ICD 2-1 M001

Orbiter Middeck/Payload Standard Interfaces Control Document

NASA-TM-87473 19850018529

National Space Transportation Systems Program Office

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Lyndon B. Johnson Space Center
Houston, Texas

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      DESIGN CRITERIA/ SYSTEMS COMPATIBILITY
ABA:  Author
ABS:  The interfaces which shall be provided by the baseline shuttle mid-deck
      for payload use within the mid-deck area are defined, as well as all
      constraints which shall be observed by all the users of the defined
      interfaces. Commonality was established with respect to analytical
      approaches, analytical models, technical data and definitions for
      integrated analyses by all the interfacing parties. Any payload interfaces
      that are out of scope with the standard interfaces defined shall be
      defined in a Payload Unique Interface Control Document (ICD) for a given
      payload. Each Payload Unique ICD will have comparable paragraphs to this
      ICD and will have a corresponding notation of A, for applicable; N/A, for
      not applicable; N, for note added for explanation; and E, for exception.
      On any flight, the STS reserves the right to assign locations to both
      payloads mounted on an adapter plate(s) and payloads stored within
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      standard lockers. Specific locations requests and/or requirements
      exceeding standard mid-deck payload requirements may result in a reduction
      in manifesting opportunities.
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ORBITER MID-DECK/PAYLOAD

STANDARD INTERFACES

BASELINE APPROVED FEBRUARY 7, 1984

NOTICE - WHEN GOVENMENT DRAWINGS, SPECIFICATIONS, OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE UNITED STATES GOVERNMENT THEREBY INCURS NO RESPONSIBILITY NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE, OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

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1.0 SCOPE.

1.1 PURPOSE.

a. Define and control the interfaces which shall be provided by the baseline shuttle mid-deck for payload use within the mid-deck area.

b. Define and control all constraints which shall be observed by all the users of the defined interfaces.

c. Establish commonality with respect to analytical approaches, analytical models, technical data and definitions for integrated analyses by all the interfacing parties.

d. Any payload interfaces that are out of scope with the standard interfaces defined in this ICD shall be defined in a Payload Unique ICD for a given payload.

e. Each Payload Unique ICD will have comparable paragraphs to this ICD and will have a corresponding notation of A, for applicable; N/A, for not applicable; N, for note added for explanation; and E, for exception.

f. On any flight, the STS reserves the right to assign locations to both payloads mounted on an adapter plate(s) and payloads stored within standard lockers. Specific locations requests and/or requirements exceeding standard mid-deck payload requirements may result in a reduction in manifesting opportunities.

1.2 STANDARD MIDDECK PAYLOAD. A standard middeck payload is defined as not exceeding the volume in 3 lockers or 3 locker volumes, the total weight (including payload, mounting plates, and/or stowage lockers) of 130 pounds with a weight density of less than 30 pounds/cubic foot, and does not consume more than 200 watts average power for up to 8 hours (or 280 watts peak power for 10 seconds or less) and requires passive air cooling. The standard mid-deck payload requires no power during ascent and/or decent mission phases.

1.3 ORGANIZATION OF DOCUMENT. Section 1 (Scope) and Section 2 (Applicable Documents) are standard and self-explanatory.

Section 3 (Physical Interfaces) identifies, codes and locates specifically all of the physical interfaces which are defined and controlled by this document. Included is a figure for each of the possible payload locations within the mid-deck, connector panels, etc., which (1) identifies individual connectors, fittings, etc., (2) locates each dimensionally within the Mid-deck area and (3) references other paragraphs herein which provide detail performance/design data for each.

Sections 4 through 6 define, for each subsystem discipline detail performance/design data necessary to achieve a satisfactory operational interface. When appropriate, the individual sections establish analytic methodologies for integrated analysis efforts.

Section 7 (Induced Environments) establishes induced environments for which the Payload must be designed. When appropriate, it also establishes analytic methodologies for integrated analysis efforts.

Section 8 (Electrical Wiring Interface) establishes wiring interfaces, including identification of connectors, connector pins, wires, etc. It also supplies pertinent wiring diagrams.

1.4 EFFECTIVITY. Unless otherwise specified, the interfaces defined and controlled herein are applicable to the operational configuration of the Shuttle System. The Orbiter Vehicle (OV) effectivity sequence is as follows: OV-102, OV-099, OV-103 and Subs.

1.5 CHANGE POLICY.

1.5.1 Scope. All changes to this document shall be controlled in accordance with the procedures prescribed herein and by JSC 07700, Volume IV. Dispositioned changes shall reflect program decisions and will record new, changed and/or deleted requirements.

1.5.2 Change Initiation. Payload community Mission Integration Control Board (MICB) members may initiate changes following JSC 07700, Volume IV procedures. All other payload community-initiated changes shall be submitted to the National Space Transportation System Program Office (NSTSPO) at JSC. NSTSPO shall review the proposed change for technical adequacy, completeness, and validity. If a change is required, a Change Request shall be submitted in accordance with JSC 07700, Volume IV.

1.5.3 Change Processing/Disposition. A change may be processed outside the formal Level II change procedure and approved by the Level II MICB when both the Space Shuttle Projects Office and NSTSPO recommend approval and there is no Level II cost, schedule, weight, or performance impact. Both the Space Shuttle Projects Office and NSTSPO shall coordinate on the MICB Directive prior to authorization signature for those specially processed changes. All other changes shall be processed for review and appropriate disposition action as specified by JSC 07700, Volume IV.

2.0 DOCUMENTS.

2.1 APPLICABLE DOCUMENTS. The following documents of the exact issue shown shall form a part of this document to the extent specified herein. In the event of conflict between the documents referenced and the contents of this document the contents of this document shall be considered a superseding requirement. Reference paragraphs listed refer to this ICD.

MIL-B-5087B (Current Issue)	Bonding, Electrical and Lightning Protection for Aerospace Systems Ref. Para. 6.4.8, 7.6.4.2, 7.6.4.2.2.1, 7.6.4.2.3
MIL-C-5541 (Current Issue)	Chemical Conversion Coatings on Aluminum and Aluminum Alloys Ref. Para. 7.6.4.2
SN-C-0005 (Current Issue)	Specification, Contamination Control Requirements for the Space Shuttle Program Ref. Para. 5.2.1.6, 7.7
SE-S-0073 February 14, 1977	Specification, Space Shuttle Fluid Procurement and Use Control Ref. Para. 5.2.1.2
MSFC-40M38277 (Current Issue)	Connectors, Electrical, Circular Miniature, High Density, Environment Resisting, Specification for Ref. Para. 2.4, 8.1.2
MSFC-40M39569 (Current Issue)	Connectors, Electrical Miniature Circular, Environment Resisting 200°C, Specification for Ref. Para. 2.4, 8.1.2

NHB1700.7 (Current Issue)	Safety Policy and Requirements for Payloads Using the Space Transportation System Ref. Para. 7.8
JSC-SE-R-0006B (Current Issue)	General Specifications NASA JSC Requirements for Materials and Processes Ref. Para. 7.8
NHB-8060.1 (Current Issue)	Flammability, Odor and Off-Gassing Requirements and Test Procedures for Materials and Environments that Support Combustion Ref. Para. 7.8

2.2 REFERENCE DOCUMENTS.

JSC 07700 Vol. IV	Space Shuttle Program, Level II Program Definition and Requirements, Configuration Management
JSC 07700 Vol. XIV	Space Shuttle Program, Level II Program Definition and Requirements, Space Shuttle System Payload Accomodations
JSC SC-A-0004B	Abbreviations, Manned Spacecraft and Related Flight Crew Equipment

2.3 ROCKWELL INTERNATIONAL DRAWINGS AND SPECIFICATIONS. All part numbers listed in this ICD beginning with the following prefixes V-602, V-646, V-070 or V-733 and all specification numbers beginning with the following letters MC, MD or ME are Rockwell International Company documents.

2.4 INTERNATIONAL LATEX CORPORATION (ILC) DRAWINGS. All part numbers listed in this ICD beginning with the following number(s) 10108-XXXXX are ILC drawings.

2.5 ELECTRICAL CONNECTOR PART NUMBERS. All electrical connectors with part number prefixes NB0 or NB6 are listed in MSFC-40M38277 or MSFC-40M39569 Specifications.

3.0 PHYSICAL INTERFACES.

3.1 GEOMETRIC RELATIONSHIPS.

3.1.1 Coordinate Systems.

3.1.1.1 Orbiter Crew Module (CM). The Orbiter crew module coordinate system shall be in conformance with Figure 3.1.1-1 and as follows:

Origin:	In the Orbiter crew module plane of symmetry, 200 inches below the crew module reference plane and at crew module X station 0.
Orientation:	The Xcm axis is in the crew module plane of symmetry, parallel to and 200 inches below the crew module reference plane. Positive sense is from the nose of the vehicle toward the tail. The Zcm axis is the crew module plane of symmetry, perpendicular to the Xcm axis positive upward in landing attitude. The Ycm axis completes a right hand system.
Characteristics:	Rotating right-handed cartesian. The standard subscript is CM (E.G. Xcm).

3.2 INTERFACE LOCATION AND DIMENSIONING.

3.2.1 Physical Interface Locations. Shuttle Orbiter Mid-Deck/Payload interface locations shall be in accordance with Figure 3.2.1-1.

3.2.2 Dimensions and Tolerances. Unless otherwise specified all linear dimensions are in inches, all angular dimensions are in degrees, and the tolerances for these are as follows:

Decimal:	X.X	= ±0.1
	X.XX	= ±0.03
	X.XXX	= ±0.010
Fractions:		±1/16
Angles:		±0°30'

3.3 STRUCTURAL INTERFACES. There are 3 locations for attaching payloads in mid-deck area as follows:

a. Aft surface of wire trays of Avionics Bays 1 and 2

b. Forward surface of wire trays of Avionics Bay 3A

c. Volume "A", located above Avionics Bay 1 and 2

3.3.1 Avionics Bay Locations. Payloads shall be attached to the surface of the wire trays forming bulkheads of Avionics Bays No. 1, 2 and 3A as shown in Figure 3.3.2-1. Availability of specific locations for payload usage is pursuant to mission profile and its length, size of Orbiter crew and amount of crew equipment to be stowed in Standard Stowage Lockers at this location.

3.3.2 Volume "A" Location. Payloads shall be installed in Volume "A", located above the forward mid-deck lockers as shown in Figure 3.3.2-1. This volume accommodates three small stowage trays with guides side by side or provides a clear volume of 5.184 inches high x 20.315 inches deep x 52.02 inches wide with the tray guides removed.

Payloads that cannot be stowed inside the small trays shall be stowed directly in this volume, provided they are isolated from vibration contact with the locker and have zero "g" retention for on-orbit activities.

The maximum weight of the locker contents including payload, protective provisions and trays shall not exceed 95 pounds.

3.4 STANDARD PAYLOAD PROVISIONS. Standard payload provisions shall consist of a standard modular stowage locker and two sizes of standard stowage trays - large and small.

3.4.1 Standard Modular Stowage Locker. Standard Modular Stowage Locker (Figure 3.4.1-1) provides 2 cubic feet of stowage volume.

The maximum weight of the locker contents, including payload, protective provisions and trays shall not exceed 60 pounds. The stowage provisions weigh approximately 10 lbs depending on the payload.

The locker can accommodate either one large tray, or two small trays containing payloads. The small trays are separated by special guides installed into a locker.

Payloads that cannot be stowed inside trays can be stowed directly in a locker, provided they are isolated from vibration contact with the locker and have zero "g" retention for on-orbit activities. Payloads, where possible, should be designed to the size and shape of a small or large stowage tray.

3.4.2 Standard Stowage Trays. Two sizes of standard stowage trays are available to payloads. Large - 1.8 cubic feet of volume (Figure 3.4.2-1) and Small - 0.85 cubic feet of volume (Figure 3.4.2-2).

The payload equipment shall be packaged in trays using foam inserts or non-structural plastic tray dividers dividing the trays into halves, quarters, eights or sixteenths. Elastic restraints, used with or without dividers, prevent equipment floating, when lockers are opened on-orbit.

3.5 OPTIONAL PAYLOAD PROVISIONS. For payloads heavier, or of a larger size than those that can be accommodated by a standard stowage locker, or those requiring electrical power there is a Mid-Deck Payload Accommodation Kit (MPAK) consisting of the following: Single Adapter Plate; Double Adapter Plate; Modified Locker Access Door; DC power cable; and Payload Mounting Panel.

3.5.1 Single Adapter Plate. Some payloads may be attached directly to a single adapter plate. This plate has a universal hole pattern for payload attachment. Maximum payload envelope and attaching hole pattern are defined in Figure 3.5.1-1. Payload shall not protrude more than 21.062 inches in Xcm direction from the avionics bay structure reference plane. Single adapter plate weight is 6.4 pounds. The maximum payload weight including single adapter plate and attaching hardware shall not exceed 69 pounds (Reference Paragraph 4.6 for weight and CG).

3.5.2 Double Adapter Plate. The payloads of a larger size, or heavier than those that can be accommodated inside a standard stowage locker, or attached to a single adapter plate or a payload mounting panel shall be attached to a double adapter plate. The double adapter plate has a universal hole pattern for payload attachment. Maximum payload envelope and attaching hole pattern are defined in Figure 3.5.2-1.

Double adapter plate attaches to two single adapter plates or two payload mounting panels installed one above the other to the avionics bay structure interface as shown in Figure 3.5.2-2 or 3.5.2-3. Payloads shall not protrude more than 21.062 inches in Xcm direction from the avionics bay structure reference plane. Double adapter plate weight is 15 pounds and it is attached to either the single adapter plates or the payload mounting panels with STS provided special bolts as noted in Paragraph 3.6. The payloads that use the double adapter plate shall provide clearance for the locker tool to engage these bolts.

The maximum payload weight, including two single adapter plates, one double adapter plate and attaching hardware shall not exceed 120 pounds (Reference Paragraph 4.6 for weight and CG).

3.5.3 Payload Mounting Panel. Payloads may be attached directly to a payload mounting panel, or directly to two payload mounting panels. A double adapter plate may be attached to two payload mounting panels. The hole patterns and mounting methods are defined in Figures 3.5.3-1 and 3.5.3-2. A single payload mounting panel weight is 3.0 pounds. The allowable mounting payload weights and CG locations are the same as the single and double adapter plates.

3.5.4 Adapter Plate Interface. The attachment points on the payload for securing to an adapter plate or mounting panel shall be designed per Figure 3.5.4-1. This requirement will allow use of a common STS supplied bolt (SPS #123374 - selflocking), Reference Paragraph 3.6.

3.5.5 Modified Locker Access Door. Payloads using standard stowage lockers, but requiring access for power or cooling shall use a modified locker door. Modified locker door has three removable panels, defined in Figure 3.5.5-1. These panels shall be payload supplied.

3.5.6 DC Cables. STS-provided optional DC cables route DC power from the Orbiter ceiling utility outlets to the payloads. The DC cables contain three conductors and shall interface with the payload through a socket connector. The DC cable is defined in Figure 3.5.6-1.

3.5.7 Mounting Access. When payloads are attached to two single plate (or panels), clearance shall be provided for the locker tool to engage the payload mounting bolts.

3.6 ATTACHMENT HARDWARE. Hardware for attaching to the avionics bay structure is an integral part of the locker, adapter plates, and mounting panel. Hardware for attaching payloads to adapter plates or mounting panels will be STS supplied for flight installation. Other installation, i.e. fit checks, etc., should use standard 1/4-28 bolts and shall be payload supplied. Reference Paragraph 3.5.4. Payload equipment designed to use mounting techniques other than those noted herein shall provide their own flight approved payload to adapter plate/mounting panel attachment hardware and spare sets for flight installation.

3.7 PAYLOAD/GSE HARD POINTS. Accommodations to install and remove payload provided equipment in the Mid-Deck area shall be provided by the payload as required. GSE quick release pin T and U handles are available as GFE and payloads, using this service, shall provide receptacles in accordance with Figure 3.7-1.

3.8 FIRE PROTECTION. Each payload display/control panel shall have adequate provisions for fire protection.

3.8.1 Fire Holes. All potential fire sources shall have on an accessible surface a "fire hole 0.500 inches in diameter", located to allow a fire extinguisher to be inserted for suppressing fire behind the panel. The hole shall be covered by a 0.75-inch-diameter GFE decal, placed over the fire hole. The decal shall be solid, to prevent any debris from passing through the panel, with tear perforations across the center which allow the smoke to escape.

3.9 PAYLOAD ENVELOPE PROTRUSIONS. The payloads having controls on front panels of the payload package shall provide hand holds to assist the astronaut in operating controls.

Payload static envelope dimensions for locker location cannot exceed the dimension as shown in Figures 3.5.1-1 and 3.5.2-1. The payload protrusions in the X-direction as defined in Paragraph 3.5.1 and 3.5.2 shall require prior approval before inclusion into the Payload Unique ICD.

Payload shall be responsible for breaking all sharp external edges to a minimum 0.020 inch radius.

3.10 PAYLOAD-TO-ORBITER ELECTRICAL BOND. Each payload element shall provide a payload-to-Orbiter electrical bond.

3.10.1 Standard Locker Locations Bonding.

3.10.1.1 Power Connector Bond. The electrical bond interface via the main DC power connector shall be accomplished by a single wire in the power connector as specified in Paragraph 7.6.4.2.

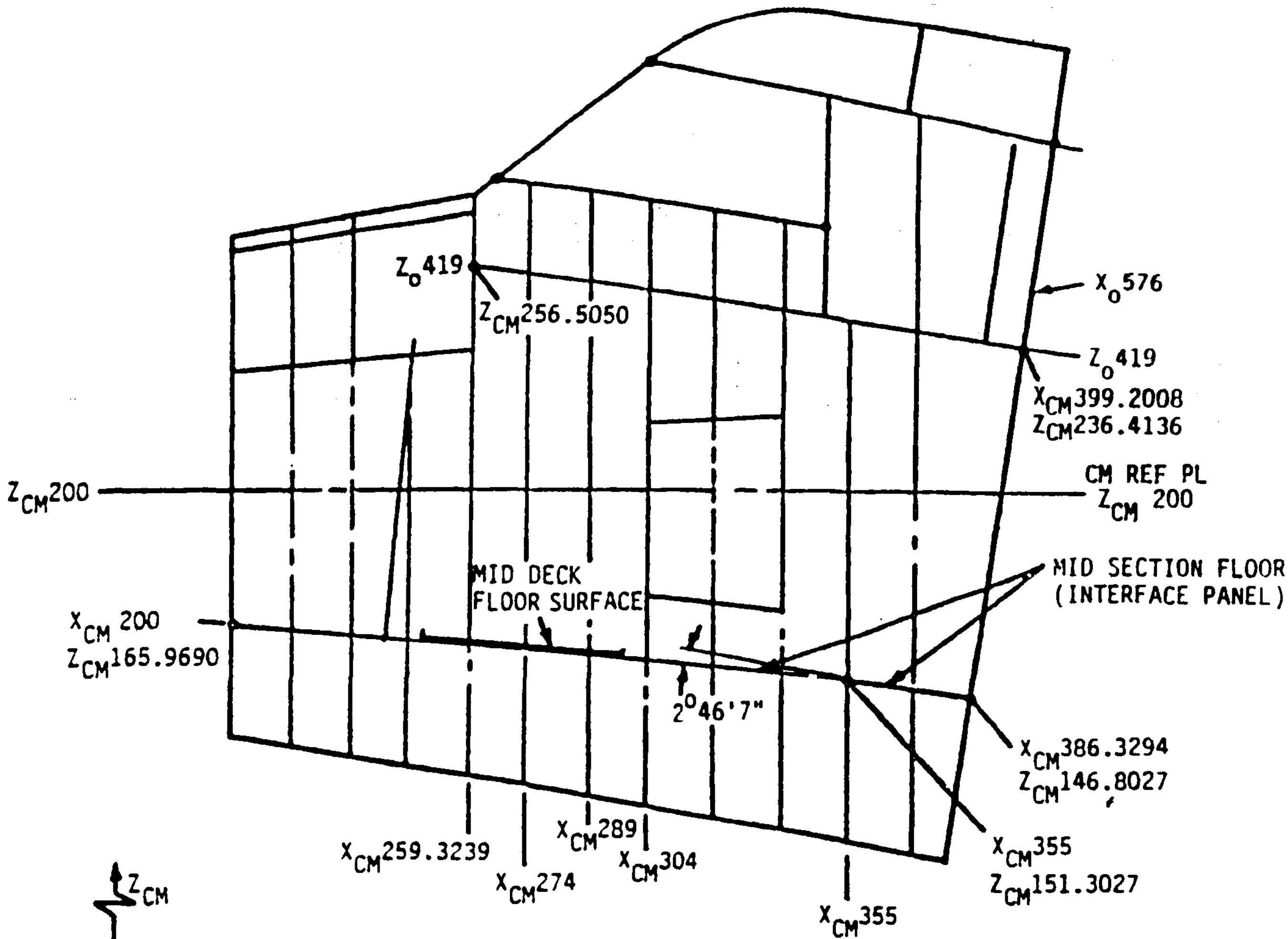
3.10.1.2 Payload to STS Supplied Mounting Surface Bond. The structural bond path shall conform to the requirements specified in Paragraph 7.6.4.2.

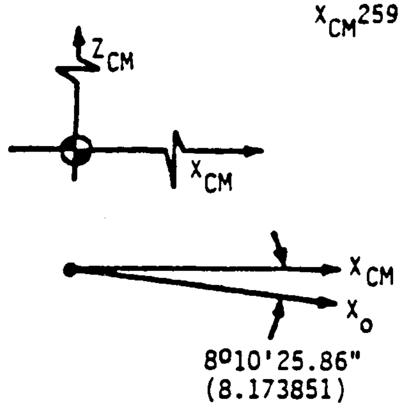
3.11 POWER PROVISIONS.

3.11.1 Mid-Deck Ceiling Location. Power interfaces at Mid-Deck Ceiling Locations shall be as shown in Figure 3.11.2-1.

3.11.2 Cable Routing. Cable routing shall be defined in Crew Compartment Control drawing for the specific mission incorporating the payload.

3.12 NOMENCLATURE. To ensure standardization of the nomenclature used on payloads with that of the Orbiter, the payloads shall use where possible the abbreviations listed in SC-A-0004B.





