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TIMED

LAUNCH VEHICLE INTERFACE DOCUMENT

PART NUMBER	SIZE	NEXT ASSEMBLY	QTY/NA	USED ON	EFFECTIVITY-END ITEM SER NO.	WEIGHT

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TIMED LAUNCH VEHICLE INTERFACE DOCUMENT

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TABLE OF CONTENTS

1.0 SCOPE

This document specifies the requirements, environments and interfaces associated with the launch vehicle selected for the TIMED spacecraft and mission.

2.0 MISSION DESCRIPTION

The Thermosphere, Ionosphere, Mesosphere - Energetics and Dynamics (TIMED) mission will use a suite of instruments to explore and chart the earth's upper atmosphere, allowing correlation of its activity with lower atmosphere phenomenon. The 2 year mission will be conducted from a spacecraft operating in a nominal 625 kilometer orbit inclined 74.1° to the equator. Launch on a NASA supplied DELTA launch vehicle as the second payload of a dual launch configuration is presently scheduled for 3 January 2000 from the WR launch complex.

3.0 APPLICABLE DOCUMENTS

The following documents shall apply to the extent specified herein. In the case of a conflict between the referenced documents and this document, this document shall have precedence.

- DELTA II Payload Planners Guide - April 1996
- WR-127-1

4.0 - The following requirements apply to the various interfaces between the TIMED spacecraft and the launch vehicle.

