4.0 STRUCTURAL INTERFACES

4.0.1 Payload Definition

4.0.1.1 Interface Loads and Relative Deflections
Interface loads and relative deflections for the combined Shuttle Orbiter and Cargo Element are determined by coupled dynamic analysis for Shuttle lift-off, landing, and by coupled static analysis for quasi-static conditions. Effects due to the random vibration environment need to be considered. The payload unique Shuttle static and dynamic models are based upon STS81-0641F. Shuttle liftoff and landing forcing functions are defined in STS88-0609 and STS86-0020A, respectively.

The Shuttle static and dynamic models and forcing functions, in conjunction with the cargo element math models, shall be the controlling factors for assessing changes in interface loads and relative deflections. Alternate design limit load factors should be coordinated with the SSP Structural/Mechanical Working Group.

4.0.1.2 Sidewall Mounted Payload
The interface load limitations for the longeron/adapter mounted payloads are governed by weight and C.G of the payload, the adapter beam design and mounting provisions, and the Orbiter longeron and frame structural capabilities. The payload structural model and stress analysis are documented in SAI-TM-794.

4.0.1.2.1 Mass Properties
The weight, center of gravity (C. G.), and mass moments of inertia (I) of the cargo element depends upon the mounting locations. See the details as follows:

Assembly	Weight (lbs)	C.G (Inches)	Moments of Inertia (Slug*ft**2)	Moments of Inertia (Slug*ft**2)
Mightysat 1:				
Bay 6 (PORT side) Launch	677.0	Xp=27.9 Yp=13.0 Zp=3.6	Ixx=22.5 Iyy=44.5 Izz=40.6	Ixy=3.81 Iyz=2.16 Izx=-4.65
Bay 6 (PORT side) landing	541.0	Xp=30.8 Yp=11.7 Zp=2.6	Ixx=19.3 Iyy=37.7 Izz=33.4	Ixy=1.66 Iyz=3.13 Izx=-6.13

Mightysat payload weight	136.0 lbs
GSFC beam & Carrier HW included	541.0 lbs
Total	677.0 lbs

The origin of the payload axes is defined as follows:
(At Port side Bay 6)

Xp 0.00 =Xo 863.00

Yp 0.00 =Yo -94.0 (Port)

Zp 0.00 =Zo 396.0

and Xp, Yp, and Zp are parallel to the Orbiter Xo, Yo, and Zo axes.

SAC-A:

Assembly	Weight (lbs)	C.G (inches)	Moments of Inertia (Slug*ft**2)	Moments of Intertia (Slug*ft*2)
Bay 2 (Port side) Launch	583.0	Xp=20.6 Yp=14.6 Zp= 2.9	Ixx=29.6 Iyy=32.1 Izz=29.8	Ixy= 5.88 Iyz= 1.32 Izx=-1.56
Bay 2 (Port side) Landing	438.0	Xp=22.0 Yp=12.8 Zp= 3.4	Ixx=28.3 Iyy=31.3 Izz=27.9	Ixy= 4.96 Iyz= 0.99 Izx=-1.32

SAC-A Payload weight	145.0 lbs
GSFC beam & Carrier HW included	438.0 lbs
Total	583.0 lbs

The origin of the payload axes is defined as follows:

Xp 0.00=Xo 636.0
Yp 0.00=Yo -94.0
Zp 0.00=Zo 396.0

4.0.1.3 (Reserved)

4.0.2 UNIQUE MISSION SPECIFIC REQUIREMENTS

4.0.2.1 Payload Induced Pyrotechnic Shock
The payload generated pyrotechnic shock detected on the trunnion at the payload to Orbiter interface shall not exceed the shock response spectrum shown in Figure 4.0.2.1-1. Payload generated pyrotechnic shock is not acceptable in the midddeck or the aft flight deck.

