

APPENDIX D

DELTA

The Delta launch vehicle configuration is specified by a four digit number designating the configuration of the launch vehicle stages. For other than the standard payload fairing, the designation of the fairing is added to the end of the number. The current designators are as follows:

1st digit - Type of augmentation/ first stage:

- 2 - Castor II augmentation, extended long tank, RS-27 engine.
- 3 - Castor IV augmentation, extended long tank, RS-27 engine.
- 4 - Castor IVA augmentation, extended long tank, MB-3 engine.
- 5 - Castor IVA augmentation, extended long tank, RS-27 engine.
- 6 - Castor IVA augmentation, extra extended long tank, RS-27 engine.
- 7 - GEM solid motors augmentation, extra extended long tank, modified RS-27 engine.

2nd digit - Quantity of augmentation motors:

- 3 - Three motors.
- 9 - Nine motors.

3rd digit - Type of second stage:

- 1 - Standard second stage [4536 Kg (10,000 lb) propellant, TRW TR-201 engine].
- 2 - Upated second stage [5987 Kg (13,200 lb) propellant, AJC ITIP engine].

4th digit - Type of third stage:

- 0 - No third stage.
- 3 - TE-364-3 third stage [653 Kg (1,440 lb) propellant].
- 4 - TE-364-4 third stage [1043 Kg (2,300 lb) propellant].
- 5 - PAM-D third stage [2009 Kg (4,430 lb) propellant max.].

Payload fairing size is designated as:

- None - Standard fairing [2.9 m (9.5 ft)].
- 8 - 2.4 m (8 ft) diameter fairing.
- 10 - 3 m (10 ft) diameter fairing, 7.9 m (26 ft) fairing length.

Structural Loads

Preliminary limit load factors for the Delta II launch vehicle are given in Table D-1.

Table D-1
DELTA II
Limit Load Factor (G)
at Spacecraft C.G.

Axis	Liftoff		MECO
	Thrust	Lateral	
Lateral	± 2.0 $\pm 2.5^{(1)}$	± 2.0 $\pm 3.0^{(1)}$	-
Thrust	$+2.4/-0.2^{(2)}$	$+2.4/-0.2^{(2)}$	$+6.0 \pm 0.6^{(3)}$

- (1) To provide correct bending moment at spacecraft separation plane, use lateral load factors of ± 2.5 for two stage and ± 3.0 for three stage Delta vehicles.
- (2) Plus indicates compression load.
- (3) This value, based on a three-stage mission with 1900-Kg (4200 lb) spacecraft, consists of a static component which is a function of spacecraft weight (see Figure D-1) and a dynamic component.

Examples of steady-state axial acceleration at MECO and third-stage burnout are given in Figures D-1 and D-2.

To avoid dynamic coupling between low-frequency vehicle and spacecraft modes, the stiffness of the spacecraft structure should be designed to produce fundamental frequencies above 35 Hz in the thrust axis and 15 Hz in the lateral axis for a spacecraft hard-mounted at the spacecraft separation plane (i.e., without payload attach fitting and separation clamp). The lateral fundamental frequency should be greater than 12 Hz if a two stage DELTA vehicle is used.

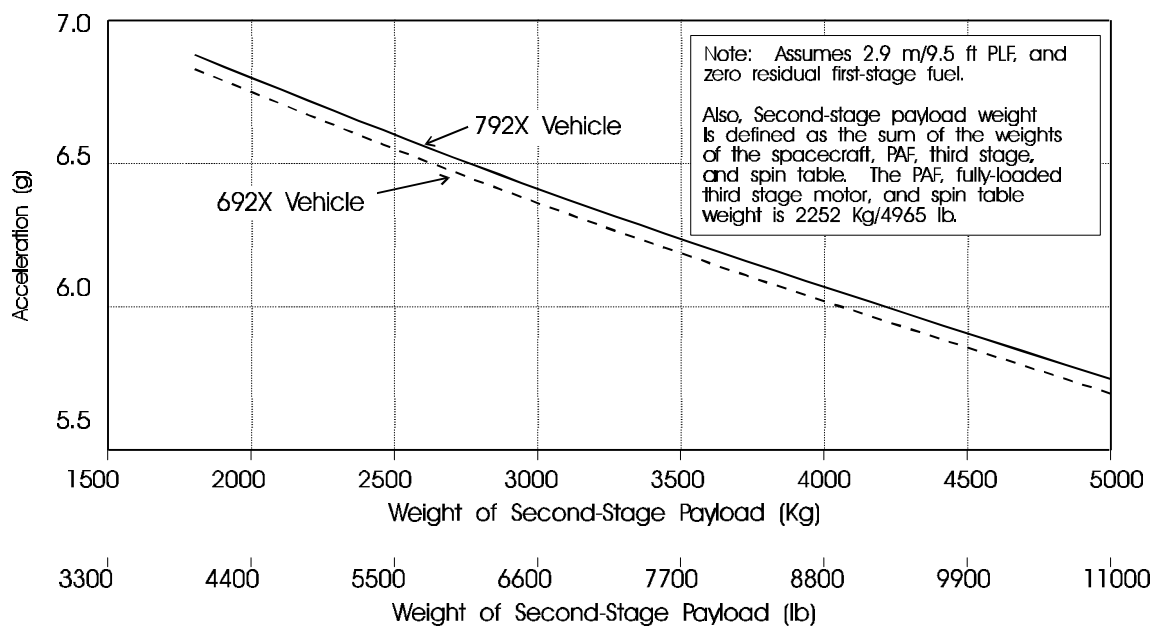


Figure D-1 DELTA II Axial Steady-State Acceleration at MECO Versus Second-Stage Payload Weight

