4.1 CARGO BAY

4.1.1 (Reserved)

4.1.2 (Reserved)

4.1.3 Cargo Limit-Load Factors/Angular Accelerations

The load factors/angular accelerations specified in the following subparagraphs shall be used for preliminary design of cargo and carrier primary structure and for determination of preliminary Orbiter/Cargo interface loads as the guiding criteria only. The center-of-rotation for angular accelerations is at the cargo element center-of-gravity. The load factors for emergency landing condition are defined in Paragraph 4.1.3.5.

Cargo load factor/angular acceleration is defined as the total externally applied force/moment on the cargo or cargo component divided by the corresponding total or component weight/mass moment of inertia and carries the sign of the externally applied force/moment in accordance with the Orbiter coordinate system. (See Figure 4.1.3-1).

4.1.3.1 (Reserved)

4.1.3.2 (Reserved)

4.1.3.3 (Reserved)

4.1.3.4 (Reserved)

4.1.3.5 Emergency Landing Load Factors

The Orbiter Vehicle design considers safe crew egress following emergency landing or water ditching. Hence, the mounting structures for equipment and crew provisions vessels and for the payload attachments, shall be designed to load factors equal to or greater than those shown in Table 4.1.3.5-1. Payload equipment inside the Orbiter crew compartment shall be designed to preclude hazards to the flight personnel after the application of the emergency landing loads defined in the table. The attachment structures (including fittings and fasteners) of the payloads must be designed for emergency landing loads. The attachment structure of payload equipment where failures could result in injury to personnel or prevent egress from the emergency landed vehicle must be designed for this requirement. Payload equipment design shall consider provisions to maximize the probability of safe crew egress following an emergency landing.

4.1.3.6 Factors of Safety for Structural Design

The structural design of all mounting hardware and/or bracketry (or any other structure which could be affected by flight loads) shall assure an ultimate factor of safety $\geq$ 1.4. Pressurized lines and fittings less than 1.5 inch in diameter shall have an ultimate factor of safety $\geq$ 4.0. Those equal to or larger than 1.5 inch in diameter shall have an ultimate factor of safety $\geq$ 1.5.

4.1.3.7 Fracture Control

Structural components, including all pressure vessels, the failure of which could cause destruction of the Orbiter or injury to the crew, shall be analyzed to preclude failures caused by propagation of pre-existing flaws.

4.1.4 (Reserved)

4.1.5 (Reserved)

4.1.6 Vibration

4.1.6.1 (Reserved)

4.1.6.2 Random Vibration

The random vibration environments associated with STS lift-off are specified for sidewall adapter mounted payloads and Orbiter longerons. The environments are applicable at Orbiter interfaces for all axial locations. Payload structure must be certified to vibration criteria that are based on these environments to be considered safe to fly on the STS. The environments may be considered statistically uncorrelated.

4.1.6.2.1 (Reserved)

4.1.6.2.2 Random Vibration for Sidewall/Adapter Mounted Payloads
The random vibration environments for hardware mounted on the Orbiter sidewall through an adapter is given in Table 4.1.6.2.2-1.

4.1.6.2.3 (Reserved)

4.1.6.3 Orbiter-to-Cargo Element Electrical Interface Random Vibration Environment

During launch and ascent, the random vibration environment of Orbiter-to-Cargo Element Electrical Interfaces shall not exceed the following:

20 - 50 Hz	+12 dB/Octave
50 - 85 Hz	0.15 g2/Hz
85 - 100 Hz	+9 dB/Octave
100 - 400 Hz	0.25 g2/Hz
400 - 2000 Hz	-6 dB/Octave

Duration: 20 seconds/axis/mission (in 3 orthogonal axes, including a fatigue scatter factor of 4).

4.1.7 (Reserved)

4.1.8 (Reserved)

4.1.9 Pyrotechnic Shock

4.1.9.1 (Reserved)

4.1.9.2 Pyrotechnic Shock From Other Sources

The maximum level of pyrotechnic shock detected on the sidewall mounted payload to Orbiter interface transmitted from other payloads or Orbiter mounted equipment, such as the RMS or the KU Band Antenna, is shown in Figure 4.1.9.2-1.

