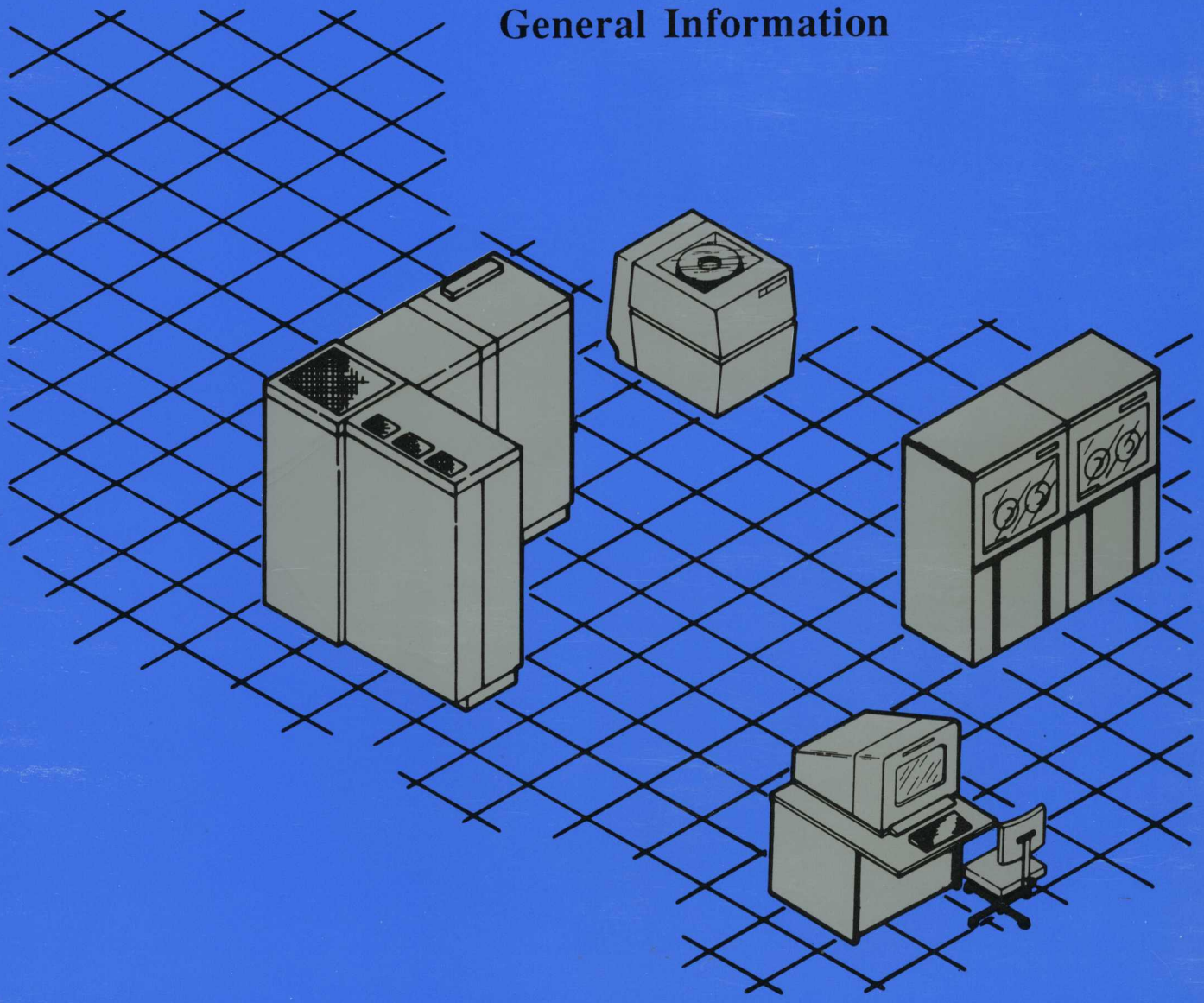
Control Data Computer Systems

Site Preparation

CONTROL DATA

General Information



60275100

Control Data Computer Systems
Site Preparation
General Information

Publication Number 60275100

Manual History

Previous Revision	Engineering, Field, or Publication Change Order(s)	Date
A	Released	September 1969
B	ECO 25957	September 1971
C	ECO 34459	November 1973
D	ECO 36986	February 1976
E	ECO 41094	April 1980
F	ECO 41756	October 1980
G	PCO 48936	June 1987

Revision G obsoletes all previous editions by adding new information throughout the manual.

About This Manual

This manual provides general information for the planning and preparing of a computer site for an effective equipment installation of CONTROL DATA® computer equipment.

Audience

This manual addresses Control Data customers or their representatives who are responsible for planning and carrying out the site preparation activities.

Terminology

This manual uses the following terms as described.

Computer room	A room with a controlled environment maintained to meet the requirements of the system equipment.
Site	The computer room and other building locations that may include one or more motor-generator (M-G) sets and data media storage.
Mainframe complex	The central processor, input/output unit, central memory, system console, associated water cooling unit, M-G set, and any power control or environmental monitoring equipment that are part of the system.
Must	A mandatory requirement.
Should	A recommendation that is advised but not required.

Manual Organization

This manual contains six chapters that are the basis for your site planning. Although the chapters follow a general order of planning, the chapters do have some overlapping information. (For example, Data Media Storage involves site environment.) Because of this, you may want to become familiar with the the entire manual before beginning. The manual is organized into six chapters dealing with major site issues, such as electrical power, and an index.

Related Manuals

This manual is the general guide for site preparation for Control Data computer systems. The manual is intended for use with the following manuals that describe the mainframe, peripheral, and communications equipment.

Control Data Computer System
Site Preparation Mainframe Complex Data
(The publication number for this manual is unique for each mainframe complex and is identified in the Literature Catalog.)

Control Data Computer Systems
Site Preparation Peripheral Equipment Data
(Publication Number 60275300)

CDCNET Local Area Network
Installation
(Publication Number 60462870)

Ordering Manuals

You can order Control Data manuals from:

Control Data Corporation
Literature and Distribution Services
308 North Dale Street
St. Paul, Minnesota 55103

Ordering information, prices, and the current revision levels are in the Literature Catalog (publication number 90310500).

Disclaimer

Site preparation information for system equipment operation is valid only as described in this manual and other referenced manuals and documents. Control Data cannot be responsible for problems that result from improper site preparation or from the customer's failure to comply with applicable building, electrical, and fire codes or ordinances.

IT IS THE CUSTOMER'S RESPONSIBILITY TO ENSURE THAT APPLICABLE BUILDING, ELECTRICAL, AND FIRE CODES OR ORDINANCES ARE FOLLOWED.

Contents

Figures

Tables

Introduction 1

Introduction 1

This chapter stresses that you become acquainted with the computer system planning and installation requirements and emphasizes meeting those requirements. The chapter also defines the Control Data assistance available to you.

Planning Site Installation

Preparations for a computer system installation at a new or existing site require your understanding the system equipment installation and operating requirements. For specific equipment requirements, this manual refers you to:

- Site Preparation Mainframe Complex Data manuals
- Site Preparation Peripheral Equipment Data manual

Customer Responsibility

As a Control Data customer, it is your responsibility to perform site planning and timely completion of the site preparations. These are essential for an effective computer installation. Your preparations include filling in a site data report and a site readiness report. Forms for both are in the Site Preparation Mainframe Complex Data manual. Control Data recommends that you designate a building facilities person to plan and coordinate these preparations.

Four weeks before delivery of your equipment, you must fill in the site data report and send it to your Control Data Engineering Services installation coordinator. The report helps you to identify and notify Control Data of potential problems associated with receiving equipment at your site.

Two weeks before delivery of your equipment, you must fill in a site readiness report. This report helps you to verify that the site is ready for the installation of equipment.

Assistance

During your site planning and preparations, you may have questions about circumstances that are beyond the descriptions covered in this and the other site preparation manuals. Your Control Data Engineering Services installation coordinator is available to answer those questions or direct you to appropriate resources.

Table 1-1 provides a list of the major site preparation considerations that appear in this manual. This table is intended as a guide to assist your planning and tracking of site preparations.

Table 1-1. Site Preparation Checklist

Planning Considerations	Planning Completed Date	Planned Work Completion Date	Actual Work Completion Date
Initial Site Considerations			
Location of Site	_____	_____	_____
Space Considerations	_____	_____	_____
Construction of Site	_____	_____	_____
Site Protection	_____	_____	_____
Environment			
Air Conditioning	_____	_____	_____
Water Supply	_____	_____	_____
Lighting	_____	_____	_____
Acoustics	_____	_____	_____
Power and Grounding			
Power Requirements	_____	_____	_____
Power Distribution	_____	_____	_____
Power Connections	_____	_____	_____
Convenience Outlets	_____	_____	_____
Motor-Generator (M-G) Sets	_____	_____	_____
Phase Rotation	_____	_____	_____
Grounding	_____	_____	_____
Communications			
Control Data Network	_____	_____	_____
Loosely Coupled Network	_____	_____	_____
Remote Technical Assistance	_____	_____	_____
Data Media Storage			
Magnetic Disk Pack Storage	_____	_____	_____
Magnetic Tape Storage	_____	_____	_____
Paper Tape and Punch Card Storage	_____	_____	_____

Initial Site Considerations 2

Initial Site Considerations 2

This chapter outlines your first site planning considerations for selecting a site, planning the equipment locations, and determining construction options.

Your responsibility in the initial site considerations includes selecting the physical characteristics of your site and designing an equipment layout. To do this, you must refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals for site information that applies to your specific equipment. These manuals also contain scaled floor templates and grids that will help you design the equipment layout.

Location of Site

Selection of a site includes space requirements in a new or existing building. In either circumstance, you will want to consider how the building location and site location within the building will impact the operation of the computer system.

Building Location

Geographical location should be among your first considerations. Its location is generally not critical, but you should avoid some undesirable conditions.

Earthquakes

Control Data computer systems can withstand minor shocks; however, the effects of such shocks are cumulative and may cause unpredictable degradation of the system performance over long periods. A selected site that is in a location that is known to have a history of severe earthquakes may require special considerations. In such a case, you should consult a structural engineer.

Interference

A site should not be in the path of high electrical field that could result from transmission sources such as radar or microwave. Such an area may have an adverse affect on the operation of the computer system.

Altitude

Control Data computer systems are designed to operate at altitudes of up to 3050 m (10 000 ft), unless stated otherwise in equipment specifications in the Site Preparation Mainframe Complex Data or Peripheral Equipment Data manuals.