X_o & Z_o KNOWN, THEN

$$X_{CM} = .989841222X_o + .142177194Z_o - 230.5199739$$

$$Z_{CM} = -.142177194X_o + .989841222Z_o - 96.4358496$$

X_{CM} & Z_{CM} KNOWN, THEN

$$X_o = .989841222X_{CM} - .142177194Z_{CM} + 214.4671943$$

$$Z_o = .142177194X_{CM} + .989841222Z_{CM} + 128.2308622$$

FIGURE 3.1.1-1 ORBITER CREW MODULE COORDINATE SYSTEM

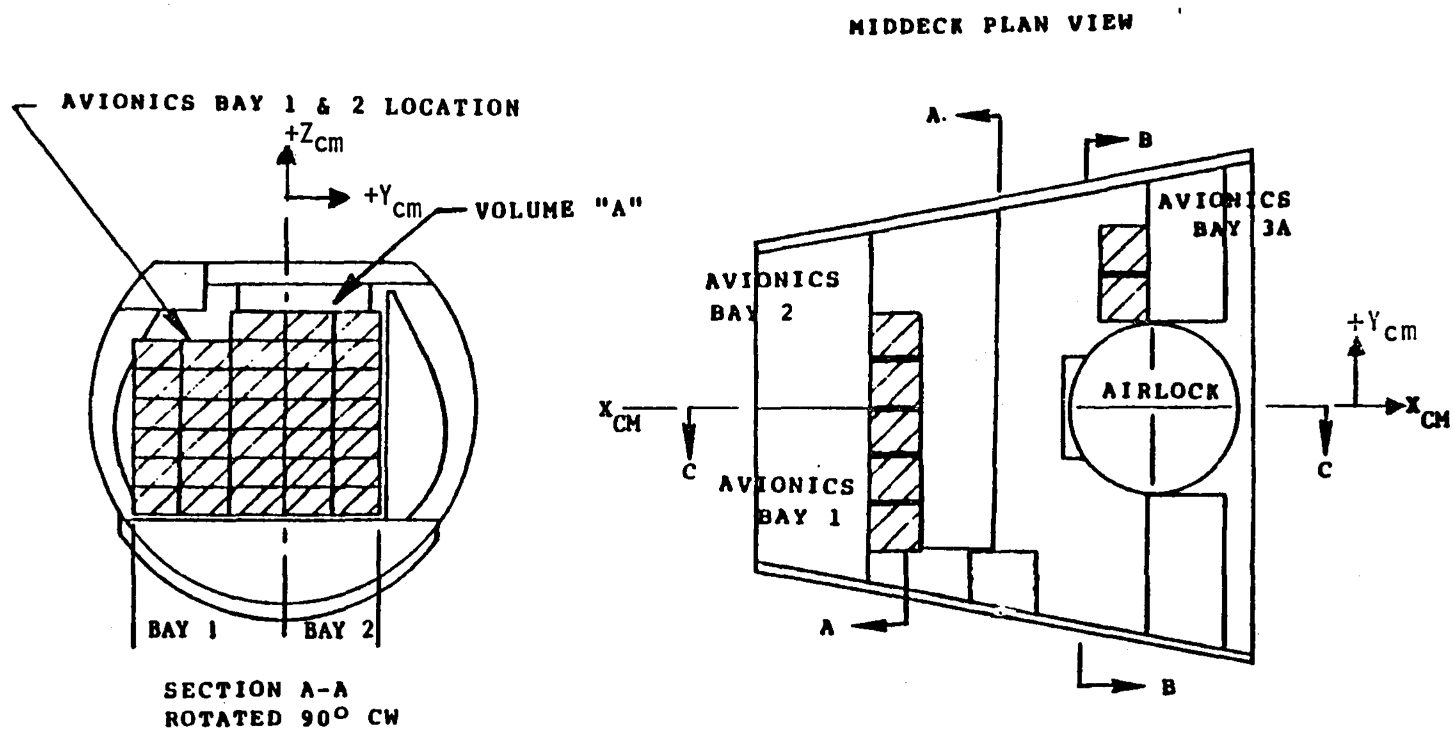
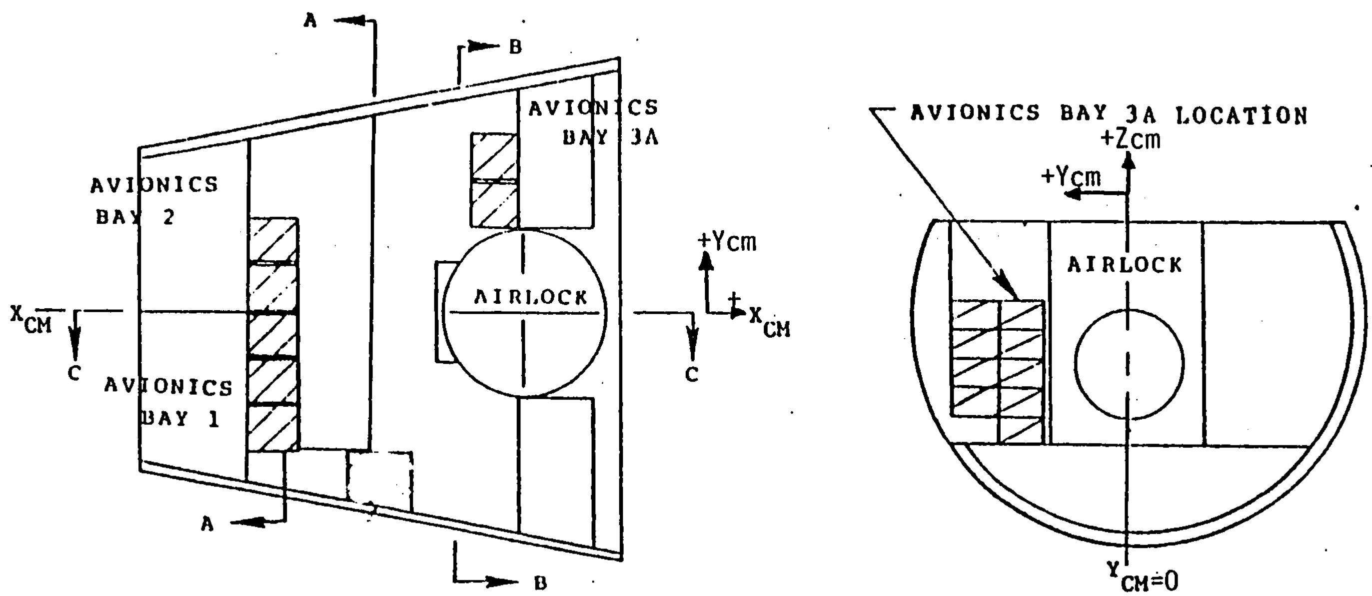


FIGURE 3.2.1-1 PHYSICAL INTERFACE LOCATION OVERVIEW
(SHEET 1 OF 3)

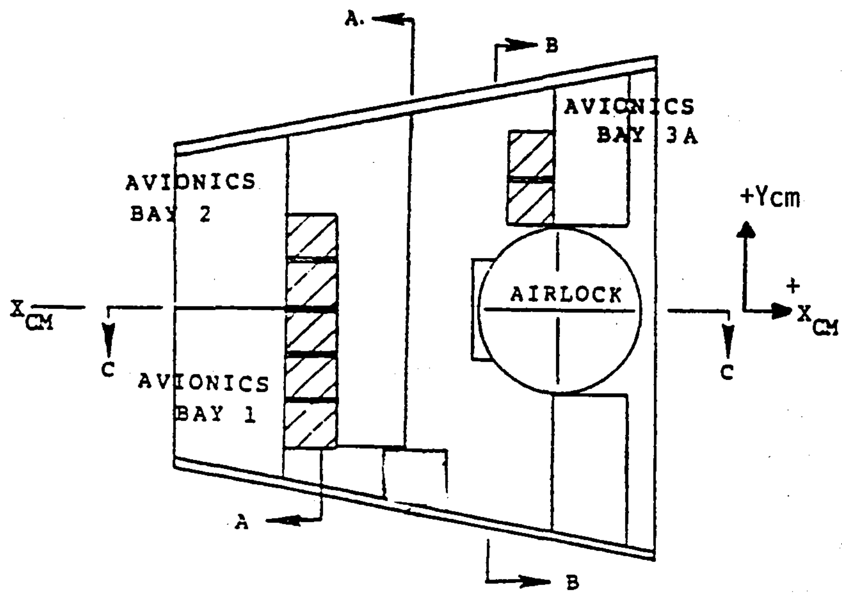
MIDDECK PLAN VIEW

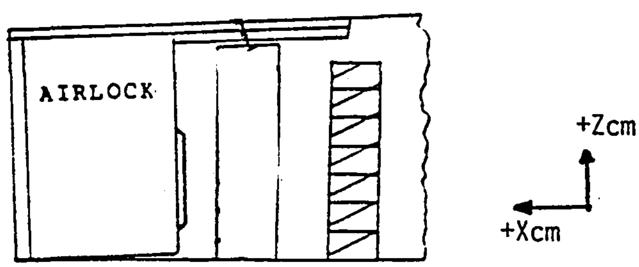


SECTION B-B
ROTATED 90° CCW

FIGURE 3.2.1-1 PHYSICAL INTERFACE LOCATION OVERVIEW
(SHEET 2 OF 3)

MIDDECK PLAN VIEW





SECTION C- C
ROTATED 180°

FIGURE 3.2.1-1 PHYSICAL INTERFACE LOCATION OVERVIEW
(SHEET 3 OF 3)

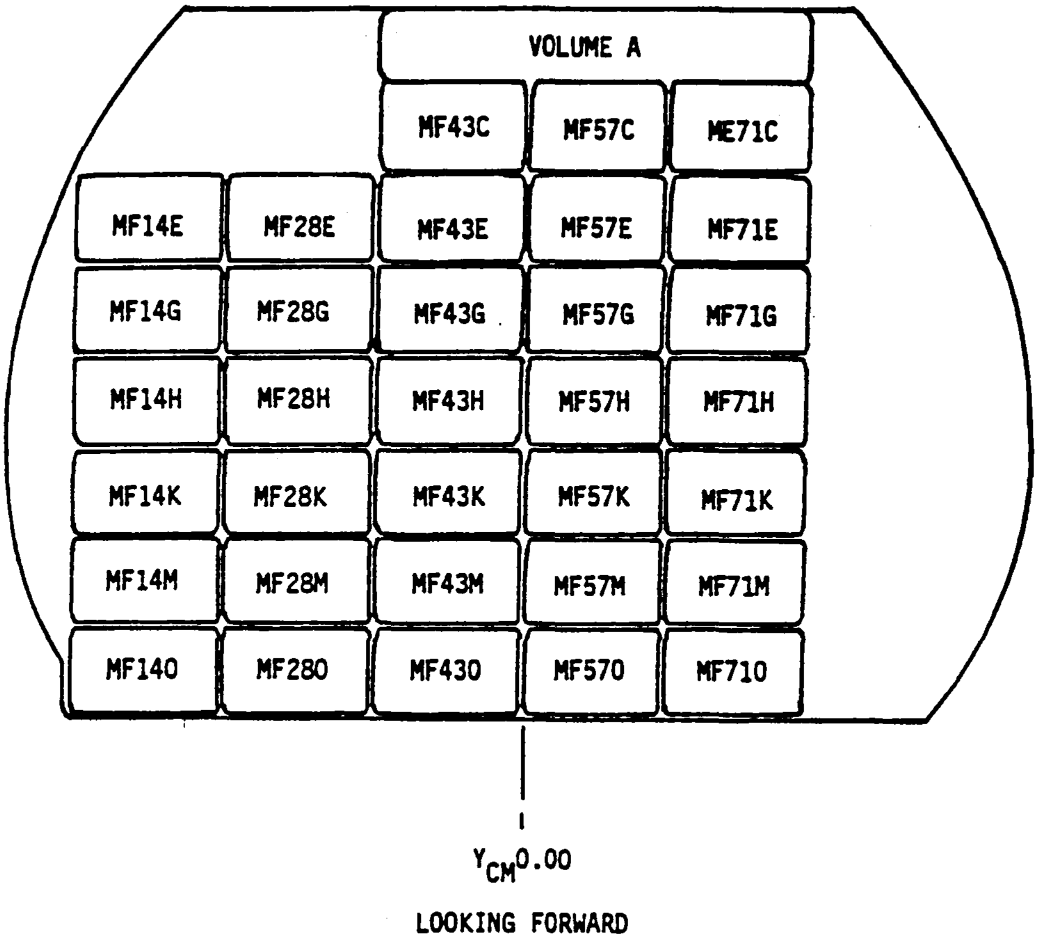


FIGURE 3.3.2-1 MIDDECK MODULAR LOCKER LAYOUT (SHEET 1 OF 2)

INTERFACE CONTROL DOCUMENT				
ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES	SIZE A	ICD NO. ICD-2-1M001	REV	SHEET OF

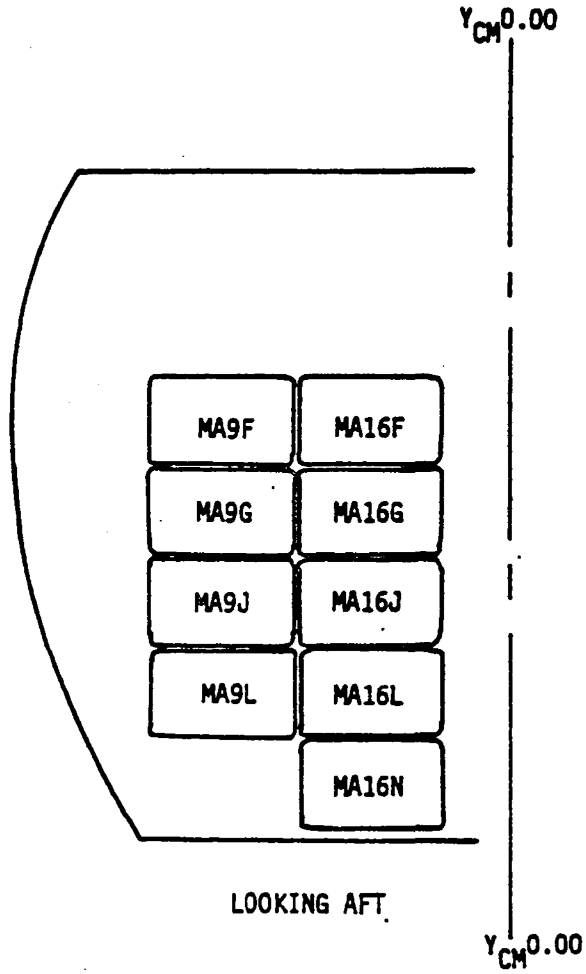
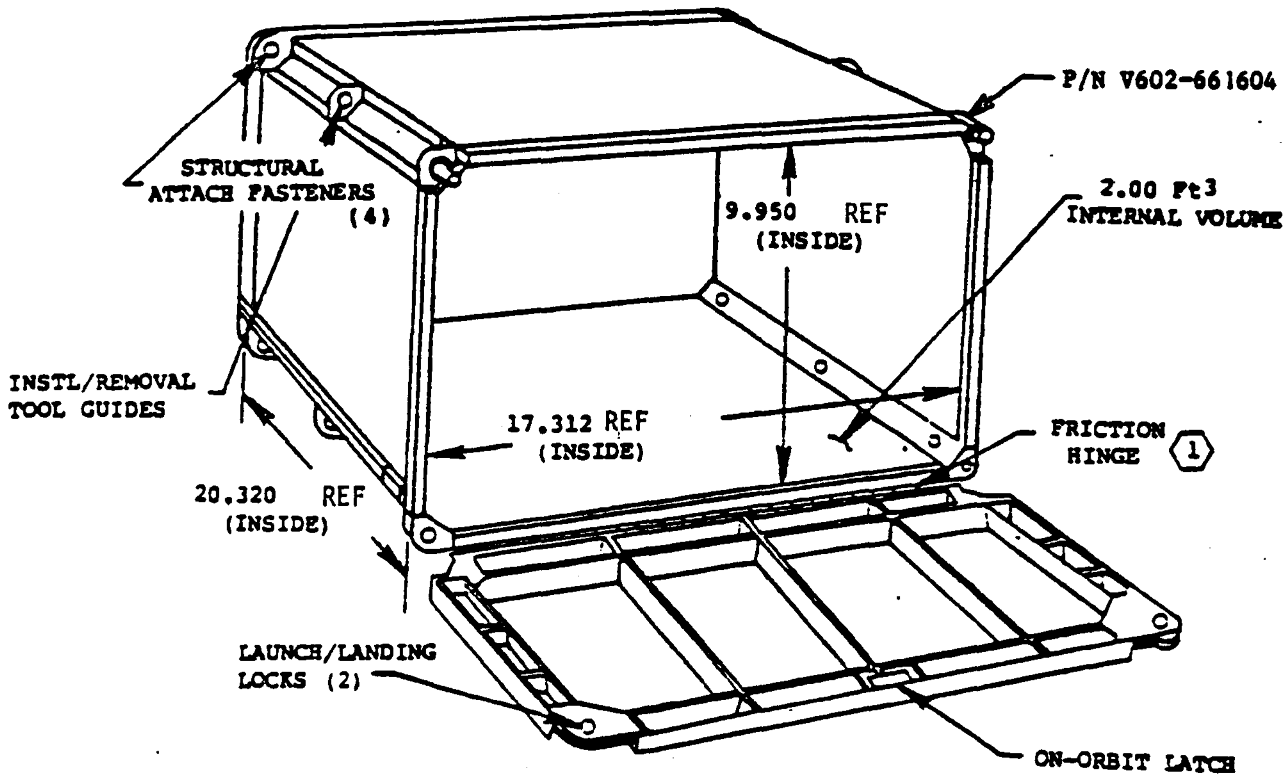


FIGURE 3.3.2-1 MIDDECK MODULAR LOCKER LAYOUT (SHEET 2 OF 2)

INTERFACE CONTROL DOCUMENT				
ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES	SIZE A	ICD NO. ICD-2-1M001	REV	SHEET ___ OF ___

FORM 3935-F-7 NEW 6-73



NOTES:

1. MODULAR LOCKER HAS A MAXIMUM DESIGN DENSITY OF 30 LBS/FT^3, AND A MINIMUM OF 10 LBS/FT^3
2. BASELINE LOCKERS ARE DESIGNED TO THE FOLLOWING CRITERIA
   - THE LOCKER IS PACKED SOLID.
   - THERE MUST BE ISOLATOR MATERIAL BETWEEN THE LOCKER WALLS AND THE CONTENTS
   - THE ISOLATOR MATERIAL (PYRELL OR SIMILAR MATERIAL) SHALL HAVE A THICKNESS AND MODULUS OF ELASTICITY COMBINATION ESTABLISHED BY DESIGN WHICH WILL PROVIDE A SPRING-RATE OF 22,000 LB/IN OR LESS
3. DOOR IS FLUSH WITH BOTTOM OF LOCKER WHEN OPENED 90° DEGREES AND CAN OPEN 180 DEGREES (STRAIGHT DOWN).
4. ⟨1⟩ DOOR HAS FRICTION HINGE FOR ZERO-G OPERATION AND A MAGNETIC LATCH FOR TEMPORARY CLOSURE OF DOOR.

FIGURE 3.4.1-1 STANDARD MIDDECK MODULAR LOCKER

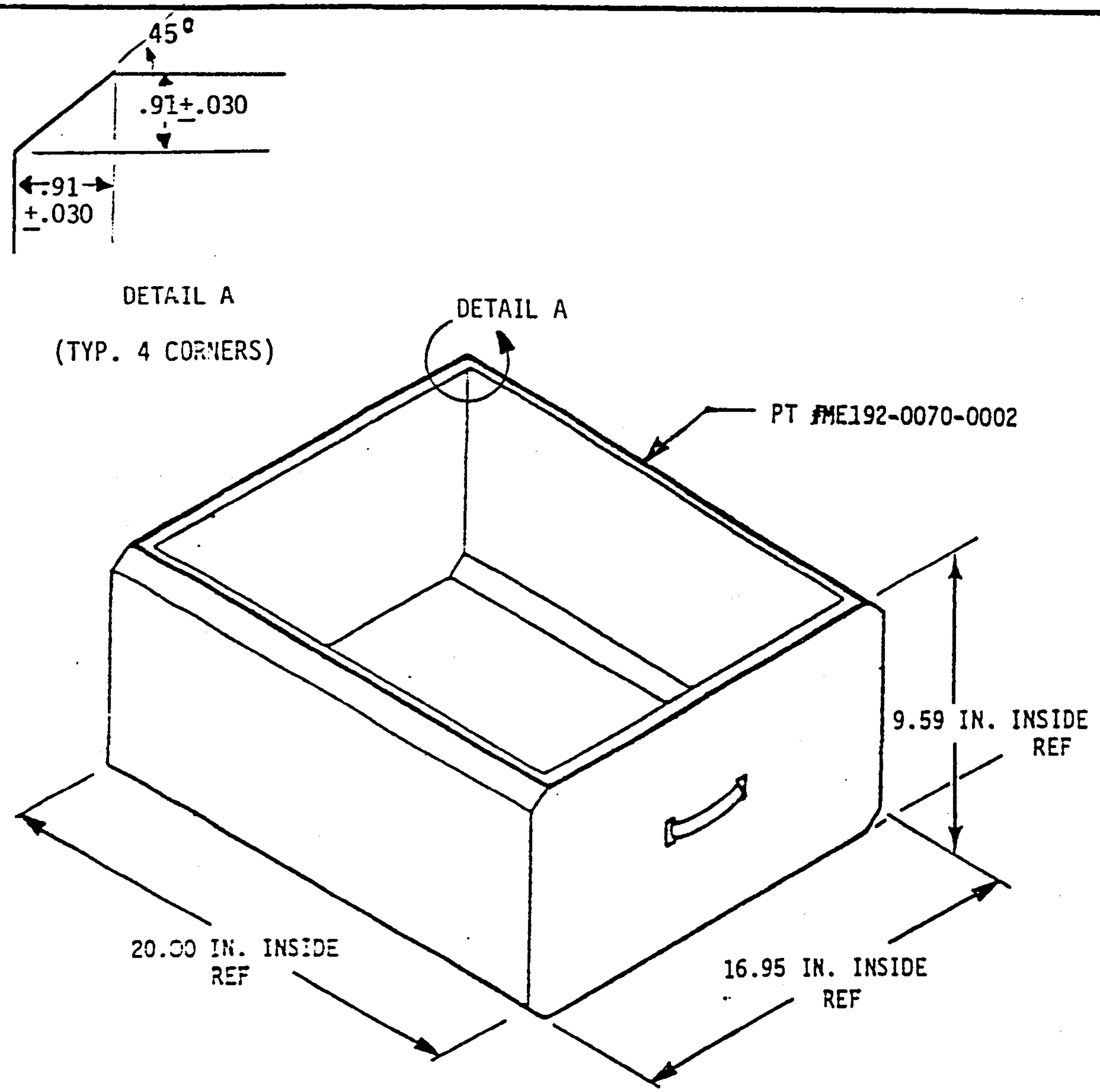


FIGURE 3.4.2-1 LARGE STOWAGE TRAY

INTERFACE CONTROL DOCUMENT				
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FORM 3935-F-? NEW 6-73

