Site preparation

ND-13.028.1 EN

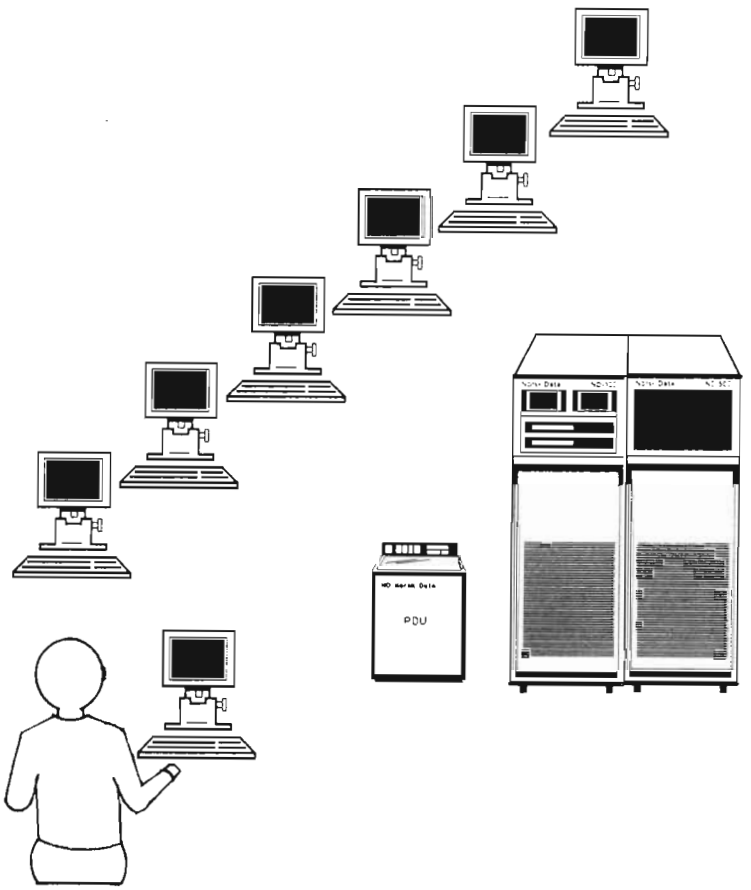
Preface

This manual is used by ND's customers in connection with planning, building and altering of the computer room before an installation.

The ND offices will be at your service with advice and recommendations.

The manual is also a referance document for ND's service and system integration departments.

It applies to the ND-100, ND-500 and ND-5000 systems.



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REQUIREMENTS FOR COMPUTER ROOMS

SPECIFICATIONS

Site preparation

1 The computer room

1.1 When is a computer room necessary?

ND Butterfly and ND Satellite are designed to work in the office area. But ND COMPACT **with filestore and larger systems** have to be placed in a separate **computer room**.

(The ND COMPACT alone can be placed in the office area.)

The generation of heat demands **cooling** of the computer equipment. This is to ensure stable operation and intended working life of the components.

Surroundings **free from dust** are important, especially for the data storage equipment.

Larger computer installations should be restricted from **unauthorized entry** to ensure secure operation.

In addition, larger systems emit some **noise** which should be kept away from the office area.

1.2 What has to be taken into account?

The environment around the computer system influences the running reliability:

- Computer equipment requires **steady and correct mains power** to give a good service.

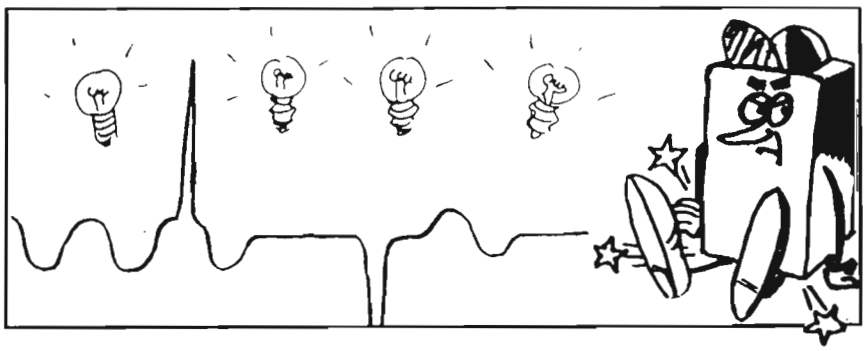


Fig 1: Varying mains power is good enough for a lighting plant, but not always for a computer.

- Computer equipment generates heat – a **cooling** system is necessary to keep the right temperature.

Fig 2: Everybody does bad brain work in intense heat - and the components will have a reduced working life.

- A **dustless environment** gives more reliable service and a longer workinglife.

Fig 3: Too much dust may break the back of data storage equipment. The dust will also cover the components inside the computer and give a greater heat generation.

- One has to think of **disposition** and **service access**.

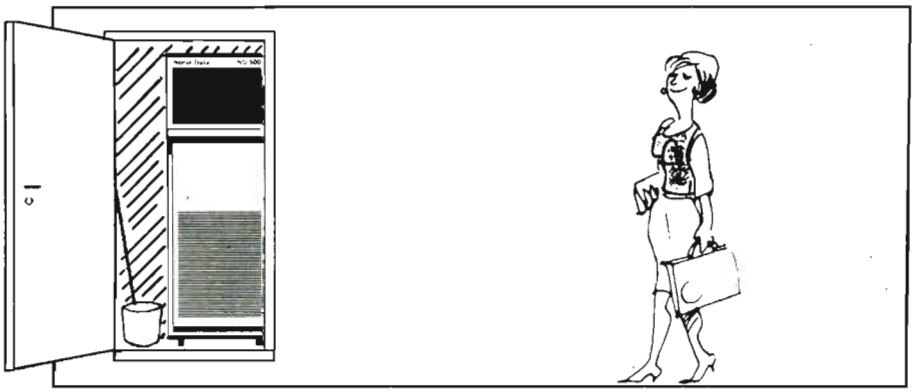


Fig 4: The closet is not a suitable computer room.

- What kind of **saftety devices** are to be installed?

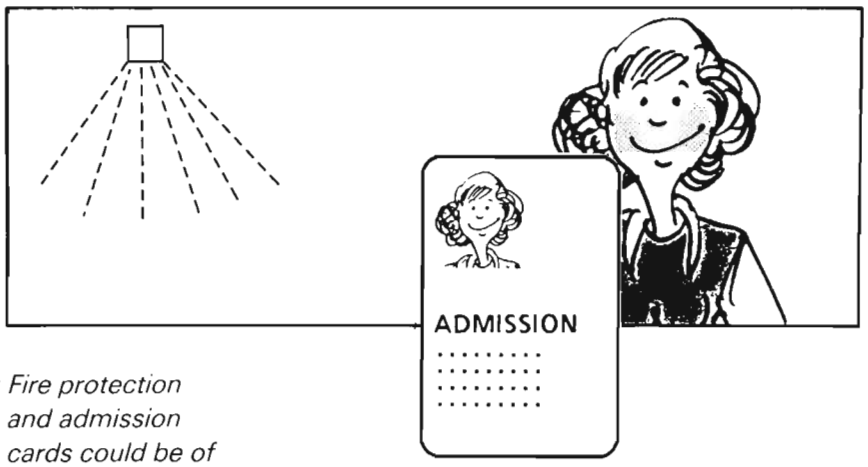


Fig 5: Fire protection and admission cards could be of actual interest.

1.3 Where to build the computer room?

Designing and outfitting a computer room is expensive. But the best way to cut the cost is **good planning.**

Firstly, put the computer facility in a place where expansion is easy.

A lot of customers experience that the computer room one day will be too limited in space. The need of data-processing is often growing fast.

Then it is a good idea to have a computer room which is big enough, or can be **easily expanded.**

So, get a growth projection for the coming years, and have a plan for what to do when eventually the computer room space becomes limited.

In site selection also think of **electromagnetic noise, light, heat** and **fire protection.**

Finaly, consider the **cable lay out** of the building.

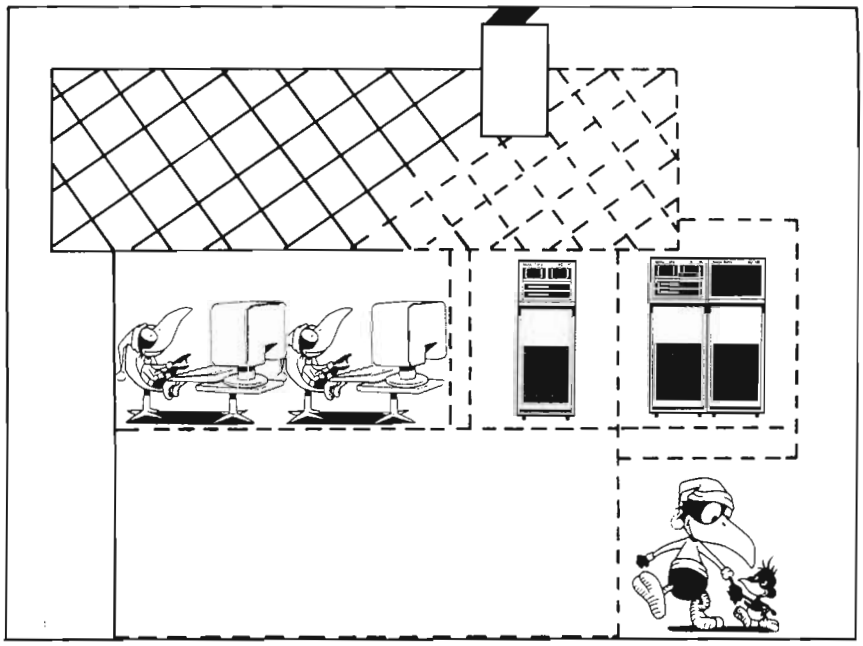


Fig 6: Put the computer facility in a place where expansion is easy.

1.4 Size of the computer room

The size of the computer room is determined by the **requirements for access space** around each unit.

The minimum size of a computer room is 3 m x 4 m.

Also take into account a possible future expansion of the equipment.

Make a point of getting the computer room large enough.

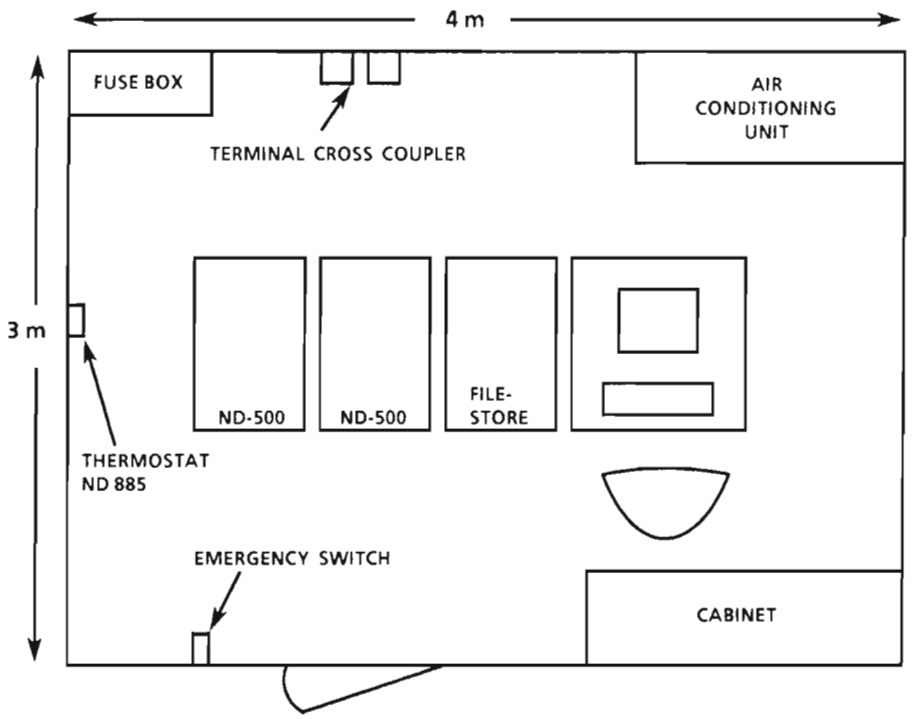


Fig 7: The figure is showing a minimum sized computer room.

