Chapter 3

System Teardown and Inspection

This chapter examines procedures for tearing down and inspecting a system. It describes the types of tools required, the procedure for disassembling the system, and the various components that make up the system. A special section discusses some of the test equipment you can use, and another section covers some problems you might encounter with the hardware (screws, nuts, bolts, and so on).

Using the Proper Tools

To troubleshoot and repair PC systems properly, you need a few basic tools:

- Simple hand tools for basic disassembly and reassembly procedures
- Diagnostics software and hardware for testing components in a system
- Wrap plugs for diagnosing serial and parallel port problems
- Test and measurement devices, such as Digital Multi-Meters (DMMs), that allow accurate measurement of voltage and resistance, and logic probes and pulsers that allow analysis and testing of digital circuits
- Chemicals, such as contact cleaners, component freeze sprays, and compressed air for cleaning the system.

In addition, you might also need soldering and desoldering tools for problems that require these operations. These basic tools are discussed in more detail in the following section. Diagnostics software and hardware is discussed in Chapter 20, “Software and Hardware Diagnostic Tools.”

Hand Tools

It becomes immediately apparent when you work with PC systems that the tools required for nearly all service operations are very simple and inexpensive. You can carry most of the required tools in a small pouch. Even a top-of-the-line “master mechanic’s” set fits inside a briefcase-sized container. The cost of these tool kits ranges from about $20 for a small-service kit to $500 for one of the briefcase-sized deluxe kits. Compare these costs to what might be necessary for an automotive technician. Most automotive service techs spend between $5,000 to $10,000, or more, for the tools they need! Not only are the tools much less expensive, but I can tell you from experience that you don't get nearly as dirty working on computers as you do when working on cars!

In this section, you learn about the tools required to make up a set capable of basic, board-level service on PC systems. One of the best ways to start such a set of tools is with a small kit sold especially for servicing PCs.

This list shows the basic tools you can find in one of the small "PC tool kits" sold for about $20:

- 3/16-inch nut driver
- 1/4-inch nut driver
- Small Phillips screwdriver
- Small flat-blade screwdriver
- Medium Phillips screwdriver
- Medium flat-blade screwdriver
- Chip extractor
- Chip inserter
- Tweezers
- Claw-type parts grabber
- T10 and T15 Torx drivers

You use nut drivers to remove the hexagonal-headed screws that secure the system-unit covers, adapter boards, disk drives, power supplies, and speakers in most systems. The nut drivers work much better than a conventional screwdriver.

Because some manufacturers have substituted slotted or Phillips head screws for the more standard hexagonal head screws, the standard screwdrivers can be used for these systems.

You use the chip-extraction and insertion tools to install or remove memory chips (or other, smaller chips) without bending any pins on the chip. Usually, you pry out larger chips, such as microprocessors or ROMs, with the small screwdriver. Larger processors, such as the 486 or Pentium chips, require a chip extractor if they are in a standard socket. These chips have so many pins on them that a large amount of force is required to remove them. The chip extractor tools for removing these chips distribute the force evenly along the chip's underside to minimize the likelihood of breakage.

The tweezers and parts grabber can be used to hold any small screws or jumper blocks that are difficult to hold in your hand. The parts grabber is especially useful when you drop a small part into the interior of a system; usually, you can remove the part without completely disassembling the system.

Finally, the Torx driver is a special, star-shaped driver that matches the special screws found in most Compaq systems, and in many other systems as well.

Although this basic set is useful, you should supplement it with some other small hand tools, such as:

- Needlenose pliers
- Hemostats
- Wire cutter or wire stripper
- Metric nut drivers
- Tamper-proof Torx drivers
- Vise or clamp
- File
- Small flashlight

Pliers are useful for straightening pins on chips, applying or removing jumpers, crimping cables, or grabbing small parts.

Hemostats are especially useful for grabbing small components, such as jumpers.

The wire cutter or stripper obviously is useful for making or repairing cables or wiring.

The metric nut drivers can be used in many clone or compatible systems, as well as in the IBM PS/2 systems, which all use metric hardware.

The tamper-proof Torx drivers can be used to remove Torx screws with the tamper-resistant pin in the center of the screw. A tamper-proof Torx driver has a hole drilled in it to allow clearance for the pin.

You can use a vise to install connectors on cables and to crimp cables to the shape you want, as well as to hold parts during delicate operations.

Finally, you can use the file to smooth rough metal edges on cases and chassis, as well as to trim the faceplates on disk drives for a perfect fit.

The flashlight can be used to light up system interiors, especially when the system is cramped and the room lighting is not good. I consider this an essential tool.

Another consideration for your tool kit is an ESD (Electro Static Discharge) protection kit. These kits consist of a wrist strap with a grounding wire, and a specially conductive mat also with its own ground wire. Using a kit like this when working on a system will help to ensure that you never accidentally zap any of the components with a static discharge.

The ESD kits, as well as all the other tools and much more, are available from a variety of tool vendors. Specialized Products Company and Jensen Tools are two of the more popular vendors of computer and electronic tools and service equipment. Their catalogs show an extensive selection of very high quality tools. These companies and several others are listed in Appendix B, "Vendor List." With a simple set of hand tools, you will be equipped for nearly every PC repair or installation situation. The total cost for these tools should be less than $150, which is not much considering the capabilities they give you.

Soldering and Desoldering Tools

For certain situations, such as repairing a broken wire, reattaching a component to a circuit board, removing and installing chips that are not in a socket, or adding jumper wires or pins to a board, you must use a soldering iron to make the repair. Even if you do only board-level service, you will need a soldering iron in some situations.

You need a low-wattage iron, usually about 25 watts. More than 30 watts generates too much heat and can damage the components on the board. Even with a low-wattage unit, you must limit the amount of heat to which you subject the board and its components. You can do this with quick and efficient use of the soldering iron, as well as with the use of heat-sinking devices clipped to the leads of the device being soldered. A *heat sink* is a small, metal, clip-on device designed to absorb excessive heat before it reaches the component that the heat sink is protecting. In some cases a pair of hemostats can be used as an effective heat sink when you solder a component.

To remove components originally soldered into place from a printed circuit board, you can use a soldering iron with a *solder sucker*. This device normally is constructed as a small tube with an air chamber and a plunger-and-spring arrangement. (I do not recommend the "squeeze bulb" type of solder sucker.) The unit is "cocked" when you press the spring-loaded plunger into the air chamber. When you want to remove a device from a board, you heat with the soldering iron the point at which one of the component leads joins the circuit board, from the underside of the board, until the solder melts. As soon as melting occurs, move the solder-sucker nozzle into position and press the actuator. This procedure allows the plunger to retract, and to create a momentary suction that inhales the liquid solder from the connection and leaves the component lead dry in the hole.

Always do the heating and suctioning from the underside of a board, not from the component side. Repeat this action for every component lead joined to the circuit board. When you master this technique, you can remove a small chip, such as a 16-pin memory chip, in a minute or two with only a small likelihood of damage to the board or other components. Larger chips with many pins can be more difficult to remove and resolder without damaging other components or the circuit board.

If you intend to add soldering and desoldering skills to your arsenal of abilities, you should practice. Take a useless circuit board and practice removing various components from the board; then reinstall the components. Try to remove the components from the board by using the least amount of heat possible. Also, perform the solder-melting operations as quickly as possible, and limit the time the iron is applied to the joint. Before you install any components, clean out the holes through which the leads must project, and mount the component into place. Then apply the solder from the underside of the board, using as little heat and solder as possible. Attempt to produce joints as clean as the joints that the board manufacturer performed by machine. Soldered joints that do not look "clean" may keep the component from making a good connection with the rest of the circuit. This "cold-solder joint" normally is created because you have not used enough heat. *Remember that you should not practice your new soldering skills on the motherboard of a system you are attempting to repair!* Don't attempt to work on real boards until you are sure of your skills. I always keep a few junk boards around for soldering practice and experimentation.

No matter how good you get at soldering and desoldering, some jobs are best left to professionals! For example, components that are surface mounted to a circuit board require special tools for soldering and desoldering, as do other components with very high pin densities. I upgraded my IBM P75 portable system by replacing the 486DX-33 processor with a 486DX2-66 processor. This would normally be a simple procedure (especially if the system uses a Zero Insertion Force or ZIF socket), but in this system the 168-pin 486DX chip is soldered into a special processor card! To add to the difficulty, there were surface mounted components also on both sides (even the solder side) of the card. Well, needless to say, this was a very difficult job that required a special piece of equipment called a *hot air rework station*. The hot air rework station uses blasts of hot air to simultaneously solder or desolder all of the pins of a chip at once. To perform this replacement job the components on the solder side were protected by a special heat resistant masking tape, and the hot air was directed at the 168-pins of the 486 chip while the chip was pulled out from the other side. Then the new chip was placed in the holes in the board, a special solder paste was applied to the pins, and the hot air was used again to simultaneously solder all 168 pins. The use of professional equipment like this resulted in a perfect job that cannot be told from factory original, and resulted in a perfectly operating 66 MHz system. Attempting a job like this with a conventional soldering iron would have probably damaged the very expensive DX2 processor chip as well as the even more expensive multilayer processor card.

Using Proper Test Equipment

In some cases you must use specialized devices to test a system board or component. This test equipment is not expensive or difficult to use, but can add much to your troubleshooting abilities. I consider wrap plugs and a voltmeter required gear for proper system testing. The wrap plugs allow testing of serial and parallel ports and their attached cables. A Digital Multi-Meter (DMM) can serve many purposes, including checking for voltage signals at different points in a system, testing the output of the power supply, and checking for continuity in a circuit or cable. An outlet tester is an invaluable accessory that can check the electrical outlet for proper wiring. This is useful if you believe the problem lies outside the computer system itself.

Logic probes and pulsers are not considered mandatory equipment, but they can add to your troubleshooting proficiency. You use the logic probe to check for the existence and status of digital signals at various points in a circuit. You use the logic pulser to inject signals into a circuit to evaluate the circuit's operation. Using these devices effectively requires more understanding of how the circuit operates.

Wrap Plugs (Loopback Connectors)

For diagnosing serial- and parallel-port problems, you need wrap plugs, also called loopback connectors, which are used to circulate, or "wrap," signals. The plugs enable the serial or parallel port to send data to itself for diagnostic purposes. Several types of wrap plugs are available. You need one for the 25-pin serial port, one for the 9-pin serial port, and one for the 25-pin parallel port (see table 3.1). Many companies, including IBM, sell the plugs separately, and IBM also sells a special version that includes all three types in one plug.

Table 3.1 Wrap Plug Types

Description	IBM Part Number
Parallel-port wrap plug	8529228
Serial-port wrap plug, 25-pin	8529280
Serial-port wrap plug, 9-pin (AT)	8286126
Tri-connector wrap plug	72X8546

The handy tri-connector unit contains all commonly needed plugs in one compact unit. The unit costs approximately $30 from IBM. Be aware that most professional diagnostics packages (especially the ones I recommend) include the three types of wrap plugs as part of the package; you may not need to purchase them separately. If you're handy, you can even make your own wrap plugs for testing. I have included wiring diagrams for the three types of wrap plugs in Chapter 11, "Communications and Networking." In that chapter you will also find a detailed discussion of serial and parallel ports.