4.0.3 (Reserved)

4.0.4 ORBITER-TO-PAYLOAD DEDICATED ACCOMMODATIONS

4.0.4.1 (Reserved)

4.0.4.2 SIDEWALL MOUNTED PAYLOADS - STRUCTURAL DESIGN

4.0.4.2.1 (Reserved)

4.0.4.2.2 (Reserved)

4.0.4.2.3 Acoustics
The acoustics levels in an empty payload bay that are defined in Table 4.0.4.2.3-1 represent the minimum level to which a payload must be considered

safe to fly on the STS. Table 4.0.4.2.3-1 represents the acoustic environment of the sidewall mounted payloads at or near Zo400.

The acoustic levels during orbit, entry, and landing are significantly below the ascent levels and shall be assumed negligible.

Acoustic levels for specific payloads are dependent on payload geometry, surface area and acoustic absorption characteristics and will differ from those of the empty payload bay.

4.0.4.2.4 Limit Load Factors
Sidewall mounted payloads that have a minimum natural frequency of 35 Hz with respect to the adapter interface may use the load factors specified in Table 4.0.4.2.4-1 (Bay 2 to 8 only) in lieu of the coupled loads analysis specified in paragraph 4.0.1.1. The load factors encompass the maximized transient responses at liftoff and landing, and the random vibration responses during liftoff. The loads associated with the quasi-static flight events after liftoff and before landing are relatively lower. Therefore, the limit load factors given in Table 4.0.4.2.4-1 may be used for the design of the payload, at all applicable locations in the payload bay, provided payloads have the minimum frequency requirement.

4.0.4.2.5 (Reserved)

4.0.4.2.6 Interface Loads
Interface load limitations for the sidewall mounted payloads are governed by the weight and C.G. of the payload, the adapter beam design and mounting provisions, and the orbiter longeron and frame structural capabilities. The allowables are specified in the following paragraphs for each of the unique sidewall carriers.

4.0.4.2.6.1 (Reserved)

4.0.4.2.6.2 (Reserved)

4.0.4.2.6.3 (Reserved)

TABLE 4.0.4.2.3-1 ORBITER PAYLOAD BAY SIDEWALL ACOUSTIC ENVIRONMENT

1/3 Octave Band Center Frequency (Hz)	Sound Pressure Level (dB) Ref. $2x10^{-5}$ N/m^2	
	Lift-Off	Aeronoise
	5 Seconds/Flight*	10 Seconds/Flight*
31.5	124.0	112.0
40.0	126.0	114.0
50.0	128.5	116.0
63.0	131.0	118.0
80.0	133.0	120.0
100.0	133.0	121.0
125.0	132.0	122.5
160.0	131.0	123.5
200.0	130.0	124.5
250.0	129.0	125.0**
315.0	128.0	125.0**
400.0	126.5	124.0**
500.0	125.0	121.5
630.0	123.0	119.5
800.0	121.5	117.5
1000.0	120.0	116.0
1250.0	118.5	114.0
1600.0	117.0	112.5
2000.0	115.5	110.5
2500.0	113.5	108.5
Overall	141.0	133.5

* Time per flight does not include a scatter factor.

** Narrowband discrete noise is radiated from the payload bay vent doors during transonic/low supersonic flight. The noise radiated from any one vent is described below.

This environment is not intended for full payload exposure but only to those areas of the payload adjacent to a cargo bay vent opening.

One-Third Octave Band Center Frequencies, Hz	Sound Power Level dB Ref. 10^{-12} watts
	8 Seconds per Flight
250	128
315	136
400	130

TABLE 4.0.4.2.4-1 ADAPTER BEAM MOUNTED PAYLOAD LIMIT LOAD FACTORS

FLIGHT EVENT	LOAD FACTOR g			ANGULAR ACCELERATION RAD/SEC^2		
	N_X	N_Y	N_Z	$\ddot{\phi}_x$	$\ddot{\theta}_y$	$\ddot{\psi}_z$
LIFT-OFF						
Low Frequency	±7	±7	±6	±75	±20	±55
Vibration	±5.4	±8.0	±5.4			
Combination (RSS on One Axis at a Time)						
1	±8.8	±7	±6	±75	±20	±55
2	±7	±10.6	±6	±75	±20	±55
3	±7	±7	±8.1	±75	±20	±55
LANDING	±6	±7	±8	±85	±30	±50

NOTES:

1. This data applies to a system with minimum natural frequency of 35 hertz when cantilevered at the interface with the beam.

