INSTALLATION PLANNING MANUAL

STRETCH COMPUTING SYSTEM

for

LOS ALAMOS SCIENTIFIC LABORATORY

Supplied by:

International Business Machines Corporation

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This is a preliminary manual and is intended to present the major factors influencing installation of the STRETCH System. Some of the information of necessity depends on the final form of the device and is subject to change. More accurate information will be furnished when it becomes available.

TABLE of CONTENTS

Units	Description of Units
Central Processing Unit	This unit performs arithmetic and logical operations upon operands taken from storage.
Exchange	This unit directs the information flow between input-output or external storage units and internal storage. Internal processing can proceed simultaneously. The Exchange has a minimum of 8 channels. The channels are independent and may be used concurrently. To each channel can be attached a control unit for a console, a card reader, a card punch, a printer, magnetic tape units, etc. These units are cable connected to their respective control units. Additional channels can be added in blocks of 8 up to a total of 32.
High Speed Exchange	This unit is used to connect Disk Storage Units to the System. It can accommodate 1 Disk Storage Unit. Facilities for additional units can be added.
Core Storage	This unit contains 16,384 words of core storage. It is possible to attach 1,2,4,6,8,10,12, or 16 of these units to the system.
Power Distribution Unit	This unit is the main power distribution point for 60 cycle and 400 cycle power to the system. It also contains circuitry to aid maintenance of the core storage units.
Disk Storage Unit	This unit contains 4,194,304 words of storage. Data can be read from or written onto this unit at the rate of 250,000 words per second.
Console	This unit contains the elements of the Console for operator control of the system including a typewriter for input and output. The Console must be attached to a Console Control Unit.
Card Reader	This unit is a 1000 card per minute Card Reader which is part of the Input-Output System. There is no control panel on this machine. In all operations using the Card Reader, it must be attached to a Card Reader Control Unit.
Card Punch	This unit is a 250 card per minute Card Punch which is part of the Input-Output System. There is no control panel on this machine. In all

operations using the Card Punch, it must be attached to a Card Punch Control Unit.

Printer

This unit is a 600 line per minute Printer which is part of the Input-Output System. There is no control panel on this machine. In all operations using the Printer, it must be attached to a Printer Control Unit.

Console Control Unit

This unit contains the buffers and electronics which control the Console and make it attachable to the Exchange.

Card Reader Control Unit

This unit contains the buffers and electronics which control the Card Reader and make it attachable to the Exchange. It contains the electronics necessary to check the information read and to provide the Exchange with information from cards.

Card Punch Control Unit

This unit contains the buffers and electronics which control the Card Punch and make it attachable to the Exchange. It contains the electronics necessary to check the information punched and to accept information for punching.

Printer Control Unit

This unit contains the buffers and electronics which control the Printer and make it attachable to the Exchange. It accepts information serially by character and checks the information printed.

Tape Control Unit

This unit controls up to 8 magnetic tape units and contains the buffers and electronics which makes them attachable to the Exchange. There are two models. One for attaching 729-II tape units and another for attaching 729-IV tape units.

COMPUTER ROOM

This section contains general requirements for the computer room.

Space

The minimum floor area requirement for the computer is 1800 sq. ft.

An additional 200 sq. ft. should be provided for an IBM customer engineering service room.

Floor

The weight of each unit is listed on page 5. The dimensions of each unit are listed on page 6. A structural engineer should determine that the floor is capable of supporting the machine weight load as oriented on the layout. However, the maximum average uniform distributed weight load imposed by the computer is 87 pounds per sq. ft.

The schematic drawings, pages 11, 16, and 17, indicate the number of external cables that interconnect the units. Each cable will average one inch in diameter. They should be covered with a ramp or raised floor to allow operating and maintenance personnel to move safely and efficiently throughout the computer room.

Ceiling Height

The ceiling height directly effects the amount of air movement, hence the drafts that will exist in the computer room. If possible, avoid a low ceiling.

Lighting

Lighting intensity satisfactory to personnel will suffice for the computer.

Computer Delivery

Be sure to determine that doorways, hallways, etc. are of sufficient size to permit movement of the computer units from the unloading platform into the computer room.

Vibration

If the proposed computer room is subject to a noticeable vibration, request an investigation by IBM.

Fire Protection

Portable carbon dioxide extinguishers are suitable, provided they comply with applicable building codes or government regulations.

If automatic water sprinklers are mandatory, we suggest the use of intermediate range sprinkler heads (175°F - 212°F).

WEIGHT

Unit	Weight (lbs.)
Central Processing Unit	26000*
Exchange	6400*
High Speed Exchange	6800*
Core Storage	15200*
Power Distribution Unit	2000
Disk Storage Unit	2000
Console	350
Card Reader	1000
Card Punch	800
Printer	1600
Console Control Unit	900
Card Reader Control Unit	900
Card Punch Control Unit	450
Printer Control Unit	900
Tape Control Unit	900
Magnetic Tape Unit	1200

*These units are comprised of numerous individual sections.
 Each individual section does not exceed 2200 lbs.
 Refer to page 6 for the floor area covered by the total unit.