Meters

Many troubleshooting procedures require that you measure voltage and resistance. You take these measurements by using a handheld Digital Multi-Meter (DMM). The meters can be analog devices (using an actual meter) or digital-readout devices. The DMM has a pair of wires, called test leads or probes. The test leads make the connections so that you can take readings. Depending on the meter's setting, the probes will measure electrical resistance, Direct-Current (DC) voltage, or Alternating-Current (AC) voltage.

Usually, each system-unit measurement setting has several ranges of operation. DC voltage, for example, usually can be read in several scales to a maximum of 200 millivolts, 2 volts, 20 volts, 200 volts, and 1,000 volts. Because computers use both +5 and +12 volts for various operations, you should use the 20-volt-maximum scale for making your measurements. Making these measurements on the 200-millivolt or 2-volt scales could "peg the meter" and possibly damage it because the voltage would be much higher than expected. Using the 200-volt or 1,000-volt scales works, but the readings at 5 volts and 12 volts are so small in proportion to the maximum that accuracy is low.

If you are taking a measurement and are unsure of the actual voltage, start at the highest scale and work your way down. Some better system-unit meters have an autoranging capability—the meter automatically selects the best range for any measurement. This type of meter is much easier to operate. You just set the meter to the type of reading you want, such as DC volts, and attach the probes to the signal source. The meter selects the correct voltage range and displays the value. Because of their design, these types of meters always have a digital display rather than a meter needle.

I prefer the small, digital meters. You can buy them for only slightly more than the analog style, and they're extremely accurate. Some are not much bigger than a cassette tape; they can fit in a shirt pocket. Radio Shack sells a good unit (made for Radio Shack by Beckman) in the $25 price range, which is only a half-inch thick, weighs 3 1/2 ounces, and is digital and autoranging as well. This type of meter works well for most if not all PC troubleshooting and test uses.

You should be aware that many analog meters can be dangerous to digital circuits. These meters use a 9-volt battery to power the meter for resistance measurements. If you use this type of meter to measure resistance on some digital circuits, you can damage the electronics because you are essentially injecting 9 volts into the circuit. The digital meters universally run on 3 to 5 volts or less.

Logic Probes and Logic Pulsers

A logic probe can be useful in diagnosing problems with digital circuits. In a digital circuit, a signal is represented as either high (+5 volts) or low (0 volts). Because these signals are present for only a short time (measured in millionths of a second), or oscillate or switch on and off rapidly, a simple voltmeter is useless. A logic probe is designed to display these signal conditions easily.

Logic probes are especially useful in troubleshooting a dead system. Using the probe, you can determine whether the basic clock circuitry is operating and whether other signals necessary to system operation are present. In some cases, a probe can help you cross-check the signals at each pin on an IC chip. You can compare the signals present at each pin to what a known, good chip of the same type would show—a comparison helpful in isolating a failed component. Logic probes can be useful in troubleshooting some disk drive problems by letting you test the signals present on the interface cable or drive-logic board.

A companion tool to the probe is the logic pulser. A pulser is designed to test circuit reaction by delivering into a circuit a logical high (+5 volt) pulse, usually lasting 1 1/2 to 10 millionths of a second. Compare the reaction to that of a known functional circuit. This type of device normally is used much less frequently than a logic probe, but in some cases can be helpful in testing a circuit.

Outlet Testers

Another very useful test tool is an outlet tester. These simple, inexpensive devices are sold at hardware stores which are used to test electrical outlets. You simply plug the device in, and three LEDs will light in various combinations indicating whether the outlet is wired correctly. Although you might think that badly wired outlets would be a rare problem, I have actually run into a large number of installations where the outlets were wired incorrectly. Most of the time it seems the problems are with the ground wire. An improperly wired outlet can result in flaky system operations such as random parity checks and lockups. With an improper ground circuit, currents can begin flowing on the electrical ground circuits in the system. Because the voltage on the ground circuits is used by the system as a comparator to determine whether bits are 0 or 1, this can cause data errors in the system. Once, while running one of my PC troubleshooting seminars, I was using a system that I literally could not approach without locking it up. As I would walk by the system, the electrostatic field generated by my body would interfere with the system, and the PC would lock up with a "parity check" error message. The problem was that the hotel we were using was very old and had no grounded outlets in the room. The only way I could prevent the system from locking up was to run the class in my stocking feet, as my leather soled shoes were generating the static charge. Another symptom of bad ground wiring in electrical outlets is electrical shocks when touching the case or chassis of the system. This indicates that voltages are flowing where they should not be! This can also be caused by bad or improper grounds within the system itself as well. By using the simple outlet tester, you can quickly determine whether the outlet is at fault.

Chemicals

Chemicals can be used to help clean, troubleshoot, and even repair a system. For the most basic function, cleaning components and electrical connectors and contacts, one of the most useful chemicals is 1,1,1 trichloroethane. This substance, sometimes sold as "carbo-chlor," is a very effective cleaner. It can be used to clean electrical contacts and components, and will not damage most plastics and board materials. In fact, carbo-chlor can be very useful for cleaning stains on the system case and keyboard. New replacements for trichloroethane are being offered by many electronic chemical supply companies because it is being regulated along with other CFCs (Chloro-Floro-Carbons) such as freon.

A very unique type of contact enhancer and lubricant is on the market called Stabilant 22. This chemical is applied to electrical contacts and acts to greatly enhance the connection as well as lubricate the contact point. It is much more effective than conventional contact cleaners or lubricants.

Stabilant 22 is actually a liquid polymer semiconductor. It behaves like liquid metal, and conducts electricity in the presence of an electric current. It also serves to fill in the air gaps between the mating surfaces of two items in contact, which makes the surface area of the contact larger and keeps out oxygen and other contaminants which can oxidize and corrode the contact point.

This chemical is available in several forms. Stabilant 22 itself is the full strength concentrated version, while Stabilant 22a is a version diluted with isopropanol in a 4 to 1 ratio. An even more diluted 8 to 1 ratio version is sold in many high-end stereo and audio shops under the name "Tweek." Just 15ml of Stabilant 22a sells for about $40, while a liter of the concentrate costs about $4,000! As you can plainly see, stabilant 22 is fairly expensive, but very little is required in an application, and nothing else has been found to be as effective in preserving electrical contacts. An application of Stabilant can provide protection for up to 16 years according to the manufacturer, and is used by NASA on spacecraft electronics. Stabilant is manufactured and sold by D. W. Electrochemicals. You will find their address and phone number in the vendor list in Appendix B.

Stabilant is especially effective on I/O slot connectors, adapter card edge and pin connectors, disk drive connectors, power supply connectors, and virtually any connectors in the PC. In addition to enhancing the contact and preventing corrosion, an application of Stabilant lubricates the contacts, making insertion and removal of the connector easier.

Compressed air often is used as an aid in system cleaning. Normally composed of freon or carbon dioxide, compressed gas is used as a blower to remove dust and debris from a system or component. Be careful when you use these devices; some of them can generate a tremendous static charge as the compressed gas leaves the nozzle of the can. Be sure that you are using the kind approved for cleaning or dusting off computer equipment, and consider wearing a static grounding strap as a precaution. Freon TF is known to generate these large static charges; Freon R12 is less severe. Of course, because both chemicals are damaging to the ozone layer, they are being phased out by most suppliers. Expect to see new versions of these compressed-air devices with carbon dioxide or some other less-harmful propellant.

Caution

If you use any chemical with the propellant Freon R12 (dichlorodifluoromethane), *do not expose the gas to an open flame or other heat source*. If you burn this substance, a highly toxic gas called *phosgene* is generated. Phosgene, used as a choking gas in WWI, can be deadly.

Freon R12 is the substance used in most automobile air conditioner systems prior to 1995. Automobile service technicians are instructed *never* to smoke near air conditioner systems. By 1996, the manufacture and use of these types of chemicals have been either banned or closely regulated by the government, and replacements will have to be found. For example, virtually all new car automobile air conditioning systems have been switched to a chemical called R-134a. The unfortunate side effect of this is that all of these newer replacement chemicals are much more expensive.

Related to compressed-air products are chemical-freeze sprays. These sprays are used to quickly cool down a suspected failing component to restore it to operation. These substances are not used to repair a device, but rather to confirm that you have found the failed device. Often, a component's failure is heat-related; cooling it temporarily restores it to normal operation. If the circuit begins operating normally, the device you are cooling is the suspect device.

A Word about Hardware

This section discusses some problems you might encounter with the hardware (screws, nuts, bolts, and so on) used in assembling a system.

Types of Hardware

One of the biggest aggravations you encounter in dealing with various systems on the market is the different hardware types and designs that hold the units together.

For example, most system hardware types use screws that can be driven with 1/4-inch or 3/16-inch hexagonal drivers. IBM used these screws in all original PC, XT, and AT systems, and most compatible systems use this standard hardware as well. Some manufacturers might use different hardware. Compaq, for example, uses Torx screws extensively in most of its systems. A Torx screw has a star-shaped hole driven by the correct-size Torx driver. These drivers carry size designations, such as T-8, T-9, T-10, T-15, T-20, T-25, T-30, T-40, and so on. A variation on the Torx screw is the tamper-proof Torx screw, found in power supplies and other assemblies. These screws are identical to the regular Torx screws except that a pin sticks up exactly in the middle of the star-shaped hole in the screw. This pin prevents the standard Torx driver from entering the hole to grip the screw; a special tamper-proof driver with a corresponding hole for the pin is required. An alternative is to use a small chisel to knock out the pin in the screw. Usually, a device sealed with these types of screws is considered a complete, replaceable unit and rarely, if ever, needs to be opened.

The more standard slotted-head and Phillips-head screws are used by many manufacturers as well. Using tools on these screws is relatively easy, but tools do not grip these fasteners as well as hexagonal head or Torx screws, and the heads can be rounded off more easily than other types. Extremely cheap versions tend to lose bits of metal as they're turned with a driver, and the metal bits can fall onto the motherboard. Stay away from cheap fasteners whenever possible; the headaches from dealing with stripped screws aren't worth it.

English versus Metric

Another area of aggravation with hardware is that two types of thread systems are available: English and metric. IBM used mostly English-threaded fasteners in its original line of systems, but many other manufacturers used metric-threaded fasteners in their systems.

The difference becomes apparent especially with disk drives. American-manufactured drives use English fasteners; drives made in Japan or Taiwan usually use metric fasteners. Whenever you replace a floppy drive in an early-model IBM unit, you encounter this problem. Try to buy the correct screws and any other hardware, such as brackets, with the drive because they might be difficult to find at a local hardware store. The OEM's drive manual has the correct data about a specific drive's hole locations and thread size.

Hard disks can use either English or metric fasteners; you will need to check your particular drive to be sure.

Caution

Some screws in a system might be length-critical, especially screws used to retain hard disk drives. You can destroy some hard disks by using a mounting screw that's too long. A screw that is too long can puncture or dent the sealed disk chamber when you install the drive and fully tighten the screw. When you install a new drive in a system, always make a trial fit of the hardware and see how far the screws can be inserted in the drive before they interfere with components on the drive. When in doubt, the drive manufacturer's OEM documentation will tell you precisely what screws are required, and how long they should be.