4.2 AFT FLIGHT DECK NOT APPLICABLE

4.3 GENERAL ACCELERATIONS

4.3.1 (Reserved)

4.3.2 (Reserved)

4.3.3 (Reserved)

4.3.4 Orbiter Towing Loads
The Orbiter shall not impose total acceleration levels in Cargo elements which exceed ±0.8g laterally, 1±1.3g vertically, and 1g axially.

4.3.5 (Reserved)

4.3.6 Contingency Orbiter Rollback/Rollout
The deceleration and centripetal acceleration that the payload will experience when the SSV is rolled back from the launch pad to the Vertical Assembly Building (VAB), and later returned to the pad for launch are as follows:

- Braking Maneuvers (Deceleration)

  0.0028 g’s along the SSV Z-axis

- Turning Maneuvers (Centripetal Acceleration)

  0.000035 g’s

TABLE 4.1.3.5-1 EMERGENCY LANDING DESIGN LOAD FACTORS

	Load Factor 65 klb (29484 kg) Up 32 klb (14515 kg) Down			Load Factor 65 klb (29484 kg) Down		
CONDITION	X	Y	Z	X	Y	Z
Emergency Landing (Outside Crew Compartment)	+4.5 -1.5	+1.50 -1.50	+4.5 -2.0	+4.50 -0.738	+0.738 -0.738	+2.215 -0.985
Emergency Landing (Inside Crew Compartment)	+20.0 -3.3	+3.3 -3.3	+10.0 -4.4			

Sign convention follows that of the Orbiter coordinate system in Figure 4.1.3-1.

Emergency landing load factors are ultimate. The longitudinal load factors are directed in all aftward azimuths within a cone of 20 degrees half-angle. The specified load factors shall operate separately.

For cargo weight between 32 klb and 65 klb, use a linear interpolation between the load factors given.

TABLE 4.1.6.2.2-1 ORBITER CARGO BAY RANDOM VIBRATION PAYLOAD SIDEWALL ADAPTERS/ORBITER INTERFACE

X Axis (same as longerons)		
	20 - 32 Hz	.003 g^2/Hz
	32 - 100 Hz	+6 dB/Octave
	100 - 500 Hz	.030 g^2/Hz
	500 - 2000 Hz	-4 dB/Octave
	Overall = 5.5 Grms	
Y Axis	20 - 45 Hz	+10 dB/Octave
	45 - 600 Hz	.060 g^2/Hz
	600 - 2000 Hz	-6 dB/Octave
	Overall = 7.7 Grms	
Z Axis (same as longerons)		
	20 - 45 Hz	.009 g^2/Hz
	45 - 70 Hz	+12 dB/Octave
	70 - 600 Hz	.050 g^2/Hz
	600 - 2000 Hz	-6 dB/Octave
	Overall = 7.0 Grms	

The associated time duration is 20 seconds per axis per flight which includes a fatigue scatter factor of 4.