DIMENSIONS

Unit		Front	Side	Height
Central Processing Unit	(1)	35' - 4"	56"	68-5/8"
Exchange	(1)	6' - 11"	56"	68-5/8"
High Speed Exchange	(1)	8' - 8"	56"	68-5/8"
Core Storage	(1)	14' - 9"	56"	68-5/8"
Power Distribution Unit		24"	56"	68-5/8"
Disc Storage		68"	33"	68-5/8"
Console		58"	30-5/8"	42-3/4"
Printer		48"	29"	53"
Card Punch		29"	35-1/4"	38-1/2"
Card Reader		29"	35-1/4"	38-1/2"
Magnetic Tape Unit		29"	33"	68-1/2"
Console Control Unit	(2)	29"	30-5/8"	58"
Printer Control Unit	(2)	29"	30-5/8"	58"
Card Punch Control Unit	(2)	29"	30-5/8"	32-1/2"
Card Reader Control Unit	(2)	29"	30-5/8"	58"
Tape Control Unit	(2)	29"	30-5/8"	58"

(1) These groups cannot be split into smaller sections. except for shipment.

(2) If desired, these units can be butted together side by side.

MACHINE LAYOUT

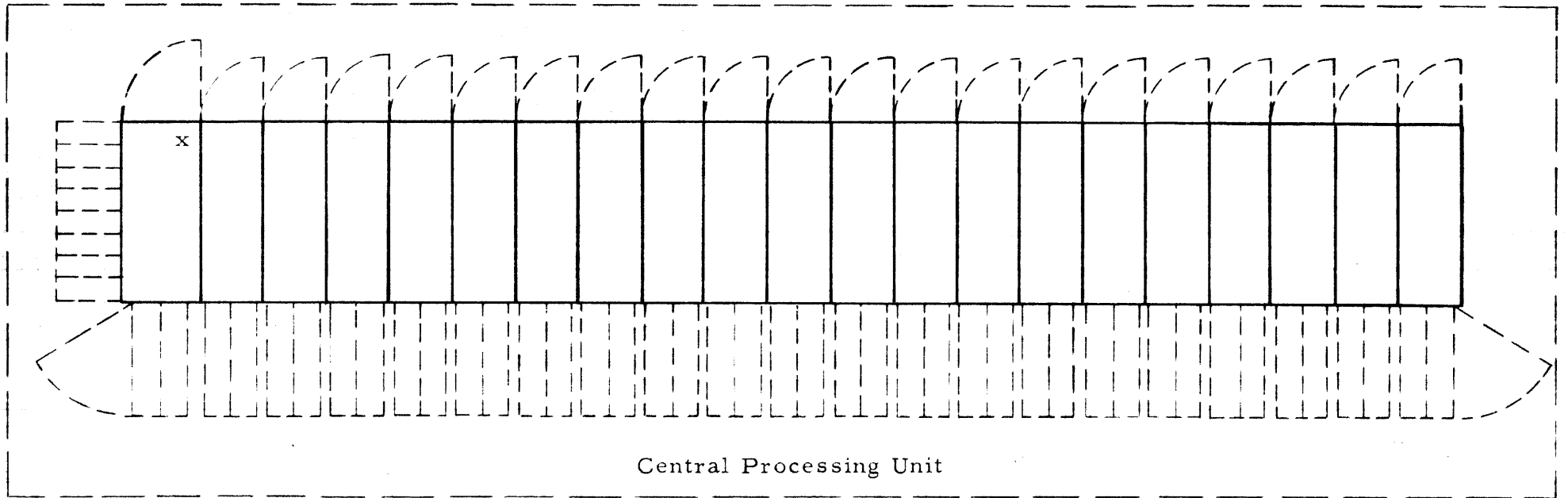A machine layout can be readily made by following three rules.

1. Locate units such that the maximum length of interconnecting signal cables is not exceeded.

2. Maintain the recommended clearances around each unit.

3. Locate the input-output units (Card Reader, Card Punch, Printer, Tape Units) near the operator's Console.

Drawings of each computer unit are shown on pages 8, 9, and 10. They are plan views, scaled 1/4" = 1'-0". Solid lines indicate the unit; broken lines adjoining the solid lines indicate extended service gates and covers; exterior broken lines indicate the clearances required for operation and maintenance. Templates can be made by cutting along the exterior broken lines. They can then be used in making a scaled layout. An extra set has been included for this purpose. Connecting points for external power and signal cables are also shown on these drawings.
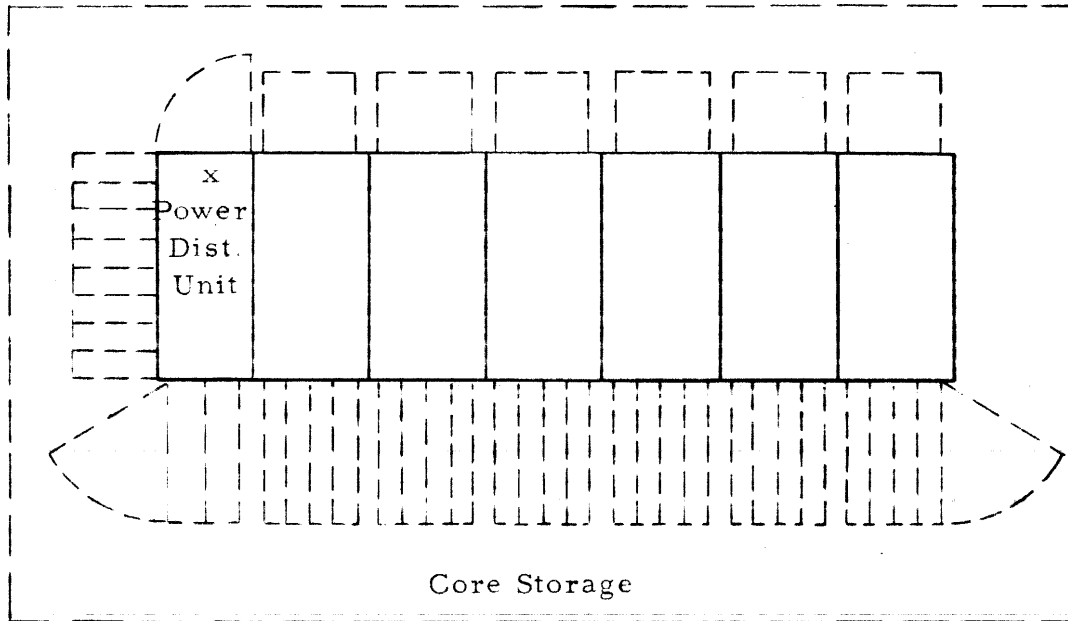
The schematic drawing on page 11 indicates how the units are connected by external signal cables. The maximum allowable length of these signal cables is listed on page 12. Connecting points, used for measuring the required length of the signal cables, are shown on the drawings, pages 8, 9, and 10.