Disassembly Procedures

The process of physically disassembling and reassembling systems isn't difficult. Because of marketplace standardization, only a couple of different types and sizes of screws (with a few exceptions) are used to hold the systems together, and the physical arrangement of the major components is similar even among systems from different manufacturers. Also, not many individual components are in each system. This section breaks down the disassembly and reassembly procedure into these sections:

- Case or cover assembly
- Adapter boards
- Disk drives
- Power supply
- Motherboard

This section discusses how to remove and install these components for several different system types. With regards to assembly and disassembly, it is best to consider each system by the type of case the system uses. For example, all systems with AT type cases are assembled and disassembled in much the same manner. Tower cases are basically AT-type cases turned sideways, so the same basic instructions would apply there as well. Most Slimline and XT style cases are similar and these systems are assembled and disassembled in much the same way as well. In the following section, disassembly and reassembly instructions are listed for several of the different case types, including standard IBM Compatible as well as several of the PS/2 systems.

Disassembly Preparation

Before beginning the disassembly of any system, several issues must be discussed. One is ESD (Electro-Static-Discharge) protection. Another is recording the configuration of the system, both with regards to the physical aspects of the system such as jumper or switch settings and cable orientations, as well as the logical configuration of the system especially with regards to things like CMOS settings.

ESD Protection. When you are working on the internal components of a system, you need to take the necessary precautions to prevent accidental static discharges to the components. At any given time, your body can hold a large static voltage charge which can easily damage components in your systems. Before I ever put my hands into an open system, I first touch a grounded portion of the chassis such as the power supply case. This serves to equalize the charge that both myself and the device are carrying. Some people would say that the charge is vented off to ground in this case, but not really. I never recommend working on a system with the cord plugged in because of the electrical hazard, as well as the simple fact that it is too easy to either power the system on at the wrong time or to simply forget to turn it off. It is too easy to drop tools and other things into systems while they are powered on, which would short out and possibly damage circuits. After destroying an adapter card because I accidentally plugged it in while the system was running, I decided that the only good way to ensure that the system is really off is to unplug it!

I have been told by some that if the system is not plugged in, the static charges cannot be vented off to ground. That is true, but the problem with static is not whether a device carries a charge or not, but only whether that charge suddenly flows from one device to another through the delicate logic circuits. By touching the system chassis, or any other part of the system's ground circuit, you equalize the charge between you and the system, which will ensure that no additional charge will pass from you to the IC chips. No matter what anybody says, you absolutely do not want the system plugged in!

A more sophisticated way to equalize the charges between you and any of the system components is to use the ESD protection kit mentioned earlier. This kit consists of a wrist strap and mat with ground wires for attachment to the system chassis. When you are going to work on a system, you place the mat next to or partially underneath the system unit. A ground wire is then clipped to both the mat and the system's chassis, tying the grounds together. Then you put on the wrist strap and attach that wire to a ground as well. Since the mat and system chassis are already wired together, you can attach the wrist strap wire to either the system chassis or mat itself. If you are using a wrist strap without a mat, clip the wrist strap wire to the system chassis. When clipping these wires to the chassis, be sure to use an area that is free from paint so that a good ground contact can be achieved. This setup insures that any electrical charges are carried equally by you and any of the components in the system, which will prevent the sudden flow of static electricity which can damage the circuits.

As you remove disk drives, adapter cards, and especially delicate items such as the entire motherboard as well as SIMMs or processor chips, you should place them on the static mat. I see some people put the system unit on top of the mat, but it should be along side so that you have room to lay out all the components as you remove them. If you are going to remove the motherboard from a system, be sure that you leave enough room on the mat for it.

If you do not have such a mat, simply lay the removed circuits and devices on a clean desk or table surface. Always pick up loose adapter cards by the metal bracket used to secure the card to the system. This bracket is tied into the ground circuitry of the card, and by touching it first you will prevent a discharge from damaging the components on the card. If the circuit board has no metal bracket, like a motherboard for example, carefully handle the board by the edges and try not to touch any of the components.

Caution

Some people have recommended that loose circuit boards and chips should be placed on sheets of aluminum foil. This is absolutely NOT RECOMMENDED and can actually result in an EXPLOSION! You see, many motherboard adapter cards and other circuit boards today have built-in lithium or nicad batteries. These batteries react violently when they are shorted out, which is exactly what you would be doing by laying such a board on a piece of aluminum foil. The batteries will quickly overheat and possibly explode like a large firecracker (with dangerous shrapnel). Because it is often not possible for you to know whether a board has a battery built into it somewhere, the simple warning is to NEVER place any board on any conductive metal surface like foil.

Recording Setup and Configuration. Before you power the system off for the last time to remove the case, you should find out several things about the system and record them. Often times when working on a system you will intentionally or accidentally wipe out the CMOS setup information. Most systems use a special battery powered CMOS clock and data chip that is used to store the system configuration information. If the battery is disconnected, or if certain pins are accidentally shorted, you can discharge the CMOS memory and lose the setup. The CMOS memory in most systems is used to store simple things such as how many and what type of floppy drives are connected, how much memory is in the system, and the date and time. A critical piece of information is the hard disk type settings. While the system or you can easily determine the other settings the next time you power on the system, the hard disk type information is another story. Most modern BIOS software can actually read the type information directly from most IDE and all SCSI drives. With older BIOS software, however, you have to explicitly tell the system the parameters of the attached hard disk. This means that you need to know the current settings for Cylinders, Heads, and Sectors per track. Some BIOS software indicates the hard disk only by a "type" number, usually from 1 through 47. Be aware that most BIOS programs use type 47 as what is called a user definable type, which means that the cylinder, head, and sector counts for this type were manually entered in and are not constant. These user definable types are especially important to write down, because this information may be very difficult to figure out later when you need to start up the system.

If you do not enter the correct hard disk type information in the CMOS Setup program, you will not be able to access the data on the hard disk. I know of several individuals who have lost some or all of their data because they did not enter the correct type information when reconfiguring the system. If this information is incorrect, the usual result is a `Missing operating system` error message when starting the system and the inability to access the C drive. Some of you might be thinking that you could just figure out the parameters by looking up the particular hard disk in a table. For example, I have included a table of popular hard disk drive parameters in Appendix A, and it has proven useful to me time and time again. Unfortunately, this only works if the original person setting up the system entered the correct parameters as well. I have encountered a large number of systems where the hard disk parameters were not entered correctly, and the only way to regain access to the data is to determine and to use the same incorrect parameters that were originally used. As you can see, no matter what, you should record the hard disk information from your setup program.

Most systems have the setup program built right into the ROM BIOS software itself. These built-in setup programs are activated by a hot key sequence such as Ctrl-Alt-Esc or Ctrl-Alt-S if you have a Phoenix ROM. Other ROMs prompt you for the setup program every time the system boots, such as with the popular AMI BIOS. With the AMI, you simply press the Delete key when the prompt appears on the screen during a reboot.

When you get the setup program running, record all the settings. The easiest way to do this is by printing it out. If a printer is connected, hit the Shift-PrintScreen keys and a copy of the screen display will be sent to the printer. Some setup programs have several pages of information, so you should record the information on each page as well. Many setup programs such as those in the AMI BIOS allow for specialized control over the particular chipset used on the motherboard. These complicated settings can take up several screens of information, however all should be recorded. Most will return all of these settings to a default state when the battery is removed, and you will lose any custom settings that were made.

MCA and EISA bus systems have a very sophisticated setup program that stores not only the motherboard configuration, but configurations for all of the adapter cards as well. Fortunately the setup programs on these systems have the ability to save the settings to a file on a floppy disk so that they can be restored later. To access the setup program for most of these systems, you will need the setup or Reference Diskette for the particular system. Many of the new PS/2 systems store a complete copy of the Reference Diskette on the hard disk in a hidden partition. When these systems boot up, you will notice that the cursor jumps over to the right-hand side of the screen for a few seconds. During this time, if you strike the Ctrl-Alt-Ins keys, the hidden setup programs will be executed.

Recording Physical Configuration. While you are disassembling a system, it is a good idea to record all the physical settings and configurations within the system. This includes jumper and switch settings, cable orientations and placement, ground wire locations, and even adapter board placement. Keep a notebook handy for recording these items, and write down all the settings. It is especially important to record all the jumper and switch settings on every card you remove from the system as well as the motherboard itself. If you accidentally disturb these jumpers or switches, you will know how they were originally set. This is very important if you do not have all the documentation for the system handy; and even if you do, undocumented jumpers and switches often do not appear in the manuals, but must be set a certain way for the item to function. It is very embarrassing, to say the least, if you take apart somebody's system and then cannot make it work again because you disturbed something. If you record these settings you will save yourself the embarrassment!

Also record all cable orientations. Most name brand systems use cables and connectors that are keyed so that they cannot be plugged in backwards, but most generic compatibles do not have this luxury. It is also possible to mix up hard disk and floppy cables; each cable should be marked or recorded as to what it was plugged into and the proper orientations. Ribbon cables will usually have an odd colored wire at one end which indicates pin 1. The devices that the cables are plugged into are also marked in some way to indicate the orientation of pin 1, and these should obviously match.

Although cable orientation and placement seems like a very simple thing, it is rare in my PC troubleshooting seminars that we get through the entire course without several groups having cable connection problems. Fortunately, in most cases (excepting power cables), plugging in any of the ribbon cables inside the system backwards rarely causes any permanent damage. Power and battery connections are a big exception to this, however, and plugging them in backwards will surely cause damage. In fact, plugging the motherboard power connectors in backwards or to the wrong plug location will put 12 volts where only 5 should be and can cause components on the board to explode violently. I know people with scars on their faces caused by shrapnel from exploding components. I always like to turn my face away from the system when I power it on for the first time! Plugging the CMOS battery in backwards can damage the CMOS chip itself, which is usually soldered into the motherboard, requiring replacement of the motherboard itself.

Finally, it is a good idea to record other miscellaneous items such as the placement of any ground wires, adapter cards, or anything else you might have difficulty remembering later. Some configurations and setups are particular to which slots the adapter cards are located in; it is usually a good idea to put everything back exactly the way it was originally. This is especially true for any MCA or EISA bus systems.

Now that we have made the necessary preparations and taken the necessary precautions, we can actually begin working on the systems.

XT and Slimline Case Systems

The procedure for disassembling the XT style or Slimline type case systems offered by most manufacturers is very simple. Only two tools are normally required: a 1/4-inch nut driver for the external screws holding the cover in place and a 3/16-inch nut driver for all other screws. Note that I almost always prefer to use a nut driver, although most of these screws have a Phillips type head embedded within the hexagonal head of the screw. Compared to a Phillips screwdriver, the nut driver can get a much better grip on the screw, and you are much less likely to strip it out.

Removing the Cover. To remove the case cover, follow these steps:

1. Turn off the system and unplug the power cord from the system unit.
2. Turn the system unit around so that the rear of the unit is facing you, and locate the screws that hold the system-unit cover in place (see fig. 3.1).

