

CRAY

RESEARCH, INC.

CRAY-1® COMPUTER SYSTEMS

**M SERIES
SITE PLANNING
REFERENCE MANUAL**

HR-0065

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PREFACE

This publication is for the management and personnel of a facility installing a CRAY-1 M Series Computer System. The manual contains technical information to plan and prepare a typical site for this installation.

Site planning and preparation are important early steps in the successful installation of a computer system. Close communications and mutual cooperation between you and Cray Research, Inc., (CRI) is essential during all phases of the preparation and installation sequence. CRI maintains a staff of highly qualified site planning engineers, experienced in handling a wide variety of site planning and preparation problems.

Since this information is subject to change, consultation with site planning personnel at Cray Research, Inc., and CRI approval of the actual site working drawings is required before preparing a site. Questions involving site planning and preparation should be directed to Cray Research, Inc., as early as possible in the installation sequence.

Submit requests for site planning information to:

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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CONTENTS

<u>PREFACE</u>	iii
1. <u>INSTALLATION PROCESS</u>	1-1
1.1 SITE PLANNING MEETINGS	1-1
1.1.1 Initial meeting	1-2
1.1.2 Interim meeting	1-2
1.1.3 Final meeting	1-2
1.2 SYSTEM INSTALLATION	1-3
1.2.1 Shipping preparation	1-3
1.2.2 System transportation	1-3
1.2.3 System installation	1-3
1.2.4 System start-up	1-4
2. <u>GENERAL REQUIREMENTS</u>	2-1
2.1 COMPUTER ROOM ENVIRONMENT	2-1
2.2 POWER PLANT ROOM ENVIRONMENT	2-1
2.3 SITE ACCESS REQUIREMENTS	2-2
2.3.1 Shipping and installation	2-2
2.4 ELECTRICAL REQUIREMENTS	2-5
2.4.1 Exceptional electrical requirements	2-5
2.4.2 Earth-grounding requirements	2-5
2.5 POWER WIRING REQUIREMENTS	2-6
2.6 WATER SUPPLY REQUIREMENTS	2-8
2.7 REFRIGERANT PIPING REQUIREMENTS	2-11
2.7.1 CRAY-1 M Series mainframe refrigerant piping requirements	2-11
2.7.2 Miscellaneous equipment refrigerant piping	2-14
2.8 COMPUTER ROOM FLOOR	2-15
2.9 MAINTENANCE PERSONNEL REQUIREMENTS	2-15
2.9.1 Maintenance engineering office	2-15
2.9.2 Maintenance engineering shop	2-16
2.9.3 Modem	2-16
3. <u>SYSTEM CONFIGURATIONS</u>	3-1

4.	<u>MFC-4 CRAY-1 M MAINFRAME</u>	4-1
4.1	WEIGHT	4-1
4.2	LOCATION	4-1
4.3	ACCESS REQUIREMENTS	4-3
4.4	COOLING REQUIREMENTS	4-3
4.5	ROOM HEAT LOADING CHARACTERISTICS	4-3
4.6	FLOOR PREPARATION	4-3
4.6.1	Floor cutout A	4-6
4.6.2	Floor cutout B	4-8
4.6.3	Floor cutout C	4-10
4.6.4	3-inch (7.62 cm) diameter holes	4-12
4.6.5	Floor supporting pedestals	4-14
4.7	PIPING REQUIREMENTS	4-14
4.8	POWER WIRING REQUIREMENTS	4-14
4.9	EARTH GROUNDING REQUIREMENTS	4-14
5.	<u>IOC-1 I/O SUBSYSTEM 4-COLUMN CHASSIS</u>	5-1
5.1	WEIGHT	5-1
5.2	LOCATION	5-1
5.3	ACCESS REQUIREMENTS	5-1
5.4	COOLING REQUIREMENTS	5-3
5.5	ROOM HEAT LOADING CHARACTERISTICS	5-3
5.6	FLOOR PREPARATION	5-3
5.6.1	Floor cutout A	5-5
5.6.2	Floor cutout B	5-7
5.6.3	3-inch (7.62 cm) diameter holes	5-8
5.6.4	Floor supporting pedestals	5-8
5.7	PIPING REQUIREMENTS	5-11
5.8	POWER WIRING REQUIREMENTS	5-11
5.9	EARTH GROUNDING REQUIREMENTS	5-11
6.	<u>SSD SOLID-STATE STORAGE DEVICE (OPTIONAL)</u>	6-1
7.	<u>MCG-2 MAINTENANCE CONTROL GROUP</u>	7-1
7.1	PEX-1 PERIPHERAL EXPANDER UNIT/MTU-1 MAGNETIC TAPE UNIT	7-2
7.1.1	Weight	7-2
7.1.2	Location	7-2
7.1.3	Access requirements	7-2
7.1.4	Cooling requirements	7-2
7.1.5	Room heat loading characteristics	7-2
7.1.6	Floor preparation	7-4

7.1	PEX-1 PERIPHERAL EXPANDER UNIT/MTU-1 MAGNETIC TAPE UNIT (continued)	
7.1.7	Power wiring requirements	7-4
7.1.8	Earth-grounding requirements	7-4
7.2	DSU-2 DISK STORAGE UNIT	7-6
7.2.1	Weight	7-6
7.2.2	Location	7-6
7.2.3	Access requirements	7-6
7.2.4	Cooling requirements	7-6
7.2.5	Room heat loading characteristics	7-6
7.2.6	Floor preparation	7-6
7.2.7	Power wiring requirements	7-9
7.2.8	Earth-grounding requirements	7-9
7.3	LP-2 LINE PRINTER	7-10
7.3.1	Weight	7-10
7.3.2	Location	7-10
7.3.3	Access requirements	7-10
7.3.4	Cooling requirements	7-10
7.3.5	Room heat loading characteristics	7-10
7.3.6	Floor preparation	7-10
7.3.7	Power wiring requirements	7-12
7.3.8	Earth-grounding requirements	7-12
7.4	TBL-2 DUAL DISPLAY TABLE	7-14
7.4.1	Weight	7-14
7.4.2	Location	7-14
7.4.3	Access requirements	7-14
7.4.4	Floor preparation	7-14
7.5	TBL-1 SINGLE DISPLAY TABLE	7-17
7.5.1	Weight	7-17
7.5.2	Location	7-17
7.5.3	Access requirements	7-17
7.5.4	Floor preparation	7-17
7.6	CRT-4 DISPLAY	7-20
7.6.1	Weight	7-20
7.6.2	Location	7-20
7.6.3	Access requirements	7-20
7.6.4	Cooling requirements	7-20
7.6.5	Room heat loading characteristics	7-20
7.6.6	Power wiring requirements	7-22
7.6.7	Earth-grounding requirements	7-22
8.	<u>MCG-3 MAINTENANCE CONTROL GROUP</u>	8-1
8.1	MMCU MAINTENANCE MICROCOMPUTER UNIT	8-3
8.1.1	Weight	8-3
8.1.2	Location	8-3
8.1.3	Access requirements	8-3
8.1.4	Cooling requirements	8-3
8.1.5	Room heat loading characteristics	8-3

8.1	MMCU MAINTENANCE MICROCOMPUTER UNIT (continued)	
8.1.6	Floor preparation	8-5
8.1.7	Power wiring requirements	8-5
8.1.8	Earth-grounding requirements	8-5
8.2	CRT-4 DISPLAY	8-7
9.	<u>PERIPHERAL EQUIPMENT</u>	9-1
9.1	DD-29 DISK STORAGE UNIT	9-1
9.1.1	Weight	9-1
9.1.2	Location	9-1
9.1.3	Access requirements	9-1
9.1.4	Cooling requirements	9-1
9.1.5	Room heat loading characteristics	9-3
9.1.6	Floor preparation	9-3
9.1.7	Power wiring requirements	9-3
9.1.8	Earth-grounding requirements	9-3
9.2	FEC-1 FRONT-END INTERFACE CABINET	9-5
9.2.1	Weight	9-5
9.2.2	Location	9-5
9.2.3	Access requirements	9-5
9.2.4	Cooling requirements	9-5
9.2.5	Room heat loading characteristics	9-7
9.2.6	Floor preparation	9-7
9.2.7	Power wiring requirements	9-7
9.2.8	Earth-grounding requirements	9-7
10.	<u>SUPPORT EQUIPMENT</u>	10-1
10.1	PDU-2 I/O SUBSYSTEM POWER DISTRIBUTION UNIT	10-1
10.1.1	Weight	10-1
10.1.2	Location	10-1
10.1.3	Access requirements	10-1
10.1.4	Cooling requirements	10-2
10.1.5	Room heat loading characteristics	10-2
10.1.6	Floor preparation	10-2
10.1.7	Power wiring requirements	10-5
10.1.8	Earth-grounding requirements	10-5
10.2	PDU-3 SOLID-STATE STORAGE DEVICE POWER DISTRIBUTION UNIT	10-6
10.3	PDU-4 MAINFRAME POWER DISTRIBUTION UNIT	10-7
10.3.1	Weight	10-7
10.3.2	Location	10-7
10.3.3	Access requirements	10-7
10.3.4	Cooling requirements	10-9
10.3.5	Room heat loading characteristics	10-9
10.3.6	Floor preparation	10-9
10.3.7	Power wiring requirements	10-11
10.3.8	Earth-grounding requirements	10-11

10.4	RCU-1 REFRIGERATION CONDENSING UNIT	10-12
10.4.1	Weight	10-12
10.4.2	Location	10-12
10.4.3	Alternate location	10-12
10.4.4	Access requirements	10-14
10.4.5	Cooling requirements	10-14
10.4.6	Room heat loading characteristics	10-14
10.4.7	Water supply requirements	10-14
10.4.8	Floor preparation	10-16
10.4.9	Power wiring requirements	10-16
10.4.10	Earth-grounding requirements	10-18
10.4.11	Piping requirements	10-18
10.5	MOTOR-GENERATOR SETS	10-22
10.5.1	MCU-1 Motor-Generator Unit (KATO)	10-23
10.5.1.1	Weight	10-23
10.5.1.2	Location	10-23
10.5.1.3	Access requirements	10-23
10.5.1.4	Cooling requirements	10-23
10.5.1.5	Room heat loading characteristics	10-25
10.5.1.6	Power wiring requirements	10-25
10.5.2	MGC-1 Motor-Generator Control Cabinet (KATO)	10-26
10.5.2.1	Weight	10-26
10.5.2.2	Location	10-26
10.5.2.3	Access requirements	10-26
10.5.2.4	Cooling requirements	10-28
10.5.2.5	Room heat loading characteristics	10-28
10.5.2.6	Power wiring requirements	10-28
10.5.3	MGU-2 Motor-Generator Unit (General Electric)	10-29
10.5.3.1	Weight	10-29
10.5.3.2	Location	10-29
10.5.3.3	Access requirements	10-29
10.5.3.4	Cooling requirements	10-29
10.5.3.5	Room heat loading characteristics	10-29
10.5.3.6	Power wiring requirements	10-31
10.5.4	MGC-2 Motor-Generator Control Cabinet (General Electric)	10-32
10.5.4.1	Weight	10-32
10.5.4.2	Location	10-32
10.5.4.3	Access requirements	10-32
10.5.4.4	Cooling requirements	10-34
10.5.4.5	Room heat loading characteristics	10-34
10.5.4.6	Power wiring requirements	10-34
10.6	MTS-3 MODULE TEST STATION	10-35
10.6.1	Weight	10-35
10.6.2	Location	10-35
10.6.3	Access requirements	10-35
10.6.4	Cooling requirements	10-37
10.6.5	Room heat loading characteristics	10-37
10.6.6	Power wiring requirements	10-37
10.6.7	Earth-grounding requirements	10-37

11. <u>EQUIPMENT SEPARATION LIMITS</u>	11-1
11.1 GENERAL REQUIREMENTS	11-1
11.2 FLOOR PLAN ARRANGEMENTS	11-2

12. <u>TEMPLATES</u>	12-1
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APPENDIX SECTION

A. ABBREVIATIONS	A-1
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TABLES

3-1 CRAY-1 Models M/1200,2200 & 4200 system configuration	3-2
3-2 CRAY-1 Models M/1300,2300 & 4300 system configuration	3-3
3-3 CRAY-1 Models M/1400,2400 & 4400 system configuration	3-4
3-4 CRAY-1 Models M/1208,1216,1232,2208,2216,2232,4208,4216, & 4232 system configuration	3-5
3-5 CRAY-1 Models M/1308,1316,1332,2308,2316,2332,4308,4316, & 4332 system configuration	3-6
3-6 CRAY-1 Models M/1408,1416,1432,2408,2416,2432,4408,4416, & 4432 system configuration	3-7
10-1 RCU-1 cooling water requirements	10-16

FIGURES

2-1 CRAY-1 M Mainframe shipping configuration	2-3
2-2 I/O Subsystem 4-Column Chassis shipping configuration	2-4
2-3 Basic power wiring for a CRAY-1 M Series Computer System	2-9
2-4 Basic power wiring for a CRAY-1 M Series pluggable peripherals	2-10
2-5 CRAY-1 M computer piping requirements.	2-13
4-1 CRAY-1 M mainframe	4-2
4-2 Standard orientation of the CRAY-1 M Computer System	4-4
4-3 CRAY-1 M mainframe floor preparation requirements.	4-5
4-4 Location of floor cutout A	4-7
4-5 Details of cutout A	4-8
4-6 Location of floor cutout B	4-9
4-7 Details of floor cutout B	4-10
4-8 Locations of cutout C.	4-11
4-9 Details of cutout C.	4-12
4-10 Hole locations	4-13
4-11 Pedestal locations	4-15
5-1 IOC-1 I/O Subsystem 4-Column Chassis	5-2
5-2 IOC-1 floor preparation requirements	5-4
5-3 Location of floor cutout A	5-5

FIGURES (continued)

5-4	Details of cutout A	5-6
5-5	Locations of floor cutout B	5-7
5-6	Details of cutout B	5-8
5-7	Hole locations	5-9
5-8	Pedestal locations	5-10
6-1	SSD Solid-state Storage Device	6-2
7-1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit . . .	7-3
7-2	PEX-1/MTU-1 floor cutout	7-5
7-3	DSU-2 Disk Storage Unit	7-7
7-4	DSU-2 Disk Storage Unit floor cutout	7-8
7-5	LP-2 Line Printer	7-11
7-6	LP-2 Line Printer floor cutout	7-13
7-7	TBL-2 Dual Display Table	7-15
7-8	TBL-2 Dual Display Table floor cutout	7-16
7-9	TBL-1 Single Display Table	7-18
7-10	TBL-1 Single Display Table floor cutout	7-19
7-11	CRT-4 Display	7-21
8-1	MCG-3 Maintenance Control Group	8-2
8-2	MMCU Microcomputer System	8-4
8-3	MMCU floor cutout	8-6
9-1	DD-29 Disk Storage Unit	9-2
9-2	DD-29 Disk Storage Unit floor cutouts	9-4
9-3	FEC-1 Front-End Interface Cabinet	9-6
9-4	FEC-1 Front-End Interface Cabinet floor cutout	9-8
10-1	PDU-2 I/O Subsystem Power Distribution Unit	10-3
10-2	PDU-2 Power Distribution Unit floor cutouts	10-4
10-3	PDU-4 Mainframe Power Distribution Unit	10-8
10-4	PDU-4 Power Distribution Unit floor cutouts	10-10
10-5	Standard RCU-1 Refrigeration Condensing Unit	10-13
10-6	Optional RCU-1 Refrigeration Condensing Unit	10-15
10-7	RCU-1 floor cutouts	10-17
10-8	RCU-1 piping locations	10-19
10-9	MGU-1 Motor-Generator Unit	10-24
10-10	MGC-1 Motor-Generator Control Cabinet	10-27
10-11	MGU-2 Motor-Generator Unit	10-30
10-11	MGC-2 Motor-Generator Control Cabinet	10-33
10-13	MTS-3 Module Test Station	10-36
11-1	Equipment separation limits for CRAY-1 M Series Computer System	11-3
11-2	Typical computer room floor plan for a CRAY-1 M Series Computer System	11-4

Site planning and preparation is a major step in the successful installation of a CRAY-1 M Series Computer System. This publication explains facility planning and preparation shared by you and Cray Research, Inc. (CRI). To assist you during the planning stages and to ensure that site preparations meet the specified requirements, CRI employs site planning personnel who are in direct communication with you during planning and preparation. CRI site planning personnel must approve any plans before any site preparation is begun. We encourage direct communications with our site planning personnel. Planning and preparation requirements ensure:

- Satisfactory system installation,
- Satisfactory operator and maintenance access,
- Satisfactory personnel safety, and
- The highest degree of system performance achievable.

You should allow at least six months to plan and prepare your facility. Each site presents a set of unique problems to be investigated and resolved. Each site must conform to local and national building codes.

1.1 SITE PLANNING MEETINGS

Site planning meetings establish a communication link between you and Cray Research, Inc. CRI site planning personnel will schedule a minimum of three site planning meetings with you at your facility to ensure proper site preparation.

1.1.1 INITIAL MEETING

The first site planning meeting is held preferably six months before system delivery. At this meeting, site planning personnel will:

- Tour and review your facility,
- Identify potential site difficulties,
- Review the site planning manual with you,
- Define the materials and labor to be supplied by you,
- Define the materials and labor to be supplied by CRI, and
- Provide specifications and charts (not working drawings) for the ordered equipment.

From CRI specifications and charts, you can prepare the working drawings and specifications for your facility to be used by your choice of an internal construction staff or an outside subcontractor.

1.1.2 INTERIM MEETING

Interim meetings are held at your facility as required to review your progress and to resolve any site problems.

1.1.3 FINAL MEETING

Approximately two to four weeks before system delivery, a final site planning meeting is held to ensure that your facility is properly prepared. By this time, you will have installed the pre-installation materials and equipment shipped by CRI. Site planning personnel will review the equipment installation, the floor cutout preparations, the refrigerant piping, and the electrical wiring.

1.2 SYSTEM INSTALLATION

The physical installation of a CRAY-1 M Series Computer System consists of four basic stages:

1. Shipping preparation
2. System transportation
3. System installation
4. System start-up

1.2.1 SHIPPING PREPARATION

One week before delivery, the computer system is prepared for shipping. Major components are disassembled to the shipping configuration and are structurally and protectively prepared. Cabling and miscellaneous materials are packaged and identified for shipment.

1.2.2 SYSTEM TRANSPORTATION

The system equipment, spares allocations, test apparatus, etc., are transported to your facility by commercially available, dedicated tractor-trailer semis. All semis are equipped with air-suspension ride and at least one semi is climate controlled.

For intercontinental shipments, transported materials are containerized for shipment and transported by commercial cargo-carrying aircraft.

1.2.3 SYSTEM INSTALLATION

Under CRI supervision, you will unload and move the system equipment into the facility. While you install all power wiring, CRI performs all of the mechanical reassembly of the computer system, connects all logic cabling, and attaches the refrigeration hoses.

Site planning representatives accompany CRI installation personnel during system installation.

1.2.4 SYSTEM START-UP

During system start-up, CRI personnel activate all necessary electrical and refrigerant controls. If any electrical circuitry or refrigeration piping is in error, you must provide knowledgeable personnel to correct such problems.

GENERAL REQUIREMENTS

2

For proper installation and operation of the CRAY-1 M Series Computer System, you must provide the general requirements outlined in this section. Specific equipment requirements are defined in sections 4 through 10. The equipment separation limits are described in section 11.

2.1 COMPUTER ROOM ENVIRONMENT

The CRAY-1 M Series Computer System requires a computer room environment with controlled temperatures, relative humidity, and air quality within the following ranges:

- Temperature: 60°F to 80°F (16°C to 27°C) with a maximum rate of change not to exceed 10°F per hour
- Humidity: 35% to 65% relative humidity (non-condensing)
- Dew point: 55°F (13°C) maximum
- Air quality: 5 X 10⁶ particles/meter³ (less than 1 micron particle size)
5 X 10⁵ particles/meter³ (less than 1.5 micron particle size)
5 X 10⁴ particles/meter³ (less than 5 micron particle size)

2.2 POWER PLANT ROOM ENVIRONMENT

The motor-generator unit (MGU-1 or MGU-2), motor-generator control cabinet (MGC-1 or MGC-2), and refrigeration condensing unit (RCU-1) require a power plant room environment. The plant room should be located close to the computer room and must have a controlled environment as specified below:

- Temperature: 65°F to 95°F (18°C to 35°C) with maximum rate of change not to exceed 20°F per hour
- Humidity: 10% to 90% relative humidity (non-condensing)

2.3 SITE ACCESS REQUIREMENTS

Before system delivery, you must ensure that site access meets the provisions discussed later in this section.

CRI provides protective covering (aluminum plates) for false floor and tiled areas during the moving-in process.

2.3.1 SHIPPING AND INSTALLATION

The central mainframe section of the CRAY-1 M computer, with all printed circuit modules in place, is shipped, moved, and installed separately from its power supply sections. Figure 2-1 illustrates the shipping configuration of the 6-column unit. Note that two specially designed lifts are secured to the mainframe. These elevate the unit to an adequate height for mobility.

The central paraframe section of the IOC-1 I/O Subsystem 4-Column Chassis, containing all the printed circuit modules in place, is shipped, moved, and installed separately from its power supply sections. Figure 2-2 illustrates the shipping configuration of the unit. Note that two specially designed lifts and supporting structure are secured to the paraframe and are designed to elevate the unit to an adequate height to allow mobility.

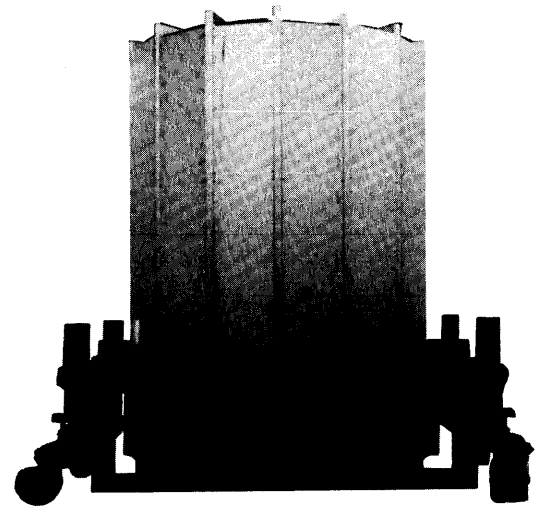
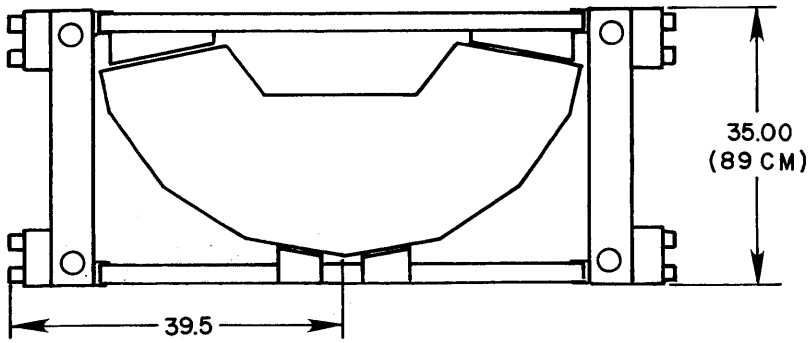
If an optional SSD Solid-state Storage Device is configured with the system, refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025, for shipping and installation information.

Access routes to the site must be able to support rolling casters with 850 pound (385 kilogram) loads. This load support requirement applies especially to any ramps where the equipment is more vulnerable to possible damage.

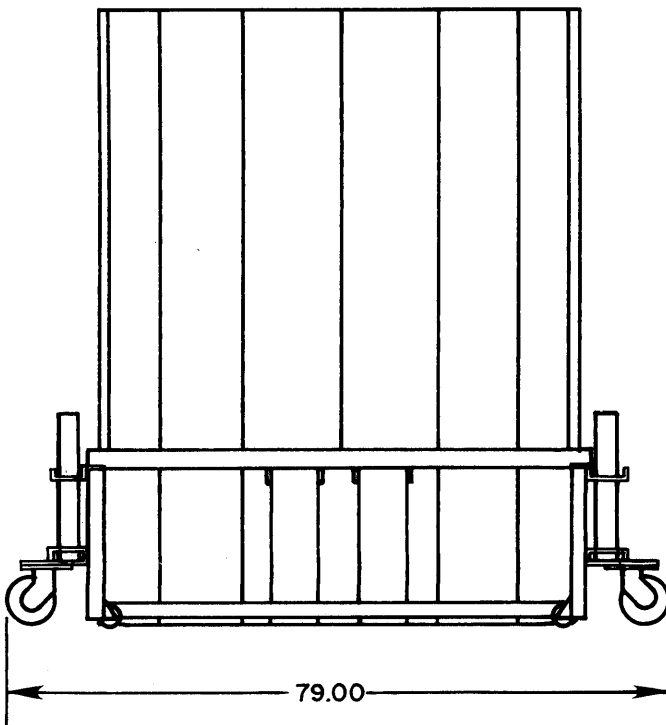
Each ramp must have a maximum slope or pitch no greater than one unit in height to five units in length.

The mainframe and paraframe sections require doors with minimum clearances of 80 inch (203 cm) height, and 60 inch (152 cm) width along the access route to the computer room. If a doorway is located close to a ramp, the door height requirement may be somewhat greater.

PLAN VIEW



FRONT VIEW



SIDE VIEW

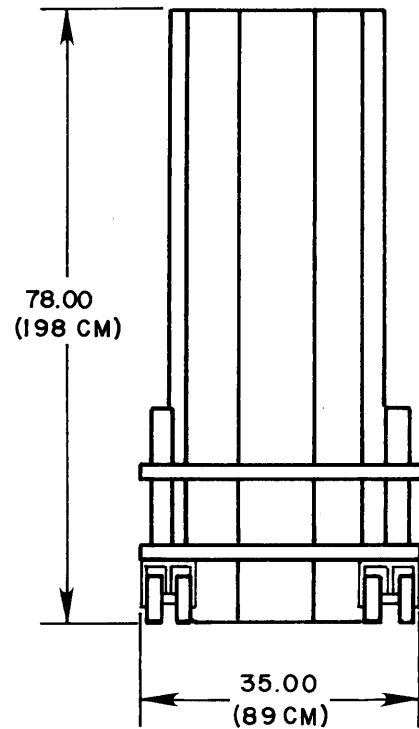


Figure 2-1. CRAY-1 M mainframe shipping configuration

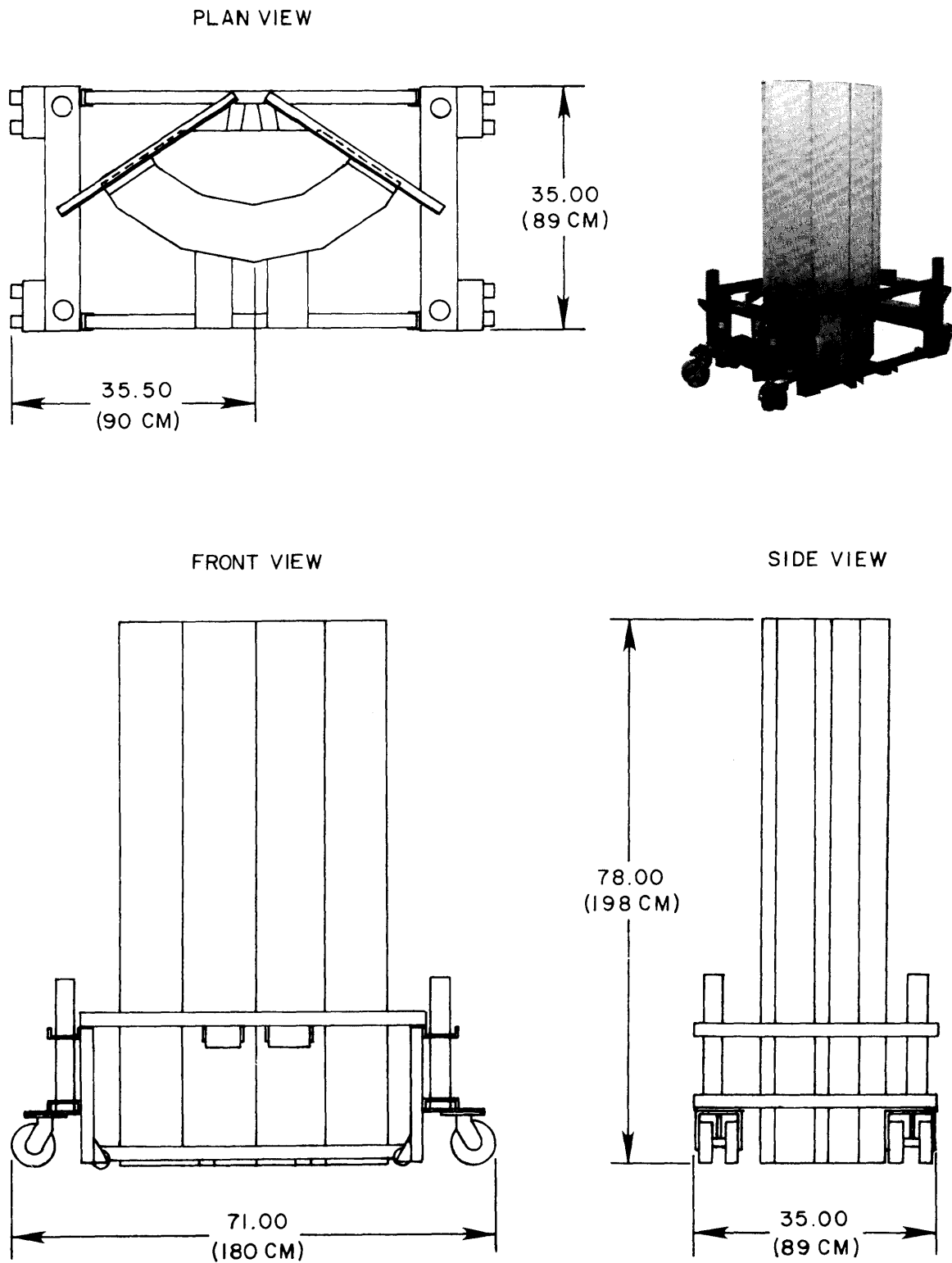


Figure 2-2. I/O Subsystem 4-Column Chassis shipping configuration

2.4 ELECTRICAL REQUIREMENTS

The following electrical services are needed for the Cray computer equipment:

- 460 volts $\pm 10\%$, -5% AC, 3-phase, 60 ± 3 hertz
- 208 volts $\pm 10\%$ AC, 3-phase, 60 ± 3 hertz
- 120 volts $\pm 10\%$ AC, 1-phase, 60 ± 3 hertz

Total power requirements depend on system configuration and expansion allowances.

2.4.1 EXCEPTIONAL ELECTRICAL REQUIREMENTS

When the facility main power is supplied at voltages and frequencies other than 460 V, 60 HZ, the following electrical services are required:

- 397 volts $\pm 5\%$, AC, 3-phase, 50 ± 3 hertz
- 208 volts $\pm 10\%$, AC, 3-phase, 60 ± 3 hertz
- 120 volts $\pm 10\%$, AC, 1-phase, 60 ± 3 hertz

When a CRAY-1 M Series Computer System is installed in an international location equipped to supply only 50 Hz power, CRI will supply the 400 Hz motor-generator units and the refrigeration condensing units in models equipped for operation with 380 or 415 volts, 3-phase, 50 Hz line power.

You are required to furnish and install a 50 Hz to 60 Hz frequency convertor, if necessary, to supply the 60 Hz power to the balance of the Cray equipment.

You should select the size of the 50 Hz to 60 Hz frequency convertor proportionate with system expansion plans.

2.4.2 EARTH-GROUNDING REQUIREMENTS

All Cray computer equipment requires two grounding systems: an earth-ground/reference-plane grid-grounding system and a protective safety ground system.

The safety ground system protects personnel from shock hazards and protects the computer equipment from damage due to electrical malfunctions. The earth-ground/reference-plane grid-grounding system provides controlled circuit paths for radio frequency interference (RFI) between associated computer equipment and the surrounding environment.

You are responsible for providing and installing an approved grid-ground system.

In some instances, the raised floor of the computer room is constructed so that a built-in grid-ground system exists. If your facility uses the raised floor grid system, the integrity of the existing earth-grounding system must be assured throughout the entire area associated with the Cray computer equipment installed. The equipment must then be connected to the raised floor grid system, with flexible, braided ground straps supplied and installed by you. All connections must be securely fastened to ensure electrical integrity.

In some instances, the computer room is prepared with an earth-grounding system by placement of insulated copper conductors in a pattern of 2 foot (60.96 cm) to 4 foot (121.92 cm) squares, located on the computer room subfloor. The grid is constructed of #2 AWG or larger, insulated, copper wire, securely bonded at all intersections. Split-bolt clamps, brazing, or welding are acceptable methods of bonding the conductors together. Solder, alone, is not acceptable. The Cray equipment must then be connected to the earth-ground grid, by flexible, braided ground straps. All connections must be securely fastened to ensure electrical integrity. A 1/4-20 threaded hole, or compression terminal is provided in all equipment for the attachment of the ground straps.

The flexible, braided ground straps used to connect the Cray equipment to either of the above mentioned earth-ground grid systems should be covered with insulation sleeving and constructed from tinned copper, flat braided wires of approximately 20,800 circular mils cross-sectional area, rated for 85 amperes.

2.5 POWER WIRING REQUIREMENTS

Approximately eight weeks before delivery of the mainframe, IOC-1 I/O Subsystem 4-Column Chassis and optional SSD Solid-state Storage Device, CRI will ship the refrigeration condensing unit, motor-generator unit with control cabinet and piping kit to your facility.

You must prepare the facility and supply all power wiring, circuit breakers, circuit breaker panels, etc., necessary for installation of this equipment. In addition, you must install this equipment and perform all necessary wiring connections to make the equipment ready for final hook-up prior to delivery of the CRAY-1 M Series Computer System.

During installation of the computer system, CRI personnel will perform all mechanical reassembly of the computer equipment, attach all refrigerant hoses, and install all associated logic cabling. You are required to supply and install all remaining power wiring needed to complete the installation.

Figure 2-3 illustrates a schematic diagram of the basic power wiring for the CRAY-1 M computer, IOC-1 I/O Subsystem, PDU-4 Mainframe Power Distribution Unit, PDU-2 I/O Subsystem Power Distribution Unit, RCU-1 Refrigeration Condensing Unit, motor-generator set, and underfloor refrigerant line solenoid valves.

Figure 2-4 illustrates a schematic diagram of the basic power wiring for the DD-29 Disk Storage Units, MTS-3 Module Test Station, and various equipment included in the MCG-1 Maintenance Control Group.

The following notes provide additional information to the schematic diagram illustrations.

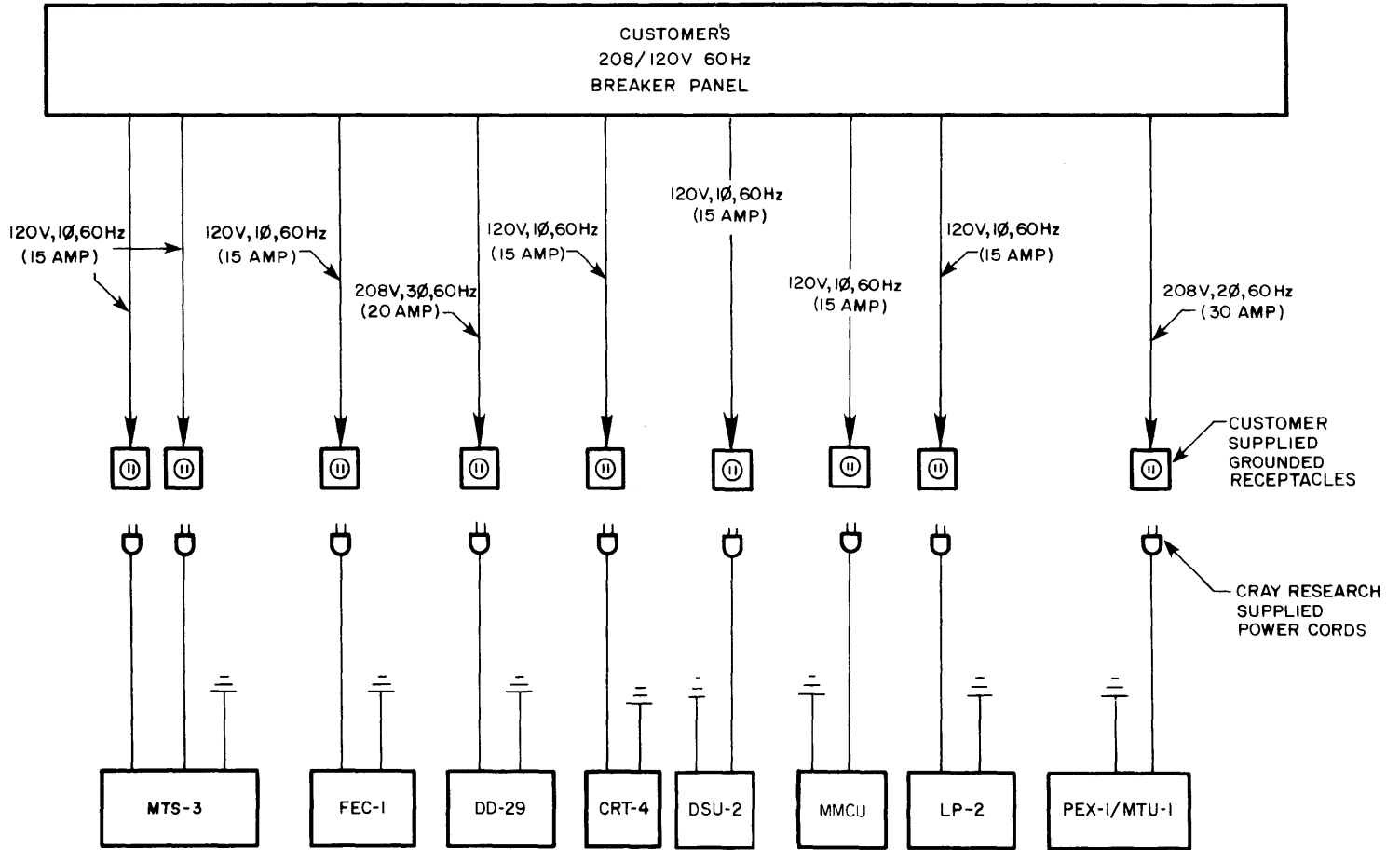
- Figures 2-3 and 2-4 are guides for your electrical design engineer and must not be used as a bid document or working drawing.
- The optional SSD Solid-state Storage Device is not illustrated in this figure; for systems configured with an SSD, refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025.
- The component arrangements shown in figures 2-3 and 2-4 do not represent actual layout of equipments. The illustrations are only a guide for estimating purposes.
- All wiring shall be prepared according to applicable local and national codes. Wire gauges indicated in figures 2-3 and 2-4 are given to suggest minimum size requirements and are to be used for reference only. Actual wire sizes must be selected to ensure that the maximum voltage drop from the 400 Hz generator output to the power distribution units input does not exceed 2%.
- The circuit breakers, circuit breaker panels, magnetic contactors, main power disconnect switches, junction boxes, and all power wiring, wiring raceways, and conduits needed shall be furnished and installed by you.