Notice that there is little room for system expansion.

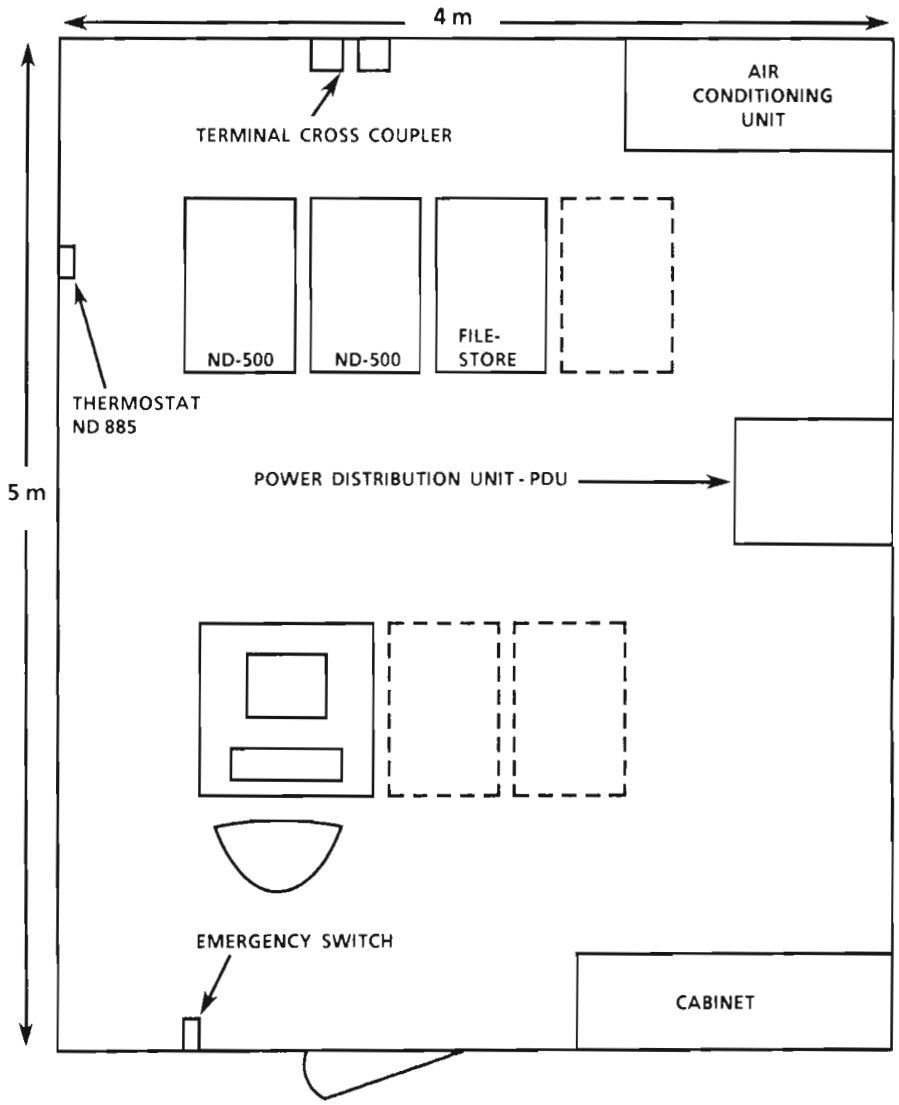


Fig 8: The figure is showing the same computer equipment in a larger computer room.

Notice that there is plenty of room for system expansion.

1.5 Service access

To carry out service there has to be space around the computer equipment.

Minimum service access around units:

Front: 1.00 m
Sides: 0.60 m
Back: 0.60 m

If there are more than 3 cabinets in a row, the space at the back should be increased to minimum 1.00 m.

2 The floor

2.1 Raised floor

If there is a choice of floor in the computer room, then a raised floor should be chosen, because it gives the following advantages:

- Good distribution of cooling air.
- Easier electrical installation.
- Protection of cables.
- Easier installation of the computer equipment.
- Greater flexibility.
- Maximum space utilization.
- Easier cleaning.
- Antistatic floor covering.

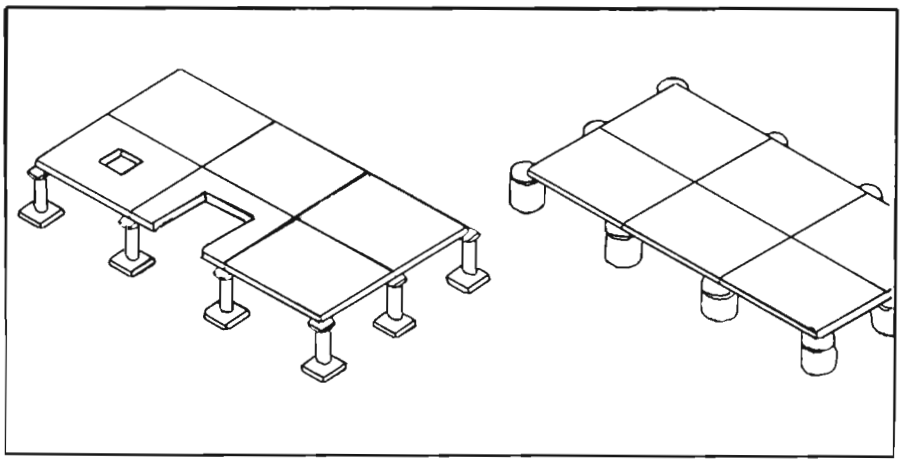


Fig 9: Raised floor.

The factors below must be taken into account when a raised floor is chosen:

- The **access space** must be at least 0.20 m.
- Untreated underfloors **must be treated** in order to eliminate dust, and for cleanliness.
- All raised floors in computer rooms **must be grounded** to comply with the supplier's specifications.

2.2 Holes in the floor panels

Holes in the floor panels have two functions:

- They will **lead cables** to the computer equipment.
- They will **distribute cooling air** to the computers.

The holes are placed below the computer equipment, and are made large enough for good air circulation.

Some of the floor panels apart from the computer(s) may be perforated, or have registers, to create a good air circulation.

Look at air conditioning equipment, p 31-33.

Diagrams for the holes in floor panels, p 47-48.

The customer is responsible for making all holes prior to delivery of the equipment!

The computer room must be cleaned before the equipment is taken in. Remember to clean the underfloor.

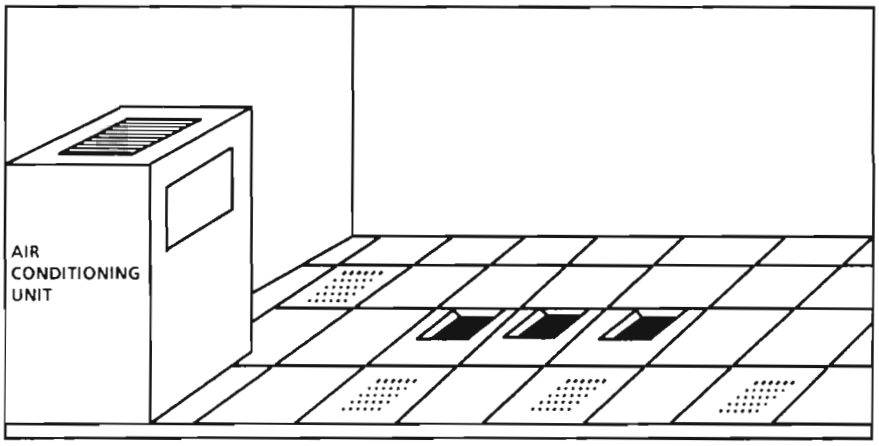


Fig 10: The holes in the floor panels must be made prior to the installation. Room and floor must be cleaned.

2.3 Single floor

A single floor can be used where the height of the ceiling prevents the choice of a raised floor, or if the system is small and no expansion is planned.

All cables must be run in ducts on the floor or the walls!

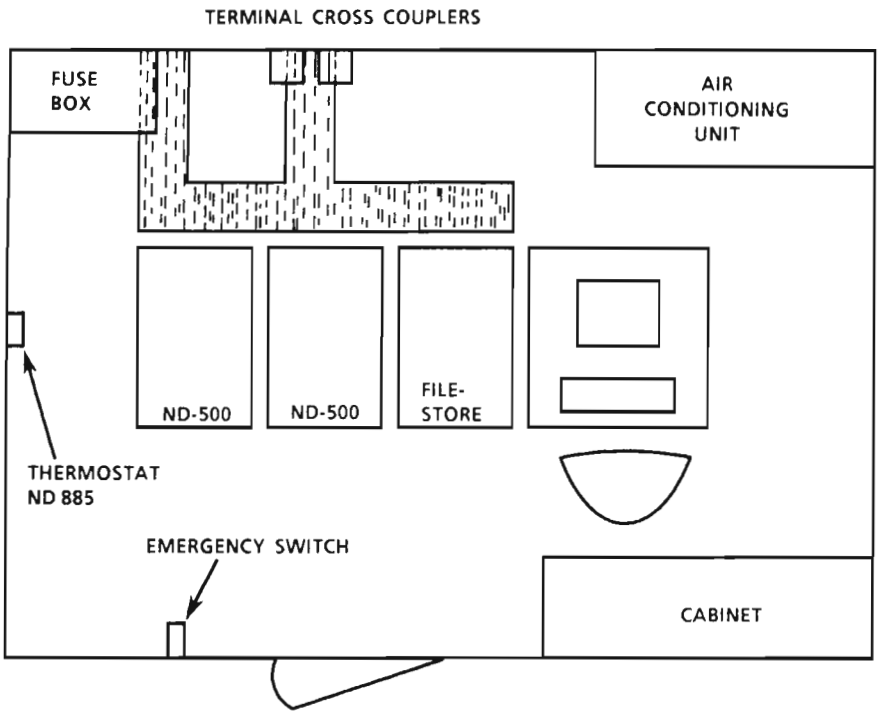


Fig 11: In computer rooms with a single floor, all cables must be run in cable ducts.

2.4 Floor covering

To avoid problems from static discharge, an electrostatic floor covering should be chosen.

Ensure that the floor covering is laid and maintained to the manufacturers' specifications!

3 Mains power

3.1 Mains power

The mains power where the computer equipment is to be installed may have **variations** or **black outs** that may affect the running of the computer.

The **service reliability** of a computer system may be affected if the quality of the mains power is too bad.

The customer should try to figure out how "dirty" the power is, and together with ND form an estimate of what sort of precautions are necessary to get reliable operation.

3.2 Electrical disturbances

The following forms of electrical disturbances may cause damages or unreliable operation:

- Electromagnetic interference and noise.
- Black outs.
- Lightning.
- Electrostatic discharge.