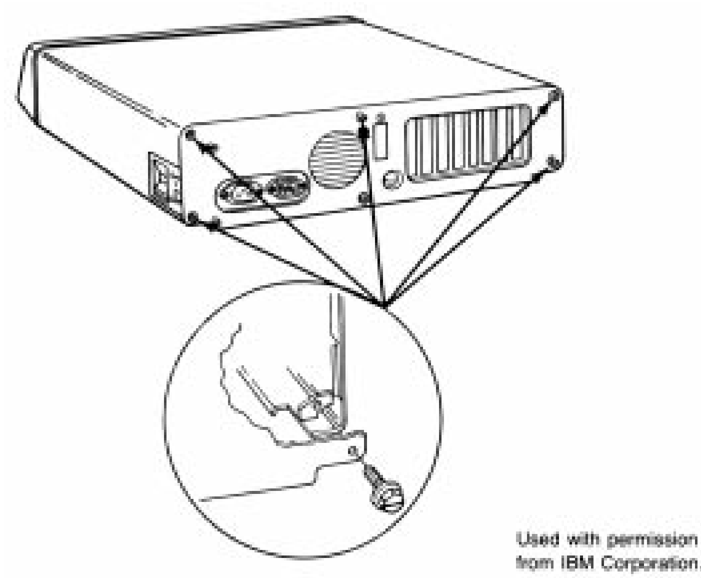


Fig. 3.1
The screws holding the XT-type case cover in place.

3. Use the 1/4-inch nut driver to remove the cover screws.
4. Slide the cover toward the front of the system unit until it stops. Lift up the front of the cover and remove it from the chassis.

To remove all adapter boards from the system unit, first remove the system-unit cover, as described earlier. Proceed as follows for each adapter:

1. Note which slots all the adapters are in. If possible, make a diagram or drawing.
2. Use the 3/16-inch nut driver to remove the screw holding the adapter in place (see fig. 3.2).
3. Note the position of any cables plugged into the adapter before removing them. In a correctly wired system, the colored stripe on one side of the ribbon cable always denotes pin number 1. The power connector is normally shaped so that it can be inserted only the correct way.
4. Remove the adapter by lifting with even force at both ends.
5. Note the positions of any jumpers or switches on the adapter, especially when documentation for the adapter isn't available. Even when documentation is available, undocumented jumpers and switches often are used by manufacturers for special purposes, such as testing or unique configurations.

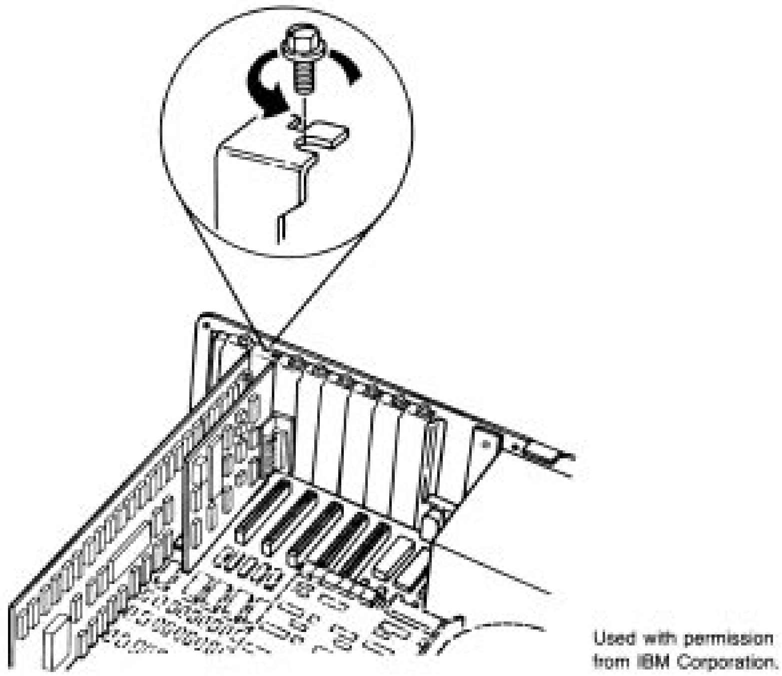


Fig. 3.2
Removing the screw that holds the adapter in place.

Jumpers and switches normally are named on the circuit board. SW1 and SW2 are used for switch 1 and switch 2, for example, and J1 and J2 are used for jumper 1 and jumper 2. If these jumpers or switches later are disturbed, you can return to the original configuration—as long as you noted it when the adapter was first removed. The best procedure usually is to make a diagram showing these features for a particular card.

Removing Disk Drives. Removing drives for XT or Slimline case systems is fairly easy. The procedures are similar for both floppy and hard disk drives.

Before you remove hard disks from the system, they should be backed up. Older drives should have the heads parked as well, but almost all newer drives automatically park the heads when the power is off. The possibility always exists that data will be lost or the drive damaged from rough handling. Hard disks are discussed in more detail in Chapter 14, “Hard Disk Drives and Controllers.”

First, remove the cover and all adapters, as previously described. Proceed as follows:

1. Some systems have drive retaining screws on the bottom of the chassis. Lift up the front of the chassis so that the unit stands with the rear of the chassis down and the disk drive facing straight up. Locate any drive-retaining screws in the bottom of the chassis and remove them. On IBM equipment, you find these screws in XT systems with hard disks or half-height floppy drives (see fig. 3.3). These screws

might be shorter than others used in the system. You must reinstall a screw of the same length in this location later; using a screw that's too long can damage the drive.

2. Set the chassis flat on the table and locate the drive-retaining screws on the outboard sides of the drive. Remove these screws (see figs. 3.4 and 3.5).

3. Slide the disk drive forward about two inches and disconnect the power and signal cables from the drive (see figs. 3.6 and 3.7). In a correctly wired system, the odd-colored stripe on one side of the ribbon cable always denotes pin number 1. The power connector is shaped so that it can be inserted only the correct way.

4. Slide the drive completely out of the unit.

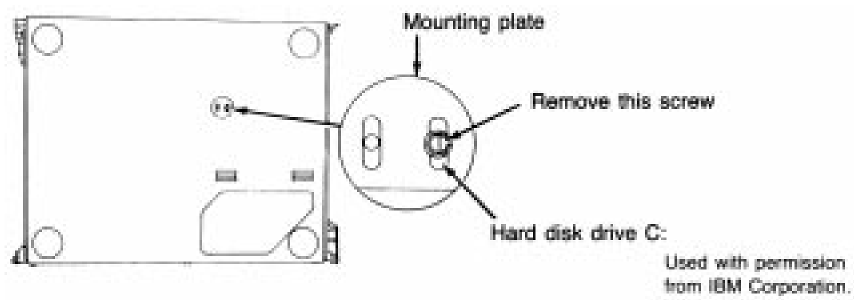


Fig. 3.3
Removing the retaining screws from the bottom of the chassis.

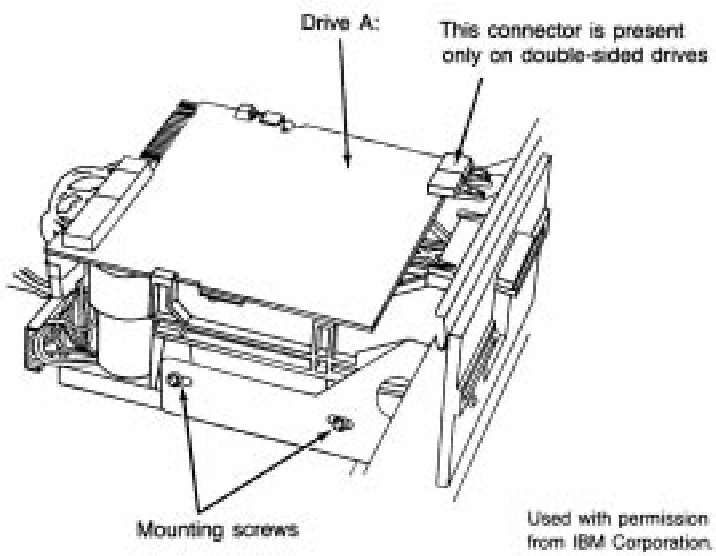


Fig. 3.4
Removing the retaining screws from the outboard sides of a floppy disk drive.

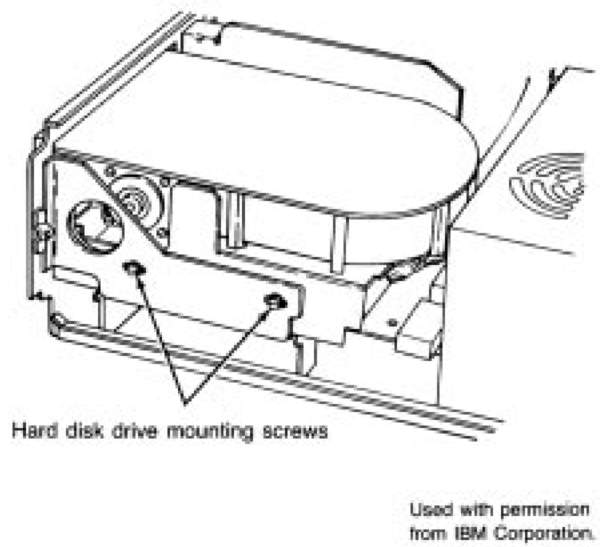


Fig. 3.5
Removing the retaining screws from the outboard sides of the hard disk drive.

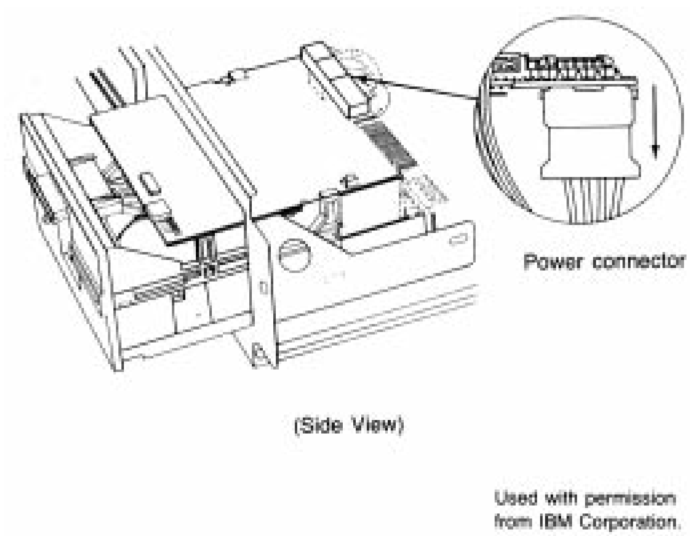


Fig. 3.6
The power connector on a floppy disk drive.

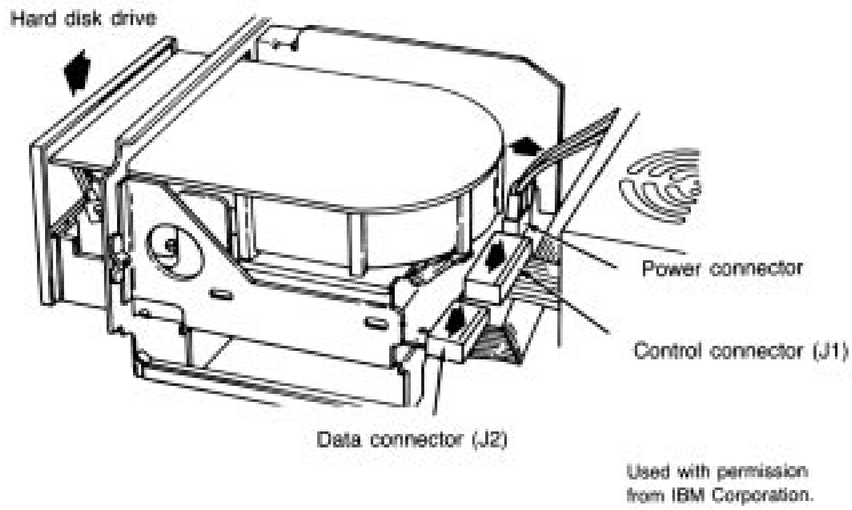


Fig. 3.7
Disconnecting the power and signal cables from the hard disk drive.