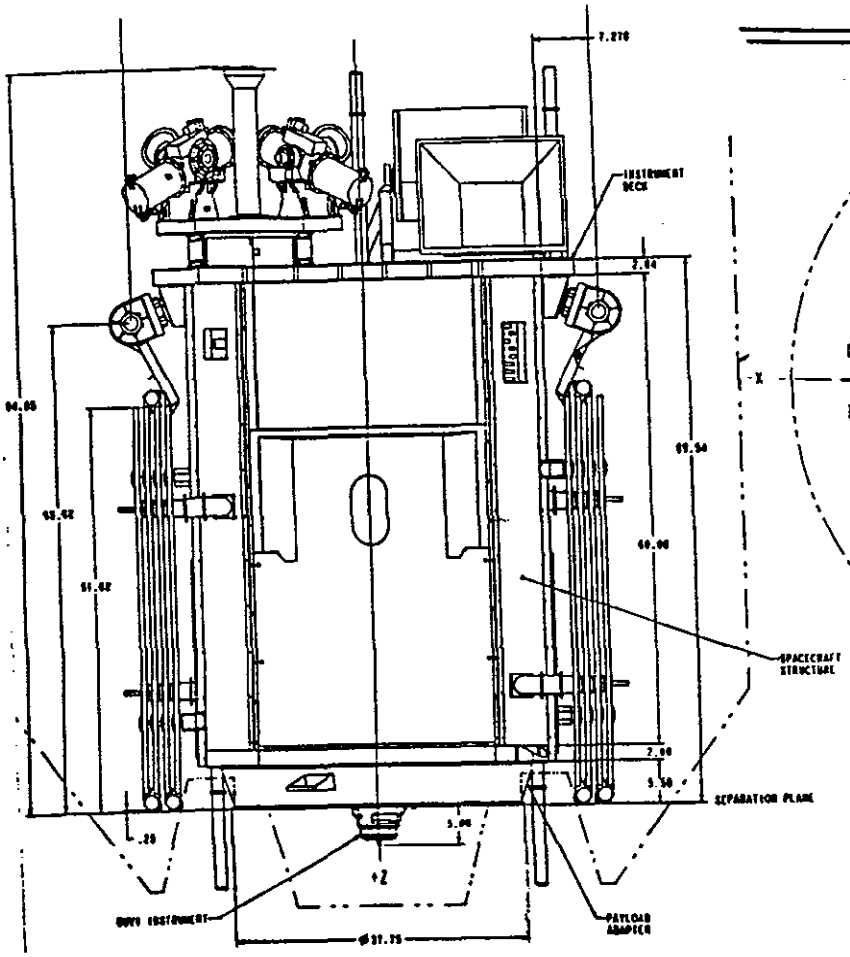
4.1 MECHANICAL

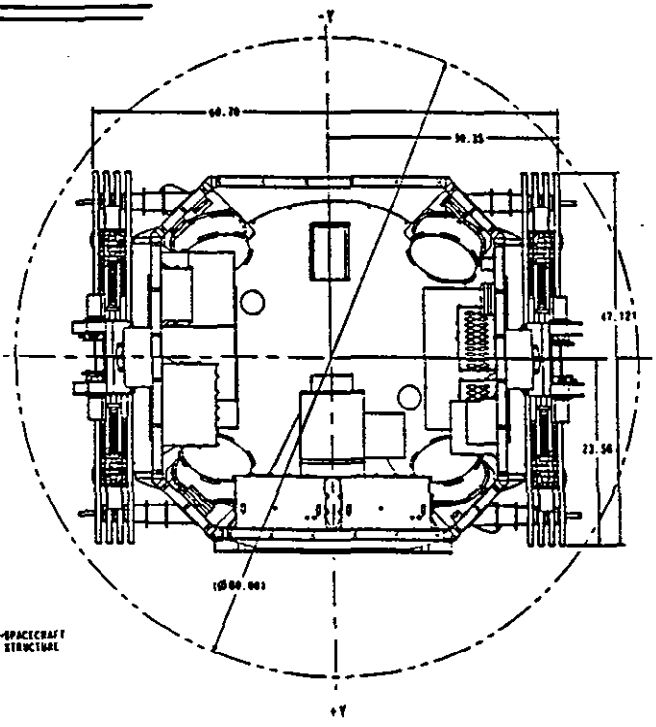
4.1.1 Envelope - The spacecraft envelope that must be accommodated by the launch vehicle Dual Payload Adapter Fitting (DPAF) can be represented by an 80.9 inch diameter cylinder, 95 inches high above the separation plane. Figure 4-1 shows views of the spacecraft in the DELTA DPAF/fairing.

4.1.2 Interface - The spacecraft has been designed to interface with the launch vehicle via an APL supplied adapter, designed to be compatible with the standard MDAC 3712 C clamp band interface. The distance from the bolted flange interface on the spacecraft to the launch vehicle adapter clamp band interface (separation plane) will be 5.5 ± 0.10 inches to accommodate instrument dimensions and fields of view.

4.1.3 Mass Properties - The maximum spacecraft launch mass will be limited by what the selected launch vehicle can launch into the desired mission orbit. For initial planning purposes a value of 660 kilograms shall be used; 680 kilograms is the desired goal.

Table 4-1 presents a PDR level set of nominal spacecraft mass property values that shall be used for analysis. All values are relative to the spacecraft launch and on-orbit axis as defined in Figure 4-2.