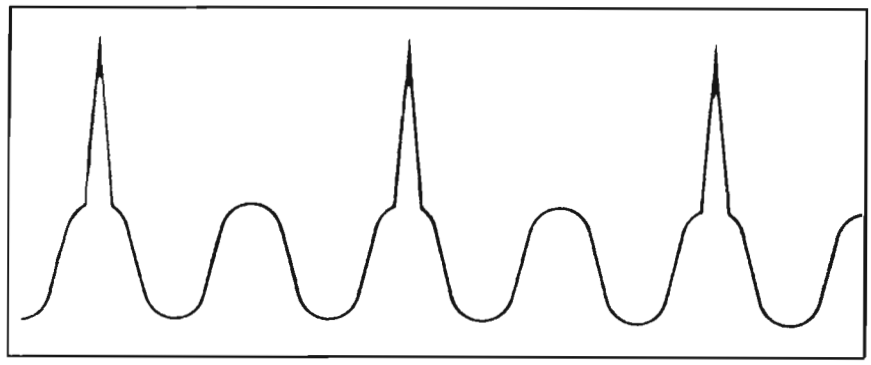


Fig 12: Starting and stopping of electric motors, and switching of fluorescent tubes may cause "dirt" on the mains.

Some **precautions** can be taken to guard against these phenomena:

3.3 Precautions

Against electromagnetic interference and noise:

- The **main supply cable** to the computer room is taken from the **building's main supply board**, to avoid variations from other power users.
- **Isolation transformers** separate the computer equipment from the mains, and give a high grade of noise suppression.
- Voltage stabilization devices.
- Mains filters.

Against black outs:

- Installation of uninterruptible power supply (UPS).

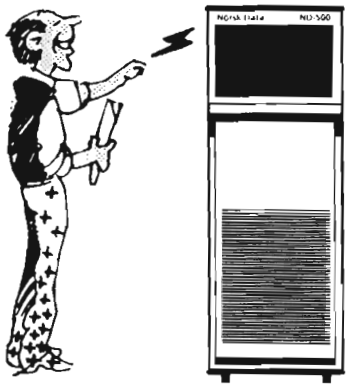
Against lightning:

- Installation of **varistors** between each phase and ground on the riser cable in the main supply board.

  (Must be checked at regular intervals!)

Against electrostatic discharge:

- **Electrostatic floor covering.**
- The **relative humidity** is kept above 40 %.



3.4 What do i need?

It depends on the mains power condition, and the desirable service reliability.

The customer must come to a decision on whether he will have a permanent installation with a fuse box, or he will have a flexible power distribution unit – PDU.

Next, the customer must decide what sort of equipment he needs, if any, to protect the computer system against bad mains power conditions. Does he need an isolation transformer, or an UPS?

3.5 The start – mains power to the computer room

No matter what solution the customer finds, the running of the mains power to the computer room must follow the same procedure:

- The **main supply cable** (rising main) to the computer room must be taken from the **building's main supply board.**

  This may be deviated from if the main fuseboard (on the floor where the computer room is situated) has sufficient capacity, and an isolation transformer is used.

- The main supply cable must be **screened.**

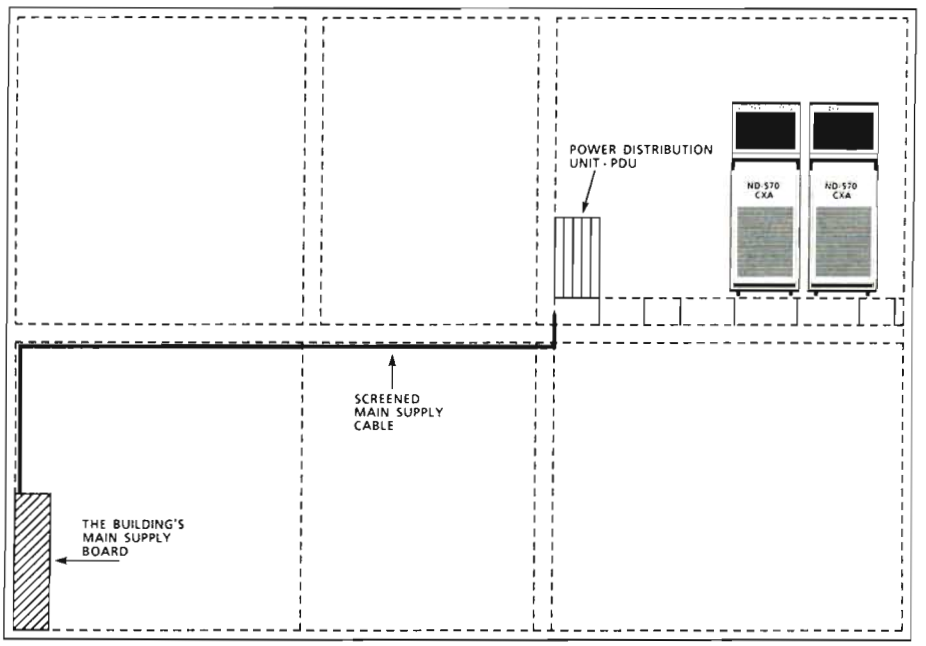


Fig 13: The mains power to the computer room is taken from the building's main supply board. The cable must be screened.

The question of 1-phase or 3-phase depends on the total load. But there should be 3-phase to the computer room.

The main supply cable from the building's main supply board to the computer room must **only give power to the computer equipment!** This is to avoid varying load on the computer mains.

Mains power to lighting, **air conditioning** and so forth is taken separatly from the main fuse board (on the same floor).

3.6 Permanent installation with a fuse box

- A fuse box must be installed in the computer room.
- A **contactor** must be mounted on the main supply cable (in the fuse box).
- The contactor must be controlled by a **room thermostat** with **manual reset** (ND 885). This will interrupt the power supply if the temperature in the room exceeds 28° C.

  This may happen if the cooling system breaks down.

  The thermostat is set 2° C lower than the maximum temperature (30 ° C) because warmer air pockets may occur.
- Each unit must have its own course, except terminals, modems, etc.
- The **separate courses** are protected by 16 a or 25 a slow automatic fuses.

See equipment specifications, p 57-61.

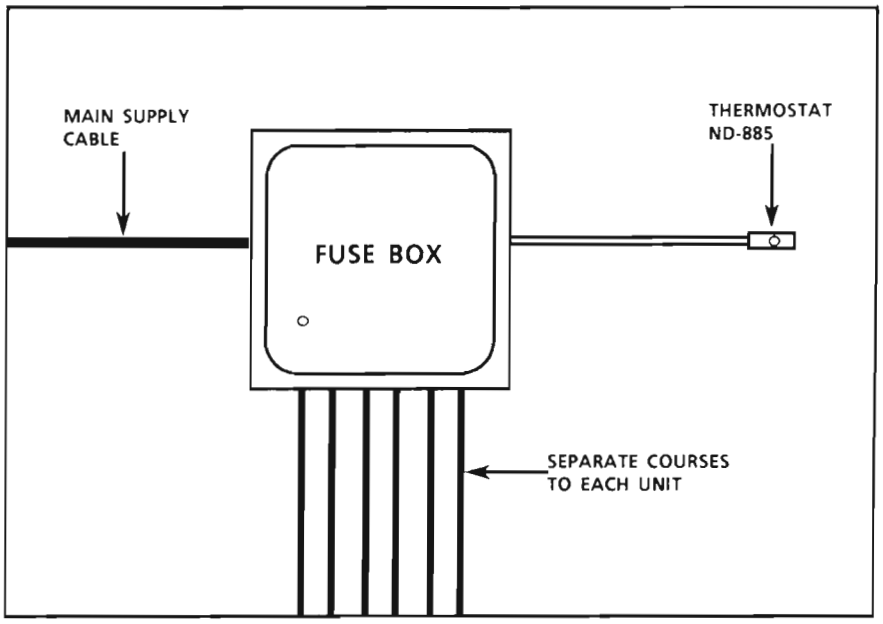


Fig 14: Permanent installation with a fuse box. A thermostat will interrupt the power supply if the temperature exceeds 28° C.

- Every outlet is **marked** with course number.
- Equipment which needs 25 A fuses should be connected with an ASEA CUI 232-6 + CR 32 outlet or equivalent.

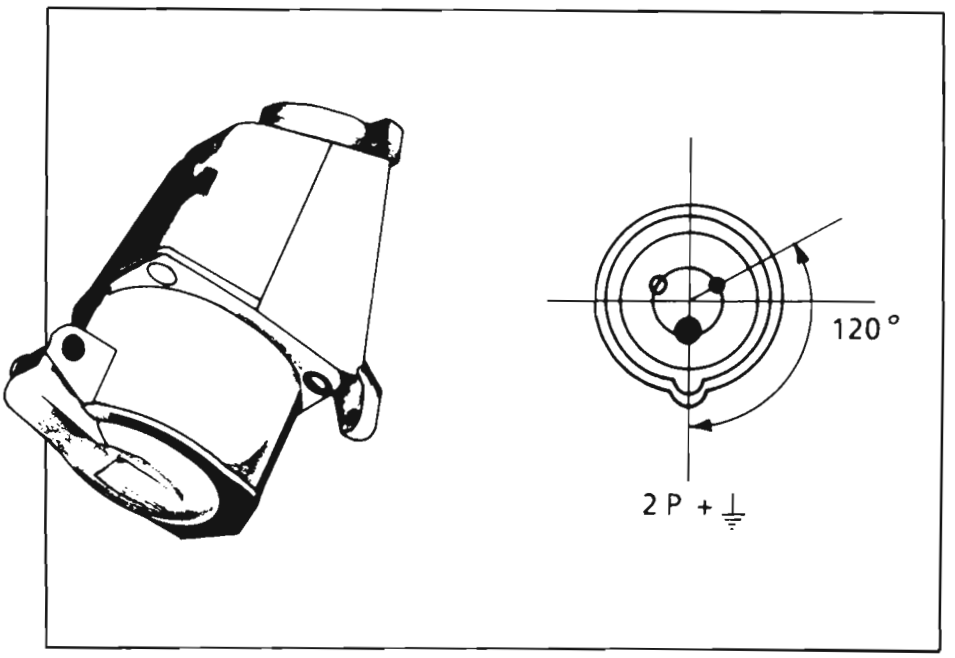


Fig 15: Outlet type to 25 A fuses: CUI 232-6 + CR 32.

This is a serviceable solution of power supply if the mains are good, and the customer does not require a 100 % up time of the system.

The main supply cable should be protected from lightning by **varistors**.

If the customer wants further protection against "dirty" mains, he may install voltage stabilization devices, isolation transformers or an UPS.

3.7 Disposition of the outlets

In computer rooms equipped with a **raised floor**, the outlets should be located under the floor, **in front of the respective units.**

When a computer system is installed in a computer room with a raised floor, the signal cable will be placed below and behind the units. The signal cables should not be mixed up with power cables.

In computer rooms with **single floor**, the outlets should be located **on the cable duct, behind the respective units.** (Of practical reasons.) See fig 11, p 11.