Site Room Location

The site may include a computer room, a shared or separate printer or tape room, a data storage area, and a separate M-G set location. In selecting these areas, you may want to consider the following characteristics.

Future Expansion

Future expansion of a site may be limited or impossible unless it is part of your initial planning considerations. Allowing for later expansion and taking into account environmental needs, power, and site water (as required) will affect your choice of a site.

Accessibility

You will want a computer room that will be easily accessible for equipment deliveries. This means adequate hallway widths, hallway turns, and door clearances for moving the system equipment, including an M-G set, from the receiving area to the computer room. If the equipment requires movement between floors, a service elevator must also be available with size and load ratings capable of carrying the equipment.

To determine the necessary equipment clearances and load requirements, refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

Hazardous Conditions

The computer room, M-G set location, and data media storage location should each provide maximum protection from water damage, hazardous chemicals, gases, and corrosive materials.

Vibrations

A computer room subject to vibrations such as those of an office environment normally will not affect Control Data computer systems. Although the systems can withstand intermittent low-frequency vibrations, the effects of vibrations are cumulative and may cause unpredictable degradation of system performance over long periods.

Control Data designs its equipment to withstand the vibration limitations defined by the bold line on the frequency and acceleration chart in figure 2-1. Equipment operating conditions must not exceed those limitations.

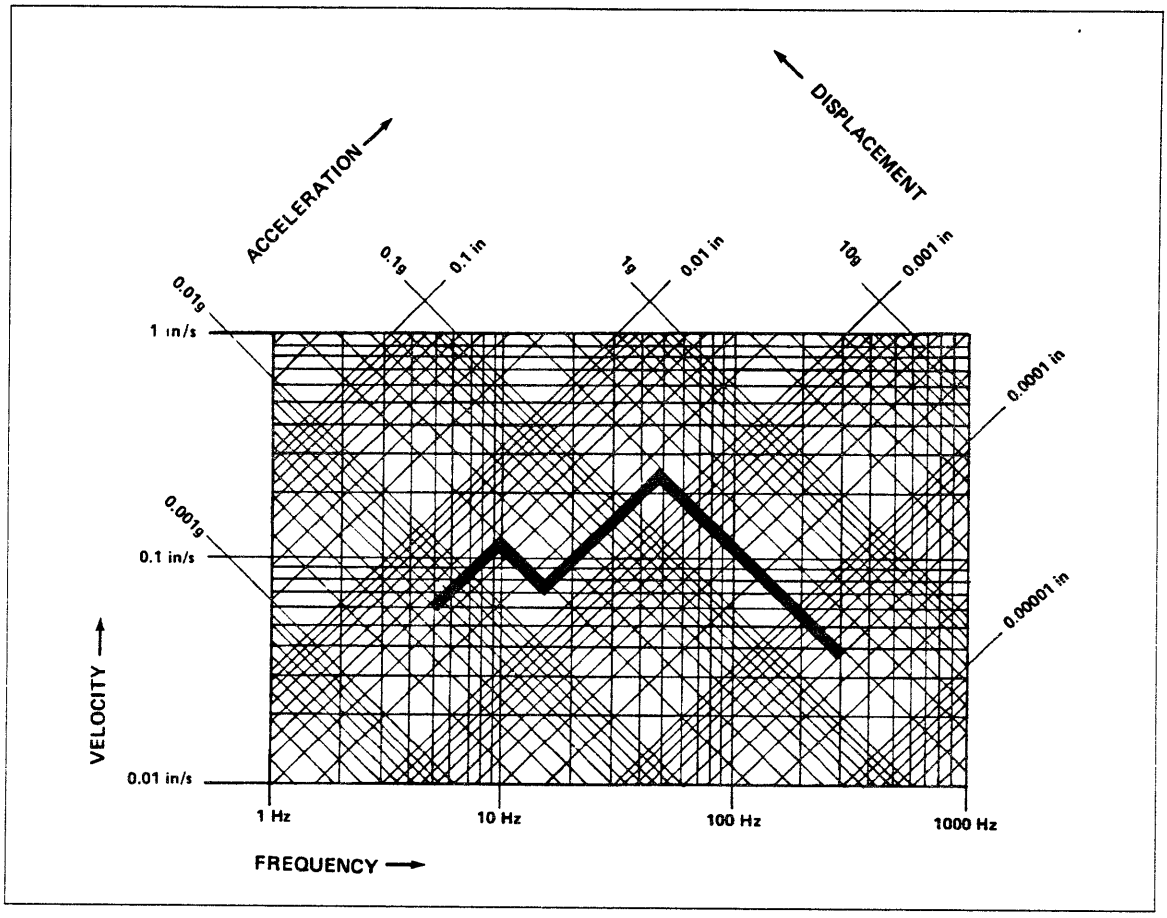


Figure 2-1. Equipment Vibration Limitations

Space Considerations

The total site floor space depends on the space required by the mainframe complex, peripheral equipment, M-G set, and any other areas for maintenance and data media storage. While planning the floor space, you may want to include any considerations for future expansion.

Equipment Floor Plan

Part of your site preparation is to develop a floor plan for the computer equipment locations. In this plan, you may want to consider the following.

- Placement of the equipment so that the operator can visibly monitor certain equipment such as tape drives.
- Placement of noisy equipment such as printers away from operator locations.
- Placement of printers away from dust-sensitive equipment such as tape and disk drives and close to room exhaust grills.
- Service clearances (figure 2-2).

  These clearances include the space around the equipment for installation, maintenance, and servicing. Two pieces of equipment may share a common service clearance area when they will not require access to that area at the same time.

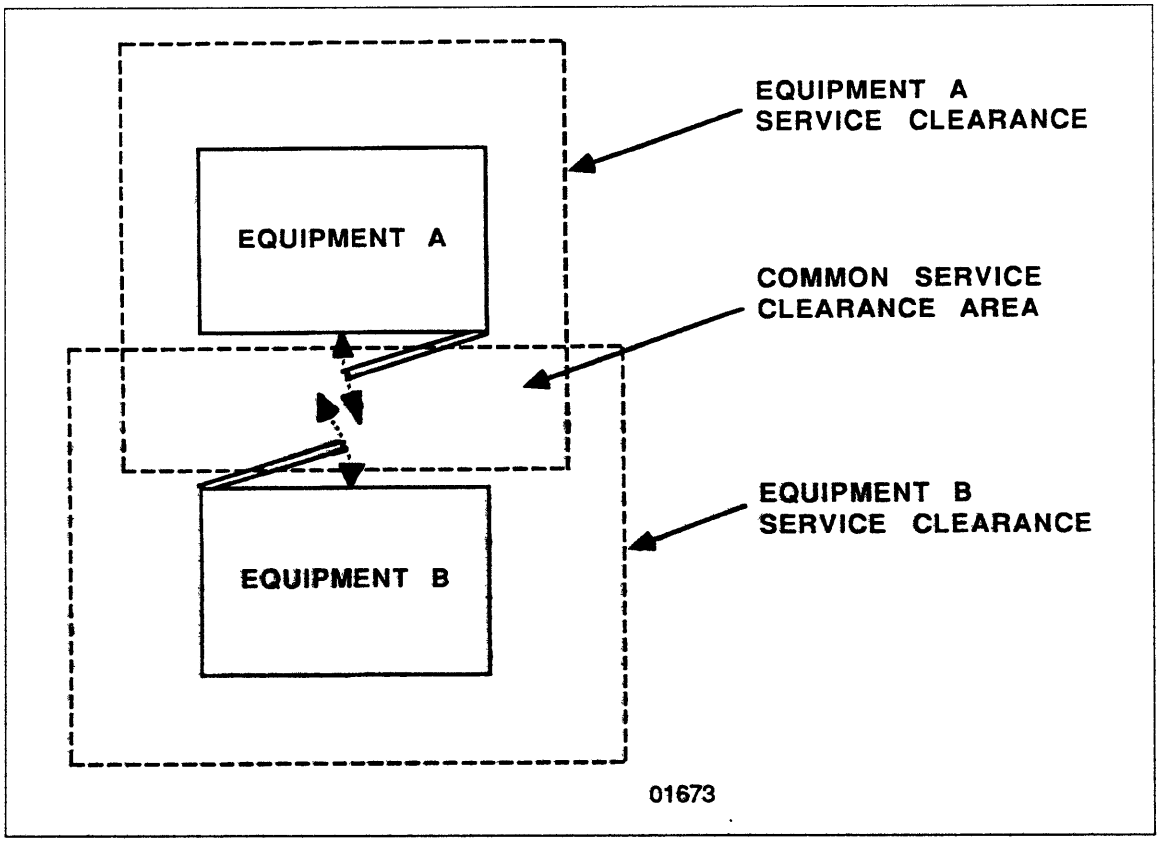


Figure 2-2. Equipment Service Clearances

- Weight distribution clearances (figure 2-3).

  These clearances include the space necessary for the equipment to meet floor loading requirements (covered later in this chapter). Depending on the equipment, weight distribution clearances may lie inside or outside of the service clearance areas. In either case, to prevent possibility of floor overloading, the weight distribution clearances of two or more pieces of equipment must not overlap.

- Clearances for air circulation on some equipment.

- Aisles for personnel, carts, and maintenance equipment.

The floor plan must also locate equipment within maximum lengths of interconnecting electrical cables and water hoses. Equipment locations must permit cables and hoses to reach up from the floor to mating connectors and couplings within the equipment.

To develop the equipment floor plan, refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals. The manuals contain the equipment dimensions and clearances, the system cable and hose lengths, and the connector locations above the floor. The manuals also include scaled equipment templates to assist your planning layout.

