sequence and plus count. However, a configuration difference was incorporated for the CRT which included nose fairing, explosive bolts monitoring with McKim boxes in the voltage monitoring position, and the installation of pyrotechnic and main missile flight type batteries. This configuration afforded an opportunity to evaluate the nose fairing vehicle interface for the first time in the armed and loaded mode. Subsequent to an evaluation of the current data to insure compatible nose fairing pyrotechnic configuration, the test was recycled to T-5 minutes and holding. The batteries were then removed and replaced with the battery simulator system and the McKim boxes were placed in the monitoring position. Prior to the count pickup for the second run, an instrumentation cable from the battery simulators to the GTR yeilded intermittent data. The test was held at this point to resolve the problem and the count was again initiated at T-5 minutes and continued according to procedure until termination. At ATLAS inverter to internal the ATLAS inverter was 1/10 of a cycle below redline, however, the countdown continued while that parameter was closely monitored. The engine start sequence was generated from the test panel and the count up in the armed configuration with umbilicals in was initiated. The realtime data indicated a successful test and the post-test critique yeilded no significant anomalies other than those previously mentioned. Systems were secured while test data was closely evaluated to expedite the breaking the system configuration to support spacecraft tasks. A test for the burp pressure switch which had malfunctioned during the previous FACT was incorporated and performed during the plus count of the CRT procedure. All data was reported as satisfactory within parameters and spacecraft tasks were put in work.

5. F-3 Day Activities June 9, 1972. Normal F-3 day activities were performed with the following events occurring. The ATLAS inverter was readjusted in frequency from a low of 401.4 Hz to a low of 401.8 Hz with an expected value at T=0 of 402 Hz. The complex 36B emergency power transfer controller was modified to delete the low voltage phase detection circuitry. The system will now transfer only upon complete loss of input voltage. A current signature was obtained from the current shunt in the LOX fill and drain valve circuitry to be used as a parameter to determine system acceptability during launch. The profile was acceptable and as expected. All ATLAS and Range safety command and telemetry batteries have been cleared of the low cell voltage anomaly with the exception of one battery which has a voltage level of 1.7 volts. This battery will be used for backup only and the cell will be monitored daily. Installation of ATLAS/CENTAUR pyrotechnics took place at 1800 hours EDT. Vehicle close out and launch preparations continued.

6. F-2 Day Activities June 10, 1972. Normal F-2 day activities were started with vehicle closeout and walkdown continuing in conjunction with readiness testing. When RP-1 was tanked to flight levels, a decrease in fuel tank pressure was discovered. A Ground Support Equipment (GSE) launcher ullage tank sensing line had developed a leak. It was decided to jumper the line with a flex cable rather then to repair or replace the leaking line. The jumpering was accomplished and the flex line secured and wrapped with blast tape. Prior to retanking, the area was cleared because of lightning. During RP-1 tanking, a circuit breaker for RP-1 pump FB dropped out. The circuit breaker was replaced resolving the problem. The tanking exercise was rescheduled for the morning of June 11, 1972, when peroxide tanking was completed, and RP-1 was again tanked to flight levels. Sequence II pressures were exercised and the vehicle secured for F-1 day operations.

7. F-1 Day Activities June 12, 1972. F-1 day activities proceeded as planned. During ordnance installation, the program pressurization harness was found to be too short. A clamp was cut and the harness was then rerouted. The Range Safety Command sensitivity check and the C-band readout were completed successfully. A pyro heater measuring 1,000 ohms was rejected and the battery was replaced. The ATLAS telemetry battery measured 0.2 vdc low open circuit voltage prior to the heater cycling. A dual detonator connector pin failed and the complete connector was replaced.

8. Launch, June 13, 1972. The countdown commenced on time and proceeded to a liftoff at the opening of the window. No major anomalies were encountered during the countdown.

C. MILESTONES (SPACECRAFT)

The significant spacecraft prelaunch milestones are listed in table 12.

Table 12. Spacecraft Prelaunch Milestones

Date	Event
5-16-72	Spacecraft arrived at ETR
5-22-72	Spacecraft performance checks complete
5-29-72	Spacecraft transported to ESA 60A
5-30-72	Mating of apogee motor to spacecraft
5-31-72	Hydrazine loading into position and orientation subsystem
6-5-72	Spacecraft processing complete
6-5-72	Spacecraft functional test
6-6-72	Mate to ground transport vehicle

Table 12. Spacecraft Prelaunch Milestones (Cont'd)

Date	Event
6-7-72	Spacecraft encapsulated
6-8-72	Transported spacecraft to Complex 36B and mated to CENTAUR
6-9-72	Spacecraft functional test
6-12-72	Spacecraft functional test
6-13-72	Launch

D. SPACECRAFT ACTIVITIES PRIOR TO LAUNCH

1. <u>Spacecraft Functional Tests.</u> Successful comprehensive functional tests were conducted on June 5, 9 and 12, 1972.

2. <u>Launch, June 13, 1972</u>. The spacecraft experienced a normal count.