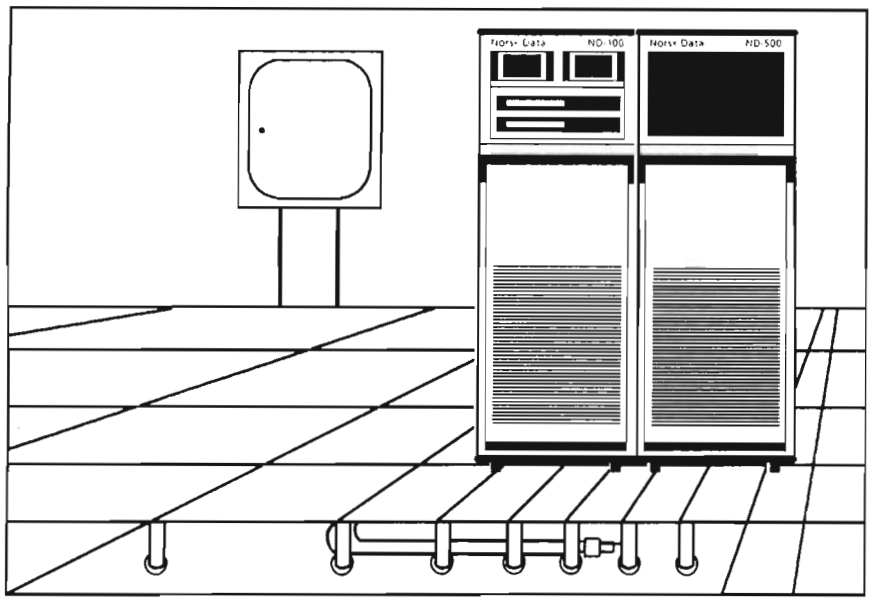


Fig 16: In computer rooms with a raised floor, the outlets should be located under the floor, in front of the units.

There should always be an extra 16 amp outlet near the computers for service purpose!!

3.8 Power distribution unit – PDU

This is a moveable unit which contains everything mentioned in **Permanent installation with a fuse box,** s. 17-18. The PDU therefore replaces a permanent installation in full measure.

In addition the PDU has:

- Isolation transformer.
- Varistors.
- Control panel.
- Automatic and sequential restart after power failure.
- Alarm indications for temperature and mains failure.
- Connection for external alarm indication.

The PDU is supplied by ND in standard sizes: 10, 20, 40 and 60 kVA. Other sizes can be supplied by special order.

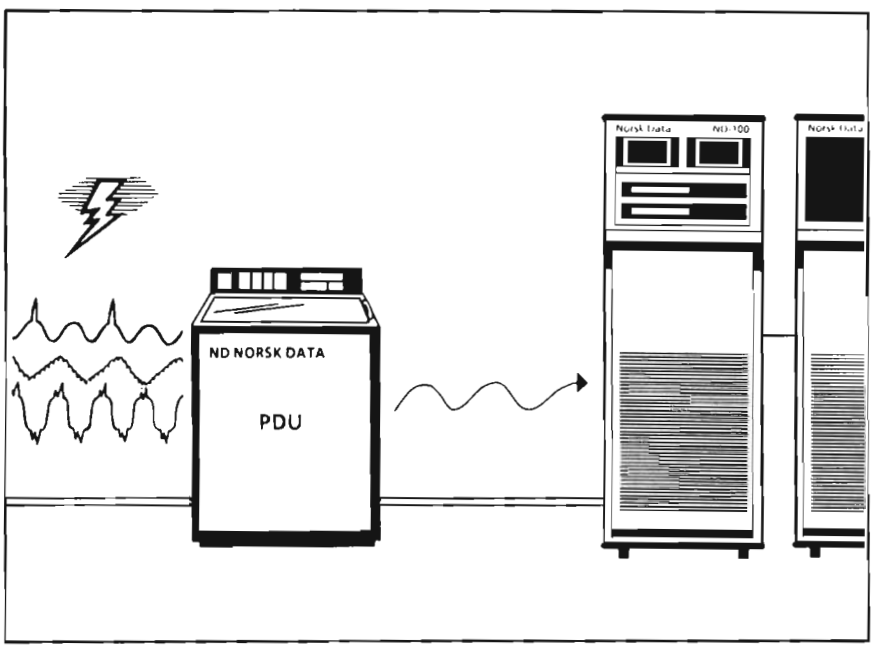


Fig 17: The PDU gives an easy and flexible installation. The PDU gives protection against electromagnetic interference and noise. It controls power in the computer room.

3.9 Advantages with PDU:

- The PDU is **moveable** and flexible. It can be wheeled into the computer room.

  If the customer after some years wishes to rebuild or move to another computer room, he can just take the PDU with him. He does not have to make a new permanent installation with a fuse box.

- The **isolation transformer** in the PDU separates the computer system from the mains, and avoids problems with "dirty" mains.

  With a PDU there is no need for isolation transformers to every cabinet in the system.

- The **control panel** gives informations about current, voltage, frequency and ground current.

- Besides **alarm indications** for temperature and mains failure, other types can be connected.

- Connection for external alarm (ringing bell, telephone etc.).

3.10 Uninterruptible power supply – UPS

If the customer wants to be guaranteed a 100 % up time of his computer system, he has to install an UPS-system.

This system is usually based on **batteries** so that the computer system can be run over shorter **black outs**.

The batteries will then automatically take over and give power to the computer system.

If there is a longer black out, there will be time to make a controlled close down.

To run the computer system over longer black outs requires an auxiliary power source, usually a diesel generator.

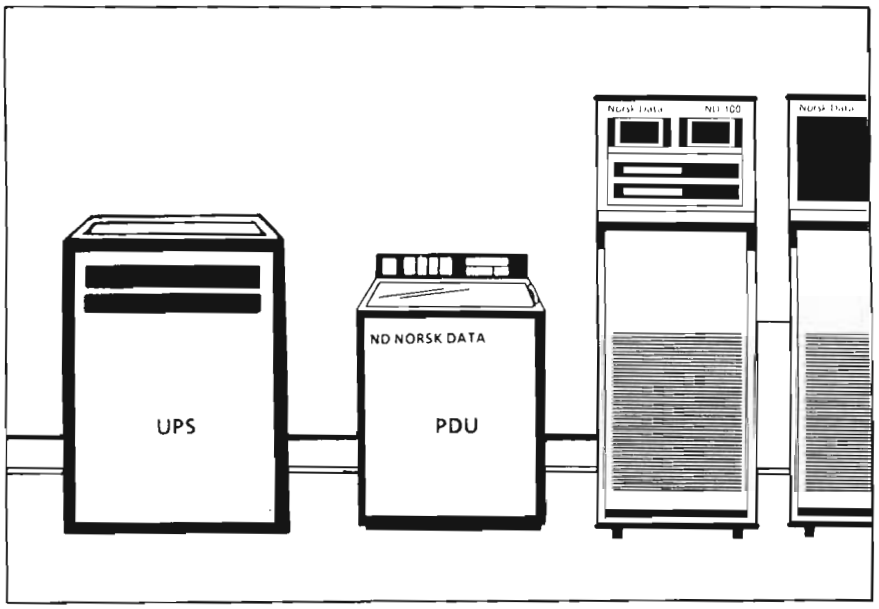


Fig 18: The UPS gives protection against black outs. The UPS also gives protection against "dirty" mains.

An UPS is connected to a permanent installation with fuse box or to a PDU.

If the UPS is used with a PDU, there is no need to overestimate the power requirements of the UPS for heavy startcurrents of the computer(s). This because of the sequentical restart of the PDU.

4 GROUNDING

4.1 Grounding

The computer system is grounded through the screened main supply cable – safety ground, and with a separate cable – system ground.

4.2 Safety ground

The safety ground is taken via **the shield** or as a separate conductor in the **main supply cable** from the building's equipotential connection (the **building's main supply board**).

It is taken to the fuse box or the PDU in the computer room.

From there it is taken **to all the outlets.**

All units in the computer system must be connected to a grounded outlet!

4.3 System ground

From the building's equipotential connection (the **building's main supply board**) a separate, insulated, **25 sq mm multicored ground conductor** must be run unbroken to a **common ground bar** in the computer room.

The ground conductor should be **marked** for easy identification.

The common ground bar must be isolated from the building.

With a PDU, the ground conductor is run unbroken to the ground terminal in the PDU.

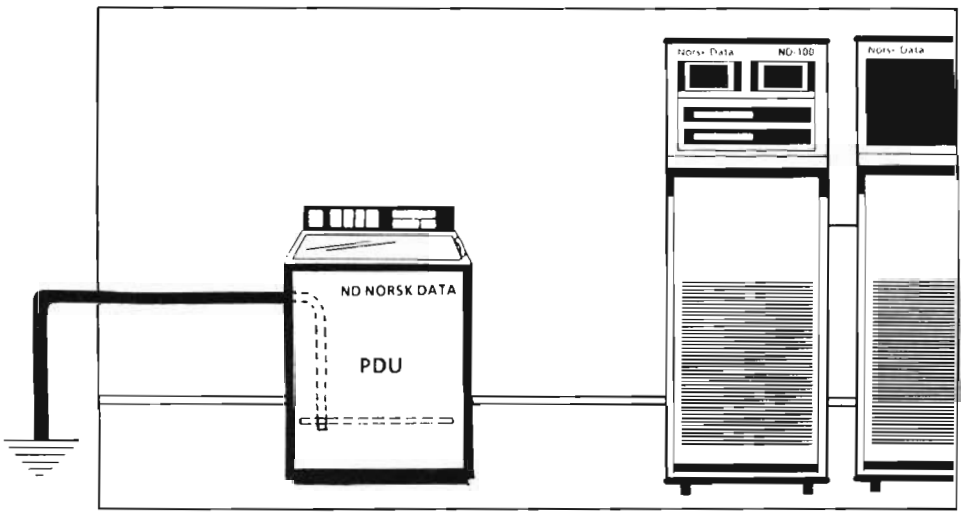


Fig 19: System ground conductor is run to the ground terminal in the PDU.

If there is a permanent installation with fuse box, and there is a **raised floor**, the ground conductor is run unbroken via the fuse box to a **common ground bar** placed below the raised floor, in front of the cabinets.

The ground bar must have a central position in the computer room.

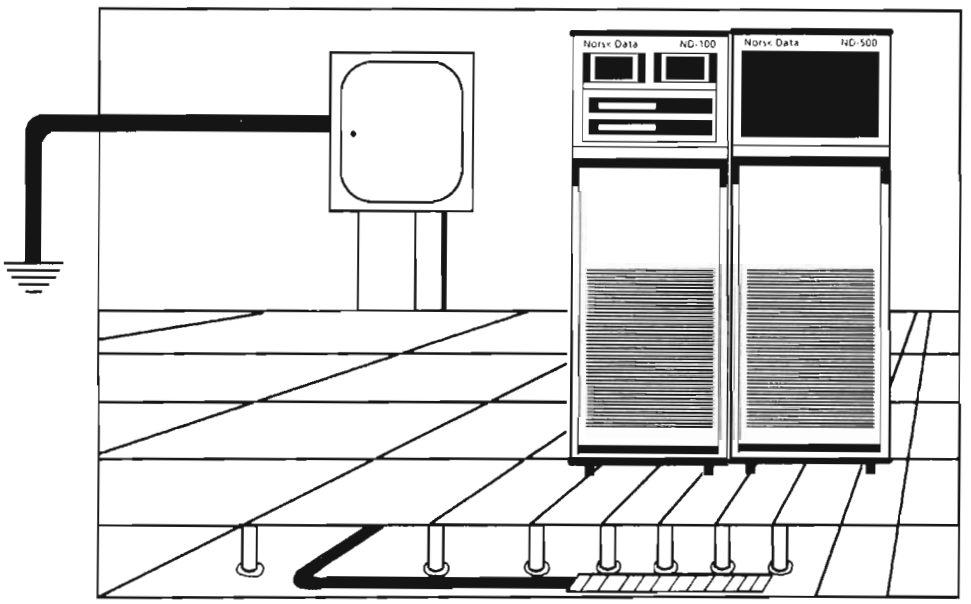


Fig 20: The common ground bar below the raised floor. The ground bar has a central position.