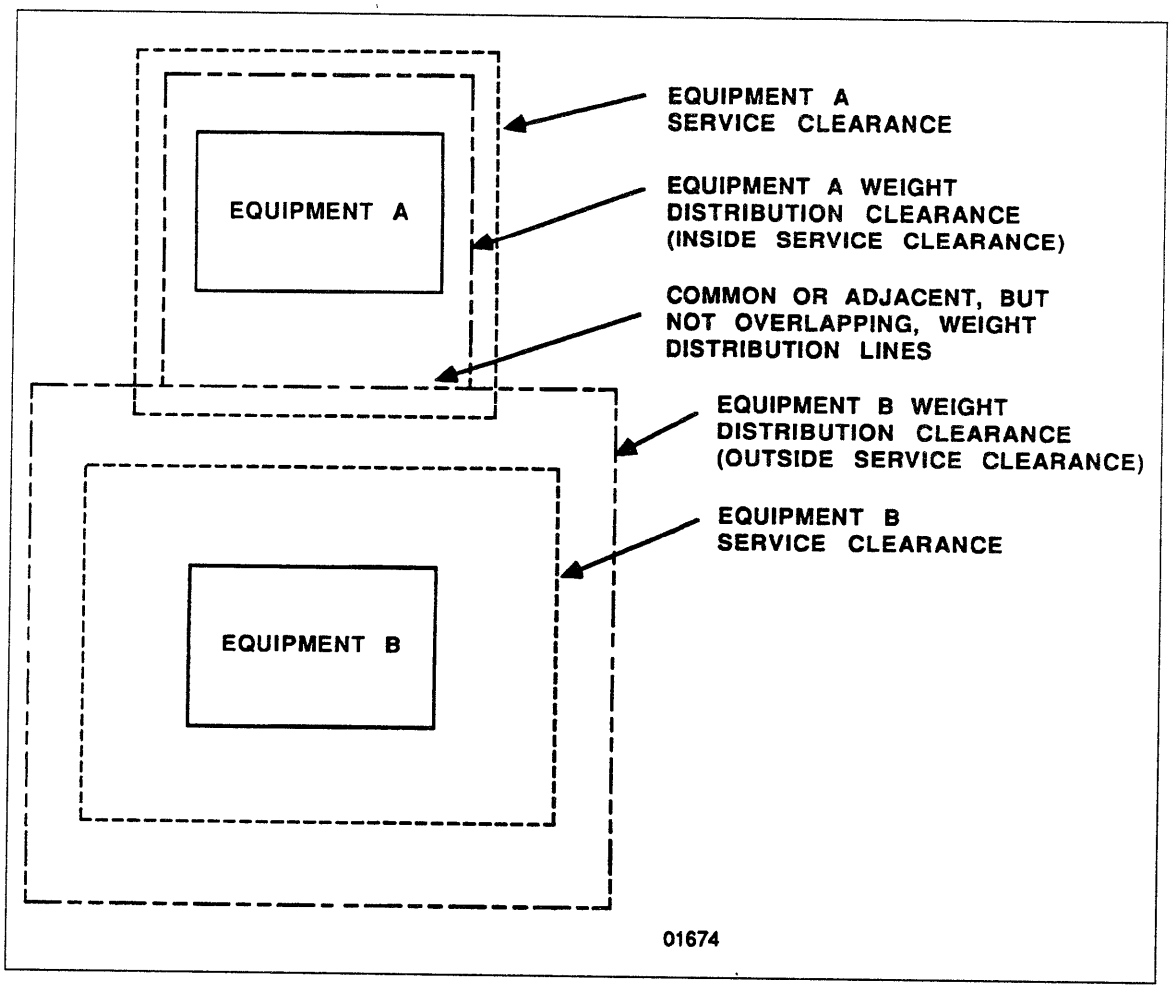


Figure 2-3. Equipment Weight Distribution Clearances

Maintenance Area

If your plans include on-site maintenance personnel, you should also consider a maintenance area that is convenient to the computer room, preferably adjacent to it but not in it. The area should provide enough space for workbenches, desks, and telephones for the planned number of maintenance personnel.

Your space planning also needs to include an area for storing equipment manuals.

The maintenance area should be consistent with an office environment for noise, heating, lighting, and ventilation.

Electrical outlets in the room should have grounded receptacles for either a 50- or 60-Hz installation (table 2-1). Separate ground connections must be present at the workbenches to permit maintenance personnel to safeguard serviced equipment from electrostatic discharge with the use of electrostatic protection devices. The ground connections can be 12 gauge or larger wires from the building frame to the workbenches.

Table 2-1. Electrical Outlets in Maintenance Area

Type of Installation	Voltage	Phase	Available Amperes
60-Hz	120	1	15
50-Hz	220, 230, or 240	1	As specified by local electrical codes.

Construction of Site

Construction of the site and installation of its facilities and utilities must comply with local building and electrical service codes. In meeting the local codes and requirements, it is your responsibility to determine the construction and installation methods. You may want to contact local consulting services to assist you in the site design and local contractors for any site construction or modification.

The computer room must meet the space requirements of your equipment floor plan and the system installation and operating requirements defined in this and the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

Utilities

The site utilities must include electrical power and, depending on the computer system cooling requirements, a site water supply. When the remote technical assistance option is part of the planned installation, you will also need a telephone service line.

Primary Power

Primary power is necessary for the mainframe complex, M-G set, and peripheral equipment. It must include one or more of the electrical services listed in table 2-2.

Refer to chapter 4 for detailed power requirements.

Table 2-2. Primary Power

Type of Installation	Voltage	Phases	Wires	Safety Ground Wire
60-Hz	120/208	3	4	Yes
60-Hz	480	3	3	Yes
50-Hz	220/380, 230/400, or 240/415 Note[1]	3	4	Yes

1. 50-Hz voltage selection to be determined by local electrical service.

Cooling Water

Some Control Data equipment in mainframe complexes uses refrigeration or water cooling units to provide internal cooling for components. These refrigeration and water cooling units require a continuous flow of site-supplied chilled water at a set temperature range and flow rate.

Refer to the Site Preparation Mainframe Complex Data manual to determine if your equipment includes refrigeration or water cooling units. If it does, your planning must include provisions for site water lines.

Refer to chapter 3 for site water and water line specifications.

Raised Floor

A computer room may require a raised floor for computer equipment that requires bottom entries for power wires, signal cables, and water hoses. Except for pedestals, the raised floor permits unrestricted routing paths for the wires, cables, and hoses. This floor also permits ease of rerouting wires, cables, and hoses in the event that you relocate some equipment within the room in the future.

Figure 2-4 shows a raised floor construction that uses pedestals and stringers for the support of floor panels. The panels are readily removable for easy access to equipment wires, cables, and hoses.

When a raised floor is added to an existing building, it requires the construction of at least one ramp for moving equipment from the building floor to the raised floor.

If you plan a new building construction, the building floor in the computer room may be constructed lower than the rest of the building floor. This permits installation of a raised floor so that it is level with the building floor outside of the computer room and eliminates the need for an equipment ramp.

Floor Surfaces

The panel surfaces of a raised floor may be tiled or carpeted.

Floor panels with a tiled high-pressure laminate surface need minimum maintenance. This surface must be a type that will withstand the equipment movement.

Floor panels with a carpeted surface have improved acoustical, aesthetic, and comfort properties, but are more vulnerable to the buildup of static electricity than other types of floor surfaces. Refer to Static Electricity Precautions later in this chapter.

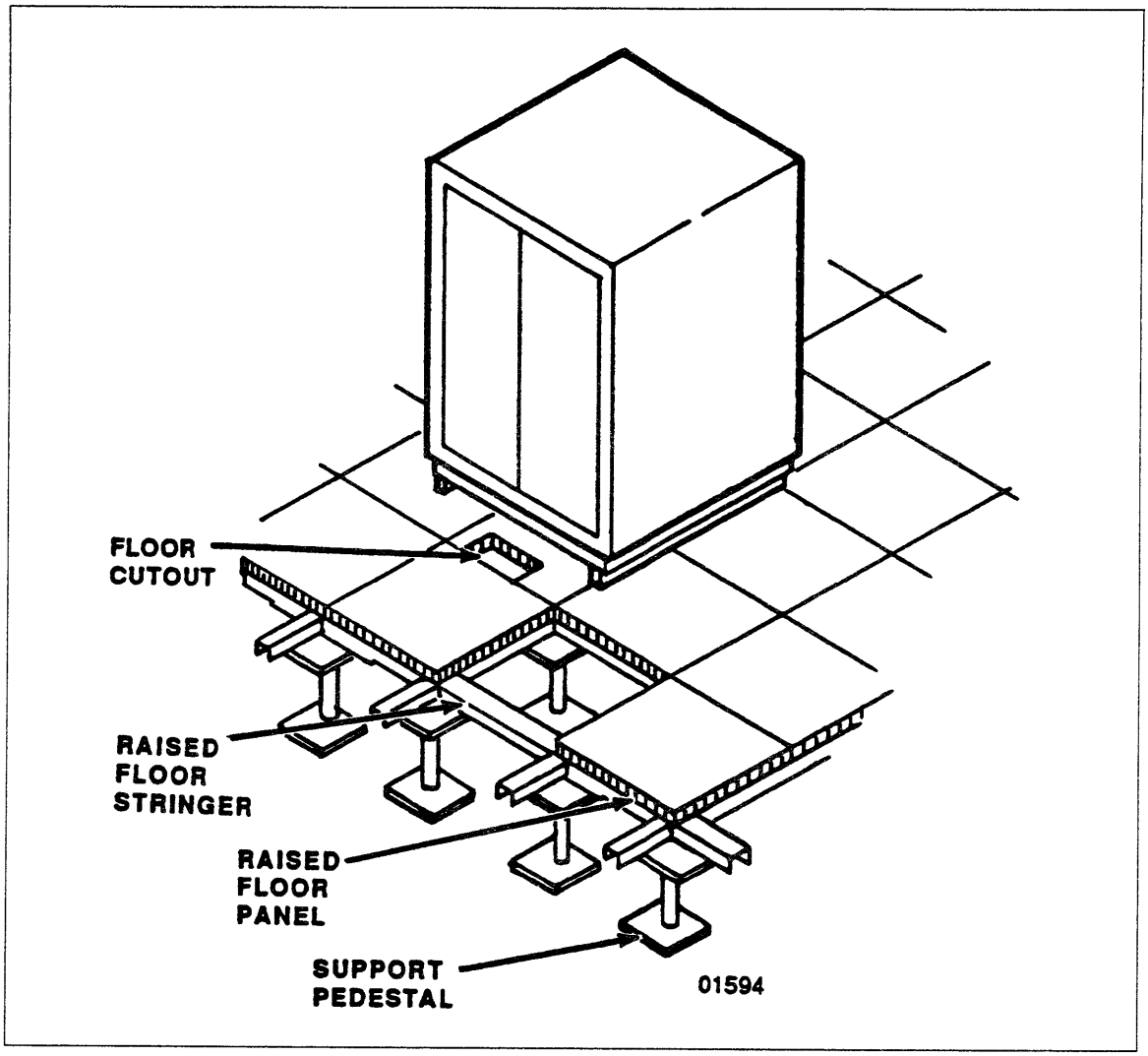


Figure 2-4. Raised Floor

Floor Structural Requirements

Construction of a raised floor includes the requirements in table 2-3.