- Aluminum conduit or raceways must be used for all 400 Hz power distribution wiring.
- All circuit breakers used with the 400 Hz power may be 60 Hz rated, but must be sized for 400 Hz application. Capacity of a 60 Hz breaker, when used to protect 400 Hz circuitry, is 82% of rated size.
- Your site preparation design should allow for circuit additions proportionate with system expansion plans.
- CRI recommends one emergency off switch at each computer room exit. All emergency off switches should be wired in series and should interrupt power to the computer equipment and to all air circulating units in the computer room.
- All power cords or conduits terminating at floor-mounted computer equipment shall be secured with approved fittings at the equipment entrance. Refer to specific equipment sections in this publication for detailed requirements.
- All Cray equipment must be earth grounded. Refer to section 2.4.2 and to specific equipment sections for detailed requirements.
- Detailed diagrams for all wiring connections to the mainframe, power distribution units, I/O Subsystem, SSD Solid-state Storage Device, refrigeration condensing units and the motor-generator set will be included within the CRI site planning documentation supplied to you.

2.6 WATER SUPPLY REQUIREMENTS

An adequate source of clean cooling water must be supplied within temperature and flow rate ranges as specified for the refrigeration condensing unit installed (see section 10.4). Cooling water temperatures (measured at condensing unit inlet) must not vary more than $\pm 10^{\circ}$ F (5.5° C) from the original design/start-up temperature. Rate of change of temperature must not exceed 5° F (2.8° C) per 15 minute cycle. CRI recommends 60° F (15° C) cooling water.

Figure 2-4. Basic power wiring for a CRAY-1 M Series pluggable peripherals



2.7 REFRIGERANT PIPING REQUIREMENTS

Certain Cray equipment is cooled by a refrigerant cooling technique that requires refrigerant piping to distribute the refrigerant liquid and to return the refrigerant vapor to a remote condensing unit.

You must prepare working drawings and documentation to provide detailed information on planned refrigerant piping.

Approximately eight weeks before delivery of a CRAY-1 M Series Computer System, CRI will make a pre-installation shipment of equipment to your facility including the refrigeration condensing unit and special refrigeration component kits.

Refrigeration component kits consist of special Y fittings and manifold assemblies, but do not include all refrigeration piping components and materials needed to prepare the facility.

Installation of the special refrigeration components and the refrigeration condensing unit are your responsibility. You are required to supply and install all piping materials, couplings, and elbows needed to interconnect the CRI supplied components and to prepare the facility refrigerant piping for the computer installation. In addition, you must test and make the refrigerant piping ready for final hook up before delivery of the CRAY-1 M Series Computer System.

At the time of computer system installation, CRI will supply and install all flexible refrigeration hoses required to complete the refrigerant piping network. In addition, CRI system installation personnel will charge the refrigeration system, adjust all controls and valves, and apply power to initialize operation of the refrigeration condensing unit. You must supply an adequate amount of R-22 refrigerant to fully charge the system (see section 10.4).

2.7.1 CRAY-1 M MAINFRAME REFRIGERANT PIPING REQUIREMENTS

To accommodate the refrigerant piping requirements of the CRAY-1 M Series Computer System, you must install all refrigerant piping below the computer room false flooring (as shown in figure 2-5), and throughout the facility to its final attachment to the RCU-1 Refrigeration Condensing Unit. The CRAY-1 M mainframe, I/O Subsystem chassis, and optional SSD chassis are all cooled by a common condensing unit and, therefore, utilize a common piping network.

Figure 2-5 illustrates the preferred piping arrangement and identifies the refrigeration components located below the computer room flooring in the area of the computer.

Although the preferred piping arrangement is as shown, the actual piping layout can vary from facility to facility, due to various facility constraints. However, the locations illustrated for the suction and liquid line manifolds are mandatory, and all manifolds must be located relative to the indicated orientation of the CRAY-1 M mainframe and IOC-1 I/O Subsystem Chassis.

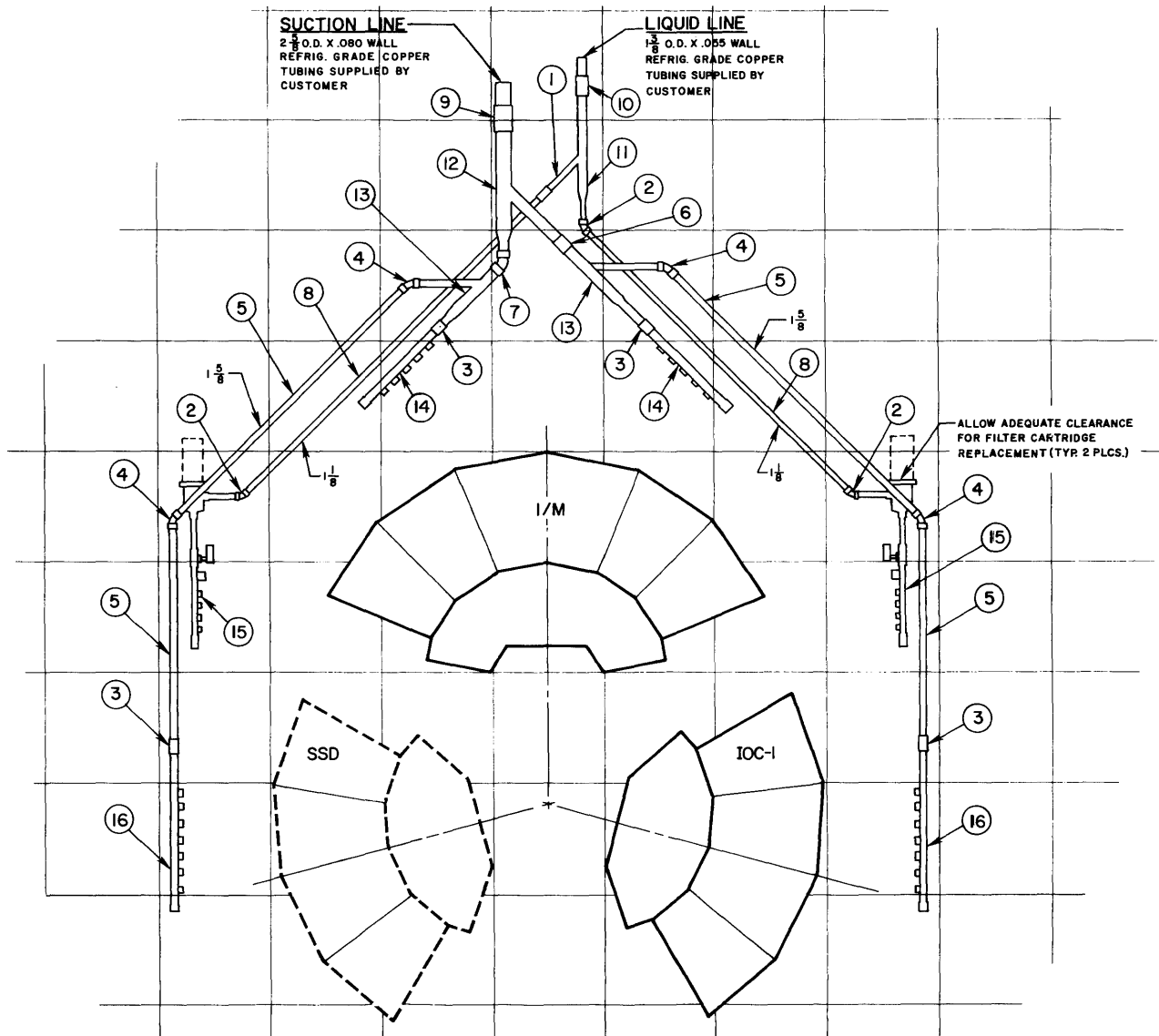
Design considerations for routing the refrigerant piping from the computer manifold network to the RCU-1 Refrigeration Condensing Unit must take into account the total equivalent lineal piping restriction of 100 feet (30.5 M) maximum, directional changes, and elevational changes.

Directional changes in pipe routing should be minimal, but if necessary, they should be at 45° angles. All refrigerant piping elbows must be long radius types.

Elevational changes in pipe routing should also be minimal. When the routing of pipework requires a vertical rise, the total vertical rise must not exceed 25 feet (7.6 M) maximum. In most instances, an extensive vertical rise requires the construction of a double-riser within the suction line. In this case, CRI site planning personnel will provide the preferred double-riser design requirements.

The following notes provide additional information for figure 2-5.

- Routing, materials, and installation of liquid line and suction line piping connecting the manifold network to the RCU-1 Refrigeration Condensing Unit are your responsibility. These items must conform to CRI Engineering Specifications, and must be approved by CRI site planning personnel.
- All refrigerant piping components and materials for the CRAY-1 M Series Computer System must be installed in accordance with location and dimensional requirements of figure 2-5, and must conform to CRI Engineering Specifications. Variations to the illustrated piping network must be approved by CRI site planning personnel.
- You must furnish and install items 1 through 10 illustrated.
- CRI will furnish and you must install items 11 through 16 illustrated.
- CRI will furnish and install all flexible refrigerant hoses for connecting the illustrated underfloor piping network to the CRAY-1 M mainframe and IOC-1 I/O Subsystem Chassis at the time of system installation.



ITEM FIND NUMBER	QUANTITY REQUIRED	CRI PART NUMBER	DESCRIPTION OF MATERIAL
1	1	-----	1-1/8" ODS - Copper Coupling (Mueller Brass #W1047)
2	3	-----	1-1/8" ODS - 45° Copper Elbow (Mueller Brass #W3044)
3	4	-----	1-5/8" ODS - Copper Coupling (Mueller Brass #W1063)
4	4	-----	1-5/8" ODS - 45° Copper Elbow (Muller Brass #W3055)
5	A/R	-----	1-5/8" OD x .060 Wall, Refrigerant Grade, Hard Copper Tube
6	1	-----	2-1/8" ODS - Copper Coupling (Mueller Brass #W1072)
7	1	-----	2-1/8" ODS - 45° Copper Elbow (Mueller Brass #W3059)
8	A/R	-----	1-1/8" OD x .050 Wall, Refrigerant Grade Hard Copper Tube
9	1	-----	2-5/8" ODS - Copper Coupling (Muller Brass #W1082)
10	1	-----	1-3/8" ODS - Copper Coupling (Muller Brass #W1055)
11	1	02197500	1-3/8" OD x 1-1/8" OD x 1-1/8" OD Copper "Y" Fitting
12	1	10569700	2-5/8" ODF x 2-1/8" ODF x 2-1/8" ODF Copper "Y" Fitting
13	2	02197600	2-1/8" ODF x 1-5/8" ODF x 1-5/8" ODF Copper "Y" Fitting
14	2	02206700	1-5/8" ODF Copper Suction Manifold Assembly
15	2	10540900	Manifold Assembly Liquid with filter
16	2	10509800	Manifold Assembly Suction 7 port

Figure 2-5. CRAY-1 M computer piping requirements

- Dimensions shown along sides of piping are for reference only, and are standard refrigerant pipe outside diameters.
- Refrigerant piping and components must be securely suspended and supported above the concrete subflooring, with suction line components located above liquid line components.
- Refrigerant piping and components must not contact concrete, false flooring, false floor support pedestals, other refrigerant piping, electrical conduits, raceways, or other fixed or movable objects.
- All refrigerant piping and components must be assembled by you, using silver solder and silver soldering techniques in accordance with CRI Engineering Specifications.
- All refrigerant piping and components must be checked, leak tested, and prepared for service by you, in accordance with CRI Engineering Specifications.
- All suction line piping must be insulated by you after verification that it has passed all tests.
- Piping support clamps must be of a type with a nylon insert between the clamp and the refrigeration piping.
- The list of materials shown in figure 2-5 identifies items 1 through 16 in the illustration. Information contained within parenthesis (Mueller Brass No.) refers to a representative source and identifies the manufacturer's part number for that component. The representative source listed is Mueller Brass Co. You may substitute with equivalent materials and components from other sources, upon approval by CRI site planning personnel.

2.7.2 MISCELLANEOUS EQUIPMENT REFRIGERANT PIPING

The optional SSD Solid-state Storage Device is refrigerant cooled and, if configured with the CRAY-1 M system, utilizes the same underfloor refrigerant piping network as the CRAY-1 M mainframe and the IOC-1 I/O Subsystem Chassis. Refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025, for detailed information.

2.8 COMPUTER ROOM FLOOR

The computer room must be prepared with a false floor a minimum of 12 inches (30.5 cm) high to accommodate routing of the various power lines, signal lines, and refrigerant components. All Cray computer equipment requires floor cutouts for power wiring, signal cable entrance, and, in some cases, refrigerant line entrance. In addition, some equipment requires reinforcement of the flooring due to concentrated floor loading conditions. Refer to specific equipment types in sections 5 through 10.

The size of the false floor tile, discussed in this manual, is 24 inches (61 cm) square. False floor tiles other than 24 inches square will require detailed review by CRI site planning personnel for placement of equipment, floor cutouts, and refrigeration piping.

2.9 MAINTENANCE PERSONNEL REQUIREMENTS

CRI provides fully trained, resident field engineers on a contractual basis for maintenance of the CRAY-1 M Series Computer System. For a typical system, CRI personnel residing on site generally include a CRI field engineer-in-charge (EIC) and one or more additional field engineers.

2.9.1 MAINTENANCE ENGINEERING OFFICE

You must provide the engineers with a quiet office environment and the following items as a minimum:

- 1 office, approximately 150 sq ft
- 2 desks
- 2 3-shelf bookcases
- 1 file cabinet
- 1 typewriter table
- 3 chairs
- 1 telephone

The maintenance engineering office should be located adjacent to the repair shop and close to the computer room.

2.9.2 MAINTENANCE ENGINEERING SHOP

Also needed by the field engineers is a maintenance repair shop environment. This shop environment needs adequate lighting and power outlets for tools, soldering irons, and test equipment. To meet these requirements, you will need to supply the following.

- 1 workshop, approximately 150 sq ft
- 1 workbench with power outlets
- 3 parts cabinets
- 1 bookshelf

The maintenance repair shop should be located adjacent to the maintenance engineering office and close to the computer room.

2.9.3 MODEM

When facility security restrictions allow, the customer should contact the local telephone company and arrange installation of the following equipment. Arrangements for handling of monthly service charges, however, should be made with CRI.

- 208B dataset with the following options:

Bell Telephone

<u>Terminology</u>	<u>Meaning</u>
A1	Internal clock, modem supplies the clock
B3	No auto call-up
C5	"Dataset ready" lead-off--DSR pin not wired
D7	No auto answer
E9	The modem sits on a desk (not rack mounted)

The Bell Telephone code for incorporating these specific options is S4801.

- Telephone for the dataset (voice grade; no dedicated line; it has a dial; a normal phone with a phone number) Bell Telephone terminology 565HK.

This equipment should be in place before the installation of the computer system. The dataset must be located within 15 feet (4.6 M) of the PEX-1 Peripheral Expander Unit.

The CRAY-1 M mainframe, IOC-1 I/O Subsystem, and associated equipment units are available with a number of options in a variety of system configurations. This arrangement makes it possible to choose a CRAY-1 M Series Computer System well suited to most applications while allowing for a wide range of expansion capabilities through the addition of additional memory, SSD Solid-state Storage Device, disk storage units, I/O channel and interface adaptations, etc.

Configurations vary from facility to facility, depending upon the application requirements and the specific site of each customer. For site planning purposes, you must know the number and type of equipment units to be included in the initial system. It is also advantageous to know future system expansion plans.

Tables 3-1 through 3-6 list the available equipment types and quantities for each CRAY-1 M model configuration. The range of quantities defines minimum to maximum capabilities. A detailed description of each equipment type is given in sections following. Section references are included in each table.

Table 3-1. CRAY-1 Models M/1200, 2200 & 4200 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
2	TBL-2 Dual Display Tables	7.4
3	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-16	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 Power Distribution Unit	10.1
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

Table 3-2. CRAY-1 Models M/1300, 2300 & 4300 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
2	TBL-2 Dual Display Tables	7.4
1	TBL-1 Single Display Table	7.5
4	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-32	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 Power Distribution Unit	10.1
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

Table 3-3. CRAY-1 Models M/1400, 2400 & 4400 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
3	TBL-2 Dual Display Tables	7.4
5	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-48	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 Power Distribution Unit	10.1
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

Table 3-4. CRAY-1 Models M/1208, 1216, 1232, 2208, 2216, 2232, 4208, 4216, & 4232 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	SSD Solid-state Storage Device	6
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
2	TBL-2 Dual Display Tables	7.4
4	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-16	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 Power Distribution Unit	10.1
1	PDU-3 SSD Power Distribution Unit	10.2
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

Table 3-5. CRAY-1 Models M/1308, 1316, 1332, 2308, 2316, 2332, 4308, 4316, & 4332 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	SSD Solid-state Storage Device	6
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
2	TBL-2 Dual Display Tables	7.4
1	TBL-1 Single Display Table	7.5
4	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-32	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 I/O Subsystem Power Distribution Unit	10.1
1	PDU-3 SSD Power Distribution Unit	10.2
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

Table 3-6. CRAY-1 Models M/1408, 1416, 1432, 2408, 2416, 2432, 4408, 4416, & 4432 system configuration

QTY	Equipment	Section
1	MFC-4 CRAY-1 M Mainframe	4
1	IOC-1 I/O Subsystem 4-Column Chassis	5
1	SSD Solid-state Storage Device	6
1	PEX-1 Peripheral Expander Unit/MTU-1 Magnetic Tape Unit	7.1
1	DSU-2 Disk Storage Unit	7.2
1	LP-2 Line Printer	7.3
3	TBL-2 Dual Display Tables	7.4
5	CRT-4 Displays	7.6
1	MCG-3 Maintenance Control Group	8
2-48	DD-29 Disk Storage Units	9.1
1-3	FEC-1 Front-End Interface Cabinets	9.2
1	PDU-2 IOC-1 I/O Subsystem Power Distribution Unit	10.1
1	PDU-3 SSD Power Distribution Unit	10.2
1	PDU-4 Mainframe Power Distribution Unit	10.3
1	RCU-1 Refrigeration Condensing Unit	10.4
1	MGU-1 Motor-Generator Unit	10.5.1
or 1	MGU-2 Motor-Generator Unit	10.5.3
1	MGC-1 Motor-Generator Control Cabinet	10.5.2
or 1	MGC-2 Motor-Generator Control Cabinet	10.5.4
1	MTS-3 Module Test Station	10.6

The MFC-4 CRAY-1 M Mainframe (figure 4-1) is a refrigerant-cooled unit. The memory and computer logic are architecturally integrated into an ultra-compact mainframe composed of six vertical columns in a semicircular configuration. Power supplies for each column rest beside the column base, forming a semicircular bench. When disassembled for shipment, the mainframe breaks down into four power supply sections plus the mainframe section.

4.1 WEIGHT

The computer weighs approximately 5300 pounds (2409 kilograms). The central mainframe section weighs approximately 3500 pounds (1509 kilograms). Each of the two air cooled power supply assemblies weighs approximately 100 pounds (45 kilograms). Each of the two refrigerant cooled power supply assemblies weighs approximately 800 pounds (364 kilograms). Floor loading for the mainframe section is approximately 5 pounds per square inch (3515 kg/m²) and 1 pound per square inch (703 kg/m²) for mainframe power supplies.

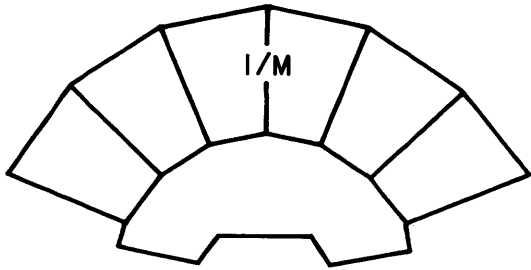
4.2 LOCATION

The CRAY-1 M mainframe must be the focal point of all associated equipment arrangement within the facility computer room.

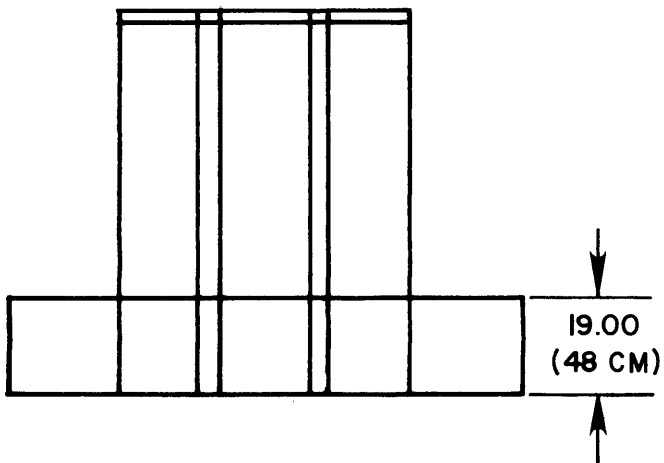
Orientation is optional within the constraints of the refrigerant piping and access requirements set forth in this manual and with consideration of the false floor grid size and structure.

Future expansion plans must also be considered.

PLAN VIEW



REAR VIEW



SIDE/FRONT VIEW

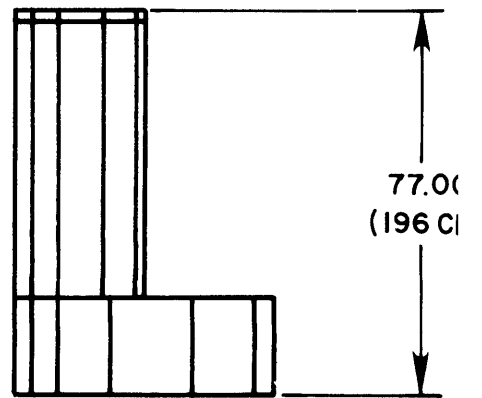


Figure 4-1. CRAY-1 M mainframe

4.3 ACCESS REQUIREMENTS

Adequate access to the computer for maintenance activities is required. The facility should allow a minimum of a 4-foot (1.2 M) clearance around the base of the unit for the movement of maintenance personnel with scope mobiles, etc., and for the removal of false floor tile for access to the underfloor refrigeration piping network.

4.4 COOLING REQUIREMENTS

The computer is a refrigerated unit which dissipates heat from the integrated circuits contained throughout the logic and memory sections and from the power supply bases. To protect the integrated circuits and power supplies from overheating, the computer incorporates refrigeration components, built into the mainframe and power supply sections. Other major components of the refrigeration system are contained in the RCU-1 Refrigeration Condensing Unit (see section 10.4) and underfloor refrigerant piping (see section 2.7).

4.5 ROOM HEAT LOADING CHARACTERISTICS

Room heat loading effects produced by the CRAY-1 M mainframe are approximately 15,000 BTU/HR (4395 watts).

4.6 FLOOR PREPARATION

The standard orientation of the CRAY-1 M mainframe to the IOC-1 I/O Subsystem Chassis and optional SSD Solid-state Storage Device is shown in figure 4-2. This orientation is essential to assure satisfaction of refrigeration piping and logic cabling. The dimensions given can be used to locate the centerlines of the devices, as well as reference line A. The tile size and stringer style of the computer room raised floor system will determine how many stringers will interfere with the floor penetrations, requiring removal. Additional floor support pedestals may be required to restore the structural integrity of the floor system in areas where stringers are removed.

The mainframe requires the preparation of several floor cutouts and various holes. Cutouts and holes must be located within $\pm 1/8$ inch (0.32 cm) of the specified dimensions. Figures 4-3 through 4-10 show the floor preparation requirements.

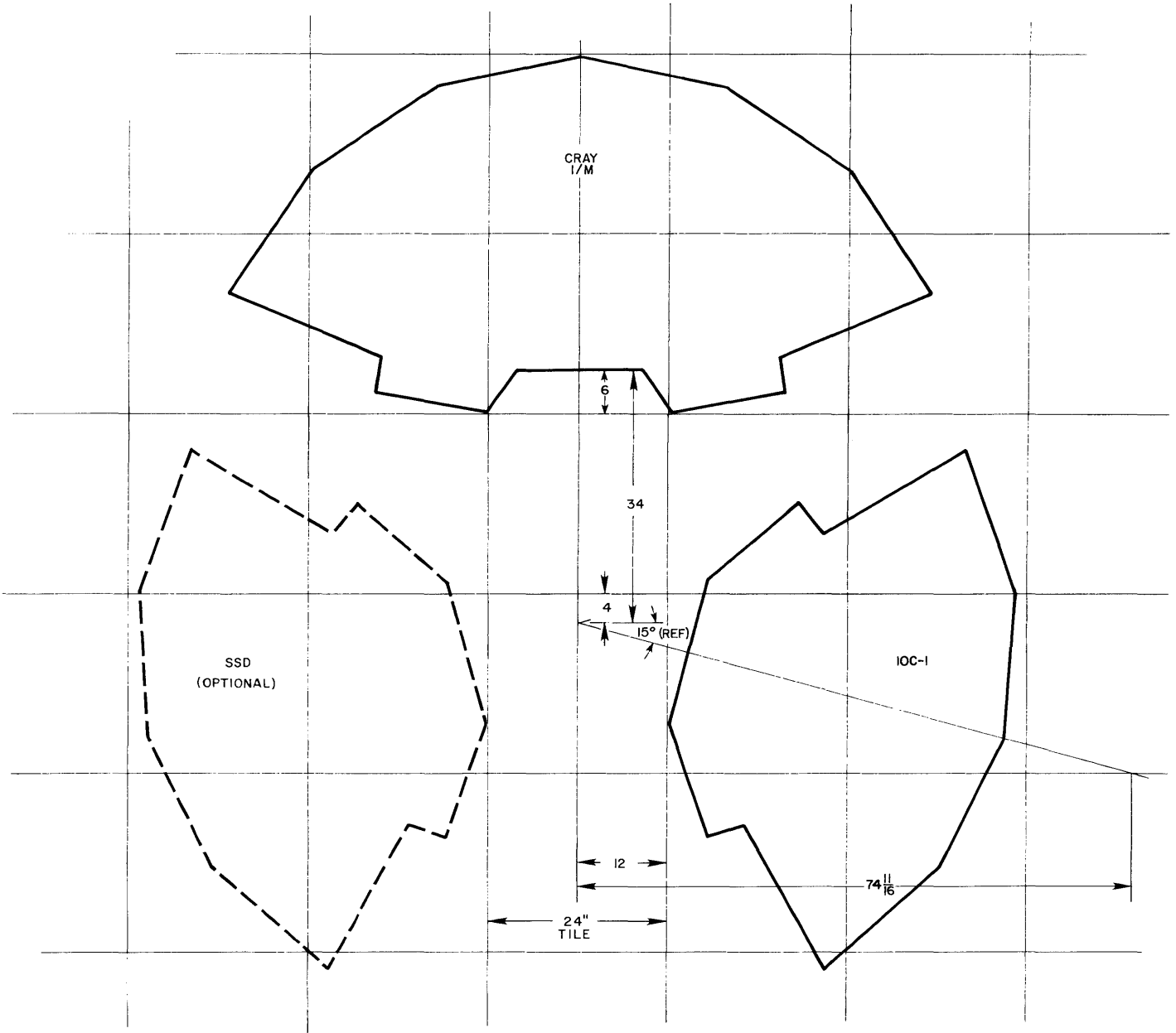
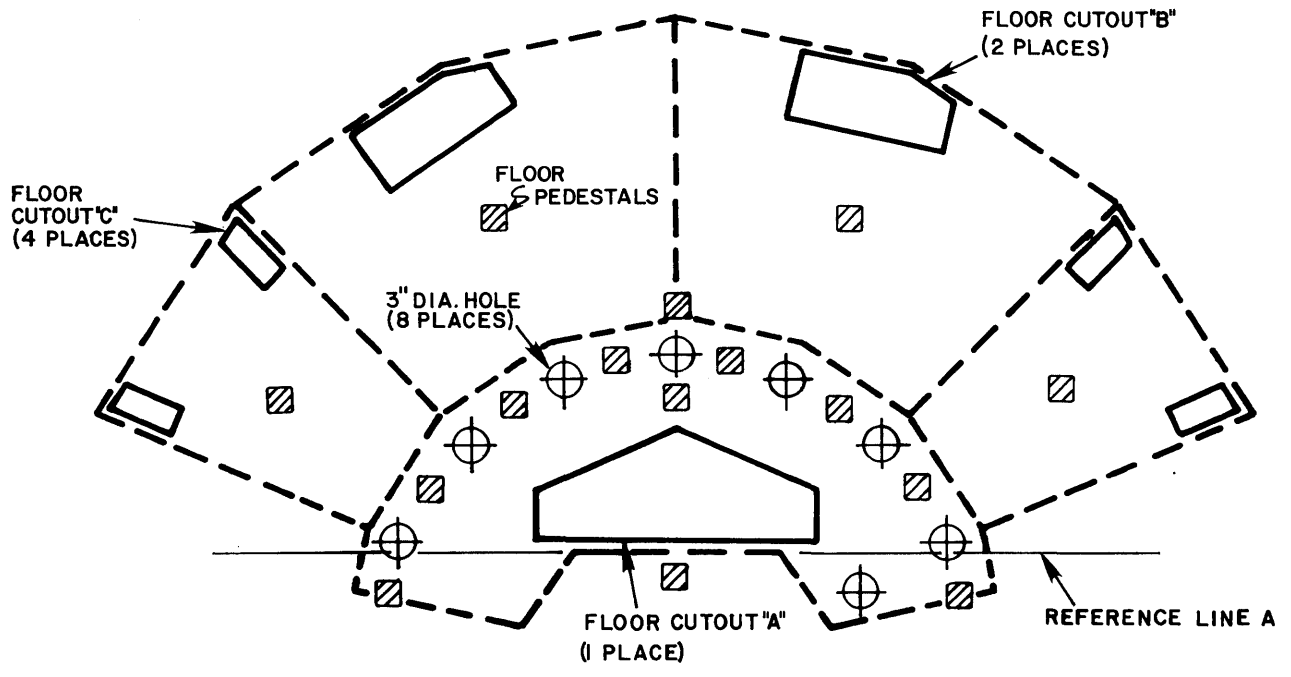


Figure 4-2. Standard orientation of the CRAY-1 M Series Computer System



Inches-to-Centimeters
 Conversion Table
 3 in. = 7.62 cm

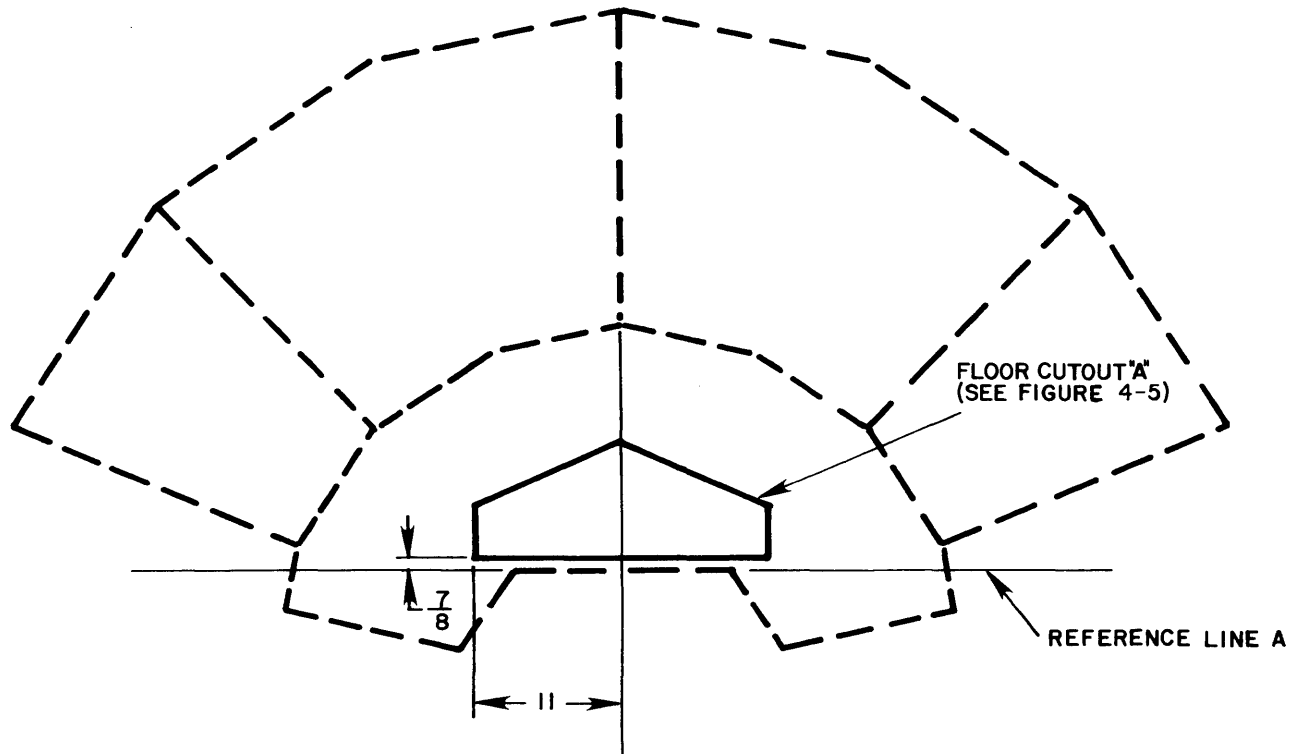
Figure 4-3. CRAY-1 M mainframe floor preparation requirements

Before delivery and installation of the central mainframe and power supply sections, the floor tiles and the supporting floor stringers located within this base area must be prepared for the floor cutouts, holes and additional underfloor support pedestals shown. All floor cutouts must be free of burrs.

The central mainframe and power supply sections of the computer are designed to rest on a flat surface, $\pm 1/16$ inch (0.16 cm). Edging material must not protrude above the surface of the floor tiles within the base area of the computer.