If there is a permanent installation with a fuse box, and a **single floor**, the ground conductor is run unbroken via the fuse box to a **common ground bar** placed on the wall behind the computer equipment.

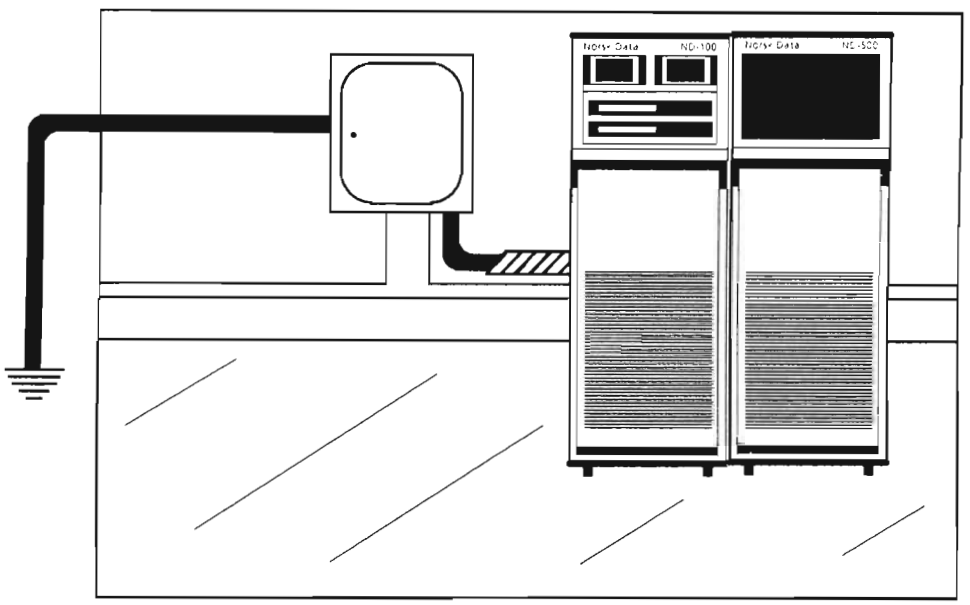


Fig 21: A common ground bar on the wall behind the computer equipment.

The final grounding of each unit will be undertaken by ND personnel.

5 Terminals/printers

5.1 Terminal wiring

To be able to distribute terminals (and printers) to present and future places of work, a cable net work with main and branch cables and the necessary connection equipment must be used.

Each terminal requires 1 **two-pair cable** and a terminal connector.

ND is using **current loop** for terminal wiring.

The customer must take into acount the numbers of terminals he will need in the future.

All terminals must be connected to grounded outlets!

Ground shield in data cables must not be in contact with terminals or parts of the building outside the computer room!

Equipment for terminal wiring, p 49.

Connection diagram and instruction for assembly, p 51-53.

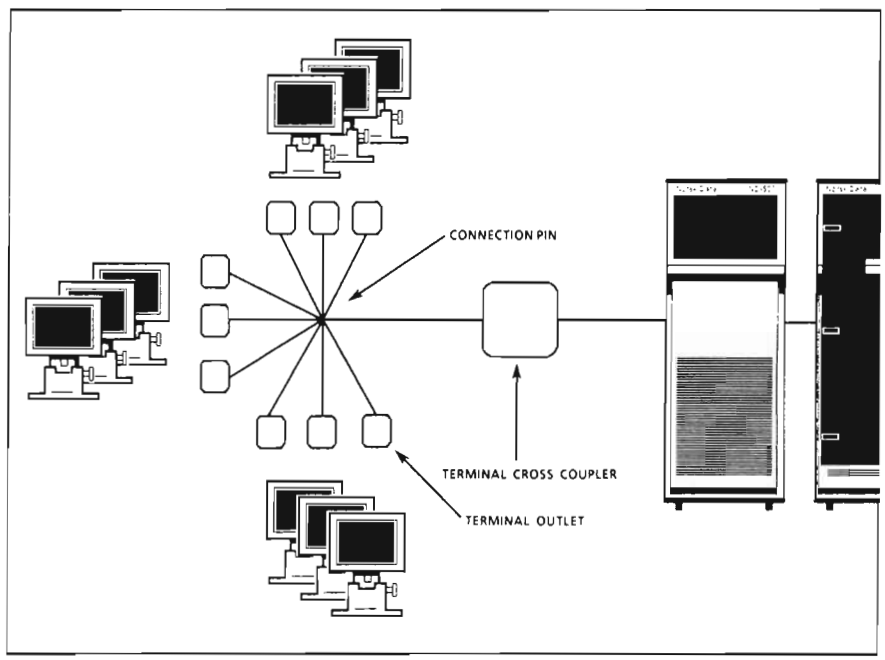


Fig 22: Terminal wiring with main and branch cables.

5.2 Printer for different users

A printer for different users is connected to the computer.

Printers situated **outside the computer room,** with RS 232 C interface, are using the same wiring as the terminals, but has to be connected to **limited distance modems.**

Limited distance modems are installed by ND with the printer.

Take into account the number of printers/terminals that will be needed in the future.

Printers with **parallel interface** must be connected with a special, separate cable. The printer is normally situated (in or) just outside the computer room.

All printers must be connected to grounded outlets!

Interface of the equipment, see equipment specifications p 57-61.

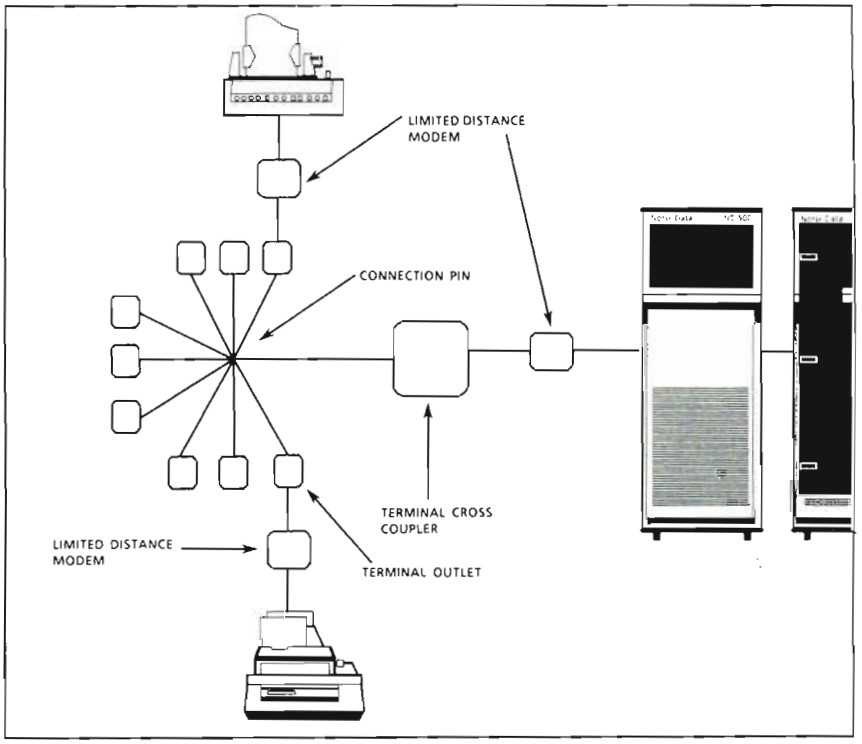


Fig 23: Printers with RS 232 C interface connected to the terminal network with limited distance modems.

5.3 Printer for one user

A printer with RS 232 C interface intended for only one user may be connected directly to the terminal. In this case there is no need for a permanent wiring.

The printer must be connected to a grounded outlet!

5.4 Printer in the computer room

Printers situated in the computer room do not normally need a connection to the network. They are connected to the computer by a **standard cable** delivered at the installation.

The maximum length of the standard cable is 15 m.

The printer must be connected to a grounded outlet!

The printer must have access to the **common ground bar** in the computer room.

5.5 ETHERNET - NET ONE

ND ETHERNET is a local area network. The network itself is just a through cable, and every attached station can communicate with all other stations on the cable.

There is no need for routing – sending data is just a matter of knowing the recipient's address.

- With an ETHERNET installation the number of cables can be drastically reduced.
- The network can easily be extended.
- One unit in the network can easily be moved.
- Additional units can easily be connected to the network.

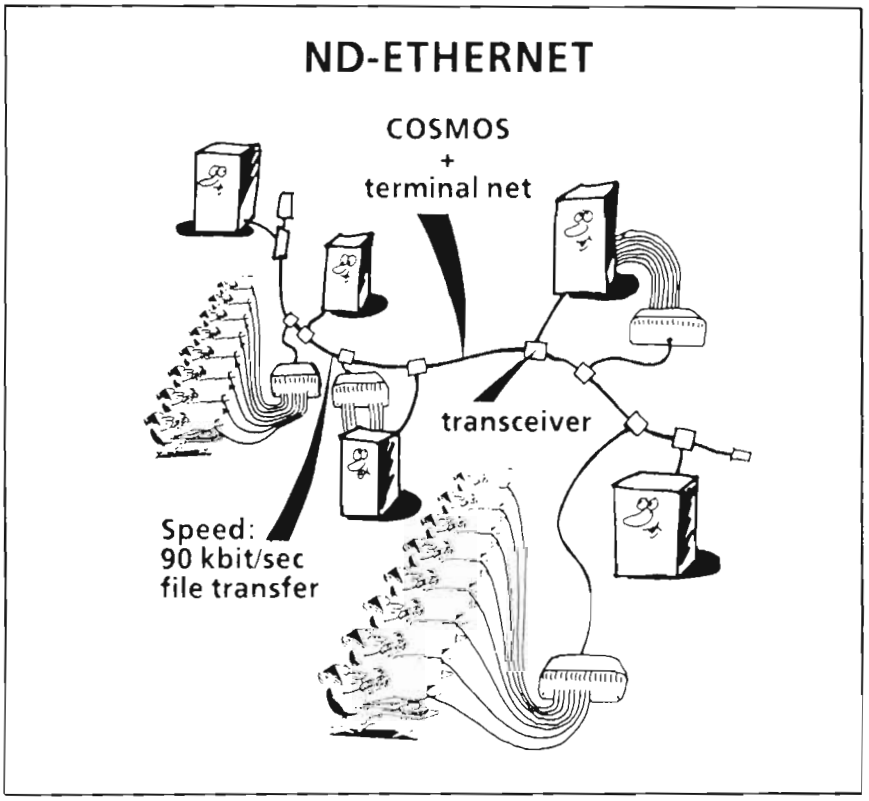


Fig 24: Sketch of the ND-ETHERNET.

ETHERNET must only be installed by a firm approved by ND.

6 Air conditioning

6.1 Air conditioning equipment

In a computer room there must be installed equipment to ensure **steady temperature and relative humidity**.

Air from the air contitioning unit is distributed below the raised floor. Holes in the panels below each unit, and floor registers, allow the air to flow into the room, partly through the computer cabinets.

The air then returns through the room to the air conditioning unit.

A **filter** and **humidifier** are placed inside the air conditioning unit.

The supply of fresh air should be protected by filters.