TOP VIEW
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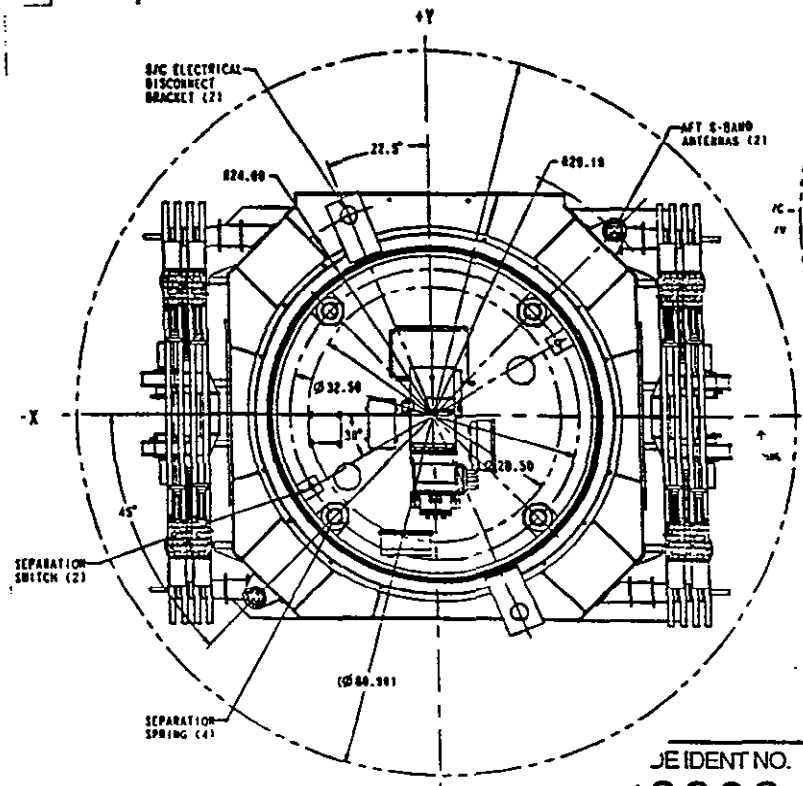
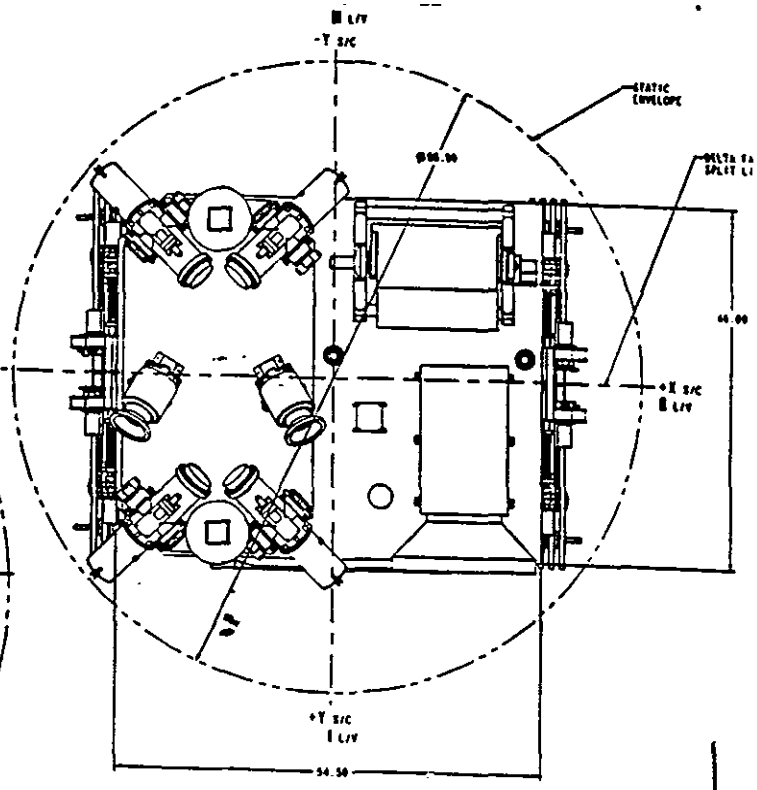


BOTTOM VIEW



TOP VIEW

FIGURE 4-1 TIMED SPACECRAFT LAUNCH CONFIGURATION

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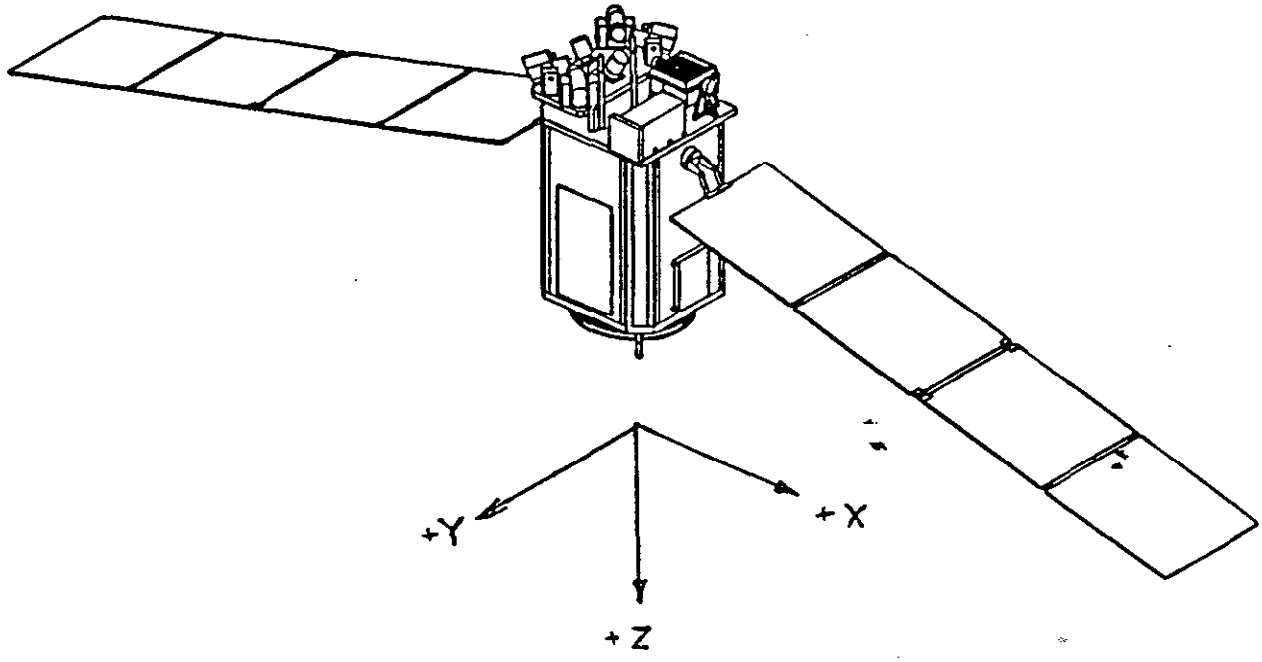
Table 4-1 Nominal Spacecraft Mass Properties