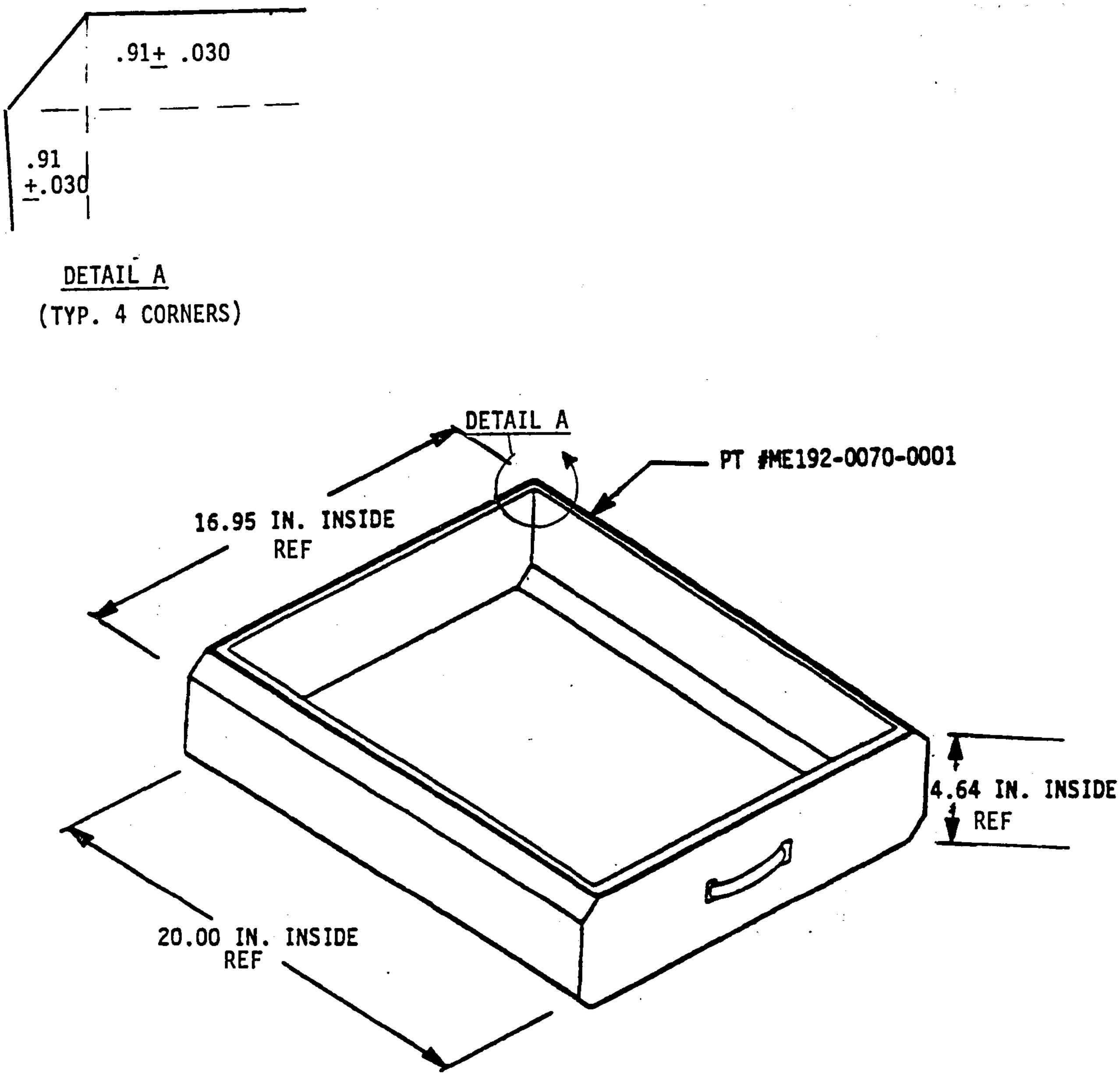
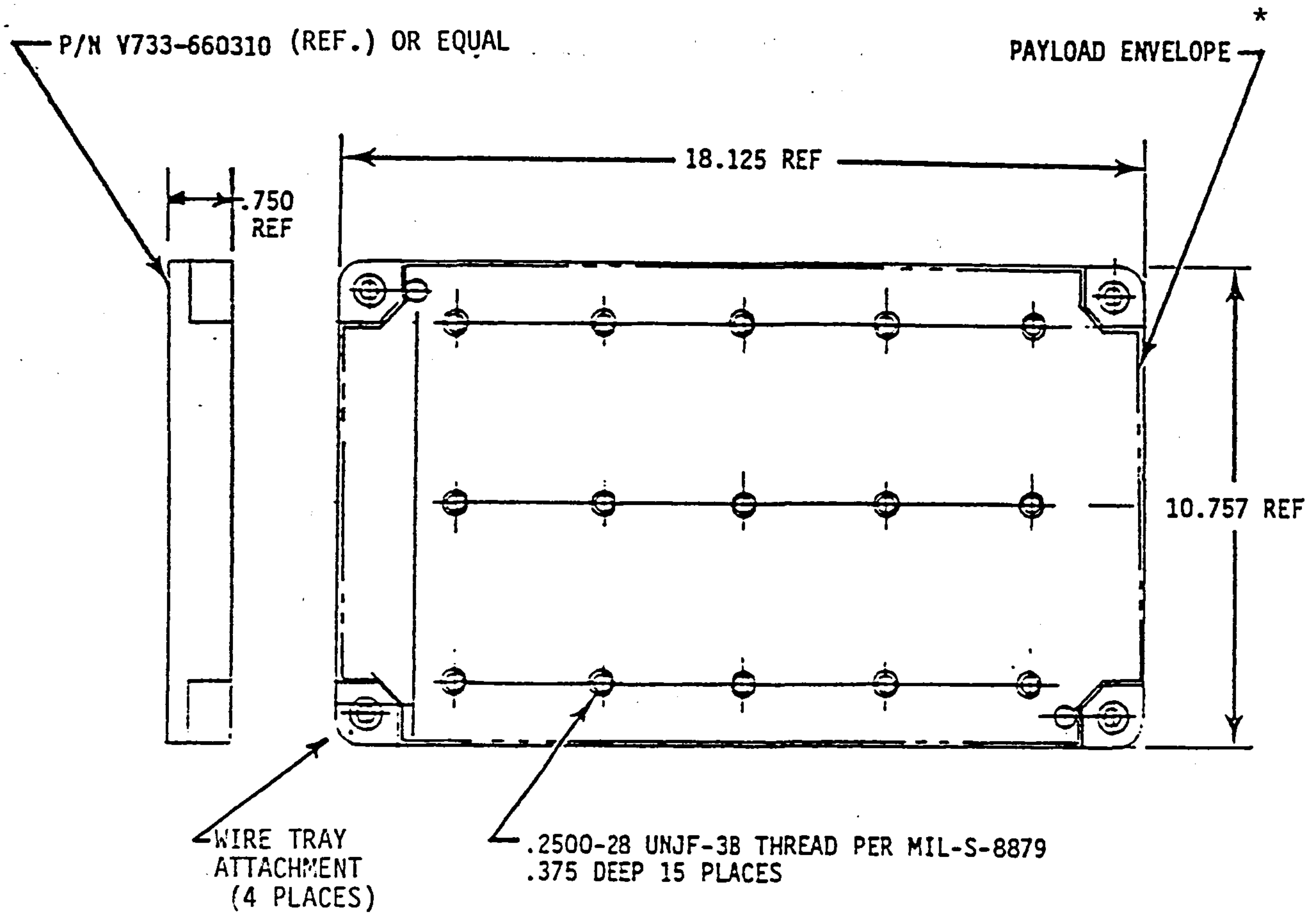


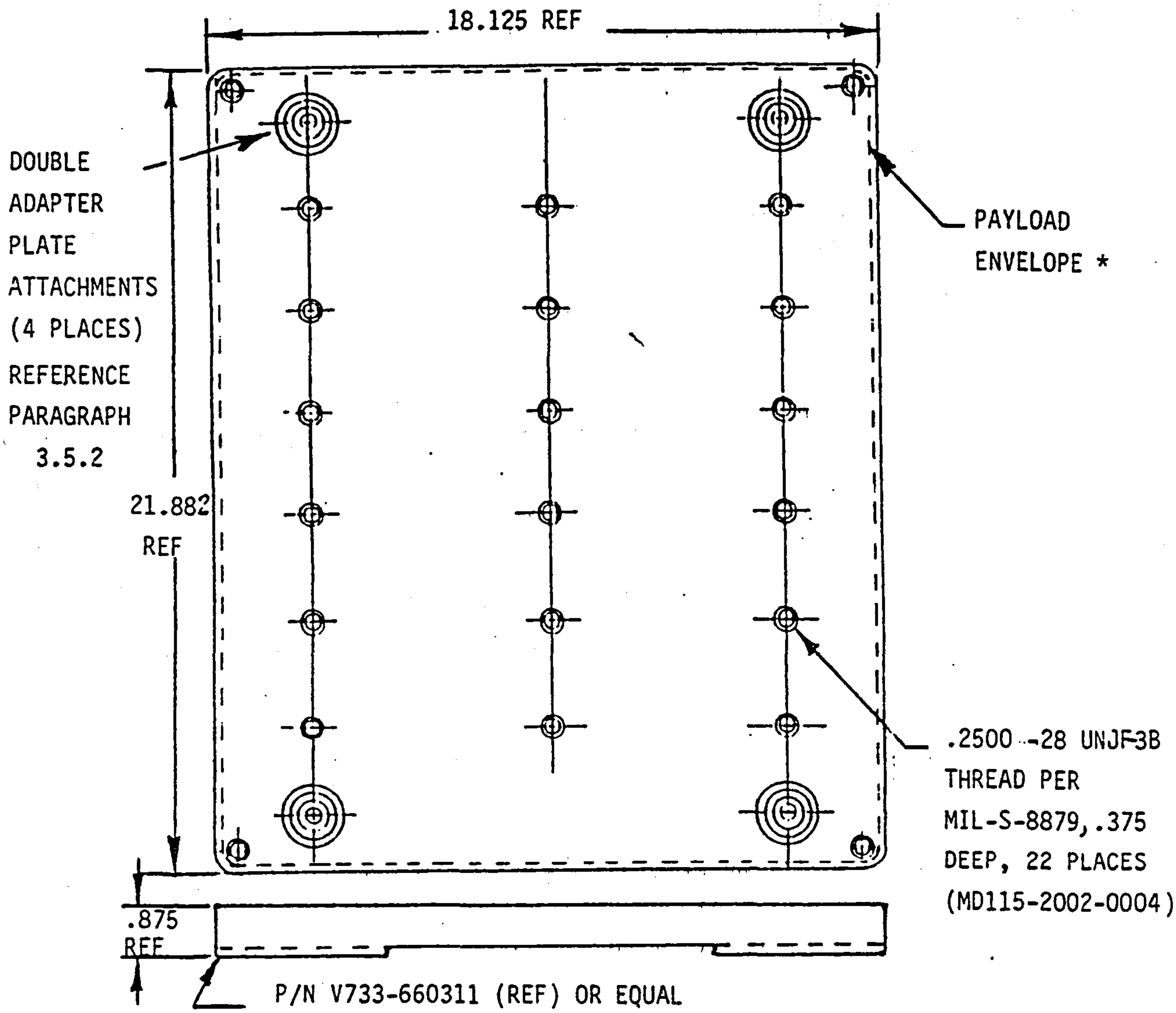
FIGURE 3.4.2-2 SMALL STOWAGE TRAY



* NOTE: PAYLOAD MUST STAY WITHIN THE OUTER DIMENSIONS OF THE PLATE. PROVISIONS MUST BE MADE BY THE PAYLOAD TO ALLOW ACCESS TO CORNER MOUNTING WIRE TRAYS ATTACHMENTS.

FIGURE 3.5.1-1 SINGLE ADAPTER PLATE

WEIGHT=6.5-Lb (3.09 kg)



* NOTE: PAYLOAD MUST STAY WITHIN THE OUTER DIMENSIONS OF THE PLATE. PROVISIONS MUST BE MADE BY THE PAYLOAD TO ALLOW ACCESS TO CORNER MOUNTING WIRE TRAY ATTACHMENTS.

FIGURE 3.5.2-1 DOUBLE ADAPTER PLATE

WEIGHT=14.4 Lb. (6.55 kg)

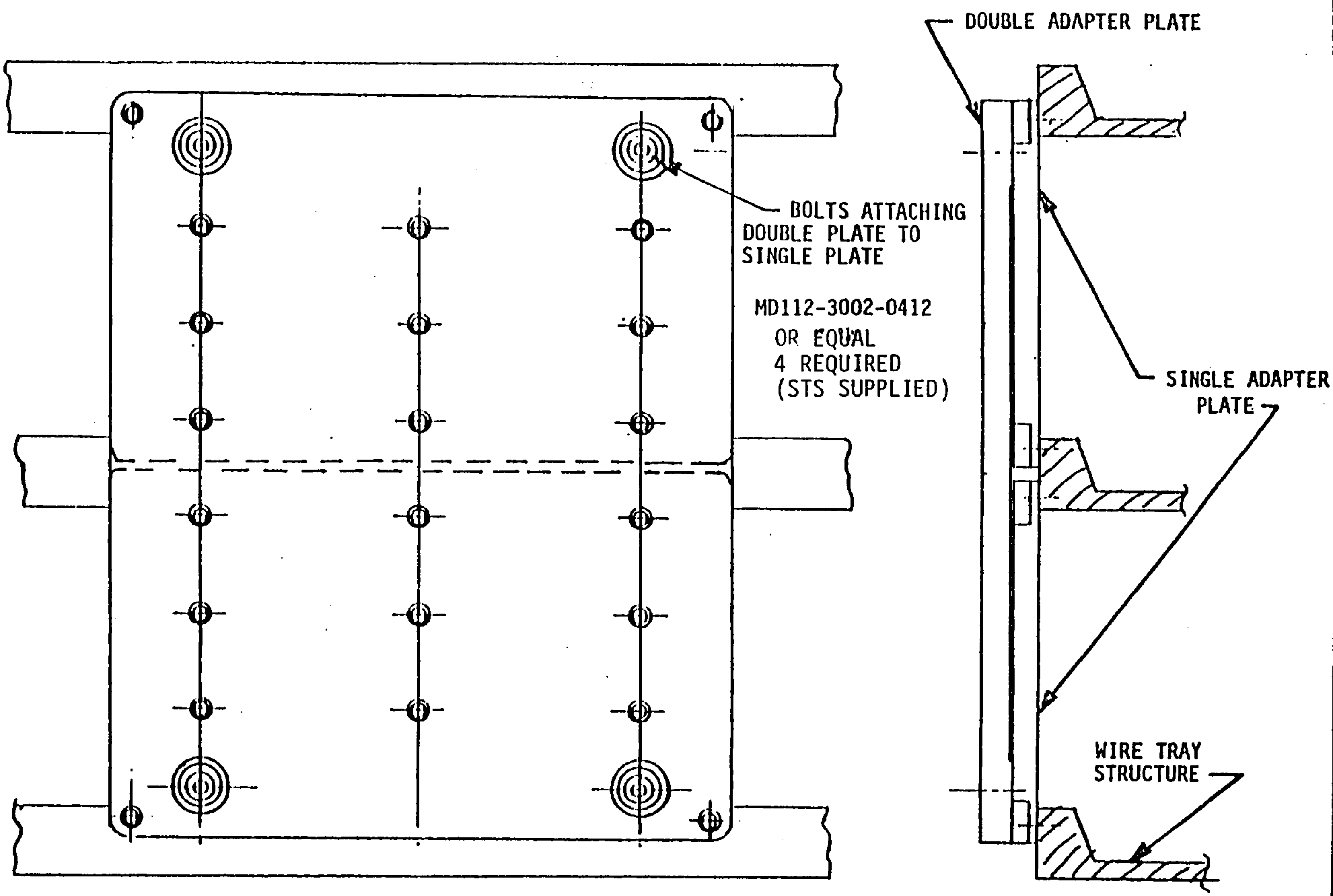


FIGURE 3.5.2-2 METHOD OF ATTACHMENT DOUBLE ADAPTER PLATE TO WIRE TRAYS

ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES

INTERFACE CONTROL DOCUMENT

SIZE	ICD NO.	REV	SHEET OF
A	ICD- 2-1M001		

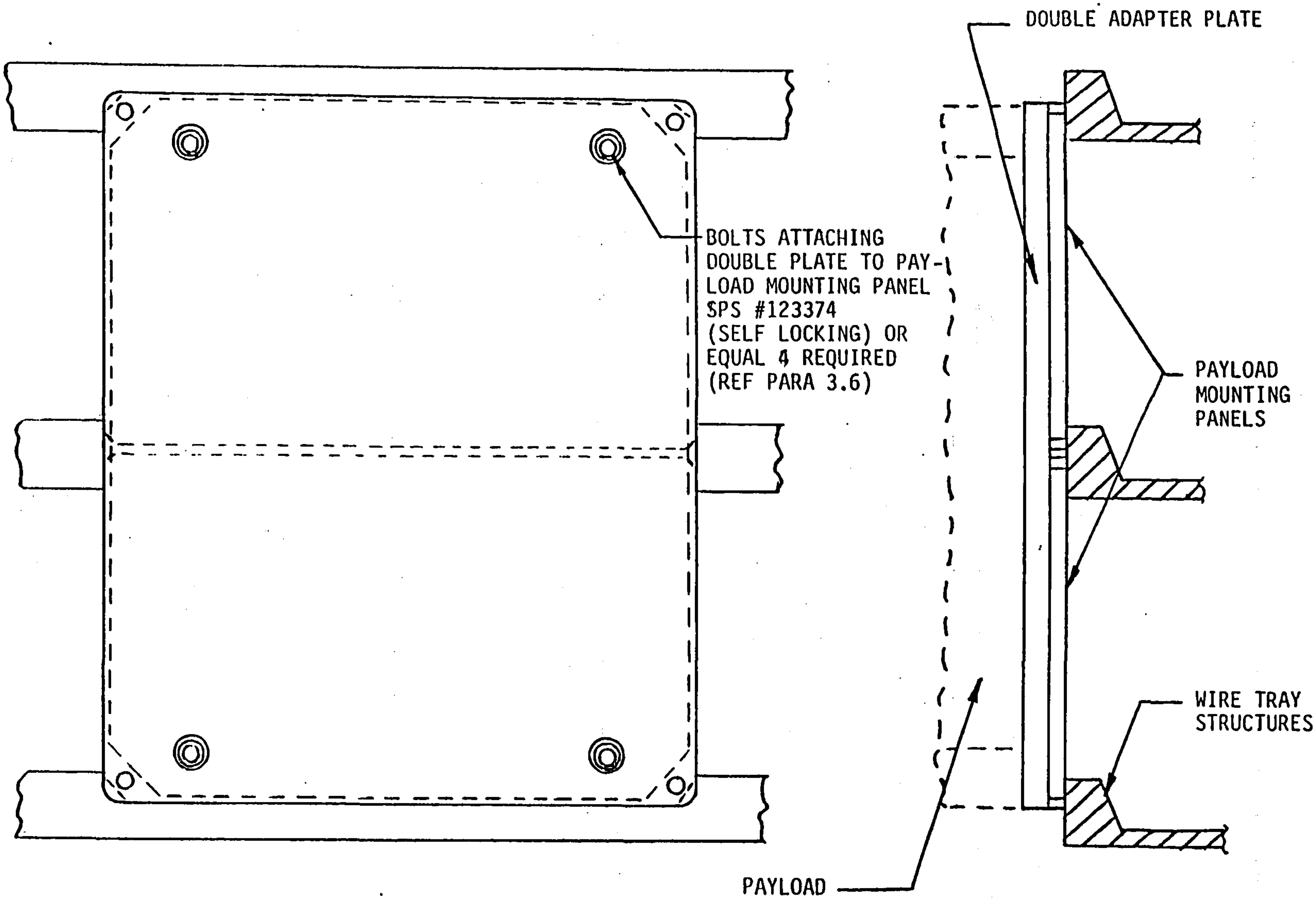
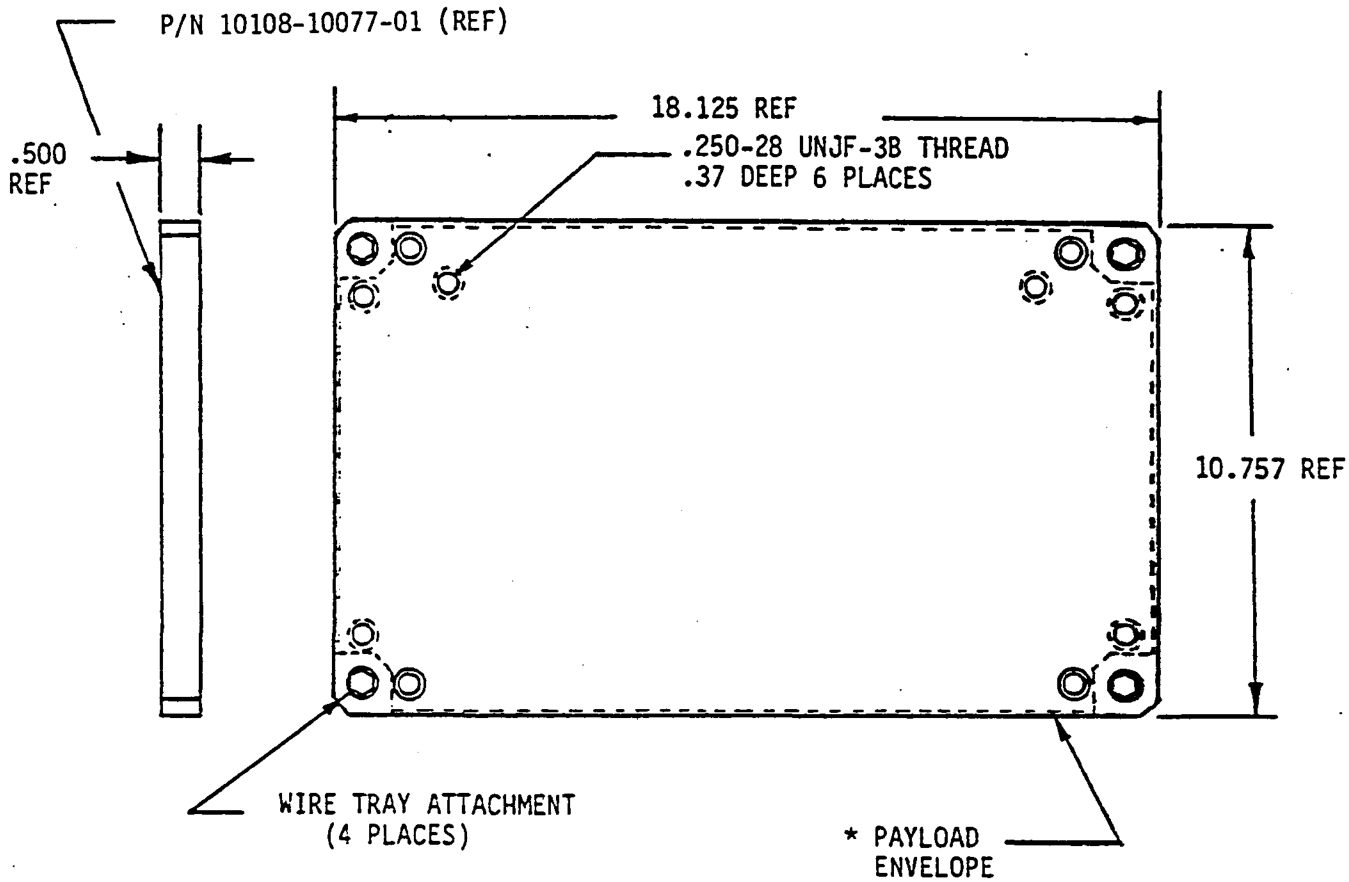


FIGURE 3.5.2-3 ALTERNATE METHOD OF ATTACHMENT DOUBLE ADAPTER PLATE TO WIRE TRAYS



* NOTE: PAYLOAD MUST STAY WITHIN OUTSIDE DIMENSIONS OF PANEL. PROVISIONS MUST BE MADE BY THE PAYLOAD TO ALLOW ACCESS TO CORNER MOUNT WIRE TRAY ATTACHMENTS.