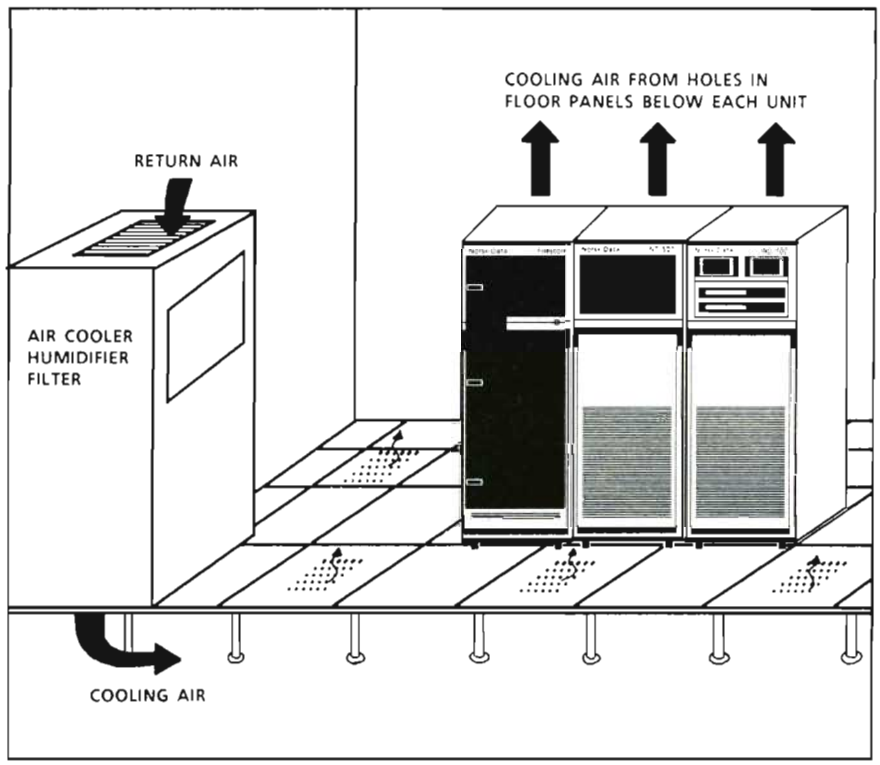


Fig 25: Air conditioning unit in the computer room. The raised floor distributes the air to the computer equipment.

Air conditioning units are based on different types of technology:

The split system: One unit inside the computer room receives the return air, filters it, and sends out cooling air.

One unit outside the building disperses the heat.

Water-cooled system: The return air is cooled directly with water.

Air cooling units of the window-type are not good enough for computer rooms.

All types of air conditioning units must be equipped with automatic restart after a power failure!

When water-cooled air conditioning units and/or waterpipes are used in computer rooms with raised floor, the **water supply must be controlled** with magnetic valve(s) and water detectors.

A **thermometer** and a **hygrometer** should be installed in the computer room.

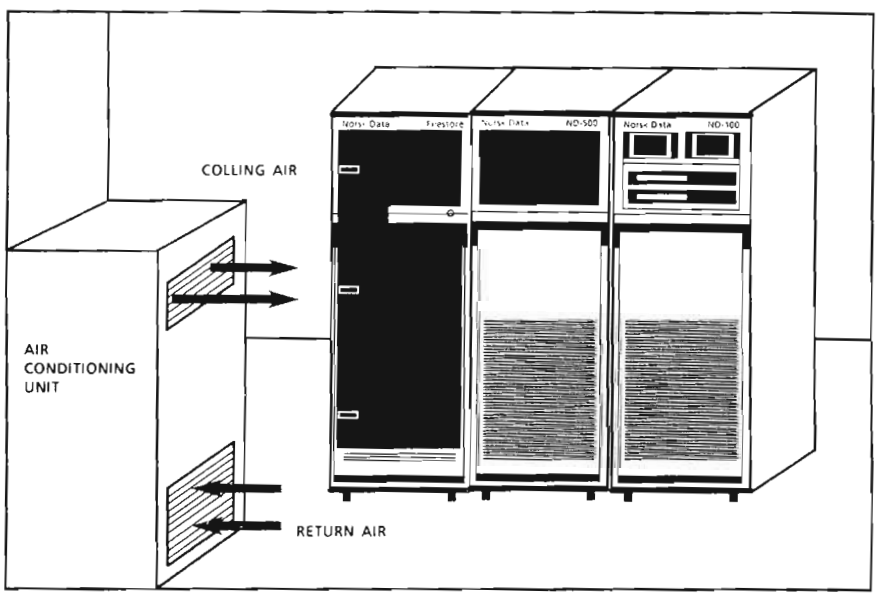


Fig 26: Air conditioning unit in a computer room with a single floor. The air distribution would have been better with a raised floor, but it is acceptable in small computer rooms.

The way ND computers take in cooling air differs slightly from one model to another. This has importance to the holes in the floor panels.

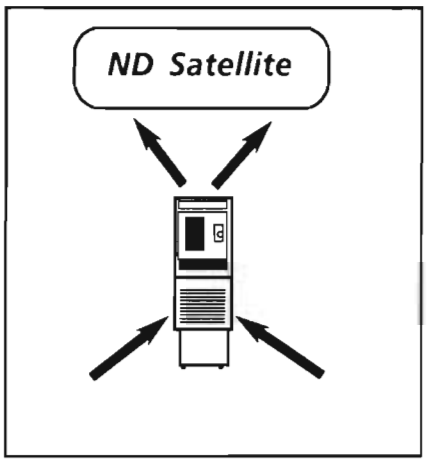


Fig 27:
The ND Satellites take the cooling air in from the bottom. If the Satellite is placed in a computer room, it is ideally to have holes in the floor panels below the unit for cooling air and cables.

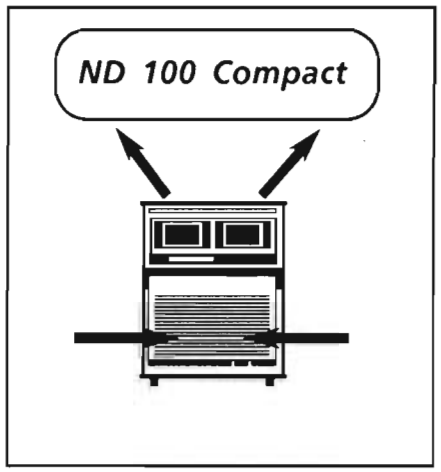


Fig 28:
The ND 100 Compact-models take the cooling air in from the front.
It is only necessary with holes in the floor panels for cables.

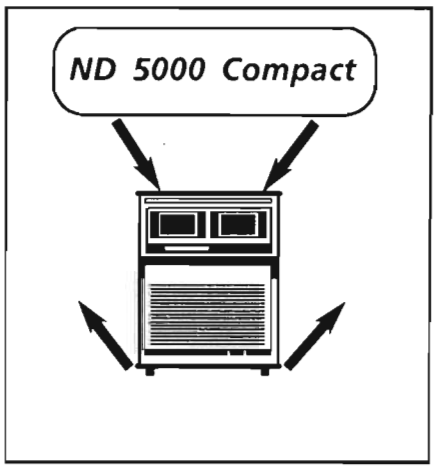


Fig 29:
The ND 5000 Compact models take the cooling air in at the top and blow it out below. If the computer is placed on a carpet the legs has to be screwed well out for good air circulation. You only need hole in the floor panel for cables.

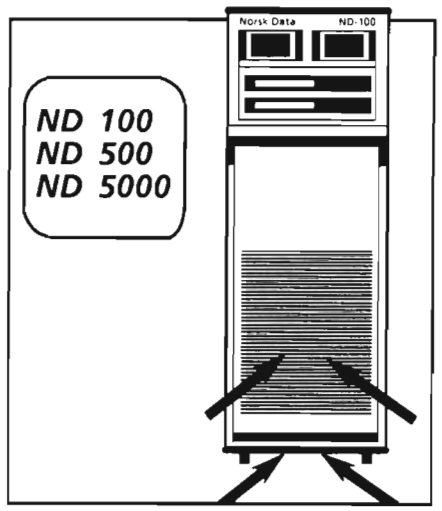


Fig 30:
ND's high cabinet models fit perfect in a computer room.
They take the cooling air in below and down in the front. When placed on a raised floor there has to be a hole in the floor panel for cables and cooling air.

Diagram of holes in the floor panels, see p 47-48.

To calculate the total generated heat from the computer equipment to be installed, see equipment specifications, p 57-61.

To calculate the total cooling requirements, also take into account the heat generated from the surroundings.

6.2 Dust, smoke, dirt

It is important to keep pollution such as dust, smoke and dirt away from the computer room.

It is especially important for the data storage equipment, such as disks and mag tapes – dust and smoke particles are considerably larger than the distance between the disk head and the disk surface.

Smoke particles are very sticky – they rapidly clog filters and other air passages.

Measures to avoid dust:

- Filters for the return air in the air conditioning unit.
- Filters for the fresh air supply.
- The air pressure is kept higher inside the computer room than outside.
- This air pressure is formed by a larger supply of fresh air inside the computer room than outside.

Requirements for computer rooms

Deviations from these requirements must be given a written approval by ND.

7 The computer room

The minimum size is determined by the requirements for service access.

Minimum service access around units:	
Front:	1,00 m
Sides:	0,60 m
Behind:	0,60 m

If there are more than three cabinets in a row, the space at the back must be minimum 1.00 m.

Minimum floor space: 3 m x 4 m.

8 The floor

8.1 Raised floor

Access space: min. 0.2 m.

A raised floor must be grounded to comply with the supplier's specifications.

8.2 Holes in the floor panels

The customer is responsible for making all holes in floor panels prior to delivery of the computer equipment.

8.3 Single floor

With a single floor all cables must be run in cable ducts on the floor or the walls.

8.4 Floor covering

An electrostatic floor covering should be chosen.

Electric conducting covering should have a derivative resistance of: 10^4 - 10^6 ohm, din 4102T4.

The floor covering is laid and maintained to the manufacturer's specifications.

9 Mains power

9.1 Voltage

Voltage (RMS):	230 V + 15 V / - 25 V

9.2 Frequency

Frequency:	50 Hz ± 0,5 Hz

9.3 Permitted voltage fluctuation

For duration of 5 ms:	+ 20% or – 100% of nominal phase voltage
For duration of 30 ms:	± 15% of nominal phase voltage

9.4 Start current

Necessary start current:	5 to 10 times normal current
Duration:	10 ms - 10 s

9.5 Electrical installation

The main supply cable (rising main) must be taken from the building's main supply board.

This may be deviated from if the main fuseboard (on the floor where the computer room is situated) has sufficient capacity, and an isolation transformer is used.

The main supply cable must be screened.

If there is no PDU, a contactor must be mounted on the main supply cable.

Each unit must have its own course, except terminals, modems, etc.

The separate courses are protected by 16 A or 25 A slow automatic fuses.

Power to the air conditioning unit must not be taken from the fuse box or the PDU in the computer room.

Equipment which needs 25 A fuses should be connected with an ASEA CUI 232-6 + CR 32 outlet or equivalent.

Every outlet is marked with a course number.

The contactor must be controlled by a room thermostat with manual reset. This will interrupt the power supply if the temperature in the room exceeds 28° C.

In computer rooms with a raised floor, the outlets should be located under the floor, in front of the respective units.

In computer rooms with a single floor, the outlets should be located on the cable duct, behind the respective units.

10 Grounding

10.1 Safety ground

The safety ground is taken via the shield or as a separate conductor in the main supply cable from the building's equipotential connection (the building's main supply board).

It is taken to the fuse box or the PDU in the computer room.

From there it is taken to all the outlets.

