VOLUME 3

CONTRACT NO. NAS8-31690
27615-6007-RU-02
DR-SE-02A

INTERFACE CONTROL DOCUMENTS (ICD)

BOOK 2 - AMPS EQUIPMENT TO SPACELAB ICD

ATMOSPHERE, MAGNETOSPHERE AND PLASMAS IN SPACE (AMPS) SPACELAB PAYLOAD DEFINITION STUDY

Final Report
November 1976

Prepared for
National Aeronautics
and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

TRW
DEFENSE AND SPACE SYSTEMS GROUP

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Approved by: W.F. Rector, III

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Project Manager, AMPS

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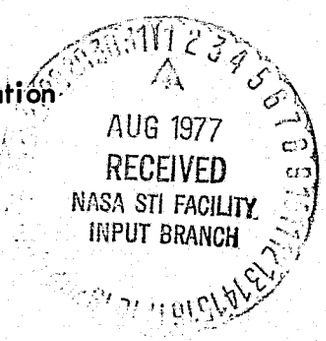


TRW
DEFENSE AND SPACE SYSTEMS GROUP

ONE SPACE PARK · REDONDO BEACH, CALIFORNIA 90278

CONTENTS

1. SCOPE

This document describes the interfaces between AMPS Payload No.(TBD) and Spacelab. The characteristics specified herein are based on the definition of Spacelab equipment and interfaces as of the date of issue of this document or date of latest revision. This document will be revised as necessary to maintain it current with the Spacelab configuration. The interfaces specified herein cover the AMPS physical, electrical, and thermal interfaces that are established to prescribe the standard Spacelab configuration required to perform the mission of overriding document 2.1.(b). If the configuration definition covered by this document changes due to change of Spacelab equipment model or serial numbers, then reidentification of the Labcraft payload by way of revision of this document may be required.

2. APPLICABLE DOCUMENTS

2.1 OVERRIDING DOCUMENTS

The current issues of the following documents are involved to the extent necessary to specify AMPS equipment and Spacelab interfaces:

(a) ESTEC/MSFC SLP-2104 Spacelab Payload Accommodations Handbook

(b) GSFC XXX.XXXX Mission Support Requirements Document - AMPS Flight TBD.

(c) GSFC XXX.XXXX AMPS/Orbiter Interface Control Document.

In the event of conflict among these documents, 2.1(a) shall have precedence regarding Spacelab interfaces. Document 2.1(c) shall have precedence regarding Orbiter interfaces.

2.2 REFERENCE DOCUMENTS

2.2.1 Program level documents. TBD.

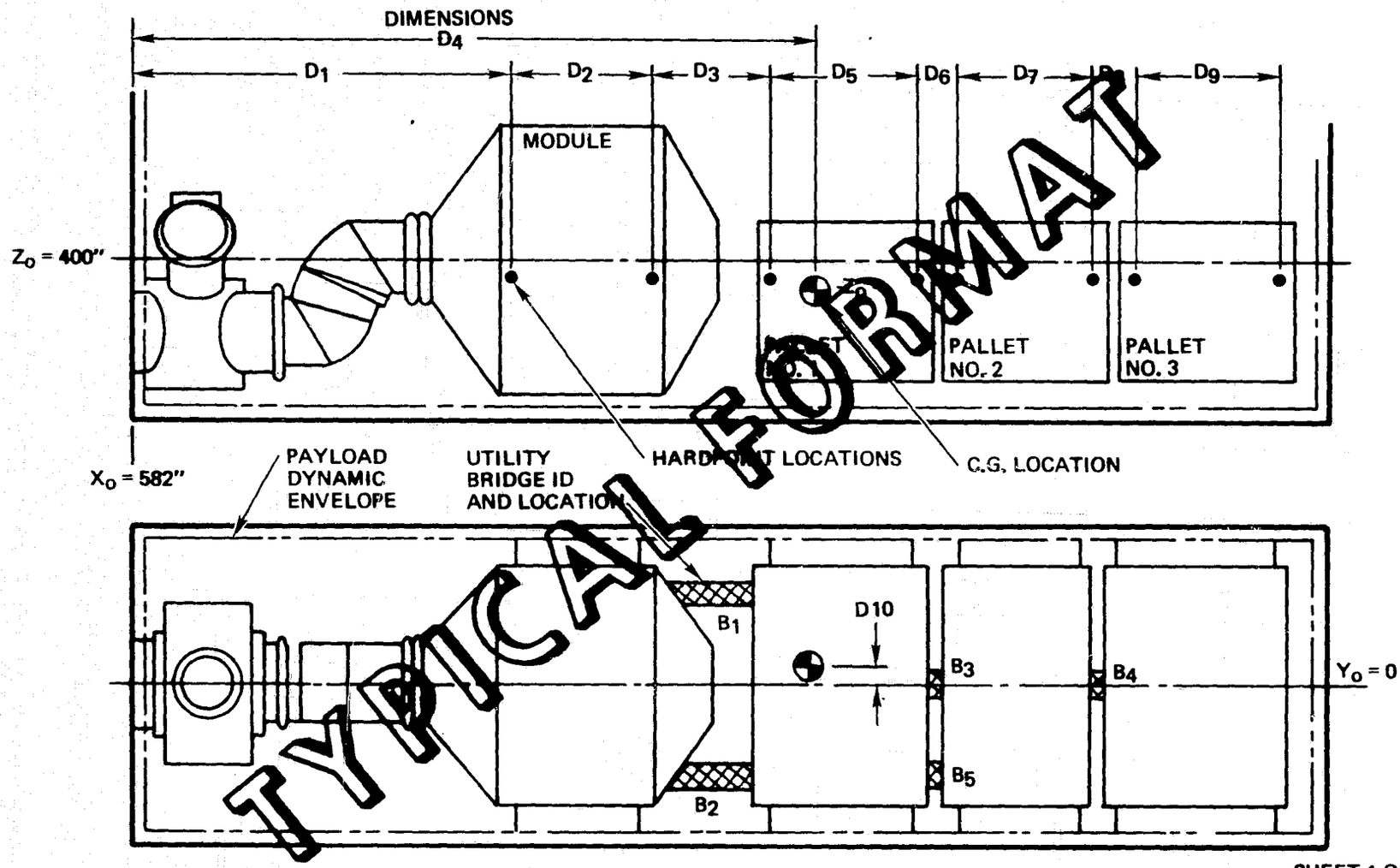
2.2.2 Labcraft system requirements. TBD.