FIGURE 3.5.3-1 PAYLOAD MOUNTING PANEL

WEIGHT 3.3 LBS. (1.5 Kg)

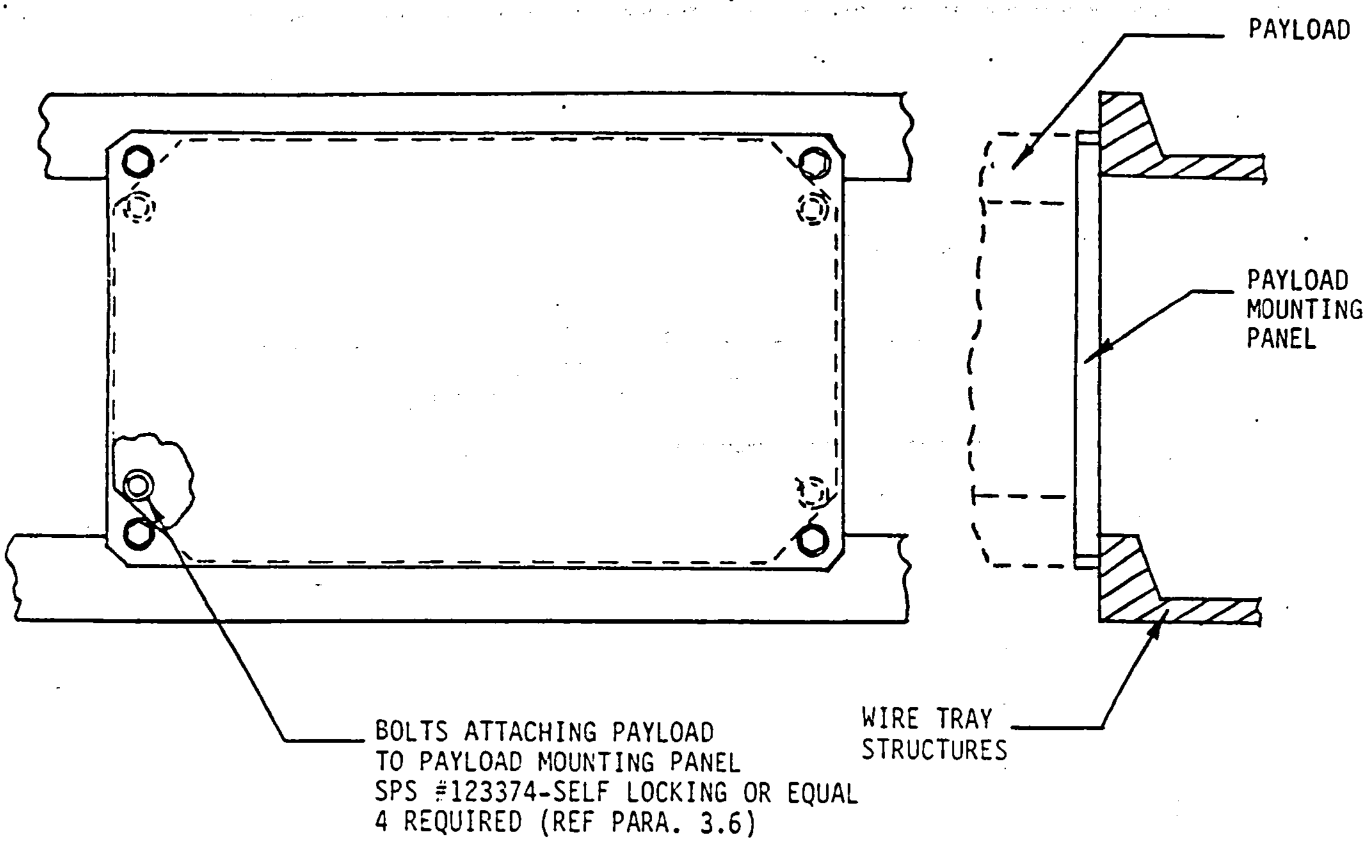
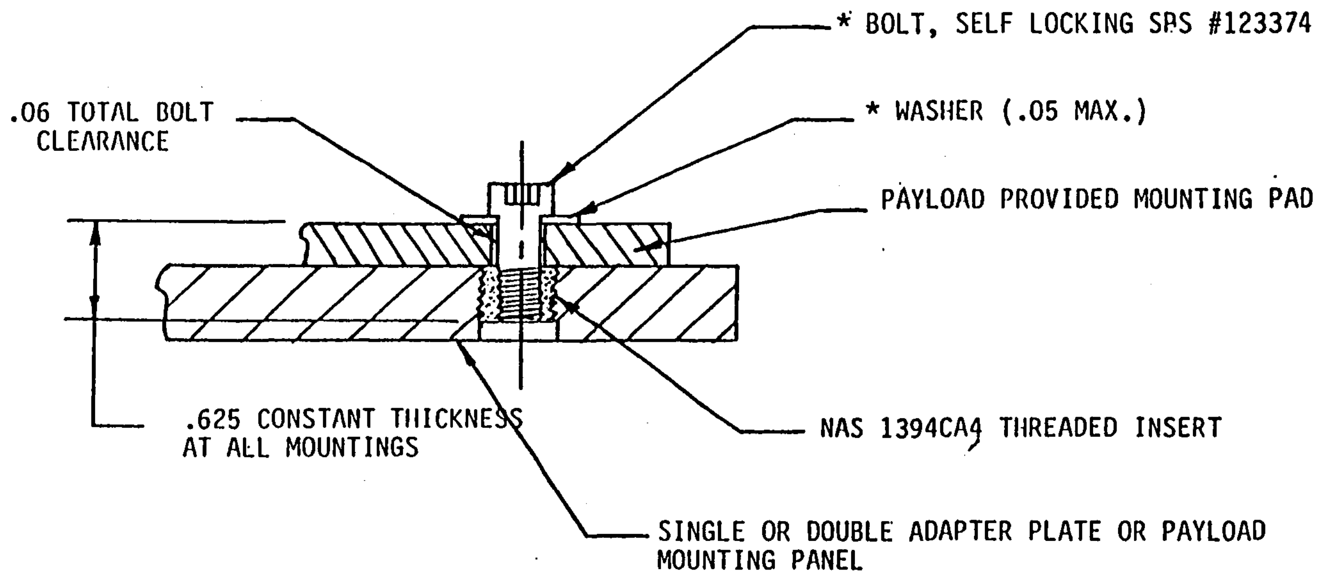


FIGURE 3.5.3-2 METHOD FOR MOUNTING PAYLOAD
TO PAYLOAD MOUNTING PANEL



* NOTE: BOLTS AND WASHERS ARE STS PROVIDED IF PAYLOAD MEETS .625 INCH THICKNESS CRITERIA AT PAYLOAD PROVIDED MOUNTING PAD (REFERENCE PARA. 3.6)

FIGURE 3.5.4-1 PAYLOAD/STS ATTACHMENT POINT DETAILS

ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES

INTERFACE CONTROL DOCUMENT

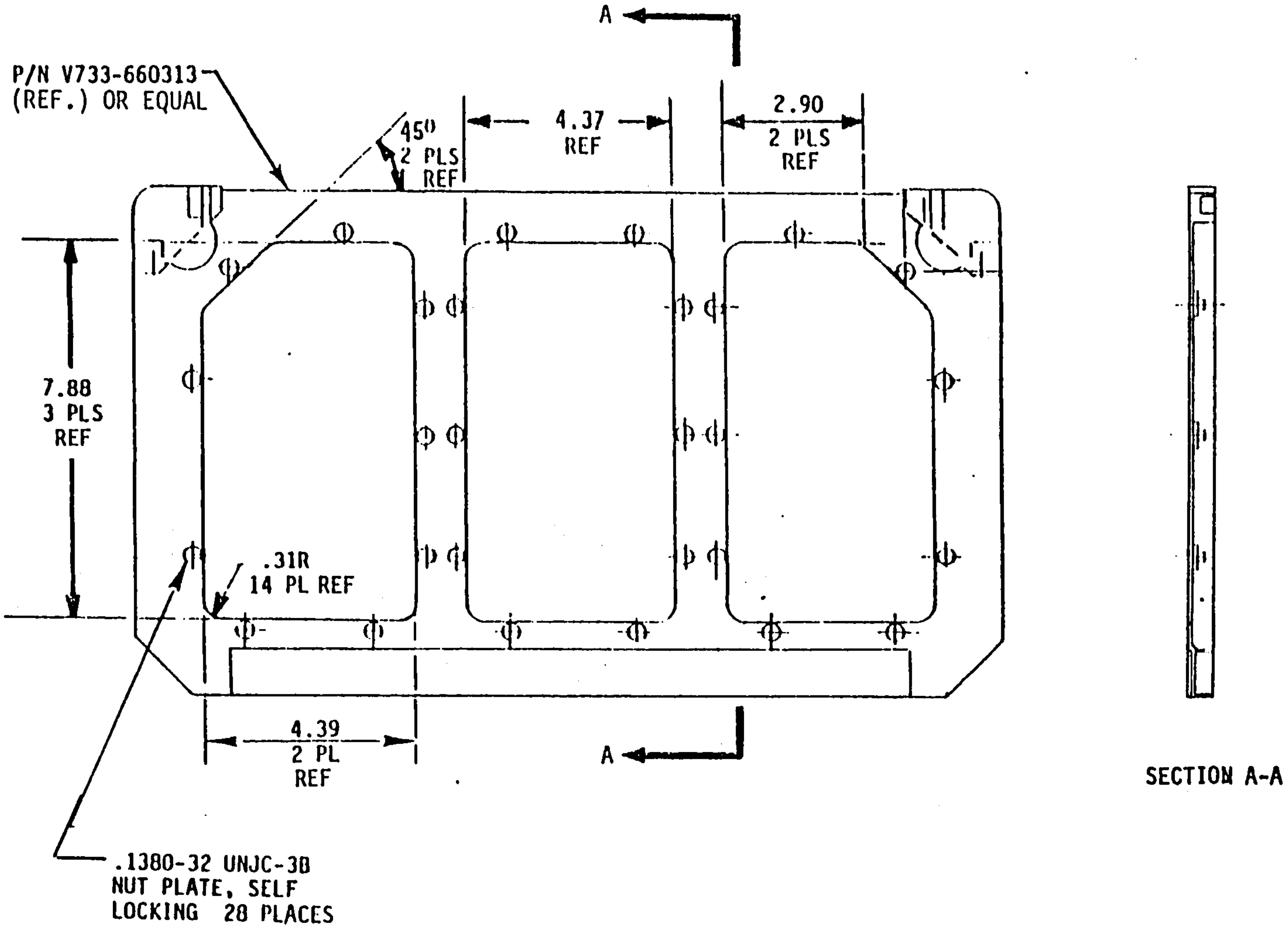


FIGURE 3.5.5-1 MODIFIED LOCKER ACCESS DOOR

SIZE	ICD NO.	REV	SHEET OF
A	ICD-2-1M001		

FORM 3935-F-7 NEW 6-73

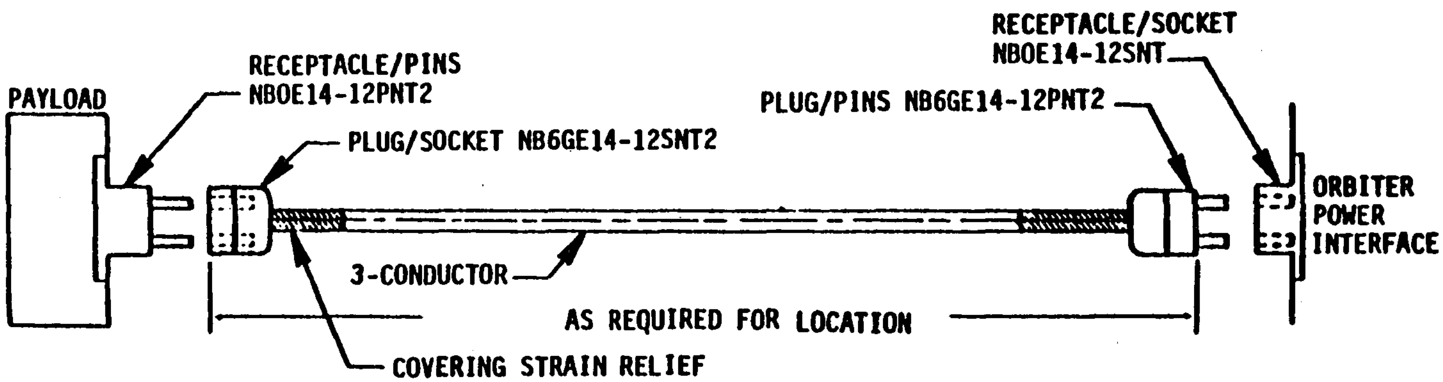


FIGURE 3.5.6-1 DIAGRAM OF DC CABLE

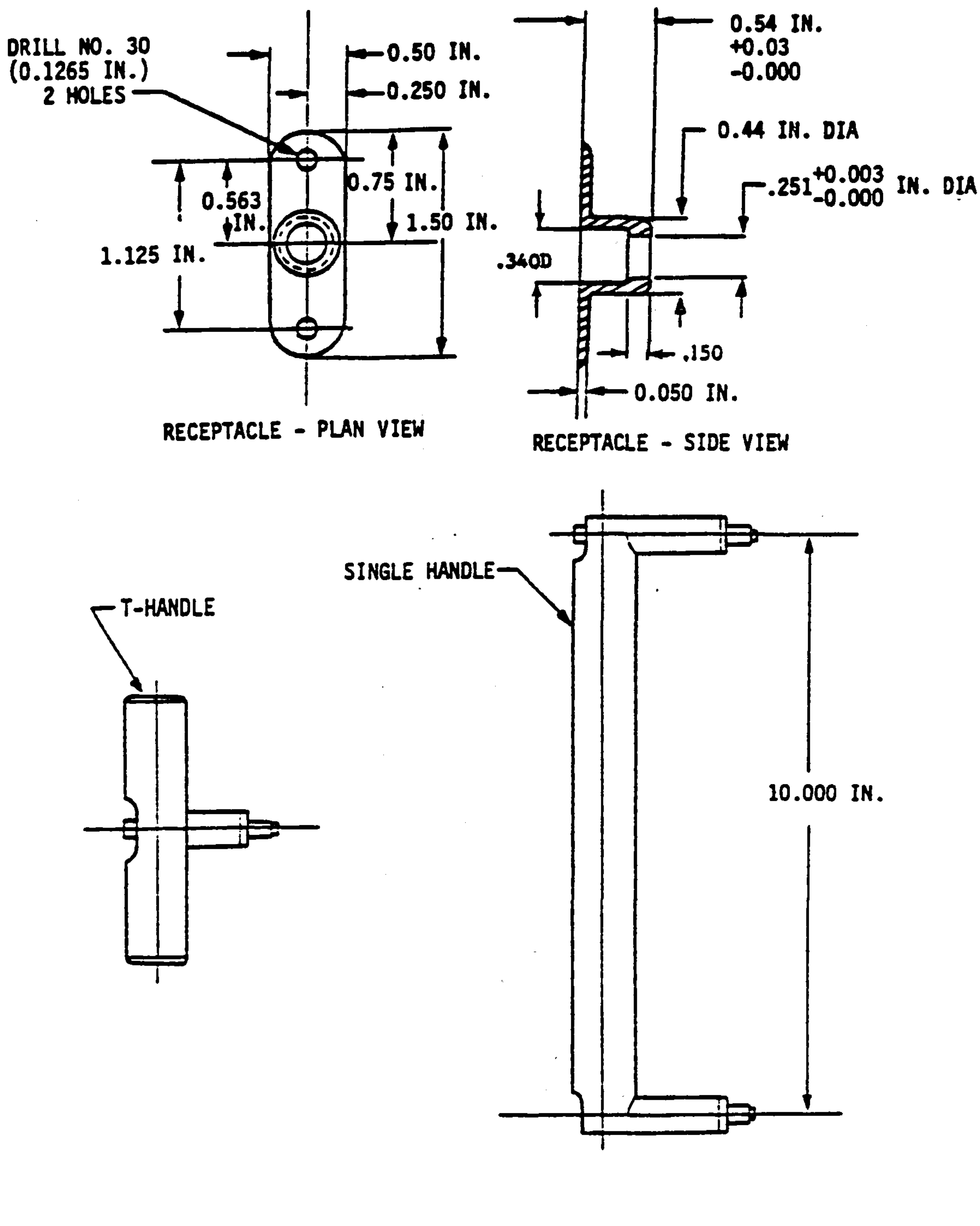
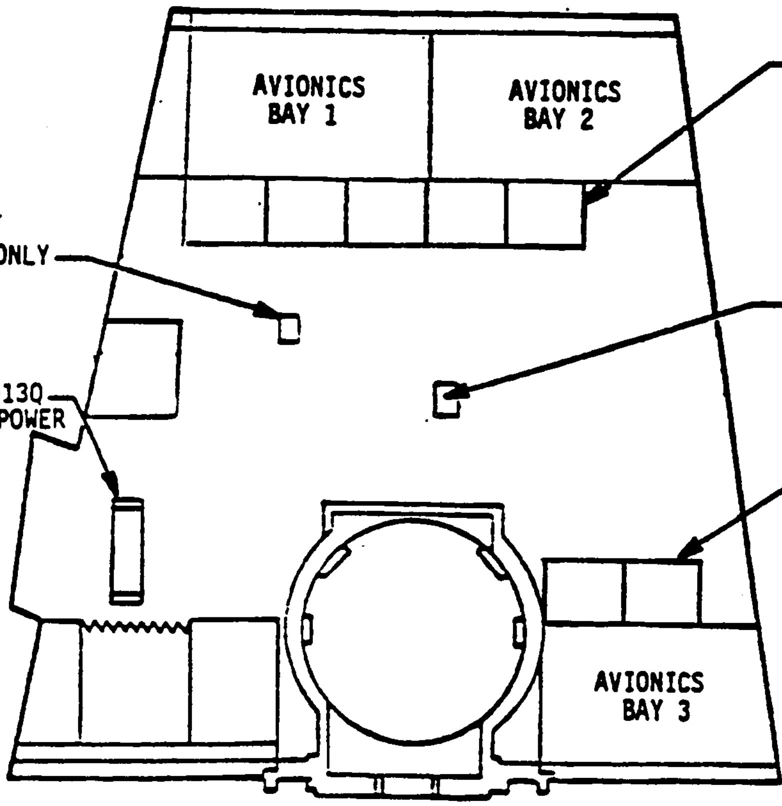


FIGURE 3.7-1 PAYLOAD/GSE HARD POINTS

INTERFACE CONTROL DOCUMENT				
ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES	SIZE A	ICD NO. ICD-2-1M001	REV	SHEET OF

FORM 3035-F-7 NEW 6-73



MIDDECK CEILING SUPERIMPOSED ON MIDDECK FLOOR

FIGURE 3.11.2-1 POWER PROVISIONS AT MIDDECK CEILING LOCATION
(SHEET 1 OF 3)

PANEL DESIG.	CONNECTOR DESIG.	RECEPTACLE	PLUG	TYPE
M013Q	J1	NB0E14-12SNT	NB6GE14-12PNT3	DC
M030F	J2	NB0E14-12SNT	NB6GE14-12PNT3	DC
M052J	J1	NB0E14-12SNT	NB6GE14-12PNT3	DC

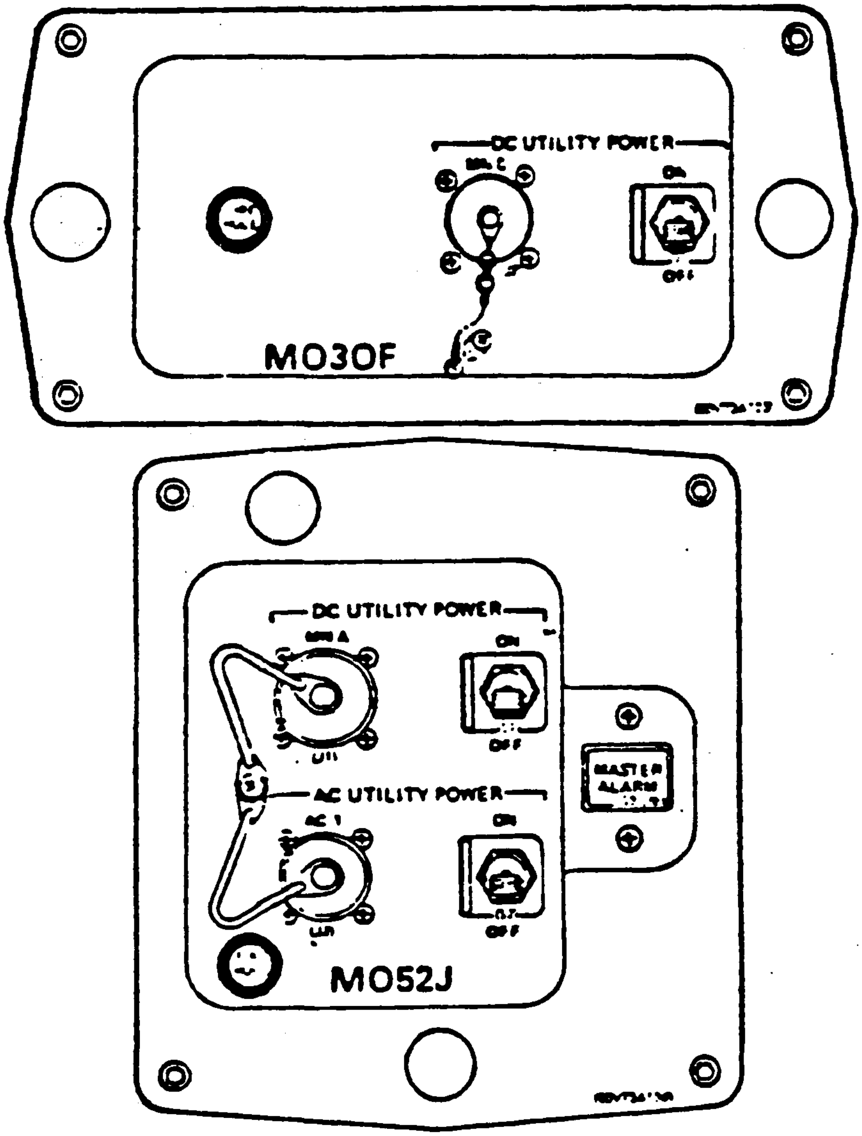


FIGURE3.11.2-1 POWER PROVISIONS AT MIDDECK CEILING LOCATION
(SHEET 2 OF 3)

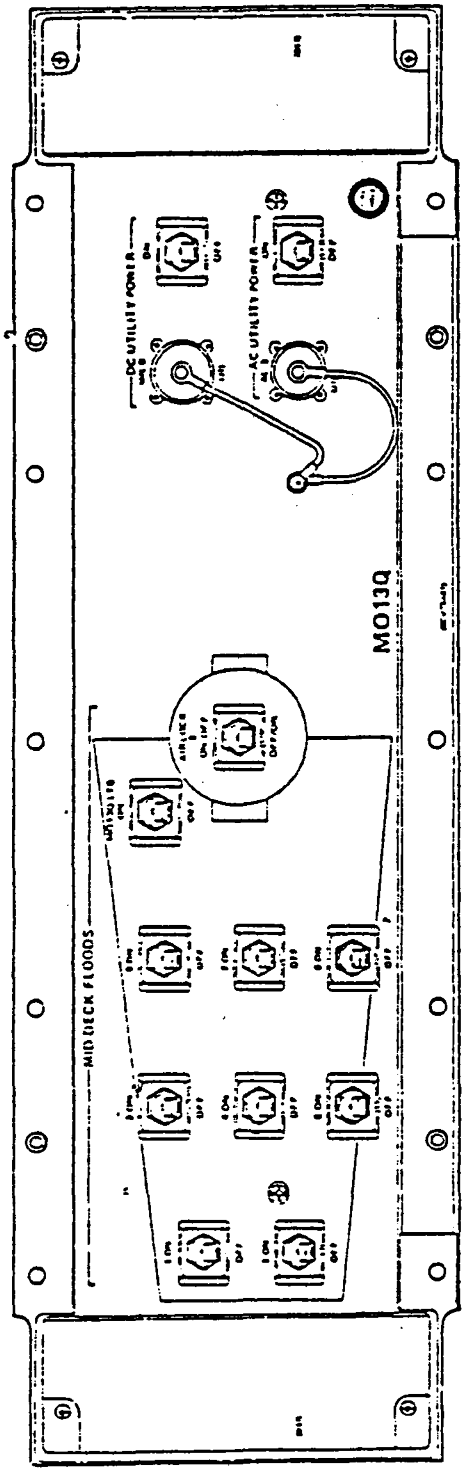


FIGURE 3.11.2-1 POWER PROVISIONS AT MIDDECK CEILING LOCATION (SHEET 3 OF 3)

INTERFACE CONTROL DOCUMENT				
ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES	SIZE A	ICD NO. ICD-2-1M001	REV	SHEET ___ OF ___

FORM 3935-F-7 NEW 6-73

4.0 STRUCTURAL INTERFACES.

4.1 OPERATIONAL INERTIA LOADS. Operational inertia load factors given in Table 4.1-1 shall apply to payload elements located in the Mid-Deck. These load factors act in the directions of Orbiter axes Xo, Yo, and Zo as defined in Figure 3.1.1-1 and Figure 4.1-1 and shall be considered in all combinations for each flight condition. For transient flight conditions lift-off and landing, the load factors are presented as the elastic responses due to the first mode of the payload element on its mounting support in each of the three axes. The first mode natural frequencies of the payload element mounted in the Mid-Deck must be determined before using Figures 4.1-2 and 4.1-3 to find the transient responses for lift-off and landing, respectively. It should be noted that the steady-state load factors are -1.6 in Xo at lift-off and +1.0 in Zo at landing.