Removing the Power Supply. In XT or Slimline case systems, the power supply is mounted in the system unit with four screws in the rear and usually two interlocking tabs on the bottom. Removing the power supply may require that you remove the disk drives before getting the power supply out. You will probably have to at least loosen the drives to slide them forward for clearance when you remove the supply.

To remove the power supply, first remove the cover, all adapter boards, and the disk drives, as described earlier. If sufficient clearance exists, you might not have to remove the adapter boards and disk drives. Proceed as follows:

1. Remove the four power-supply retaining screws from the rear of the system-unit chassis (see fig. 3.8).

2. Disconnect the cables from the power supply to the motherboard (see fig. 3.9). Disconnect the power cables from the power supply to the disk drives. Always grasp the connectors themselves; never pull on the wires.

3. Slide the power supply forward about a half-inch to disengage the interlocking tabs on the bottom of the unit. Lift the power supply out of the unit (see fig. 3.10).

Removing the Motherboard. After all the adapter cards are removed from the unit, you can remove the system board, or *motherboard*. The motherboard in XT and Slimline case systems is held in place by only a few screws and often several plastic standoffs that elevate the board from the metal chassis so that it does not touch the chassis and cause a short. The standoffs slide into slots in the chassis. *These standoffs should remain with the motherboard*. You do not have to extract these standoffs from the motherboard to remove it; you just remove the motherboard with the standoffs still attached. When you reinstall the motherboard, make sure that the standoffs slide properly in their slots. If one or more standoffs have not properly engaged the chassis, you might crack the motherboard when you tighten the screws or install adapter cards.

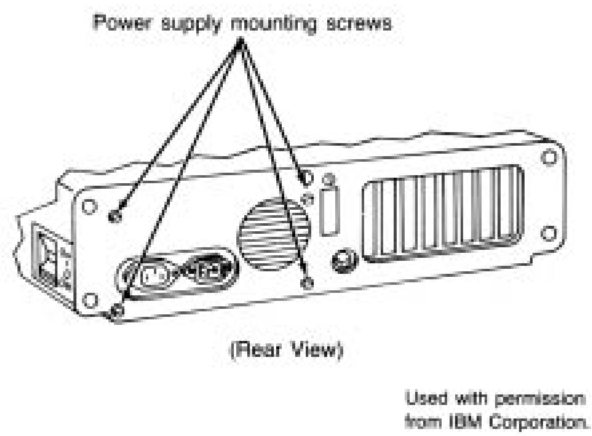


Fig. 3.8
Removing the power supply retaining screws from the rear of the chassis.

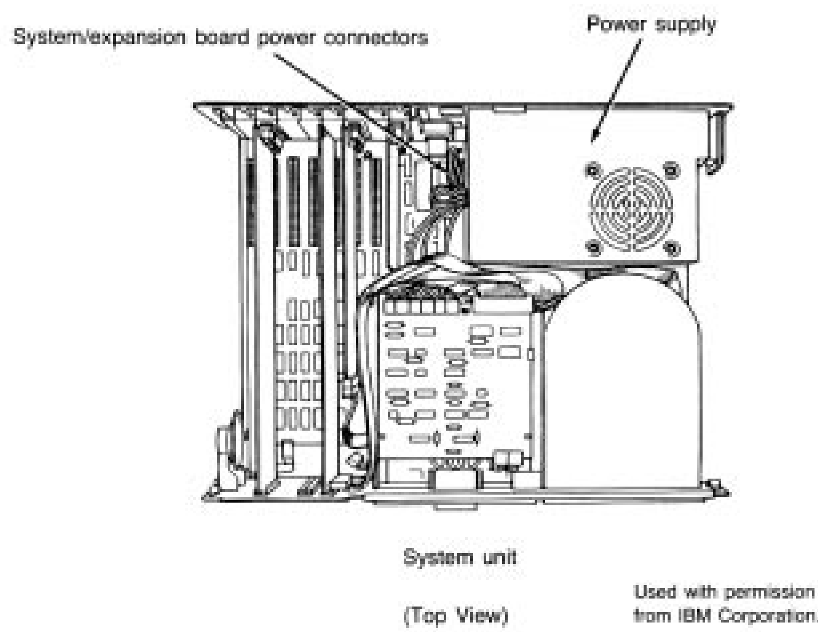


Fig. 3.9
Disconnecting the cables from the power supply to the motherboard.

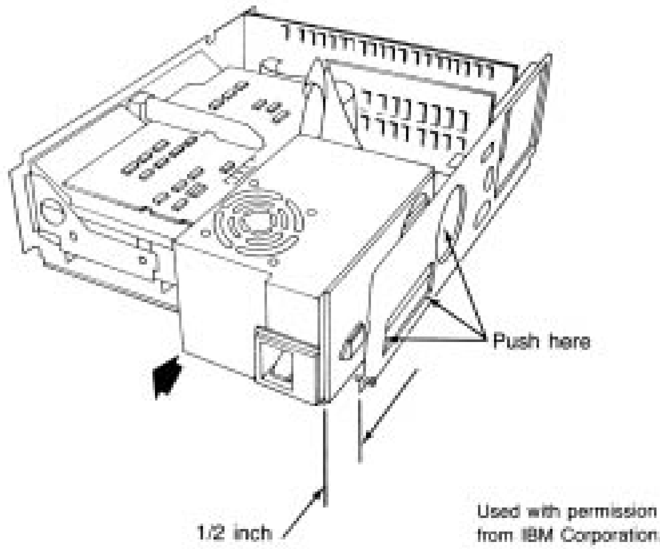


Fig. 3.10
Sliding the power supply forward to disengage the interlocking tabs on the unit's bottom.

To remove the motherboard, first remove all adapter boards from the system unit, as described earlier. Proceed as follows:

1. Disconnect all electrical connectors from the motherboard, including those for the keyboard, power supply, and speaker.
2. Locate and remove the motherboard retaining screws.
3. Slide the motherboard away from the power supply about a half-inch until the standoffs have disengaged from their mounting slots (see fig. 3.11).
4. Lift the motherboard up and out of the chassis.

AT and Tower Case Systems

Disassembling an AT or Tower case system normally requires only two tools: a 1/4-inch nut driver for the external screws holding the cover in place and a 3/16-inch nut driver for all the other screws.

Most of the procedures are exactly like those for the XT or Slimline case systems. One difference, however, is that many AT case systems use a different method for mounting the disk drives. Special rails are attached to the sides of the drives, and the drives slide into the system-unit chassis on these rails. The chassis has guide tracks for the rails, which enables you to remove the drive from the front of the unit without having to access the side to remove any mounting screws. Normally the rails are made of plastic or fiberglass, but they can also be made of metal in some systems. A diagram showing how most of these rails are constructed can be found in Chapter 13, "Floppy Disk Drives and Controllers."

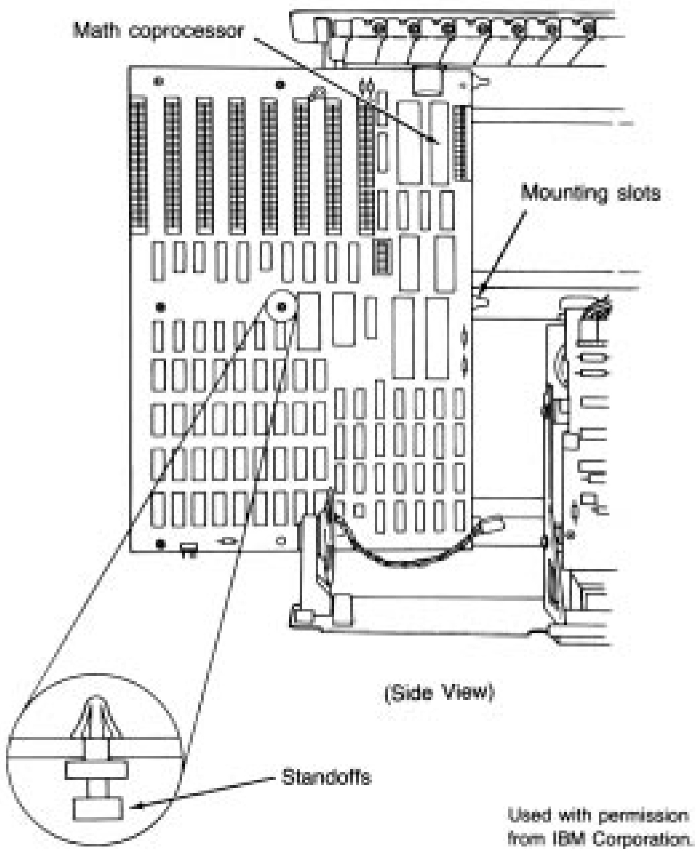


Fig. 3.11
Sliding the motherboard away from the power supply until standoffs disengage from mounting slots.

Removing the Cover. To remove the case cover, follow these steps:

1. Turn off the system and unplug the power cord from the system unit.
2. Turn the system unit around so that you're facing the rear of the unit. Locate the screws that hold the system-unit cover in place (see fig. 3.12).
3. Use the 1/4-inch nut driver to remove the cover screws.
4. Slide the cover toward the front of the system unit until it stops. Lift up the front of the cover and remove it from the chassis.

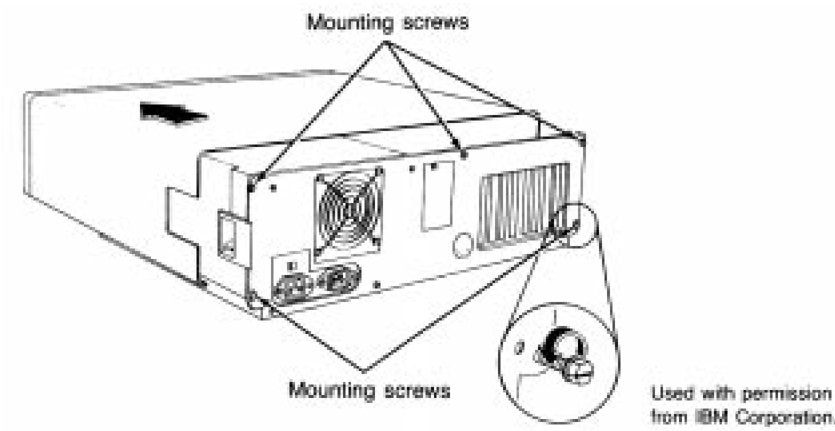


Fig. 3.12
Removing the screws that hold the AT case cover in place.