3. INTERFACES

3.1 PHYSICAL INTERFACES

3.1.1 Total payload interfaces. The Spacelab/AMPS payloads physical characteristics are given on Figure 3.1.1-1.

[Sheet 1 - shows total payload (Spacelab plus AMPS equipment) installed in the Orbiter payload bay; shows location of units, Orbiter hardpoints used, the center-of-gravity location for the total payload, the location of utility bridges, and other key features of the total payload.]



SHEET 1 OF 6

AMPS EQUIPMENT – SPACELAB PAYLOAD LAYOUT-FLIGHT A			
SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

Figure 3.1.1-1

FLIGHT MANIFEST				
DESCRIPTION	WEIGHT (KG)	C.G. LOCATION		
		X_0	Y_0	Z_0
TUNNEL S/L MODULE PALLET NO. 1 NO. 2 NO. 3 OAFD EQUIPMENT CABLING OPTIONAL EQUIP. EXPENDABLES				
TOTALS				

SHEET 2 OF 6			
NOTES:	AMPS–SPACELAB PAYLOAD LAYOUT		
	SIZE	CODE IDENT NO.	ICD – XXX REV
	SCALE	DATE	DRAWN BY

MISSION EXPENDABLES				
DESCRIPTION	WEIGHT (KG)	C.G. LOCATION		
		X_0	Y_0	Z_0
OMS PROPELLANT RMS PROPELLANT FUEL CELL REACTANTS ESP CRYO FLUIDS RELEASES TEST BODY				
TOTALS				

SHEET 3 OF 6			
	AMPS–SPACELAB PAYLOAD LAYOUT		
	SIZE	CODE IDENT NO.	ICD – XXX REV
	SCALE	DATE	DRAWN BY

OPTIONAL ORBITER EQUIPMENT				
DESCRIPTION	WEIGHT (KG)	C.G. LOCATION		
		X_0	Y_0	Z_0
OMS TANKAGE ENERGY KIT CREW (n) CREW – RELATED RMS STEERABLE ANTENNA MSS–PCM RECORDER KIT				
TOTALS				

SHEET 4 OF 6			
NOTES:	AMPS–SPACELAB PAYLOAD LAYOUT		
	SIZE	CODE IDENT NO.	ICD – XXX REV
	SCALE	DATE	DRAWN BY

DRAWING REGISTER				
TITLE	DRAWING NUMBER	REV	DATE	ORIGINATOR

SHEET 5 OF 6			
NOTES:	AMPS–SPACELAB PAYLOAD LAYOUT		
	SIZE	CODE IDENT NO.	ICD – XXX REV
	SCALE	DATE	DRAWN BY

Figure 3.1.1-1 (Continued)

FLIGHT____ CABLE AND UTILITY LINE ROUTING

CABLE (ID)	CABLE LENGTH	CONNECTOR ROUTING		PHYSICAL ROUTING					
		FROM	TO	FROM	TO	BEND	TIEDOWN	THERMAL COVERING	REMARKS
CL-01	20.16M	JM-1	JP-1	$X_1Y_1Z_1$	X_2 Y_1Z_2	90° AT X_2	2' INTER-VALS	NONE	

SHEET 6 OF 6

AMPS – SPACELAB PAYLOAD LAYOUT			
SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

Figure 3.1.1-1 (Continued)

Sheet 2 - a summary flight manifest identifying major payload components, their weight, and their center-of-gravity locations..

Sheet 3 - a listing of mission expendable and selected mass properties.

Sheet 4 - a listing of optional Orbiter equipment plus weight and center-of-gravity locations.

Sheet 5 - a listing of the top drawings defining the configured payload — should have the same headings as sheet 2.

Sheet 6 - a description of the physical routing of all cables used to interconnect the major payload components. Some method of tabulating this routing may be preferable to a drawing and that is the technique suggested. The idea is to define every end point and the routing of lines and cables by means of a coordinate system. Tie-downs and thermal shielding or other cable protection would be indicated on the table.

3.1.2 Pallet interfaces.

3.1.2.1 Pallet segment No. 1 interfaces. The physical interfaces between the forward pallet segment, pallet segment No. 1, and the AMPS equipment to be mounted are described on Figure 3.1.2-1.

Sheet 1 - a drawing showing the preparation/staging of the pallet including hole patterns to be drilled, MDE equipment installation, and hardpoints to be used.

Sheet 2 - a manifest of all equipment installed on the pallet plus the pallet itself.

Sheet 3 - a description of the physical routing of cables and utility lines on the pallet plus appropriate notations.

3.1.2.2 Pallet segment No. 2 interfaces. The physical interfaces between forward pallet segment, pallet segment No. 2, and the AMPS equipment to be mounted are described in Figure (~~TBD~~) (similar to Figure 3.1.2-1).

Sheet 1 - a drawing showing the preparation/staging of the pallet including hole patterns to be drilled, MDE equipment installation, and hardpoints to be used.

Sheet 2 - a manifest of all equipment installed on the pallet plus the pallet itself.