The transient responses at lift-off shall be combined with the appropriate vibro-acoustic responses due to random vibration and acoustics environments defined in the subsequent paragraphs. The root-sum-square method may be used for combining the responses.

Table 4.1-1 Operational Inertia Load Factors

CONDITION	LIMIT Nx	LOAD Ny	FACTORS Nz
Lift-Off	-1.6 ± *	± *	± *
High-q Boost	-1.90	±0.08	-0.35
	-1.60	±0.20	-0.35
Max Boost	-3.15	±0.12	-0.25
Orbiter Max Load Factor	-3.15	±0.18	-0.60
	-3.00	0	-0.77
TAEM Maneuvers	+1.22	0	0
	-0.05	0	+2.00
	+0.72	±0.80	+1.00
	+1.19	0	+2.50
	+1.09	0	-1.00
Landing	± **	± **	+1.0 ± **

* See Figure 4.1-2
** See Figure 4.1-3

4.2 EMERGENCY LANDING LOAD FACTORS. Emergency landing load factors specified in Table 4.2-1 shall apply to payload elements mounted in the Mid-Deck. They shall apply to components whose failure could result in injury to personnel or prevent egress from the vehicle. These load factors shall act independently and the longitudinal load factor (Nx) shall be directed in all directions with 20° of the longitudinal axis.

Table 4.2-1 Emergency Landing Load Factors

ULTIMATE INERTIA LOAD FACTORS		
Nx	Ny	Nz
+20.0	+3.3	+10.0
-3.3	-3.3	-4.4

4.3 RANDOM VIBRATION. The random vibration environments applicable to components mounted in the Mid-Deck during launch and ascent shall be as follows:

20 - 150 Hz	+6.00 dB/Octave
150 - 1000 Hz	0.03 g^2/Hz
1000 - 2000 Hz	-6.00 dB/Octave
	Composite = 6.5 g(rms)

Environment exposure duration = 18.0 sec/flight in each of Xo, Yo, Zo axes.

The exposure duration includes a fatigue scatter factor of 4.

Static equivalent limit load factors resulting from the random vibration input are:

X-Axis	Y-Axis	Z-Axis
±12g	±12g	±12g

4.4 ACOUSTICS. Equipment to be mounted in the mid-deck shall be subjected to the acoustic spectra given in Table 4.4-1.

4.5 KICK/PUSH-OFF LOADS. Payload-provided mid-deck equipment shall be designed for a limit 125 pound load distributed over a 4 in x 4 in area.

4.6 CENTER-OF-GRAVITY ALLOWANCE VERSUS WEIGHT.

4.6.1 Payload Attached to Avionics Bay Wiretrays.

4.6.1.1 Standard Locker. For all Shuttle Orbiter Vehicles the CG of the payload element, packaged in a Standard Locker shall be not more than 14 inches from wiretray reference surface for all rows.

4.6.1.2 Payloads Attached to a Single Plate. Weight to CG relation for payloads attached to a single plate or panel, is shown in Figure 4.6.2.1-1. Restrictions on CG location specified in Paragraph 4.6.1.1 shall apply to payloads attached to single adapter plate(s).

4.6.1.3 Payload Attached to a Double Plate. Restrictions on CG location, specified in Paragraph 4.6.1.1 shall apply to payloads attached to a double plate.

Weight to CG relation for payloads attached to double adapter plate is shown in Figure 4.6.2.2-1.

4.6.1.4 Payloads Attached to Payload Mounting Panel(s). Weight to CG relation for payloads attached to a single payload mounting panel is shown in Figure 4.6.2.1-1. Weight to CG relation for payloads attached to two payload mounting panels, is shown in Figure 4.6.2.2-1.

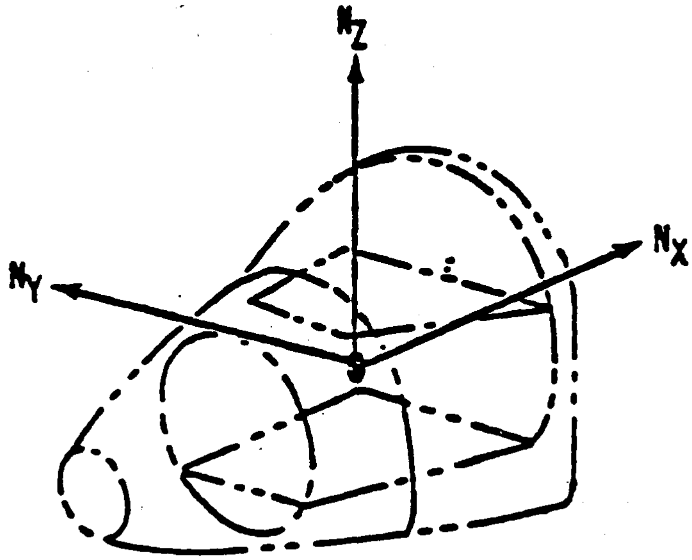
Restrictions on CG locations specified in Paragraphs 4.6.1.2 and 4.6.1.3 shall apply to payloads attached to payload mounting panels.

4.7 FACTORS OF SAFETY FOR STRUCTURAL DESIGN. The design of payload structures 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 larger than 1.5 inch in diameter shall have an ultimate factor of safety $\geq$ 1.5. Pressure vessels shall have an ultimate factor of safety $\geq$ 1.5. Structural factors of safety shall be verified in accordance with NHB1700.7 during the Payload safety process.

4.8 FRACTURE CONTROL. Payload structural components, including all pressure vessels, the failure of which would cause damage to the Orbiter or injury to personnel, shall be analyzed to preclude failures caused by propagation of pre-existing flaws. Fracture control of critical structural components shall be verified in accordance with NHB1700.7 during the Payload safety process.

Table 4.4-1 Mid-Deck Deck Acoustic Environment

1/3 Octave Band Center Frequency (Hz)	Sound Pressure Level - dB Ref. 2 x $10^{-5}N/m^2$	
	Lift-Off	Aeronoise
	5 Seconds/Mission	10 Seconds/Mission
31.5	107	99
40.0	108	100
50.0	109	100
63.0	109	100
80.0	108	100
100.0	107	100
125.0	106	100
160.0	105	99
200.0	104	99
250.0	103	99
315.0	102	98
400.0	101	98
500.0	100	97
630.0	99	97
800.0	98	96
1000.0	97	95
1250.0	96	94
1600.0	95	93
2000.0	94	91
2500.0	93	91
OVERALL	117.5	111



LOAD FACTOR IS DEFINED AS THE TOTAL EXTERNALLY APPLIED FORCE DIVIDED BY THE CORRESPONDING TOTAL OR COMPONENT WEIGHT AND CARRIES THE SIGN OF THE EXTERNALLY APPLIED FORCE IN ACCORDANCE WITH THE ORBITER COORDINATE SYSTEM.

FIGURE 4.1-1 DIRECTIONS OF LOAD FACTORS

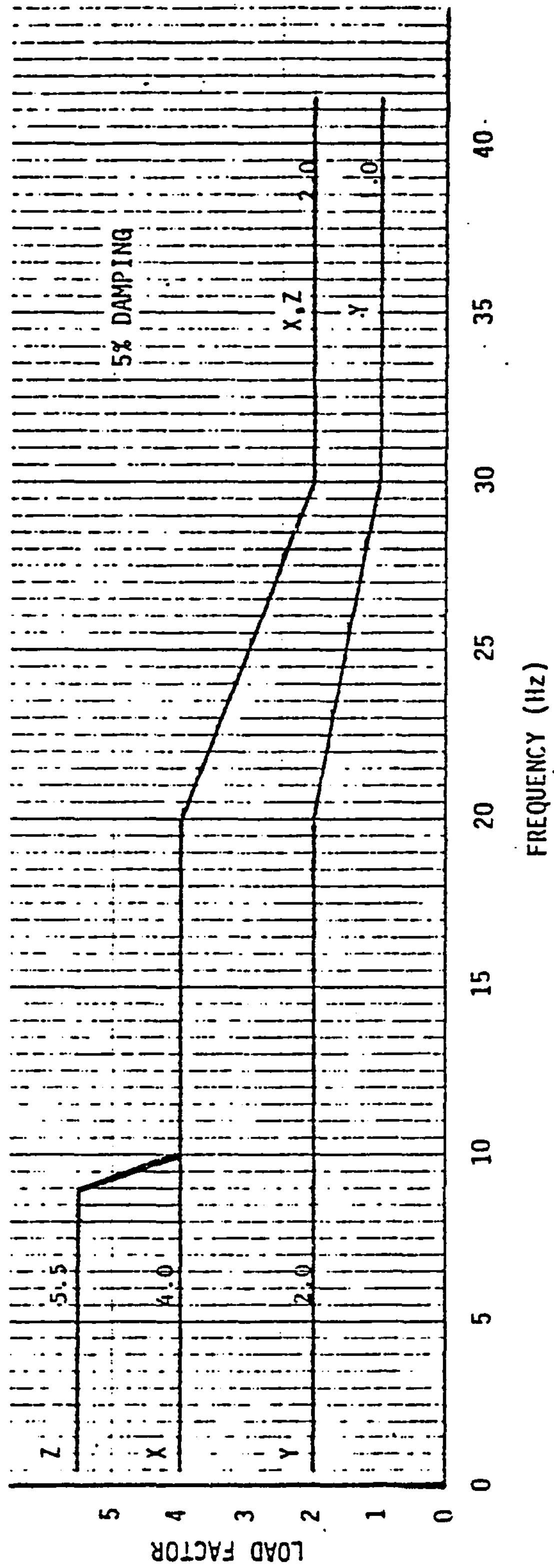


FIGURE 4.1-2 TRANSIENT RESPONSE AT LIFTOFF

INTERFACE CONTROL DOCUMENT

ORBITER MIDDECK/PAYLOAD STANDARD INTERFACES	SIZE A	ICD NO. ICD-2-1M001	REV	SHEET OF

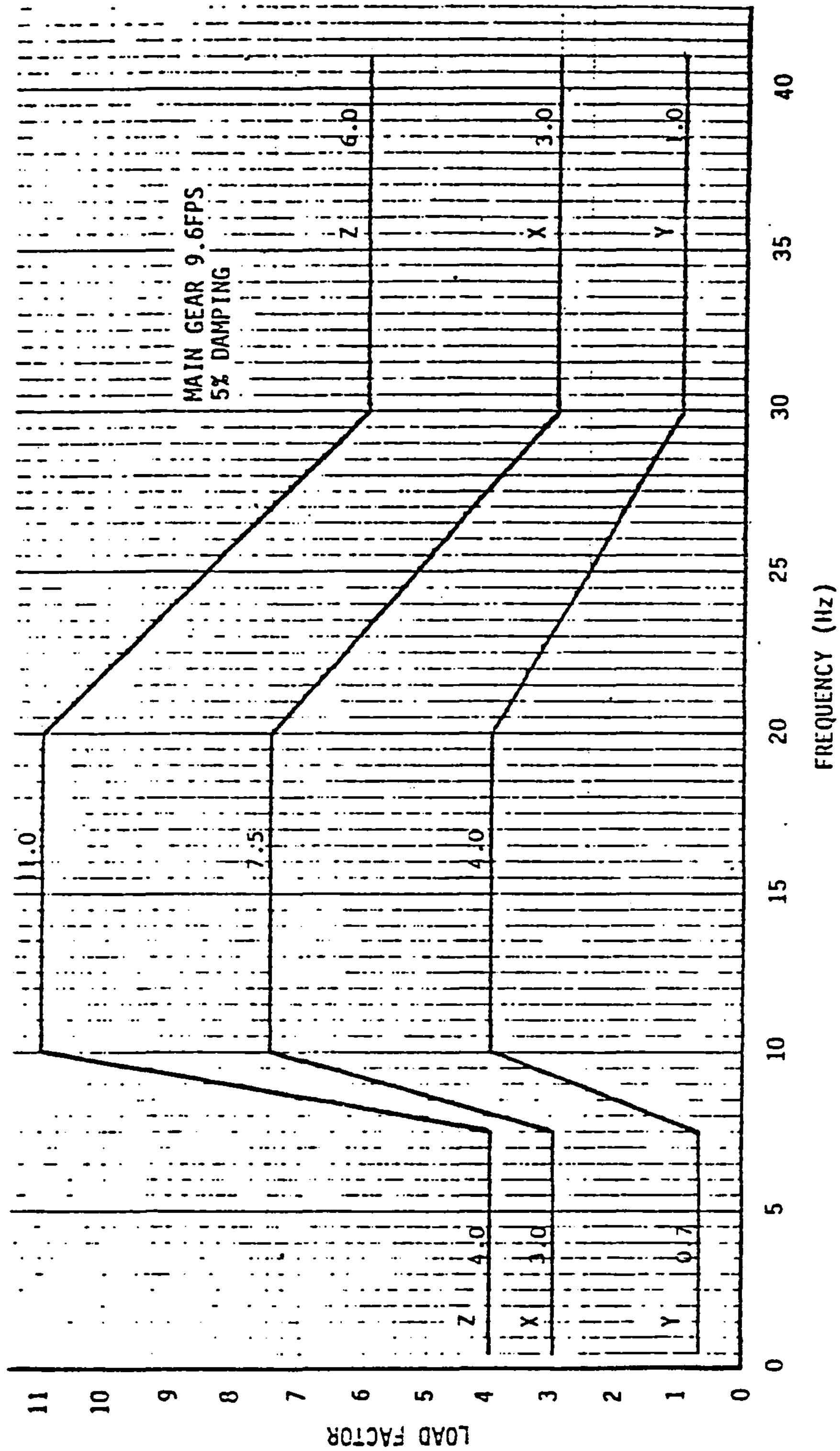
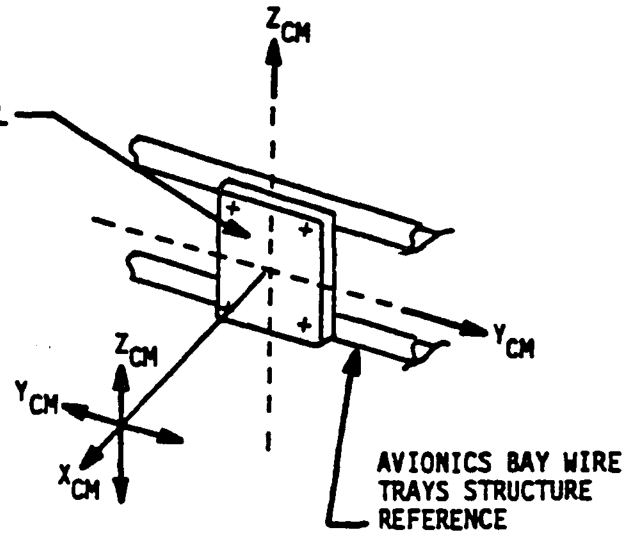


FIGURE 4.1-3 TRANSIENT RESPONSE AT LANDING



CENTER OF PLATE

CG(IN.) X	UNIT WEIGHT (LB)
14 MAX	51
13	55
12	59
11	65
10	69

±3 INCH Y

CG(IN.) X	UNIT WEIGHT (LB)
14 MAX	37
13	40
12	44
11	48
10	52

±3 INCH Z

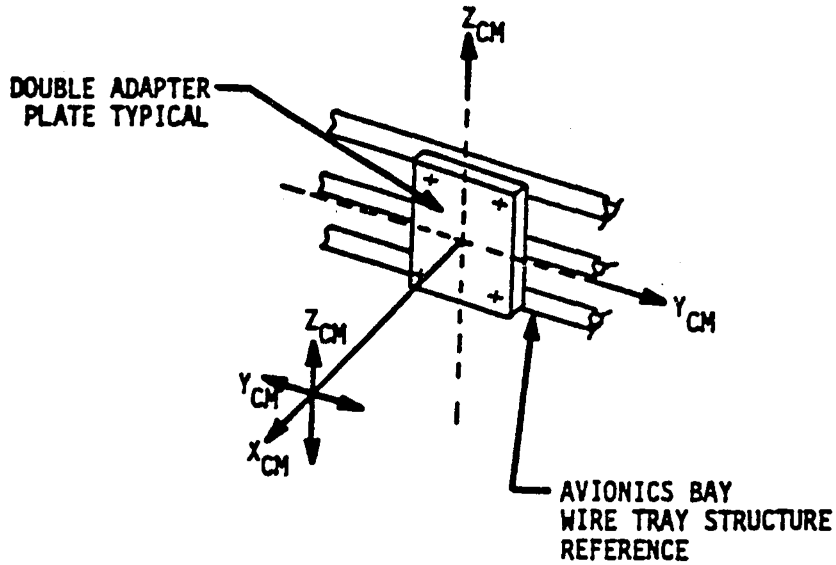
CG(IN.) X	UNIT WEIGHT (LB)
14 MAX	51
13	55
12	59
11	65
10	69

UNIT WEIGHT = WEIGHT OF PAYLOAD + WEIGHT OF SINGLE PLATE

DATA SHOWN HERE IS FOR OPERATIONAL VEHICLES

CG LOCATION IN INCHES FROM WIRE TRAY STRUCTURE REFERENCE

FIGURE 4.6.2.1-1 MAXIMUM PAYLOAD WEIGHT AND CENTER OF GRAVITY FOR SINGLE-ADAPTER PLATE



CENTER OF PLATE

CG(IN.)X	UNIT WT (LB)
14 MAX	120 MAX

±3 INCH Y

CG(IN.)X	UNIT WT (LB)
14 MAX	88
13	94
12	102
11	112
10	120 MAX

±3 INCH Z

CG(IN.)X	UNIT WT (LB)
14 MAX	87
13	94
12	101
11	110
10	120 MAX

UNIT WEIGHT = WEIGHT OF PAYLOAD + WEIGHT OF DOUBLE ADAPTER PLATE + WEIGHT OF 2 SINGLE ADAPTER PLATES

DATA SHOWN HERE IS FOR OPERATIONAL VEHICLES

CG LOCATION IN INCHES FROM WIRE TRAY STRUCTURE REFERENCE

FIGURE 4.6.2.2-1 MAXIMUM PAYLOAD WEIGHT AND CENTER OF GRAVITY FOR DOUBLE ADAPTER PLATE

5.0 THERMAL INTERFACE.

5.1 ENVIRONMENTAL CONDITIONS. The environmental conditions for the mid-deck will vary as follows:

Dew Point	+61°F to +39°F
Cabin Pressure	14.7 ± 0.2 PSIA (Normal Operation)
	8.0 ± 0.2 PSIA (Abort Operations - Payload required to be powered off)
	18.1 PSIA maximum (Ground Pressurization Test)
	10.2 ± 0.2 PSIA (EVA)
Cabin Rate of Pressure Change	
Nominal Ops	2.0 psi/min Repressurization/Depressurization
Contingency	9.0 psi/min Depressurization/ Repressurization
Cabin O_2 Concentration	25.9 percent at 14.7 ± 0.2 PSIA 32.0 percent at 8.0 ± 0.2 PSIA 31.0 percent at 10.2 ± 0.2 PSIA
Temperature (Air)	65-80°F (Normal Operations)
	95°F Max. Peak (Ascent and Entry Transients)
	TBD°F (Ferry Flight)
Temperature (Structure)	120° Max (All Mission Phases)

5.2 PAYLOAD ELEMENT COOLING.

5.2.1 Passive Cooling. Payload waste heat shall be considered dissipated to cabin air. This Section shall define the maximum total payload heat load that may be passively cooled with or without payload provided capability to internally circulate cabin air during on-orbit operations. Payloads which are required to operate during EVA or EVA prebreathe periods shall design cooling based on 10.0 psia cabin pressure.

5.2.1.1 Maximum Allowable Heat Loads. Passively cooled mid-deck payloads shall dissipate heat to the cabin air to the extent defined in Figures 5.2.2.1-1 and -2. This maximum allowed shall be governed by several factors relating to the Orbiter and the particular mission flown. The total heat load consumed by any payload shall not exceed 200 watts average power (300 watts peak power for 30 minutes or less). It shall be the responsibility of the STS to manifest a complement of compatible payloads.

5.2.1.2 Passive Cooling Design Constraints. Payloads generating waste heat and not incorporating in the design a means of rejecting this heat to the cabin air by means of a fan or similar means shall be constrained to the following maximum continuous heat loads:

Payload Container	Heat Load
Standard Storage Locker	60W
Experiment Apparatus Container	90W

Maximum air outlet temperature shall not exceed 120°F.

The allowable mid-deck heat load defined in Figure 5.2.2.1-1, is the total that payload(s) will contribute to the cabin air. Payloads shall have the option of sharing the allowed heat load or staggering operations.

If a payload configuration requires multiple containers, then the design shall be based on a worse case thermal interaction between containers. This shall apply particularly to the internal component design.

5.3 EXTERNAL SURFACE TEMPERATURES. External surface temperatures of the payload elements accessible to the crew shall not exceed 113°F; inaccessible external surfaces shall not exceed 120°F.