The proper operational and service clearances are indicated by exterior broken lines on the drawings, pages 8, 9, and 10. They are also listed on page 13. When considering two or more adjacent units, it is permissible to overlap the clearances. However, the largest clearance shall always predominate.

Locating the Card Reader, Card Punch, Printer and Magnetic Tape Units near the Console will facilitate the operation of the computer and reduce the operator's walking to a minimum.
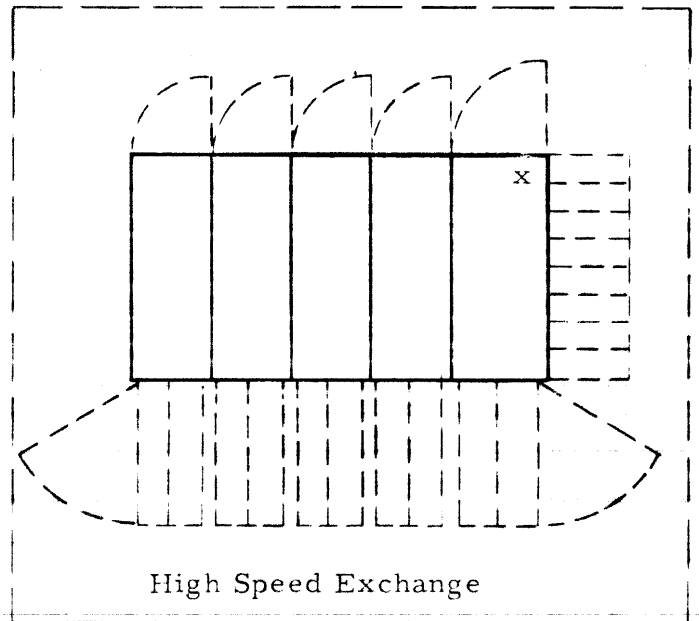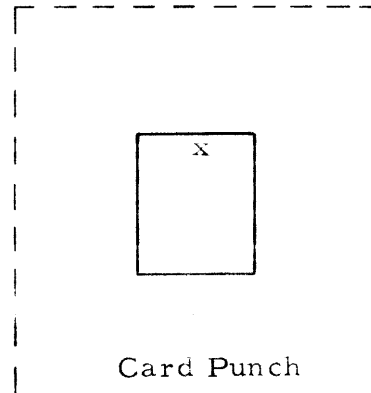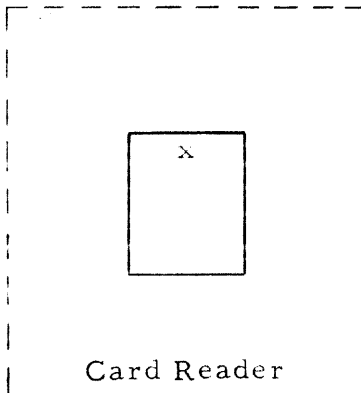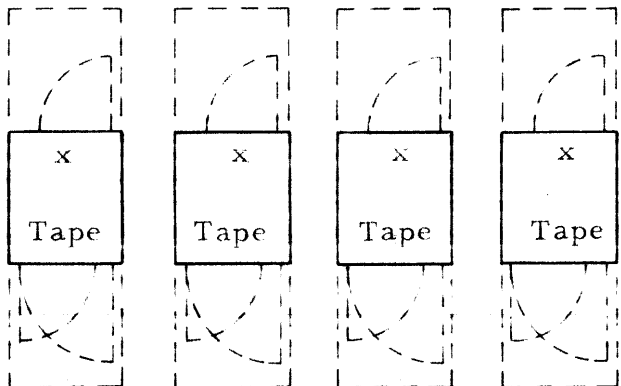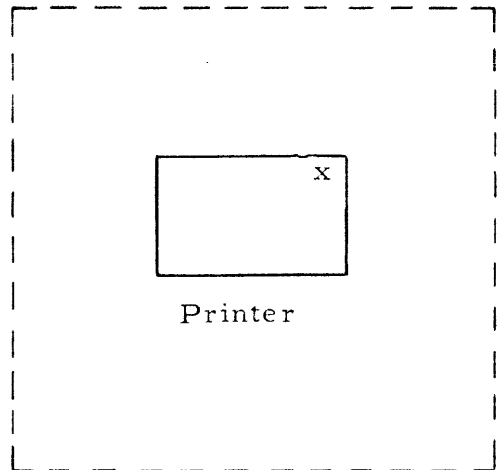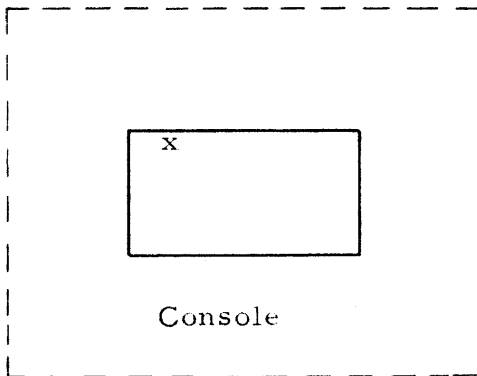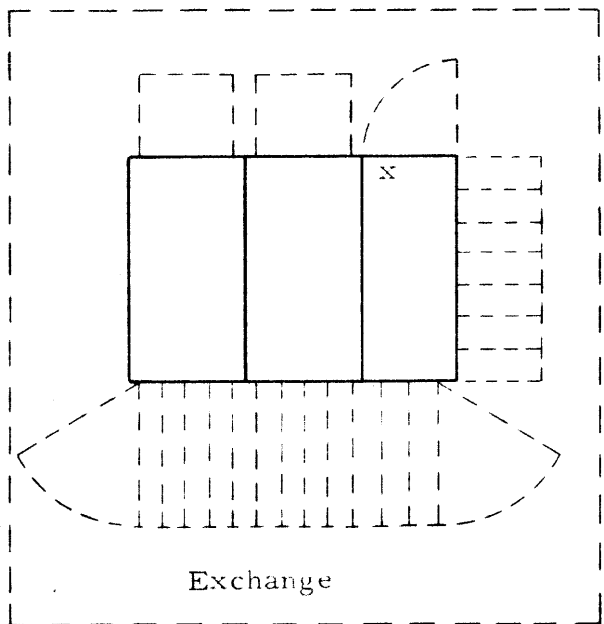
Central Processing Unit