Removing Adapter Boards. To remove all the adapter boards from the system unit, first remove the system unit cover, as described earlier. Proceed as follows for each adapter:

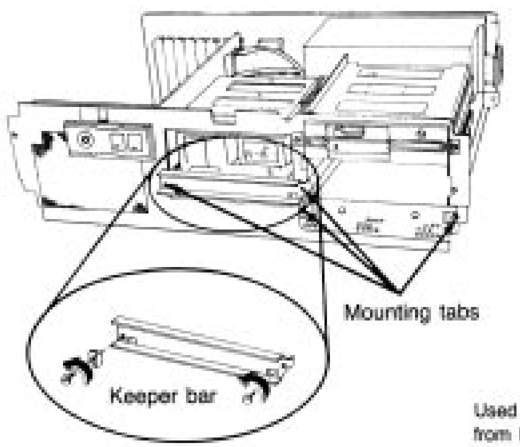
1. Note which slot each adapter is in. If possible, make a diagram or drawing.
2. Use the 3/16-inch nut driver to remove the screw holding the adapter in place (refer to fig. 3.2).
3. Note the positions of any cables plugged into the adapter before you remove them. In a correctly wired system, the colored stripe on one side of the ribbon cable always denotes pin number 1. Some connectors have keys that enable them to be inserted only the correct way.
4. Remove the adapter by lifting with even force at both ends.
5. Note the positions of any jumpers or switches on the adapter, especially when documentation for the adapter is not available. Even when documentation is available, undocumented jumpers and switches often are used by manufacturers for special purposes, such as testing or unique configurations. It's a good idea to know the existing settings in case they are disturbed.

Removing Disk Drives. Removing drives from AT case systems is very easy. The procedures are similar for both floppy and hard disk drives.

Always back up hard disks completely and park the heads before removing disks from the system. Most newer drives (IDE and SCSI) automatically park the heads when powered off. A backup is important because the possibility always exists that data will be lost or the drive will be damaged from rough handling.

To remove the drives from an AT case system, first remove the cover, as described earlier. Proceed as follows:

1. Depending on whether the drive is a hard disk or floppy disk drive, it is retained by either a metal keeper bar with two screws or two small, L-shaped metal tabs each held in place by a single screw. Locate these screws and remove them, along with the tabs or keeper bar (see figs. 3.13 and 3.14).
2. Slide the disk drive forward about two inches, disconnect the power cables, signal and data cables, and ground wire from the drive (see figs. 3.15 and 3.16). In a correctly wired system, the colored stripe on one side of the ribbon cable always denotes pin number 1. The power connector is shaped so that it can be inserted only the correct way.
3. Slide the drive completely out of the unit.



Used with permission from IBM Corporation.

Fig. 3.13
Removing mounting tabs and the keeper bar on a hard drive.

Removing the Power Supply. In AT case systems, the power supply is mounted in the system unit with four screws in the rear and usually two interlocking tabs on the bottom. Removing the power supply usually requires that you slide the disk drives forward for clearance when you remove the supply.

To remove the power supply, first remove the cover, loosen the disk drive mounting screws, and move the disk drive forward about two inches, as described earlier. Proceed as follows:

1. Remove the four power supply retaining screws from the rear of the system unit chassis (see fig. 3.17).
2. Disconnect the cables from the power supply to the motherboard (see fig. 3.18). Disconnect the power cables from the power supply to the disk drive. Always grasp the connectors themselves; never pull on the wires.
3. Slide the power supply forward about a half-inch to disengage the interlocking tabs on the bottom of the unit. Lift the power supply out of the unit.

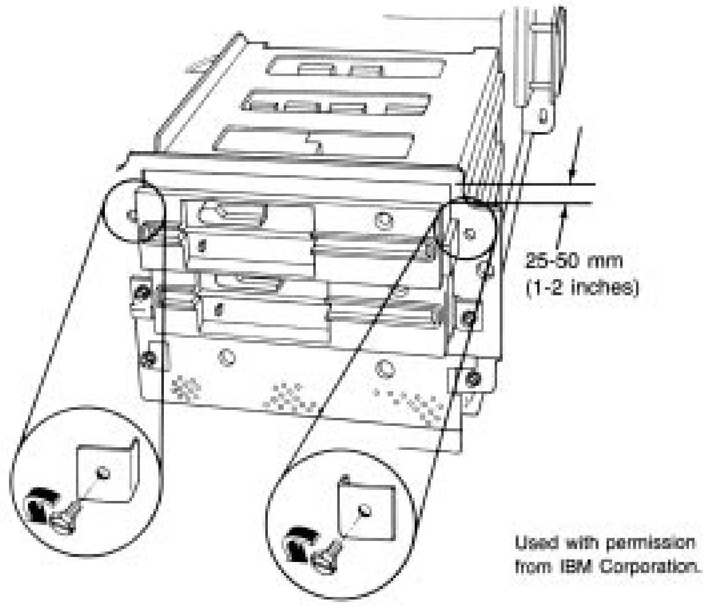


Fig. 3.14
Removing the mounting tabs on a floppy drive.

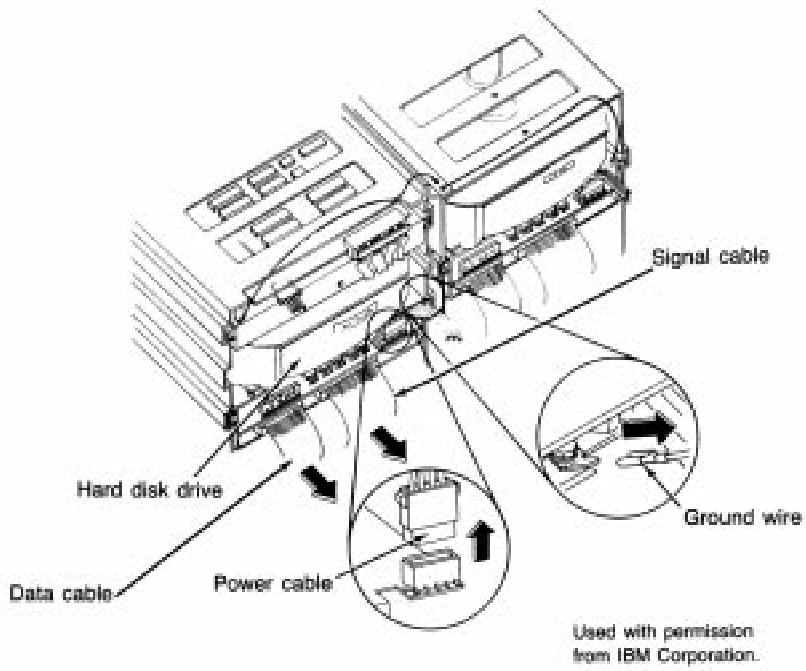


Fig. 3.15
Disconnecting the hard drive power cable, signal and data cables, and ground wire.

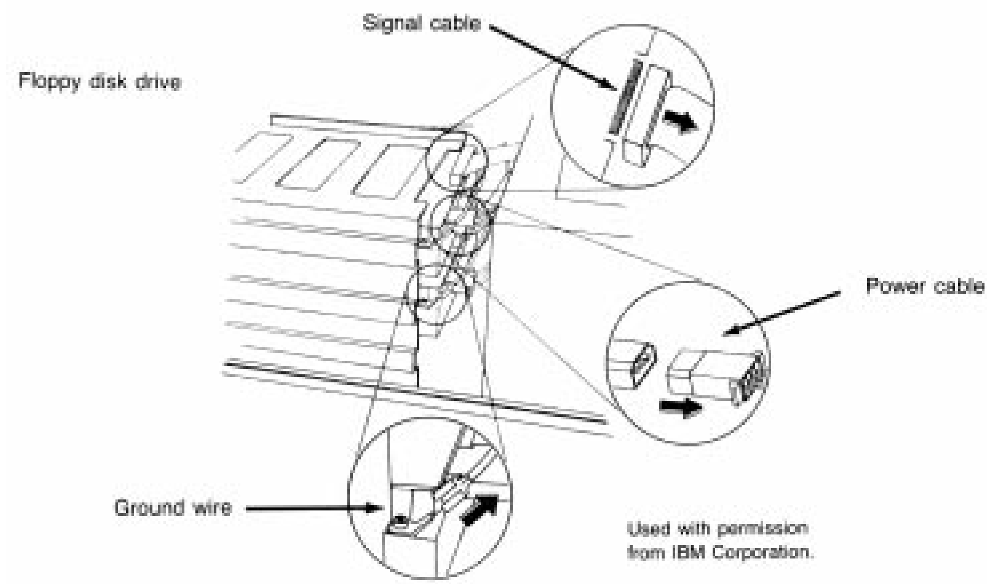


Fig. 3.16
Disconnecting the floppy drive power cable, signal cable, and ground wire.

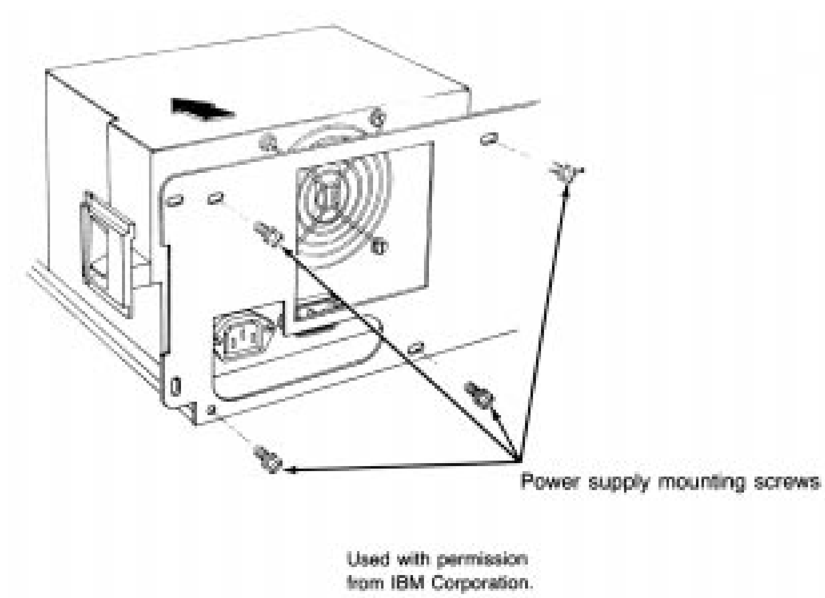


Fig. 3.17
Removing the power supply retaining screws from the rear of the chassis.

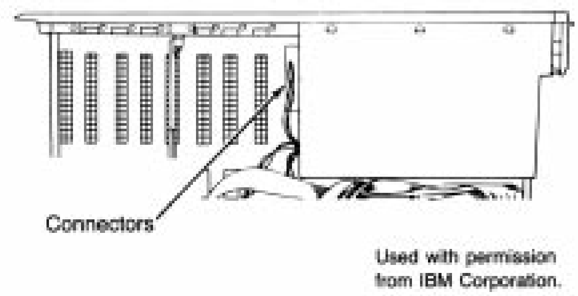


Fig. 3.18
Disconnecting the cables from the power supply to the motherboard.

Removing the Motherboard. After all adapter cards are removed from the unit, you can remove the motherboard. The motherboard in AT case systems is held in place by several screws as well as plastic standoffs that elevate the board from the metal chassis so that it does not touch the chassis and cause a short. You should not separate the standoffs from the motherboard; remove the board and the standoffs as a unit. The standoffs slide into slots in the chassis. When you reinstall the motherboard, make sure that the standoffs are located properly in their slots. If one or more standoffs have not engaged the chassis properly, you might crack the motherboard when you tighten the screws or install adapter cards.

To remove the motherboard, first remove all adapter boards from the system unit, as described earlier. Proceed as follows:

1. Disconnect from the motherboard all electrical connectors, including those for the keyboard, power supply, speaker, battery, and keylock.
2. Locate and remove the motherboard retaining screws.
3. Slide the motherboard away from the power supply about a half-inch until the standoffs have disengaged from their mounting slots (see fig. 3.19).
4. Lift the motherboard up and out of the chassis.