ITEM	LAUNCH	LAUNCH
Mass	lb	kg
	1302	590.5
Center of Gravity	in	cm
CGx	-0.51	-1.29
CGy	-2.69	-6.83
CGz	40.0	101.6
Moments of Inertia	slug-ft2	kg-m2
Ixx	219	297
Iyy	258	349
Izz	132	179
Product of Inertia	slug-ft	kg-m
Pxy	0.12	0.53
Pxz	-4.0	-17.71
Pyz	4.06	17.98

Figure 4-2 Spacecraft On-Orbit Axis Definition



4.2 ELECTRICAL -

4.2.1 Interface Connector - The 2 umbilical interface connectors shall contain provisions for the items specified in Table 4 -2.

Table 4 -2 Umbilical Interface Connector

ITEM	QUANTITY	CHARACTERISTICS	WIRE SIZE
POWER	6 POWER 6 GROUND	22-35 vdc, 16 amps max	# 1 6
GROUND	3		# 2 0
COMMAND /TELEMETRY	4 3		# 2 0
RADIO FREQUENCY	0		
PYROTECHNIC	0		

4.2.2 Radio Frequency - While attached to the launch vehicle, all spacecraft RF transmissions will be absorbed by hat-couplers.

4.2.3 ElectroMagnetic Interference - The spacecraft will be designed per the EMI requirements of WR-127-1.

4.3 INJECTION

4.3.1 Orbit Accuracy - The desired initial mission orbit is 625 KM circular at an inclination of 74.1°. Including the maximum allowable tolerances results in orbit ranges of 625 KM ± 25 KM (3 sigma) at an inclination of 74.1°± 0.1° (3 sigma).

4.3.2 Launch Window - The TIMED launch time-of-day is TBD. It is dependent on the launch date and will be agreed upon between APL and MDAC when the launch date is fixed.

The launch window will be about 79 minutes long, with the nominal launch time centered in the window. This window does not include any launch vehicle insertion uncertainties and may be tightened after the uncertainties are known.

The launch window and launch time-of-day must allow the beta angle of the final orbit to be at 0 degrees (Sun in the orbit plane) on July 1, 2000 ±5 days. The nodal regression rate of the target orbit is 720 deg/year.

4.3.3 Tip Off Rates - Given the stowed spacecraft mass properties listed in Table 4 -1, the launch vehicle separation system shall not impart tip off rates to the spacecraft greater than those shown in Table 4-3. Axis are as defined in Figure 4-2.

Table 4-3 Maximum Allowable Tip-off Rates

Around x - Deg/sec	1.0
Around y - Deg/sec	4.1
Around z - Deg/sec	6.9

4.4 SAFETY - Safety of the payload, launch vehicle and personnel shall be covered in the applicable operational procedures.

4.4.1 Lifting - All spacecraft lifts shall be covered by a lift procedure that assures that a trained operator is conducting the lift, that the lift equipment has a valid calibration/proof tag and that no personnel are ever exposed to an overhead lift hazard.

4.4.2 Electrostatic Static Discharge (ESD) - During all operations involving the spacecraft all personnel shall be in antistatic clothing and shall wear a daily certified, properly grounded wrist-stat to prevent accidental ESD from damaging the spacecraft.