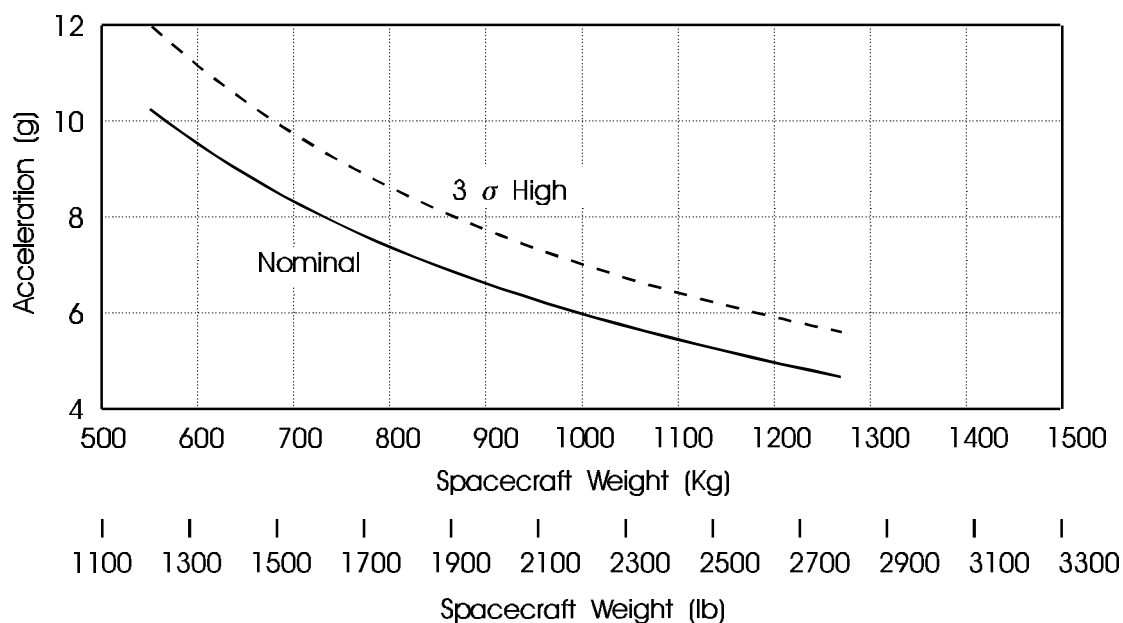


Figure D-2 DELTA II Axial Steady-State Acceleration at Third Stage Burnout

Acoustics

The qualification and acceptance acoustic test levels for a three stage Delta-II utilizing the 2.9 m (9.5-ft) and 3 m (10-ft) payload fairings are given in Tables D-2 and D-3 respectively. For a two stage Delta-II using a 3-m/10-ft payload fairing, the levels are the same as for the three stage version. For a three stage DELTA II utilizing the 2.4 m (8-ft) payload fairing, the acoustic test levels are given in Table D-4.

Spacecraft Random Vibration

The maximum expected random vibration levels (limit levels) at the spacecraft interface during Delta II launch are given in Table D-6.

Sine Vibration

The Delta user's guide provides the maximum expected levels given in Table D-7.

Mechanical Shock

The maximum expected separation shocks for the two and three stage Delta II vehicles are given in Tables D-7 and D-8.

Spacecraft Spin Balance

Refer to the Delta II Commercial Payload Planner's Guide, McDonnell Douglas Corporation, document MDC H3224B for the spacecraft spin balance requirements.

Table D-2
DELTA II (7925 Vehicle)*
Acoustic Test Levels
Inside 2.9 m (9.5-ft) Payload Fairing
with 7.6 cm (3 in.) Acoustic Blankets Installed

One-Third Octave Center Frequency (Hz)	Noise Level (dB) re: .00002 Pa	
	Qualification	Acceptance
25	-	-
32	124.5	121.5
40	127	124
50	129	126
63	130	127
80	131.5	128.5
100	132	129
125	132.5	129.5
160	132.5	129.5
200	133	130
250	133	130
315	133	130
400	132	129
500	129	126
630	126.5	123.5
800	123	120
1000	119.5	116.5
1250	117.5	114.5
1600	115	112
2000	112.5	109.5
2500	110	107
3150	108.5	105.5
4000	106.5	103.5
5000	106	103
6300	105	102
8000	104.5	101.5
10000	104.5	101.5
Overall	142.6	139.6

* For the 6925 vehicle, decrease all levels by 0.5 dB.
For 6920 or 7920 vehicles, contact the System Reliability & Safety Office (Code 302).