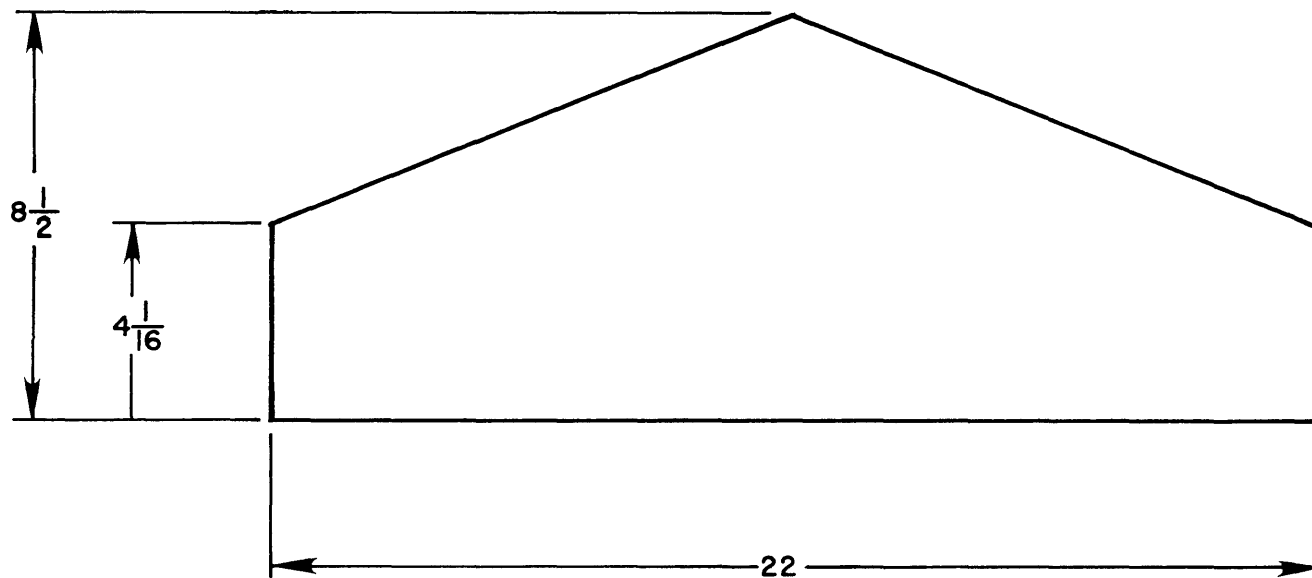
4.6.1 FLOOR CUTOUT A

Floor cutout A permits the underfloor routing of interconnecting data and control signal cables between the computer and other Cray equipment units. Dimensions showing the location of floor cutout A are given in figure 4-4. Floor stringers running through floor cutout A may remain intact and in place. Detailed dimensions for floor cutout A are given in figure 4-5.



Inches-to-Centimeters Conversion Table	
7/8 in.	= 2.22 cm
11 in.	= 27.94 cm

Figure 4-4. Location of floor cutout A

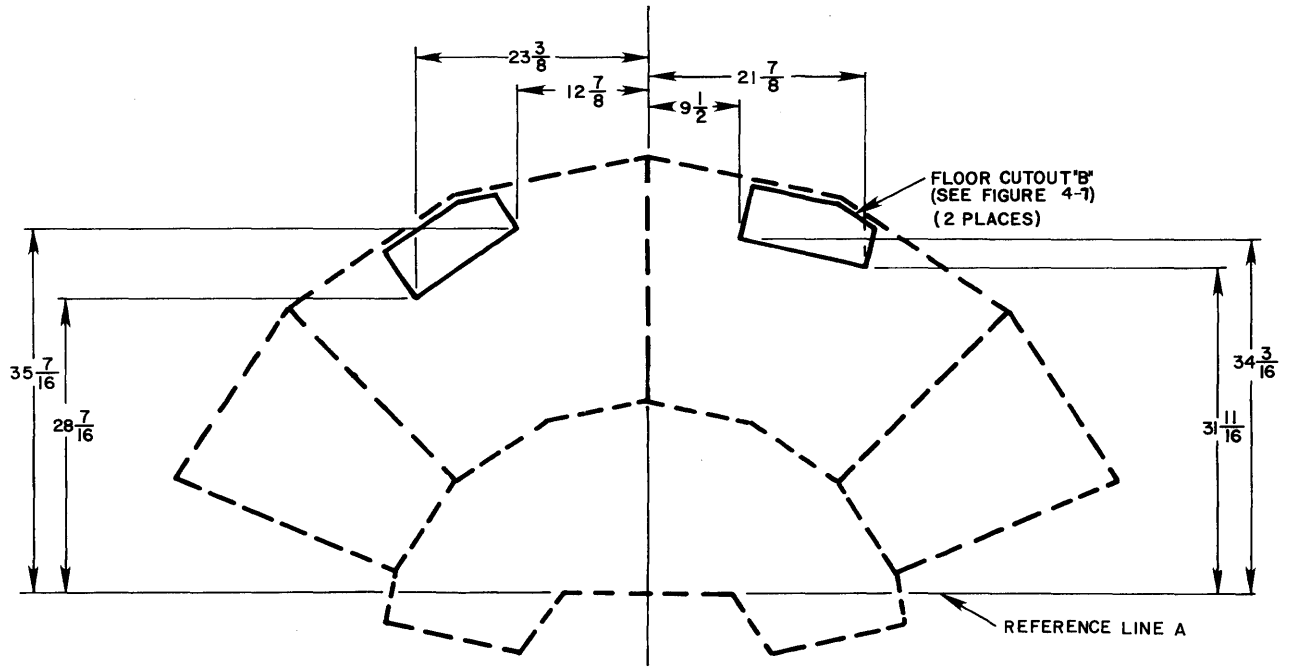


Inches-to-Centimeters Conversion Table	
4 1/16 in.	= 10.32 cm
8 1/2 in.	= 21.59 cm
22 in.	= 55.88 cm

Figure 4-5. Details of cutout A

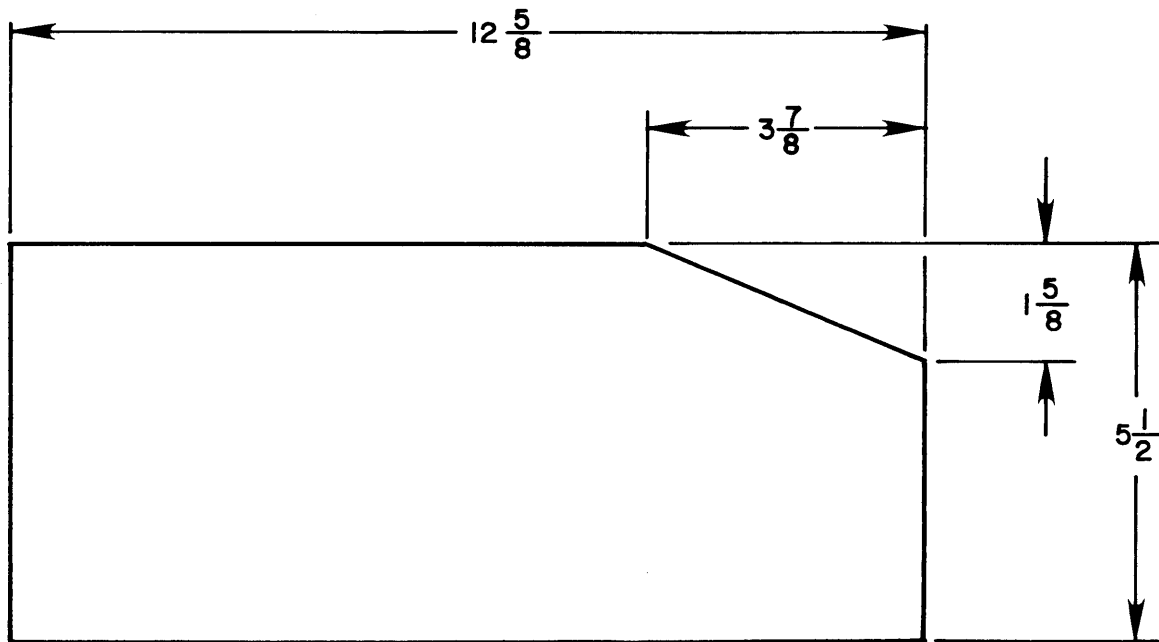
4.6.2 FLOOR CUTOUT B

The two cutouts labeled floor cutout B provide for the connection of refrigeration hoses and 400 Hz power wiring. The location of each B cutout is shown by the dimensions given in figure 4-6. Detailed dimensions of floor cutout B are given in figure 4-7. Any floor stringers running through the floor cutout must be removed.



Inches-to-Centimeters Conversion Table			
9 1/2 in. = 24.13 cm	28 7/16 in. = 72.23 cm		
12 7/8 in. = 32.70 cm	31 11/16 in. = 80.49 cm		
21 7/8 in. = 55.56 cm	34 3/16 in. = 86.84 cm		
23 3/8 in. = 59.37 cm	35 7/16 in. = 90.00 cm		

Figure 4-6. Locations of floor cutout B

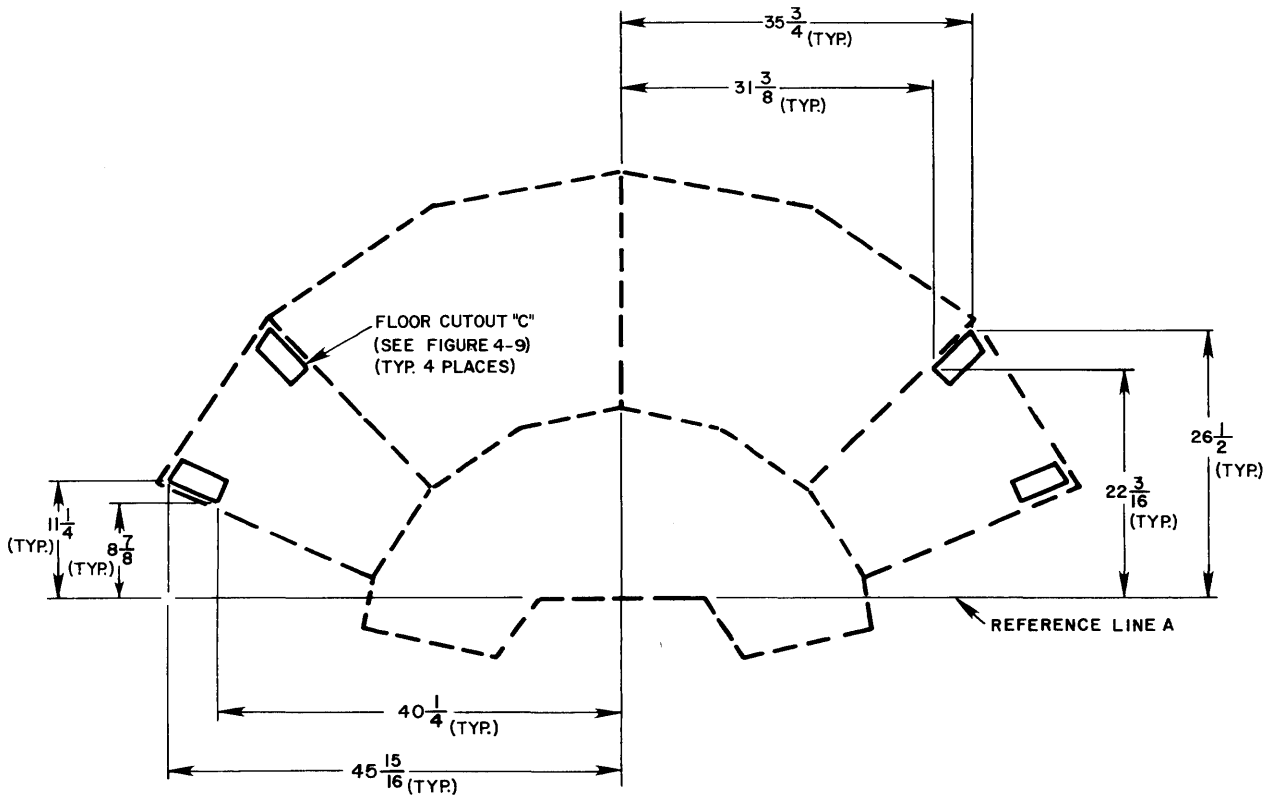


Inches-to-Centimeters Conversion Table			
1 $\frac{5}{8}$ in.	=	4.12 cm	5 $\frac{1}{2}$ in. = 13.97 cm
3 $\frac{7}{8}$ in.	=	9.84 cm	12 $\frac{5}{8}$ in. = 32.07 cm

Figure 4-7. Details of cutout B

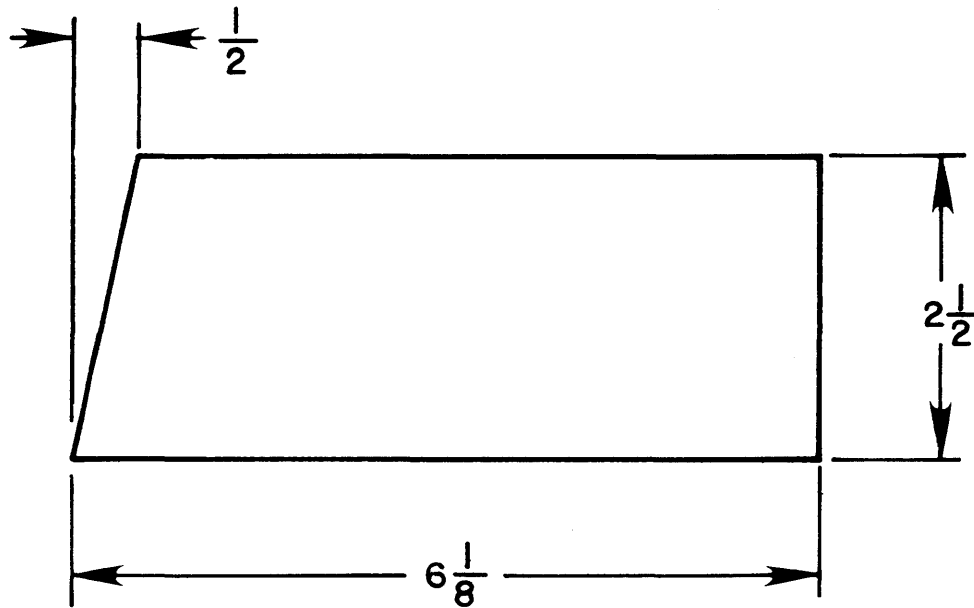
4.6.3 FLOOR CUTOUT C

The four cutouts labeled floor cutout C provide for the connection of 400 Hz/60 Hz power wiring. The location of each C cutout is shown by the dimensions given in figure 4-8. Detailed dimensions of floor cutout C are given in figure 4-9.



Inches-to-Centimeters Conversion Table			
8 7/8 in. =	22.54 cm	31 3/8 in. =	79.69 cm
11 1/4 in. =	28.57 cm	35 3/4 in. =	90.80 cm
22 3/16 in. =	56.36 cm	40 1/4 in. =	102.23 cm
26 1/2 in. =	67.31 cm	45 15/16 in. =	116.68 cm

Figure 4-8. Locations of cutout C

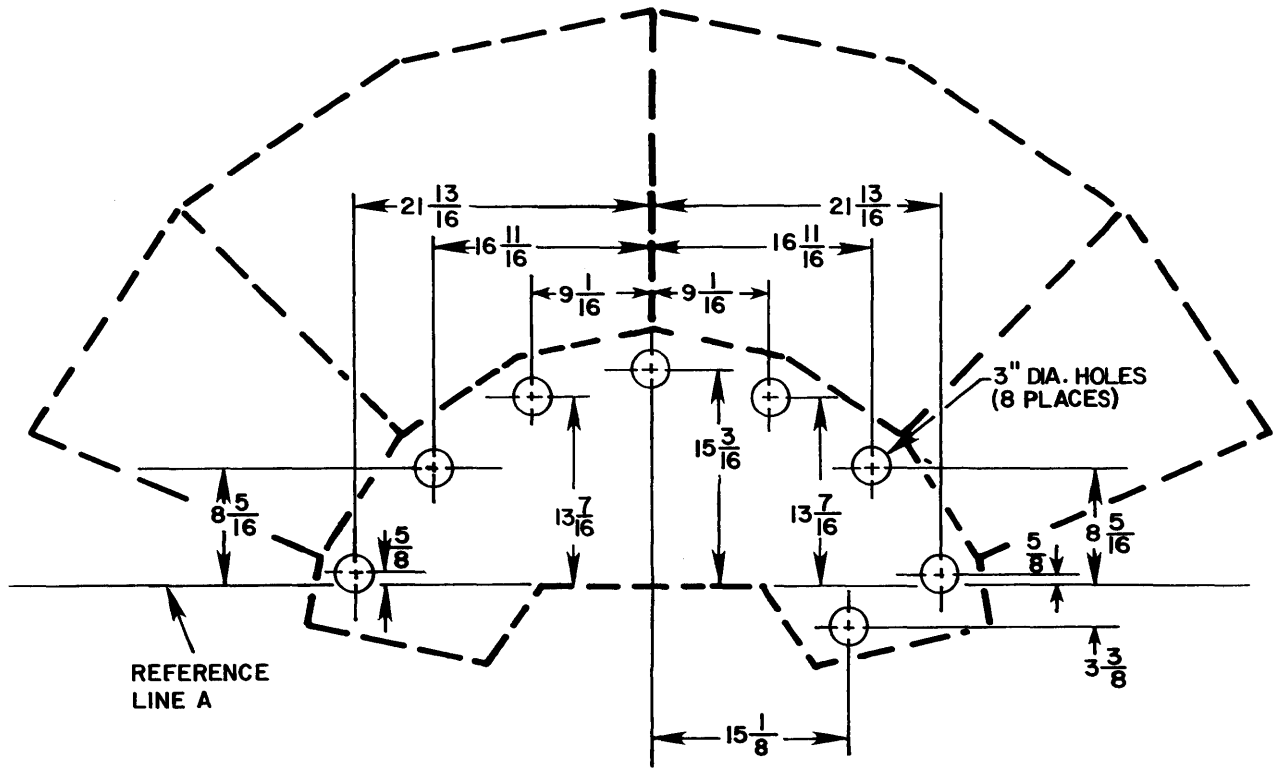


Inches-to-Centimeters Conversion Table	
1/2 in.	= 1.27 cm
2 1/2 in.	= 6.35 cm
6 1/8 in.	= 15.55 cm

Figure 4-9. Details of cutout C

4.6.4 3-INCH (7.62 CM) DIAMETER HOLES

Eight 3-inch (7.62 cm) diameter holes shown in figure 4-10 provide for the connection of refrigeration hoses to the mainframe. The exact location of each hole is given in figure 4-10.



Inches-to-Centimeters Conversion Table			
5/8 in. =	1.59 cm	13 7/16 in. =	34.13 cm
3 in. =	7.62 cm	15 1/8 in. =	38.42 cm
3 3/8 in. =	8.57 cm	15 3/16 in. =	38.58 cm
8 5/16 in. =	21.11 cm	16 11/16 in. =	42.39 cm
9 1/16 in. =	23.02 cm	21 13/16 in. =	55.40 cm

Figure 4-10. Hole locations

4.6.5 FLOOR SUPPORTING PEDESTALS

The concentrated floor loading characteristics of the computer require additional floor support pedestals. You must furnish and install 15 additional floor support pedestals to reinforce the computer room floor tiles after the addition of the various floor cutouts and holes (see figure 4-11). Additional floor support pedestals may be required to restore the structural integrity of the floor system where stringers which interfere with floor penetrations are removed.

4.7 PIPING REQUIREMENTS

The refrigerant-cooled CRAY-1 M mainframe requires the installation of refrigeration components, piping, etc., in the underfloor area of the computer and connected to the associated condensing unit. You must install the piping and supply all materials not pre-shipped by CRI. Refer to subsection 2.7 for detailed piping requirements.

4.8 POWER WIRING REQUIREMENTS

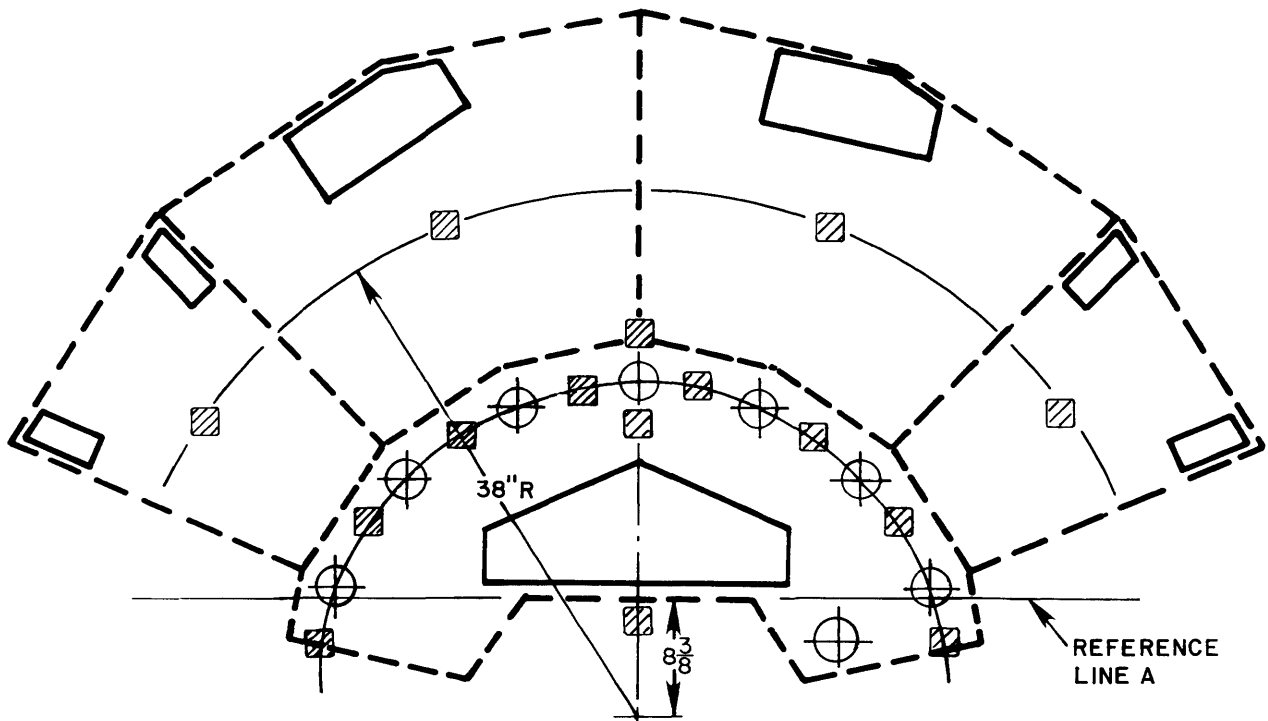
Installing the CRAY-1 M mainframe requires that you supply and install:

- Eight 400 Hz, 4-wire circuits from the PDU-4 Mainframe Power Distribution Unit
- Eight 400 Hz, 3-wire circuits from the PDU-4 Mainframe Power Distribution Unit

All electrical connections are in the power supplies. There are 3/4-inch (1.9 cm) knockouts provided for cable restraint. Individual conductors must extend 4 feet (1.2 M) above the false floor cutouts to ensure adequate length for termination. Refer to figure 2-3 for the basic power wiring diagram.

4.9 EARTH GROUNDING REQUIREMENTS

You must supply and install four earth ground straps in accordance with subsection 2.4.2.



Inches-to-Centimeters Conversion Table	
8 3/8 in.	= 21.28 cm
38 in.	= 96.52 cm

Figure 4-11. Pedestal locations

The IOC-1 I/O Subsystem 4-Column Chassis (figure 5-1) is a refrigerant-cooled unit. The memory and computer logic is architecturally integrated into an ultra-compact paraframe composed of four vertical columns, in a semicircular arrangement. Power supplies for each column rest beside the column base, forming a semicircular bench around the central paraframe. When disassembled for shipment, the unit breaks down into two power supply sections plus the paraframe section.

5.1 WEIGHT

The IOC-1 weighs approximately 3290 pounds (1496 kilograms). The central paraframe weighs approximately 2150 pounds (977 kilograms). The two power supplies each weigh approximately 570 (259 kilograms). Floor loading for the central paraframe is approximately 5 pounds per square inch (703 kg/m^2) and 1 pound per square inch (3515 kg/m^2) for I/O power supplies.

5.2 LOCATION

The IOC-1 must be located within the facility computer room and placed adjacent to the CRAY-1 M mainframe, as illustrated in figure 4-2.

5.3 ACCESS REQUIREMENTS

Adequate access to the IOC-1 for maintenance activities is required. The facility should allow a minimum of a 4-foot (1.2 M) clearance around the base of the unit for the movement of maintenance personnel with scope mobiles, etc., and for the removal of false floor tile for access to the underfloor refrigeration piping network.

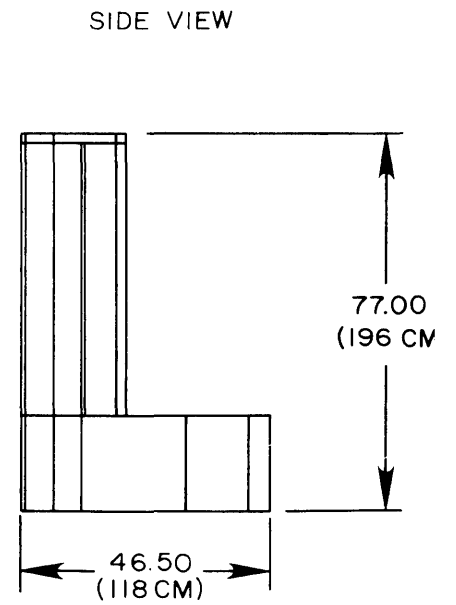
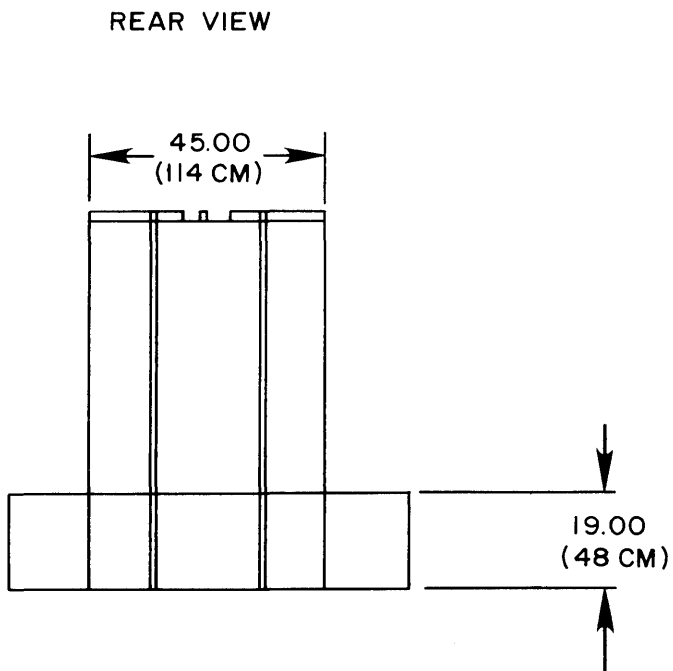
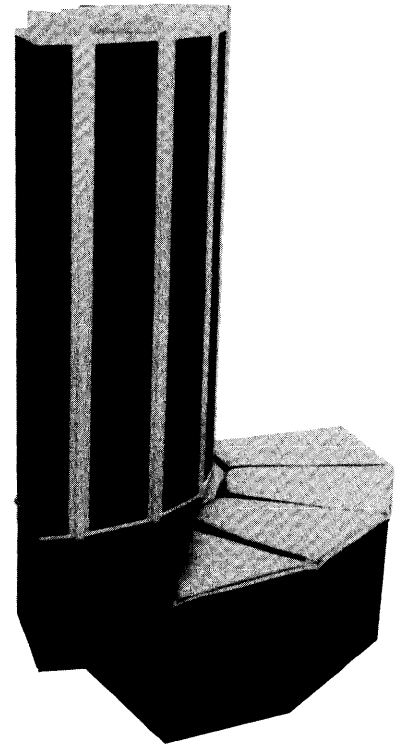
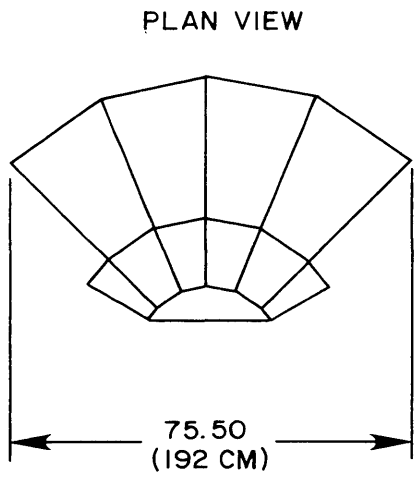


Figure 5-1. IOC-1 I/O Subsystem 4-Column Chassis

5.4 COOLING REQUIREMENTS

The IOC-1 is a refrigerated unit which dissipates heat from the integrated circuits throughout the logic and memory sections and from the power supply bases. To protect the integrated circuits and power supplies from overheating, the unit incorporates refrigeration components built into the paraframe and power supply sections. Other major components of the refrigeration system are contained in the RCU-1 Refrigeration Condensing Unit (see section 10.4).

5.5 ROOM HEAT LOADING CHARACTERISTICS

The IOC-1 is connected to the same refrigeration system piping network as the CRAY-1 M mainframe. Room heat loading effects produced by the unit are approximately 4000 BTU/HR (1170 watts).

5.6 FLOOR PREPARATION

Refer to figure 4-2 for proper orientation of the IOC-1 I/O Subsystem to the CRAY-1 M mainframe. The dimensions given can be used to locate the centerline of the IOC-1 I/O Subsystem Chassis as well as reference line A. This orientation is essential to assure satisfaction of refrigeration piping and logic cabling requirements.

The tile size and stringer style of the computer room raised floor system will determine how many stringers will interfere with floor penetrations, requiring removal. Additional floor support pedestals may be required to restore the structural integrity of the floor system in areas where stringers are removed.

The IOC-1 requires the preparation of several floor cutouts and holes. Cutouts and holes must be located within $\pm 1/8$ inch (0.32 cm) of the specified dimensions. Figures 5-2 through 5-9 show the floor preparation requirements.

Before delivery and installation of the paraframe and power supply sections, the floor tiles and the supporting floor stringers located within this base area must be prepared for the floor cutouts, holes, and additional underfloor support pedestals shown. All floor cutouts must be free of burrs.

The paraframe and power supply sections of the IOC-1 are designed to rest on a flat surface, $\pm 1/16$ inch (0.16 cm). Edging material must not protrude above the surface of the floor tiles within the unit base area.

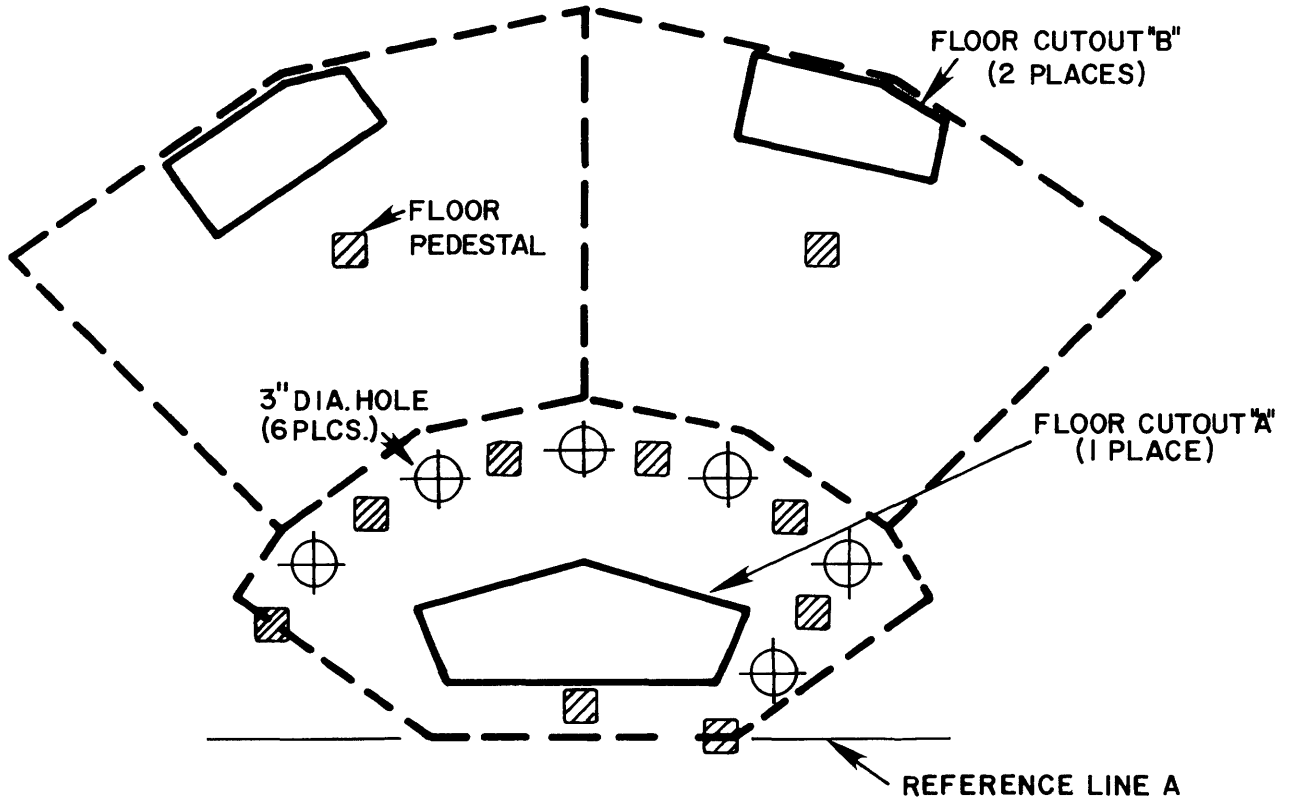
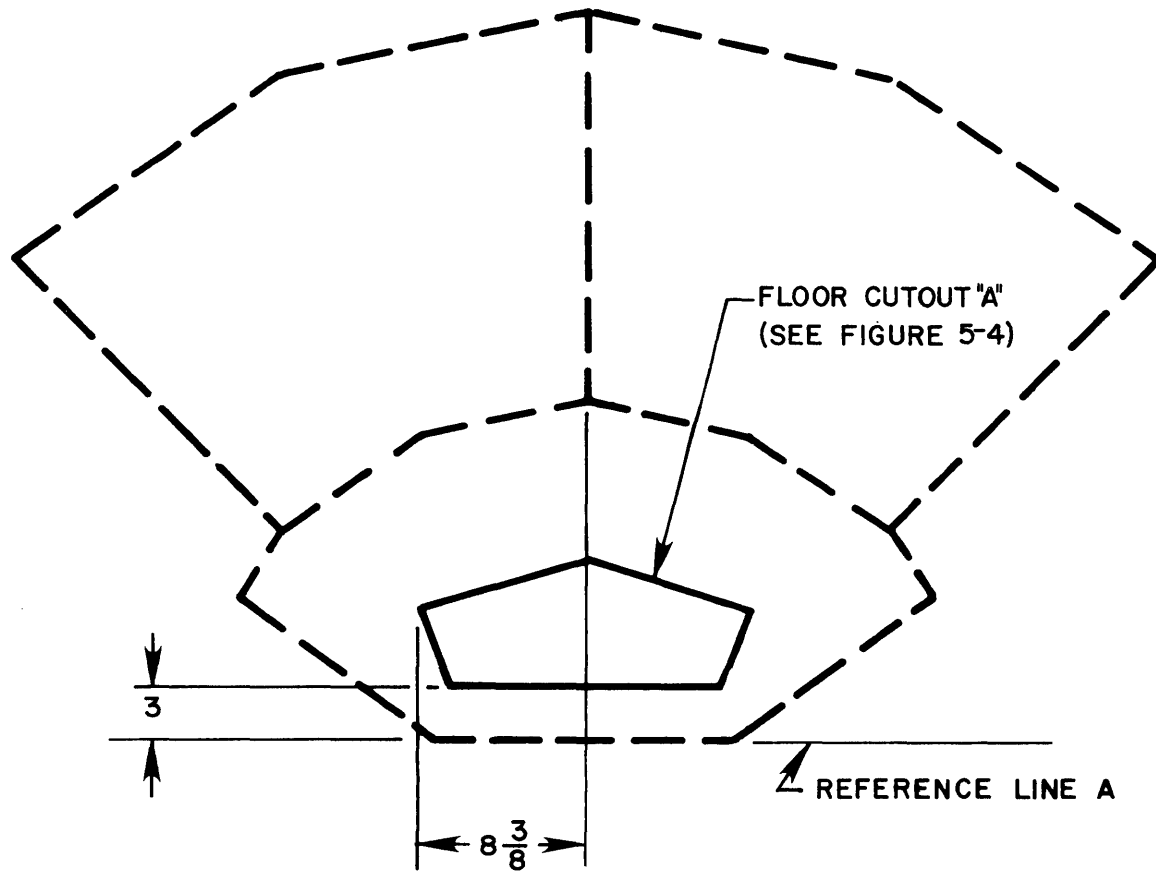


Figure 5-2. IOC-1 floor preparation requirements

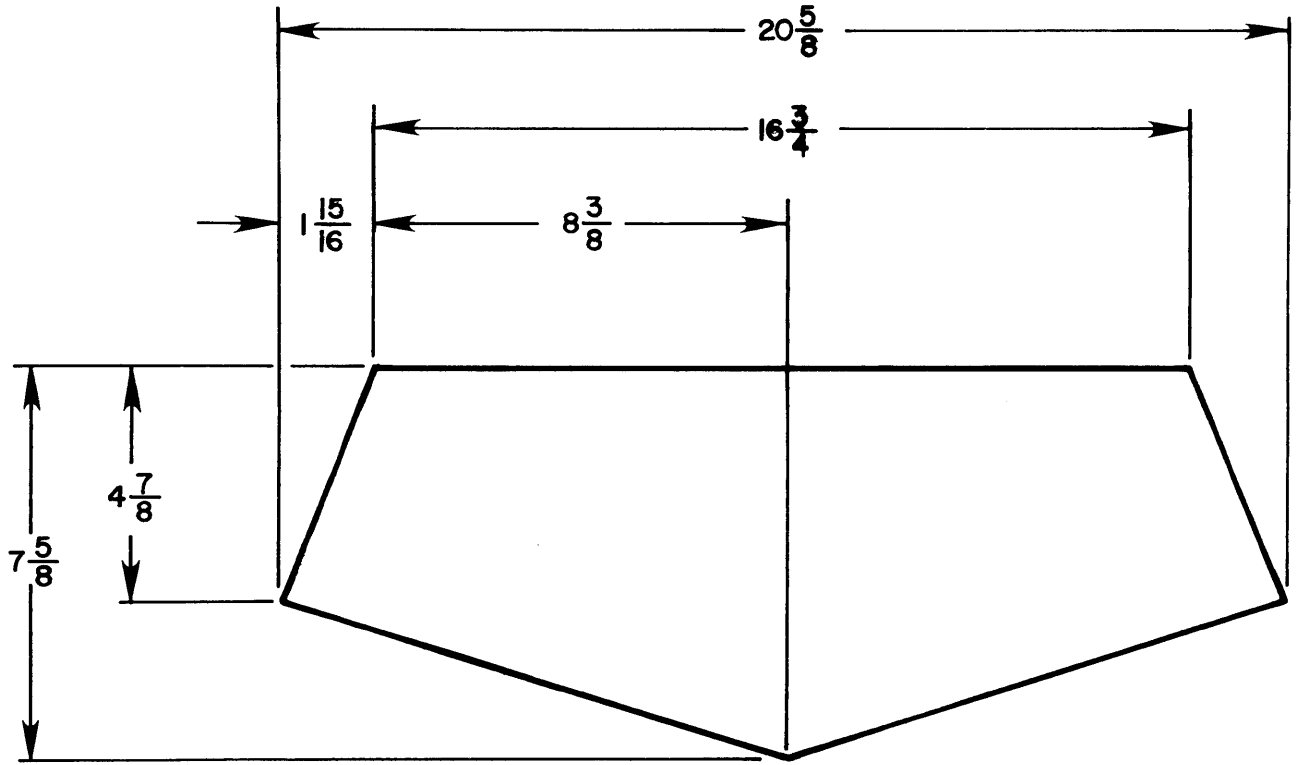
5.6.1 FLOOR CUTOUT A

Floor cutout A permits the underfloor routing of interconnecting data and control signal cables between this unit and other equipment units. Dimensions showing the location of floor cutout A are given in figure 5-3. Floor stringers running through floor cutout A may remain intact and in place. Detailed dimensions for floor cutout A are given in figure 5-4.