Table 2-3. Raised Floor Requirements

Floor Condition	Characteristic	Notes
Clearance between raised floor and building floor	305 mm (12 in).	Greater clearance than 305 mm (12 in) for power wires, signal cables and water cooling connections must be stated in individual equipment requirements.
Underfloor space	Relatively free of obstructions.	Underfloor space must allow for installation of and accessibility to water lines, valves, manifolds, hoses, wiring, and cabling.
Supporting capability of raised floor panels	1220 kg/m^2 (250 lb/ft^2) evenly distributed with 455 kg (1000 lb) concentrated loads in 51 mm (2 in) diameter areas.	
Maximum deflection of raised floor panels with concentrated loads	2 mm (5/64 in).	
Leveling of raised floor	1.6 mm (1/16 in) over a floor distance of 1524 mm (60 in) and within 3.2 mm (1/8 in) over any continuous length of cabinets joined end-to-end.	
Supports under raised floor	Must maintain supporting capability around floor cutouts.	Floor cutouts may be for power wires, signal cables, and water hoses.
Cutouts in raised floor	Should have protective edging to protect wires, cables, and hoses.	Edging must not protrude above floor, so equipment frames may sit flat, unless casters or leveling pads permit an exception to this.
Ramp between raised floor and building floor	15° is the maximum ramp slope for Control Data equipment.	A ramp is necessary to allow movement of equipment between floors.
Sealing of building concrete floor	Sealing should inhibit dust and particles from concrete floor.	

Building Floor

If your computer equipment does not require underfloor space for power wires, signal cables, or water hoses, you may choose to install the equipment directly on the building floor. This type of installation requires alternative cable routing methods as shown in figure 2-5.

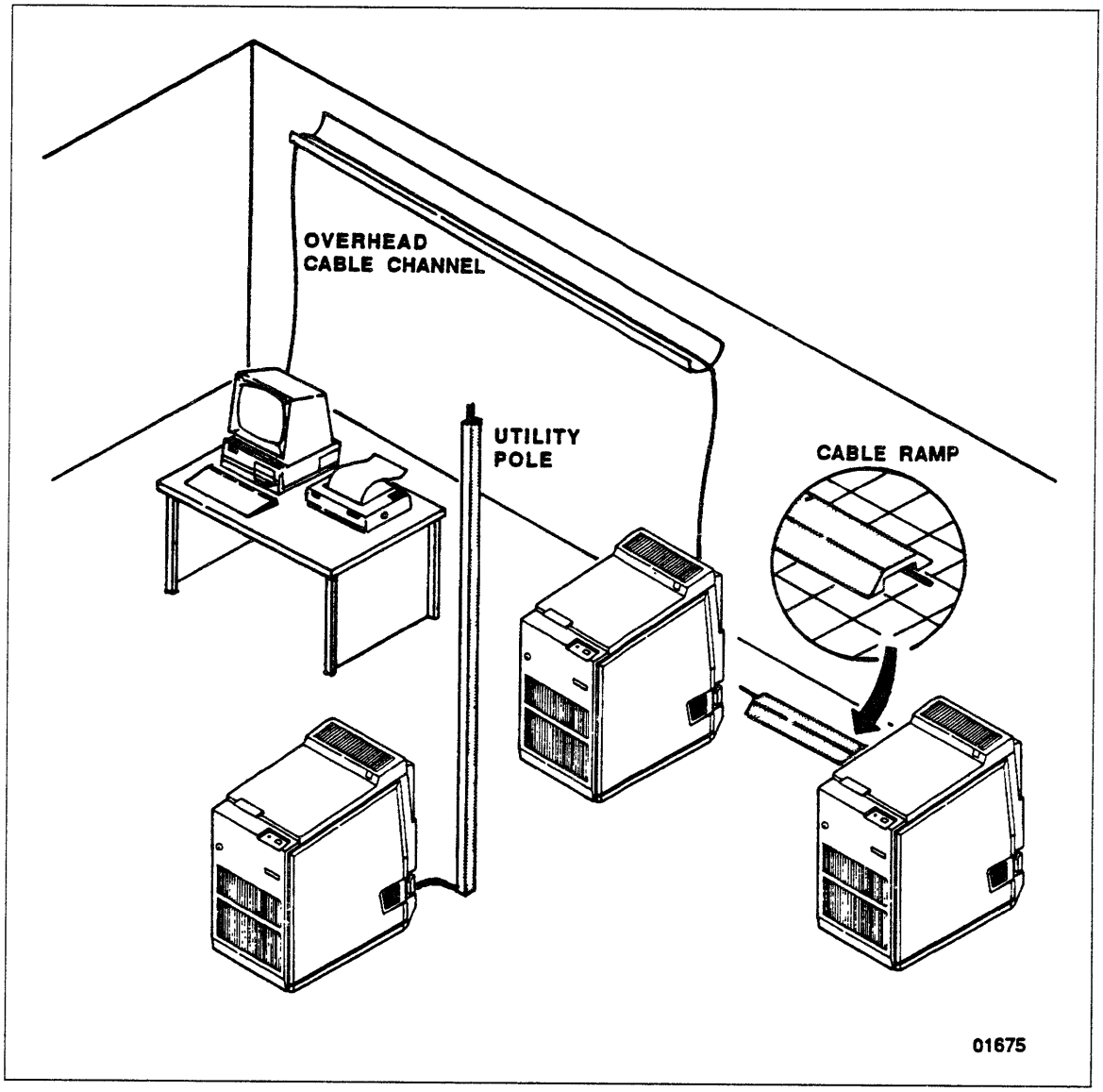


Figure 2-5. Alternative Cable Routing Methods

Floor Loading

Control Data designs equipment to be within a distributed floor loading limit of 340 kg/m^2 (70 lb/ft^2). This floor loading number includes the equipment weight, the raised floor that extends to one-half the equipment service clearance, one-half the weight of power and signal cables, equipment cooling fluid, and (when part of the installation) cooling distribution hoses filled with cooling fluid.

The floor loading covers an area that extends outward from the equipment to at least one-half of the service clearance around the equipment. For some heavy equipment and its associated hardware to meet the desired floor loading number, the floor loading area must extend beyond the service clearance to a weight distribution clearance (refer to figure 2-3).

The Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals identify the service clearances for all equipment and the weight distribution clearance for the equipment that requires it.

The building floor load calculations must include the weight considerations in table 2-4.

Table 2-4. Building Floor Loads

Items	Weights	References
System equipment	Weight depends on total amount of system equipment.	Refer to individual equipment data in site preparation manuals.
Water hoses and manifolds	Weight depends on system equipment.	Refer to individual equipment data in site preparation manuals.
Signal cables	Approximately 0.6 kg/m (0.4 lb/ft).	
Power cables, wiring, conduit, and raceways	Weight depends on power system designs and wiring concentrations.	Consult material suppliers.
Raised floor structure	Approximately 50 kg/m^2 (10 lb/ft^2).	
Data media stored within equipment room	Weight depends on quantity and type of media.	Consult media suppliers.
Furniture within room	Weight depends on type and quantity of furniture.	Consult furniture suppliers.

If calculations cause any doubts as to the capability of the building floor to support the weight, you should consult a structural engineer.

Floor Protection

Movement of heavy equipment across the raised floor will require temporary protection to prevent surface damage.

Static Electricity

A buildup of static electricity from movement of personnel or equipment across the floor can result in electrical discharges that can be uncomfortable to site personnel and harmful to the equipment. Static electricity is generally controlled by grounding metal parts of a raised floor and maintaining the computer room humidity to the equipment specifications provided in the Site Preparation Mainframe Complex and Peripheral Equipment Data manuals.

When the computer room floor is carpeted, the carpeting requires an acceptable static electricity rating. This rating should be available through your carpet supplier. The rating should ensure that static electricity voltage generated by the movement of a person across the floor is limited to a maximum level shown by the chart or calculated from the formula in figure 2-6. For example, when room relative humidity is 50%, the maximum voltage that should be generated from a carpeted floor is 1.92 kV. The AATCC (American Association of Textiles Chemists and Colorists) defines the measurement of this voltage through industry test methods.

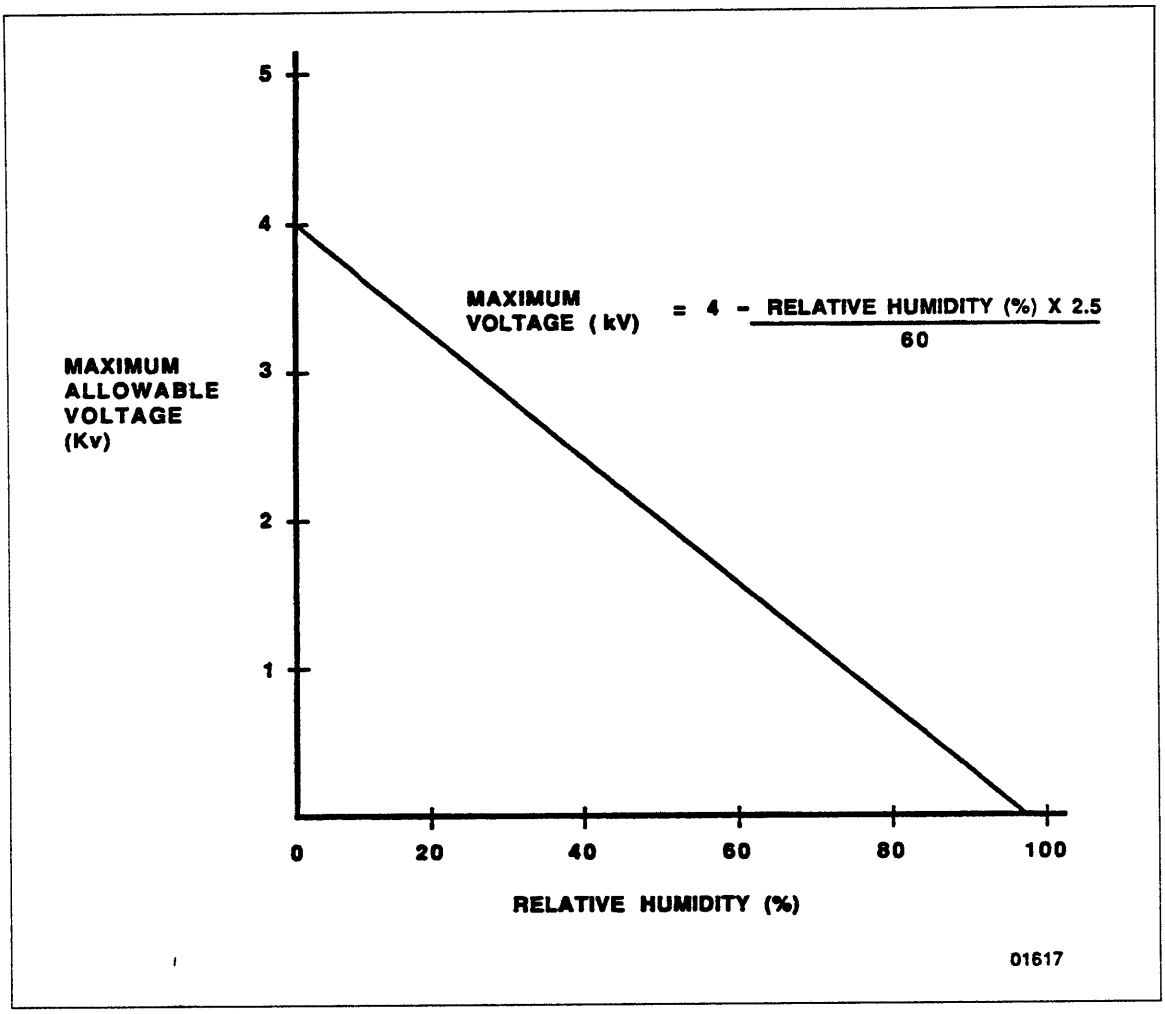


Figure 2-6. Maximum Allowable Static Electricity from Floor

Site Protection

In your site planning, you may want to consider personnel safety, fire precautions, and security precautions. The extent of the measures you take depends on their application to your site goals, local codes, and possibly requirements for insurance coverage.