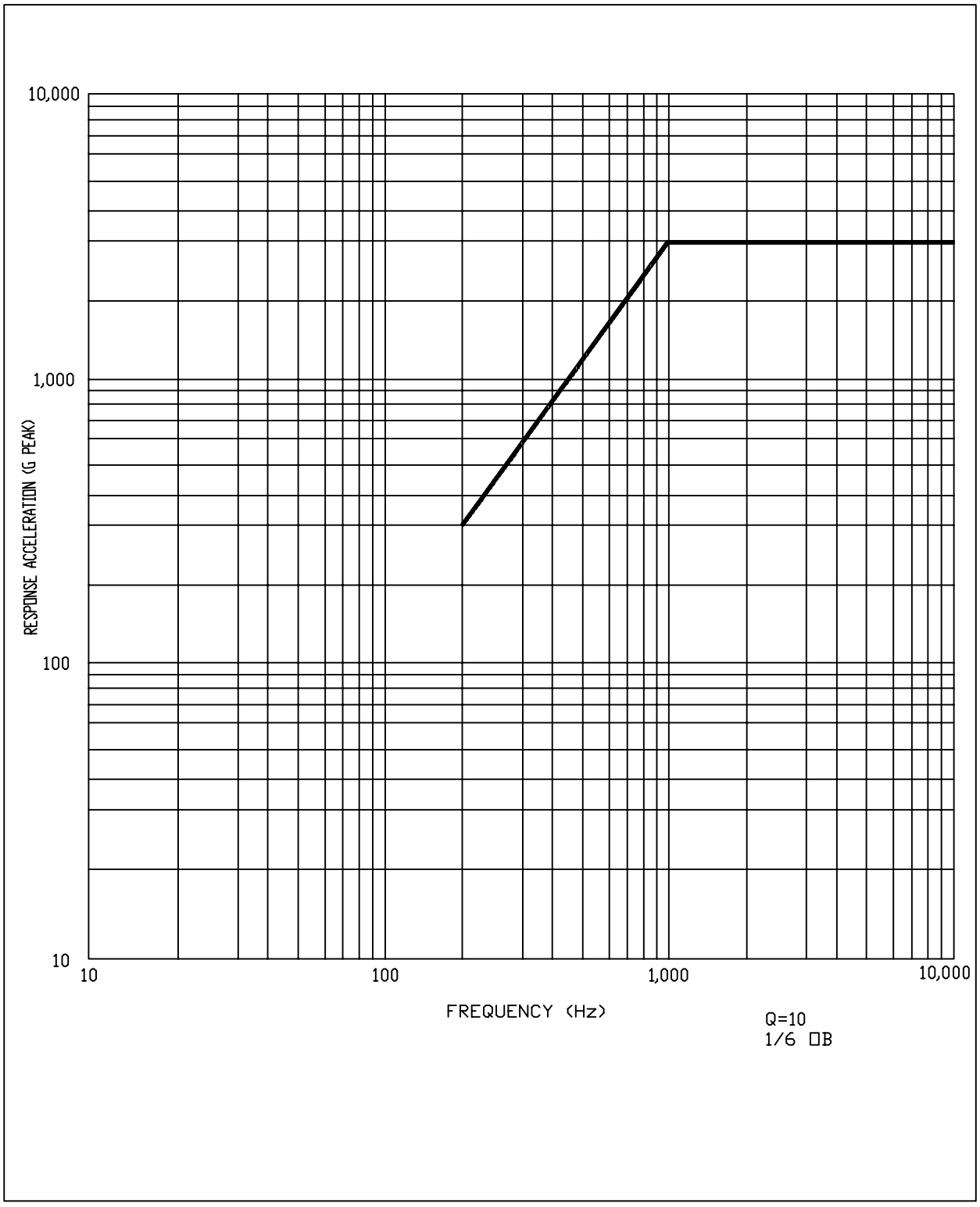

FIGURE 4.0.2.1-1 ORBITER/PAYLOAD INTERFACE SHOCK RESPONSE SPECTRUM PAYLOAD PYROTECHNIC SHOCK

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