5.0 DESIGN ENVIRONMENTS - The following environments represent the maximum expected to be imparted to the TIMED spacecraft at the launch vehicle interface or experienced by the TIMED spacecraft during pre-launch and launch operations. These environments are taken from the latest DELTA users guide and TIMED TIM meeting handouts.

5.1 Structural Loads

5.1.1 Design Load Factors

Flight Event	**Thrust**	**Lateral**
Lift-off/Aero	2.8/-0.2	± 3.0
MECO	8.0/6.8	±0.1

5.1.2 Frequency Constraints

Thrust > 35 Hz
Lateral > 20 Hz

5.2 Dynamic Environment

5.2.1 Sinusoidal Vibration

	Frequency (Hz)	**Level**
Thrust	5 - 6.2	0.5 in DA
	6.2 - 100	1.0 g
Lateral	5 - 100	0.7 g

5.2.2 Clampband Separation Shock

Frequency (Hz)	**SRS Levels (g)**
100	40
1500	4100
10,000	4100

5.2.2 Pressure Profile - The fairing and DPAF vent system shall assure that the internal DPAF pressure decay rate does not exceed 0.5 psi/sec during the ascent. Internal fairing pressure at separation shall not exceed 0.2 psi.

5.3 ACOUSTIC - The maximum fairing internal noise level spectrum for the DELTA dual-launch fairing is shown in the following figure. These values encompass the peak values that occur at lift-off, during transonic crossover and at maximum dynamic pressure.

Octave Band Center Freq (Hz)	Protoflight Levels (dB)
32	122.5
40.0	125.5
50.0	129.5
63.0	131.0
80.0	131.5
100.0	132.5
125.0	133.0
160.0	133.0
200.0	133.5
250.0	134.5
315.0	135.5
400.0	134.5
500.0	131.5
630.0	128.0
800.0	125.0
1000.0	123.0
1250.0	121.5
1600.0	120.0
2000.0	119.5
2500.0	119.0
3150.0	118.0
4000.0	116.5
5000.0	114.5
6300.0	110.0
8000.0	106.0
10000.0	103.0

OASPL = 143.8 dB
1 minute duration
(dB Ref 2.0 x 10^{-5} N/m^2)

5.4 THERMAL - Prior to lift off the spacecraft thermal environment shall be controlled by air conditioned air flow into the launch vehicle fairing and DPAF per section 6.3. After lift-off the DPAF internal surface temperature shall not exceed 250 °F.

5.5 EMI -DELTA RF sources during pre-flight preparation and flight ascent are shown in table 5-1. Note that the payload fairing/DPAF combination is RF-opaque, so payload exposure to the DELTA RF environment prior to fairing/payload separation is negligible.

Table 5-1 DELTA RF Sources

Radio Frequency Sources	Frequencies
UHF Command Destruct Transmitters (3)	TBD MHz
Stage 2 C-Band Transponder -	
Receive	5.690 MHz
Transmit	5.765 MHz
S-Band (Stage I)	2244.5 MHz
S-Band (Stage 2)	2241.5 MHz
S-Band (Stage 3)	2252.5 MHz

RF emissions at the WR shall be limited to a maximum electric field intensity of 5 volts/meter over a frequency range of 14 KHz to 26 GHz to prevent detrimental exposure of the TIMED S/C.

5.6 CLEANLINESS - From encapsulation through lift-off, the spacecraft environment and all incoming air flow shall be maintained and periodically certified to be at Class 100000 or better with hydrocarbon levels of less than 15 ppm. The interior surfaces of the DPAF shall be clean to Level 750 A per FED-STD-1246C. From lift-off through separation, the spacecraft environment shall be maintained at Class 100000 or better with hydrocarbon levels of less than 15 ppm. The DPAF shall provide a positive contamination barrier between the top payload and TIMED.