PS/2 Systems

The disassembly of IBM's PS/2 systems is incredibly easy. In fact, ease of disassembly and reassembly is one of the greatest features of these systems. In addition to being easy to service and repair, they were designed to be assembled primarily by robots and automated machinery. This type of machinery does not handle conventional fasteners such as screws, nuts, and bolts very well. Most PS/2 systems therefore are assembled with a great deal of "snap together" technology. The screws that are used have a special self-centering design in which the screw end is tapered so that it is self-guiding, to mate with the threads in the hole. Automated robotic machinery then can insert and tighten the screws more easily and accurately, and without stripping the threads. This approach to construction makes these systems not only easier to assemble by machine, but also much easier for people to disassemble and reassemble.

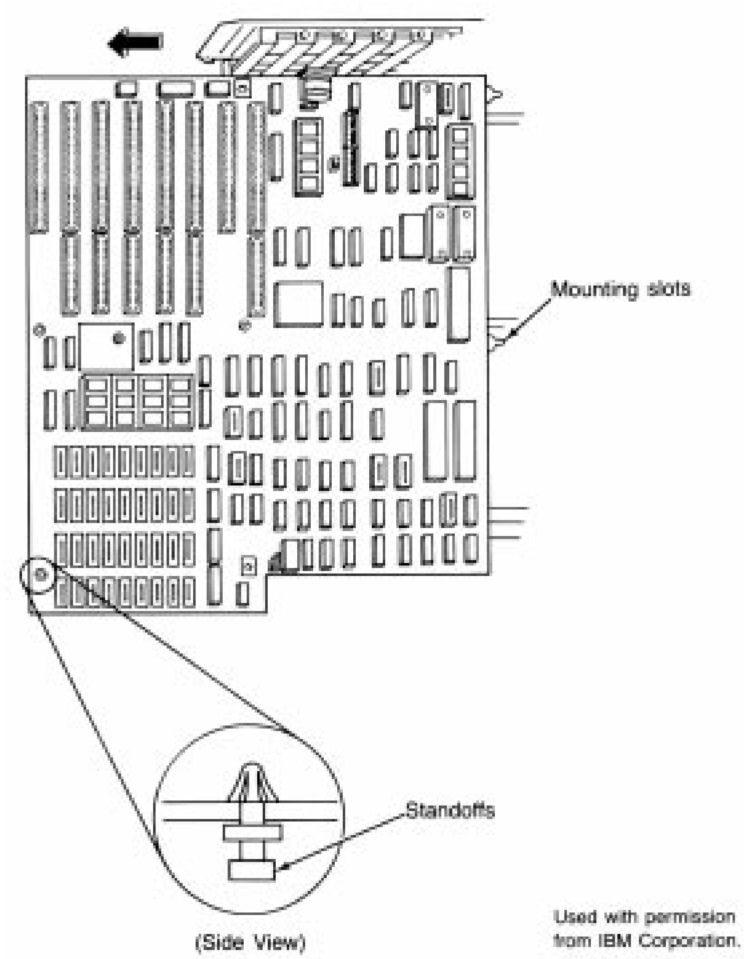


Fig. 3.19
Disengaging standoffs from their mounting slots.

If you can disassemble one PS/2 system, you see how easily the others come apart as well, especially systems that are similar or identical physically. Although a variety of PS/2 designs exist, many of them are similar. The three primary original types of PS/2 chassis design are the 30/30-286/55 SX, the 50/70, and the 60/65/80. Other designs, including the 90, 95, and 35/40/57/76/77, are similar in many ways to the three primary types. Models 25 and 25-286 are unique in that they have a built-in display.

- Models 25 and 25-286 have a unique design with a built-in monitor.
- Models 30, 30-286, and 55 SX share a common chassis and mechanical design, although their circuit boards are different.
- The newer 35, 40, 56, 57, 76, and 77 systems physically are nearly identical to each other. Many of these different models even share motherboards.

- Models 50, 50 Z, and 70 represent the "ultimate" in ease of disassembly and reassembly. These units have not a single cable in their default configuration and are snapped together almost entirely without conventional fasteners. Models 50 Z and 70 especially share many physical components and are difficult to tell apart from the outside.
- Models 60, 65 SX, and 80 are full-size, floor-standing systems. These systems are virtually identical to each other from a physical standpoint and share most of their physical components, even though the motherboards are different.
- The newer Model 90 is similar to the 50/70 systems in construction, but is unique in some ways. The newer Model 95 is similar to the 60/65/80 systems, but also differs in some ways.

The following section discusses, step-by-step, disassembly and reassembly procedures for the PS/2 systems. The three main system types each cover a section. The disassembly procedures for the three primary designs can be applied to the other, similar PS/2 system designs as well.

Models 30, 30-286, and 55 SX. This section describes the disassembly procedures for the PS/2 Model 30, Model 30-286, and Model 55 SX. The systems are modular in nature, and most of the procedures are simple.

Removing the Cover. To remove the system-unit cover, follow these steps:

1. Park the hard disk.
2. Turn off the system and unplug the power cord from the wall socket.
3. Disconnect all external options.
4. If the keylock option is installed, make sure that the lock is in the unlocked position and the key removed.
5. Loosen all four screws located at the bottom corners on the sides of the system. Slide the cover back and lift it up and away.
6. Remove the rear cover that covers the system's back panel. You remove this cover by loosening the screw on each corner of the rear cover on the back of the system. Pull the rear cover back and away from the system unit (see fig. 3.20).

Removing the 3 1/2-inch Floppy Disk Drive. The procedure for removing the floppy drive is very simple. Proceed as follows:

1. Remove the front cover (the bezel) from the drive by pushing down on the two plastic tabs on top of the bezel.
2. Pull the bezel off and away from the front of the system.
3. Disconnect the disk cabling by gently pulling the cable away from the drive.
4. Remove the plastic nails from each side of the drive bracket.

5. Press up on the plastic tab under the front of the drive.

6. Pull the drive forward out of the system (see fig. 3.21).

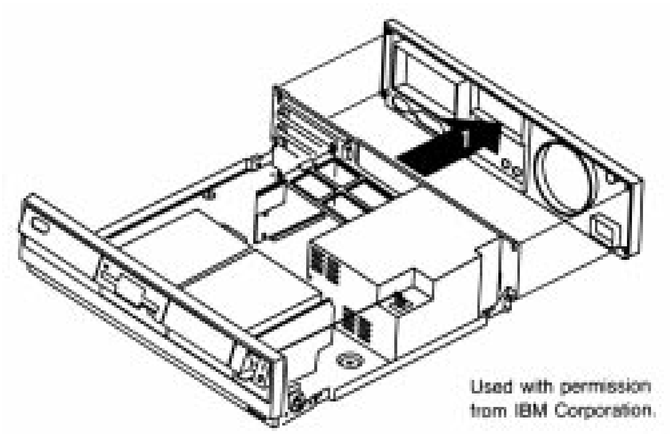


Fig. 3.20
Removing the rear cover (Models 30, 30-286, and 55 SX).

Removing the Hard Disk Drive. Before removing the hard disk, make sure that the heads have been parked. You can use the Reference Disk to perform this task. Simply boot the disk, and select the Move the Computer option from the main menu. If this option is not present, IBM supplied your system with only self-parking drives; you park them by simply turning off the power. Even if the option is present, you still might have a self-parking drive (refer to Chapter 14, "Hard Disk Drives and Controllers"). You can remove the drive by following these steps (which are similar to the steps for removing a floppy drive):

1. Remove the front cover (the bezel) from the drive by pushing down on the two plastic tabs on top of the bezel and pulling it off and away from the front of the system.

2. Disconnect the disk cabling by gently pulling the cable away from the drive.

3. Remove the plastic nails from each side of the drive bracket.

4. Press upward on the plastic tab under the front of the drive, and pull the drive forward out of the system.

Removing Adapters. To remove all adapter cards from the system unit, first remove the system-unit cover, as described earlier. Proceed as follows for each adapter:

1. Remove the screw from the bracket retaining the card.

2. Slide the adapter sideways out of the system unit (see fig. 3.22).

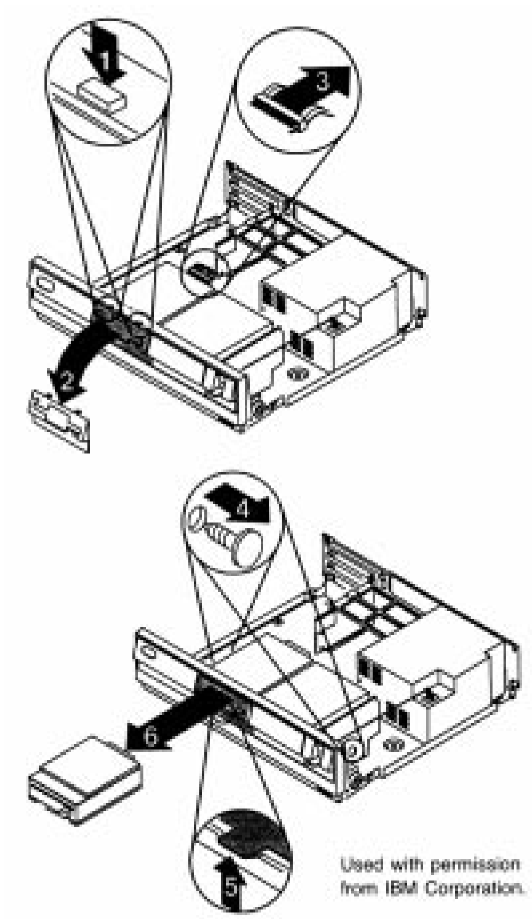


Fig. 3.21
Removing a 3 1/2-inch floppy drive (Models 30, 30-286, and 55 SX).

If you add new options, their installation might require that you remove the plastic insert on the rear panel. Also, if you add a 3/4-length adapter, you must adjust the sliding support bracket to support the adapter properly.

Removing the Bus Adapter. These systems have a bus adapter card that contains the slots. This adapter plugs into the motherboard. To remove the device, proceed as follows:

1. Push in on the two tabs on top of the bus adapter support.
2. Gently rotate the end of the support upward and disengage the tabs in the power supply.
3. Lift up and remove the bus adapter (see fig. 3.23).

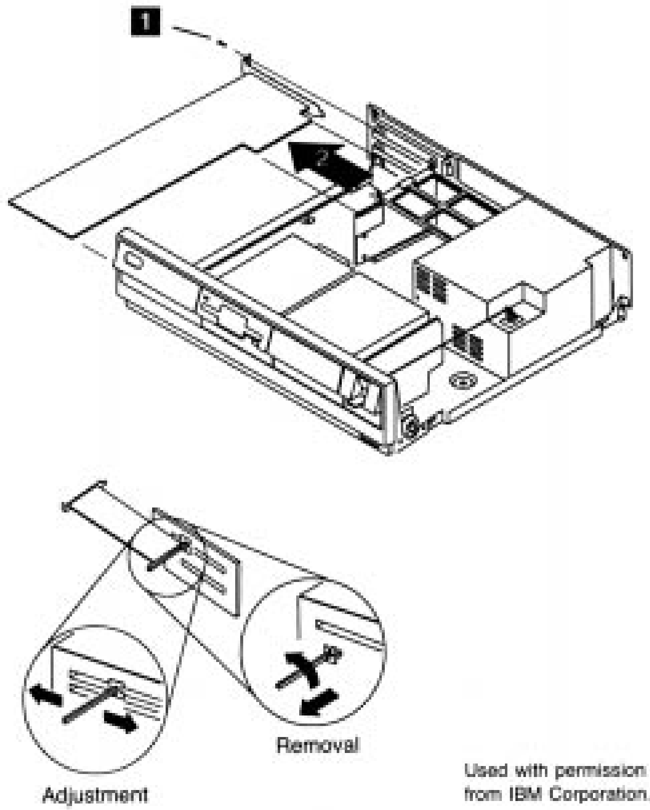


Fig. 3.22
Removing adapter cards (Models 30, 30-286, and 55 SX).