Personnel Safety

Planning for personnel safety should be part of your initial site planning. This planning may include considerations for:

- Locating system emergency off switches in accordance with local codes.
- Identifying locations and numbers of emergency exit doors.
- Identifying personnel evacuation routes.
- Installing emergency lighting.

Fire Precautions

For fire protection requirements, you must refer to your local building codes. Control Data also recommends the following minimum requirements.

- A water sprinkler system for a dedicated computer room. This should be a preaction (dry pipe) system that will prevent accidental sprinkling.
- Fire dampers to inhibit the spread of a fire in any air ducts that connect the computer room and other rooms.

Security Precautions

Security precautions are for the protection of the site and computer system against malicious damage, theft, removal of proprietary information, and accidental damage. Considerations for these precautions will vary, depending on their application to your site design, personnel access to the site, and any contingency plans.

These considerations may include:

- Locating the computer room in the interior of a building and without viewing windows.
- Protecting vital information stored in the computer room in the event of a site disaster.
- Controlling access to the site by limiting it to authorized personnel.
- Locating critical power and air conditioning components in areas that will minimize the possibility of malicious damage.

Environment 3

Environment 3

This chapter provides information for the computer room environmental requirements. These include cooling and cleaning room air, supplying site water, and meeting your needs for room lighting and acoustics.

Your responsibility is to meet the equipment environmental requirements. To do this, you must refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals for environmental information that applies to your specific equipment. Your environmental preparations include supplying and installing the necessary air conditioning equipment, site water equipment and water lines, and other applicable equipment.

Air Conditioning

A room air conditioning system must have the capacity to cool the heat-dissipating components of the computer equipment while maintaining the room air at defined temperature, humidity, and dew point conditions. The system needs to distribute cooled air to the equipment and maintain the air cleanliness within system requirements.

Temperature, Humidity, and Dew Point

The room temperature, humidity, and dew point must be within the intended operating range of the system. Control Data designs its equipment to operate properly without damage or interruption in a wide range of environmental conditions (table 3-1). Within these conditions, some equipment may require temperature restrictions. The Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals specify these individual equipment requirements.

Table 3-1. General Temperature and Humidity Conditions

	Operating Conditions		Nonoperating Conditions
Environmental Conditions	**Computer Room[1]**	**Office[2]**	**Storage**
Temperature	15° to 32°C (59° to 90°F)	10° to 40°C (50° to 104°F)	-40° to 60°C (-40° to 140°F)
Temperature Rate of Change (1 hr)	6°C (60°F)	12°C (20°F)	40°C (72°F)
Relative Humidity	35% to 60%	20% to 80%	5% to 95%
Maximum Dew Point[3]	16°C (60°F)	24°C (75°F)	28°C (82°F)

1. A dedicated computer room, air conditioned to meet equipment requirements only.

2. An office or home type environment having a wide temperature/humidity range.

3. This is a general limit. Room dew point must be constrained for water and refrigerant cooled equipment as specified in the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

Some Control Data equipment uses internal water or refrigeration type cooling. For this equipment, automatic control of the room temperature and humidity is necessary to maintain the room dew point below the minimum equipment temperature. An equipment temperature that falls below the room dew point will cause condensation that may result in malfunction and serious damage to the equipment.

To ensure maximum performance and reliability. Control Data defines target criteria for the environment of all equipment as shown in table 3-2.

Table 3-2. Target Environment

Condition	Target
Temperature	22°C (72°F)
Relative Humidity	50%

Plans for an equipment installation must not change the environmental requirements of a room beyond the limits of equipment previously installed in the room.

Although many Control Data systems have alarm systems for temperature and dew point, a computer room should also have equipment that continuously monitors the environment and provide alarms for conditions that approach the system temperature and dew point operating limits.

Air Conditioning Capacity

In determining the requirements for the cooling capacity of an air conditioning system, you need to know the heat output of the equipment that will be installed at your site. Heat output rates are available in the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

Your cooling considerations must include the heat outputs from any other equipment within the room and include room construction characteristics. These chacteristics may involve the transfer of heat by conduction and radiation from lighting fixtures, walls, doors, windows, ceiling, and roof. The room size and insulation are also factors that will influence the room cooling.

If your air conditioning system is designed to operate near its capacity, the latent and active heat values from personnel working in the room may make a difference in the selection of your air conditioning system. These values vary according to the number of people and their activities.

Air Distribution System

A computer room air distribution system must provide enough conditioned air to meet the equipment cooling requirements. The following paragraphs summarize two main types of air distribution systems.

In either of the two systems, air supply registers or diffusers should not be closer than 2 m (6 ft) to equipment cabinets that have internal water or refrigeration cooling lines. The Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals identify the equipment that contains this type of cooling.

Depending upon the local climate, you may need to add preheating and humidifying functions to the room air distribution system to adequately control the room temperature and humidity conditions.

You may also want to consider:

- Minimizing noise and draft conditions by sizing air supply diffusers to deliver air at a maximum rate of 150 m/min (500 ft/min).
- Placing air supply diffusers at locations that will ensure adequate cooling of equipment cabinets.
- Providing air supply diffusers with dampers to permit balancing of air volumes to the equipment air inlets and allowing flexibility for future equipment changes in the room.
- Placing of air supply diffusers at locations that will not interfere with room air sensing devices.
- Including outside air ventilation for the room occupants as prescribed by prevailing building codes.

Overhead Air Distribution

An overhead air distribution system (figure 3-1) supplies cooled air from a pressurized air conditioning system through a ceiling duct with overhead diffusers. Air circulates downward from the diffusers through the room, absorbs heat from the computer equipment and any other heat producing elements, and returns to the air conditioner.

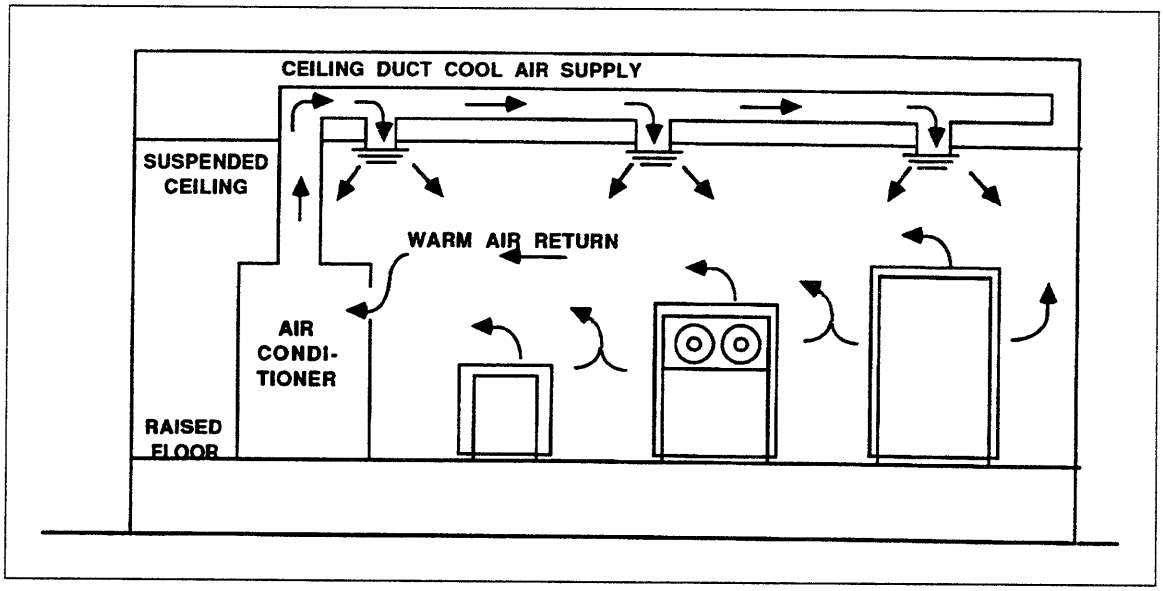


Figure 3-1. Overhead Air Distribution System

Underfloor Air Distribution

An underfloor air distribution system supplies cooled air from a pressurized air conditioning system through a subfloor plenum (figure 3-2). Air circulates up through floor registers or grills placed to provide the most effective cooling. The air absorbs heat from the computing equipment, any other heat producing elements in the room, and returns to the air conditioner.