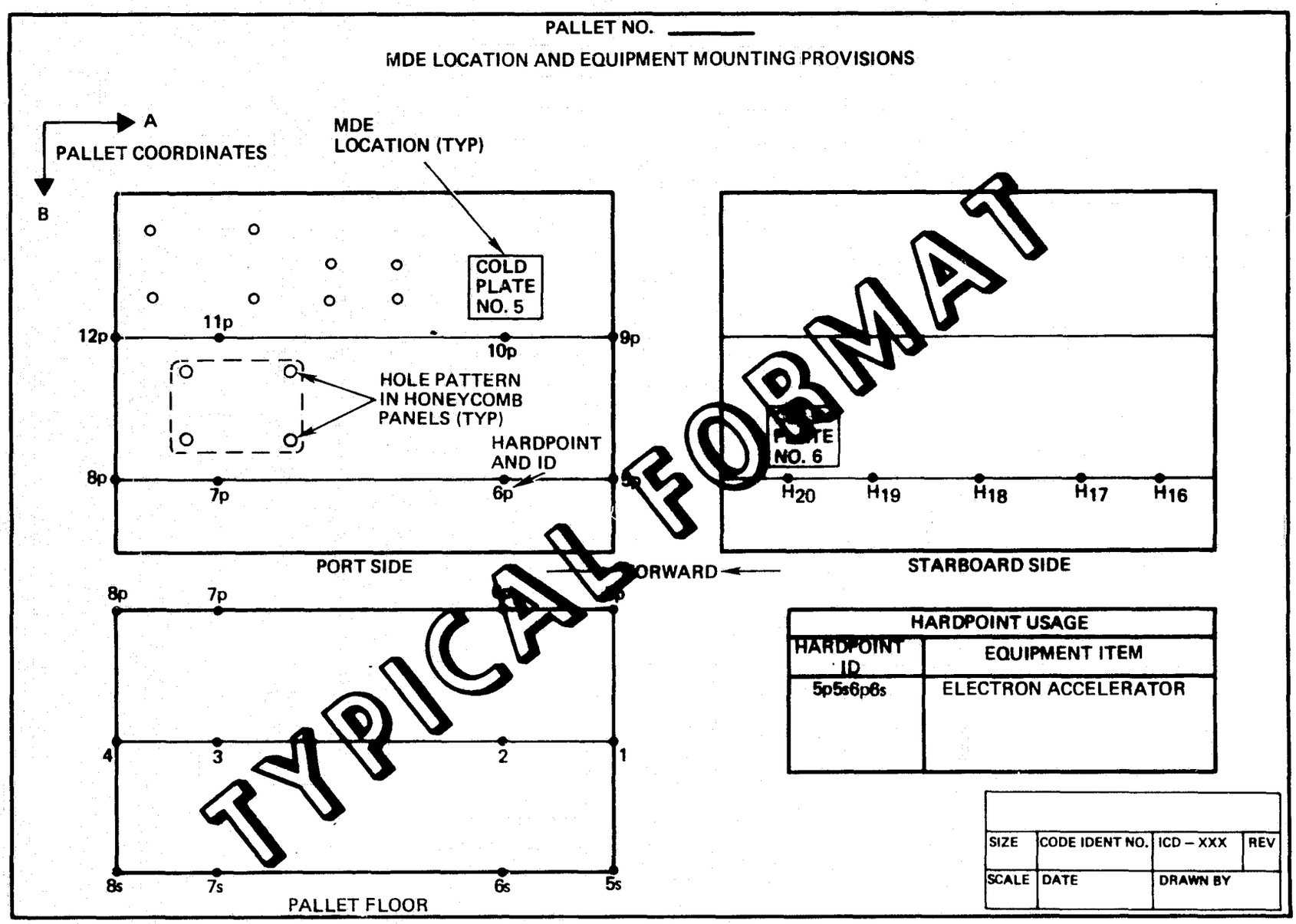

PALLET NO. _____
MDE LOCATION AND EQUIPMENT MOUNTING PROVISIONS
A
B
PALLET COORDINATES
MDE
LOCATION (TYP)
COLD
PLATE
NO. 5
12p
11p
10p
9p
HOLE PATTERN
IN HONEYCOMB
PANELS (TYP)
HARDPOINT
AND ID
8p
7p
6p
5p
PORT SIDE
FORWARD
STARBOARD SIDE
H20
H19
H18
H17
H16
8p
7p
4
3
2
1
8s
7s
6s
5s
PALLET FLOOR
HARDPOINT USAGE
HARDPOINT ID
EQUIPMENT ITEM
5p5s6p8s
ELECTRON ACCELERATOR
SIZE
CODE IDENT NO.
ICD – XXX
REV
SCALE
DATE
DRAWN BY
TYPICAL FORMAT

Figure 3.1.2-1

PALLET FLIGHT MANIFEST

EQUIP. CAT.	ITEM DESC	MODEL NO.	SERIAL NO.	WEIGHT (KG)	C.G. LOCATION		
					X_0	Y_0	Z_0

SHEET 2 OF 3

SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

PALLET CABLE AND UTILITY LINE ROUTING

CABLE ID	CONNECTOR ROUTING		PHYSICAL ROUTING					
	FROM	TO	FROM	TO	BENDS	TIEDOWN	THERMAL COVERING	REMARKS

SHEET 3 OF 3

SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

Figure 3.1.2-1 (Continued)

Sheet 3 - a description of the physical routing of cables and utility lines on the pallet plus appropriate notations.

3.1.2.3 Pallet segment No. 3 interfaces. The physical interfaces between forward pallet segment, pallet segment No. 3, and the AMPS equipment to be mounted are described in Figure (TBD) (similar to Figure 3.1.2-1).

Sheet 1 - a drawing showing the preparation/staging of the pallet including hole patterns to be drilled, MDE equipment installation, and hardpoints to be used.

Sheet 2 - a manifest of all equipment installed on the pallet plus the pallet itself.

Sheet 3 - a description of the physical routing of cables and utility lines on the pallet plus appropriate notations.

3.1.3 Module layout. The interfaces between the Spacelab module and the AMPS payload are given on Figure 3.1.3-1.

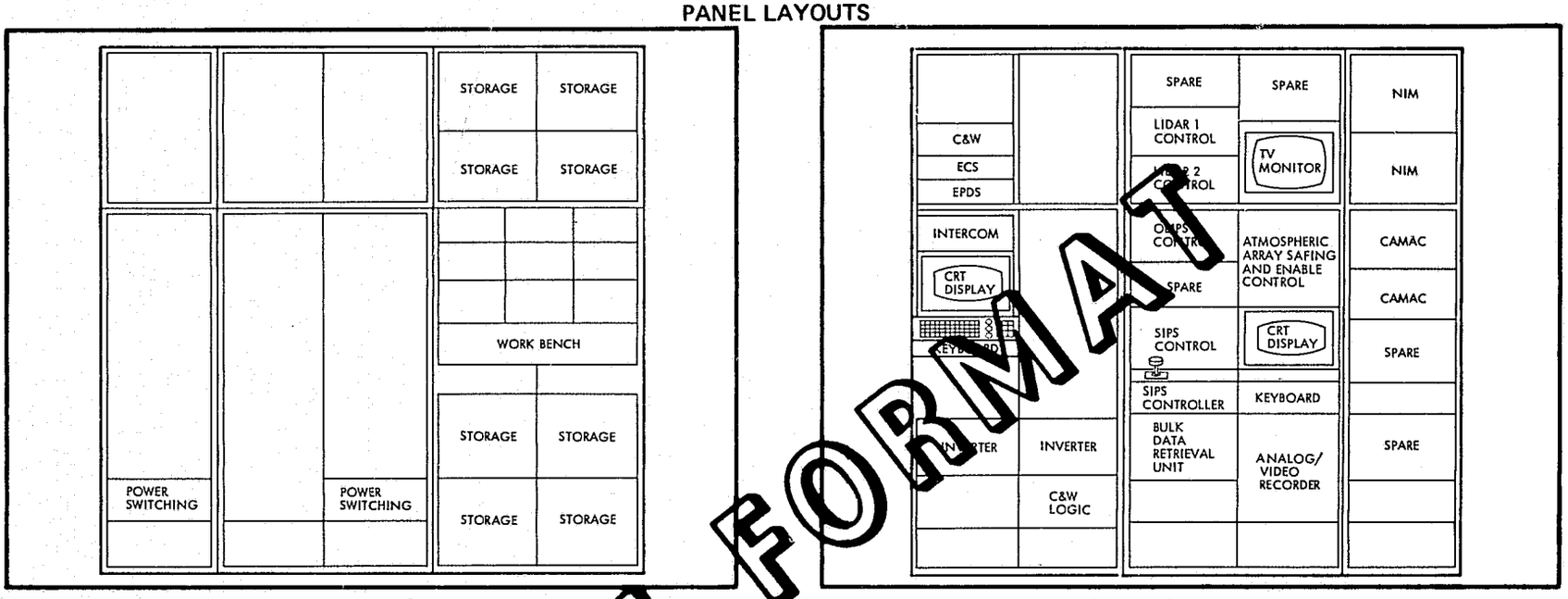
Sheet 1 - drawings of the panel layouts plus planned usage of other module volume. Also may include a layout of a more detailed description of the aft feedthrough connector.