Inches-to-Centimeters Conversion Table	
3 in.	= 7.62 cm
8 3/8 in.	= 21.28 cm

Figure 5-3. Location of floor cutout A

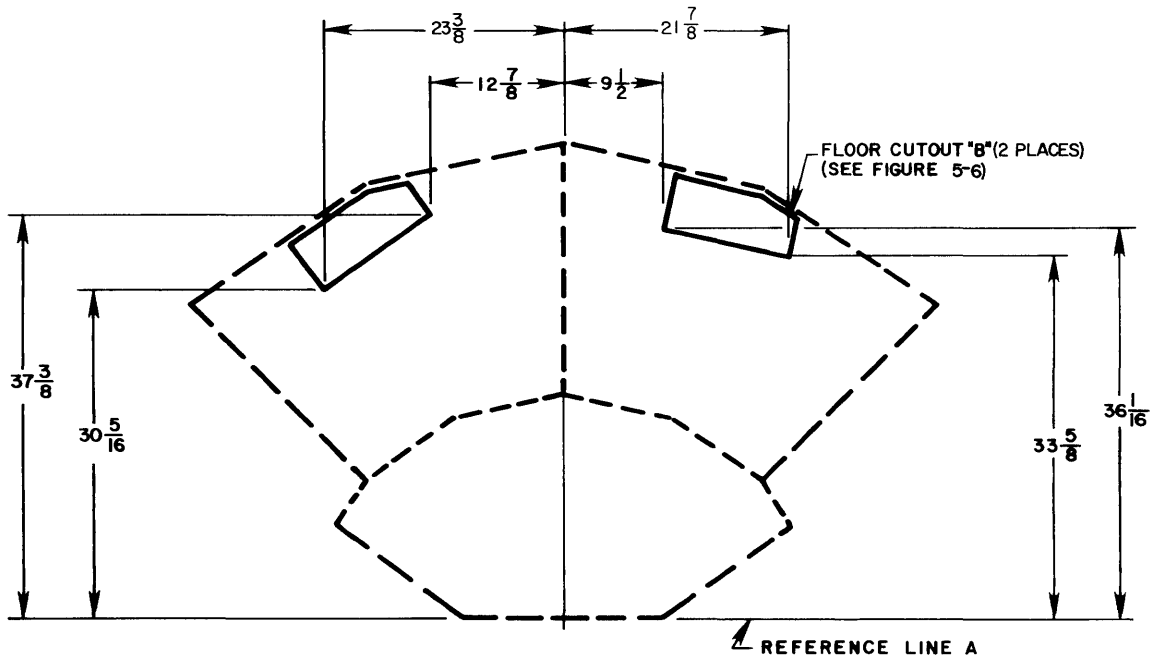


Inches-to-Centimeters Conversion Table			
$1\frac{15}{16}$ in.	= 4.92 cm	$8\frac{3}{8}$ in.	= 21.28 cm
$4\frac{7}{8}$ in.	= 12.38 cm	$16\frac{3}{4}$ in.	= 42.55 cm
$7\frac{5}{8}$ in.	= 19.37 cm	$20\frac{5}{8}$ in.	= 52.39 cm

Figure 5-4. Details of cutout A

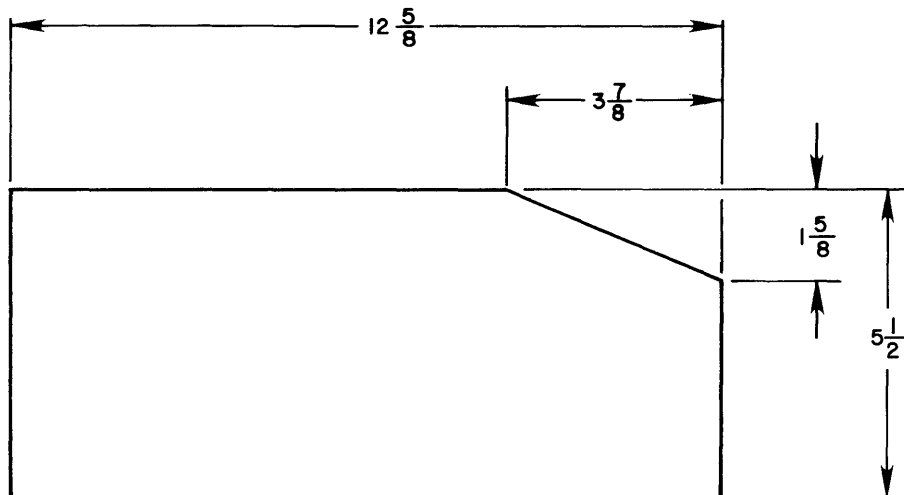
5.6.2 FLOOR CUTOUT B

The two cutouts labeled floor cutout B provide for the connection of refrigeration hoses and 400 Hz power wiring. The location of each B cutout is shown by the dimensions given in figure 5-5. Detailed dimensions of floor cutout B are given in figure 5-6. Any floor stringers running through these floor cutouts must be removed.



Inches-to-Centimeters Conversion Table			
9 1/2 in.	= 24.13 cm	30 5/16 in.	= 76.99 cm
12 7/8 in.	= 32.70 cm	33 5/8 in.	= 85.41 cm
21 7/8 in.	= 55.56 cm	36 1/16 in.	= 91.60 cm
23 3/8 in.	= 59.37 cm	37 3/8 in.	= 94.93 cm

Figure 5-5. Locations of floor cutout B



Inches-to-Centimeters Conversion Table			
1 $\frac{5}{8}$ in.	= 4.12 cm	5 $\frac{1}{2}$ in.	= 13.97 cm
3 $\frac{7}{8}$ in.	= 9.84 cm	12 $\frac{5}{8}$ in.	= 32.07 cm

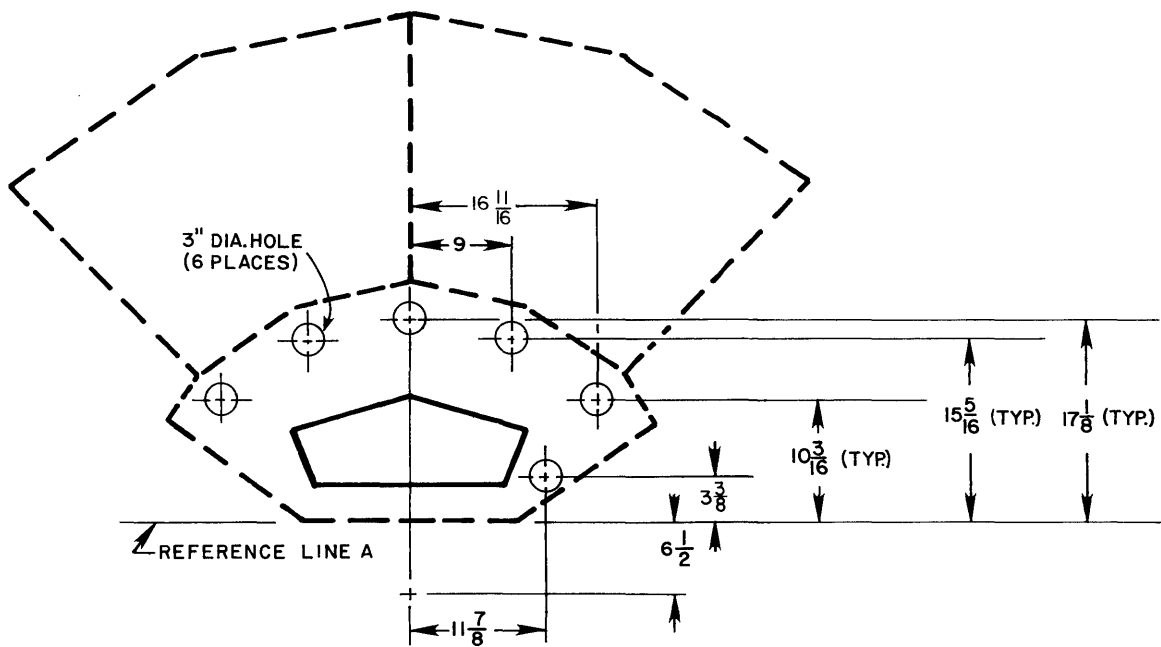
Figure 5-6. Details of cutout B

5.6.3 3-INCH (7.62 CM) DIAMETER HOLES

The six 3-inch (7.62 cm) diameter holes shown in figure 5-7 provide for the connection of refrigeration hoses to the IOC-1. The exact location of each hole is given in figure 5-7.

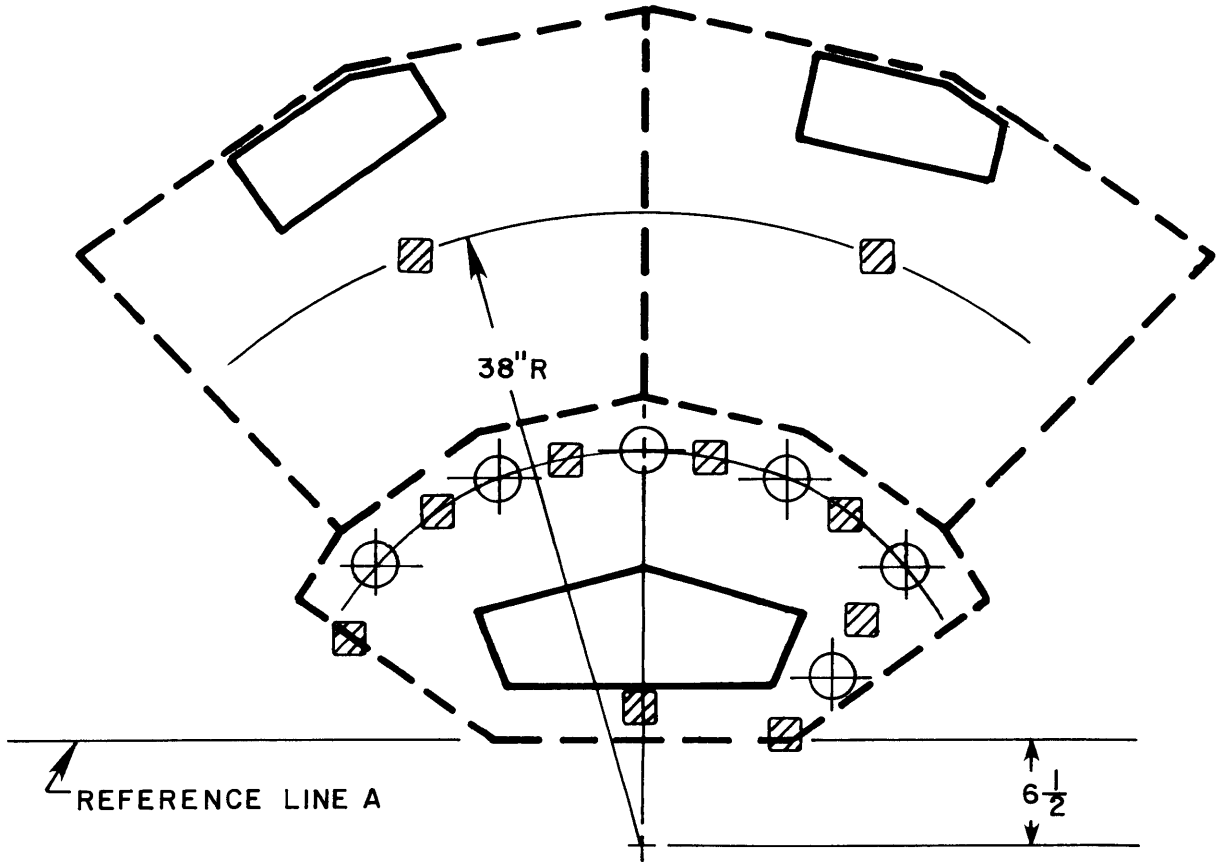
5.6.4 FLOOR SUPPORTING PEDESTALS

The concentrated floor loading characteristics of the IOC-1 requires additional floor support pedestals. You must furnish and install 10 additional floor support pedestals to reinforce the computer room floor tiles after the addition of the various floor cutouts and holes (see figure 5-8). Additional floor support pedestals may be required to restore the structural integrity of the floor system where stringers which interfere with floor penetrations are removed.



Inches-to-Centimeters Conversion Table	
3 in. = 7.62 cm	11 $\frac{7}{8}$ in. = 30.16 cm
3 $\frac{3}{8}$ in. = 8.57 cm	15 $\frac{5}{16}$ in. = 38.89 cm
6 $\frac{1}{2}$ in. = 16.51 cm	16 $\frac{11}{16}$ in. = 42.39 cm
9 in. = 22.86 cm	17 $\frac{1}{8}$ in. = 43.50 cm
10 $\frac{3}{16}$ in. = 25.88 cm	

Figure 5-7. Hole locations



Inches-to-Centimeters Conversion Table	
6 1/2 in.	= 16.51 cm
38 in.	= 96.52 cm

Figure 5-8. Pedestal locations

5.7 PIPING REQUIREMENTS

CRAY-1 M Series Computer Systems utilize a common refrigeration system for the MFC-4 mainframe, IOC-1 I/O Subsystem 4-Column Chassis and optional SSD Solid-state Storage Device. Refer to subsection 2-7 for detailed piping requirements.

For detailed refrigerant piping information on the SSD, refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025.

5.8 POWER WIRING REQUIREMENTS

Installing the IOC-1 I/O Subsystem 4-Column Chassis requires that you provide and install:

- Eight 400 Hz, 4-wire circuits from the PDU-2 IOC-1 Power Distribution Unit
- Four 400 Hz, 2-wire circuits from the PDU-2 IOC-1 Power Distribution Unit

All electrical connections are performed in the power supplies located at the base of each column. The 3/4-inch (1.9 cm) knockouts are provided for cable restraint. Individual conductors must extend 4 feet (1.2 M) above the false floor cutouts to ensure adequate length for termination (refer to figure 2-3).

5.9 EARTH GROUNDING REQUIREMENTS

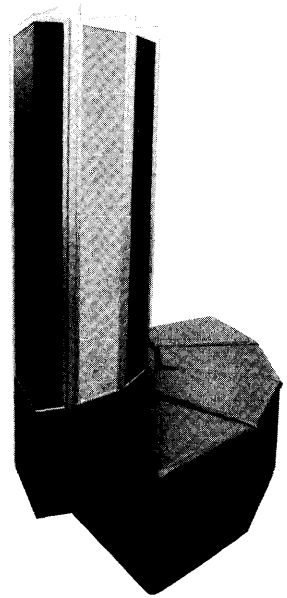
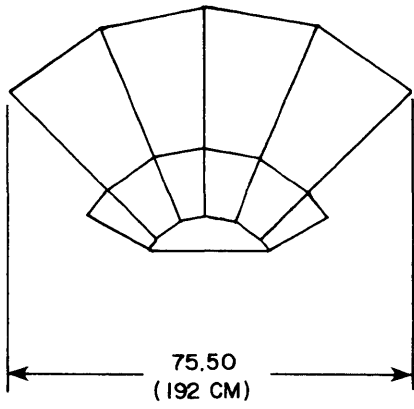
You must supply and install two earth ground straps in accordance with paragraph 2.4.2.

SSD SOLID-STATE STORAGE DEVICE (OPTIONAL) 6

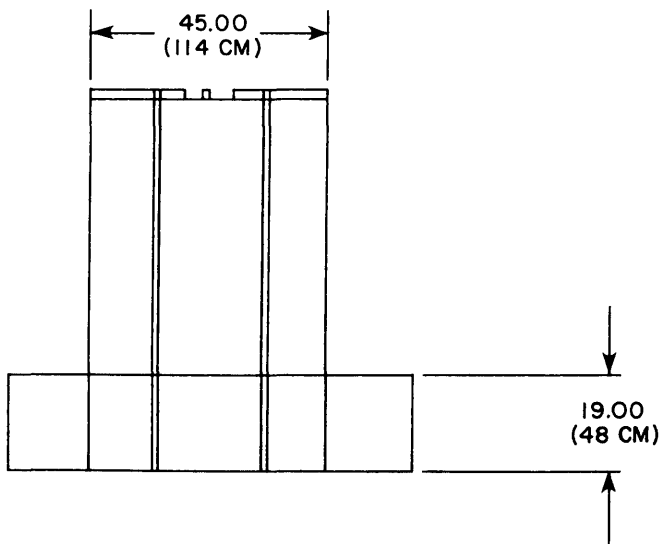
The optional SSD Solid-state Storage Device (figure 6-1) is a refrigerant-cooled unit. The memory and computer logic is architecturally integrated into an ultra-compact paraframe composed of four vertical columns in a semicircular configuration. Power supplies for each column rest beside the column base, forming a semicircular bench. When disassembled for shipment, the unit breaks down into two power supply sections plus the paraframe section.

Refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025, for detailed information regarding floor preparation, piping and power wiring requirements of the SSD Solid-state Storage Device.

PLAN VIEW



REAR VIEW



SIDE VIEW

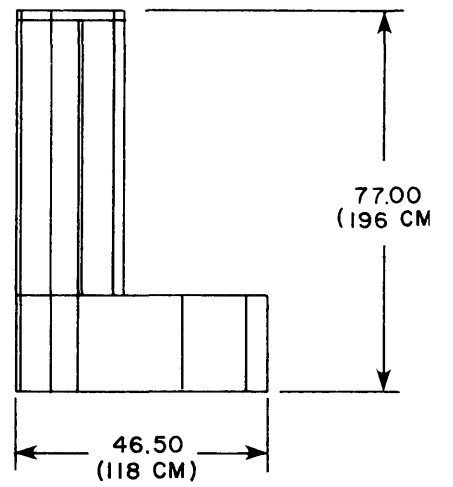


Figure 6-1. SSD Solid-state Storage Device

An equipment subsystem or maintenance control group is configured within the CRAY-1 M Series Computer Systems for the purpose of system communications and the performance of system maintenance activities.

The CRAY-1 M Series Computer Systems utilize a maintenance control group (MCG-2) consisting of a peripheral expander unit (PEX-1) and associated magnetic tape unit (MTU-1) in a rack mounted package plus a disk storage unit (DSU-2), line printer (LP-2) and displays (CRT-4).

The equipment contained in the maintenance control group is illustrated and discussed in this section of the manual.

7.1 PEX-1 PERIPHERAL EXPANDER UNIT/MTU-1 MAGNETIC TAPE UNIT

The PEX-1/MTU-1 (figure 7-1) is an I/O maintenance subsystem interface supporting maintenance peripherals for CRAY-1 M Series Computer Systems. The PEX-1 and MTU-1 are housed in one cabinet. The PEX-1 contains the controller units for the associated LP-2 Line Printer, DSU-2 Disk Storage Unit, and CRT-4 Displays.

7.1.1 WEIGHT

The cabinet housing PEX-1 and MTU-1 weighs approximately 500 pounds (230 kilograms).

7.1.2 LOCATION

The PEX-1/MTU-1 must be located in the computer room near the I/O Subsystem 4-Column Chassis. (See section 11 for recommended arrangement and restrictions.)

7.1.3 ACCESS REQUIREMENTS

Adequate provision must be made at both the front and rear of the unit for door swing clearance. The rear access door requires at least 19 1/2 inches (49.5 cm) for door swing clearance. The front access door to the tape transport and the chassis-slide drawer at the front of the unit require a minimum of 19 1/2 inches (49.5 cm) at both the front and rear of the unit for the movement of operators and maintenance personnel.

7.1.4 COOLING REQUIREMENTS

The PEX-1/MTU-1 is a fan-cooled unit using ambient room air.

7.1.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading of this unit is approximately 7800 BTU/HR (2290 watts).

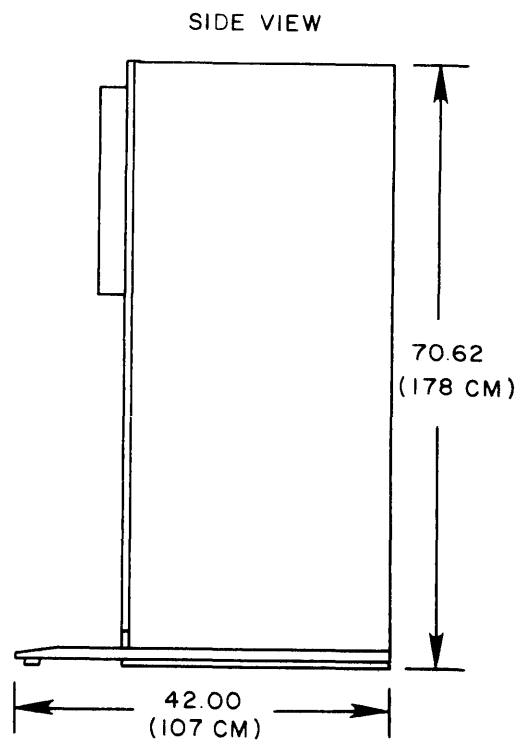
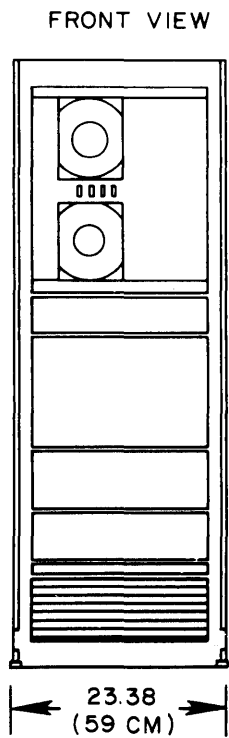
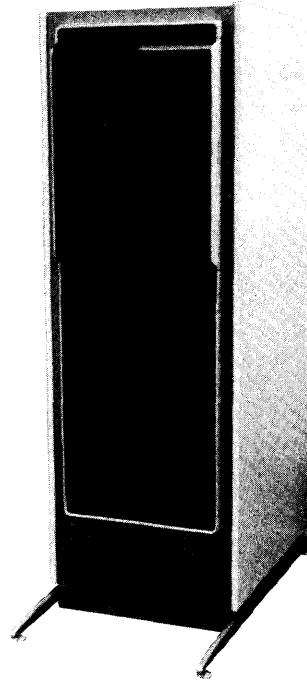
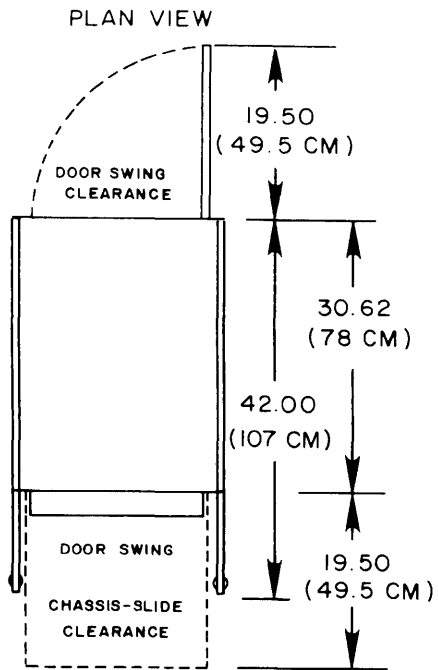


Figure 7-1. PEX-1 Peripheral Expander Unit/
MTU-1 Magnetic Tape Unit

7.1.6 FLOOR PREPARATION

The PEX-1/MTU-1 requires a single floor cutout (figure 7-2) for the underfloor routing of interconnecting drop cables and power cables. The floor cutout must be free of burrs.

7.1.7 POWER WIRING REQUIREMENTS

The PEX-1/MTU-1 is equipped with a 5-foot (1.5 M) pluggable drop cord power cable. You must provide and install a mating power receptacle near the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be either the box-mounted or in-line type.

The drop cord power plug furnished with the PEX-1/MTU-1 is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you and shall apply to your particular installation.

7.1.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to the unit in accordance with paragraph 2.4.2.

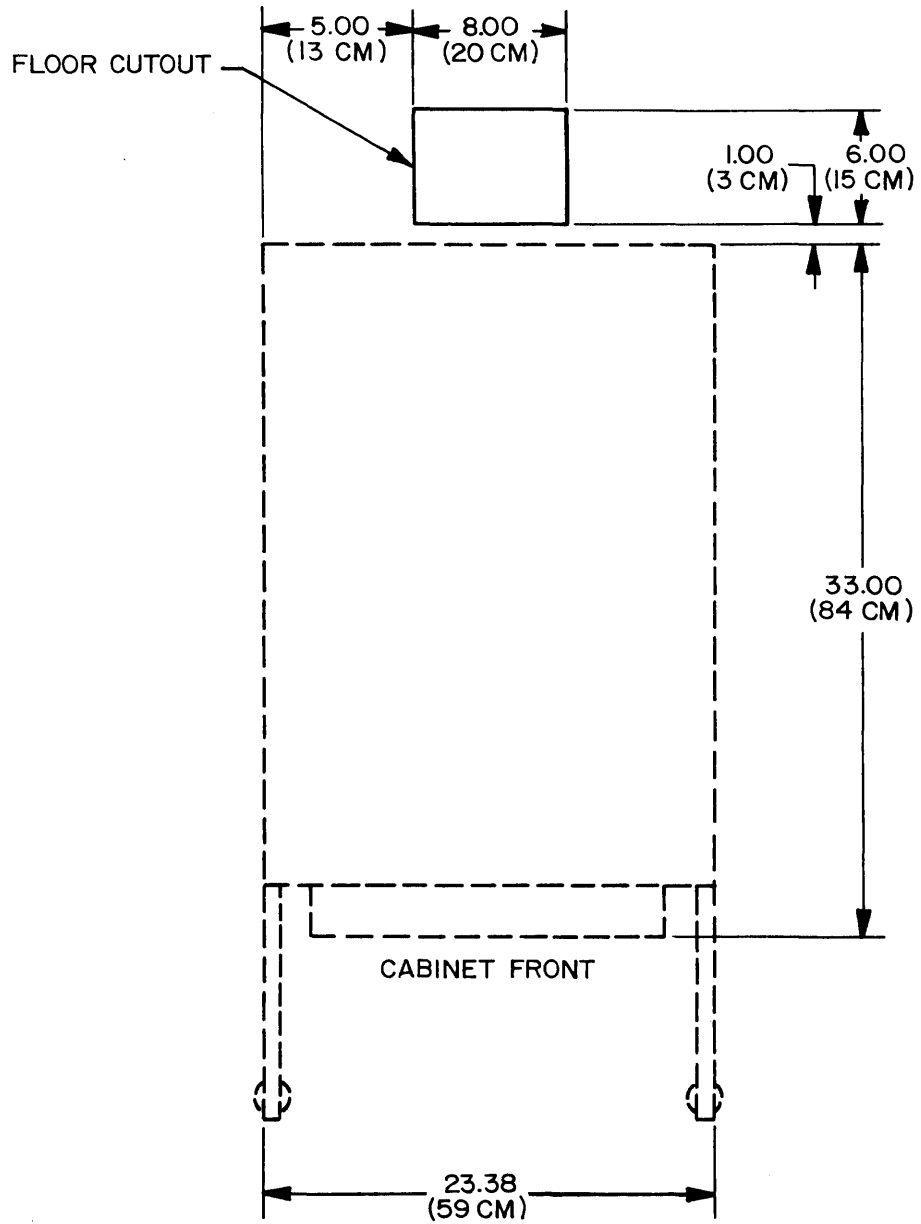


Figure 7-2. PEX-1/MTU-1 floor cutout

7.2 DSU-2 DISK STORAGE UNIT

The DSU-2 Disk Storage Unit (figure 7-3) is a high-speed, random-access memory device used with the PEX-1 Peripheral Expander Unit.

7.2.1 WEIGHT

The DSU-2 weighs approximately 170 pounds (77 kilograms).

7.2.2 LOCATION

The DSU-2 Disk Storage Unit must be located in the computer room near the PEX-1. Refer to section 11 for recommended arrangement and restrictions.

7.2.3 ACCESS REQUIREMENTS

Adequate access to the front of the unit is required for normal operator activity and for removal of the cabinet front panel for maintenance purposes.

7.2.4 COOLING REQUIREMENTS

Adequate clearance must be maintained at the rear of the DSU-2 cabinet for the unrestricted flow of exhaust air from the lower portion of the cabinet back panel.

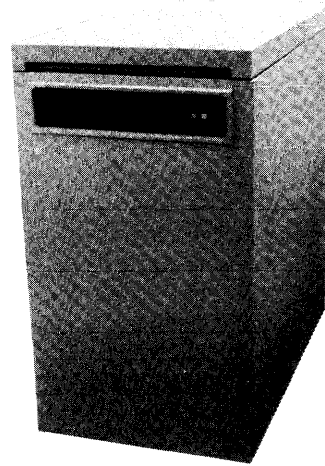
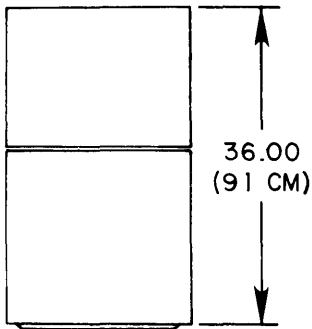
7.2.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading of this unit is approximately 1600 BTU/HR (470 watts).

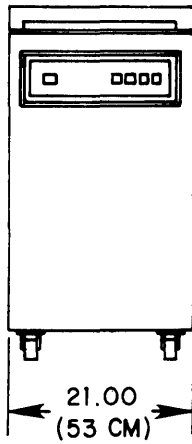
7.2.6 FLOOR PREPARATION

The DSU-2 Disk Storage Unit requires a single floor cutout (figure 7-4) for the underfloor routing of interconnecting data and power cables. The floor cutout must be free of burrs.

PLAN VIEW



FRONT VIEW



SIDE VIEW

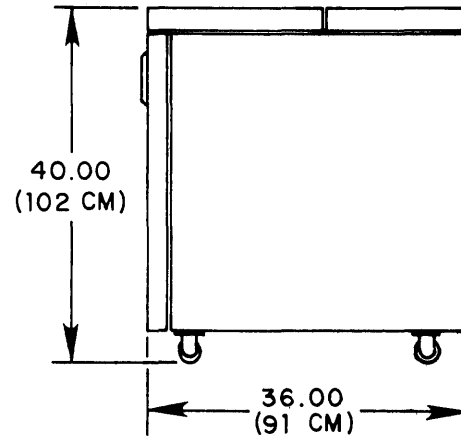


Figure 7-3. DSU-2 Disk Storage Unit

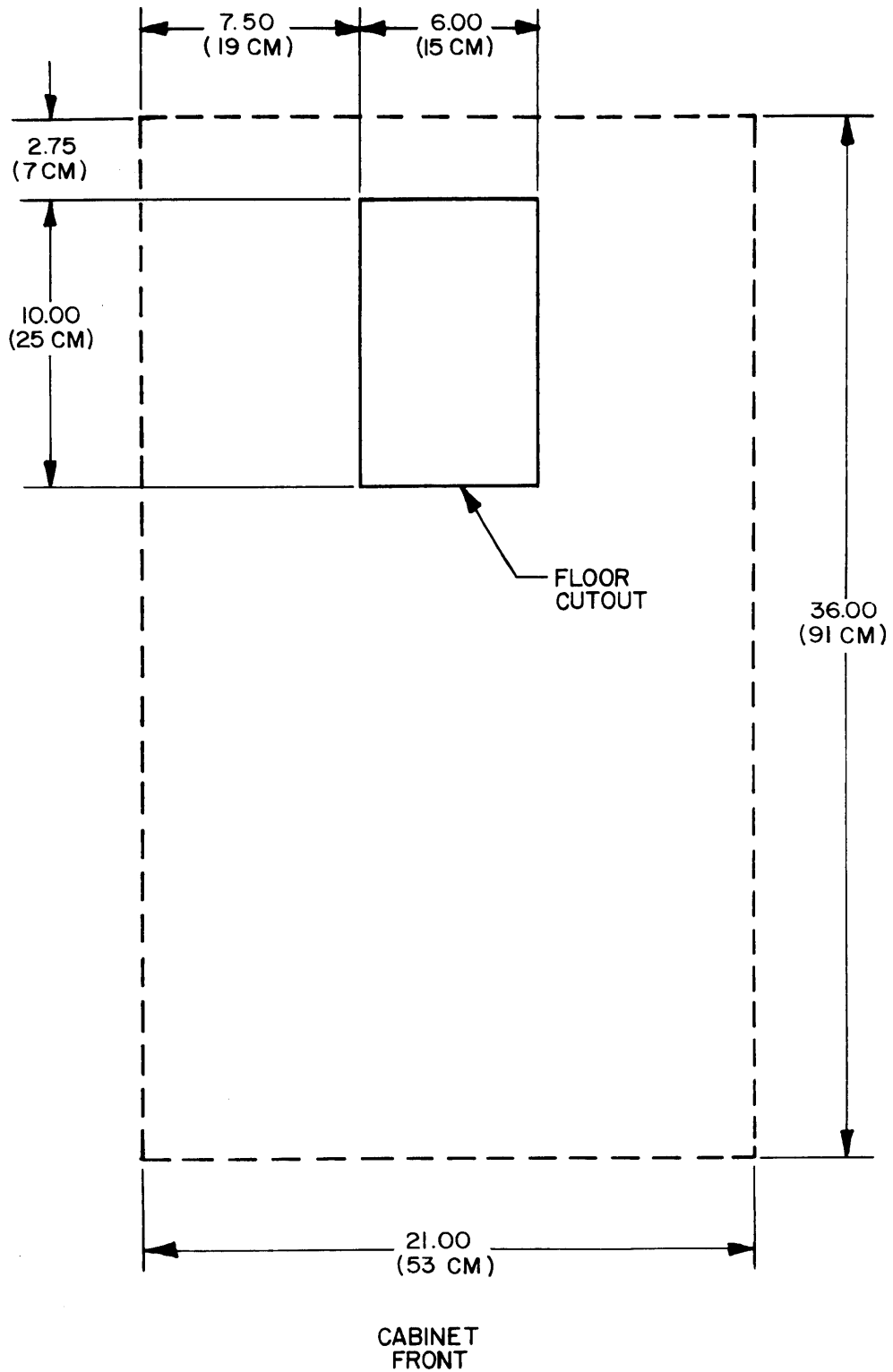


Figure 7-4. DSU-2 Disk Storage Unit floor cutout

7.2.7 POWER WIRING REQUIREMENTS

The DSU-2 is equipped with a 5-foot (1.5 M) pluggable drop cord power cable.