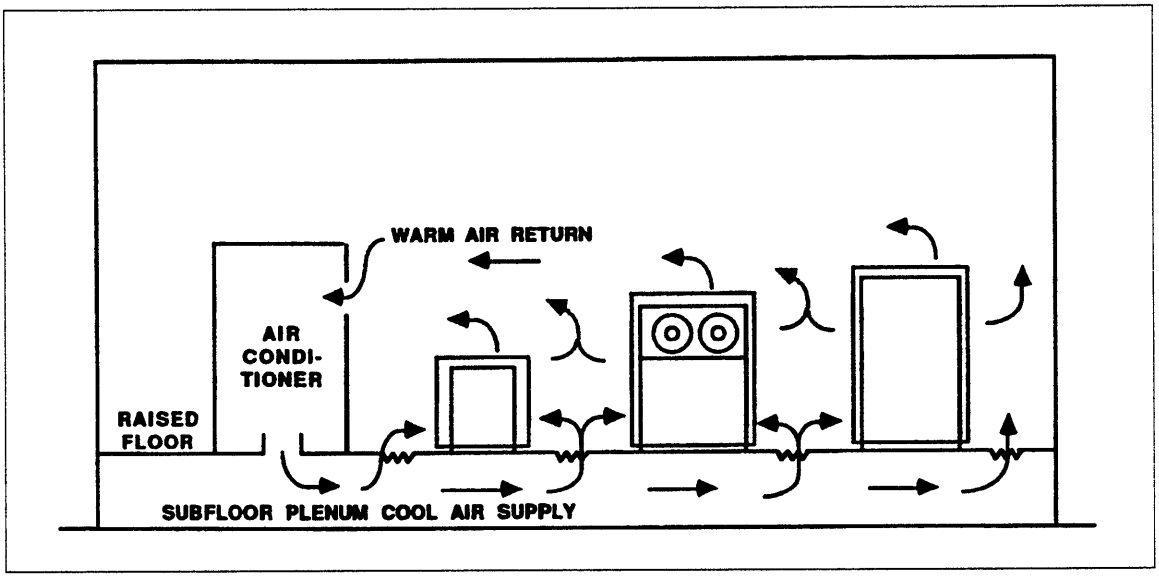


Figure 3-2. Underfloor Air Distribution System

Air Filtration

Air filtration provides room air cleanliness that is necessary to minimize troubles in magnetic tape units, disk storage units, and other equipment. To properly maintain air cleanliness, a computer room should have an air filtering system that cleans all of the air in the room. The air filtering system may be part of the room air conditioning unit(s) and consist of mechanical filters.

Mechanical air filters should have an efficiency rate of 80% on a particle size of 5 microns, as determined by the National Bureau of Standards (NBS) discoloration test, using 96 cottrell precipitate and 4% cotton linters. The efficiency rate is 30% when determined by the NBS discoloration test using atmospheric dust.

An equipment area that will have exposure to unusual conditions of dust or corrosive air particles may require special air filtering techniques.

Water Supply

A site chilled water supply is a requirement for the Control Data mainframes that use refrigerant or water cooling units. This water supply consists of a closed-loop system that circulates distilled water through the refrigerant or water cooling units. The system typically includes a customer-supplied three-way diverting valve that controls the temperature of the site chilled water to the refrigerant or water cooling units. In these units, the water goes through conventional shell-and-tube type heat exchangers. The heat exchangers permit the chilled site water to absorb heat from a second closed-loop system that circulates distilled water through the mainframe.

Table 3-3 lists the site water general requirements.

Table 3-3. Site Water Supply General Requirements

Items	Requirements	References and Notes
Site water supply and return lines	One supply and one return line for each water cooling unit and refrigeration unit in the system. Supply and return lines must be close enough for connecting hoses to reach equipment.	Refer to hose lengths in Site Preparation Mainframe Complex Data manual.
Supply pressure	689 kPa (100 lbs/in^2) gauge.	
Differential pressure between supply and return lines.	For refrigerant cooled equipment 103 kpa (15 lbs/in^2). For water cooled equipment 35 kpa (5 lbs/in^2).	
Rate of flow	Dependent on equipment.	Refer to flow rates in Site Preparation Mainframe Complex Data manual.
Supply temperature	7°C (45°F) recommended. Range of operation for refrigerant cooled equipment 4.4°C to 26.7°C (40°F to 80°F), for water cooled equipment 4.4°C to 10.0°C (40°F to 50°F).	The higher the temperature the higher the flow rate.
Temperature stability	Approximately ±2.2°C (±4°F).	
Hardness	Not to exceed 150 parts per million (ppm) $CaC0_3$ (per ASTM D 1126-60).	
Alkalinity level	ph of 7.0 to 8.5 (per ASTM D 1293-G2T).	
Suspended solids	Not to exceed 500 ppm (per ASTM D 1888-GMT).	
Water treatment	To prevent growth of slime and algae.	

The applicable Site Preparation Mainframe Complex Data manuals define additional site water requirements for specific mainframes.

CAUTION

Control Data manufactures refrigeration and water cooling units to meet its own equipment specifications. The use of other refrigeration and water cooling units may damage the equipment and is not permitted unless they meet or exceed Control Data specifications.

Control Data also suggests:

- Planning the locations of the site water lines under the raised floor so that the lines provide clearance for the installations of equipment power wires, water hoses and manifolds, and signal cables.
- Installing warning devices under the raised floor to detect any water leakage from a broken pipe or hose. Such recommended devices consist of either float-operated switches or electronic water-sensing switches that control an audible alarm and a sump pump.
- Providing a readily available floor plan of the computer room for emergency purposes. The plan should show all water shut-off valves, alarm indicators, and sump pumps.
- Insulating the supply and return water lines to prevent condensation of water on the lines.

Lighting

The computer room general lighting should be at least 60 foot candles (646 lumens/in^2). Lighting should be designed for uniform illumination level and glare free. To enable proper visibility of lighted equipment indicators and system console display screens, avoid excessive illumination from spot lights, floodlights, or direct sunlight.

Emergency lighting system for exit light(s) must be included to ensure safe exit of room personnel in the event of a power failure.

Acoustics

Acoustical treatment of the computer room is desirable but not essential for system operation. This treatment involves design considerations for the major noise sources that orginate from the computer equipment and supporting power and environmental control systems within the room. For the best design for room acoustics, you may want to follow the recommendations of an acoustical consultant.

When considering the noise level for personnel comfort, be sure to take into account all of the equipment in the room. For specific equipment noise levels, refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

A computer room design that limits the noise level from equipment in an operating mode from 65 to 75 dBA (or below) is adequate for personnel communication and provides a negligible hazard to hearing.

General considerations to help reduce the room noise level are:

- Enough floor area to allow proper spacing of equipment, the most important factor in controlling noise.
- A suspended acoustical ceiling, preferably with a height of 2.7 to 3.6 m (9 to 12 ft) above the floor.
- Tightly sealed walls, ceiling, and doors to reduce room noise from adjacent areas.
- Placement of equipment uniformly throughout the room with noisiest equipment farthest away from operator areas.

Power and Grounding 4

Power and Grounding 4

This chapter describes the computer system power and grounding requirements that you need in planning a site power distribution system. This planning must result in a design that meets the equipment power requirements and the local electrical codes and ordinances.

Your responsibility is to design and install a power distribution system to meet the equipment requirements. To design this system, you must refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals for power information that applies to your specific equipment. To install the power distribution system, you must provide the necessary power distribution boxes, circuit breakers, contactors, and power wiring to the equipment locations.

If your equipment includes any Control Data-supplied power control or environmental monitoring equipment, you must include this equipment in the design of the power distribution system. You must mount this equipment and connect its power and control wiring.

If your equipment includes an M-G set, you must include this equipment in the design of the power distribution system. You must place the M-G set, connect its equipment power and control wiring, and check its operation in a local mode.

Power Requirements

All Control Data computer systems require 50-Hz or 60-Hz primary power from the site electrical service entrance. In the larger systems, this power operates one or more M-G sets that provide 400-Hz secondary power to the systems.

To determine the 50/60-Hz primary and 400-Hz secondary power requirements for the site, you need to refer to the power requirements in the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals.

Power Distribution

Follow your local electrical codes in planning and installing a power distribution system. Consider the following general and special power distribution characteristics.

General Power Distribution

A power distribution system for a Control Data computer system must include the characteristics in table 4-1.

Table 4-1. General Power Distribution Characteristics

Items	Descriptions
Single-phase 50/60-Hz primary power wiring	To include either or both of the following wiring methods: • Phase-to-phase voltage using two phase wires and one insulated ground wire. • Phase-to-neutral voltage using one phase wire, one neutral wire, and one insulated ground wire.
Three-phase 50/60-Hz primary power wiring	To include three phase wires, one neutral wire, and one insulated ground wire.
Three-phase 400-Hz secondary power wiring	To include three phase wires, one neutral wire, and one insulated ground wire.
Power line phases	To include balanced loads.
Disconnects	To isolate the main power line, or the main subpower feeder lines, or both.
Circuit breakers and associated mounting panels	For 50/60-Hz and 400-Hz power distribution and individual equipment line protection.
Magnetic contactors	To energize and de-energize groups of 50/60-Hz circuit breakers in a predetermined sequence. **CAUTION** To prevent voltage transients in other 400-Hz lines and potential damage to equipment, do not install magnetic contactors in 400-Hz power lines.
Neutral conductor	In some instances of wiring with the neutral conductor considered as a current carrying conductor, special considerations are required. Refer to the next section on Special Power Distribution.

(Continued)

Table 4-1. General Power Distribution Characteristics *(Continued)*

Items	Descriptions
50/60-Hz and 400-Hz power wires	For distribution of 50/60-Hz and 400-Hz power from circuit breaker panels to system equipment, the wiring needs to be in separate power wiring ducts, raceways, or other approved wire runs, as required.
400-Hz power wires	For three-phase wires in a 100 A or greater feeder, the wires must be grouped together at all times to prevent noise problems on the 400-Hz circuits. Wire runs between an M-G set and the system equipment must not have more than a 2% voltage drop. The wire runs include separate power wiring ducts, raceways, or other wire runs specified by local codes. Connection of non-Control Data loads to a Control Data 400-Hz system may cause noise on the system because of equipment incompatibilities.
Control wiring	For power control panels and magnetic contactors includes separate power wiring ducts, raceways, or other wire runs specified by local codes.
Underfloor wiring protection	To protect wiring from accidental spills that could seep down through the raised floor or from under floor pipes or hoses.
Emergency off switches	To be placed at room exits as may be required by some local codes.
Electrical convenience outlets	For use by test equipment. Refer to the description of Convenience Outlets later in this chapter.

Power Line Isolation

Control Data recommends that you consider the installation of an electrostatically-shielded line-isolation transformer on a dedicated 50/60-Hz power line that connects only to your computer system. The transformer will attenuate common-mode noise to help protect the computer system from high frequency disturbances that may be present on the 50/60-Hz power line outside of your computer room. The transformer will not compensate for power problems such as brownouts or voltage sags and surges.

The dedicated power line will reduce the magnitude of voltage sags and surges that may be generated outside of your computer room but within your facility. These voltage sags and surges may be caused by cyclical loads such as air conditioning, copy machines, and elevators.