Sheet 2 - a manifest of the equipment in the module including identification of the model and serial number of key items (e.g., the module itself).

Sheet 3 - a description of the physical routing of cabling and utility lines within the module plus appropriate notes describing the characteristics, handling, installation, or treatment of lines and cables.

Sheet 4 - Drawings and/or descriptions of any special or nonstandard installations of equipment in or on the Spacelab module.

PANEL LAYOUTS



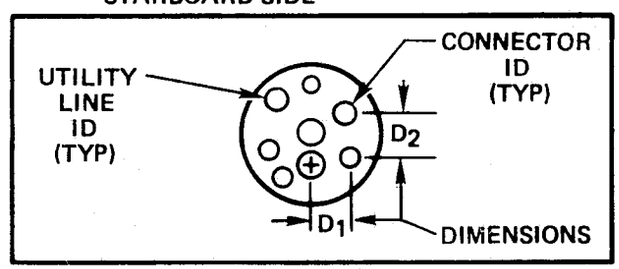
PORT SIDE → FWD ← STARBOARD SIDE

(TBD)

OVERHEAD RACK USAGE

(TBD)

WORKBENCH STOWAGE USAGE

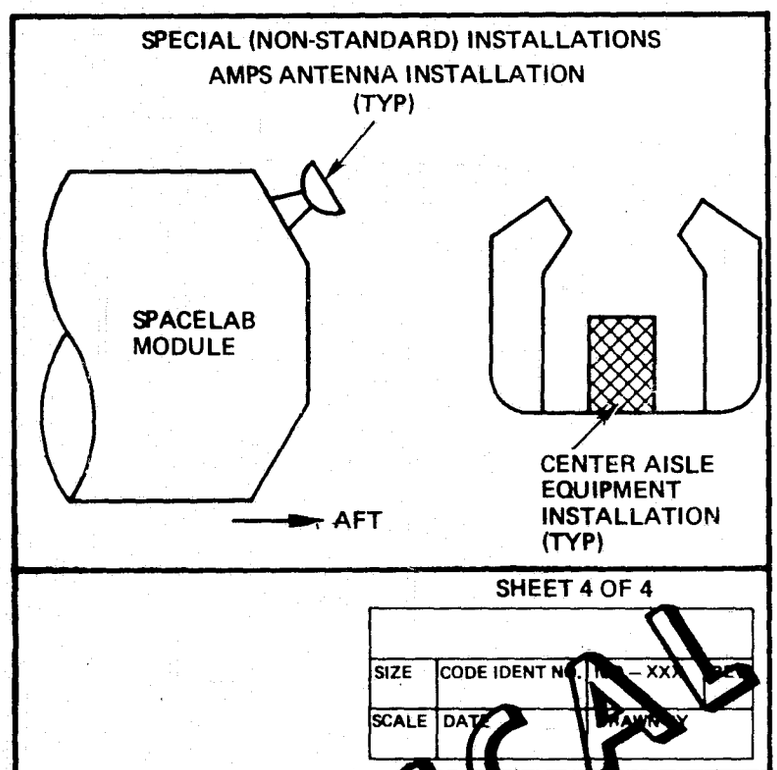


FEEDTHROUGH CONFIGURATION

SHEET 1 OF 4

SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

Figure 3.1.3-1



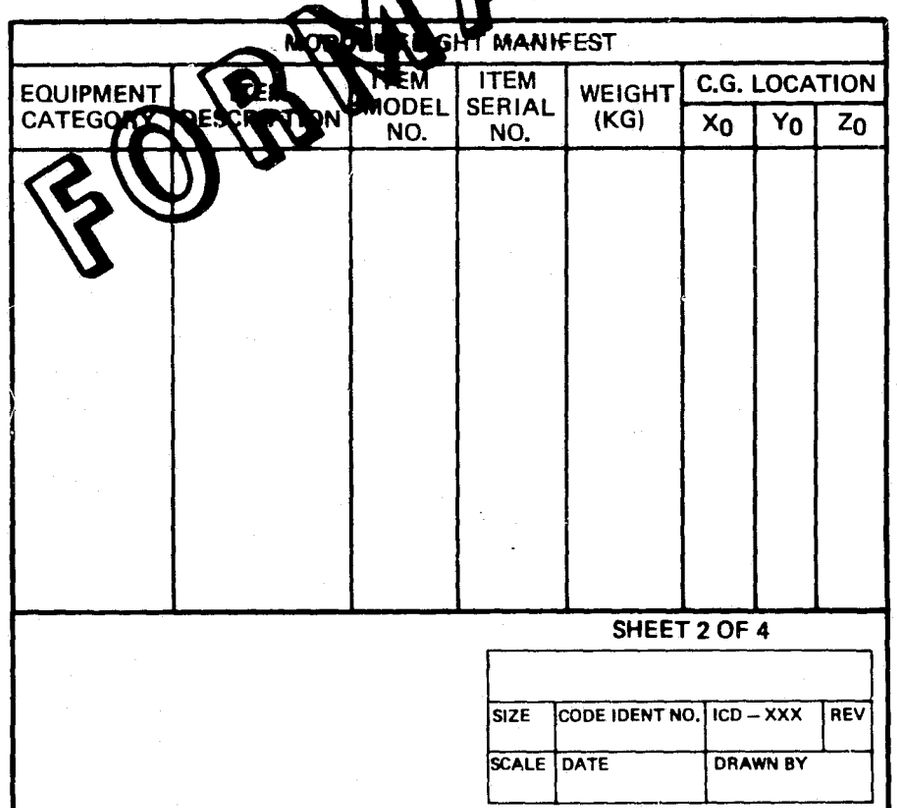
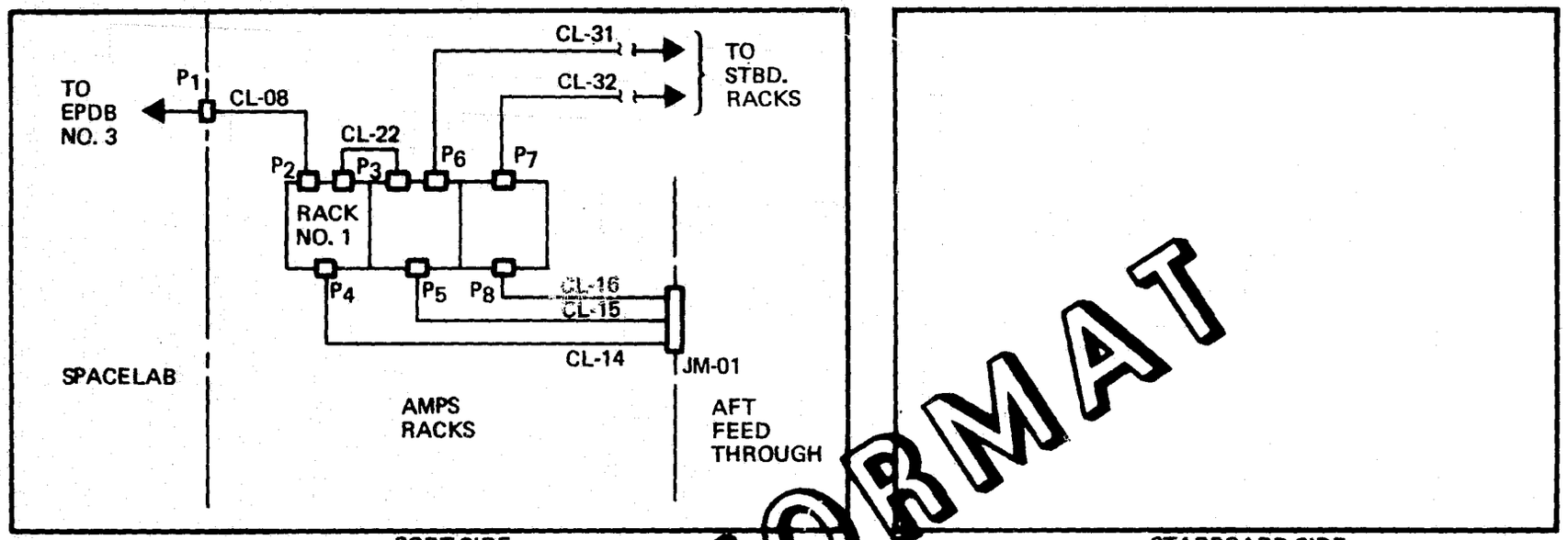


Figure 3.1.3-1 (Continued)



MODULE CABLING AND UTILITIES ROUTING

CABLE OR LINE IDENT.	CONNECTOR ROUTING	PHYSICAL ROUTING			
		FROM		ALONG	TIEDOWNS
CL-08	$P_1 - P_2$	RACK NO.	EPDB NO. 3	FRAME 34	2' INTERVALS

NOTES (TYP):

1. ALL WATER LINES ARE TBD DIAMETER STEEL WITH TBD FITTINGS AND RATED FOR TBD PSIA SERVICE.
2. CABLE HARNESSES TO BE PREFORMED UNLESS OTHERWISE NOTED

SHEET 3 OF 4

SIZE	CODE IDENT NO.	ICD – XXX	REV
SCALE	DATE	DRAWN BY	

Figure 3.1.3-1 (Continued)

3.2 ELECTRICAL INTERFACES

3.2.1 Payload schematics.

3.2.1.1 Electric power schematic. The electrical power interface schematic for this payload is given on Figure 3.2.1-1.

3.2.1.2 Communication and data handling schematic. The communication and data handling interface schematic for this payload is given on Figure 3.2.1-2.