Core Storage

High Speed Exchange

x
Power
Dist.
Unit

Plan View   Scale 1/4" = 1' - 0"   x Location of Cable Connections

Exchange

X

Console

X

Printer

X

Tape

X

Tape

X

Tape

X

Tape

X

Card Reader

X

Card Punch

X

Plan View   Scale 1/4" = 1' - 0"   x Location of Cable Connections

Reader

Control

Punch

Control

Printer

Control

Spare

Control

Disk Storage

Console

Control

Tape

Control

Tape

Control

Spare

Control

Plan View   Scale 1/4" = 1' - 0"   x Location of Cable Connections

CENTRAL PROCESSING UNIT

(1)

II

(1)

POWER
DIST.
UNIT

CORE STORAGE

(2)

CONTROL UNITS

MAGNETIC TAPE UNITS

PRINTER

EXCHANGE

CONSOLE

DISC
STORAGE

HIGH SPEED
EXCHANGE
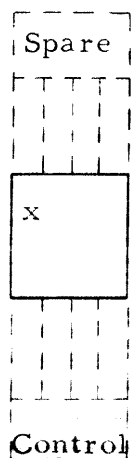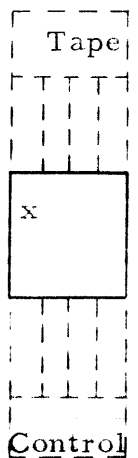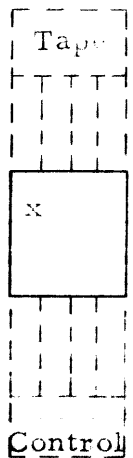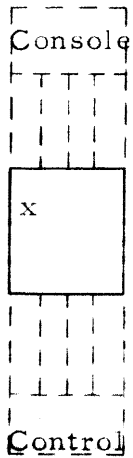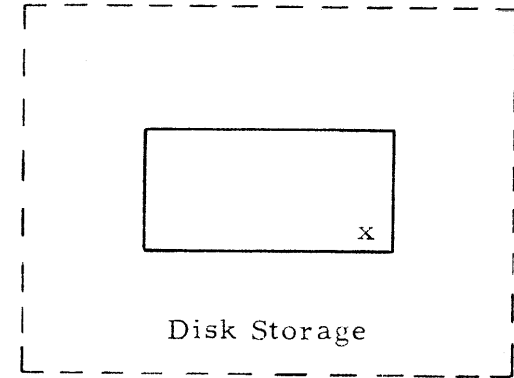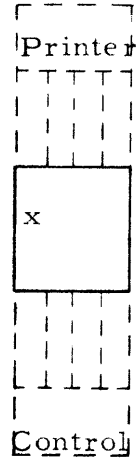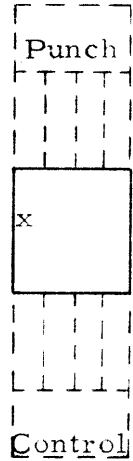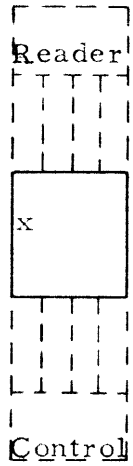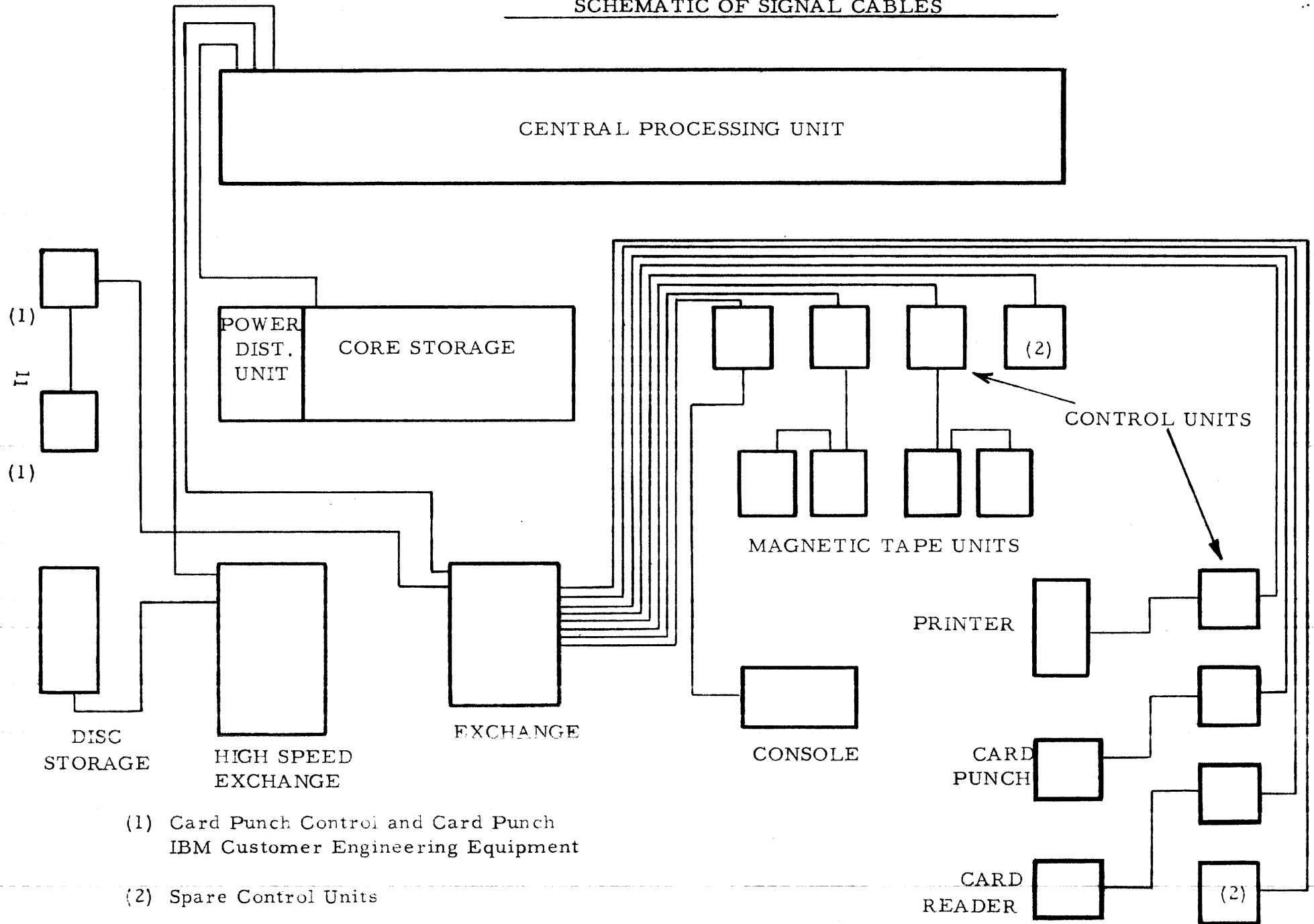
CARD
PUNCH

(1) Card Punch Control and Card Punch
     IBM Customer Engineering Equipment

(2) Spare Control Units

CARD
READER

(2)
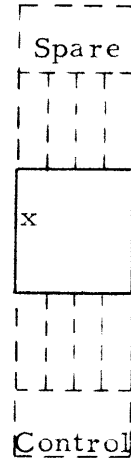
SIGNAL CABLE LENGTHS (MAXIMUM)

Units	Length (Ft.)
CPU - Core Storage	25
CPU - Exchange	40
CPU - H. S. Exchange	50
H. S. Exchange - Disc Storage	90 (1)
Exchange - C. E. Punch Control	100
Exchange - Console Control	100