6.0 INTEGRATION INTERFACES

6.1 FLOW - Figure 6.1 gives an overview of the planned launch vehicle/spacecraft (payload) integration flow from spacecraft arrival to launch. Detailed activities will be addressed in the Payload Launch Site Test Plan

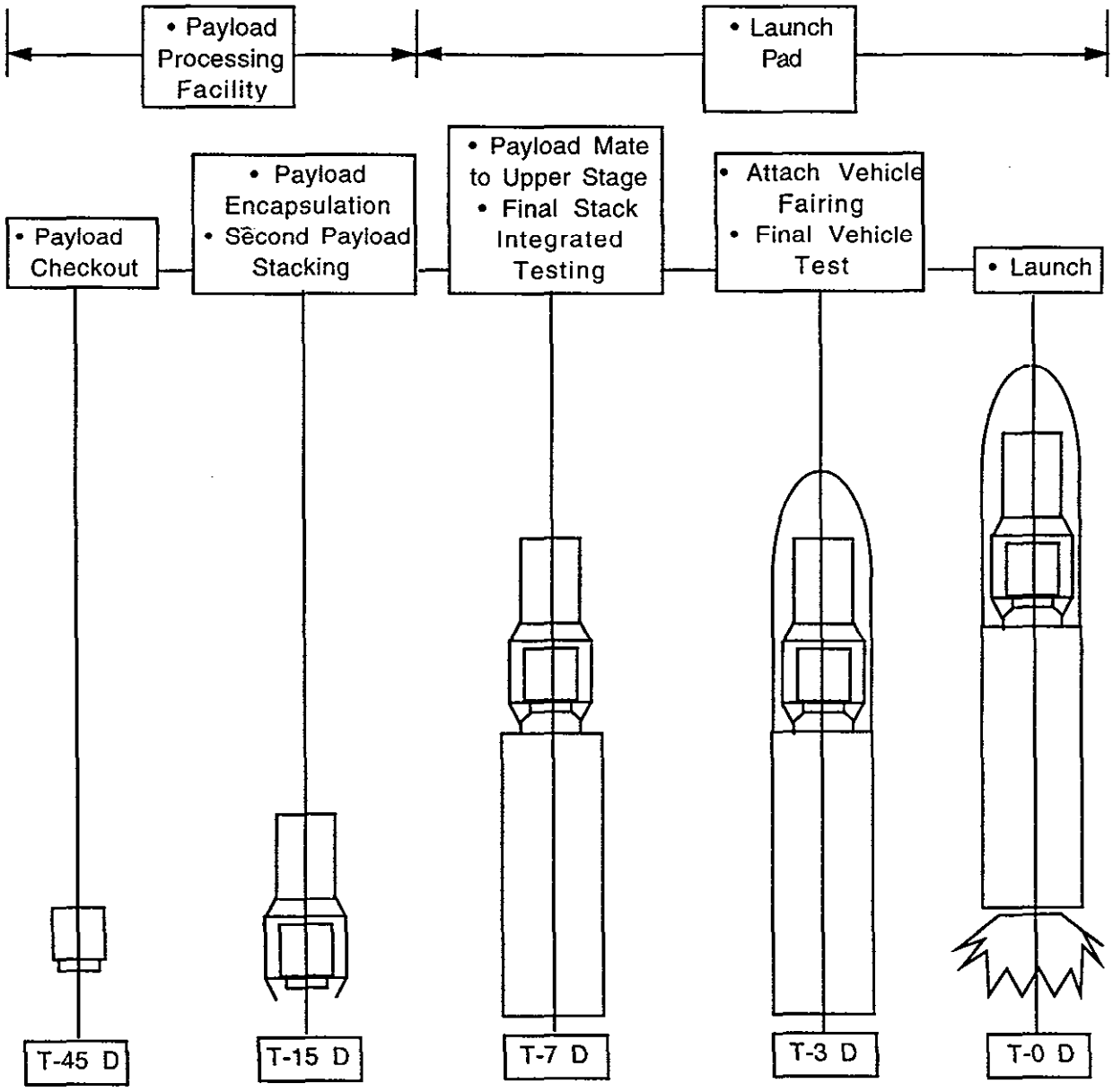


Figure 6.1 Payload/Launch Vehicle Processing Flow Overview

6.2 PAYLOAD ACCESS - Access to the spacecraft is required after encapsulation to install/maintain the instrument purge, install/remove safe/arm plugs, connect/remove RF-hat couplers and visually inspect antennas and connector mating. Access doors in the fairing and/or the DPAF need to be located for access to the indicated positions, radially and above the separation plane as shown in figure 6.2.