3.2.1.3 Caution and warning schematic. The caution and warning interface schematic for this payload is given on Figure 3.2.1-3.

3.2.2 Payload power/mode requirements. The AMPS payload shall require power from the Spacelab EPDS in accordance with the data on Table III.II.II-1.

3.2.3 Cable identification and wire lists. All cables and their associated wire lists for the AMPS payload that interface with Spacelab are identified on Table III.II.III-1.

3.3 THERMAL INTERFACES

3.3.1 Insulation blankets. The AMPS payload requires the installation of multilayer insulation blankets on the Spacelab module and on all pallets as illustrated in Figure 3.3.1-1 through 3.3.1-4.

3.3.2 Cold plates. Figure 3.3.1-5 shows the location and interconnection of all Spacelab TCS coldplates, the maximum average load and peak temperature imposed on each cold plate plus a table showing several representative flight modes and the resulting thermal load.

3.3.3 Heater power. Table III.III.III-1 identifies active heating elements required to maintain payload thermal control and shows those elements that may require power during ascent or prior to Spacelab activation.

3.4 SOFTWARE.

Payload and Spacelab software will be compiled on a certified flight tape which will include the following:

(a) Spacelab subsystem operating software

(b) Experiment-CDMS operating software

(c) Experiment application programs

(d) Other (TBD)

The flight tape will be installed in the Spacelab CDMS mass memory during level III/II integration and will be used in all subsequent checkout operations. Two spare copies of the certified flight tape will be delivered and stored aboard Spacelab for possible use during the flight.