You must provide and install a mating power receptacle near the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be either the box-mounted or in-line type.

The drop cord power plug furnished with the DSU-2 is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you and shall apply to your particular installation.

7.2.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to the unit in accordance with paragraph 2.4.2.

7.3 LP-2 LINE PRINTER

The LP-2 Line Printer (figure 7-5) is an electrostatic printing device equipped with a 128-character ASCII character set and interfaces to the PEX-1 Peripheral Expander Unit.

7.3.1 WEIGHT

The LP-2 Line Printer weighs approximately 200 pounds (90 kilograms).

7.3.2 LOCATION

The LP-2 Line Printer must be located in the computer room near the PEX-1. Refer to section 11 for recommended arrangement and restrictions.

7.3.3 ACCESS REQUIREMENTS

Adequate access to the front of the unit is required for normal operator activity and for removal of the cabinet front panel for maintenance purposes (refer to figure 7-5). At least 9 1/4 inches (23 cm) of clearance must be provided at the rear of the unit for an attached paper tray and to permit the unrestricted flow of intake air at vents located in the back panels of the unit.

7.3.4 COOLING REQUIREMENTS

The LP-2 is air cooled by fans mounted within the cabinet.

7.3.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading for this unit is approximately 2000 BTU/HR (600 watts).

7.3.6 FLOOR PREPARATION

The LP-2 requires a single floor cutout (figure 7-6) for the underfloor routing of interconnecting data cables and power cables. The floor cutout must be free of burrs.

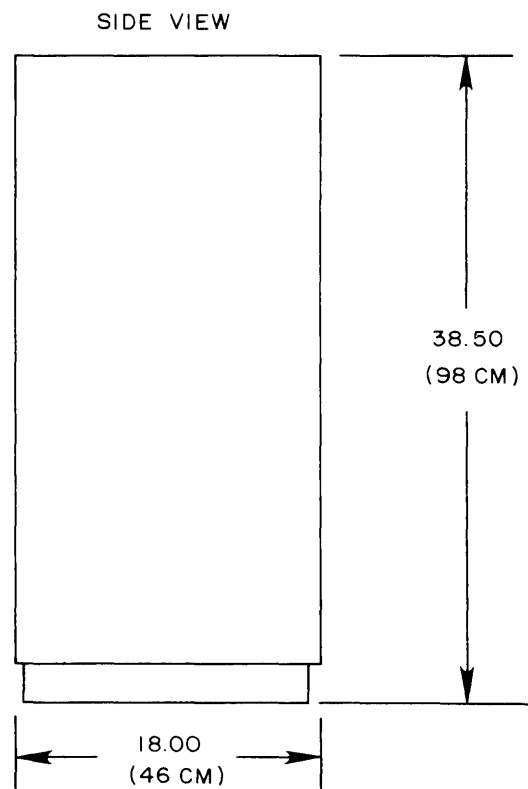
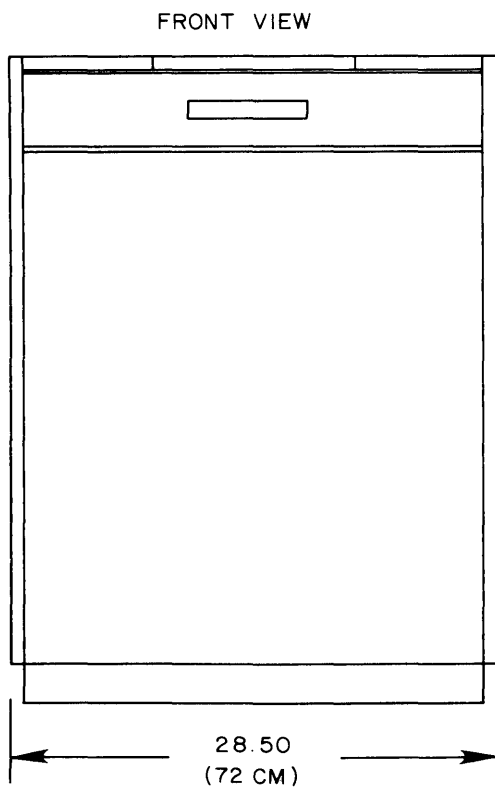
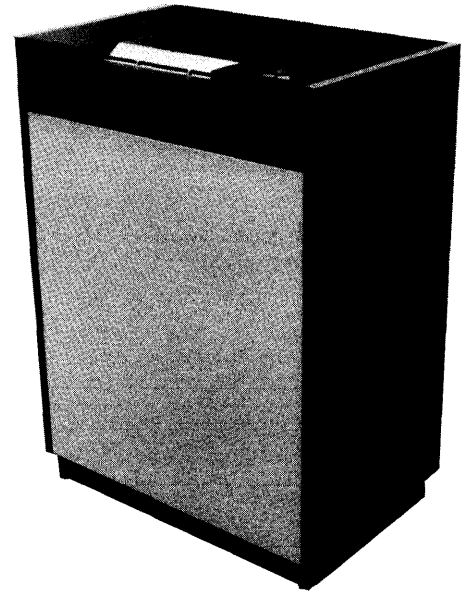
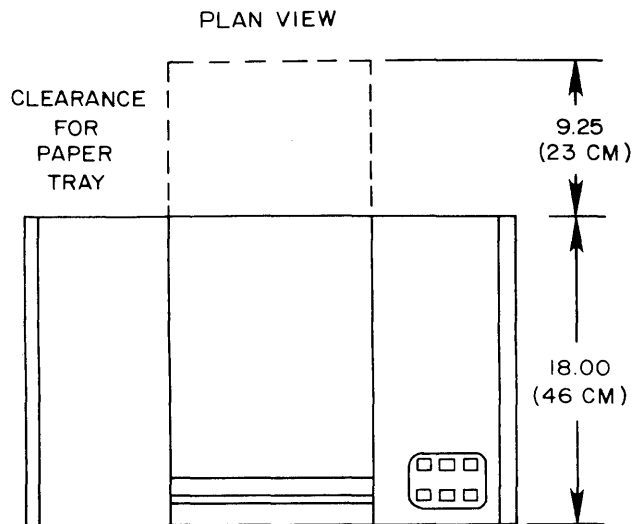


Figure 7-5. LP-2 Line Printer

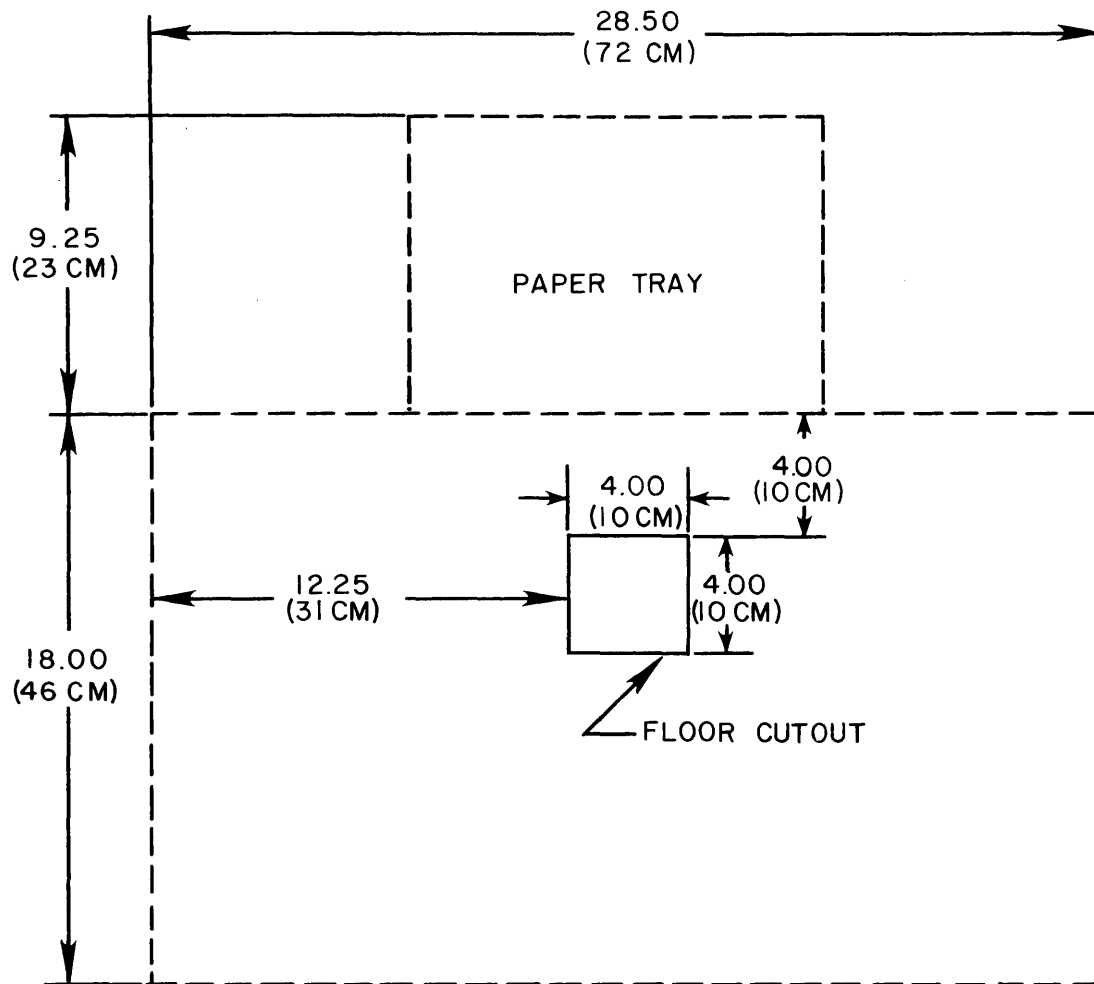
7.3.7 POWER WIRING REQUIREMENTS

The LP-2 is equipped with a 5-foot (1.5 M) pluggable drop cord power cable. You must provide and install a mating power receptacle near the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be either the box-mounted or in-line type.

The drop cord power plug furnished with the LP-2 is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you and shall apply to your particular installation.

7.3.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to the unit in accordance with paragraph 2.4.2.



CABINET FRONT

Figure 7-6. LP-2 Line Printer floor cutout

7.4 TBL-2 DUAL DISPLAY TABLE

The TBL-2 Dual Display Table (figure 7-7) provides an operator work area and table space for the displays included in the CRAY-1 M Series Computer System.

7.4.1 WEIGHT

The TBL-2 Dual Display Table weighs approximately 150 pounds (68 kilograms).

7.4.2 LOCATION

The primary CRAY-1 M display group must be located in the computer room near the PEX-1 Peripheral Expander Unit, but should be positioned so that the front panel indicators of the power distribution units are fully visible from the display operator's normal point of observation. Additional displays, beyond those required by CRI customer engineers for maintenance purposes, can be located remote from the CRAY-1 M Series Computer System. A cable length restriction of 1000 feet (305 M) exists.

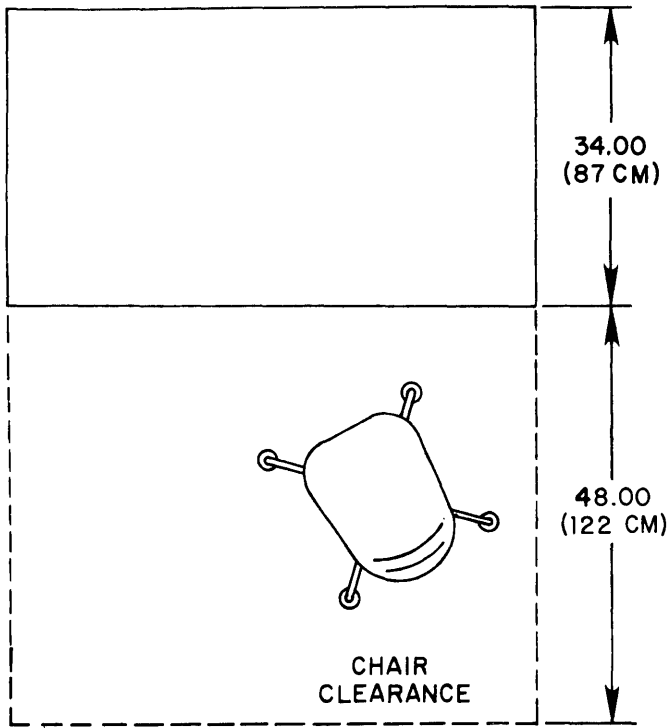
7.4.3 ACCESS REQUIREMENTS

Adequate provision must be made for normal operator activities at the front of the TBL-2. An area extending approximately 48 inches (122 cm) away from the front of the table should be reserved to provide clearance for the operator's chair.

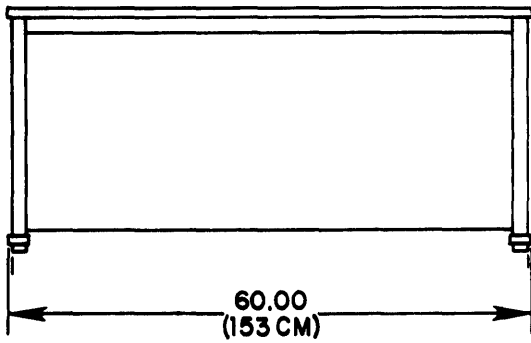
7.4.4 FLOOR PREPARATION

The TBL-2 Dual Display Table requires a single floor cutout (figure 7-8) for the underfloor routing of interconnecting data cables and power cables. Floor cutout must be free of burrs.

PLAN VIEW



FRONT VIEW



SIDE VIEW

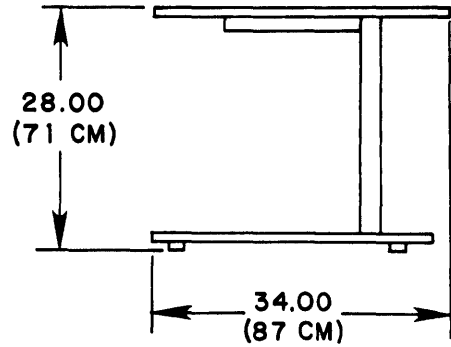


Figure 7-7. TBL-2 Dual Display Table

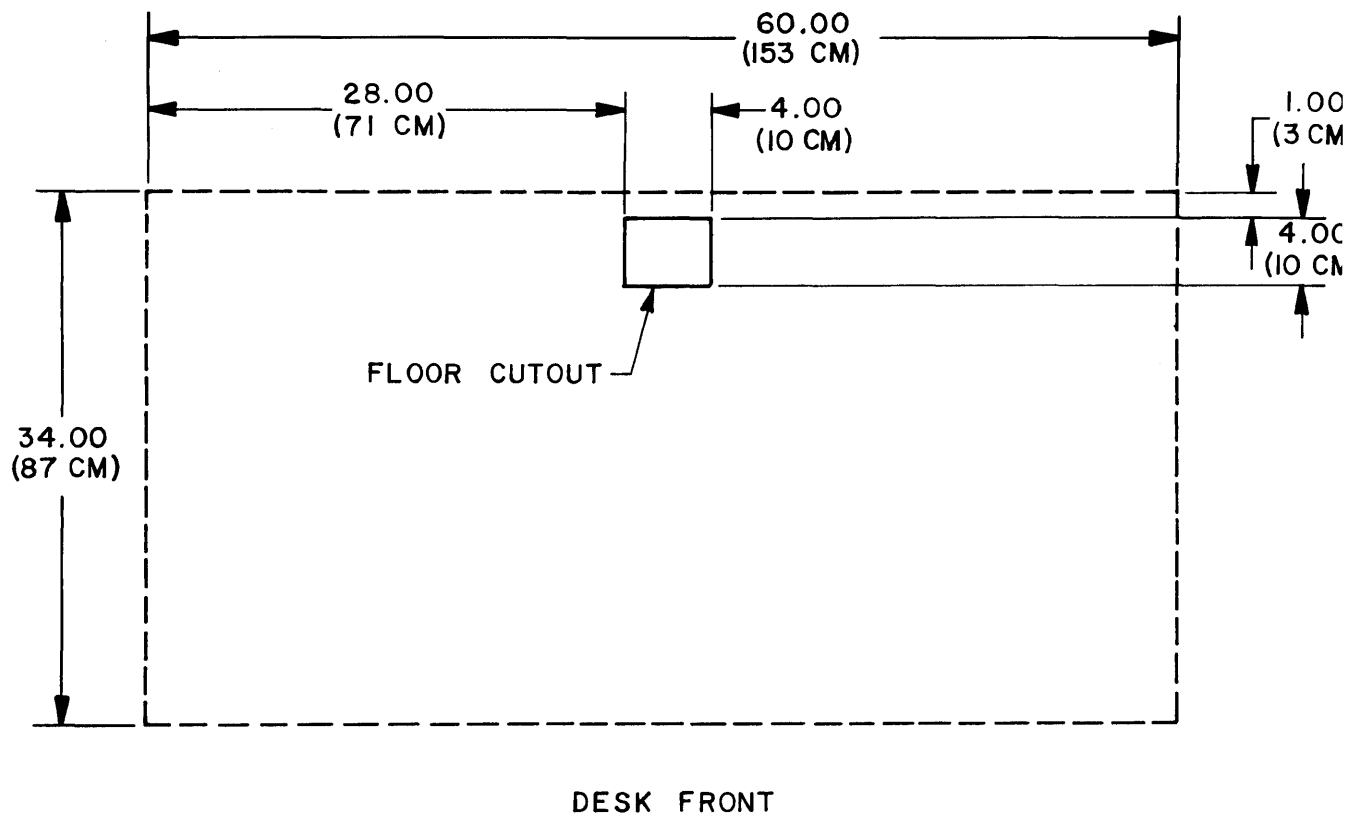


Figure 7-8. TBL-2 Dual Display Table floor cutout

7.5 TBL-1 SINGLE DISPLAY TABLE

The TBL-1 Single Display Table (figure 7-9) provides an operator work station and table space for one of the display terminals which is included in the CRAY-1 M Series Computer System. A wedge shaped table section is also supplied. When computer room space allows, the dual and single display tables may be arranged in an angular configuration by adding the wedge shaped table section.

7.5.1 WEIGHT

The TBL-1 weighs approximately 100 pounds (45.5 kilograms).

7.5.2 LOCATION

The primary CRAY-1 M display group must be located in the computer room near the MCU-1 Maintenance Control Unit or the PEX-1 Peripheral Expander Unit, but should be positioned so that the front panel indicators of the Power Distribution Units are fully visible from the display operator's normal point of observation. Additional displays, beyond those required by CRI customer engineers for maintenance purposes, can be located remote from the CRAY-1 M Series Computer System. A cable length restriction of 1000 feet (305 M) exists.

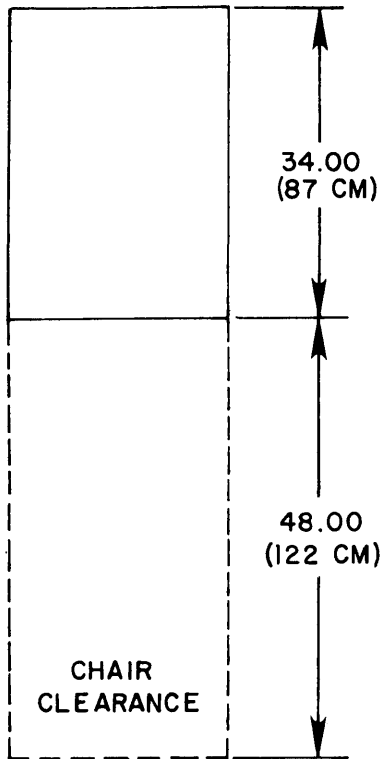
7.5.3 ACCESS REQUIREMENTS

Adequate provision must be made for normal operator activities at the front of the TBL-1. An area extending approximately 48 inches (122 cm) away from the front of the table should be reserved to provide clearance for the operator's chair.

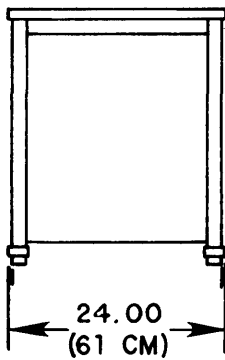
7.5.4 FLOOR PREPARATION

The TBL-1 requires a single floor cutout (figure 7-10) for the underfloor routing of interconnecting data cables and power cables. The floor cutout must be free of burrs.

PLAN VIEW



FRONT VIEW



SIDE VIEW

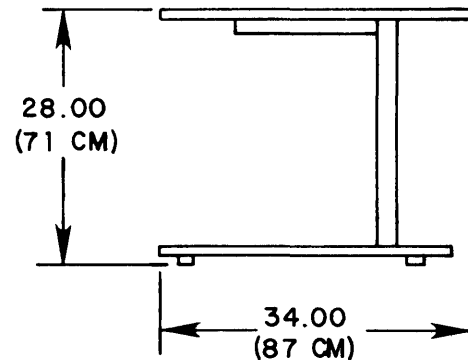


Figure 7-9. TBL-1 Single Display Table

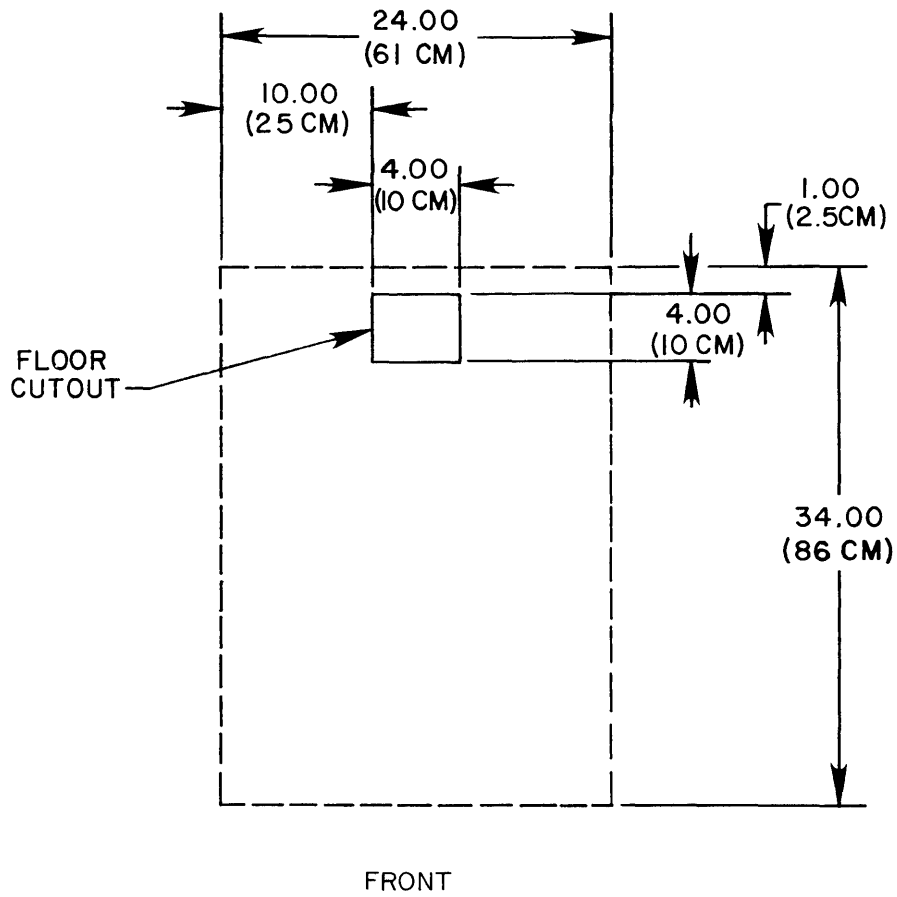


Figure 7-10. TBL-1 Single Display Table floor cutout

7.6 CRT-4 DISPLAY

The CRT-4 Display (figure 7-11) is designed for table mounting. The terminal consists of a display/keyboard unit.

7.6.1 WEIGHT

The CRT-4 weighs approximately 33 pounds (15 kilograms).

7.6.2 LOCATION

The CRT-4 is located on a CRI furnished display table, when located within the primary CRAY-1 M display group.

7.6.3 ACCESS REQUIREMENTS

Adequate provision must be made for normal operator activities at the front of the CRT-4 Display.

7.6.4 COOLING REQUIREMENTS

Adequate clearance must be provided at the rear of the CRT-4 to permit the unrestricted flow of intake and exhaust air through vents in the back panel.

7.6.5 ROOM HEAT LOADING CHARACTERISTICS

The CRT-4 is air cooled by a fan mounted within the display cabinet. Room air intake and exhaust vents are on the back panel. The room heat loading is approximately 345 BTU/HR (100 watts).

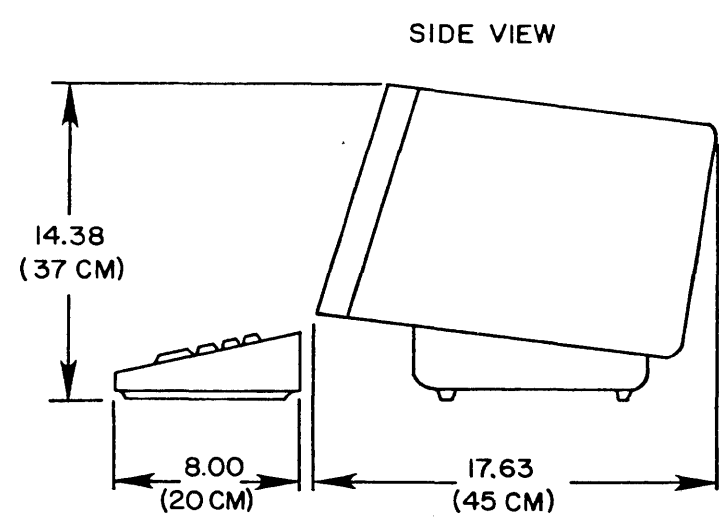
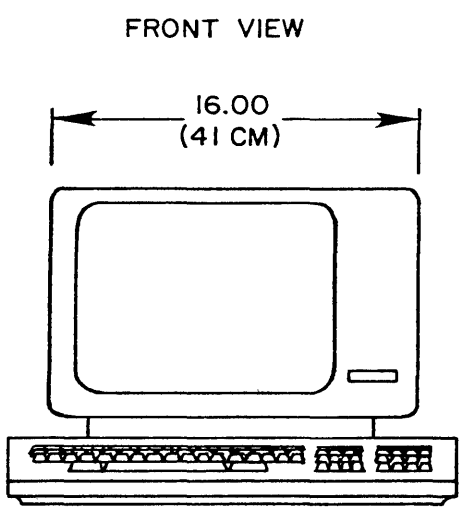
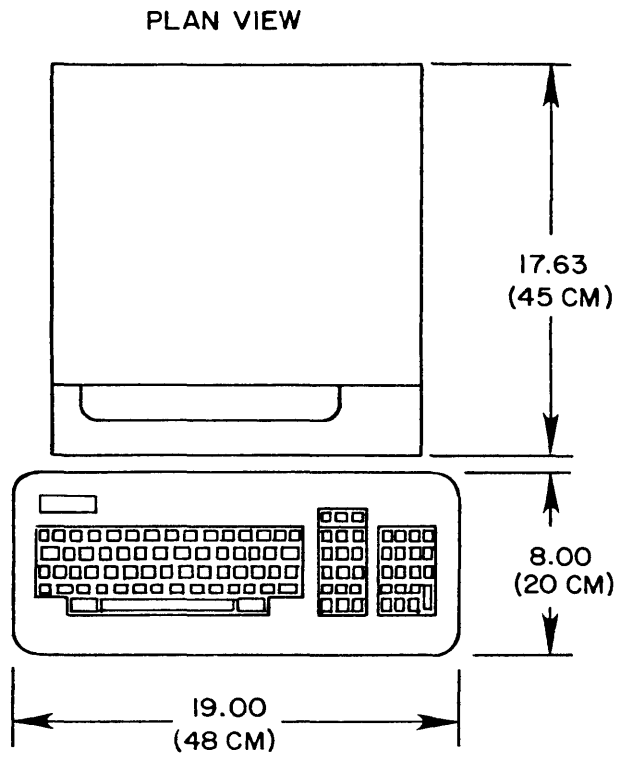


Figure 7-11. CRT-4 Display

7.6.6 POWER WIRING REQUIREMENTS

The CRT-4 is equipped with a 5-foot (1.5 M) pluggable drop cord power cable. You must provide and install a mating power receptacle near the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be either the box-mounted or in-line type.

The drop cord power plug furnished with the CRT-4 is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you and shall apply to your particular installation.

7.6.7 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to the unit in accordance with paragraph 2.4.2.

MCG-3 MAINTENANCE CONTROL GROUP

8

An equipment subsystem called the MCG-3 Maintenance Control Group is also configured with the CRAY-1 M Series Computer Systems for the purpose of device communications and the performance of device maintenance activities.

The MCG-3 consists of a MMCU Maintenance Microcomputer Unit and a CRT-4 Display (see figure 8-1).

The equipment contained in the MCG-3 Maintenance Control Group is illustrated and discussed in this section of the manual.

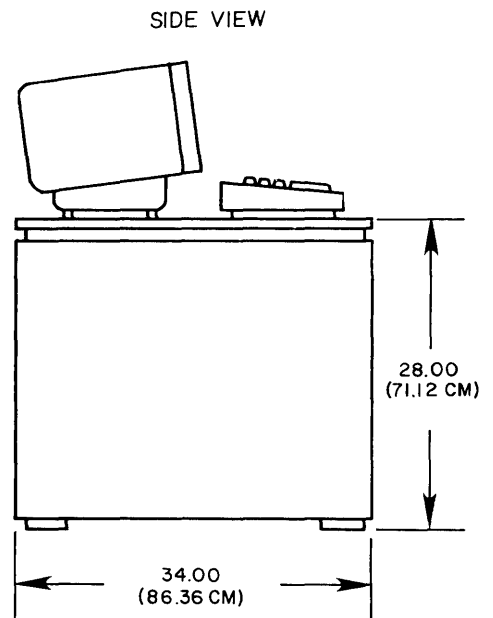
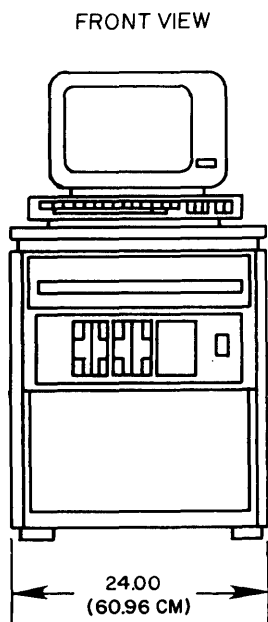
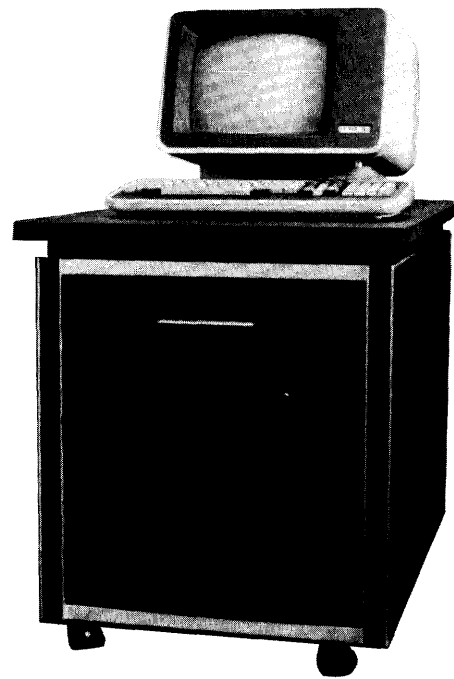
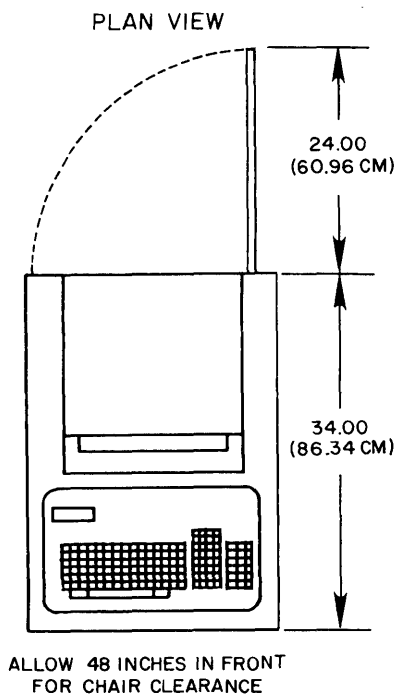


Figure 8-1. MCG-3 Maintenance Control Group

8.1 MMCU MAINTENANCE MICROCOMPUTER UNIT

The MMCU performs the function of a maintenance control unit for the CRAY-1 M Series Computer Systems. The MMCU is a self-contained microcomputer system housed in a caster mounted table height cabinet. The MMCU is equipped with a multiple Cray error channel interface board and dual floppy disk drives. The cabinet consists of a 19-inch rackmount frame with woodgrain trim and a hinged rear door (refer to figure 8-2).

8.1.1 WEIGHT

The MMCU cabinet weighs approximately 250 pounds (114 kilograms).

8.1.2 LOCATION

The MMCU must be located in the computer room in the general vicinity of the CRAY-1 M mainframe (see section 11 for recommended arrangement and restrictions.)

8.1.3 ACCESS REQUIREMENTS

Adequate provision must be made at both the front and rear of the unit for access. The rear access door requires at least 24 inches (61 cm) for door swing clearance. Approximately 48 inches (122 cm) in the front of the unit should be reserved to provide room for the operator's chair.

8.1.4 COOLING REQUIREMENTS

The MMCU is a fan-cooled unit which uses ambient room air for cooling purposes.

8.1.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading of this unit is approximately 1911 BTU/HR (560 watts).

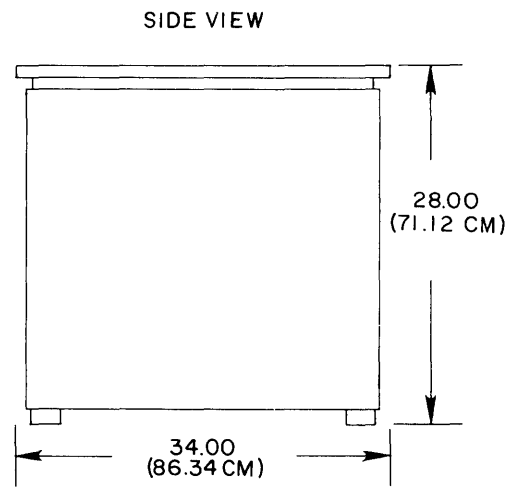
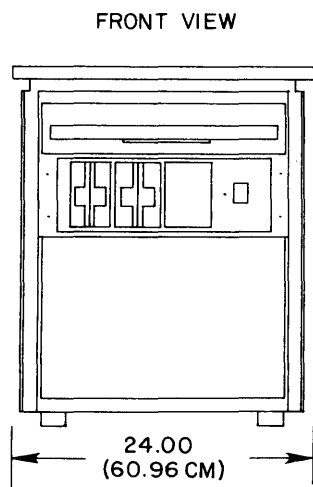
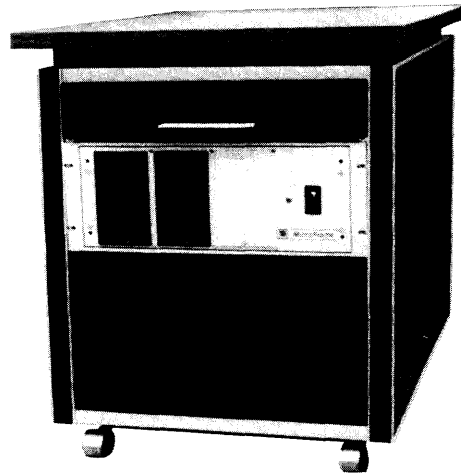
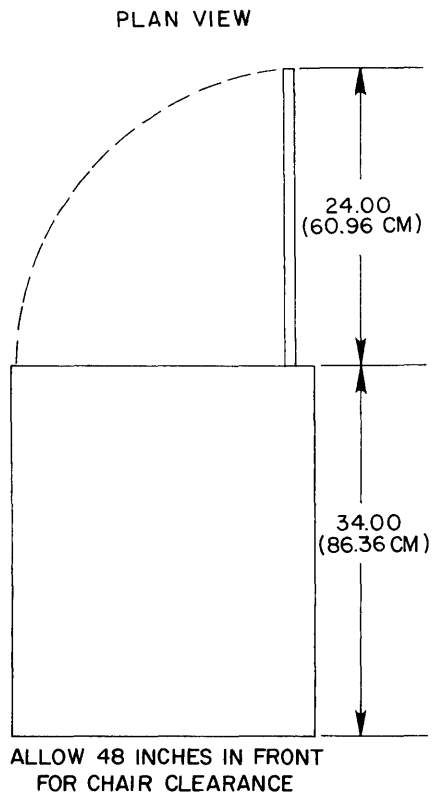


Figure 8-2. MMCU Maintenance Microcomputer System

8.1.6 FLOOR PREPARATION

The MMCU requires a single floor cutout (figure 8-3) for the underfloor routing of interconnecting drop cables and power cables. The floor cutout must be free of burrs.