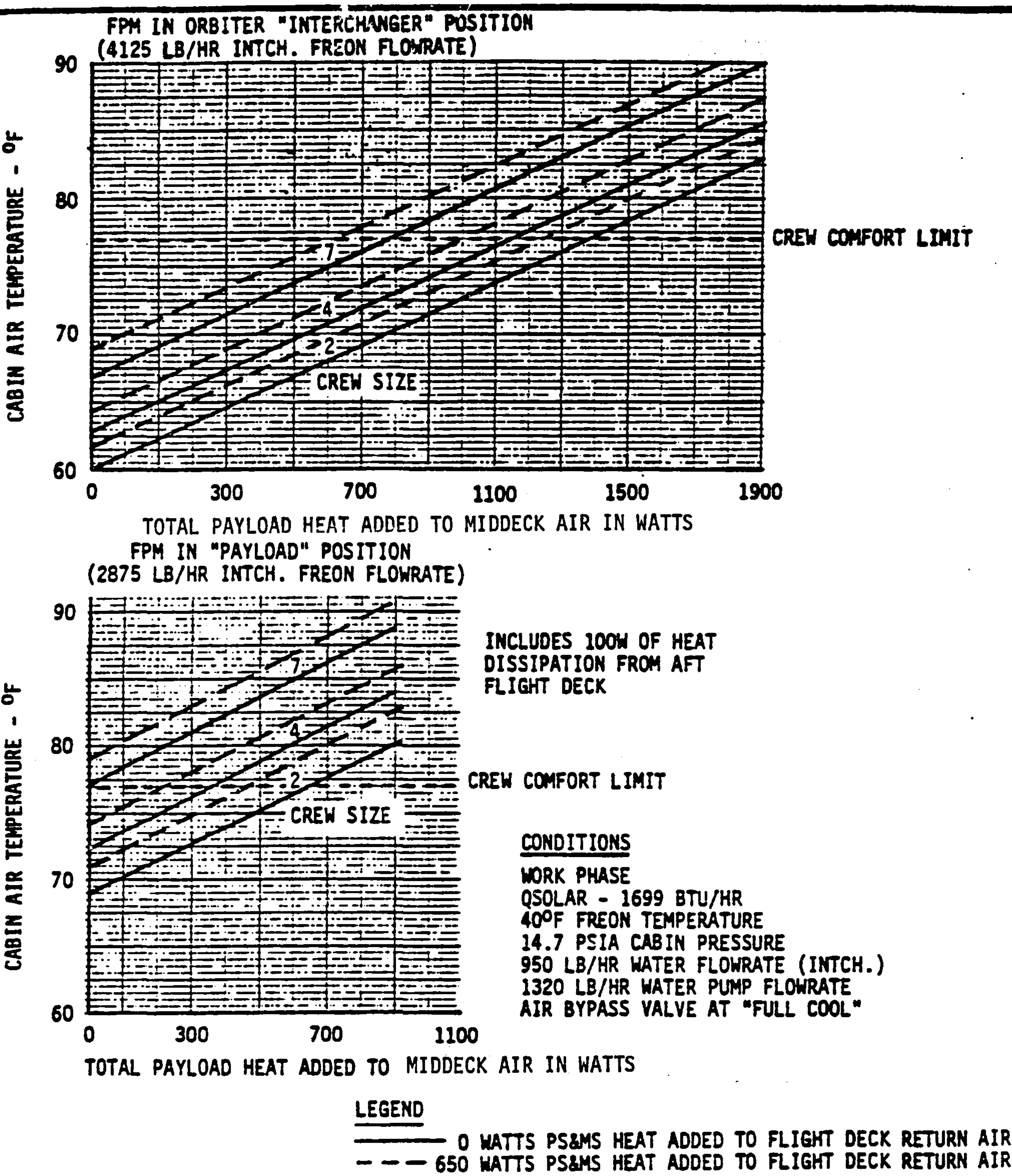
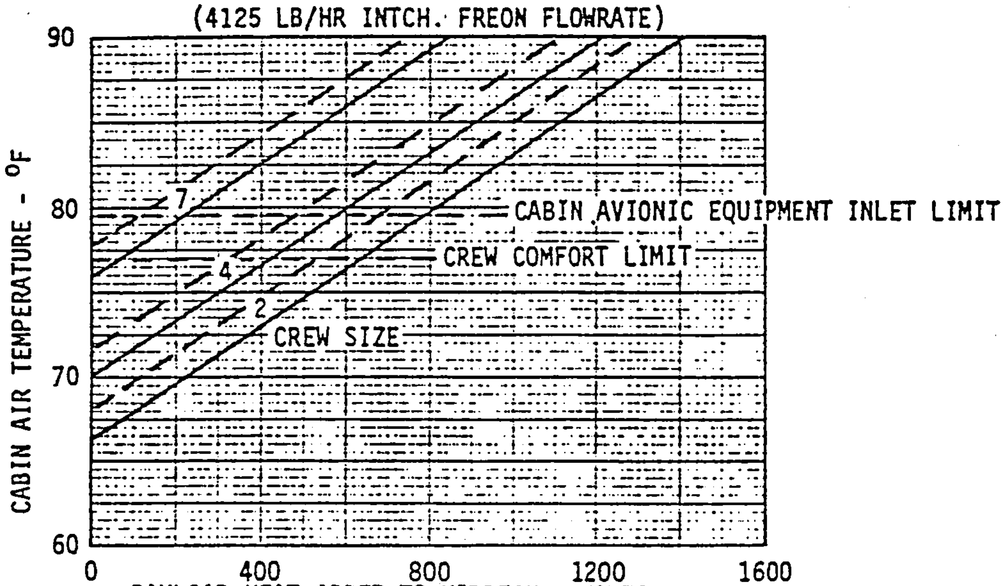


FIGURE 5.2.2.1-1 MAXIMUM ALLOWABLE HEAT LOAD FOR A CABIN PRESSURE OF 14.7 PSIA

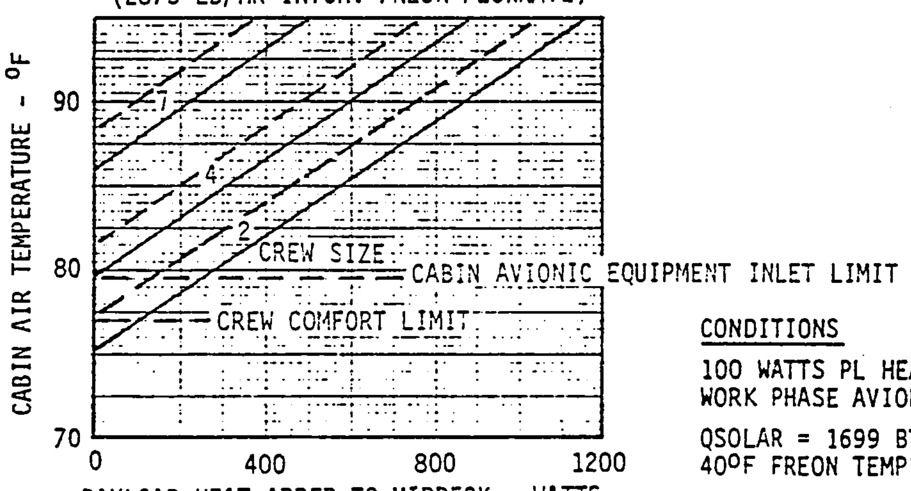
FPM IN "INTERCHANGER" POSITION

(4125 LB/HR INTCH. FREON FLOWRATE)



FPM IN "PAYLOAD" POSITION

(2875 LB/HR INTCH. FREON FLOWRATE)



CONDITIONS

100 WATTS PL HEAT TO FLT DECK AIR
WORK PHASE AVIONICS & METABOLIC LOADS

QSOLAR = 1699 BTU/HR
40°F FREON TEMPERATURE, IC INLET

10.2 PSIA CABIN PRESSURE
950 LB/HR WATER FLOWRATE (INTCH.)
1320 LB/HR WATER PUMP FLOWRATE
AIR BYPASS VALVE AT "FULL COOL"

LEGEND

——— 0 WATTS PS&MS HEAT ADDED TO FLIGHT DECK RETURN AIR
— — — 650 WATTS PS&MS HEAT ADDED TO FLIGHT DECK RETURN AIR

FIGURE 5.2.2.1-2 MAXIMUM ALLOWABLE HEAT LOAD FOR A CABIN PRESSURE OF 10.2 PSIA

6.0 ELECTRICAL POWER INTERFACES.

6.1 ELECTRICAL ENERGY.

6.1.1 Payload Element Energy Allocation. The payload-element electric energy allocation shall be as defined in its Payload Integration Plan.

6.2 DC POWER CHARACTERISTICS.

6.2.1 Power and Voltage Rating.

6.2.1.1 Mid-Deck Ceiling Location. DC electrical power provided by the Orbiter at the mid-deck ceiling location utility outlets (connector reference designators M013Q-J1, M030F-J2 and M052J-J1) shall be as follows:

Mission Phase	Voltage			Power (1) (Max Continuous at Minimum Voltage)		
				M052J	M013Q	M030F
	MIN (VDC)	NOM (VDC)	MAX (VDC)	BUS A	BUS B	BUS C
Prelaunch (Servicing)	23	28	32	224w	215w	165w
Ascent	0	0	0	0	0	0
On-Orbit	23	28	32	224w	215w	165w
Entry	0	0	0	0	0	0

(1) Power specified is total available to be shared by mid-deck and flight deck utility outlets during simultaneous operation. Each outlet is capable of providing this power level when outlets on the same circuit breaker are not in operation. The total power consumed by any payload is limited to 200 watts average power for up to 8 hours (or 280 watts peak power for 10 seconds or less). No power will be available to payloads during ascent and/or descent mission phases.

6.2.2 Transient Surge Voltage Limits (Single Event). Orbiter power transients shall be within the limits of Figures 6.2.2-1, 6.2.2-2 and 6.2.2-3 for normal, abnormal and emergency conditions respectfully.

6.3 INTERFACE DESIGN.

6.3.1 Overload Protection. Orbiter circuit protection devices shall be as specified below.

6.3.1.1 Mid-Deck Ceiling Outlets. Main DC power shall be supplied to mid-deck ceiling outlets at payload interface connectors M013Q-J1, M030F-J2 and M052J-J1. Orbiter circuit protection for these connectors shall be provided by 10 amp circuit breakers, which also shall protect flight deck utility outlets. Each mid-deck utility outlet shall be capable of providing up to 7.0 amps when the associated flight deck utility outlets are not in operation.

6.3.2 Wire Sizing. All payload element wiring connecting to Orbiter power sources shall be sized to be consistent with associated circuit protection devices.

6.3.3 Equipment Return and Grounding. Mid-Deck payload equipment electrical circuits shall have power returns isolated from each other and from equipment chassis, case, or enclosure by a minimum of 100 K OHMS.

6.3.4 Power Loss. Loss of Orbiter supplied power to the mid-deck payload element during on-orbit operation shall require manual reconfiguration of Orbiter power to restore power to the mid-deck payload elements. The power shall normally be restored within 15 minutes of the mid-deck payload element power loss detection.

6.3.5 Emergency Operational Modes. For emergency operational modes, the payloads shall be able to sustain a safe condition with permanent loss of Orbiter power.

6.3.6 Payload Element Activation/Deactivation and Isolation. Each payload element shall isolate its input power circuits from all other payload elements.

6.3.6.1 Mid-Deck Ceiling Outlets. Activation/Deactivation of payloads utilizing the mid-deck ceiling outlets shall be provided by switches located on mid-deck panels M013Q, M030F and M052J.

6.3.7 Isolation of Power Sources. The payload shall have provisions to assure the isolation of Orbiter power sources within the equipment such that no single failure, including short circuits, shall cause the power sources to be tied together electrically.

6.3.8 Electrical Bonding. Electrical bonding provisions shall be accomplished in accordance with MIL-B-5087.

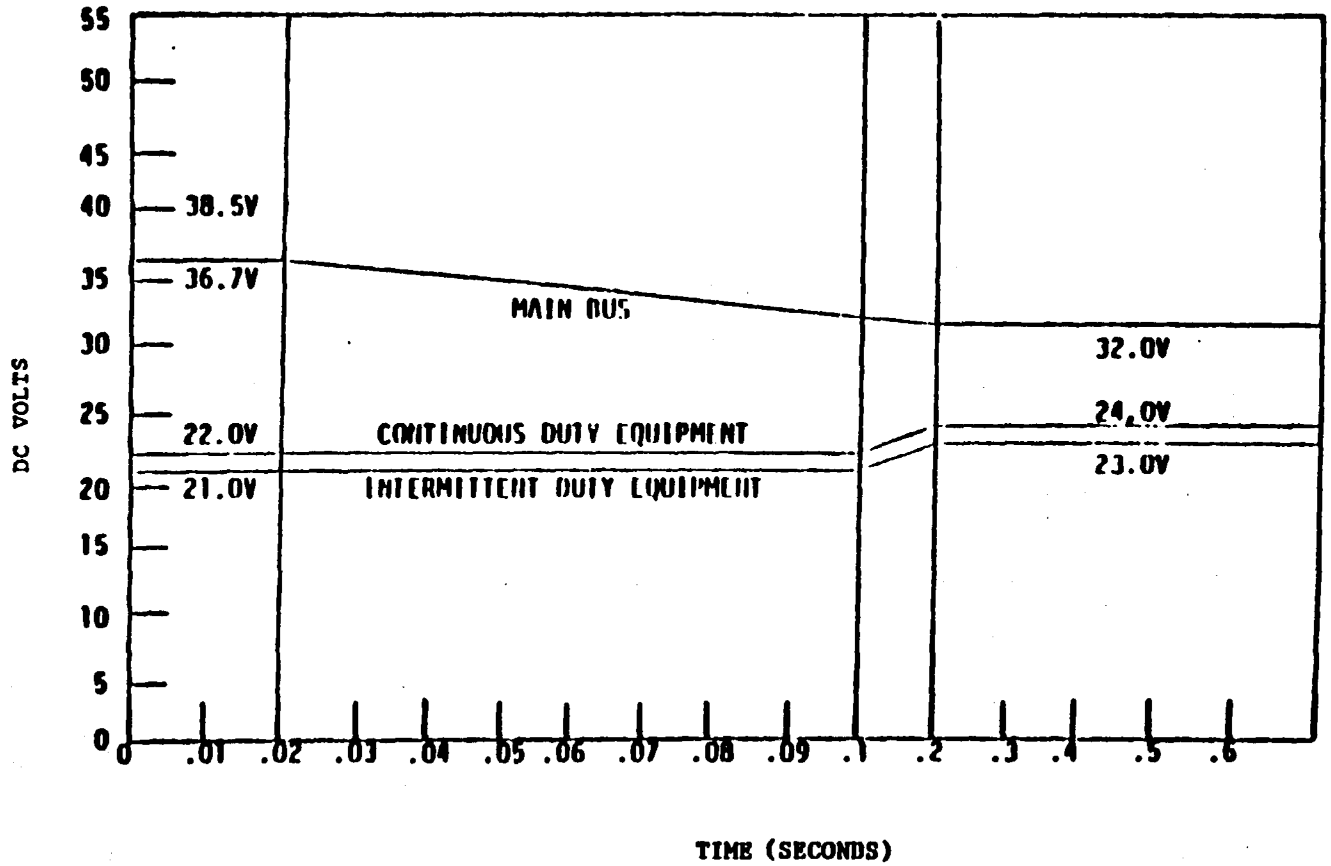


Figure 6.2.2-1 Transient Surge of DC Voltage Step Function Loci Limits During Normal Equipment Switching Conditions

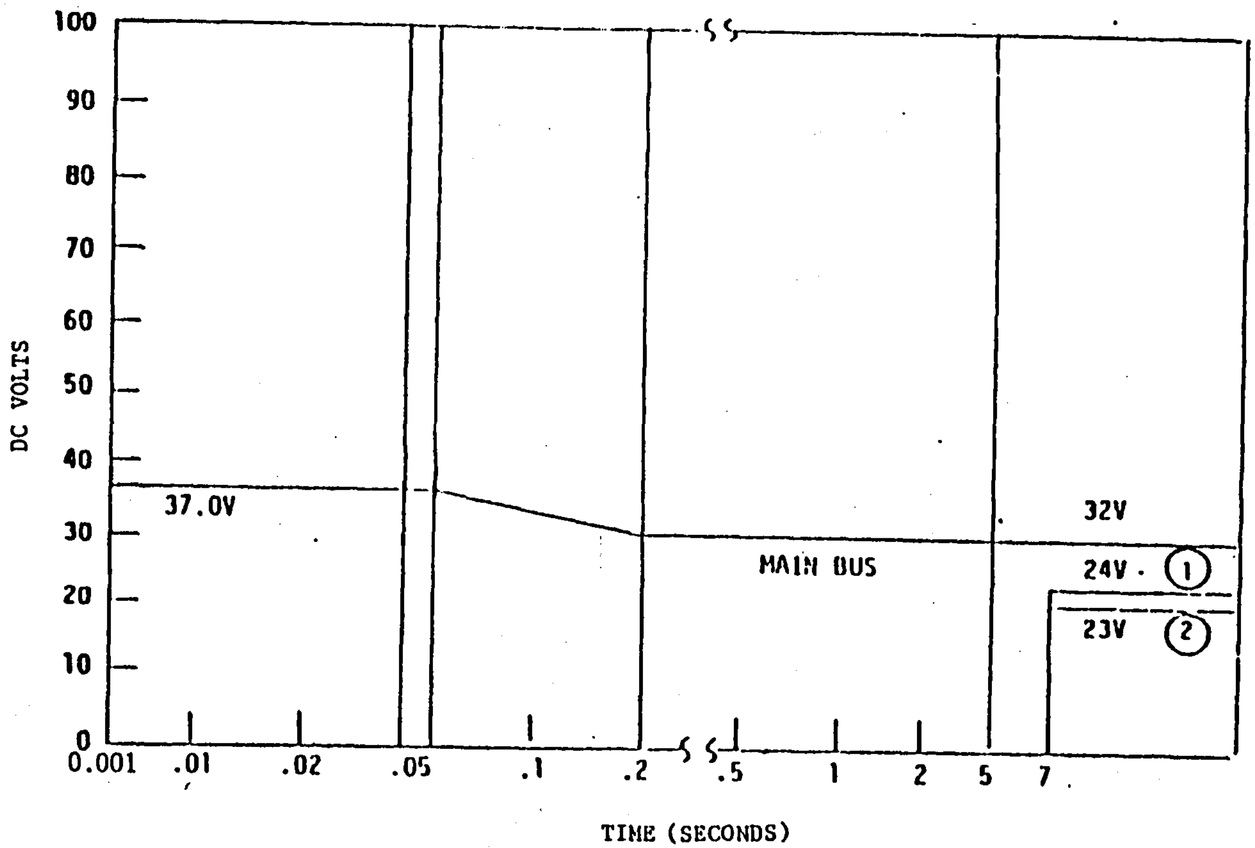


Figure 6.2.2-2 Transient Surge of DC Voltage Step Function Loci Limits During Abnormal Switching Conditions

NOTES

① Continuous Duty

② Intermittent Duty

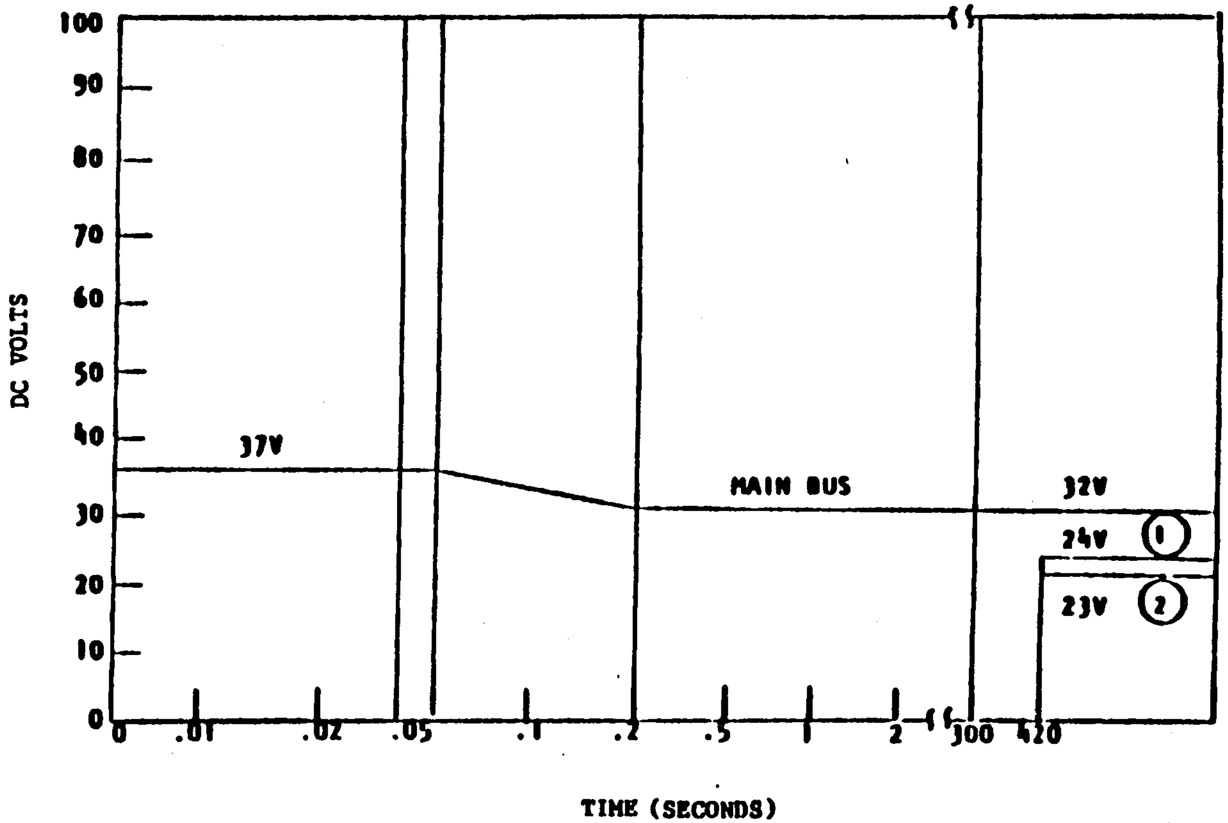


Figure 6.2.2-3 Transient Surge of DC Voltage Step Function Loci Limits During Emergency Switching Conditions

NOTES

① Main Bus Continuous Duty

② Main Bus Intermittent Duty

7.0 INDUCED ENVIRONMENTS.

7.1 VIBRATION. (See Paragraph 4.3).

7.2 ACOUSTIC. (See Paragraph 4.4).

7.3 SHOCK. N/A.

7.4 LOAD FACTOR. (See Paragraphs 4.1, 4.2).

7.5 TEMPERATURE. (See Paragraph 5.1).

7.6 ELECTROMAGNETIC COMPATIBILITY (EMC).

7.6.1 Shuttle-Produced Interference Environment.

7.6.1.1 DC Power Characteristics.

7.6.1.1.1 Ripple and Transient Spike (Repetitive) Limits. Ripple and transient spike limits for electrical power provided by the Orbiter at the indicated interfaces shall not exceed the voltage values specified in the following sub-paragraphs:

a. In-flight DC power bus ripple at the interface shall not exceed:

   1. 0.9 volts peak-to-peak narrowband (30 Hz to 7 kHz) falling 10 dB per decade at 0.28 volts peak-to-peak at 70 kHz, thereafter remaining constant to 400 MHz.

      On orbit, during the Orbiter hydraulic circulation pump start up (300 milliseconds) a sawtooth ripple voltage of 4 volts peak-to-peak amplitude will appear on the 28 volt DC power bus at a frequency of 500 to 700 Hz.

   2. The momentary coincidence of 2 or more signals at any one frequency shall not exceed the envelope defined as 1.6 volts peak-to-peak (30 Hz to 7 kHz), falling 10 dB per decade to 0.5 volts peak-to-peak at 70 kHz, thereafter remaining constant to 400 MHz.

b. In flight DC Power Transients Spikes (Repetitive).

   1. In flight DC power transient spikes (measured common mode) shall not exceed the impulse equivalent of 300 X 10^{-6} volt seconds above or below normal line voltage. Peak transient spikes shall be limited to ±50 volts from nominal bus voltage on the positive line, and ±30 volts from nominal on the negative line.

Rise and fall rates shall not exceed 56 volts/microsecond.

c. Ground DC Power.