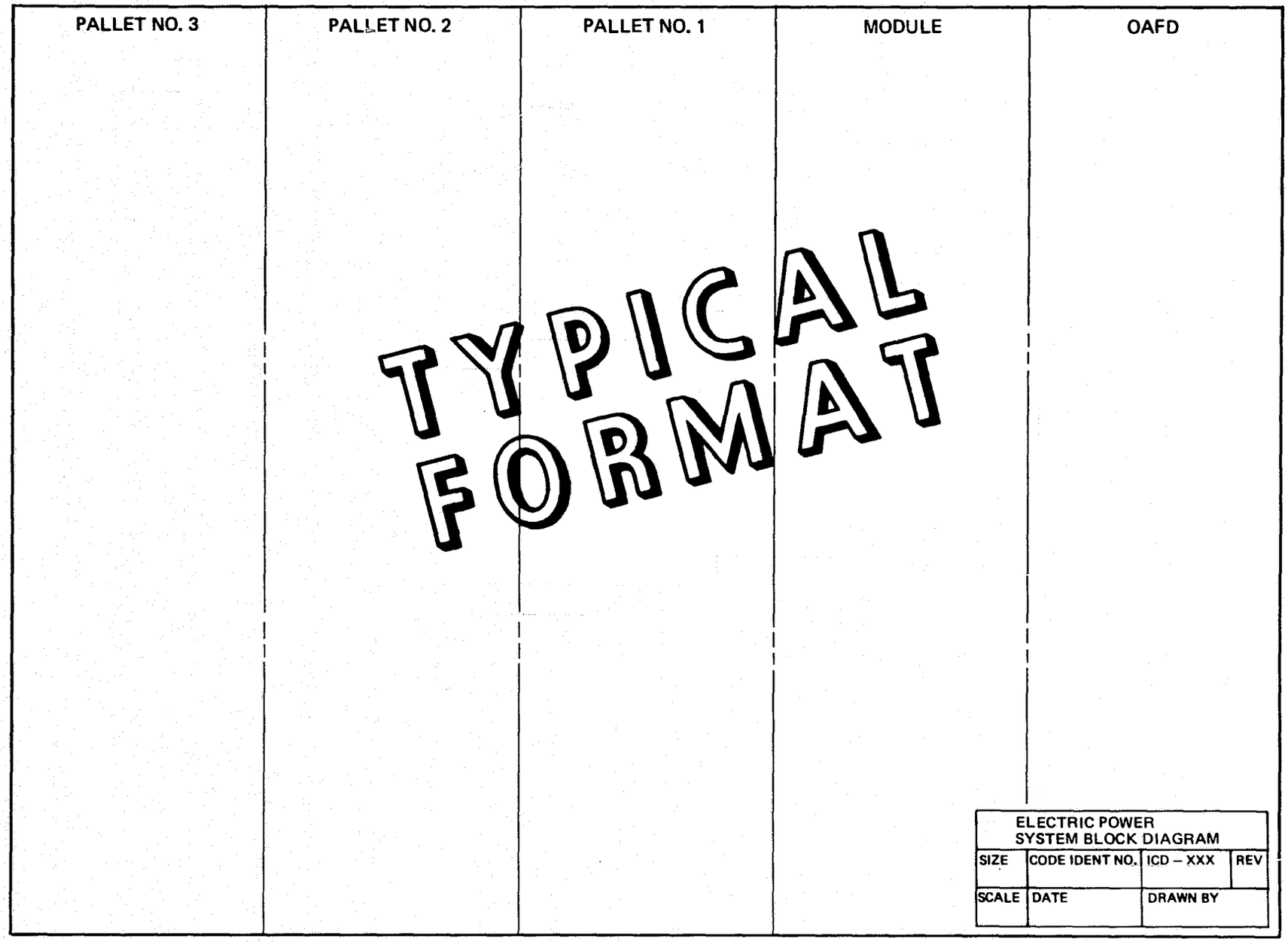

PALLET NO. 3
PALLET NO. 2
PALLET NO. 1
MODULE
OAFD
TYPICAL FORMAT
ELECTRIC POWER SYSTEM BLOCK DIAGRAM
SIZE
CODE IDENT NO.
ICD – XXX
REV
SCALE
DATE
DRAWN BY

FIGURE 3.2.1-1.