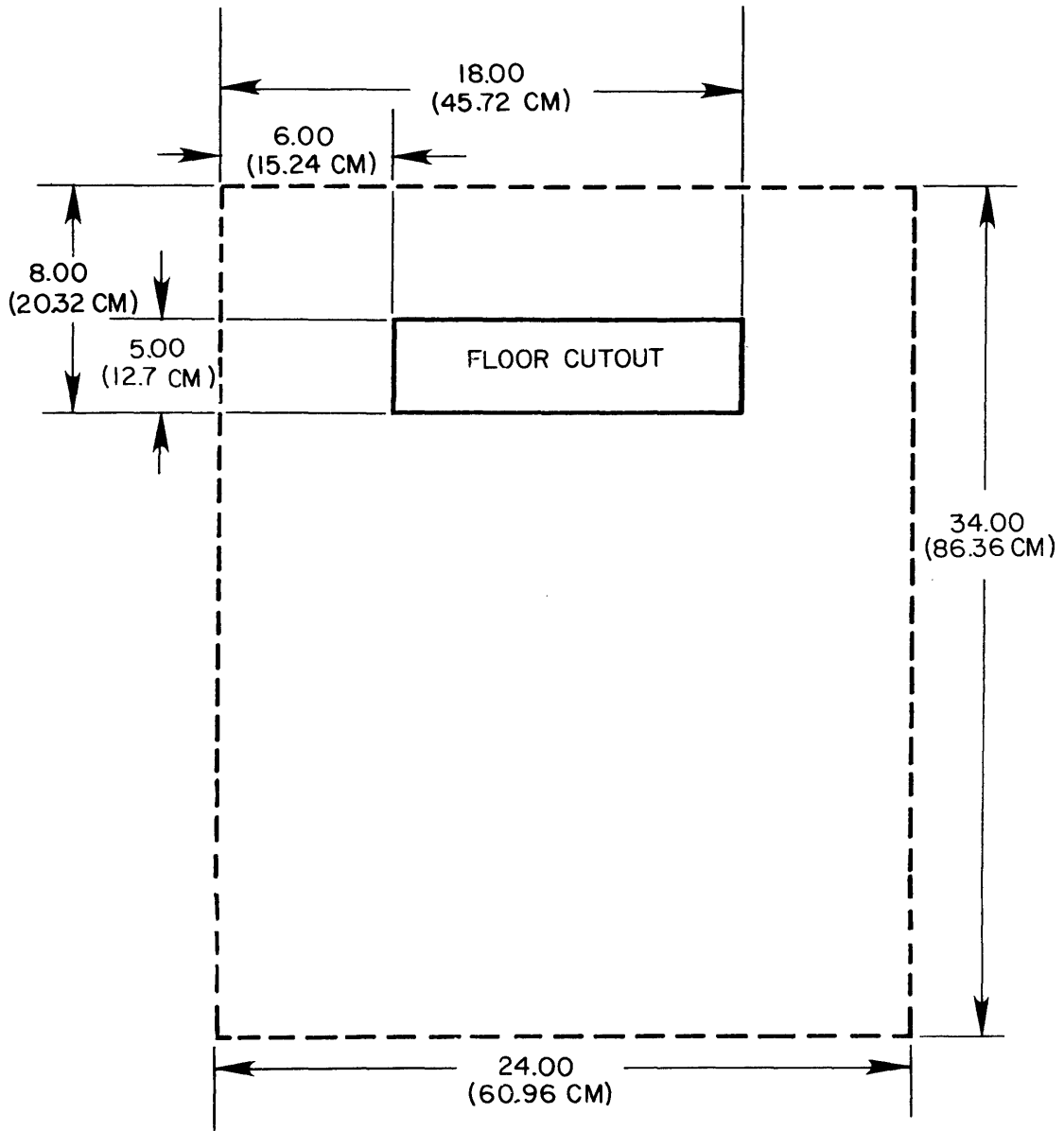
8.1.7 POWER WIRING REQUIREMENTS

The MMCU is equipped with a 7-foot (2.1 M) pluggable drop cord power cable. You must provide and install a mating power receptacle in the near vicinity of the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be of either the box-mounted or in-line type.

The drop cord power plug furnished with the MMCU is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you and shall apply to your particular installation.

8.1.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to the unit in accordance with section 2.4.2.



CABINET FRONT

Figure 8-3. MMCU floor cutout

8.2 CRT-4 DISPLAY

For site planning information on the CRT-4 Display, refer to section 7.6.

9.1 DD-29 DISK STORAGE UNIT

The DD-29 Disk Storage Unit (figure 9-1) is a high-speed, random access, air-cooled storage device.

9.1.1 WEIGHT

The unit weighs approximately 800 pounds (363 kilograms).

9.1.2 LOCATION

The DD-29s must be located in the computer room near the IOC-1 I/O Subsystem 4-Column Chassis. Several DD-29s can be arranged side by side. A 4-inch (10 cm) clearance between units is required to allow maintenance activity access. Refer to section 11 for the recommended arrangement and dimensional restrictions.

9.1.3 ACCESS REQUIREMENTS

Adequate provision must be made for normal operator activities at the front of the unit and for access to control switches and indicators located inside the hinged logic chassis door at the rear of the unit. Allow at least 22 inches (56 cm) for logic chassis door swing clearance at the rear of the unit.

9.1.4 COOLING REQUIREMENTS

The DD-29 is fan cooled, using ambient room air for cooling. If your facility uses a negative-pressurized underfloor air system in its computer room, you must provide means to ensure that cool air is supplied to each unit air inlet opening.

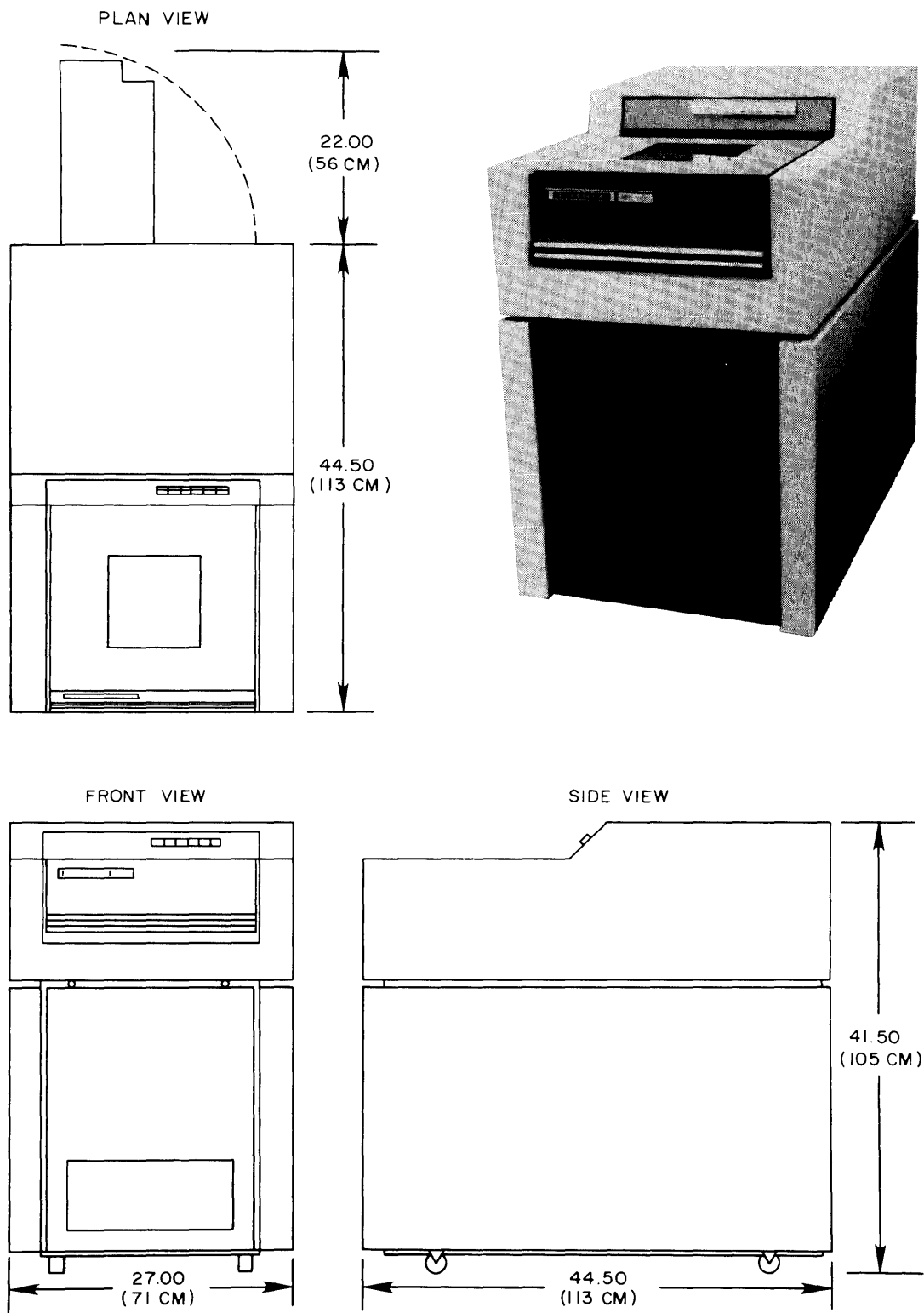


Figure 9-1. DD-29 Disk Storage Unit

9.1.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading effects produced by each unit are approximately 2500 BTU/HR standby, 3500 BTU/HR average and 10,000 BTU/HR maximum.

9.1.6 FLOOR PREPARATION

The DD-29 requires a single floor cutout (figure 9-2) for the underfloor routing of interconnecting data and power cables. The floor cutout must be free of burrs.

If the facility uses a positive-pressurized, cool air system in the underfloor area of the computer room, air openings must be placed in the floor tiles located beneath each unit, as indicated in figure 9-2, to deliver cooling air to the four air inlet openings.

9.1.7 POWER WIRING REQUIREMENTS

The unit is equipped with a 5-foot (1.5 M) pluggable drop cord power cable. You must provide and install a mating power receptacle near each DD-29 cabinet (refer to figure 2-4). The mating power receptacle may, at your option, be either the box-mounted or in-line type.

The drop cord power plug furnished with the DD-29 Disk Storage Unit is specified by manufacturer's type designation in the CRI site planning documentation supplied to you and shall be applicable to the particular installation.

9.1.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to each DD-29 Disk Storage Unit in accordance with paragraph 2.4.2.

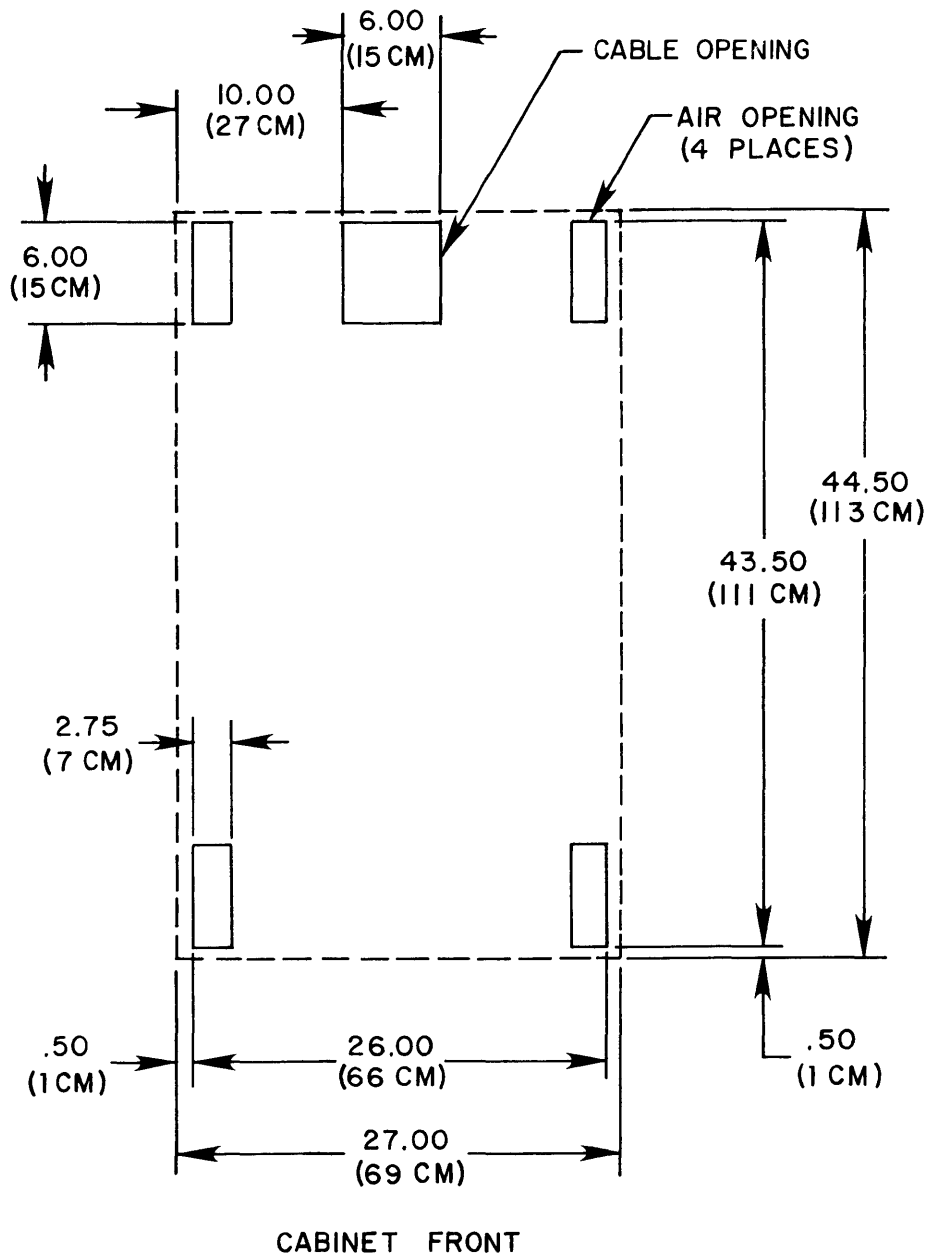


Figure 9-2. DD-29 Disk Storage Unit floor cutouts

9.2 FEC-1 FRONT-END INTERFACE CABINET

Interface units are specially designed and developed to provide I/O communications between the CRAY-1 M computer and other computer systems according to the applications requirements of the facility. The special interface units are housed in the FEC-1 Front-end Interface Cabinet.

The FEC-1 (figure 9-3) is an air-cooled unit containing printed circuit modules, specially designed to provide I/O communications between the CRAY-1 M computer system and another computer system. The FEC-1 also contains power supplies, fans and air filters, a power ON indicator, and a power ON/OFF circuit breaker.

9.2.1 WEIGHT

The FEC-1 weighs approximately 200 pounds (91 kilograms).

9.2.2 LOCATION

An FEC-1 can be remotely located at distances up to 300 feet (91.44 M) from the CRAY-1 M computer to meet cable length restrictions of the interfacing computer system. Cable length restrictions between the FEC-1 and the interfacing computer system vary depending on the type of interfacing computer system. Specific limitations will be furnished by CRI upon definition of the interfacing computer system type.

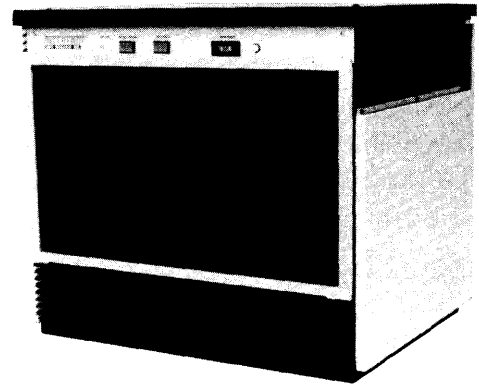
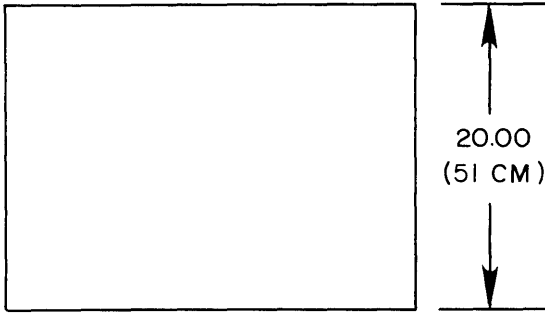
9.2.3 ACCESS REQUIREMENTS

Adequate access to the power ON/OFF circuit breaker at the front of the interface unit is required for removal of the front and rear panels for maintenance.

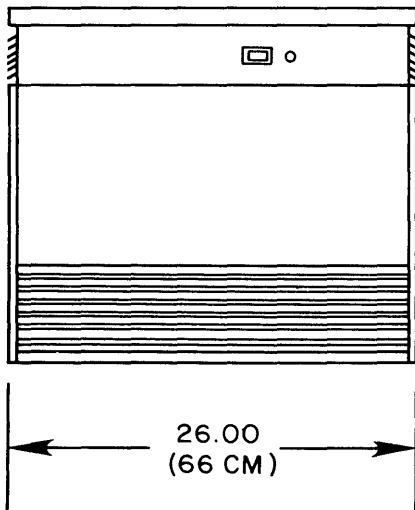
9.2.4 COOLING REQUIREMENTS

Adequate clearance must also be provided at the side grilles and front grille for the unrestricted flow of intake and exhaust air for cooling purposes. Clearance of 36 inches (91 cm) is required to the front and rear of the cabinet for maintenance purposes. A minimum of 6 inches (15 cm) is required on the two sides for air flow.

PLAN VIEW



FRONT VIEW



SIDE VIEW

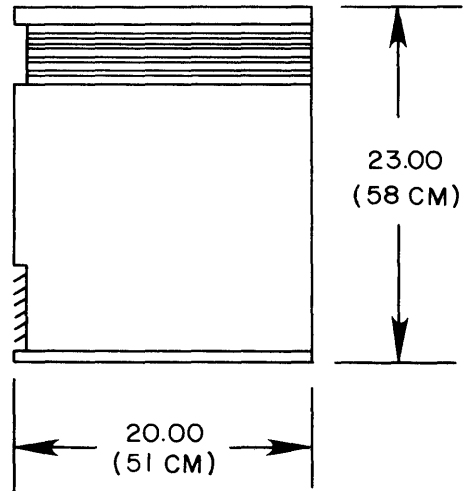


Figure 9-3. FEC-1 Front-end Interface Cabinet

9.2.5 ROOM HEAT LOADING CHARACTERISTICS

The FEC-1 is air cooled by two fans mounted in the upper portion of the cabinet. Intake air is drawn in from the two sides and exhausted at the front of the cabinet. The unit produces room heat loading effects of approximately 850 BTU/HR (250 watts).

9.2.6 FLOOR PREPARATION

The FEC-1 Front-end Interface Cabinet requires a single floor cutout (figure 9-4) for the underfloor routing of interconnecting data and power cables. The floor cutout must be free of burrs.

9.2.7 POWER WIRING REQUIREMENTS

This cabinet is equipped with a 10-foot (3.1 M) pluggable drop cord power cable. You are required to provide and install a mating power receptacle near the cabinet (refer to figure 2-4). The mating power receptacle can, at your option, be either box-mounted or in-line type.

The drop cord power plug furnished with the front-end interface cabinet is specified by manufacturer's type designation in the Cray Research site planning documentation supplied to you.

9.2.8 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacle, you must also provide and install an earth-ground strap to each front-end interface cabinet in accordance with paragraph 2.4.2.

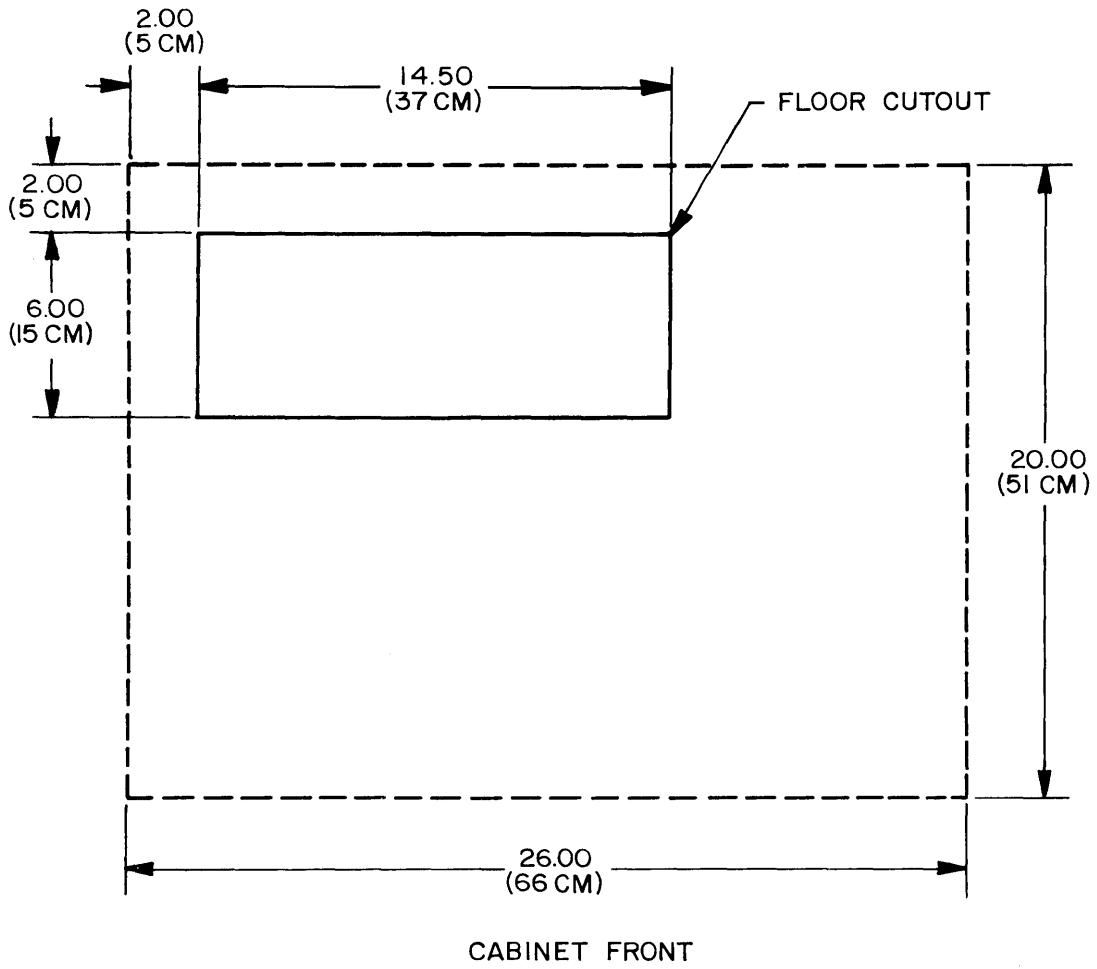


Figure 9-4. FEC-1 Front-end Interface Cabinet floor cutout

10.1 PDU-2 I/O SUBSYSTEM POWER DISTRIBUTION UNIT

The PDU-2 I/O Subsystem Power Distribution Unit (figure 10-1) is a fan-cooled unit that uses ambient room air for cooling purposes. It contains eight variable transformers for the control of input power to the eight DC power supplies located around the base of the IOC-1 I/O Subsystem 4-Column Chassis.

The PDU-2 is equipped with panel meters to indicate the temperature of chassis cold bars within the I/O Subsystem 4-Column Chassis and elapsed operating time. The PDU-2 is also equipped with power supply selector switches and a panel-mounted digital voltmeter for measuring the DC output voltage levels of the power supplies located at the base of the IOC-1 cabinet.

In addition, the PDU-2 contains system ON-OFF control circuitry, temperature monitoring circuitry, warning system indicators and alarm circuits, and other related functions.

10.1.1 WEIGHT

The PDU-2 weighs approximately 800 pounds (363 kilograms).

10.1.2 LOCATION

The PDU-2 must be located in the computer room next to the PDU-1 (see section 11). The unit should be positioned so that the controls and indicators on the front panel are fully visible from the mainframe, I/O Subsystem and from the CRT-4 Displays.

10.1.3 ACCESS REQUIREMENTS

The PDU-2 must be positioned to allow approximately 4 feet (1.2 M) between the rear of the cabinet and any other equipment or wall surface to ensure proper circulation of intake and exhaust air and allow maintenance activities.

10.1.4 COOLING REQUIREMENTS

The PDU-2 is a fan-cooled unit that uses ambient room air for cooling purposes. If your facility uses a positive-pressurized, cool-air system in the underfloor area of the computer room, air grilles or perforated floor tile must be placed in the floor immediately in back of the PDU-2 cabinet. If the facility uses a negative-pressurized, underfloor air system in the computer room, you must provide other means to ensure that cool air is supplied to the inlet openings at the rear of the cabinet.

10.1.5 ROOM HEAT LOADING CHARACTERISTICS

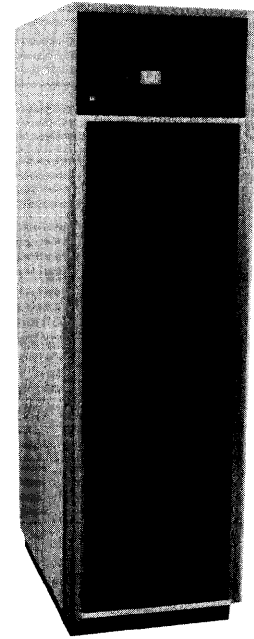
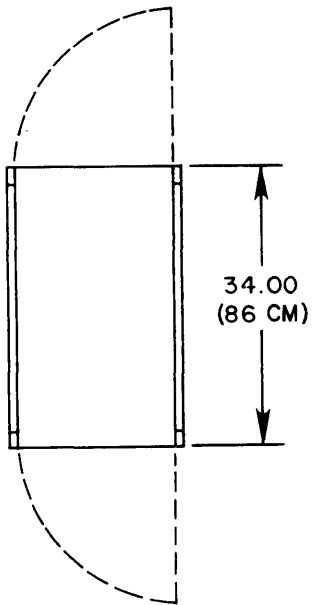
The room heat loading by this unit is approximately 3200 BTU/HR (940 watts).

10.1.6 FLOOR PREPARATION

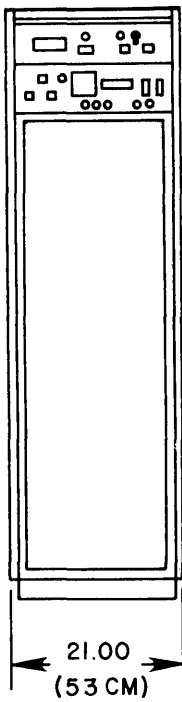
The PDU-2 requires a single floor cutout (see figure 10-2) for the attachment of power and control cables. The rectangular floor cutout must be positioned under the base of the PDU-2 cabinet. No floor stringers are permitted in the cutout area. Additional underfloor support (not shown) may also be required to keep the cut floor tiles in place, depending on the type of floor construction used in the facility. Floor cutout must be free of burrs.

The front 3 inches (7.62 cm) of the cutout area are used for the entrance of the two input power lines for the 3-phase, 400 Hz circuits which are fed through 1 1/2-inch (3.81 cm) knockouts located in the base of the PDU-2 cabinet. The rear 8 inches (20.34 cm) of the cutout area are used for the exit of the twelve 400 Hz power distribution cables which go to the IOC-1 I/O Subsystem 4-Column Chassis, plus a number of miscellaneous control cables running to the PDU-4 Mainframe Power Distribution Unit, and to the IOC-1. The 400 Hz power cables are fed through eight 3/4-inch (2.00 cm) and four 1/2-inch (1.28 cm) knockouts. The control wires are fed through four 3/4-inch (2.00 cm) and eight 1/2-inch (1.28 cm) knockouts located in the base of the cabinet (see figure 2-3).

PLAN VIEW



FRONT VIEW



SIDE VIEW

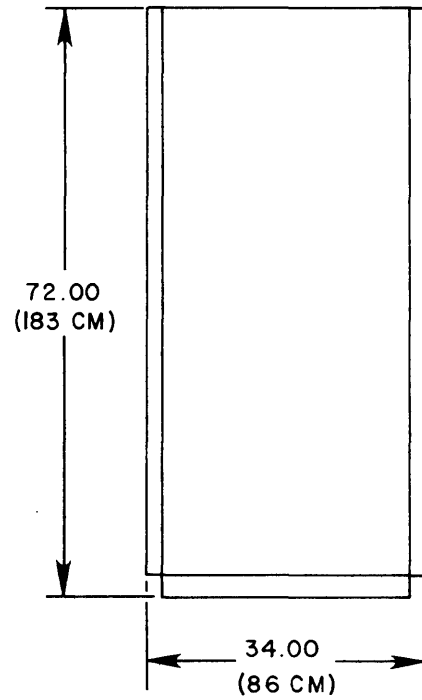


Figure 10-1. PDU-2 I/O Subsystem Power Distribution Unit

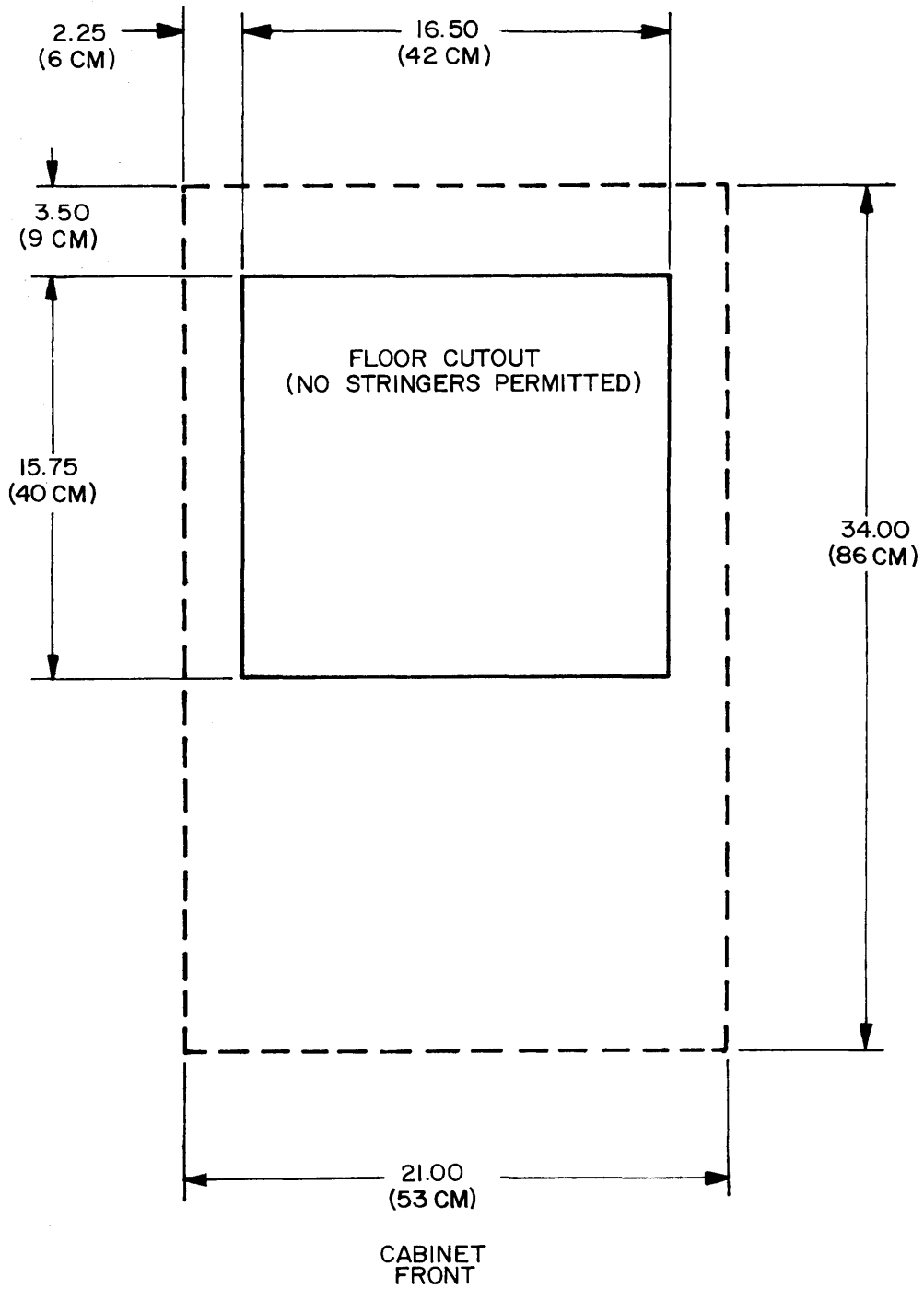


Figure 10-2. PDU-2 Power Distribution Unit floor cutouts

10.1.7 POWER WIRING REQUIREMENTS

Installing the PDU-2 requires that you supply and install:

- Two incoming 400 Hz, 4-wire circuits
- One incoming 60 Hz, 3-wire circuit
- Eight outgoing 400 Hz, 4-wire circuits
- Four outgoing 400 Hz, 2-wire circuits
- One earth-ground #2/0 AWG 1-wire circuit to the 400 Hz breaker panel
- One earth-ground strap

All electrical connections are made inside the cabinet base from the back of the unit.

When preparing the facility, allow 2 feet (0.61 M) of excess wire length above the floor surface to ensure adequate wire length for termination. All additional non-power cables are supplied and installed by CRI at the time of system installation.

10.1.8 EARTH-GROUNDING REQUIREMENTS

You must supply and install one earth-ground strap as stated in section 2.4.2.

10.2 PDU-3 SOLID-STATE STORAGE DEVICE POWER DISTRIBUTION UNIT

The PDU-3 Solid-state Storage Device Power Distribution Unit is required when the optional SSD Solid-state Storage Device is configured with the computer system. The PDU-3 Solid-state Storage Device Power Distribution Unit is a fan-cooled unit using ambient room air. It is similar in size, shape, and function to the PDU-2.

For detailed information regarding floor preparation, cooling and power wiring requirements, refer to the Solid-state Storage Device (SSD) Site Planning Reference Manual, CRI publication HR-0025.

10.3 PDU-4 MAINFRAME POWER DISTRIBUTION UNIT

The PDU-4 Mainframe Power Distribution Unit (figure 10-3) is a fan-cooled unit that uses ambient room air for cooling purposes. It contains eight variable transformers for the control of input power to the power supplies located around the base of the CRAY-1 M mainframe (MFC-4).

The PDU-4 is equipped with panel meters to indicate the temperature of chassis cold bars within the 6-column mainframe and elapsed operating time. The PDU-4 is also equipped with power supply selector switches and a panel-mounted digital voltmeter for measuring the DC output voltage levels of the power supplies located at the base of the CRAY-1 M cabinet.

In addition, the PDU-4 contains system ON-OFF control circuitry, temperature monitoring circuitry, warning system indicators and alarm circuits, and other related functions.

10.3.1 WEIGHT

The PDU-4 weighs approximately 800 pounds (363 kilograms).

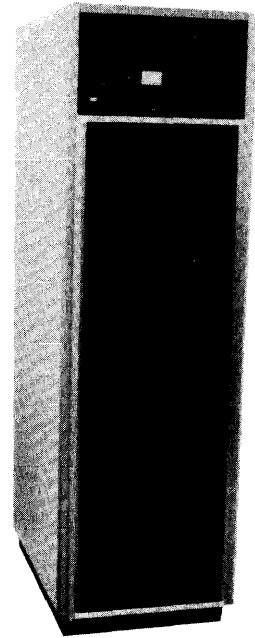
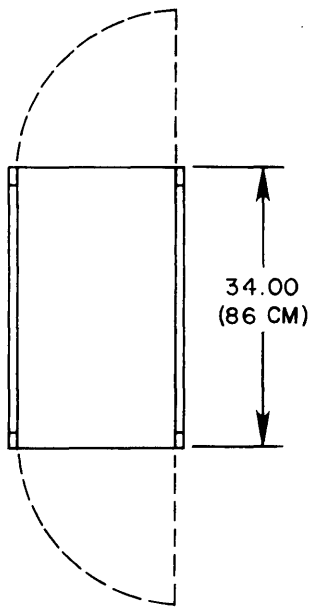
10.3.2 LOCATION

The PDU-4 must be located in the computer room next to the PDU-2 (see section 11). The unit should be positioned so that the controls and indicators on the front panel are fully visible from the mainframe, I/O Subsystem and from the CRT-4 Displays.

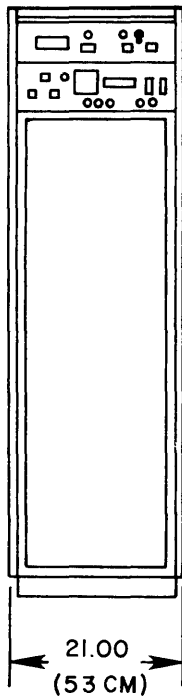
10.3.3 ACCESS REQUIREMENTS

The PDU-4 must be positioned to allow approximately 4 feet (1.2 M) between the rear of the cabinet and any other equipment or wall surface to ensure proper circulation of intake and exhaust air and for maintenance activities.