1. The narrowband ripple voltage at the interface shall not exceed an envelope with limits 1.2 volts peak-to-peak (30 Hz to 7 kHz), falling log-linear to 0.28 volts peak-to-peak at 70 kHz, thereafter remaining constant to 400 MHz.

2. The momentary coincidence of two or more signals at any one frequency shall not exceed an envelope with limits 2.0 volts peak-to-peak (30 Hz to 7 kHz), falling log-linear to 0.5 volts peak-to-peak at 70 kHz, thereafter remaining constant to 400 MHz.

3. Transient spikes (measured common mode) shall not exceed the impulse equivalent of 300 X 10^{-6} volt seconds above or below normal line voltage. Peak transient spikes shall be limited to $\pm$50 volts from nominal bus voltage on the positive line, and $\pm$30 volts from nominal on the negative line. Rise and fall rates shall not exceed 56 volts/microsecond.

7.6.2 Radiated Interference. The Shuttle produced radiated fields environment shall be limited as follows:

a. AC magnetic fields shall be limited to less than 130 dB above 1 picotesla (30 Hz to 2 kHz), falling 40 dB per decade to 50 kHz.

b. Electric fields are defined in Figures 7.6.2-1 and 7.6.2-2 for unintentional emissions, and Figure 7.6.2-3 for intentional emissions.

Electric fields are listed below for intentional emissions from the Wireless Crew Communication Units (WCCU). Duplex voice communications shall be provided by bulkhead/panel mounted spacecraft terminal units and remote body-worn units in each system. As many as 5 systems could be in use depending on number of crew. There shall be 10 VHF carriers available.

No.	Carrier Freq. in MHz	Electric Field in dB micro V/m
1	169.500	114
2	174.100	114
3	171.925	114
4	180.300	114
5	170.325	114

6	174.300	114
7	171.025	114
8	180.100	114
9	171.825	114
10	186.200	114

These levels shall be considered when evaluating the possibility of operating radio frequency receiving equipment or electronic field sensing equipment.

c. Lightning produced magnetic fields shall be limited to a peak level of 10 amperes/meter with a rise to peak value in 2 microseconds and fall to zero in 100 microseconds. The payload shall be designed so that a failure due to a lightning strike shall not propagate to the Space Shuttle.

d. The design of the Orbiter shall preclude any electrostatic discharges.

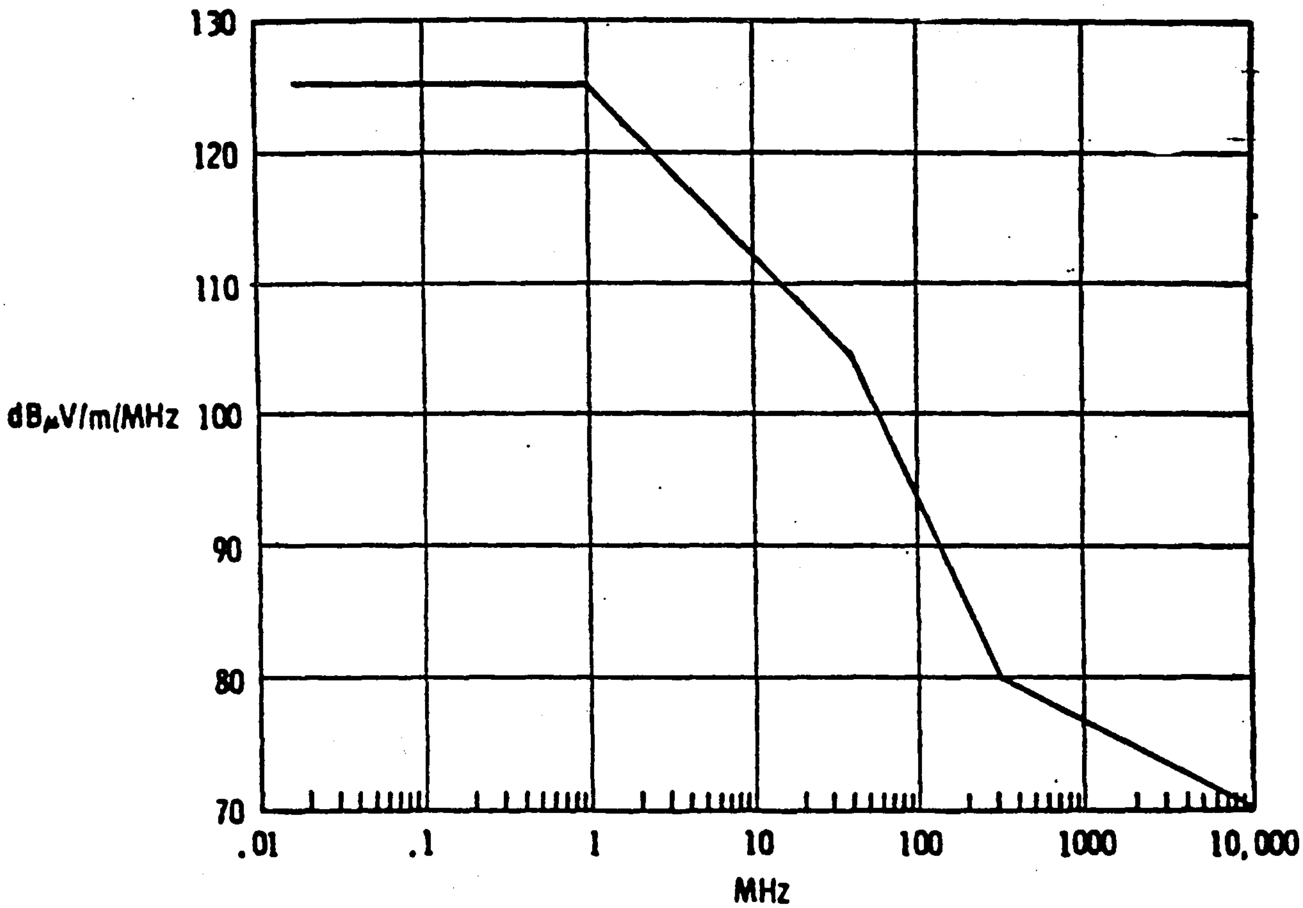


FIGURE 7.6.2-1 SHUTTLE-PRODUCED RADIATED BROADBAND EMISSIONS, UNINTENTIONAL

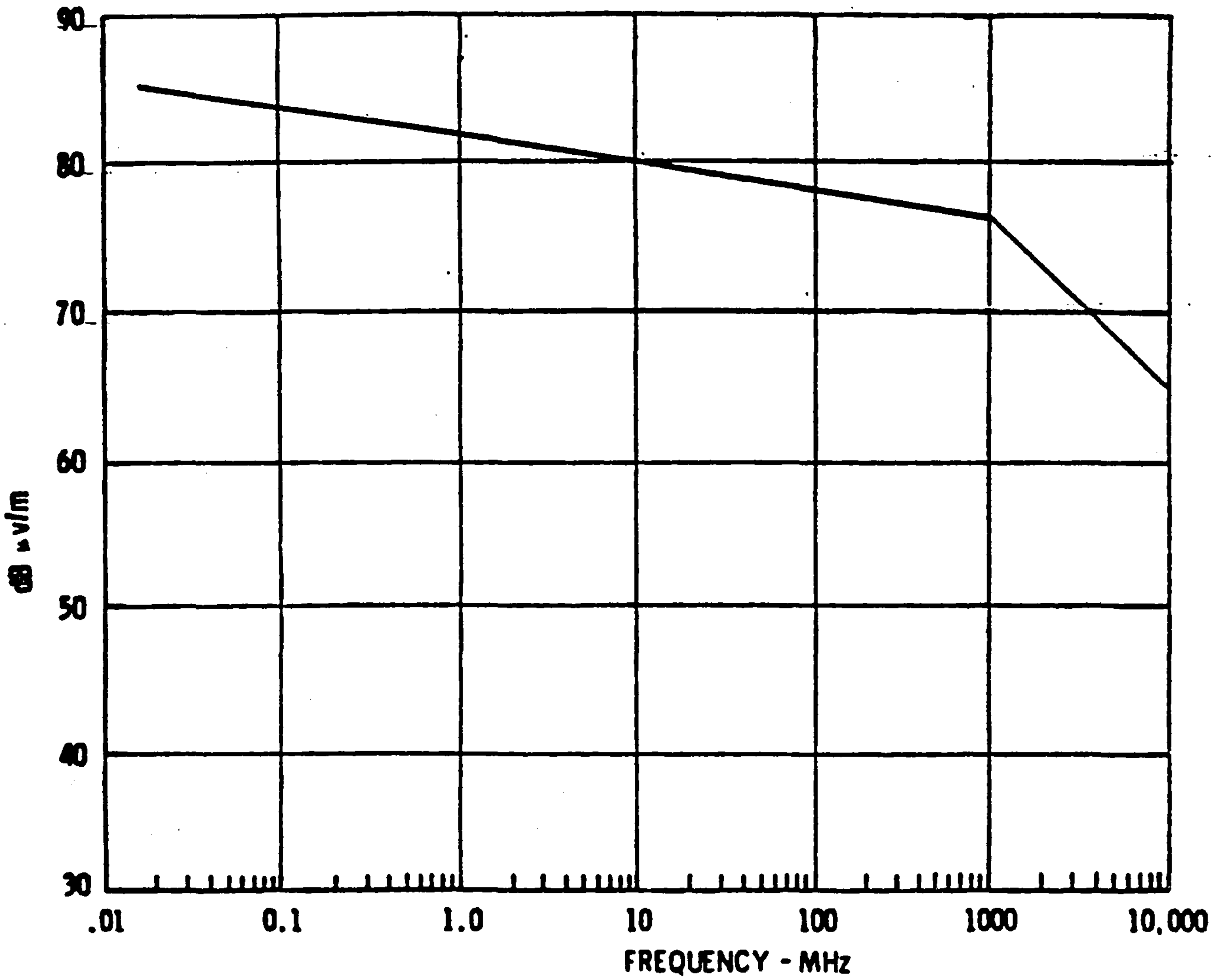


FIGURE 7.6.2-2 SHUTTLE-PRODUCED RADIATED NARROWBAND EMISSIONS, UNINTENTIONAL

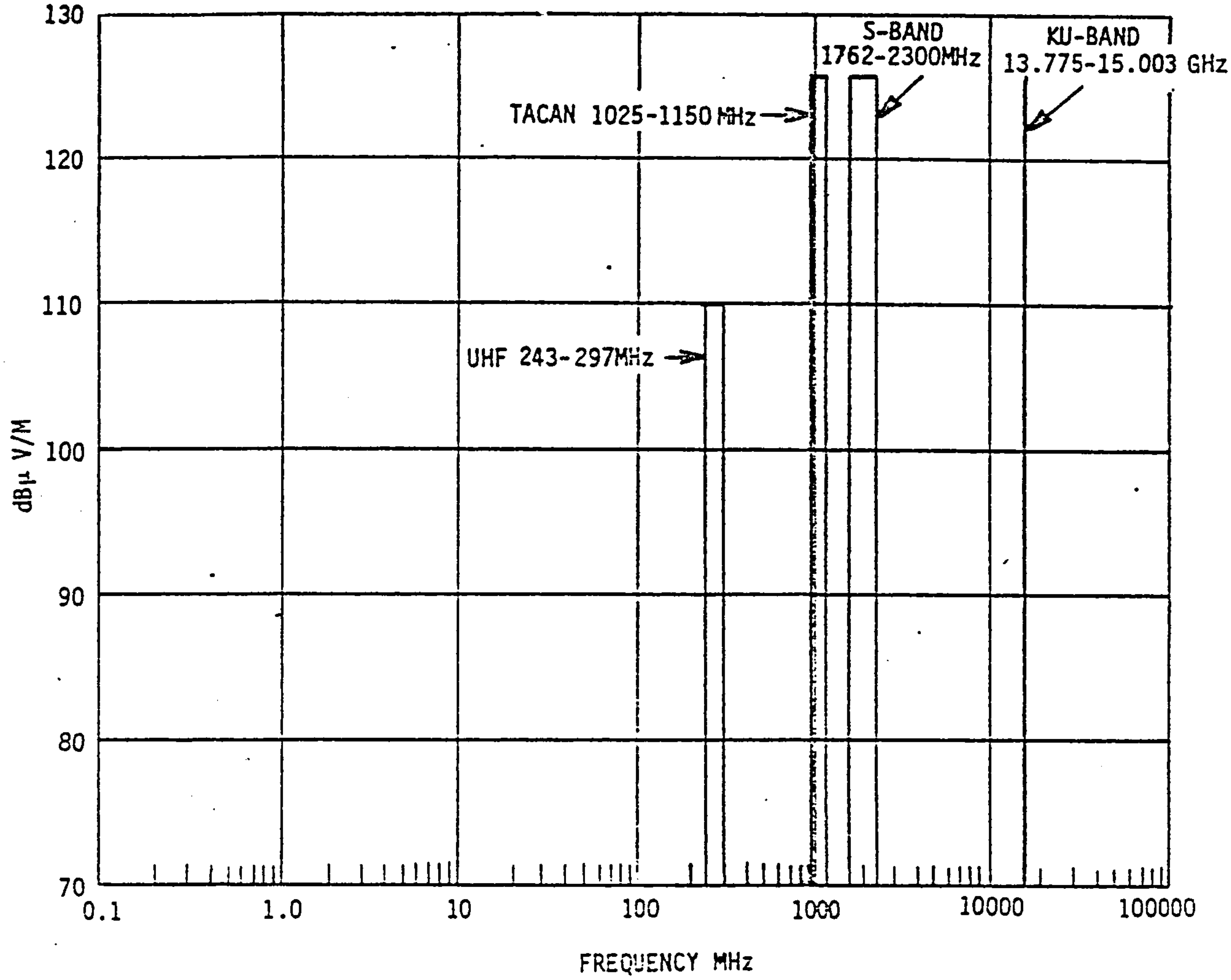


FIGURE 7.6.2-3 SHUTTLE-PRODUCED RADIATED NARROWBAND EMISSIONS, INTENTIONAL

7.6.3 Payload Element Produced Interference Environment.

7.6.3.1 Payload Element Produced Conducted Noise. The Payload generated conducted emission limits, applicable to all DC power interfaces, shall be as follows:

a. DC Power

1. The power line conducted emissions shall be limited to the levels indicated in Figure 7.6.3.1-1.

2. The payload generated transient spikes produced on DC power lines by switching or other operations shall not exceed the limits defined in Figure 7.6.3.1-2 for normal operation and Figure 7.6.3.1-3 for abnormal operation. Rise and fall rates shall not exceed 56 volts/microsecond.

7.6.3.2 Payload Produced Radiated Fields. The payload produced radiated fields shall be limited as follows:

a. The generated AC magnetic fields (applies at a distance of 1 meter from any payload equipment) shall not exceed 130 dB above 1 picotesla (30 Hz to 2 kHz) falling 40 dB per decade to 50 kHz.

b. The radiated electric fields shall not exceed the levels defined in Figures 7.6.3.2-1 and 7.6.3.2-2.

c. Electrostatic discharges shall not occur within the Orbiter other than those isolated from the gaseous environment (nitrogen-oxygen mixture) and shielded by the payload to satisfy the requirements of the subparagraphs "a" and "b" above.

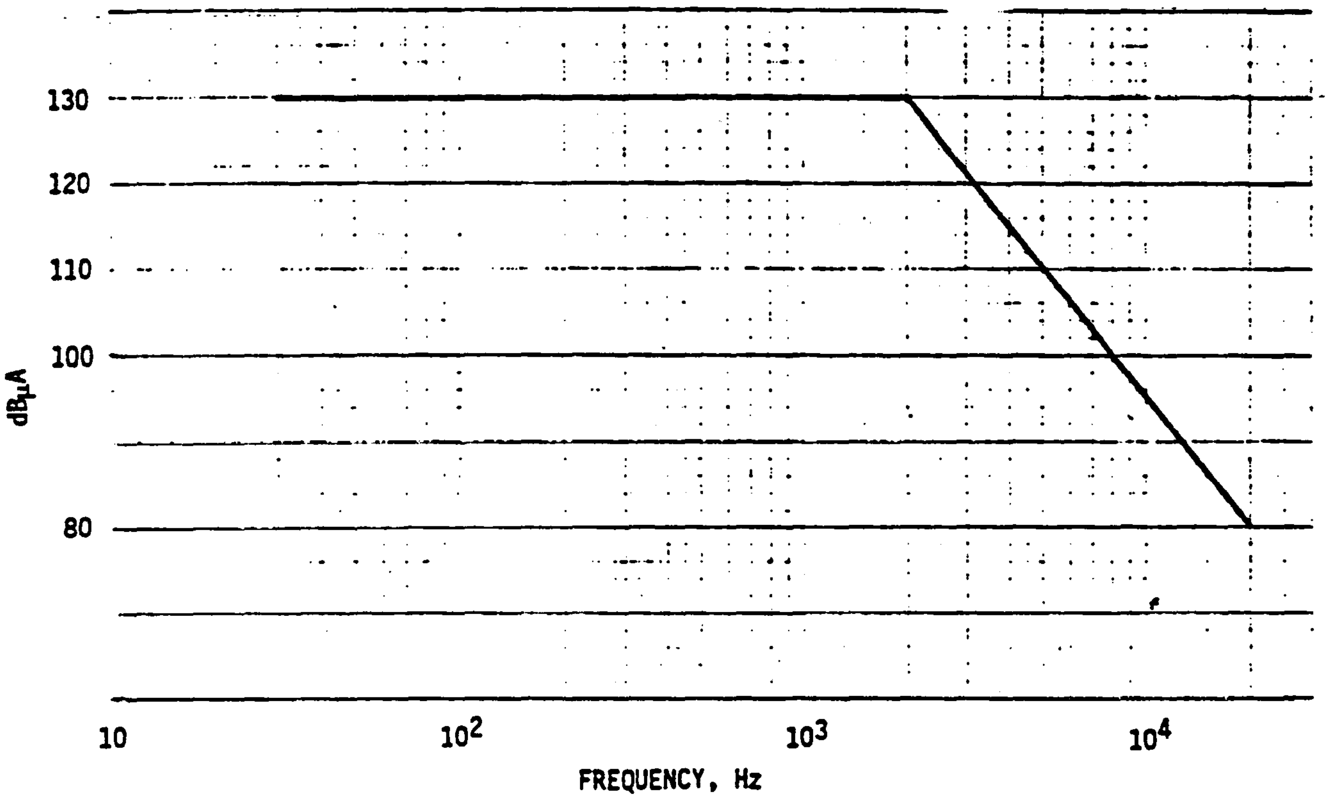


FIGURE 7.6.3.1-1 PAYLOAD ALLOWABLE CONDUCTED NARROWBAND EMISSIONS (SHEET 1 OF 2)

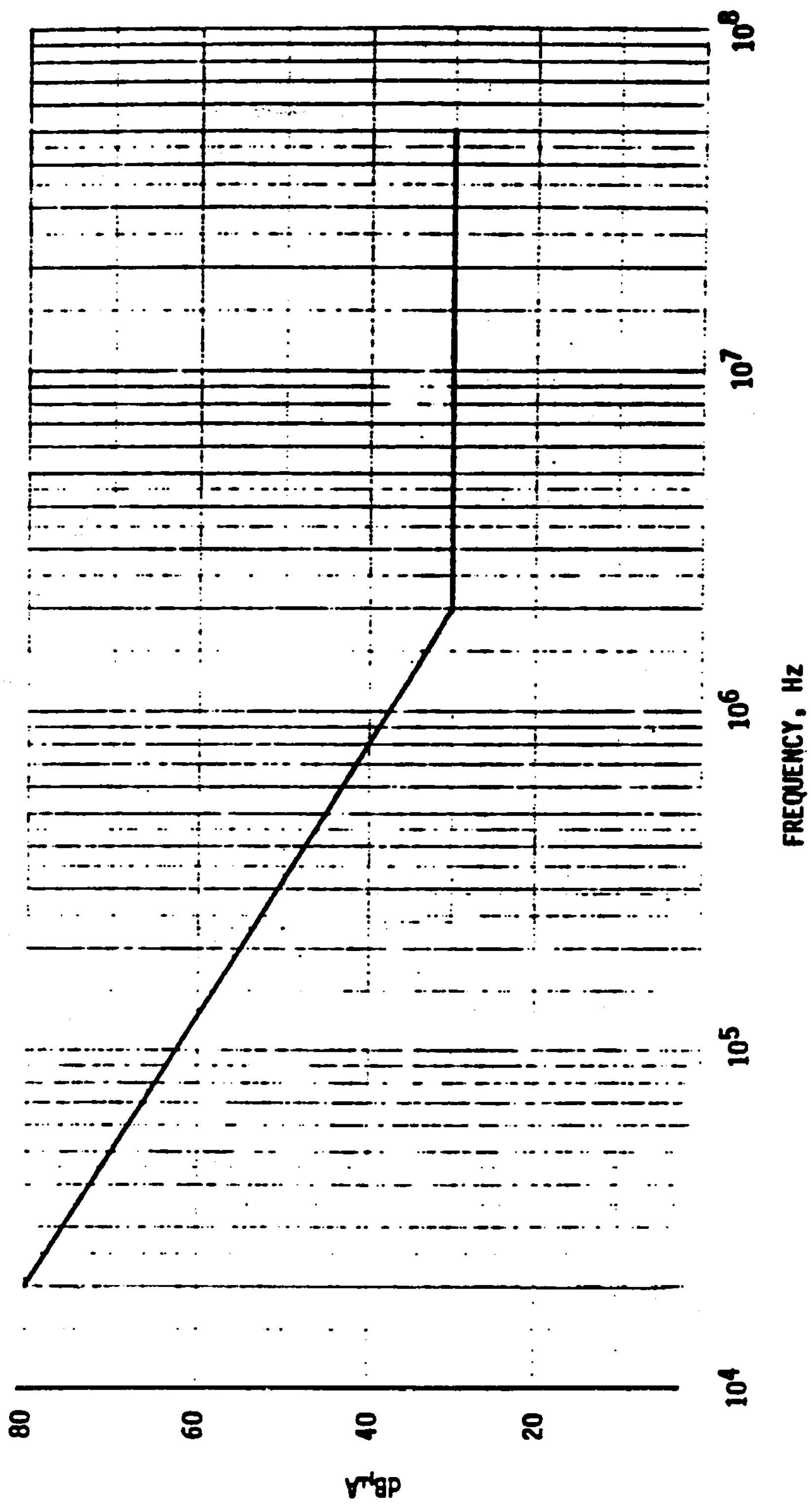


FIGURE 7.6.3.1-1 PAYLOAD ALLOWABLE CONDUCTED NARROWBAND EMISSIONS (SHEET 2 OF 2)