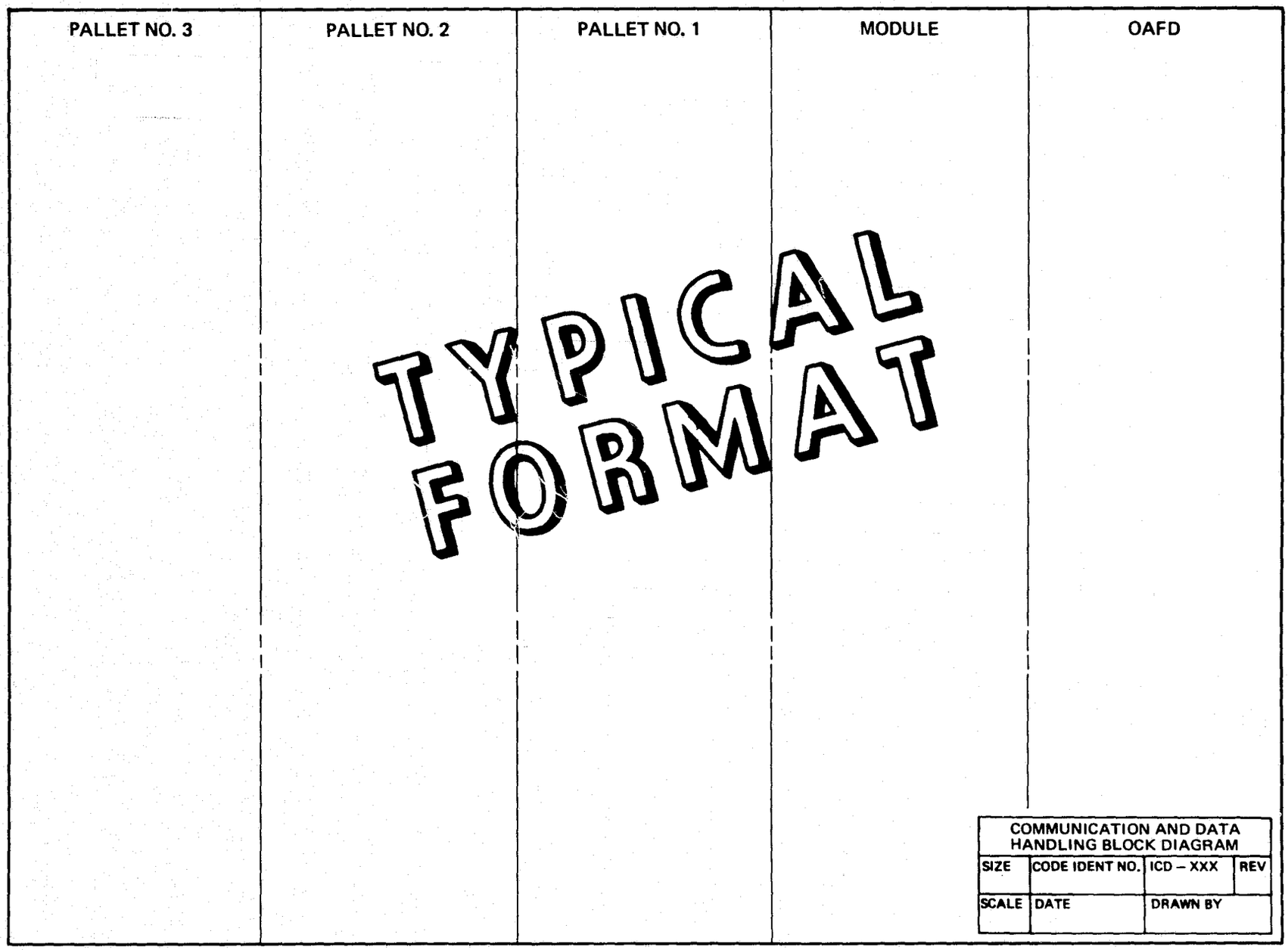

PALLET NO. 3
PALLET NO. 2
PALLET NO. 1
MODULE
OAFD
TYPICAL FORMAT
COMMUNICATION AND DATA HANDLING BLOCK DIAGRAM
SIZE
CODE IDENT NO.
ICD – XXX
REV
SCALE
DATE
DRAWN BY

FIGURE 3.2.1-2.

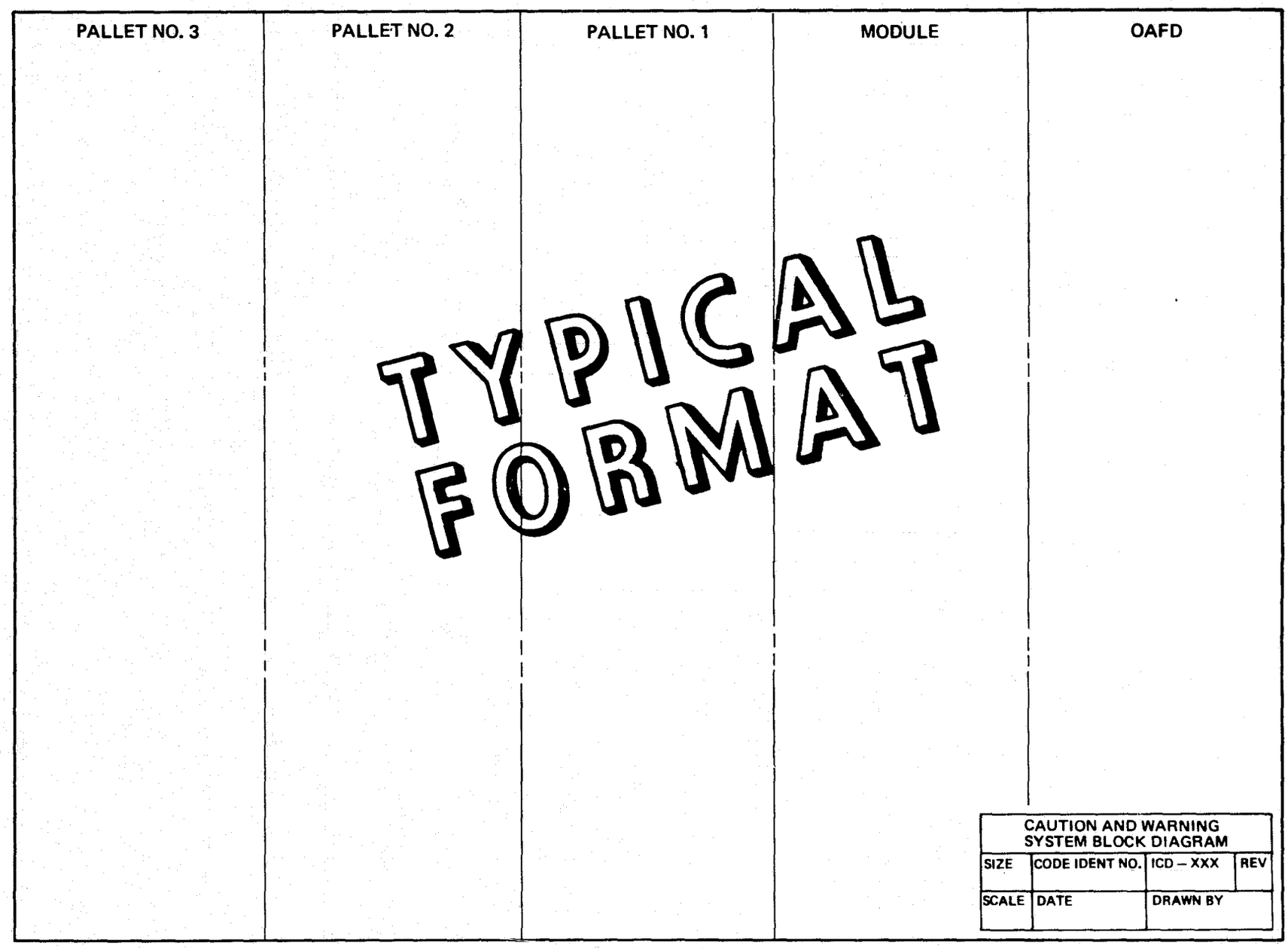

PALLET NO. 3
PALLET NO. 2
PALLET NO. 1
MODULE
OAFD
TYPICAL FORMAT
CAUTION AND WARNING SYSTEM BLOCK DIAGRAM
SIZE
CODE IDENT NO.
ICD – XXX
REV
SCALE
DATE
DRAWN BY

FIGURE 3.2.1-3.