PLAN VIEW



FRONT VIEW



SIDE VIEW

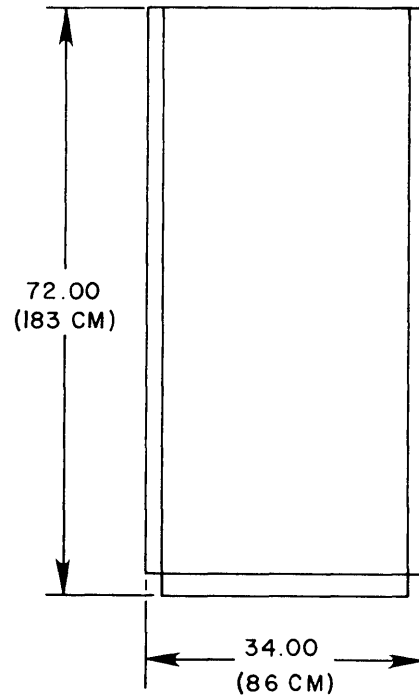


Figure 10-3. PDU-4 Mainframe Power Distribution Unit

10.3.4 COOLING REQUIREMENTS

The PDU-4 is a fan-cooled unit that uses ambient room air for cooling purposes. If your facility uses a positive-pressurized, cool-air system in the underfloor area of the computer room, air grilles or perforated floor tiles must be placed in the floor immediately in back of the PDU-4 cabinet. If the facility uses a negative-pressurized, underfloor air system in the computer room, you must provide other means to ensure that cool air is supplied to the air inlet openings at the rear of the cabinet.

10.3.5 ROOM HEAT LOADING CHARACTERISTICS

The room heat loading by this unit is approximately 3200 BTU/HR (940 watts).

10.3.6 FLOOR PREPARATION

The PDU-4 requires a single floor cutout (figure 10-4) for the attachment of power and control cables. The rectangular floor cutout must be positioned under the base of the PDU-4 cabinet. No floor stringers are permitted in the cutout area. Additional underfloor support (not shown) may also be required to keep the cut floor tiles in place, depending on the type of floor construction used in the facility. The floor cutout must be free of burrs.

The front 3 inches (7.62 cm) of the cutout area are used for the entrance of the two input power lines for the 3-phase, 400 Hz circuits which are fed through 1 1/2-inch (3.81 cm) knockouts located in the base of the PDU-4 cabinet. The rear 8 inches (20.34 cm) of the cutout area are used for the exit of the sixteen 400 Hz power distribution circuits which go to the CRAY-1 M mainframe power supplies, plus a number of miscellaneous control cables running to the RCU-1 Refrigeration Condensing Unit. The 400 Hz power cables are fed through sixteen 1-inch (2.50 cm) knockouts. The control wires are fed through twelve 3/4-inch (2.00 cm) knockouts located in the base of the cabinet (see figure 2-3).

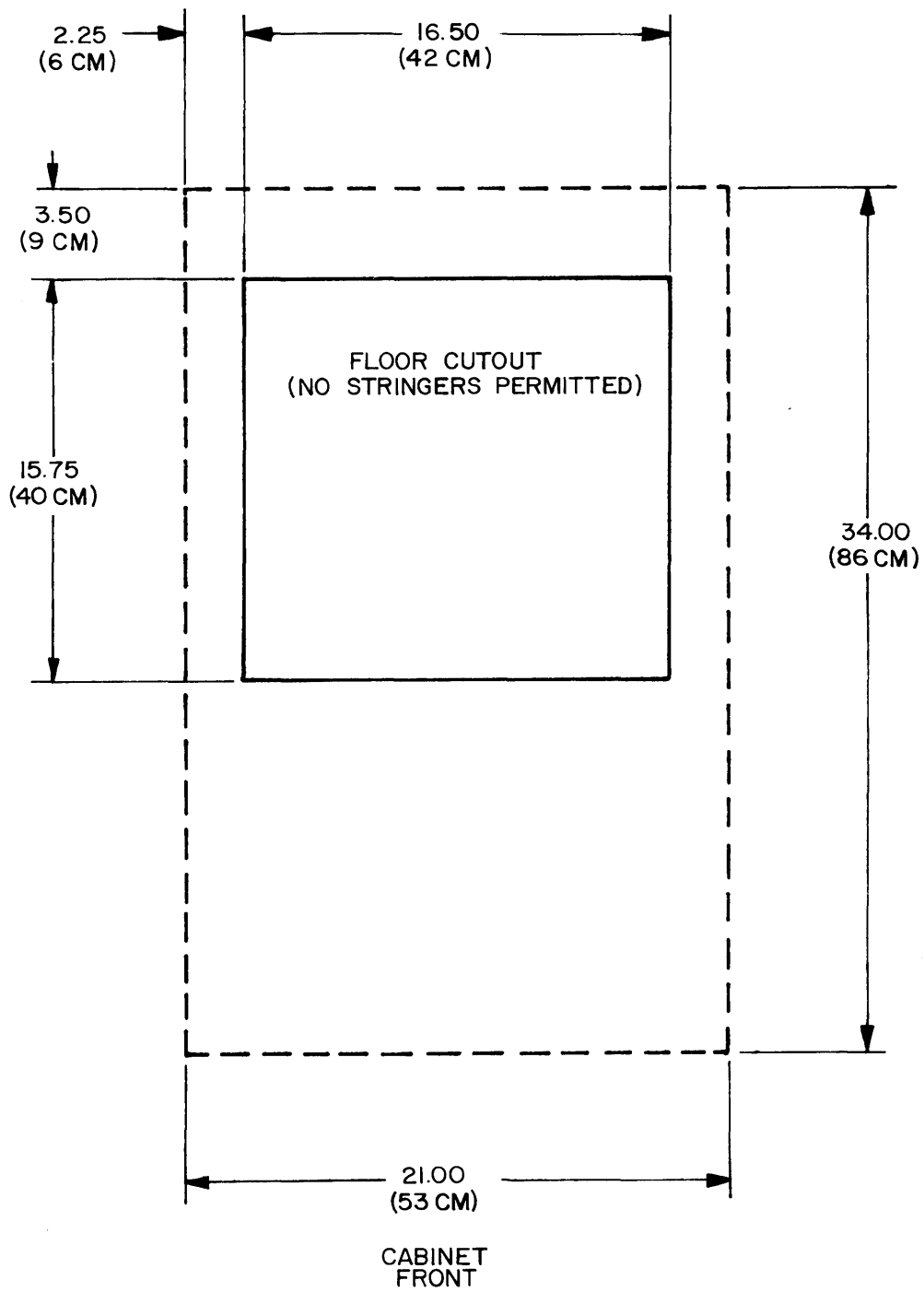


Figure 10-4. PDU-4 Power Distribution Unit floor cutouts

10.3.7 POWER WIRING REQUIREMENTS

Installing the PDU-4 requires that you supply and install:

- Two incoming 400 Hz, 4-wire circuits
- One incoming 60 Hz, 3-wire circuit
- Eight outgoing 400 Hz, 4-wire circuits
- Eight outgoing 400 Hz, 3-wire 400 Hz circuits
- One outgoing 60 Hz circuit to underfloor solenoid valves
- One monitoring 2-wire circuit to RCU-1 Refrigeration Condensing Unit
- One earth-ground #2/0 AWG 1-wire circuit to the 400 Hz breaker panel
- One earth-ground strap

All electrical connections are made inside the cabinet base from the back of the unit.

When preparing the facility, allow 2 feet (0.61 M) of excess wire length above the floor surface to ensure adequate wire length for termination. All additional non-power cables are supplied and installed by CRI at the time of system installation.

10.3.8 EARTH-GROUNDING REQUIREMENTS

You must supply and install one earth-ground strap in accordance with paragraph 2.4.2.

10.4 RCU-1 REFRIGERATION CONDENSING UNIT

The RCU-1 Refrigeration Condensing Unit (figure 10-5) contains major components of the refrigeration system used to cool the CRAY-1 M mainframe, IOC-1 I/O Subsystem 4-Column Chassis and the optional SSD Solid-state Storage Device, if configured with the system.

The RCU-1 contains two 25-hp motor driven compressors that operate in tandem; a water-cooled condenser; oil pressure, head pressure and suction pressure controls and gauges; filter driers; a liquid-line sight glass; a water regulating valve; and capacity-reduction controls. The standard mainframe refrigeration condensing unit is supplied without cabinet panels (skins), but optional cabinet top, side, and end panels, and a frame end extension cabinet can be ordered for this unit.

10.4.1 WEIGHT

The standard RCU-1 weighs approximately 2000 pounds (909 kilograms).

10.4.2 LOCATION

CRI recommends locating the RCU-1 in a plant room environment because of valuable computer room floor space and potential noise abatement problems. The remote RCU-1 is then interconnected to the CRAY-1 M Series Computer System via two large, copper refrigeration pipes, and a network of manifold and flexible copper hoses. The location of the RCU-1 is restricted by a maximum refrigerant pipe length of 100 equivalent lineal feet (30.48 M) for the suction line when the RCU-1 and the computer are located on the same floor level. If the RCU-1 is located at an elevation different from that of the mainframe, or if the refrigerant piping must change elevations due to facility obstructions, the 100 lineal foot requirement will include a vertical restriction of 25 feet (7.62 M) maximum.

10.4.3 ALTERNATE LOCATION

Although not recommended, the RCU-1 can be located within the computer room if the facility plant room is an unsatisfactory location or because of space limitations within the plant room.

In such instances, CRI offers optional cabinet top, side, and end panels for the unit. Since installation within the computer room requires that through-floor interconnections must be made for water pipes, refrigerant pipes, and electrical cables, an optional frame and extension cabinet is

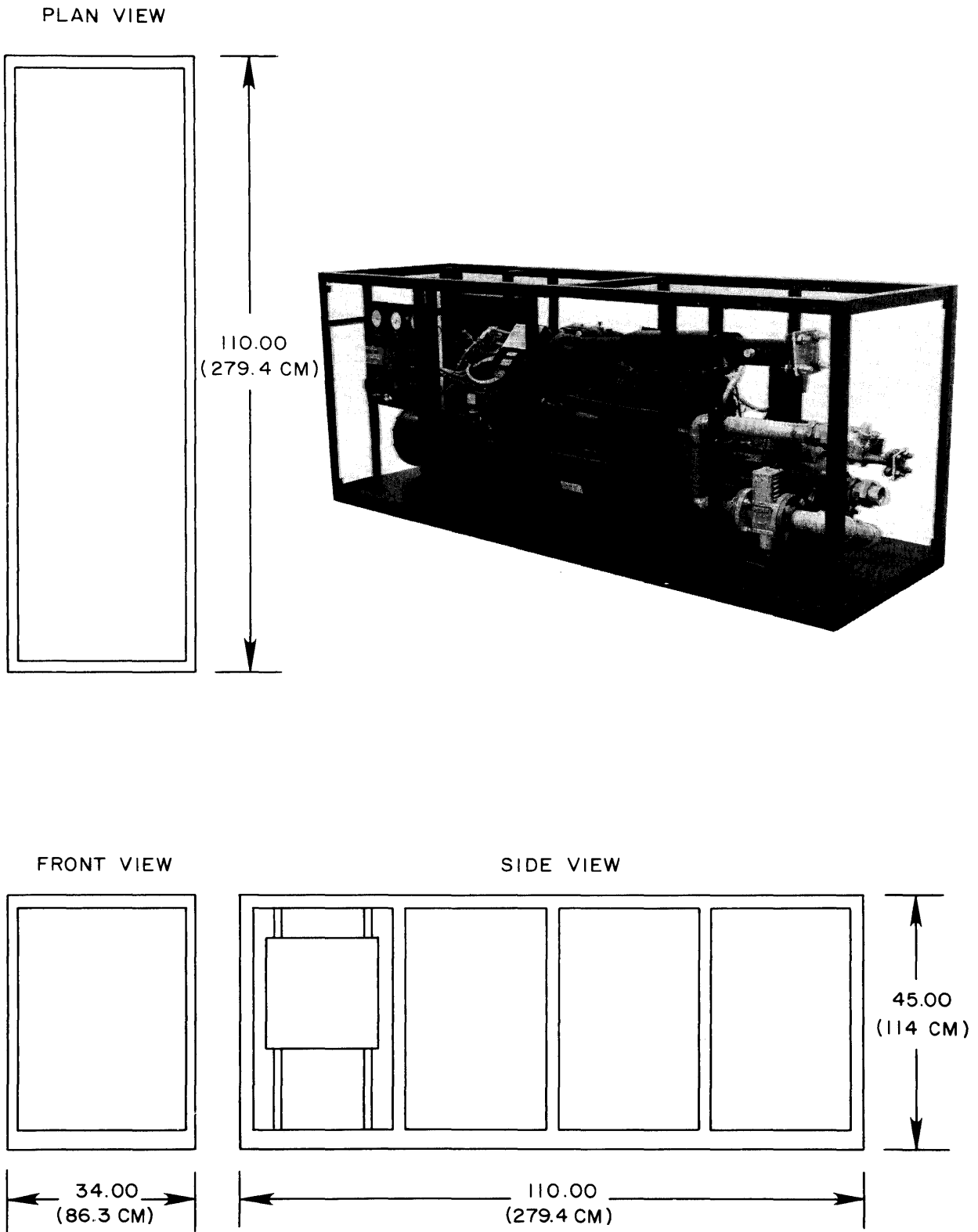


Figure 10-5. Standard RCU-1 Refrigeration Condensing Unit

also offered to cover the floor cutout area and the piping arrangement at the end of the unit. Figure 10-6 identifies the overall dimensions of the RCU-1 when equipped with panels and the frame end extension cabinet.

10.4.4 ACCESS REQUIREMENTS

Adequate access to all four sides of the RCU-1, allowing approximately 2 feet (0.61 M) clearance all around, is required. This space is for the removal and reinstallation of cabinet side panels (when provided), inspection of oil level and pressure gauges and access to filter canisters and controls for changing filters and other maintenance activities.

10.4.5 COOLING REQUIREMENTS

The unit is cooled by a combination of ambient air and cooling water.

10.4.6 ROOM HEAT LOADING CHARACTERISTICS

The RCU-1 produces room heat loading effects estimated at approximately 16,910 BTU/HR (4,960 watts) based upon maximum power consumption.

10.4.7 WATER SUPPLY REQUIREMENTS

The RCU-1 requires that the facility provides an adequate source of clean cooling water which must be supplied at temperatures and flow rates within the ranges indicated by the following table. Although the unit will perform satisfactorily when cooling water temperatures and flow rates fall within the values shown in table 10-1, a water supply at 60° F (16° C) is recommended. Cooling water temperatures (measured at the condensing unit inlet) must not vary more than $\pm 10^{\circ}$ F (5.5° C) from the original design/start-up temperature. Rate of change must not exceed 5° F (2.8° C) per 15 minute cycle.

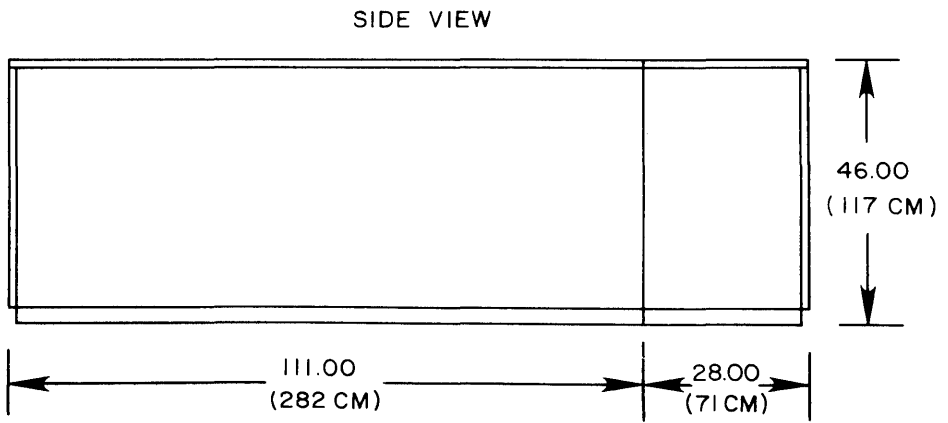
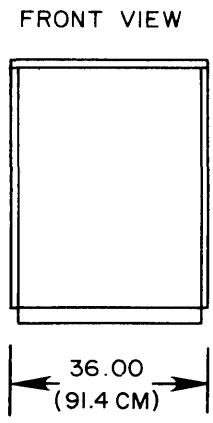
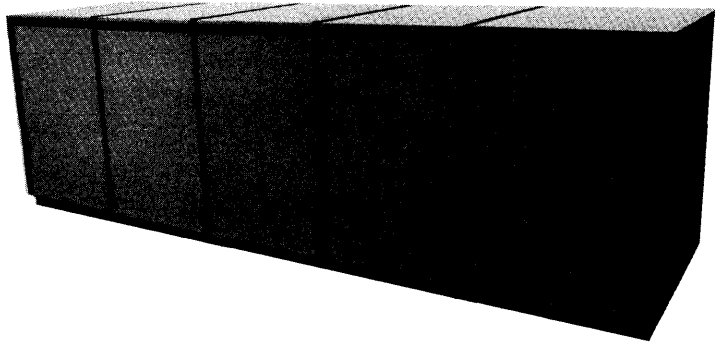
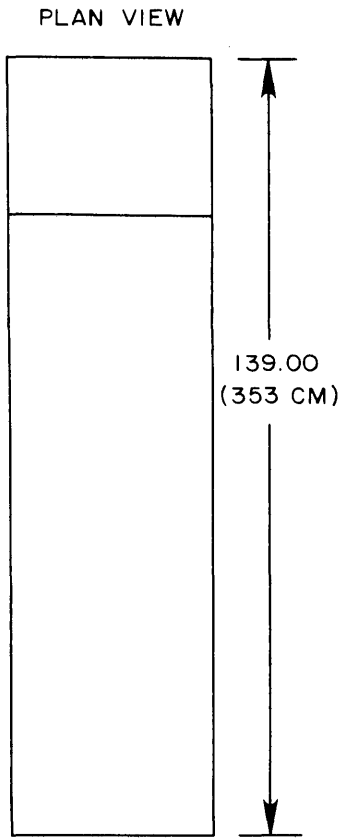


Figure 10-6. Optional RCU-1 Refrigeration Condensing Unit

Table 10-1. RCU-1 cooling water requirements[†]

Temperature (inlet)		Min-flow Rate		Δ P Across cond.	
°F	°C	gpm	m3/min	psi	KPa
40	4	25	0.10	1.0	6.9
50	10	30	0.11	2.0	13.8
60	16	40	0.15	3.0	20.7
70	21	52.5	0.20	6.5	44.8
80	27	85	0.32	22.0	151.6

10.4.8 FLOOR PREPARATION

The RCU-1 Refrigeration Condensing Unit requires floor cutouts only when located within the computer room.

Installation within the computer room requires that floor cutouts be prepared to permit through-floor interconnections for the water pipes, refrigerant pipes, and electrical cables, as shown in figure 10-7.

10.4.9 POWER WIRING REQUIREMENTS

Installing the RCU-1 requires that you supply and install:

- Two 60 Hz, 4-wire circuits for incoming power
- One 2-wire monitoring circuit to the PDU-4 Mainframe Power Distribution Unit, as shown in figure 2-3.

Each of the two 60 Hz circuits must be protected by 60 Ampere circuit breakers, supplied by you, and located close to the RCU-1. No additional cabling is required for the RCU-1.

The incoming power circuits and the monitoring circuit can enter the RCU-1 electrical box from either top or bottom if the unit is installed in a plant room environment. If the unit is installed within the computer room, these circuits must enter from the bottom. Refer to figure 10-6 for an illustration showing the location of the RCU-1 electrical box.

[†] Based on a fully loaded RCU-1

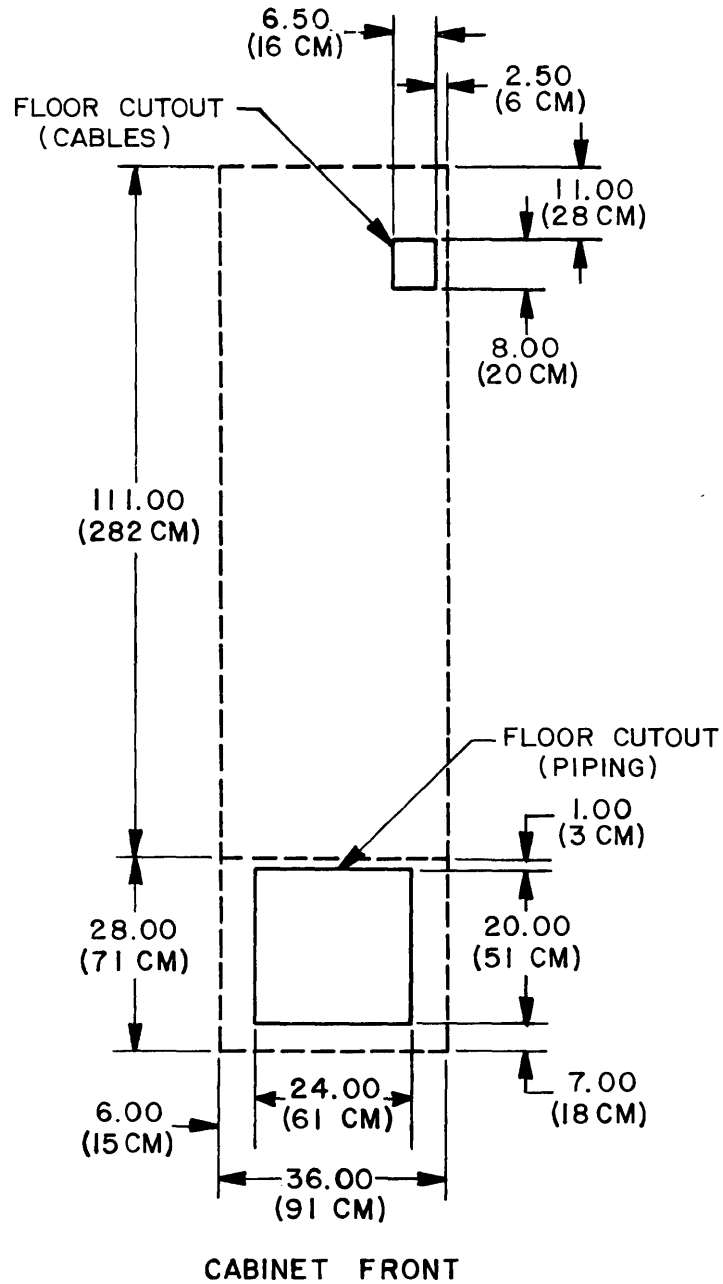


Figure 10-7. RCU-1 floor cutouts

10.4.10 EARTH-GROUNDING REQUIREMENTS

You must provide and install one earth-ground attachment between the RCU-1 and facility ground if the unit is located in a plant room. If located within the computer room, one earth-ground strap must be provided and installed by you in accordance with paragraph 2.4.2.

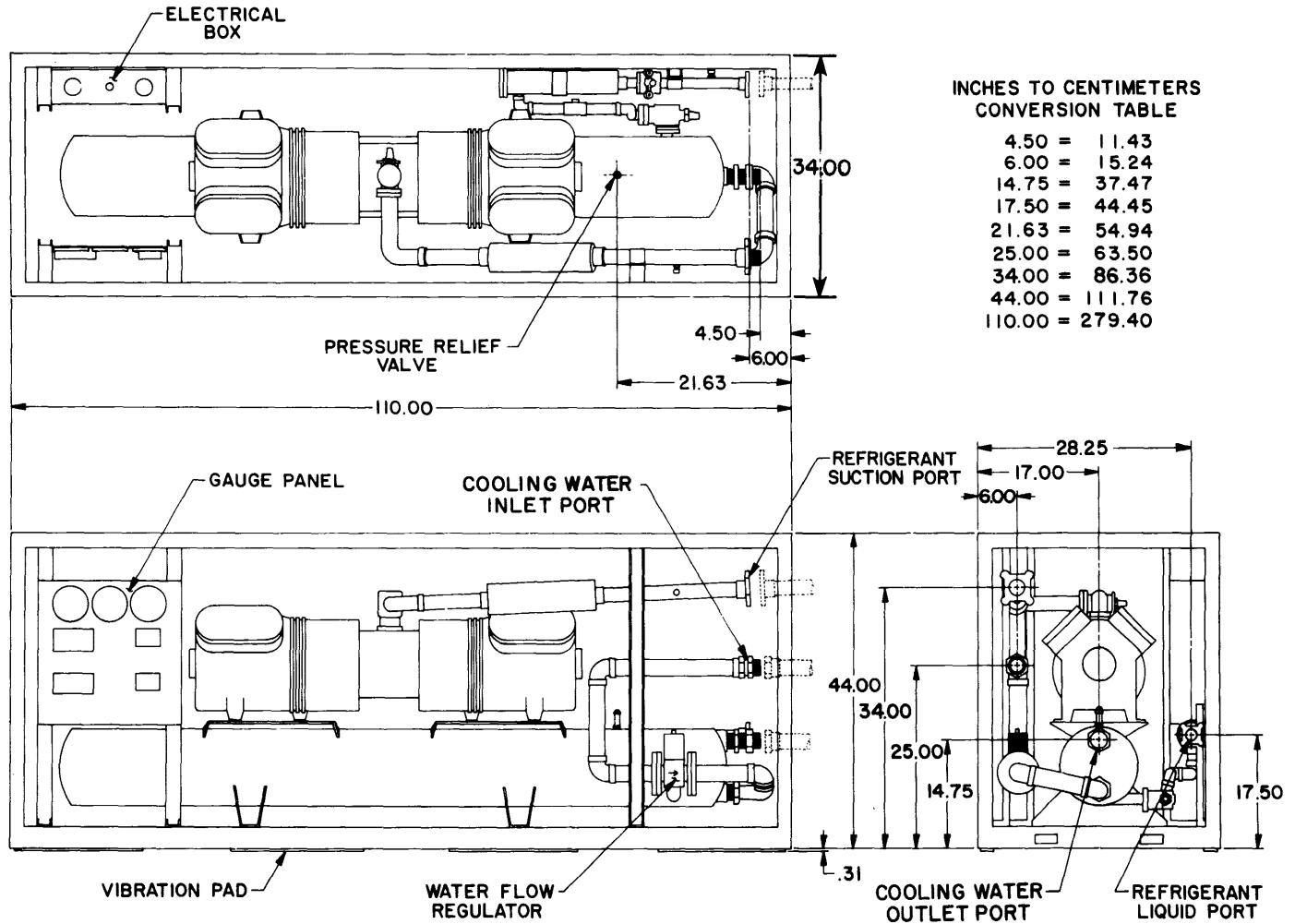
10.4.11 PIPING REQUIREMENTS

You must install the RCU-1 Refrigeration Condensing Unit. In addition, you must supply and install all supplemental materials and components associated with the refrigerant piping and cooling water piping connected to the RCU-1.

Figure 10-8 illustrates the RCU-1 and identifies the locations of the cooling water and refrigerant piping attachments. The following notes provide supplemental information for figure 10-8.

- You must install the RCU-1 with a minimum clearance of 2 feet (0.61 M) on all sides.
- You must install eight vibration pads supplied by CRI with the RCU-1. The pads must be located and spaced along each side, approximately as illustrated in figure 10-8.
- The liquid and suction refrigerant line attachment ports are located as shown in figure 10-8. CRI supplies mating halves of the refrigerant flange couplings and the associated flange coupling gaskets. The suction line flange coupling will accept a 2 5/8-inch (66.68 mm) OD copper tube, and the liquid line flange coupling will accept a 1 3/8-inch (34.93 mm) OD copper tube.
- The liquid and suction refrigerant lines must extend out the end of the RCU-1 and then be routed in the desired direction. You must install refrigerant line vibration eliminators within the liquid and suction lines immediately before the RCU-1 Refrigeration Condensing Unit attachment ports. If the RCU-1 is installed within the computer room of your facility, the refrigerant lines must be routed downward and must be covered by a RCU-1 frame end extension cabinet as defined in subsection 10.4.3.
- Customer supplied refrigerant-line vibration eliminators must be sized in accordance with the main liquid and suction line flange couplings.

Figure 10-8. RCU-1 piping locations



INCHES TO CENTIMETERS
CONVERSION TABLE

4.50	=	11.43
6.00	=	15.24
14.75	=	37.47
17.50	=	44.45
21.63	=	54.94
25.00	=	63.50
34.00	=	86.36
44.00	=	111.76
110.00	=	279.40

- The RCU-1 inlet and outlet ports for the attachment of cooling water pipes are located as shown in figure 10-8. CRI supplies mating halves for the cooling water union couplings. The cooling water union couplings accept a 2 5/8-inch (66.68 mm) OD copper tube.
- The cooling water inlet and outlet lines must extend out the end of the RCU-1 and then be routed in the desired direction. You must install vibration eliminators in the cooling water lines immediately before the RCU-1 attachment ports.
- CRI recommends that you install all refrigerant and cooling water piping in the area of the RCU-1 as soon as possible following receipt of the RCU-1 Refrigeration Condensing Unit. This procedure permits time to discover and correct any slight discrepancies in the location of attachment ports, which can vary from unit to unit.
- Your cooling water system must include a water strainer on the inlet side of the water circuit. This strainer must be located near the RCU-1. Installation of the water strainer must be designed with a by-pass to allow for cleaning and replacement without disruption of water flow.
- The RCU-1 incorporates a water flow regulator valve located as shown in figure 10-8.

At your option, additional water temperature, pressure, and flow rate indicators may be installed within your cooling water piping system. These indicators, if desired, must be supplied and installed by you.

- Maximum RCU-1 Refrigeration Condensing Unit pressure is held to 350 psig (2412 KPa) by a pressure relief valve located as shown in figure 10-8. Discharge capacity of the pressure relief valve is 29.5 pounds of air/minute (0.22 kgs) [standard conditions 1 pound of air at 60° F equals 13.34 cubic feet (3.78 cu. M)] through a 5/8-inch (15.88 mm) flare fitting. At your option, the pressure relief valve discharge port may be directed to atmosphere outside the facility by means of copper tubing. Attachment to the pressure relief valve requires use of a customer-supplied and installed 5/8-inch (15.88) flare fitting and a vibration eliminator.

- The RCU-1 valves must not be opened by you or by your subcontractor before, during, or after installation of the RCU-1 and associated pipework. The RCU-1 is minimally factory charged with refrigerant, and at the time of system installation, CRI system installation personnel must open the valves, adjust all controls and valves, apply power to initiate operation of the unit, and add additional R-22 refrigerant to fully charge the system.
- You must supply a minimum of 250 pounds (113.6 kilograms) of R-22 refrigerant for use by CRI personnel to fully charge the system at the time of start-up.

10.5 MOTOR-GENERATOR SETS

The following four subsections describe in detail the motor-generator sets supplied by CRI to power the CRAY-1 M Series Computer Systems. During the initial stages of the site planning process, you will be notified whether you will be supplied with a KATO Engineering Co. (MGU-1, MGC-1) or General Electric Co. (MGU-2, MGC-2) motor-generator unit and motor-generator cabinet.

Though the general installation requirements are quite similar, there are some differences between the two products. Please refer to the sections appropriate to your installation.

10.5.1 MGU-1 MOTOR-GENERATOR UNIT (KATO)

One MGU-1 Motor-Generator Unit (figure 10-9) is required for each CRAY-1 M Series Computer System. An associated MGC-1 Motor-Generator Control Cabinet is supplied with each motor-generator unit. The motor-generator unit is equipped with one 250 horsepower, 1,800 RPM, 460 volts AC, 3-phase, 60 Hz drive motor and a 40 horsepower "Pony" starting motor. Generator output rating is 150 kW @ .90 to 1.0 PF, 225 volts AC, 3-phase, 400 Hz.

For international locations equipped to supply only 50 Hz power, the motor-generator unit will be supplied for operation from 380-415 volt, 3-phase, 50 Hz line power.

The motor-generator units are equipped with vibration shock pads to dampen the effect of vibration. You must install the MGU-1 and supply and install all associated wiring.

10.5.1.1 Weight

The MGU-1 weighs approximately 4700 pounds (2136 kilograms).

10.5.1.2 Location

The MGU-1 and the MGC-1 must be grouped on a one-for-one basis, and located in the plant room environment in consideration for noise abatement in the computer room. The position of the motor-generator set should be chosen carefully and relative to the location of other equipment for ease of removal and replacement without disrupting the operation of other equipment as well as consideration for the motor-generator unit air inlet/outlet openings.

10.5.1.3 Access requirements

Adequate accessibility for maintenance and replacement of the motor-generator unit is required. The access route for installation and/or removal must provide clearances for both the motor-generator unit and the moving equipment provided by the facility. When the unit is installed and in place, a minimum of 24-inch (15.2 cm) end clearance must be provided for removal of the access covers located at each end of the unit.

10.5.1.4 Cooling requirements

The motor-generator unit requires ambient air for cooling. The maximum air inlet temperature must not exceed 95°F (35°C).

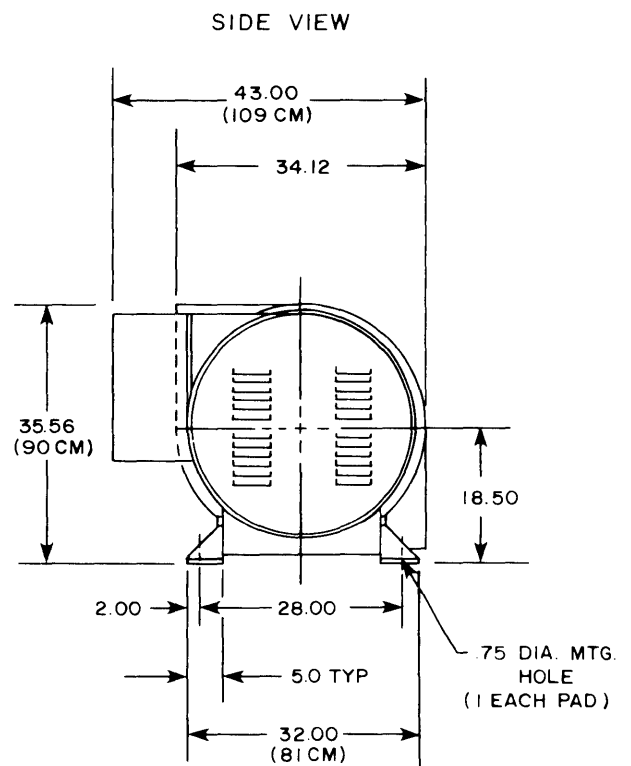
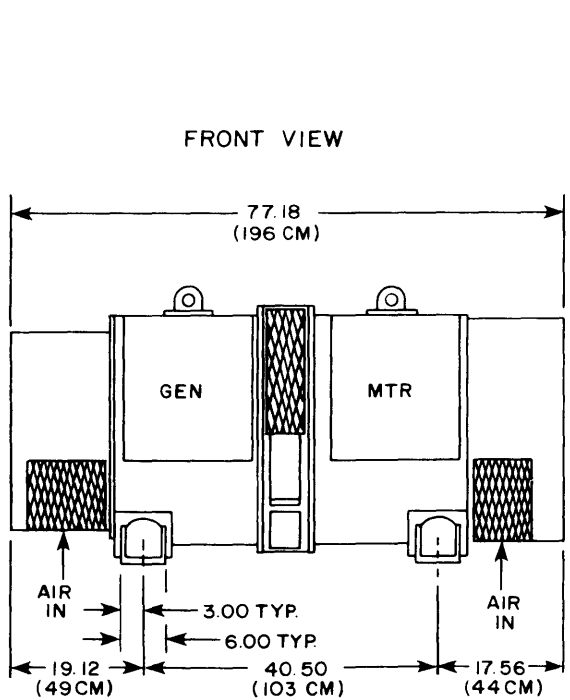
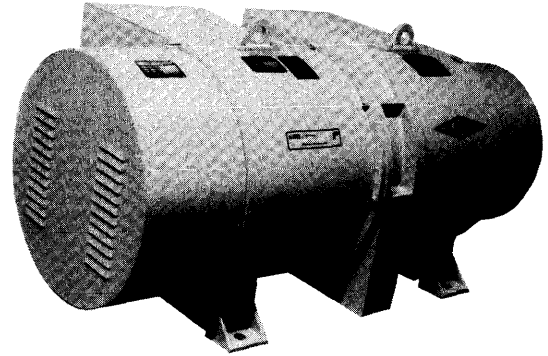
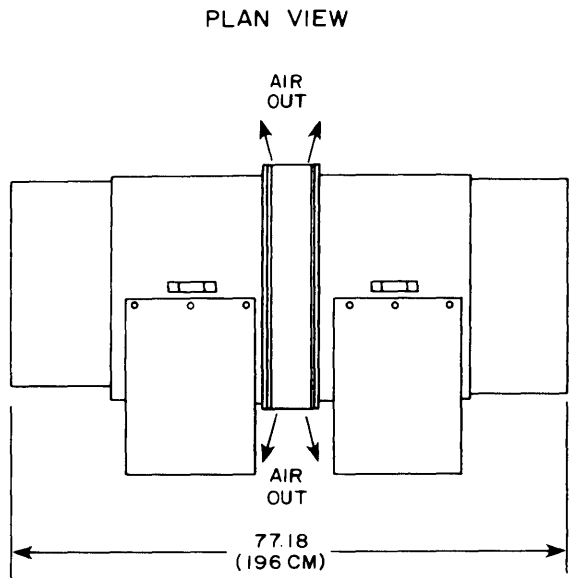


Figure 10-9. MGU-1 Motor-Generator Unit

10.5.1.5 Room heat loading characteristics

The room heat loading effect produced by the unit is approximately 100,000 BTU/HR under maximum loading conditions.