Exchange - Tape Control	100
Exchange - Printer Control	100
Exchange - Card Punch Control	100
Exchange - Card Reader Control	100
Console Control - Console	50
Tape Control and Two Tapes	50
Printer Control - Printer	25
Card Punch Control - Card Punch	50
Card Reader Control - Card Reader	50

(1) When additional disk storage units are installed, they are connected in serial within groups of 4. For each such group the maximum cable length used to connect the units in serial should be 100 ft. - n x 10 ft. where n is the number of units in the string.

OPERATIONAL AND SERVICE CLEARANCES

Unit	Front	Rear	Left	Right
Central Processing Unit	60"	36"	60"	36"
Exchange	60"	36"	36"	60"
High Speed Exchange	60"	36"	36"	60"
Core Storage	60"	36"	--	36"
Power Distribution Unit	60"	36"	36"	--
Disc Storage	36"	36"	36"	36"
Console	60"	36"	36"	36"
Printer	48"	36"	36"	36"
Card Punch	36"	36"	36"	36"
Card Reader	36"	36"	36"	36"
Magnetic Tape Unit	30"	30"	SEE NOTE	
Console Control Unit	48"	48"	"	"
Printer Control Unit	48"	48"	"	"
Card Punch Control Unit	48"	48"	"	"
Card Reader Control Unit	48"	48"	"	"
Tape Control Unit	48"	48"	"	"

NOTE: These units do not require side clearances. However, if they are butted together side by side, the group should have a 30-inch clearance on each side. In the case of tape units, 3 inches of clearance should be provided between units to facilitate their removal for maintenance.