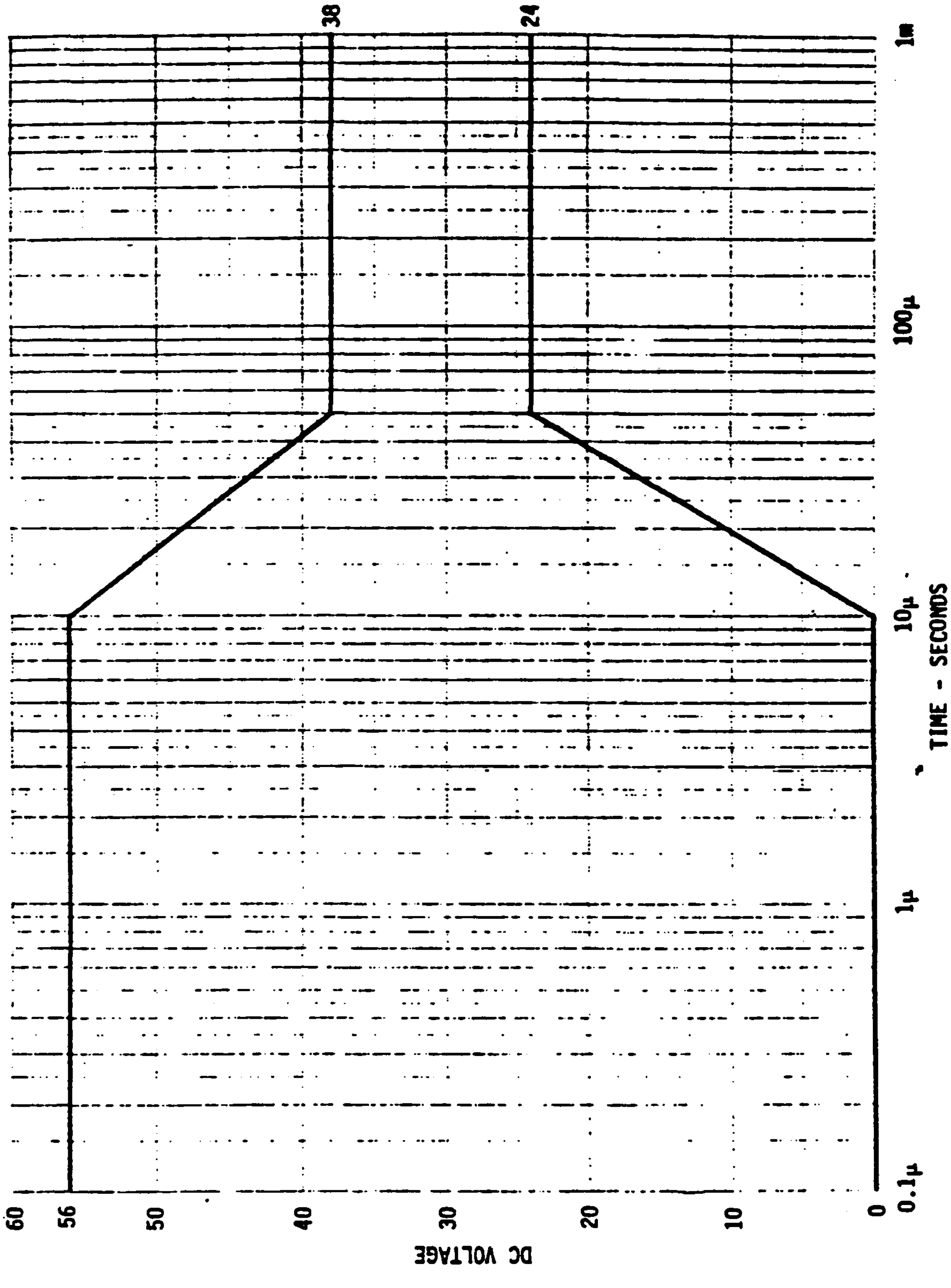


FIGURE 7.6.3.1-2 ENVELOPE OF PAYLOAD ALLOWED TRANSIENT SPIKES ON DC POWER BUSSES FOR NORMAL ELECTRICAL SYSTEM OPERATION

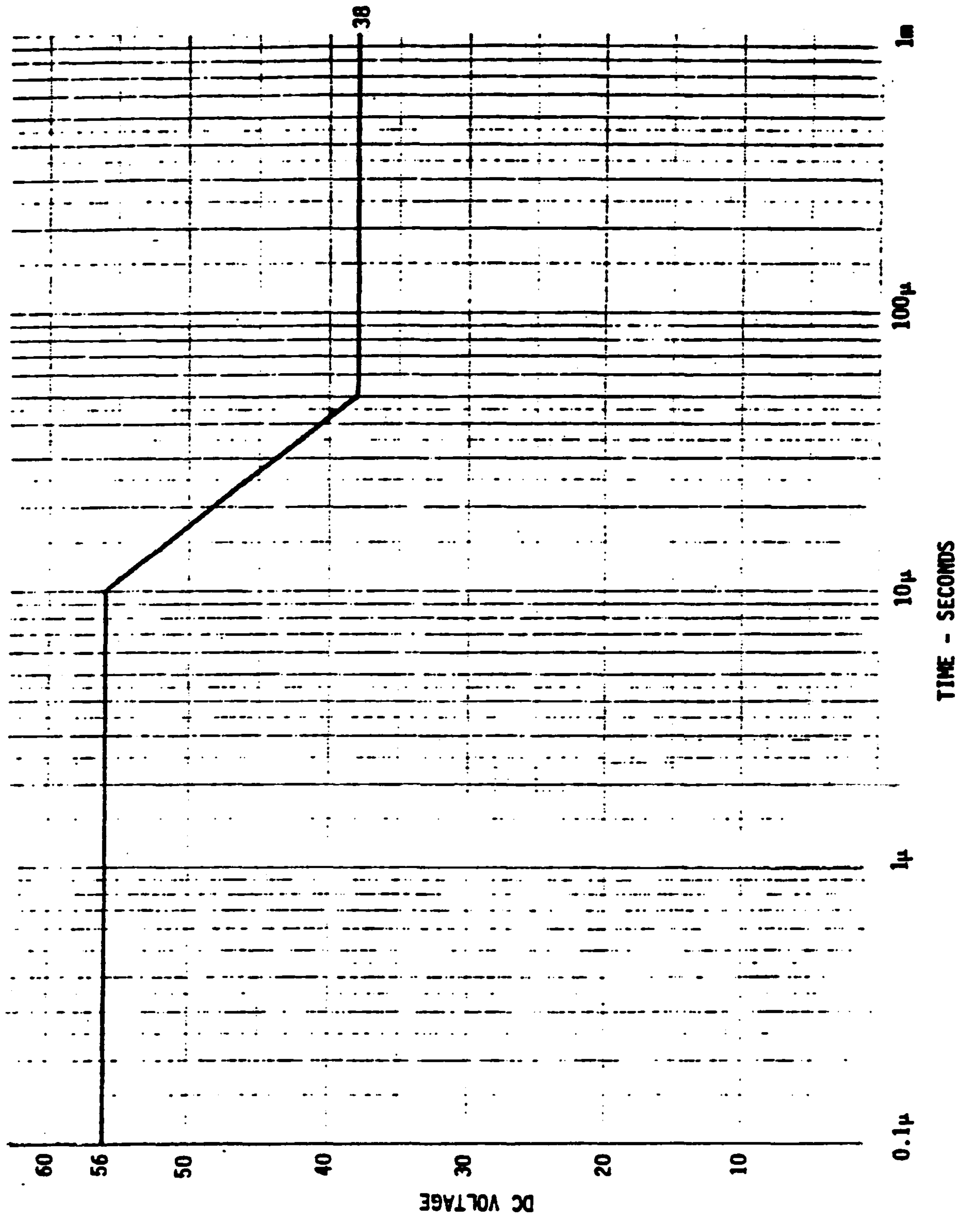


FIGURE 7.6.3.1-3 ENVELOPE OF PAYLOAD ALLOWED TRANSIENT SPIKES ON DC POWER BUSSES FOR ABNORMAL ELECTRICAL SYSTEM OPERATION

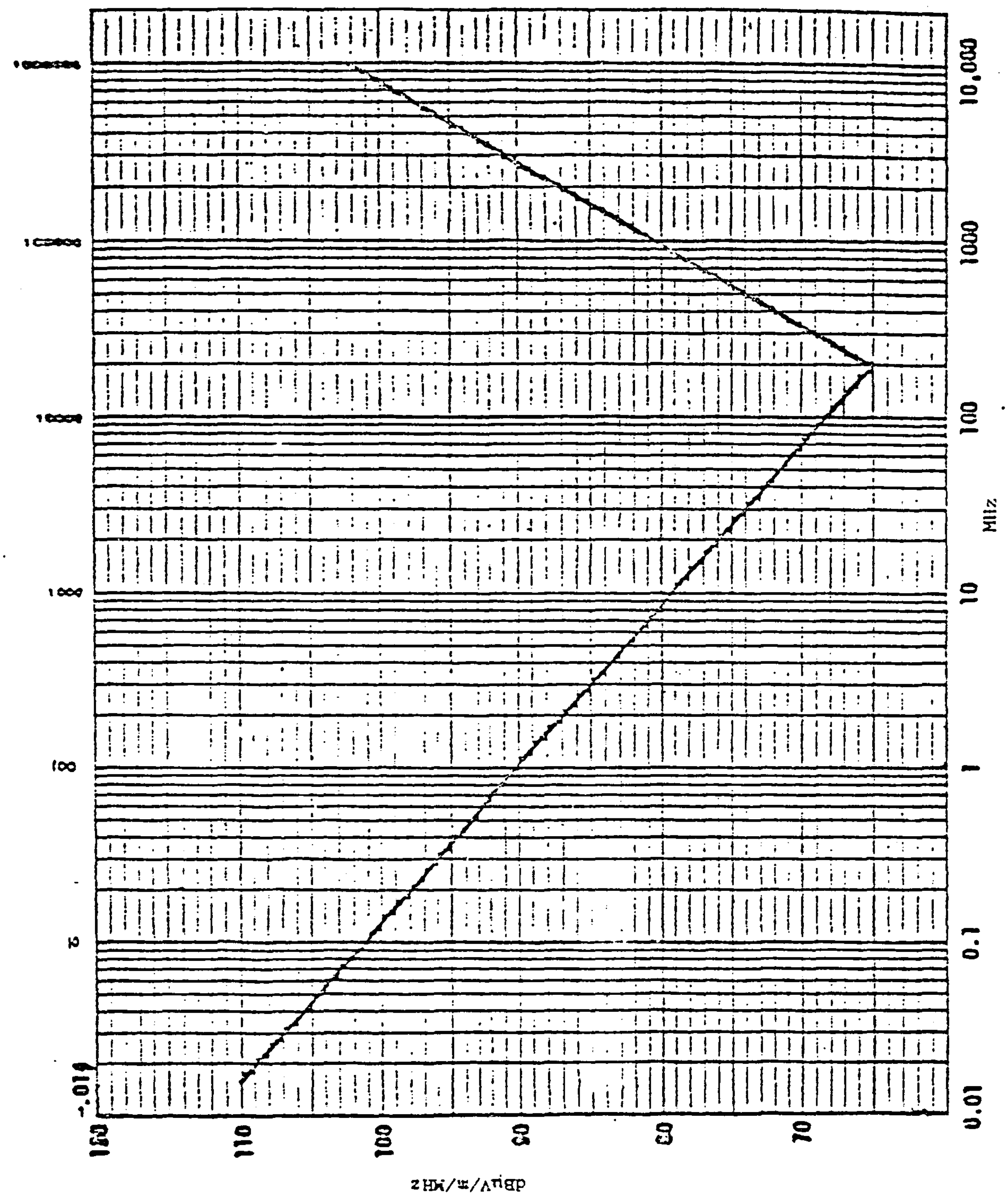


FIGURE 7.6.3.2-1. PAYLOAD ALLOWABLE RADIATED BROADBAND EMMISSIONS

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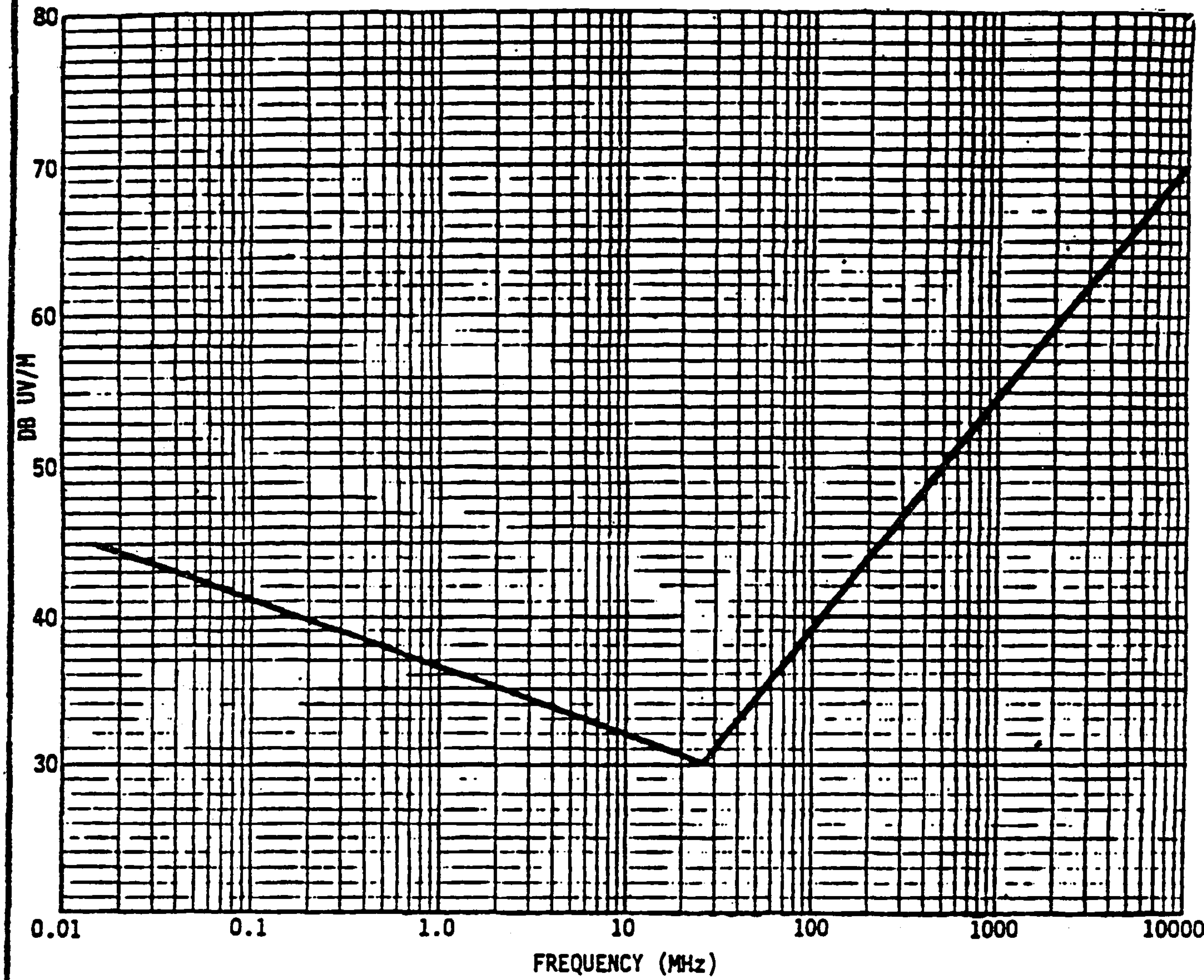

FIGURE 7.6.3.2-2 PAYLOAD ALLOWABLE RADIATED NARROWBAND EMISSIONS

7.6.4 Avionics Electrical Compatibility.

7.6.4.1 Payload Element Power Returns. Circuit returns and isolation of circuit returns shall be maintained.

7.6.4.2 Electrical Bonding. The Orbiter-to-Payload electrical mounting interface shall be electrically bonded to provide homogeneous electrical characteristics. All electrical and mechanical elements shall be securely bonded to structure in compliance with MIL-B-5087. The payload bonding surfaces shall match the alodined surfaces shown on the assembly drawings for the payload mounting panels and adapter plates. All aluminum surfaces used for bonding shall be originally cleaned to bare metal and then chemical filmed per MIL-C-5541, Class 3 (gold alodine 1200LN9368, or equivalent).

A cleaned and alodined test point shall be provided and identified on the payload.

7.6.4.2.1 Electrical Bonding of Equipment. Equipment containing electrical circuits which may generate radio frequencies or circuits which are susceptible to radio frequency, shall be so installed that there will be a continuous, low-impedance path from the equipment enclosure to structure. The metallic shells of all electrical connectors shall be electrically bonded to the equipment case or the bulkhead mount with a DC resistance of less than 2.5 milliohms. The DC resistance between the mated halves of the connectors shall not exceed 50 milliohms.

Wire harness shields external to equipment, requiring grounding at the equipment, shall have provisions for grounding the shields to the equipment through the harness connector backshell, or for carrying single point grounded shields through the connector pins.

All equipment electrical bonds and their respective interfaces shall comply with MIL-B-5087.

7.6.4.2.2 Electrical Bonding of Structures. All electrical bond interfaces shall be in accordance with Paragraph 7.6.4.2.

7.6.4.2.3 Payload Surface Electrostatic Charging. All payload hardware elements shall comply with the Class-S bond requirements of MIL-B-5087. All payload hardware elements shall be designed to prevent the accumulation of an electrostatic charge on their surfaces. The specific usage and method employed shall be negotiated with STS.

7.6.4.2.4 Circuit Reference Symbols. The circuit reference symbols for use on the Space Shuttle program shall be as illustrated and defined as follows:

Structure reference - a connection to vehicle structure.

Primary power reference - a connection to the vehicle primary DC power return.

7.6.4.3 Power Circuit Isolation and Grounding.

7.6.4.3.1 Ground Support Equipment Isolation and Grounding. GSE interfacing with payloads shall be isolated from payload circuits by a minimum of 1 megohm, except where balanced differential circuits are used. In the case of balanced differential circuits, each side of the circuit shall be balanced to ground by no less than 4000 ohms. Coax cables, with their inherent grounding of the signal return to structure, are permitted, providing their interface with other payload or systems does not propagate that ground to circuits which are already referenced to ground at some other point.

7.7 PAYLOAD ELEMENT CLEANLINESS. The external surfaces of the Payload Element shall be cleaned prior to its installation into the Orbiter Mid-deck. Cleanliness shall conform with a visibly clean level as specified in SN-C-0005.

7.8 MATERIALS AND PROCESSES. Materials and processes used in design and fabrication of the Payload Element and associated support equipment shall comply with SE-R-0006 and NHB-8060 and shall be verified in accordance with NHB1700.7 during the payload safety process.

7.9 PAYLOAD EFFLUENTS. The Payload shall provide for safe containment of any by-product of payload experiment-gaseous, liquid or solid. No toxic or any other gases shall be discharged into the mid-deck environment.

7.10 ILLUMINATION. Any special illumination shall be provided by the Payload.

7.11 NUCLEAR RADIATION. Materials used in any payload subsystem, containing natural or man made radioisotopes (in any quantity, including trace amounts) shall be avoided without prior approval by waiver obtained from NASA-JSC. The waiver request shall specify the radioisotope species, quantities or activities, and other pertinent data such as the exact location within the mid-deck area where the material is to be installed.

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8.0 ELECTRICAL WIRING INTERFACE.

8.1 GENERAL.

8.1.1 Identification of Interface.

8.1.1.1 Mid-Deck Panels and Connectors.

a. Ceiling Area

	CONNECTOR DESIG	PLUG/SOCKET CABLE	RECEPTICLE PAYLOADS	TYPE
M013Q	P1	NB6GE14-12SNT2	NBOE14-12PNT2	DC
M030F	P2	NB6GE14-12SNT2	NBOE14-12PNT2	DC
M052J	P1	NB6GE14-12SNT2	NBOE14-12PNT2	DC

8.1.2 Approved Connectors for Mid-Deck Payload Element Use. All mid-deck payload element electrical connectors and connector contacts that interface with the Orbiter shall satisfy the requirements specified in the following NASA applicable specifications:

40M38277

40M39569

8.1.3 Connector Dead Face. At the time of connector mate or demate, no current shall be flowing across the interface.

8.2 CABLE SCHEMATICS.

8.2.1 Mid-Deck Panel M013Q, M030F, M052J.
DC electrical power cable interfaces are shown, in Figure 8.2.1-1.

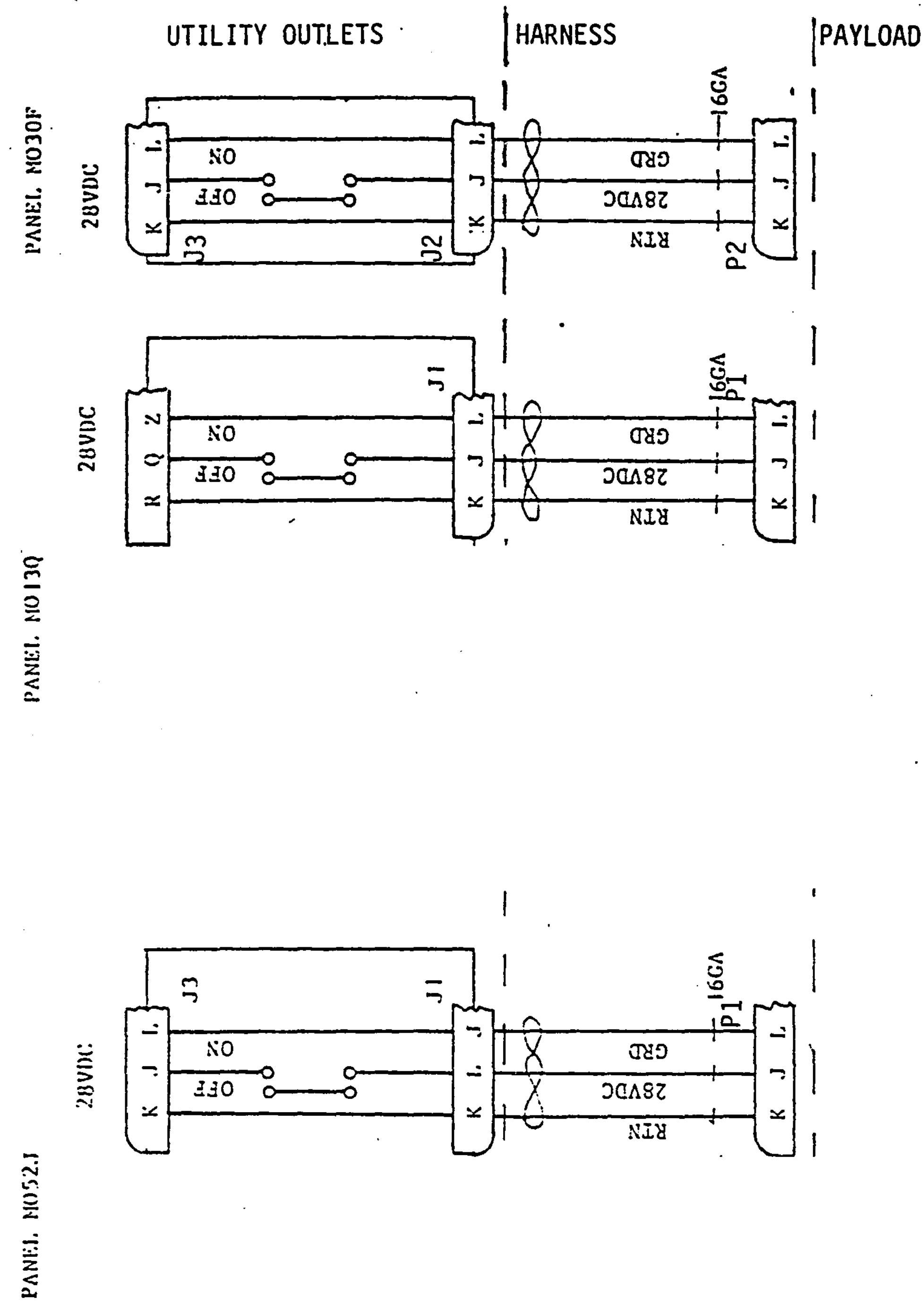

FIGURE 8.2.1-1 PLUG ASSIGNMENTS AT CEILING LOCATIONS

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