10.5.1.6 Power wiring requirements

The CRAY-1 M Series Computer System requires that one motor-generator unit is installed (see figure 2-3). In addition to all 50 Hz/60 Hz and 400 Hz power wiring, you must supply and install:

- One 5-conductor control circuit between the PDU-4 Mainframe Power Distribution Unit and the motor-generator control cabinet
- One 3-wire #14 AWG twisted cable (in separate conduit) from the 400 Hz computer room circuit breaker panel to the motor-generator control cabinet

The 400 Hz circuit shall each consist of the 3-phase lines and a neutral line, and the wires used for these circuits must be sized to meet a 2% maximum voltage drop. Conductor size and quantities must be approved by CRI.

10.5.2 MGC-1 MOTOR-GENERATOR CONTROL CABINET (KATO)

A MGC-1 Motor-Generator Control Cabinet (figure 10-10) is required for the MGU-1 Motor-Generator Unit. The control cabinet contains specially designed motor start/stop and control circuitry to provide for remote control of the motor and excitation fields of the motor-generator unit from the Mainframe Power Distribution Unit. The control and regulating devices are housed in two interconnecting cabinet sections called the motor control section and the generator control section.

The motor control section is located on the left side. It contains the motor starting equipment, motor protective equipment, switches, meters, and indicating lights required for motor operation.

The generator control section is located on the right side. It contains generator control and protective equipment, switches, meters, and indicating lights required for generator operation, plus other components required for external control.

Terminals for motor-generator unit control lines, 60 Hz input power lines, and 400 Hz output power lines are located near the bottom, within the two cabinet sections. Detailed information will be supplied during the initial stages of the site planning process regarding location of all power and control wire terminations.

The motor-generator control cabinet is equipped for surface mounting and includes accommodations for securing to the floor or supporting surface.

You must install the motor-generator control cabinet and supply and install all associated wiring.

10.5.2.1 Weight

The motor-generator control cabinet weighs approximately 1200 pounds (545 kilograms).

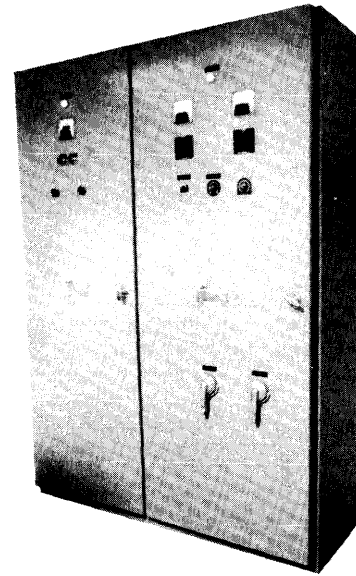
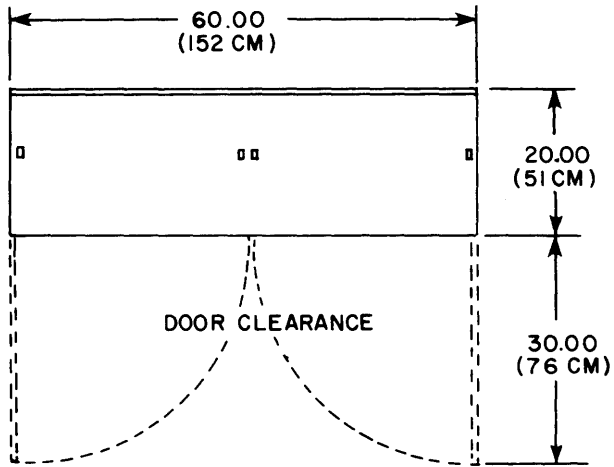
10.5.2.2 Location

The motor-generator control cabinet must be located near the motor-generator unit and placed in a plant room environment.

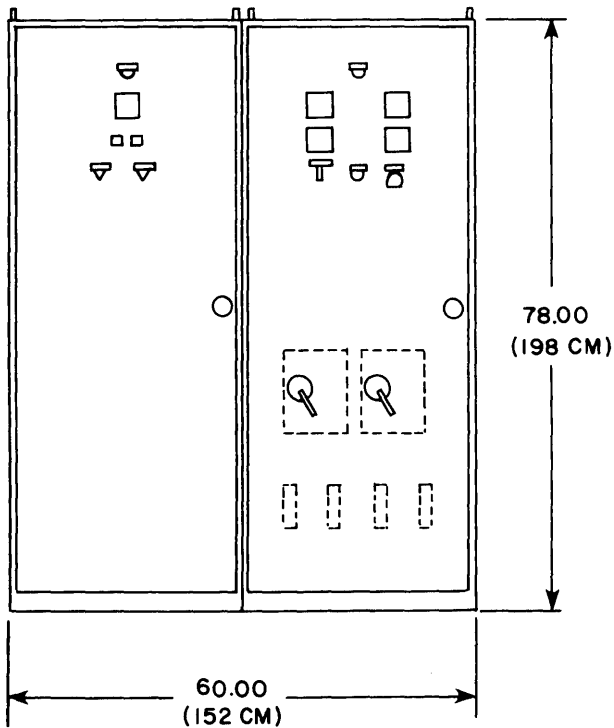
10.5.2.3 Access requirements

A 36-inch (91.4 cm) clearance must be provided at the front of the control cabinet to allow for door swing to gain access to internal components and wiring.

PLAN VIEW



FRONT VIEW



SIDE VIEW

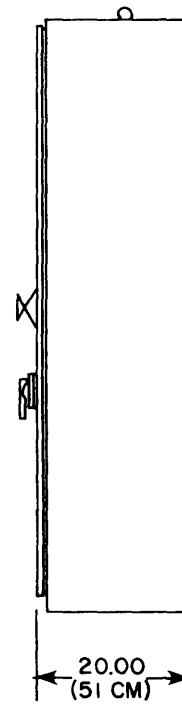


Figure 10-10. MGC-1 Motor-Generator Control Cabinet

10.5.2.4 Cooling requirements

The motor-generator control cabinet requires ambient air for cooling purposes. Use care when locating the cabinet to prevent adjacent equipment from exhausting heated air directly onto it.

10.5.2.5 Room heat loading characteristics

The motor-generator control cabinet does not generate heat beyond the normal temperature rise of the associated controls and cables. Therefore, room heat loading effects are negligible.

10.5.2.6 Power wiring requirements

All 50 Hz/60 Hz and 400 Hz power wiring and associated control wiring, for operation of the motor-generator unit, occurs through the motor-generator control cabinet (refer to figure 2-3). Cabinet construction allows for wiring entrance through the base or top of the unit.

10.5.3 MGU-2 MOTOR-GENERATOR UNIT (General Electric)

One MGU-2 Motor-Generator Unit (figure 10-11) is required for each CRAY-1 M Series Computer System. An associated MGC-2 Motor-Generator Control Cabinet is supplied with each motor-generator unit. The motor-generator unit is equipped with one 250 horsepower, 3600 RPM, 460 volts AC, 3-phase, 60 Hz drive motor. Generator output rating is 150 kW @ .90 to 1.0 PF, 225 volts AC, 3-phase, 400 Hz.

The motor-generator units are equipped with vibration shock pads to dampen the effect of vibration. You must install the MGU-2 and supply and install all associated wiring.

10.5.3.1 Weight

The MGU-2 weighs approximately 3500 pounds (1590 kilograms).

10.5.3.2 Location

The MGU-2 and the MGC-2 must be grouped on a one-for-one basis, and located in the plant room environment in consideration for noise abatement in the computer room. The position of the motor-generator set should be chosen carefully and relative to the location of other equipment for ease of removal and replacement without disrupting the operation of other equipment as well as consideration for the motor-generator unit air inlet/outlet openings.

10.5.3.3 Access requirements

Adequate accessibility for maintenance and replacement of the motor-generator unit is required. The access route for installation and/or removal must provide clearances for both the motor-generator unit and the moving equipment provided by the facility. When the unit is installed and in place, a minimum of 24-inch (15.2 cm) end clearance must be provided for removal of the access cover located at the generator end of the unit.

10.5.3.4 Cooling requirements

The motor-generator unit requires ambient air for cooling. The maximum air inlet temperature must not exceed 95°F (35°C).

10.5.3.5 Room heat loading characteristics

The room heat loading effect produced by the unit is approximately 100,000 BTU/HR under maximum loading conditions.

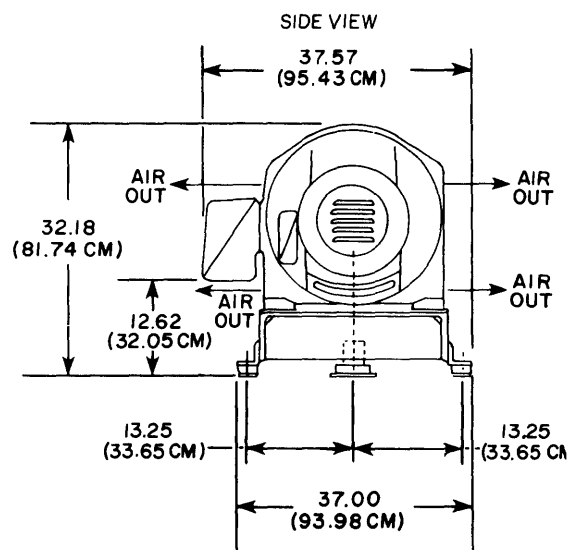
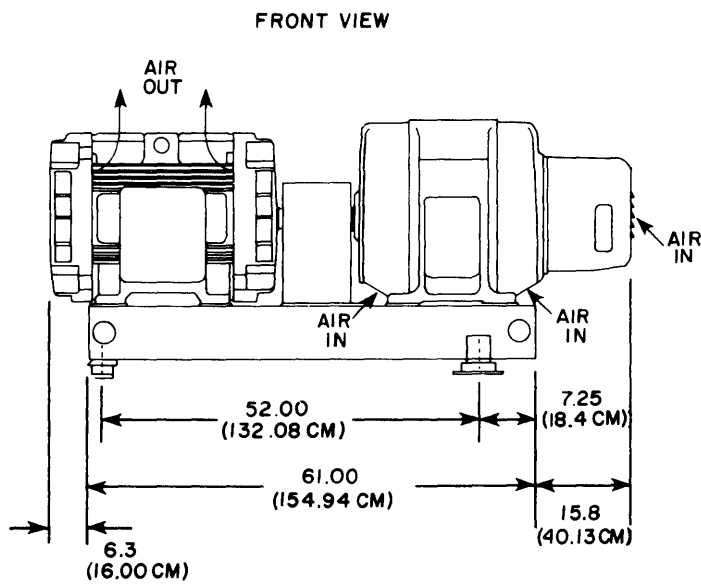
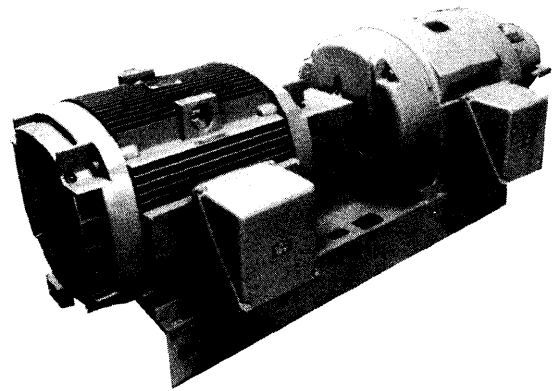
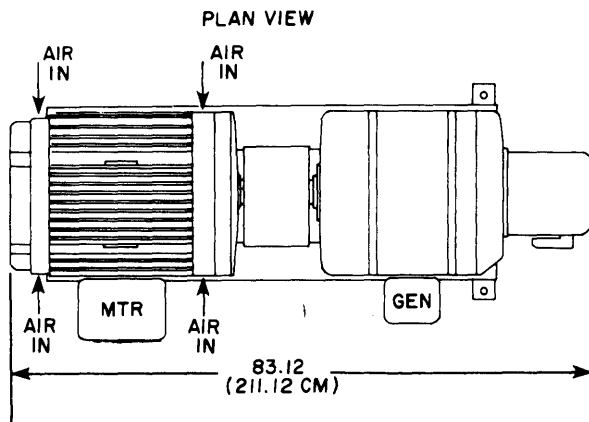


Figure 10-11. MGU-2 Motor-Generator Unit

10.5.3.6 Power wiring requirements

The CRAY-1 M Series Computer System requires that one motor-generator unit is installed (see figure 2-3). In addition to all 50 Hz/60 Hz and 400 Hz power wiring, you must supply and install:

- One 5-conductor control circuit between the PDU-4 Mainframe Power Distribution Unit and the motor-generator control cabinet
- One 3-wire #14 AWG twisted cable (in separate conduit) from the 400 Hz computer room circuit breaker panel to the motor-generator control cabinet

The 400 Hz circuit shall each consist of the 3-phase lines and a neutral line, and the wires used for these circuits must be sized to meet a 2% maximum voltage drop. Conductor size and quantities must be approved by CRI.

10.5.4 MGC-2 MOTOR-GENERATOR CONTROL CABINET (General Electric)

A MGC-2 Motor-Generator Control Cabinet (figure 10-12) is required for the MGU-2 Motor-Generator Unit. The control cabinet contains specially designed motor start/stop and control circuitry for remote control of the motor and excitation fields of the motor-generator unit from the Mainframe Power Distribution Unit. The control and regulating devices are housed in two interconnecting cabinet sections called the motor control section and the generator control section.

The motor control section is located on the left side. It contains the motor starting equipment, motor protective equipment, switches, meters, and indicating lights required for motor operation.

The generator control section is located on the right side. It contains generator control and protective equipment, switches, meters, and indicating lights required for generator operation, plus other components required for external control.

Terminals for motor-generator unit control lines, 60 Hz input power lines, and 400 Hz output power lines are located near the top, within the two cabinet sections. Detailed information will be supplied during the initial stages of the site planning process regarding location of all power and control wire terminations.

The motor-generator control cabinet is equipped for surface mounting and includes accommodations for securing to the floor or supporting surface.

You must install the motor-generator control cabinet and supply and install all associated wiring.

10.5.4.1 Weight

The motor-generator control cabinet weighs approximately 1350 pounds (613 kilograms).

10.5.4.2 Location

The motor-generator control cabinet must be placed in a plant room environment near the motor-generator unit.

10.5.4.3 Access requirements

A 36-inch (91.4 cm) clearance must be provided at the front of each control cabinet to allow for door swing to gain access to internal components and wiring.

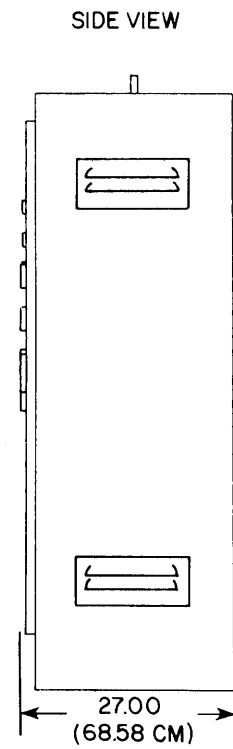
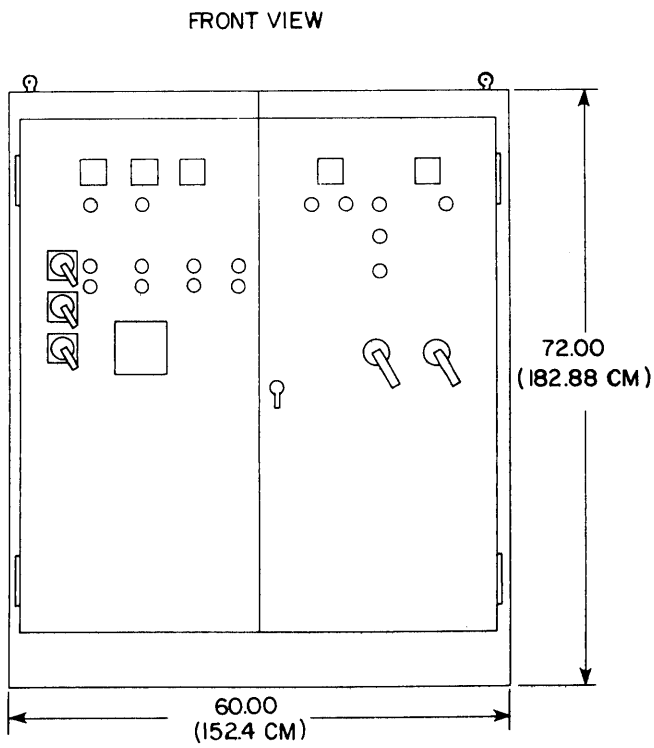
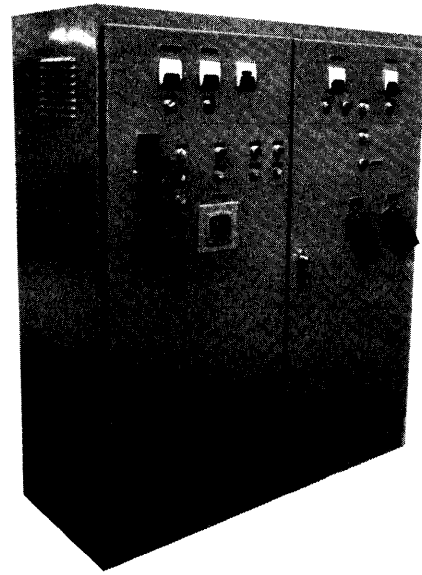
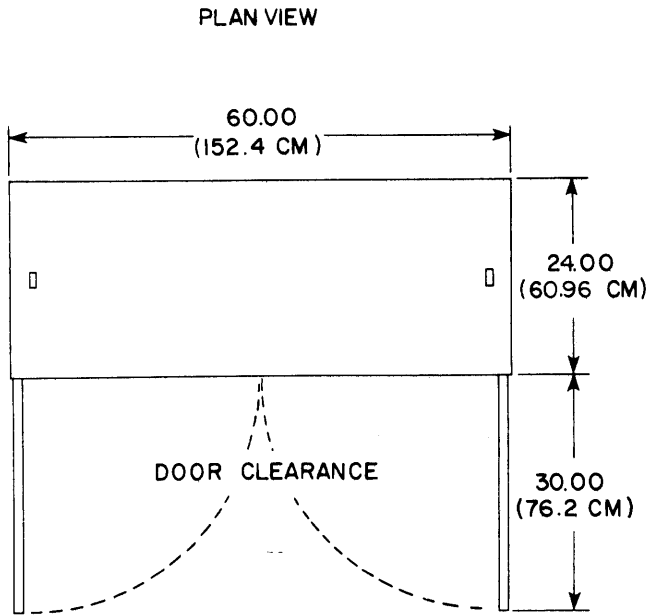


Figure 10-12. MGC-2 Motor-Generator Control Cabinet

10.5.4.4 Cooling requirements

The motor-generator control cabinet requires ambient air for cooling purposes. Use care when locating the cabinet to prevent adjacent equipment from exhausting heated air directly onto it.

10.5.4.5 Room heat loading characteristics

The motor-generator control cabinet does not generate heat beyond the normal temperature rise of the associated controls and cables. Therefore, room heat loading effects are negligible.

10.5.4.6 Power wiring requirements

All 60 Hz and 400 Hz power wiring and associated control wiring, for operation of the motor-generator unit, occurs via the motor-generator control cabinet (refer to figure 2-3). Cabinet construction allows for wiring entrance through the base or top of the unit.

10.6 MTS-3 MODULE TEST STATION

Miscellaneous support equipment for the CRAY-1 M Series Computer System may include an MTS-3 Module Test Station.

The test station is not part of the CRAY-1 M Series Computer System but is part of the field engineering equipment, which remains CRI property if the computer system is acquired by you under a purchase contract.

The MTS-3 Module Test Station (figure 10-13) is a functionally integrated, self-contained field support station. The unit consists of an MCG-3 Maintenance Control Group and an air-cooled module test unit housed in separate cabinets. The MCG-3 Maintenance Control Group consists of an MMCU Maintenance Microcomputer Unit and a CRT-4 Display (see section 8). The module test unit provides a cold-plate module chassis for both static and dynamic module testing, and separate power supplies to drive the electronics within the tester and the modules undergoing tests.

10.6.1 WEIGHT

The two cabinets weigh approximately a total of 450 pounds (205 kilograms).

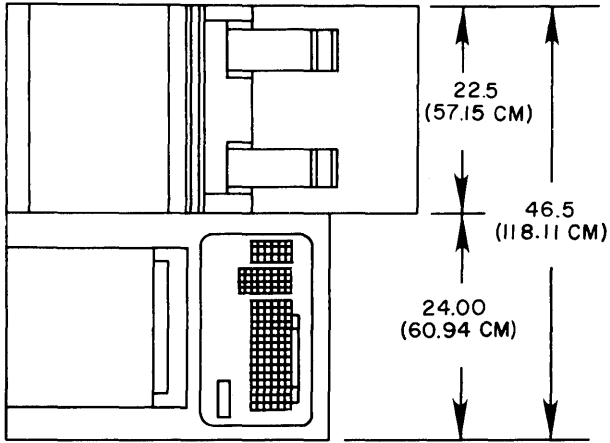
10.6.2 LOCATION

The test station should be located in the maintenance engineering shop area provided for the resident CRI field engineers. The units are equipped with casters for mobility.

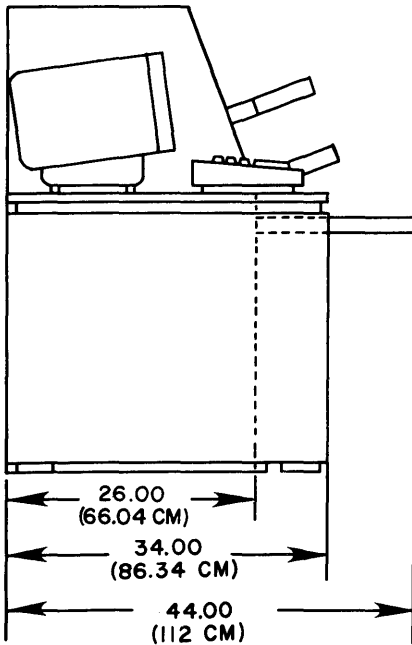
10.6.3 ACCESS REQUIREMENTS

Adequate provision must be made for access at the front of the test station for an operator's chair and for module testing activities. Adequate clearance (approximately 12 inches or 30.5 cm) must also be maintained at the rear of the cabinet to permit the unrestricted flow of exhaust air from the power supply and condensing unit cooling fans.

PLAN VIEW



SIDE VIEW



FRONT VIEW

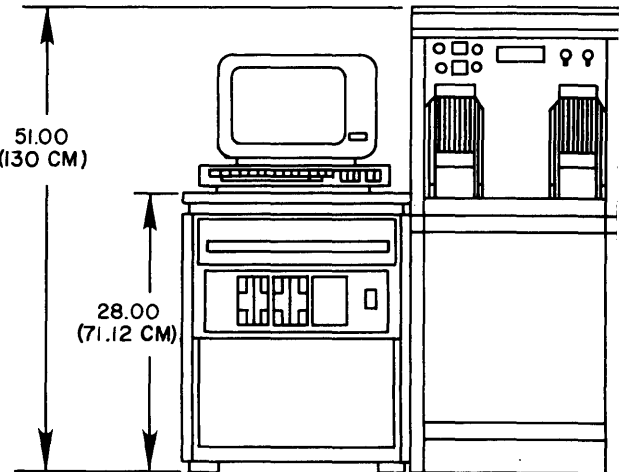


Figure 10-13. MTS-3 Module Test Station

10.6.4 COOLING REQUIREMENTS

The module test station is a fan-cooled unit using ambient room air.

10.6.5 ROOM HEAT LOADING CHARACTERISTICS

Room heat loading effects produced by the unit are approximately 5300 BTU/HR (1556 watts).

10.6.6 POWER WIRING REQUIREMENTS

The two cabinets of the module test station are each equipped with 7-foot (2.1 M) pluggable drop cord power cables (see figure 2-4). You must provide and install mating power receptacles. The mating power receptacles can, at your option, be either the box-mounted or in-line type.

The drop cord power plugs furnished with the test station are specified by manufacturer's type designation in the CRI site planning documentation supplied to you.

10.6.7 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing the mating power receptacles, you must also provide and install two earth-ground straps to the units in accordance with paragraph 2.4.2.

This section discusses the restrictions associated with the arrangement of CRAY-1 M Series Computer System equipment in a computer room.

Technical data and references contained within this section are intended as an overview of general requirements and are given for a typical installation only. Many of the detailed requirements vary from site to site; therefore, some of this information may change.

You must prepare drawings and adequate documentation to provide specific, detailed information about the arrangement and location of individual equipment units. You should submit proposed floor plans to CRI for review and approval at an early stage of the site planning sequence. Prior to beginning site preparations, CRI site planning personnel must approve the proposed equipment arrangement.

11.1 GENERAL REQUIREMENTS

The arrangement of computer equipment within the facility must meet certain placement and separation requirements while satisfying the following general requirements:

- Satisfactory system installation and set-up
- Satisfactory operator and maintenance access
- Satisfactory personnel safety
- The highest degree of system performance achievable

Although many different equipment arrangements are feasible, all must meet the signal cable and refrigerant piping length requirements. Consideration should also be given to the power wiring lengths to minimize voltage drops.

Figure 11-1 illustrates equipment separation limits for the CRAY-1 M Series Computer System. An optional SSD Solid-state Storage Device is included in this illustration. Indicated dimensions relate to the maximum signal cable and refrigerant piping lengths permissible. Actual placement and orientation of equipment can be restricted due to available routes for cables and piping below the computer room raised flooring.

11.2 FLOOR PLAN ARRANGEMENTS

Figure 11-2 illustrates an acceptable arrangement of a CRAY-1 M Series Computer System. An optional SSD Solid-state Storage Device is included in this illustration. This floor plan represents a computer room of 572 square feet (51.5 m²). The equipment units are located on a 11 x 13 grid, which represents 24-inch square (60.96 cm) computer room floor tiles. A triangular symbol located on each of the equipment units indicates the operator's access to the equipment unit.

The FEC-1 Front-End Interface Cabinet, RCU-1 Refrigeration Condensing Unit, and motor-generator sets are not illustrated in figure 11-2 due to their remote locations.

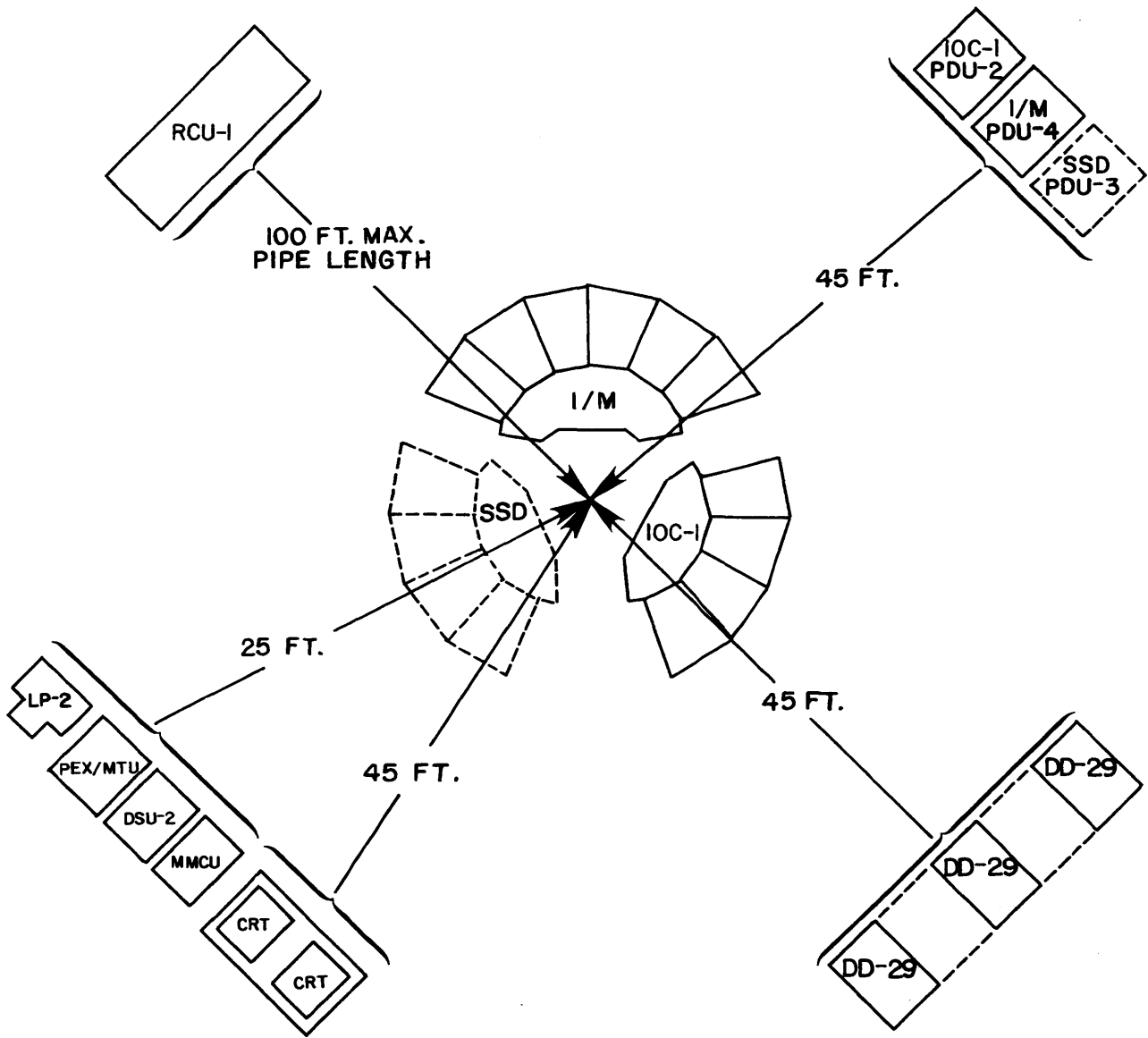


Figure 11-1. Equipment separation limits for CRAY-1 M Series Computer System

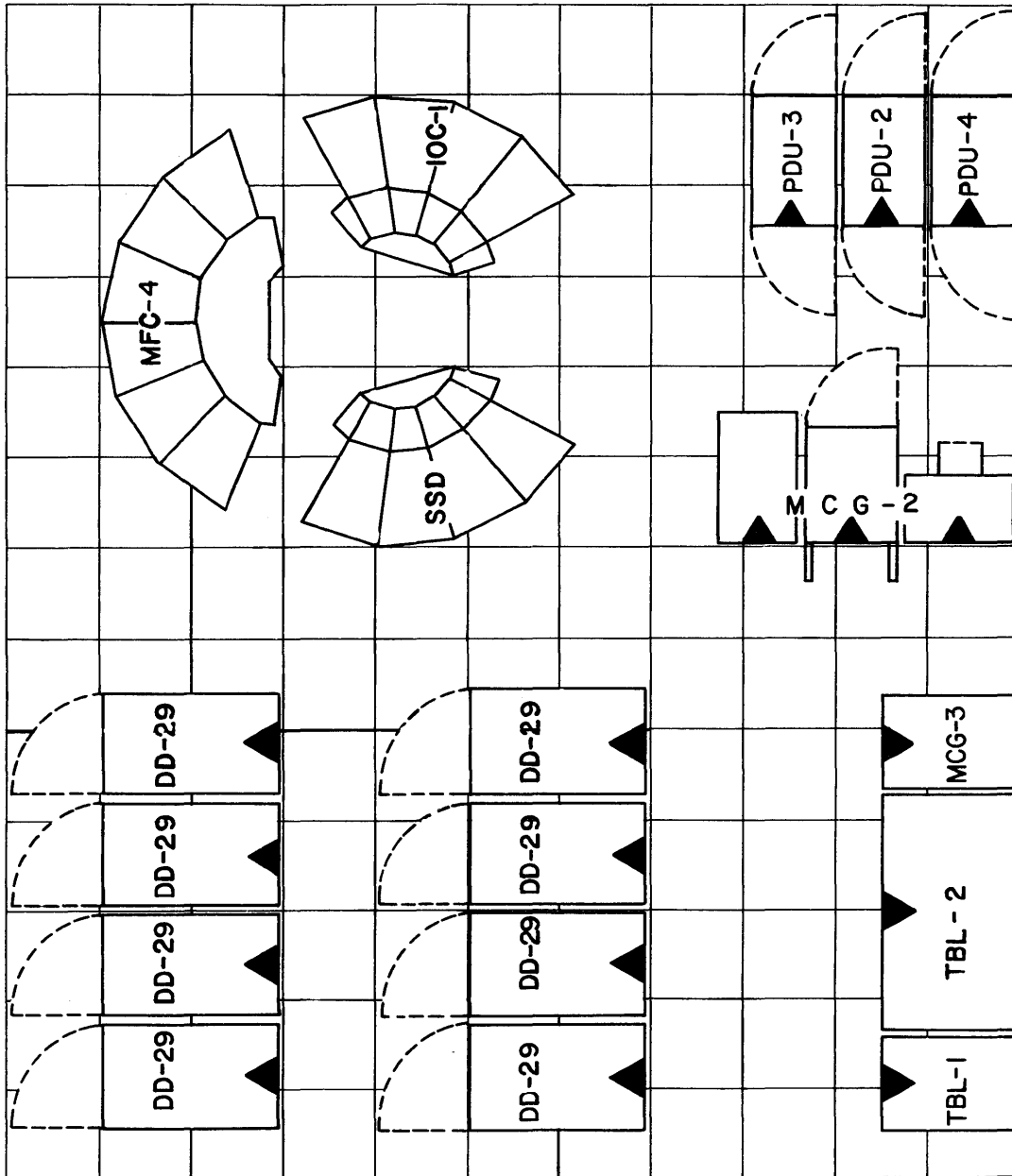


Figure 11-2. Typical computer room floor plan for a CRAY-1 M Series Computer System

Figures 1, 2, 3 and 4 provide scaled, peel-off templates to aid in the configuration of a CRAY-1 M Series Computer System. Figures 5 and 6 are computer room layouts scaled for 2-foot floor tile.

The templates contained in figures 1, 2 and 5 are scaled in U.S. standard units.

The templates contained in figures 3, 4 and 6 are scaled in S.I. metric units.

ABBREVIATIONS

A

The following abbreviations were used in this publication.

AC	Alternating current
ASCII	American Standard Code for Information Interchange
BTU	British thermal units
°C	Degrees Celsius
cm	Centimeter
CRI	Cray Research, Incorporated
CRT-4	Display
DC	Direct current
DCC-1	Disk controller cabinet
DSU-2	Disk storage unit
ΔP	Change in pressure
°F	Degree Fahrenheit
FEC-1	Front-end interface cabinet
ft	Foot, feet
gpm	Gallons per minute
Hertz	Cycles per second
Hp	Horse power
HR	Hour
Hz	Hertz
ID	Inside diameter
IOC-1	I/O Subsystem 4-column chassis
KPa	Kilo Pascals
KVA	Kilo volt amperes
LP-2	Line printer
M	Meter
MCG-2	Maintenance control group (PEX and subsystem)

MCG-3	Maintenance control group (MMCU and CRT-4)
m^3/min	Cubic meters per minute
MFC-4	CRAY-1 M Series 6-Column Mainframe
MGU-1	Motor-generator unit (KATO)
MGU-2	Motor-generator unit (G.E.)
MGC-1	Motor-generator control cabinet (KATO)
MGC-2	Motor-generator control cabinet (G.E.)
MMCU	Maintenance Microcomputer Unit
MTS-3	Module test station
MTU-1	Magnetic tape unit
OD	Outside diameter
PEX-1	Peripheral Expander Unit
PDU-2	IOC-1 Power Distribution Unit
PDU-3	SSD Power Distribution Unit
PDU-4	Mainframe Power Distribution Unit
PF	Power factor
PSI	Pounds per square inch
RCU-1	Mainframe refrigeration condensing unit
RFI	Radio frequency interference
SSD	Solid-state Storage Device
TBL-1	Single display table
TBL-2	Dual display table
V	Voltages, volt

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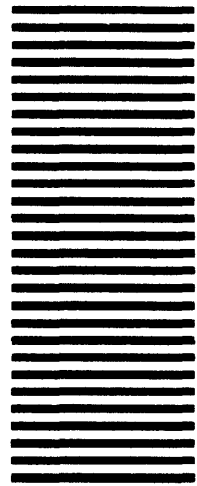


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