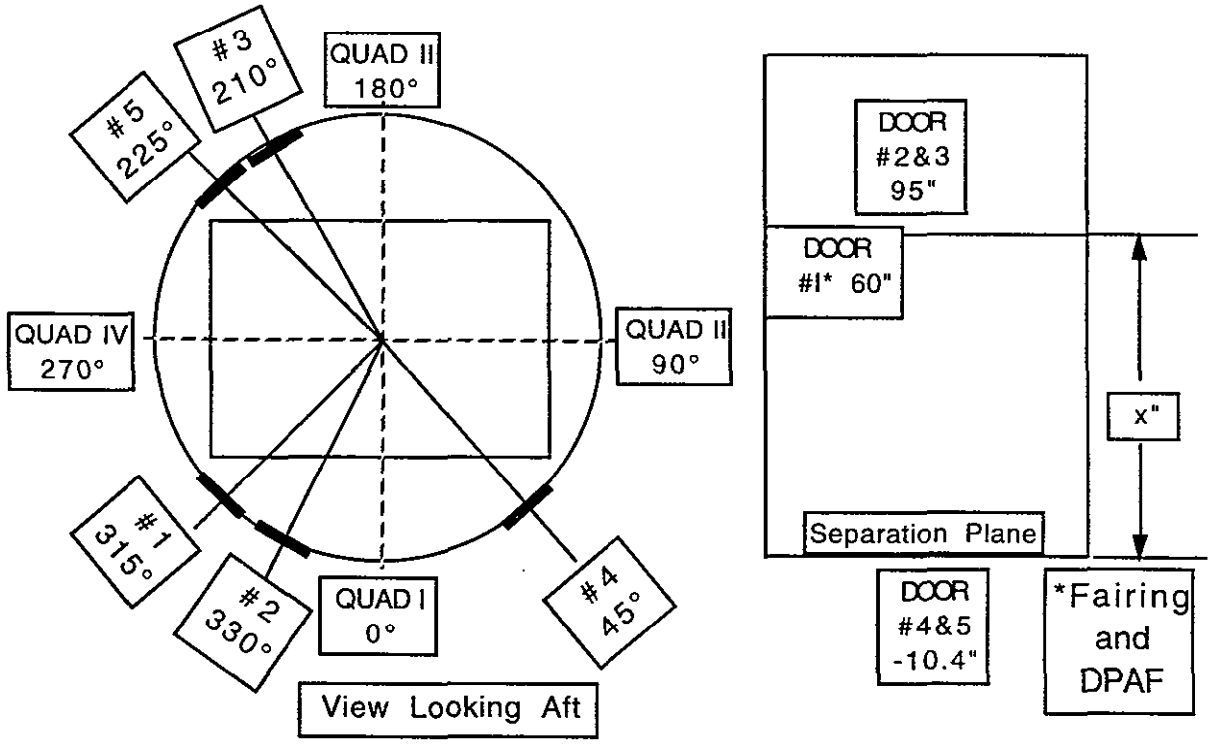


Figure 6.2 Location of Fairing Access Doors

6.3 AIR CONDITIONING - Air conditioned flow to the encapsulated payload is required continuously from the time of encapsulation until lift-off. Provisions for directing the air flow to each of the two TIMED batteries shall be accommodated. The conditioned air shall meet the following requirements:
Flow Rate - Minimum flow per battery of 150 scfm
Cleanliness - Class 100000 or better
Humidity - 30-50% relative humidity
Temperature @ Fairing Entry - <15 °C
Temperature Difference Between Legs at The Outlet - <3°C
Hydrocarbons - Less than 15 ppm
Other Volatiles - Less than 15 ppm

6.4 PURGES - An instrument purge of about 2 scfm at up to 15 psig is required and provided by APL to maintain instrument optical cleanliness continuously from the time of encapsulation until lift-off. Provisions for an APL provided purge line and associated pull-away hardware shall be made on the launch vehicle fairing and/or the DPAF.

6.5 ARMING PLUG - Safe and arm plugs are required to be installed/exchanged after the spacecraft is encapsulated. Provisions for personnel access through the fairing and the DPAF shall be provided.

7.0 QUALITY ASSURANCE PROVISIONS AND GENERAL REQUIREMENTS

7.1 - Procedures

7.2 - Plans

7.3 - Certification and Training