Power Islands

As an alternative to the conventional power distribution system, you may want to consider the installation of a power island, sometimes referred to as a power distribution unit or power center. The power island is a general purpose unit in a standalone cabinet. It distributes 50/60-Hz power, 400-Hz power, or both from site power sources to the computer system through integral circuit breakers and power cables. The power cables have lengths and fittings specifically designed to reach and connect to each cabinet in the computer system. These features permit the power island to replace most of the wall-mounted panels used in a conventionally-wired power distribution system, and allow system modifications and moves with minimal impact to your facility.

A basic power island has an enclosure, an input circuit breaker, and output circuit breakers. The design of these and other integral components custom tailor the power island to your computer system configuration. You may also add optional features such as an electrostatically-shielded line-isolation transformer, line filtering, monitoring of critical power parameters, status indicators, alarms, and controls to meet your present and future needs.

Power islands are not part of the mainframe complex equipment supplied by Control Data. For additional power island information, contact your Control Data sales representative.

Special Power Distribution

A power distribution system that has 50% or more of its load connected to switching type power supplies requires special features. These features are necessary because of the characteristics of the switching power supplies which cause heavier-than-normal currents in the neutral lines of 50/60-Hz or 400-Hz, 3-phase, 4-wire, line-to-neutral wye circuits. As a result, the power distribution system must have features that will protect the feeder branch circuits and transformers that supply power to the equipment.

To determine whether to add the special features to the power distribution system, refer to the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals to:

- Identify the equipment that contains switching power supplies
- Determine the extent of their loading on the power distribution system.

Include the following special features in the power distribution system when required by the loading of switching power supplies on the system.

- The 3-phase neutral conductor size must not be less than 175% of the line conductor ratings.
- The line and neutral conductors must be derated the same as for conventional power supplies except when existing circuits have the same size neutral and line conductors. When this condition exists, the neutral and line conductors must be derated as shown in table 4-2.

Table 4-2. Conductor Deratings

Number of Conductors in Conduit or Raceway	Percent of Values Specified in USA National Electrical Code (NFPA 70-1984) or Local or National Codes
4 through 6	70
7 through 24	61
25 through 42	53
43 and above	44

- A transformer that supplies power to computer equipment and has more than one-half of its load connected to switching power supplies must be derated to 70% of its nameplate full load primary current rating. Measurements of this current require a true RMS type meter.
  - Input protection devices to such a transformer must be set at not more than 70% of the transformer nameplate full load primary current rating.
  - Neutral connections to such a transformer's secondary windings must be to a neutral bus or strap which must be sized for not less than 175% of the total secondary load current.
  - Individual leads from the transformer secondary windings must connect directly to the neutral bus or strap.

Power Connections

Power connections to Control Data equipment cabinets are either by direct connection of power wires to cabinet terminals or by connection of power cords to a mating connector on the site power wires. To determine which equipment ships with power cords and when you must obtain mating power connectors for the site power wires, refer to the Site Preparation Mainframe Complex Data and Peripherial Equipment Data manuals.

When power cord connections are used with the equipment, your electrician must install the site power wiring to permit connection of the mating power cord receptacles within 1 m (3 ft) of the equipment.

When electrical codes require power wire connections directly to the equipment terminal strips, your electrician must prepare the wires as listed in table 4-2:

Table 4-3. Direct Power Wiring Preparations

Task	Condition
Install power wiring to equipment	Wire ends must be able to extend 1220 mm (48 in) above raised floor.
Remove armored coverings and insulation	Armored coverings must be cut back 150 mm (6 in) from wire ends.
	Insulation must be cut back 13 mm (0.5 in) from wire ends.
Provide strain reliefs	Power wires must have strain reliefs wherever the wires go through a junction box.

Convenience Outlets

The computer room should have convenience outlets located within 4.6 m (15 ft) of each equipment cabinet for test equipment connections. The outlets may be in the room walls, building pillars, or raised floor sections.

The outlets must have standard grounded-type receptacles and be used exclusively for test equipment. They must connect to 50/60 Hz 1-phase power that connects to the same source as the computer equipment 50/60-Hz power, but must not be controlled by either the mainframe complex or peripheral power panels. The nominal voltages at the outlets should be as listed in table 4-3.

Table 4-4. Voltages for Convenience Outlets

Installation	Voltage
50-Hz	220, 230, or 240 V
60-Hz	120 V

Motor-Generator Sets

An M-G set includes a motor-generator and control cabinet that convert 50/60-Hz, 3-phase power to 400-Hz, 208-V, 3-phase power. This is a normal M-G set that is a requirement for some Control Data computer systems that require frequency conversion and stabilization of the site power. Depending on the system configuration and its power load requirements (mainframes and peripheral equipment), the computer system may require more than one normal M-G set.

To provide M-G set redundancy, you may want to plan for the installation of an optional standby M-G set that could replace any of the normal M-G sets in case of a malfunction. A standby M-G set must have the same power output capacity as the largest of the system normal M-G sets.

CAUTION

Control Data manufactures M-G sets to meet its own equipment specifications. The use of other 400-Hz power sources may damage the central computer and/or peripheral equipment and is not permitted unless they meet or exceed Control Data specifications.

M-G Set Power Loading

To allow equipment additions to the computer system and for the operation of the equipment at a 10% voltage increase during maintenance tests, Control Data suggests a planned power load of no more than 85% of the rated capacity of an M-G set. To determine the M-G set loading, total the 400-Hz power requirements for the equipment to be installed. These power requirements are in the Site Preparation Mainframe Complex and Peripheral Equipment Data manuals.

M-G Set Location

The system M-G set requires indoor installation in an area where temperature and humidity control is within the limits defined in the Site Preparation Mainframe Complex manual. Because of the noise level and heat generation, most M-G sets should be in a room separate from the computer equipment. Exceptions to this are computer systems that include acoustically treated M-G sets. These may be either the 12.5 kVA, 25 kVA, or special order M-G sets. When selecting the M-G location, consider the following.

- Placement to allow clearances that may be required by local codes.
- Placement in an area free from exposure to steam, corrosive air, or flooding.
- Placement in an area that is restricted to authorized personnel.
- Placement on a flat surface. Control Data recommends a minimum 10-cm (4-in) concrete base. The base must support the M-G weight, defined in the Site Preparation Mainframe Complex Data manual.
- Placement to minimize the wire run distances to the equipment.
- Placement to permit easy access for maintenance.
- Placement to allow free or ducted air flow to the M-G set air intakes and to allow a free air discharge, preferrably to the outside of the building.

Phase Rotation

Phase rotation for either the 50/60-Hz or 400-Hz power may be in either direction unless specified differently in the Site Preparation Mainframe Complex Data and Peripheral Equipment Data manuals. All 50/60-Hz wire connections must have the same phase rotation. All 400-Hz wire connections must have the same phase rotation.

In the United States, the color code to phase relationship fits the following standard.

White wire is neutral.
Green wire is ground.
Black wire is phase A.
Red wire is phase B.
Orange wire is phase C.

In other countries, the code relationship differs according to manufacturers, areas, and countries. The color code may differ depending on the electrical codes.

Grounding

All Control Data computer system equipment requires protective safety grounds for the protection of site personnel and equipment. Metal parts of a raised floor must also have a connection to ground for safety reasons.

Control Data equipment has auxiliary (AUX) or electromagnetic compatibility (EMC) ground connections. These connections are for use only when the equipment connects to non-Control Data equipment, a grid EMC ground, or an analog ground.

Safety Grounds

Installation of safety grounds must be in accordance with the equipment requirements and the local electrical codes and ordinances. Figure 4-1 shows an example of a safety ground system.

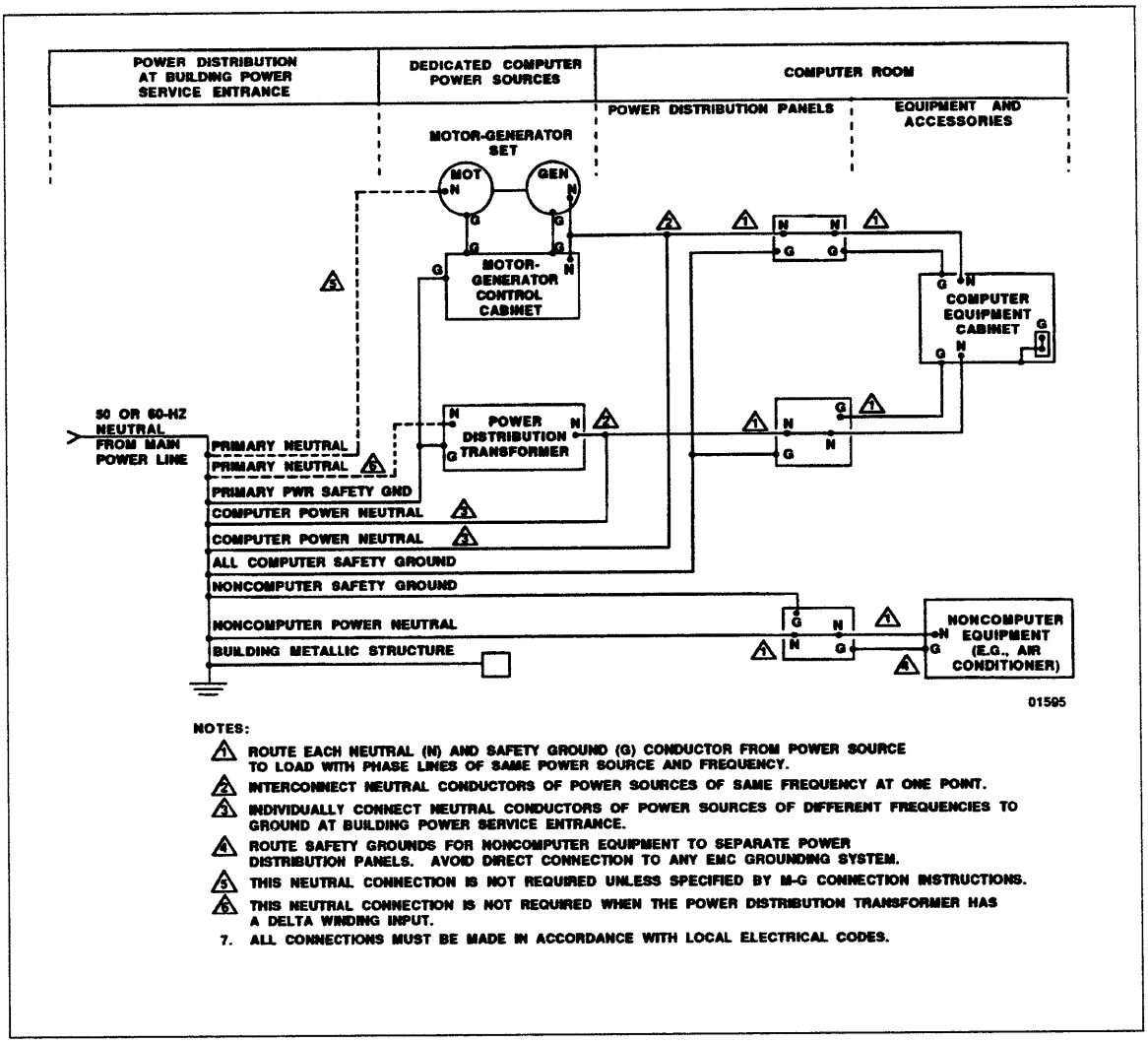


Figure 4-1. Equipment Neutral and Safety Ground System

EMC Grounding

EMC grounding within Control Data computer systems provides the systems with a high degree of immunity from external electrical interference. This grounding also contains internally generated electrical emissions that meet the requirements of Federal Communications Commission in the United States and the requirements of most foreign countries. Except for an extreme environment of outside interference, Control Data equipment is not susceptible to EMC interference. Control Data computer systems currently use two types of EMC grounds, shield and hybrid. A third ground type, grid ground, applies to Control Data equipment installations before 1978.