POWER

The schematic drawing, page 15, indicates the required power services for the STRETCH computer.

Motor-Generator

A 208 volt, 3 phase, 4 wire, 60 cycle service is required to power the motor. This service should be sized to carry 300 amperes. Power disconnects, serving the input to the motor and the output of the generator, are included with the motor-generator set.

Computer Power

The computer requires two supply power services.

1. 400 cycle, 208 volt, 3 phase, 5 wire
2. 60 cycle, 208 volt, 3 phase, 5 wire

These services terminate at IBM furnished circuit breakers located in the Power Distribution Unit which adjoins the Core Storage Unit. IBM furnishes the interconnecting power cables between the computer units.

60 Cycle Service

60 cycle power should be obtained from a balanced, 208 volts, 3 phase source. It is permissible to use the same 60 cycle source which feeds the Motor-Generator.

A circuit breaker should be installed in the 60 cycle service feeding the computer.

A 5 wire service should be provided consisting of 3 phase conductors, 1 neutral conductor and 1 equipment ground wire. Each phase conductor should be sized to carry 210 amperes.

400 Cycle Service

400 cycle power is derived from the Motor-Generator Set.

A 5 wire service should be provided consisting of 3 phase conductors, 1 neutral conductor and 1 equipment ground wire. Each phase conductor should be sized to carry 300 amperes.

Equipment Ground Wires
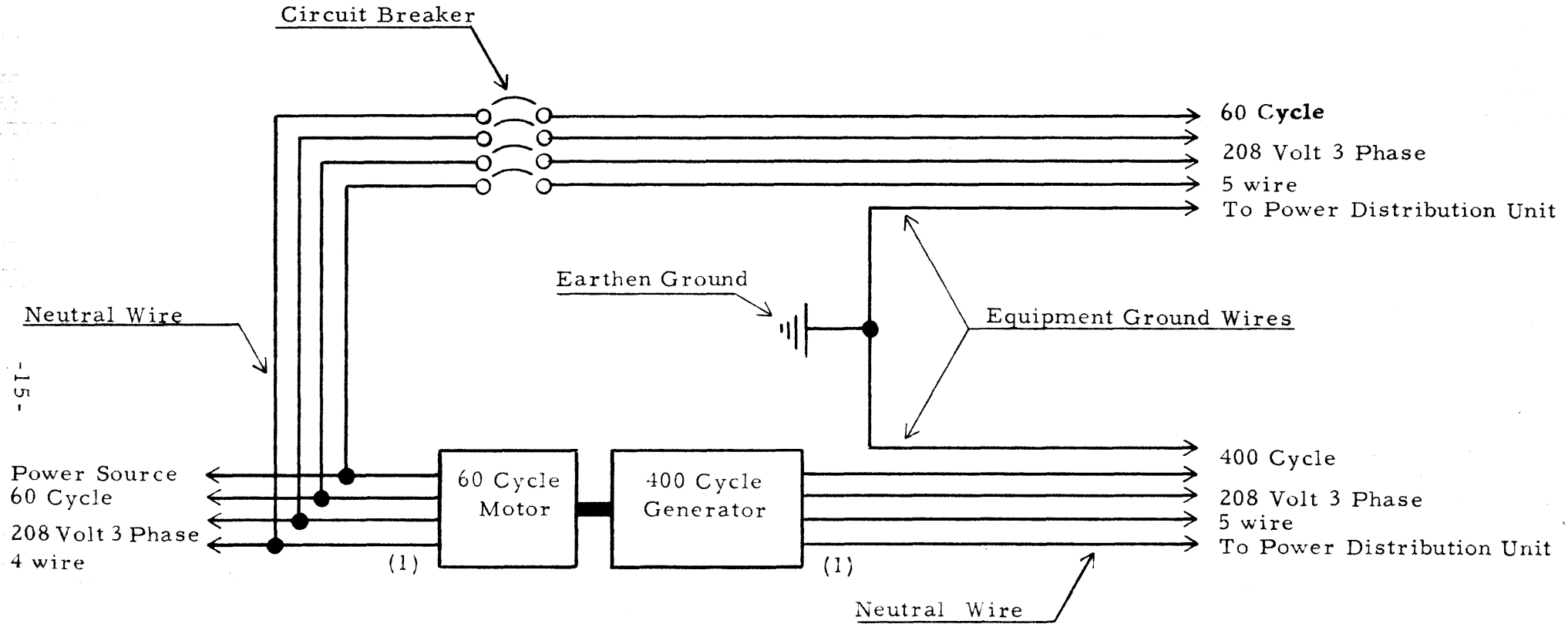
The equipment ground wires of the 60 cycle and 400 cycle services should be carried from the Power Distribution Unit to the Motor-Generator location (if possible) and terminated in an earthen ground. A common ground is permissible.

SCHEMATIC OF 60 CYCLE AND 400 CYCLE POWER SERVICES*

Circuit Breaker

60 Cycle

208 Volt 3 Phase

5 wire
To Power Distribution Unit

Earthen Ground

Equipment Ground Wires

Neutral Wire

Power Source
60 Cycle

208 Volt 3 Phase
4 wire

60 Cycle
Motor

400 Cycle
Generator

(1)

(1)

400 Cycle

208 Volt 3 Phase

5 wire
To Power Distribution Unit

Neutral Wire

* Furnished by Customer.