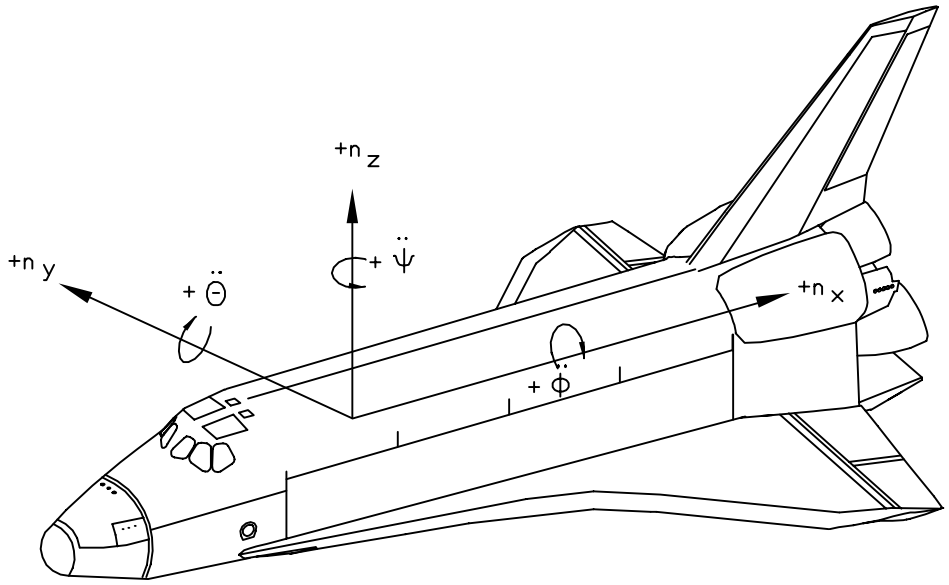

FIGURE 4.1.3-1 SIGN CONVENTION FOR CARGO LIMIT-LOAD FACTORS/ANGULAR ACCELERATIONS

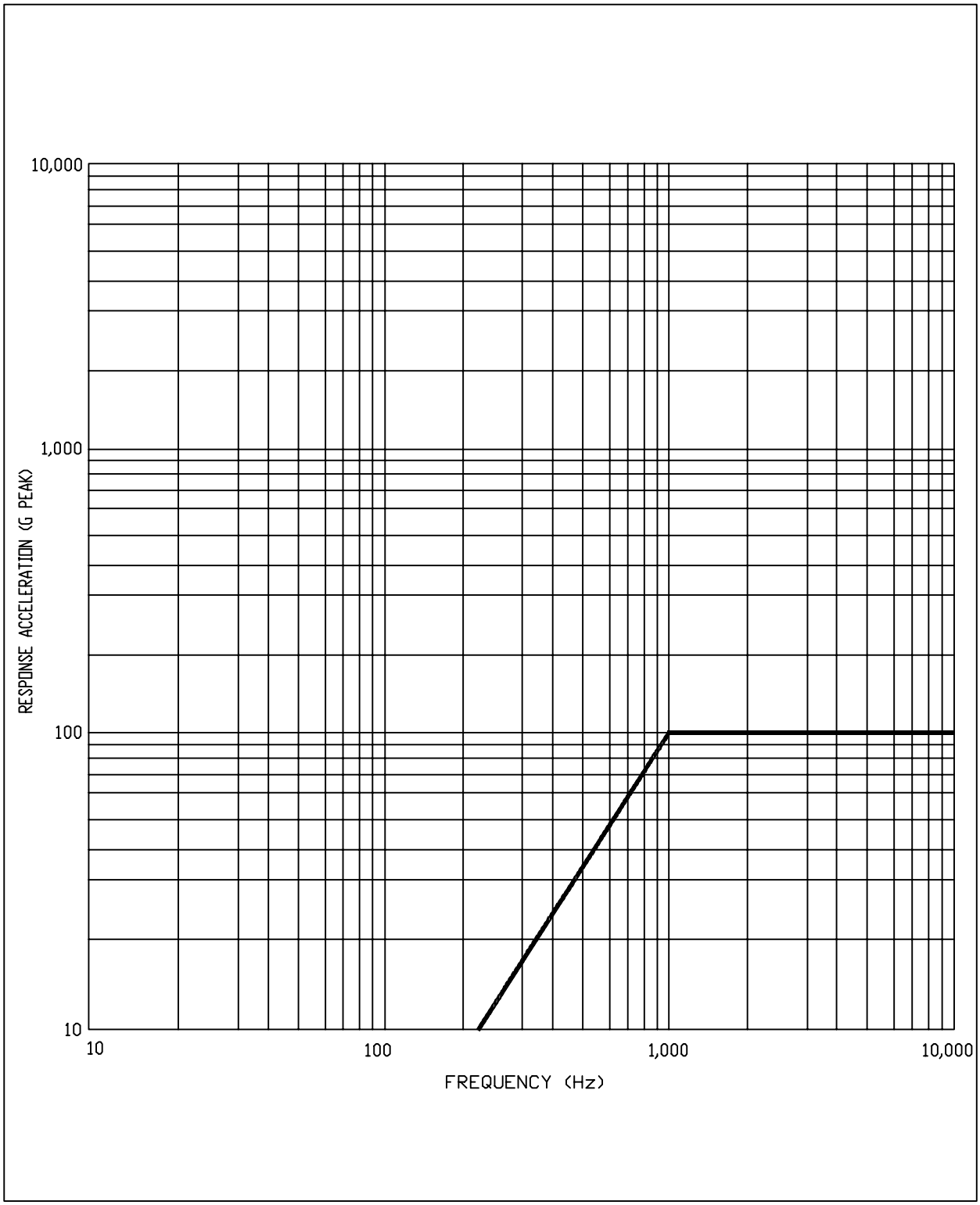

FIGURE 4.1.9.2-1 ORBITER/PAYLOAD INTERFACE SHOCK RESPONSE SPECTRUM ORBITER PYROTECHNIC SHOCK

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