Shield EMC Ground

The shield EMC ground system consists of the equipment metal frames and the shields of the interconnecting cables within and between the equipment cabinets. The cable shields connect to cabinet grounds near their place of entry or exit.

Hybrid EMC Ground

The hybrid EMC ground system is a combination of the shield and grid EMC ground systems. It is for use with computer equipment that does not comply with the shield EMC ground requirements or for use with non-Control Data equipment that has unknown EMC characteristics. This equipment and the equipment it communicates with connects to a grid ground.

A variation of the hybrid EMC grid ground is to install and connect a partial grid only under the equipment that requires it.

Grid EMC Ground

The grid EMC ground system can be achieved in three ways.

- Connection to an existing raised floor grid. Such a grid must be metallic and have a bolted stringer system. Floating floors and nonmetallic or snap-in stringers are not acceptable for an EMC grid.
- Connection to a wire mesh grid installed under the raised floor.
- Connection to a braided strap grid installed under the raised floor.

Lightning Protection

Control Data recommends lightning protection on the power lines that come into your building and a check of the following conditions to avoid electrical surge entry paths into the computer room.

- Ensure that any refrigerant or other cooling pipes from a penthouse or rooftop to the computer room are not virtual lightning rods.
- Ensure that any ground rod system used for lightning protection is not used for power grounding.
- Ensure that any interconnected electronic data processing cables are routed to avoid the possibility of a direct or side-flash lightning path.

In evaluating the extent of your lightning protection measures, you may want to consider the following.

- The cost of the protection against the possible cost of consequences of a lightning strike.
- The frequency and severity of thunderstorms in your area.
- The value of the equipment that could be damaged.
- The possibility of a personnel hazard.
- The effect on insurance premiums.

Refer to your local electrical code for the details of lightning protection installation.

Communications 5

Communications 5

This chapter presents information and references for you to determine the installation requirements for communication equipment that you may want or need for your computer system.

Your responsibility in communications preparations is to meet the requirements described in this chapter or those referenced by this chapter as they apply to your equipment.

The communications equipment offered by Control Data includes:

- Control Data Distributed Communications Network (CDCNET).
- Loosely Coupled Network (LCN).
- Remote Technical Assistance (RTA).

Any of these communication installations that include outdoor wiring should have lightning protection at building entry and exit points for the protection of the wiring and equipment. A wide variety of commercial devices are available for this protection and must be selected to fit your particular installation.

Control Data Distributed Communications Network

CDCNET is a local area network that includes a family of compatible hardware and software products linked by segment cables. These products provide for the interconnection and high-speed data exchange between computers, data terminals, and other digital devices connected to the network.

CDCNET is optional for Control Data computer systems that use NOS and NOS/BE and required for systems that use NOS/VE.

The CDCNET Local Area Network Installation manual, listed in the front of this manual under Related Manuals, provides detailed site planning information for space, power, and cabling of the CDCNET products.

Loosely Coupled Network

LCN is an optional local subsystem that includes network access devices (NADs) connected by coaxial cables. These cables carry serial data between the NADs to enable a number of computers and peripheral equipment to interface in a local network environment.

The Site Preparation Peripheral Equipment Data manual provides detailed site planning information for space, power, and cabling of LCN.

Remote Technical Assistance

RTA installation is optional but recommended by Control Data. It is a communication link between a site and a Control Data remote support office to allow the center to remotely run diagnostics on the site computer to assist site personnel in maintenance functions.

Site preparation for an RTA installation includes:

- Planning space for the RTA equipment, preferably within 2 m (6 ft) of the main system display console. The equipment normally includes a modem and, in some cases, an optional switching unit. Each requires only a small table-top size space of approximately 645 square centimeters (100 square inches).
- Installing power outlets within 2 m (6 ft) of the RTA location.
  - Installations in the United States and Canada require 60-Hz, 120-V power.
  - Installations outside of the United States and Canada typically require 50-Hz, 220- or 240-V power.
- Installing one or two telephone lines within 2 m (6 ft) of the RTA location. The number of lines depends on the RTA equipment.
  - For one telephone line, a modem with voice/data switching capabilities must be used. In the United States and Canada the line must have an RJ11C standard modular jack installed by the telephone company. For installations outside of the United States and Canada, you will need to refer to the modem instructions to identify the jack required on the telephone line.
  - When two telephone lines are available, one may be used with a nonswitching modem and the other for voice communications. The modem lines should be dedicated for RTA.
- Planning a cable routing path between the RTA equipment and the central computer for a maximum cable length of 15.2 m (50 ft).

Data Media Storage 6

Data Media Storage 6

This chapter suggests planning considerations for storing data recording media.

Your responsibility in data media storage preparations is to evaluate and design the site storage according to your needs.

To minimize a business interruption that could result from a catastrophic event, Control Data recommends that all vital records be duplicated and stored at a location that is separate from the site and not subject to the same damage risks as the site.

Magnetic Disk Pack Storage

Recommended storage methods for magnetic disk packs are to:

- Maintain the following storage area conditions.
  - Temperature at 16.6°C to 48.8°C (60°F to 120°F)
  - Relative humidity at 8% to 80%
  - Maximum wet bulb reading at 25.5°C (70°F)
- Permit extended storage of up to 5 years for recorded or unrecorded magnetic disk packs under the following wider storage limits:
  - Temperature at -40°C to 65.5°C (-40°F to 150°F)
  - Relative humidity at 8% to 80%
  - Maximum wet bulb reading at 29.4°C (85°F)
- Condition the disk packs by bringing them into the computer room for a minimum of 2 hr before their use if they were exposed to environmental extremes or to different storage area conditions from those of the computer room.
- Use self-sealing cases to store the disk packs and protect them from dust and environmental changes during their transportation between the storage and the computing areas.
- Store the disk packs horizontally in steel cabinets. Control Data does not recommend stacking disk packs on top of one another.
- Use caution during storage or transport of disk packs to prevent their exposure to a magnetic field with an intensity of 50 gauss or more. Such exposure may cause loss of data.

Magnetic Tape Storage

Recommended storage and post storage methods for magnetic tapes are:

- Maintain the same storage area conditions for temperature and humidity as the computer room.
- Store the tapes in self-sealing cases to protect them from dust and environmental changes while moving them between the storage and the computing areas.
- Store the tapes vertically in bins or on racks.
- Prevent exposure of the tapes to a magnetic field with an intensity of 70 gauss or more. Such exposure may cause loss of data.
- Condition the tapes by bringing them into the computer room before their use if they were exposed to environmental extremes or to different storage area conditions from those of the computer room. Depending on the conditions and exposure time to which the tapes were subjected, the conditioning time should be a minimum of 24 hrs.
- Maintain the temperature between tape subsystems in which magnetic tape will be interchanged. In the operating environment, the temperature variation between the tape subsystems should be no more than ±5°C (3°F) to prevent degraded tape performance, and temporary and permanent errors.
- Equalize the tension on any tape used between interchange facilities or different tape subsystems that may have different environments. Do this prior to any attempted system operation by executing a forward pass of the tape in continuous motion, followed by a rewind.

Paper Tape and Punch Card Storage

Recommended storage methods for paper tapes and punch cards are:

- Maintain the same storage area conditions for temperature and humidity as the computer room.
- Locate the storage area outside of the computer room to minimize the fire hazard, fibrous lint, and dust from paper products in the computer room.

Index

Index

R

S

T

U

V

W

Comments (continued from other side)

Please fold on dotted line;
seal edges with tape only.

FOL

FOLD

FOL

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
First-Class Mail Permit No. 8241 Minneapolis, MN

POSTAGE WILL BE PAID BY ADDRESSEE

CONTROL DATA
Technology & Publications Division
ARH219
4201 N. Lexington Avenue
Arden Hills, MN 55126-6198

We value your comments on this manual. While writing it, we made some assumptions about who would use it and how it would be used. Your comments will help us improve this manual. Please take a few minutes to reply.

Who are you?

- ☐ Manager
- ☐ Systems analyst or programmer
- ☐ Applications programmer
- ☐ Operator
- ☐ Other _____

How do you use this manual?

- ☐ As an overview
- ☐ To learn the product or system
- ☐ For comprehensive reference
- ☐ For quick look-up

What programming languages do you use? _____

_____

How do you like this manual? Check those questions that apply.

Yes	Somewhat	No	
☐	☐	☐	Is the manual easy to read (print size, page layout, and so on)?
☐	☐	☐	Is it easy to understand?
☐	☐	☐	Does it tell you what you need to know about the topic?
☐	☐	☐	Is the order of topics logical?
☐	☐	☐	Are there enough examples?
☐	☐	☐	Are the examples helpful? (☐ Too simple? ☐ Too complex?)
☐	☐	☐	Is the technical information accurate?
☐	☐	☐	Can you easily find what you want?
☐	☐	☐	Do the illustrations help you?

Comments? If applicable, note page and paragraph. Use other side if needed.

Would you like a reply? ☐ Yes ☐ No

From:

Name _____ Company _____

Address _____ Date _____

_____ Phone _____

Please send program listing and output if applicable to your comment.

CONTROL DATA