(1) Power Disconnects are a part
of the Motor-Generator.
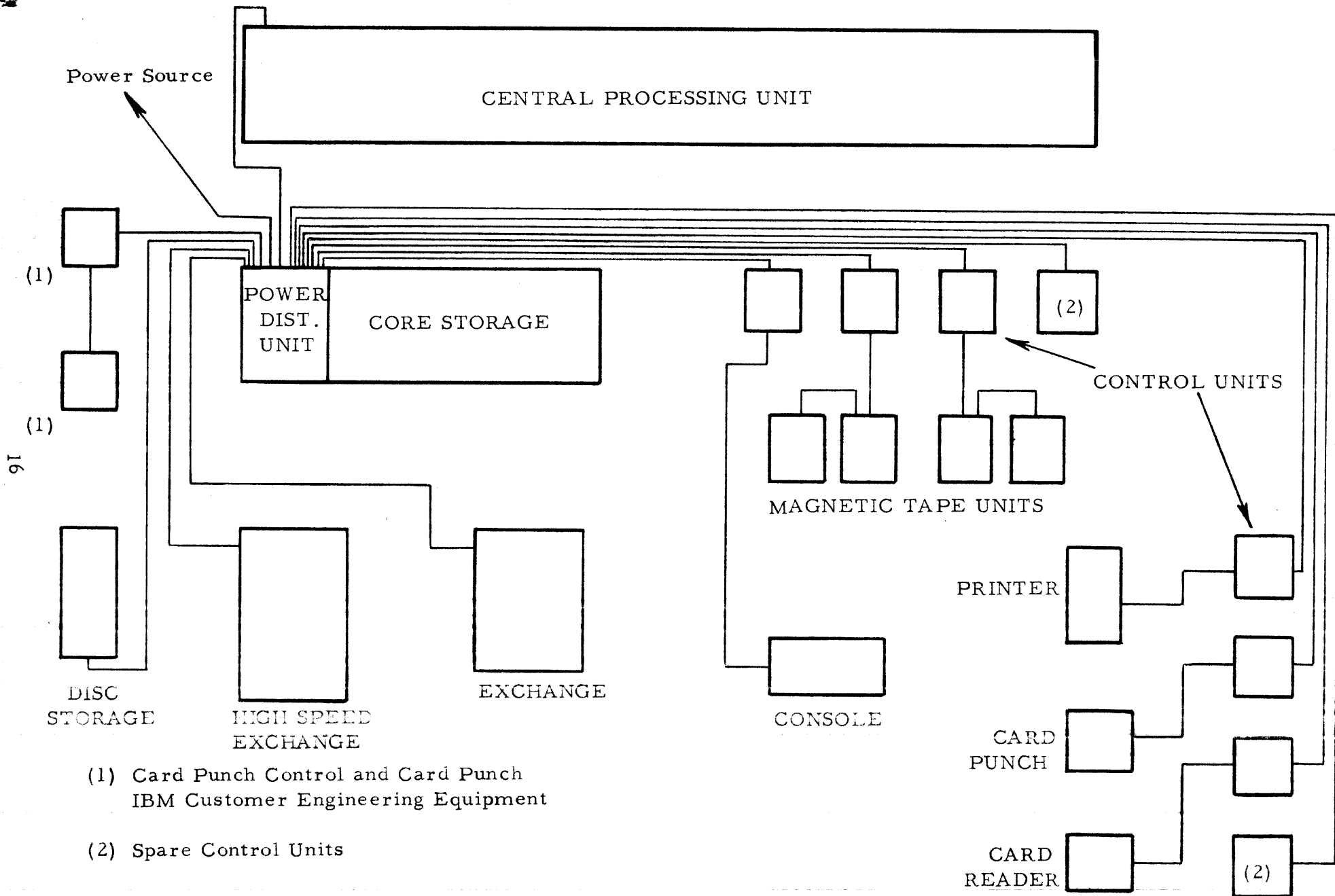
Power Source

CENTRAL PROCESSING UNIT

(1)

POWER DIST. UNIT

CORE STORAGE

(2)

CONTROL UNITS

MAGNETIC TAPE UNITS

(1)

16

PRINTER

DISC STORAGE

HIGH SPEED EXCHANGE

EXCHANGE

CONSOLE

CARD PUNCH

(1) Card Punch Control and Card Punch
IBM Customer Engineering Equipment

(2) Spare Control Units

CARD READER

(2)

Power Source

CENTRAL PROCESSING UNIT

(1)

(1)

17

POWER DIST. UNIT

CORE STORAGE

CONTROL UNITS

(2)