10.2 System ground

From the building's equipotential connection (the building's main supply board) a separate, insulated, 25 sq mm multicored ground conductor must be run unbroken to a common ground bar in the computer room.

The common ground bar must be isolated from the building.

The impedance to ground at the building's equipitential connection must not be higher than 10 ohm in the frequency range 0-30 MHz, or measured maximum 0.5 V RMS.

11 Terminals/printers

All terminals must be connected to grounded outlets.

Ground shield in data cables must not be in contact with terminals or parts of the building outside the computer room.

All outlets must be marked for easy identification.

Each terminal requires 1 two-pair cable. If equipment with RS 232 C interface is used over a distance longer than 15 m from the computer (cable length), or outside the computer room, it must be connected using limited distance modems.

12 Air conditioning

12.1 Temperature

Maximum room temperature:	30° C
Minimum room temperature:	16° C
Maximum temperature gradient:	3° C pr. hour

Ideal room temperature: 22° C ± 2° C

12.2 Relative humidity

Relative humidity:	15% – 80% non condensing

Ideal relative humidity: 50% ± 10

12.3 Air conditioning equipment

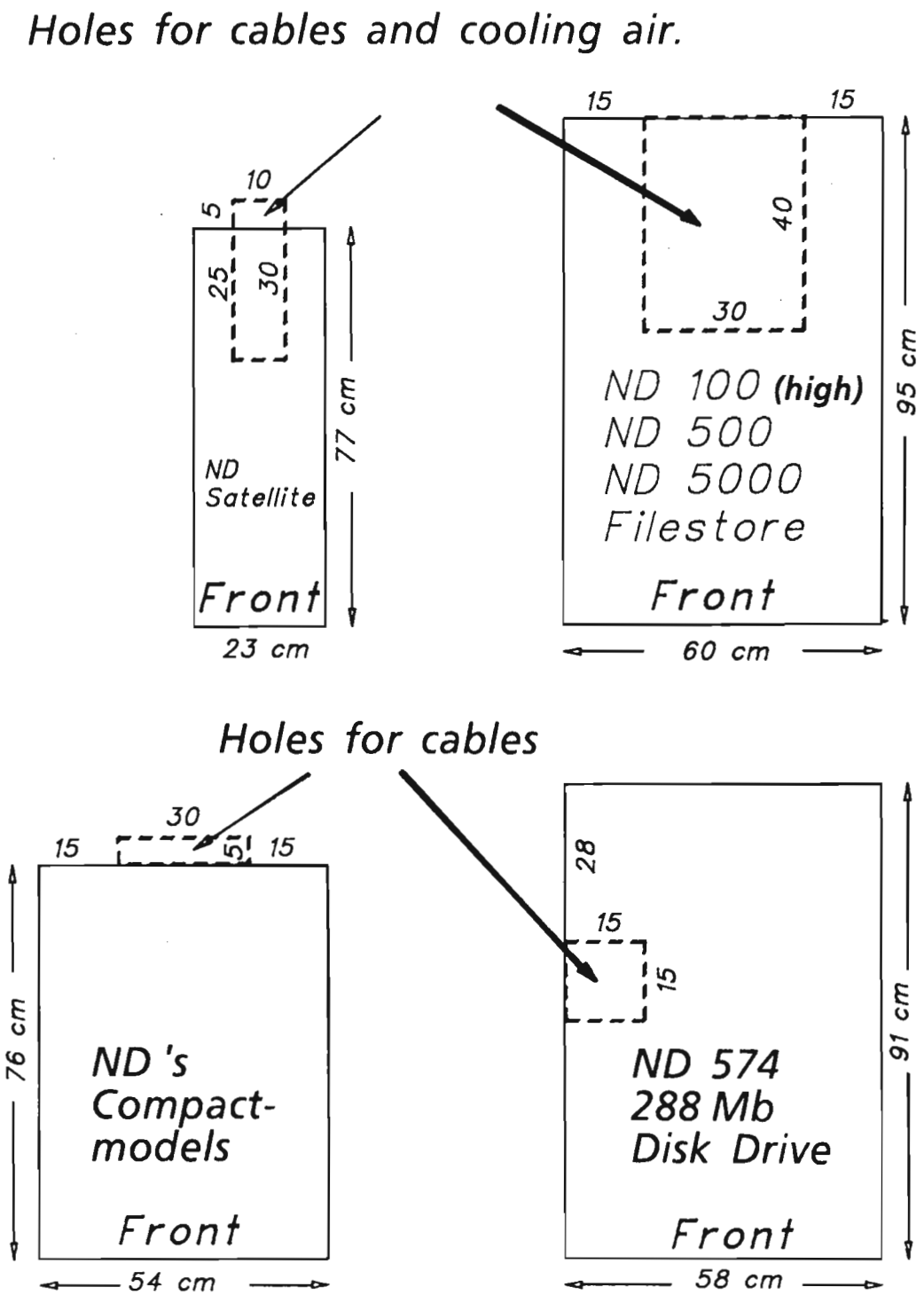
All types of air conditioning units must be equipped with automatic restart after a power failure.

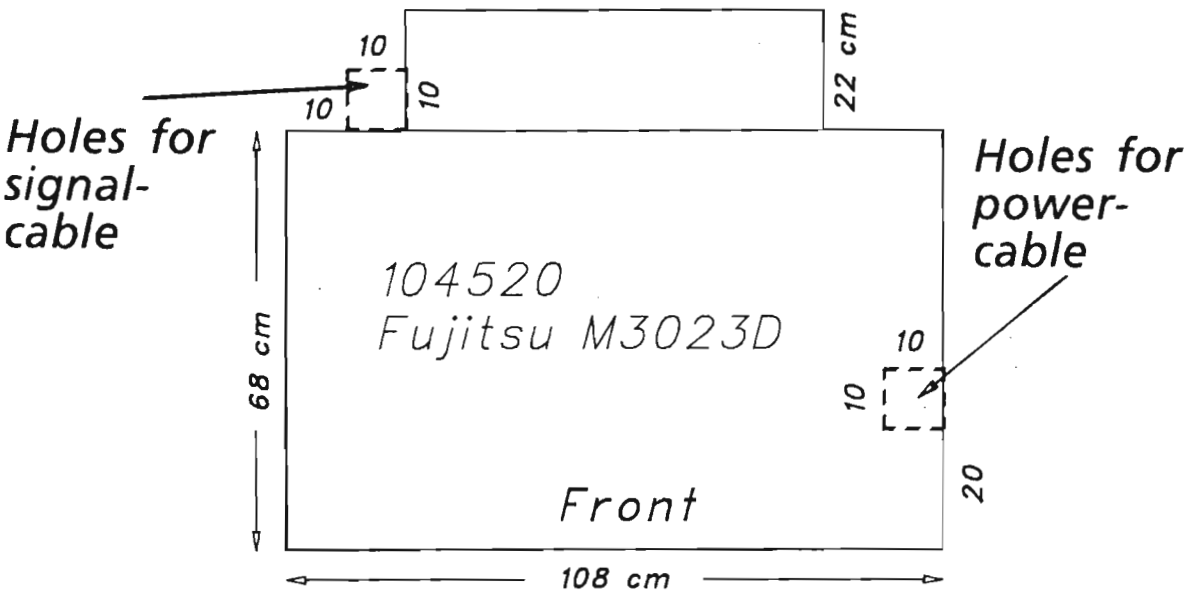
A thermometer and a hygrometer should be installed in the computer room.

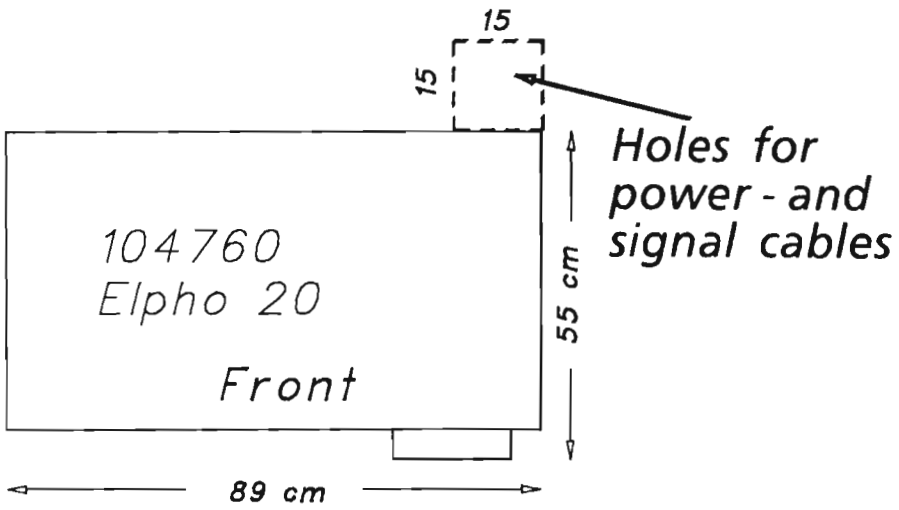
Specifications

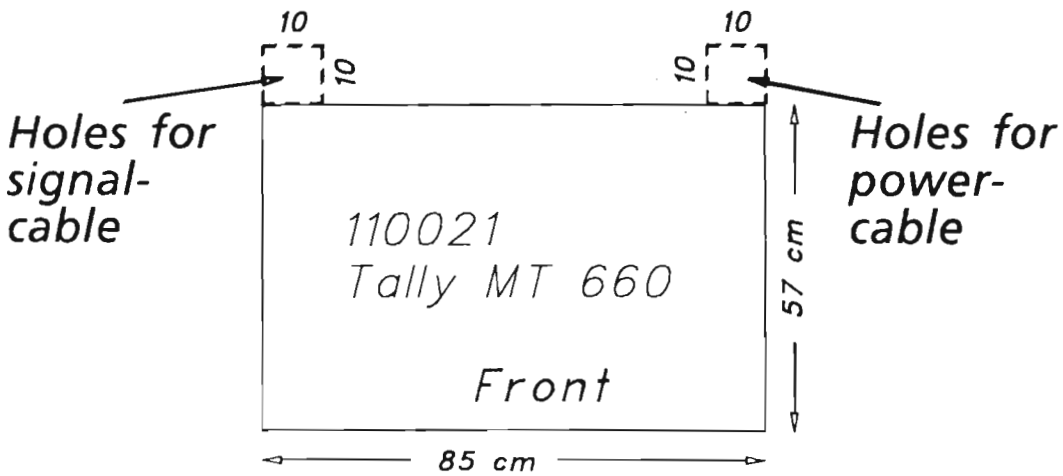
13 Diagrams of cutouts in the floor panels

The diagrams specify the size and disposition of the cutouts:







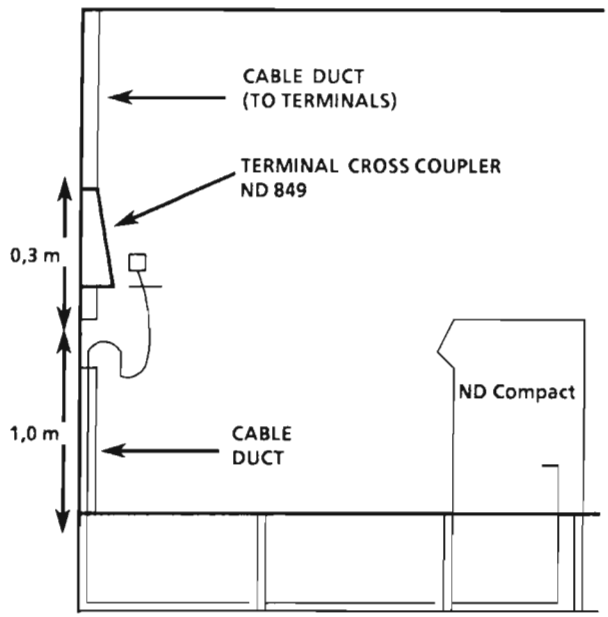


14 Equipment for terminal distribution

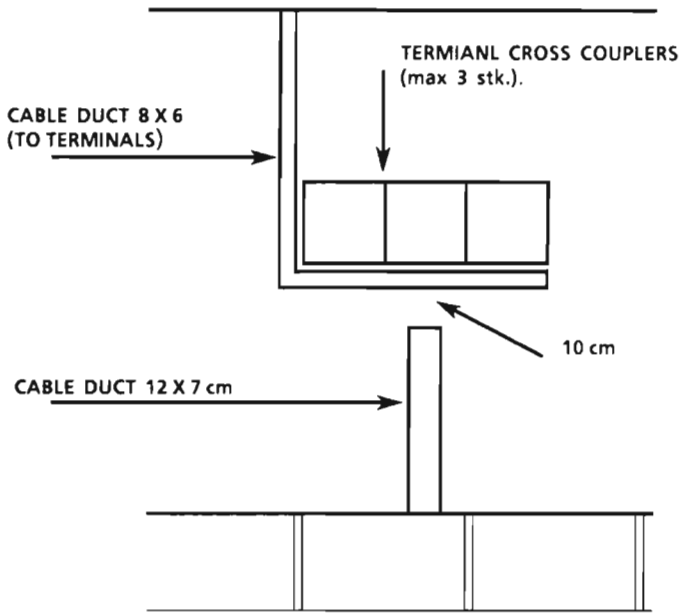
- ND 109360 multi cross coupler cabinet for up to 450 terminal connectors.
- ND 849 terminal cross coupler for up to 24 terminal connectors.
- External connection pin.
  Connection of main and branch cables.
- Terminal connector.
  Type ADO AP code B2.
- Terminal connector.
  Type ADO UP code B2.
- Modular connector.
  Type AMP 4 pin modular.
- Telephone cables (twisted pairs) with an overall screen.

15 Installation of the ND 849 terminal cross coupler

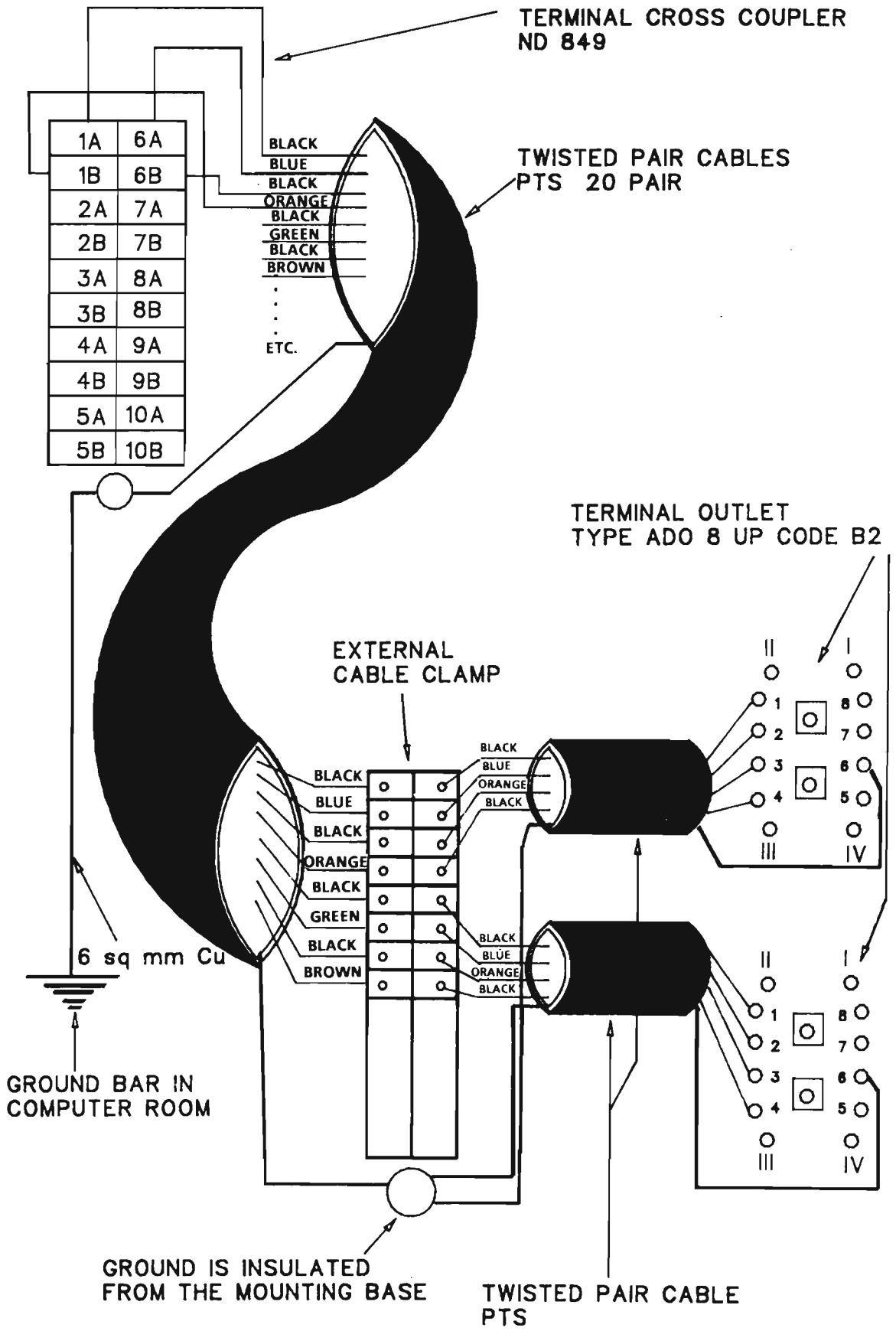
SIDE VIEW:



FRONT VIEW:



16 Connection diagram for terminal wiring



17 Computer and terminal connection

20 mA current loop

	CPU in the computer	ND 849 Terminal Cross Coupler CPU/Telex 8 p	Terminal outlet office	ND 109360 Multi Cross Coupler
Plug type		Burndy	Telex ADO 8 pin	Modular 4/4-Barrel
Receive +	16	B/6A	2	1/1
Receive -	15	A/1A	1	2/2
Transmit +	18	D / 6B	3	3/3
Transmit -	17	C / 1B	4	4/4

18 Equipment specifications

ND computers:

PRODUCT	H/W/D (cm)	WEIGHT (kg)	CONS. (W)	CABLE (m)	INTERF.	FUSE (A)
ND SATELLITE-models	64/23/77	35	400			16 slow
ND COMPACT-models	69/54/76	78	800			16 slow
ND 100-models	169/60/95	130-200	1600			16 slow
ND 500-models 1 cabinet	169/60/95	180-250	3200			25 slow
ND 500-models 2 cabinets	169/60/95 pr. cabinet	450	2700/ 1600			25 slow 16 slow
ND 5000 COMPACT-models	69/54/76	100	1250			16 slow
ND 5000-models 1 cabinet	169/60/95	180-250	2200			25 slow

Filestore:

ND	PRODUCT	H/W/D (cm)	WEIGHT (kg)	CONS. (W)	CABLE (m)	INTERF.	FUSE (A)
106240/ 106241	FILESTORE CABINET COMPACT	69/54/76	55-150				16 slow
106210	MAGTAPE CIPHER			360			
106130	DISK 140 Mb			408			
110041	DISK 288 Mb			140			
106150	DISK 450 Mb			250			
106170	CARTRIDGE DISK 70 Mb			200			
106350/ 110048/ 110025	FILESTORE CABINET	169/60/96	100-215				16 slow
106210	MAGTAPE CIPHER			360			
110017	MAGTAPE STC 2922			250			
106130	DISK 140 Mb			408			
110041	DISK 288 Mb			140			
106150	DISK 450 Mb			250			
106170	CARTRIDGE DISK 70 Mb			200			
	FILESTORE CABINET WITH MAGTAPE STC 1950	169/60/96	234/275				25 slow
105430	MAGTAPE STC 1950			1650			
105370/ 105490	FORMATTER TO MAGTAPE STC 1950			880			
105740	FREE STANDING DISK CDC 288 Mb	91/58/91	321	1300			25 slow

Terminals:

ND	PRODUCT	H/W/D (cm)	WEIGHT (kg)	CONS. (W)	CABLE (m)	SIGNAL	FUSE (A)
103190	TWIST 4440	44/39/35	19	70	6/10	R/C[1]	10 quick
103200	NOTIS-models	31/38/36	14	80	6/10	R/C[1]	10 quick
110002	NORTEXT-models 110003	31/38/36	14	80	6/10	R/C[1]	10 quick
110007	COLOR-TERMINAL COLOR-TREND 210	38/39/43	17	105	6/10	R/C[1]	10 quick
110140	TINY	30/34/34	13	45	6/10	R/C[1]	10 quick

1) R means RS-232 C
C means CURRENT LOOP

Printers:

ND	PRODUCT	H/W/D (cm)	WEIGHT (kg)	CONS. (W)	CABLE (m)	SIGNAL	FUSE (A)
102180	COLOR PLOTTER	13/57/37	7	35		R [1]	10 quick
102380	OLIVETTI DY250	14/55/33	14	50		R [1]	10 quick
104480	PHILIPS GP 300 L	19/62/50	23	180		R [1]	10 quick
104520	FUJITSU M3023 D	110/108/68	330	1300		P [1]	25 slow
104750	GENICOM 3024	13/63/30	15	83		R [1]	10 quick
104760	ELPHO 20	117/89/55	150	320		R/P[1]	16 quick
110020	CANON LBP-8	29/48/42	32	850		R [1]	16 quick
110021	TALLY MT 660	98/85/57	158	1200		R [1]	16 quick
110079	INKJET PT88S	14/41/31	7,5	30		R [1]	10 quick
110080	INKJET PT88S	14/41/31	7,5	30		O [1]	10 quick
110090	EPSON LX-86	8/42/31	5	60		R [1]	10 quick

1) R means RS-232 C
O means RS-422
C means CURRENT LOOP
P means PARALLEL

Mains power units:

ND	PRODUCT	H/W/D (cm)	WEIGHT (kg)	HEAT (W)	CABLE (m)	FUSE (A)	FUSE SIZE
108720	PDU 10 kVA	97/63/58	200	200		25 high effective	00
108740	PDU 20 kVA	97/63/58	235	400		50 high effective	00
108760	PDU 40 kVA	115/65/86	330	800		100 high effective	00
108780	PDU 60 kVA	190/102/62	485	1300		250 high effective	0

19 Conversion tables

Effect:

1 W	=	0,860 kcal/h
1 W	=	2,39 x 10^{-4} kcal/s
1 W	=	3,41 Btu/h
1 kcal/h	=	1,16 W
1 kcal/h	=	2,78 x 10^{-4} kcal/s
1 kcal/h	=	3,97 Btu/h
1 kcal/s	=	4,187 x 10^{3} W
1 kcal/s	=	3,60 x 10^{3} kcal/h
1 kcal/s	=	1,43 x 10^{4} Btu/h
1 Btu/h	=	0,293 W
1 Btu/h	=	0,252 kcal/h
1 Btu/h	=	7,00 x 10^{-5} kcal/s

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