Table III.II.II-1. AMPS Payload No. _____
Flight Power/Mode Analysis

EPDB		MODE 1			MODE 2			MODE 3				MODE N		
		PAYLOAD STANDBY			PAYLOAD SYSTEM CHECKOUT			EXPERIMENT NO. 1				PAYLOAD SAFING		
NUMBER	LOCATION	STEADY STATE (WATTS)	PEAK (WATTS)	ENERGY (KW-HR)	STEADY STATE (WATTS)	PEAK (WATTS)	ENERGY (KW-HR)	STEADY STATE (WATTS)	PEAK (WATTS)	ENERGY (KW-HR)		STEADY STATE (WATTS)	PEAK (WATTS)	ENERGY (KW-HR)
X _____														
Y _____														
Z _____														
	TOTALS													

TYPICAL FORMAT

MODE DEFINITIONS

MODE NO.	AMPS EQUIPMENT	MISSION DEPENDENT EQUIPMENT	ACTIVITY DURATION	ORBITER ATTITUDE	NOTES

Table III.II.III-1. AMPS/Spacelab Interface Cable Wire List

CABLE IDENTIFICATION NO. _____
TYPE: _____
SUPPLIER: _____

A. CONNECTOR NO. _____
MFGR OR TYPE: _____
LOCATION: _____
MATING CONNECTOR NO. _____

PIN NO.	FUNCTION CODE	NOTES

B. CONNECTOR NO. _____
MGFR OR TYPE: _____
LOCATION: _____
MATING CONNECTOR NO. _____

PIN NO.	FUNCTION CODE	NOTES

Table III.II.III-1. AMPS/Spacelab Interface Cable Wire List (Continued)

Wire Function Codes

A. POWER

FUNCTION CODE	WIRE SIZE	WIRE TYPE	VOLTAGE AC/DC	MAX POWER	FWD IMPEDANCE (RESISTANCE)	BACK IMPEDANCE (RESISTANCE)

B. SIGNAL AND CONTROL

B.1 DIGITAL

FUNCTION CODE	WIRE SIZE	WIRE TYPE	VOLTAGE "ON"	VOLTAGE "OFF"	SIGNAL			
					DATA RATE	CODE	FWD IMPEDANCE	BACK IMPEDANCE

B.2 ANALOG

FUNCTION CODE	WIRE SIZE	WIRE TYPE	VOLTS	FWD IMPEDANCE	BACK IMPEDANCE	BANDWIDTH

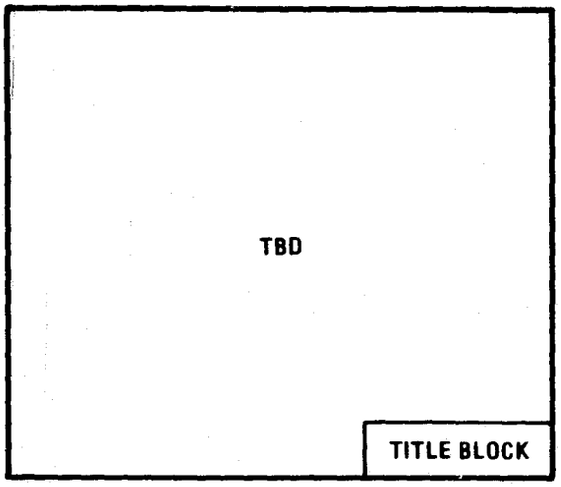


Figure 3.3.1-1. Module Thermal Blanket Installation

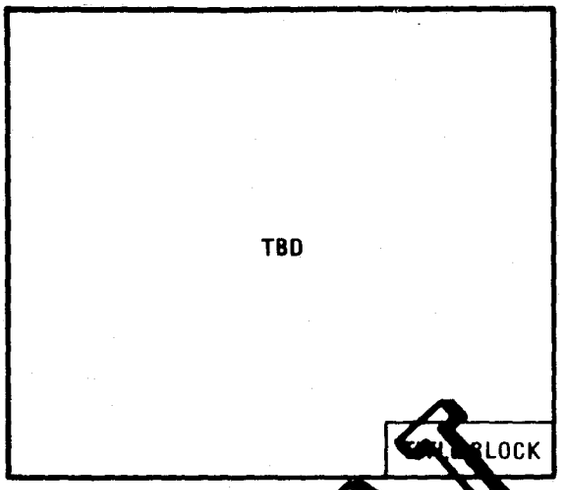


Figure 3.3.1-2. Pallet No. 1 Thermal Blanket Installation

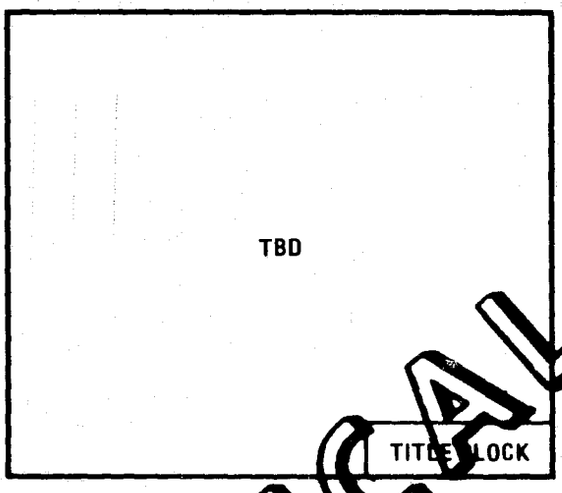


Figure 3.3.1-3. Pallet No. 2 Thermal Blanket Installation

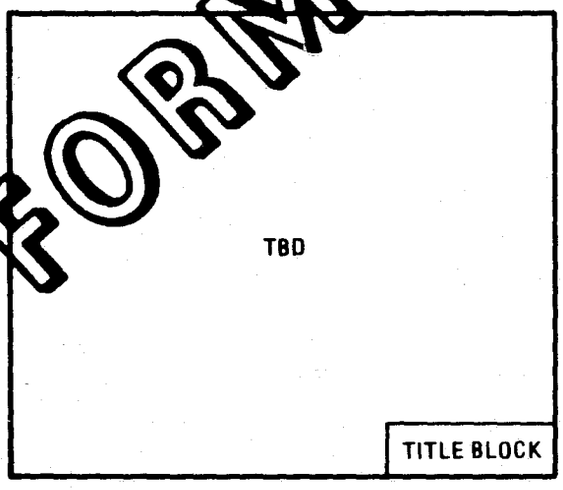


Figure 3.3.1-4. Pallet No. 3 Thermal Blanket Installation

Table III.III.III-1. Active Thermal Elements

ELEMENT DESCRIPTION	POWER CONSUMPTION (WATTS)	ACTIVATION TEMPERATURE (°K)	DUTY CYCLE (%)	ACTIVE ON ASCENT?		REMARKS
				YES	NO	