MAGNETIC TAPE UNITS

DISC STORAGE

HIGH SPEED EXCHANGE

EXCHANGE

CONSOLE

PRINTER

CARD PUNCH

CARD READER

(2)
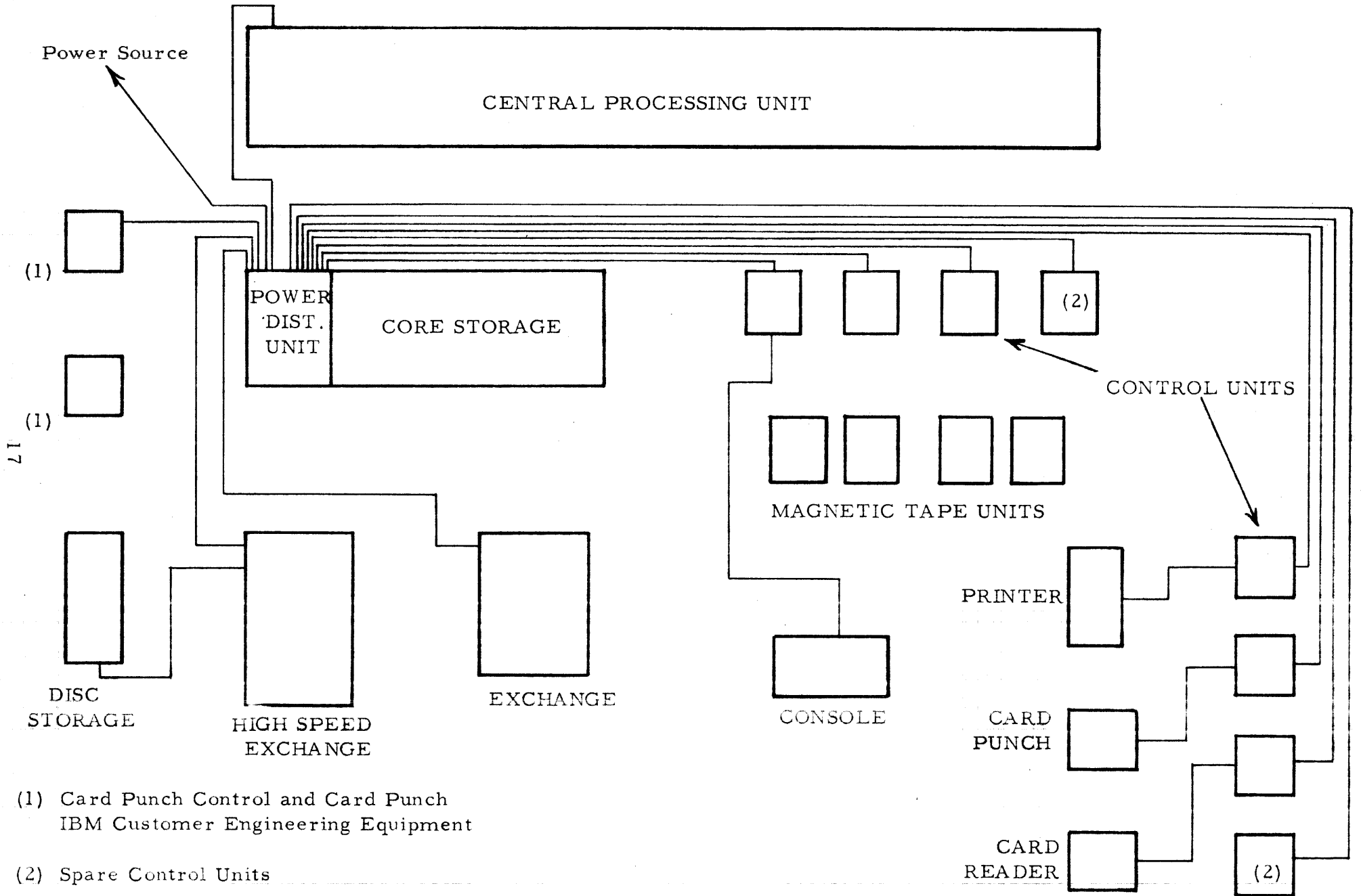
(1) Card Punch Control and Card Punch
     IBM Customer Engineering Equipment

(2) Spare Control Units

AIR CONDITIONING

The room which contains the STRETCH computer should be maintained within the following limits of temperature and relative humidity during operational periods of the computer. Operational period refers to any time that computer power is turned on.

Temperature   50°F - 80°F *
Relative Humidity   20% - 80%

*Maximum Recommended Design Temperature is 75° F.

Heat Loads

The air conditioning system must be sized to handle the summation of the heat loads of the Computer, Computer Room and Outside Air.

Computer

The machine layout indicates the number and type of computer units and their orientation. The heat loads of each type of computer unit is listed on page 20. The sum of these heat loads, considering the number of each type of unit, is the computer load. This is strictly a sensible heat load and is expressed in terms of BTU/HR.

Computer Room

The computer room heat load is calculated by the customer and consists of the heat gains from such sources as:

1. People
2. Lights
3. Infiltration resulting from such occurrences as opening doors.
4. Conduction through walls, floor, ceiling and windows.
5. Solar heat from the sun.

Outside Air

Outside air is introduced into the air conditioning system for purposes of ventilation. The amount required and the resultant heat load is governed and calculated by the customer.

Air Movement

It is not unusual to have up to one air change per minute in the computer room. This is a natural result of the concentrated heat load imposed by the computer. A low ceiling aggravates this condition. Therefore, a room with a high ceiling (12' or above) is preferable.

The proper distribution of supply and exhaust air is a second primary factor in keeping drafts to a minimum.

Tonnage

The total heat load (Computer, Room, Outside Air) can be expressed in terms of BTU/HR. This figure, divided by 12000, gives the requirement of the air conditioning system expressed in terms of tons.

HEAT LOADS

Unit	BTU/HR.
Central Processing Unit	102,000
Exchange	32,000
High Speed Exchange	45,000
Core Storage	65,000
Power Distribution Unit	28,000
Disk Storage Unit	28,800
Console	1,700
Card Reader	4,400
Card Punch	4,800
Printer	4,800
Console Control Unit	10,000
Card Reader Control Unit	10,000
Card Punch Control Unit	5,000
Printer Control Unit	10,000
Tape Control Unit	9,200
Magnetic Tape Unit	3,900