Table D-3
DELTA II (7920 and 7925 Vehicles)*
Acoustic Test Levels
Inside 3 m (10-ft) Payload Fairing
with 7.6 cm (3 in.) Acoustic Blankets Installed

One-Third Octave Center Frequency (Hz)	Noise Level (dB) re: .00002 Pa	
	Qualification	Acceptance
25	-	-
32	122.5	119.5
40	125.5	122.5
50	128	125
63	130	127
80	131.5	128.5
100	132.5	129.5
125	133	130
160	133	130
200	133	130
250	133	130
315	133	130
400	132.5	129.5
500	131	128
630	128	125
800	125	122
1000	123	120
1250	121	118
1600	120	117
2000	119.5	116.5
2500	119	116
3150	118	115
4000	116.5	113.5
5000	114	111
6300	110	107
8000	106	103
10000	106	100
Overall	143	140

* For 6920 and 6925 vehicles, decrease all levels by 0.5 dB.

Table D-4
DELTA II (7920 and 7925 Vehicles)*
Acoustic Test Levels
Inside 3 m (10-ft) Payload Fairing
with 3.8 cm (1.5 in.) Acoustic Blankets Installed

One-Third Octave Center Frequency (Hz)	Noise Level (dB) re: .00002 Pa	
	Qualification	Acceptance
25	-	-
32	122.5	119.5
40	125.5	122.5
50	128.5	125.5
63	131	128
80	133	130
100	134	131
125	134.5	131.5
160	135	132
200	135	132
250	135	132
315	135	132
400	135	132
500	133.5	130.5
630	130.5	127.5
800	127.5	124.5
1000	125	122
1250	122.5	119.5
1600	121	118
2000	120	117
2500	119.5	116.5
3150	118.5	115.5
4000	117.5	114.5
5000	115.5	112.5
6300	111.5	108.5
8000	107.5	104.5
10000	104	101
Overall	145	142

* For 6920 and 6925 vehicles, decrease all levels by 0.5 dB.

Table D-5
DELTA II 7920 and 7925 Vehicles*
Acoustic Test Levels
Inside 2.4 m (8 ft) Payload Fairing,
with 3.8 cm (1.5 in) Blanket

One-Third Octave Center Frequency (Hz)	Noise Level (dB) re: .00002 Pa	
	Qualification	Acceptance
25	122	119
32	123.5	120.5
40	125	122
50	126.5	123.5
63	128	125
80	129.5	126.5
100	131	128
125	132.5	129.5
160	134	131
200	134.5	131.5
250	135.5	132.5
315	137	134
400	139	136
500	140.5	137.5
630	139	136
800	135	132
1000	132	129
1250	131	128
1600	130.5	127.5
2000	129.5	126.5
2500	128.5	125.5
3150	127	124
4000	125.5	122.5
5000	124.5	121.5
6300	123.5	120.5
8000	122.5	119.5
10000	121.5	118.5
Overall	148	145

* For 6920 and 6925 vehicles, decrease all levels by 0.5 dB.

Table D-6
DELTA II
Spacecraft Random Vibration
Limit Levels

Frequency (Hz)	ASD Level (G^2/Hz)
20	.0016
20-300	+4 dB/oct
300-700	.06
700-2000	-3 dB/oct
2000	.021
Overall	8.7 G_{rms}

Table D-7
DELTA II
Maximum Expected Spacecraft Interface
Sinusoidal Vibration Environment

Frequency (Hz)	Sine Vibration Level (G_{0-p})
Thrust Axis 5 - 6.2 6.2 - 100	12.5-mm (0.5-in) DA 1.0
Lateral Axes 5 - 100	0.7

Table D-8
DELTA II (6920 & 7920 Vehicles)
Maximum Flight Shock Levels
(Explosive Nut Separation System)
Q=10

Frequency (Hz)	Shock Response Spectrum (G)	
	Qualification	Acceptance
350	140	100
350-1700	+12.3 dB/oct	+12.3 dB/oct
1700	3500	2500
1700-4000	+5.5 dB/oct	+5.5 dB/oct
4000-5000	7700	5500
5000-10000	-9 dB/oct	-9 dB/oct
10000	2730	1950

Table D-9
DELTA II (6920 & 7920 Vehicles)
Maximum Flight Shock Levels
(Clampband Separation System)
Q=10

Frequency (Hz)	Shock Response Spectrum (G)	
	Qualification	Acceptance
100	140	100
100-800	+9.9 dB/oct	+9.9 dB/oct
800-3000	4200	3000

Table D-10
DELTA II (6925 & 7925 Vehicles)
Maximum Flight Shock Levels
(Clampband Separation System)
Q=10

Frequency (Hz)	Shock Response Spectrum (G)	
	Qualification	Acceptance
100	56	40
100-1500	+10.3 dB/oct	+10.3 dB/oct
1500-3000	5740	4100