Removing the Power Supply. When you remove the power supply, first remove the rear cover and the bus adapter support, as described earlier. Proceed as follows:

1. Disconnect the power connector from the power supply to the motherboard by pulling the connector straight up.
2. Disengage the power-switch link from the power supply.
3. Remove the three screws that secure the power supply to the system frame. The screws are at the back of the power supply.
4. Gently slide the power supply toward the front of the system to disengage the power supply from the base of the frame.
5. Lift the power supply up and away from the unit (see fig. 3.24).

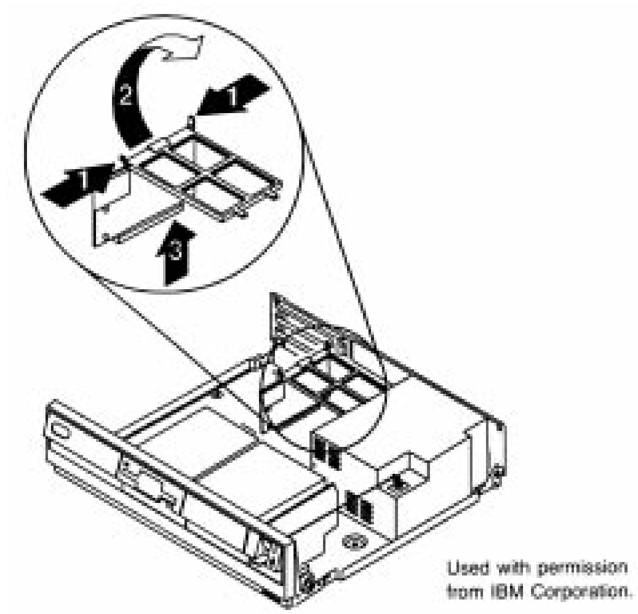


Fig. 3.23
Removing the bus adapter (Models 30, 30-286, and 55 SX).

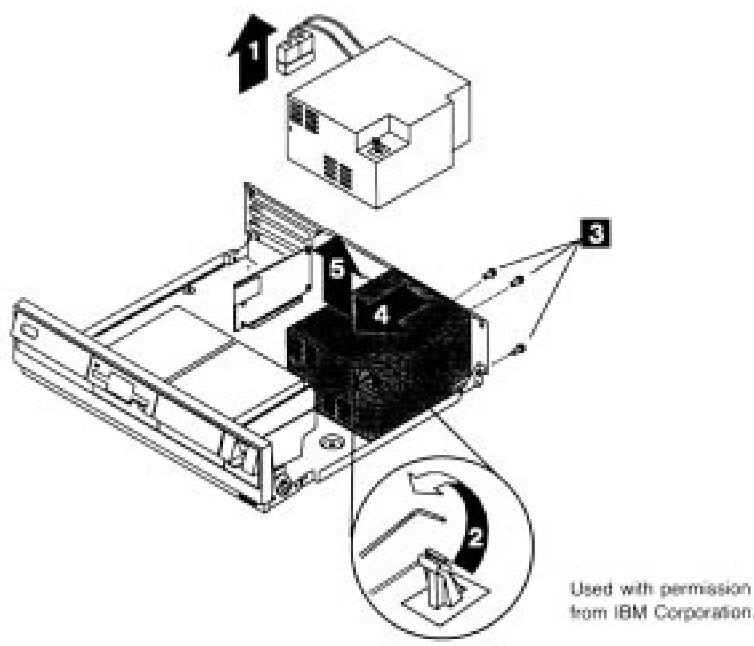


Fig. 3.24
Removing the power supply (Models 30, 30-286, and 55 SX).

Removing Single In-Line Memory Modules (SIMMs). One benefit of using single in-line memory modules (SIMMs) is that they're easy to remove or install. When you remove memory modules, remember that because of physical interference you must remove the memory-module package closest to the disk drive bus-adapter slot before you remove the package closest to the edge of the motherboard. To remove a SIMM properly, follow this procedure:

1. Gently pull the tabs on each side of the SIMM socket outward.
2. Rotate or pull the SIMM up and out of the socket (see fig. 3.25).

Caution

Be careful not to damage the connector. If you damage the motherboard-SIMM connector, you could be looking at an expensive repair. Never force the SIMM; it should come out easily. If it doesn't, you are doing something wrong.

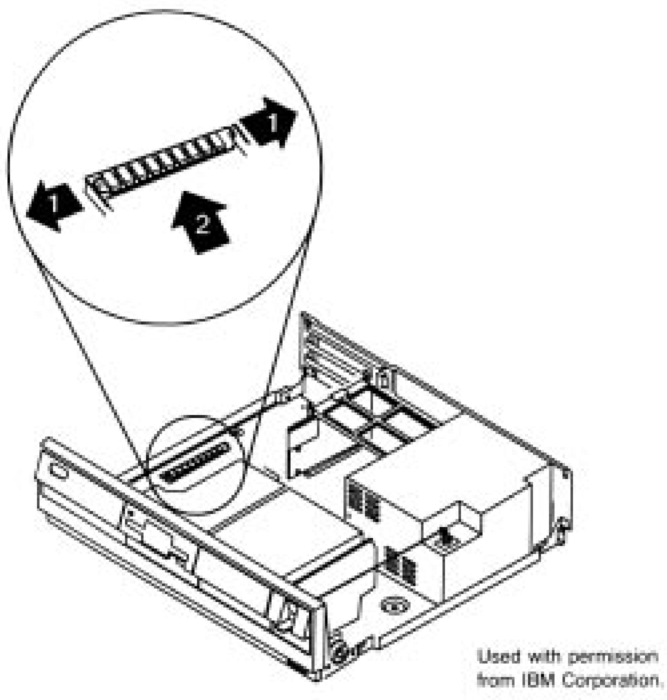


Fig. 3.25
Removing a SIMM (Models 30, 30-286, and 55 SX).

Removing the Motherboard. The motherboard is held in place by several screws, all of which must be taken out. Proceed as follows:

1. Remove all screws.
2. Carefully slide the motherboard to the left.
3. Lift the motherboard out of the system unit (see fig. 3.26).

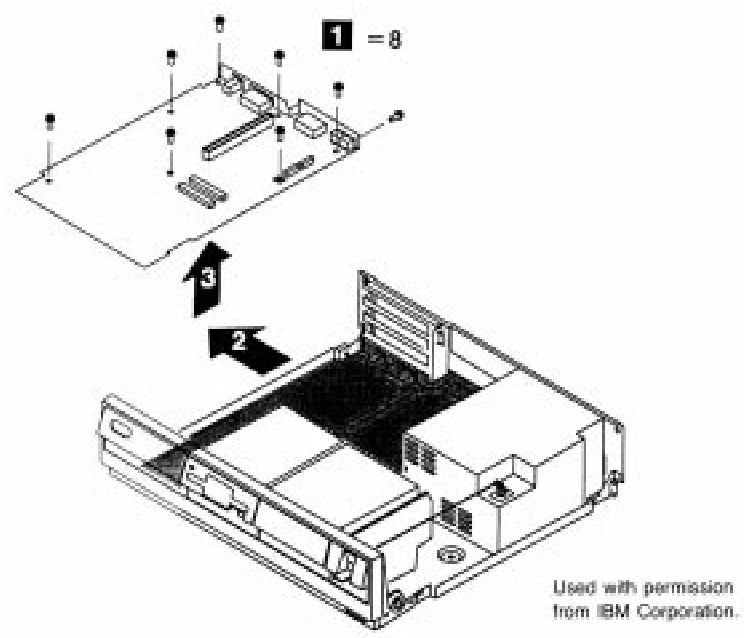


Fig. 3.26
Removing the motherboard (Models 30, 30-286, and 55 SX).

Models 50, 50 Z, and 70. This section describes the disassembly procedures for the PS/2 Model 50, Model 50 Z, and Model 70. These systems are modular in nature, and most of the procedures are simple.

Removing the Cover. To remove the system-unit cover, follow these steps:

1. Park the hard disk. Nearly all these systems come with self-parking hard disks; only the 20M drive used in the Model 50 does not. Self-parking drives require no manual parking operation. Because no parking program is necessary, the reference disks for the Model 70 do not have a head-parking program or menu selection.
2. Turn off the system and unplug the power cord from the wall socket.
3. Unlock the cover.
4. Loosen the two cover thumbscrews on the back of the system.
5. Slide the cover toward you and lift it off (see fig. 3.27).

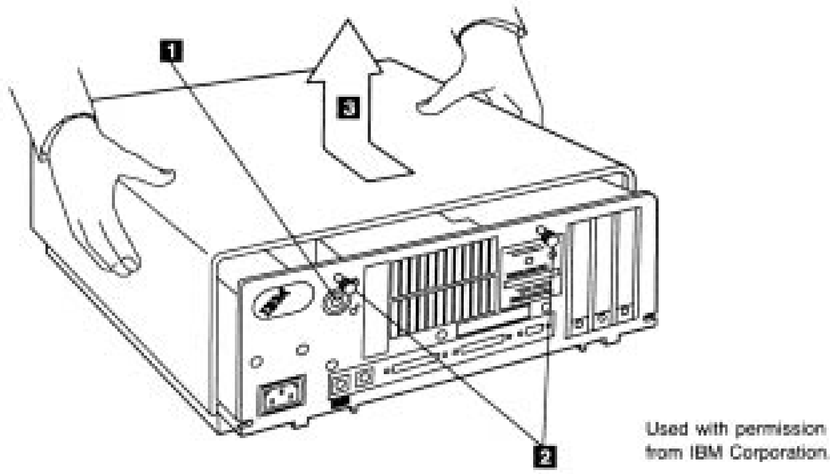


Fig. 3.27
Removing the cover (Models 50 and 70).

Removing the Battery-and-Speaker Assembly. The battery and speaker are contained in a single assembly. To remove this assembly, follow these steps:

1. To avoid accidentally discharging the battery, remove the battery from its holder before removing the battery-and-speaker assembly: bend the tabs on the holder toward the rear and pull the battery straight up. Remember to install this assembly before replacing the battery.
2. Push the tab on the bottom of the speaker unit to disengage the speaker assembly from the support structure.
3. Lift the entire battery-and-speaker assembly up and out of the system (see fig. 3.28).

Removing the Fan Assembly. The fan assembly in Model 70 systems is an integral part of the power supply. In these systems, the fan is screwed directly to the power supply. You remove the fan by removing the power supply.

In Model 50 systems, remove the fan assembly as follows:

1. Disengage the two plastic push-button tabs on either side of the fan assembly by prying them upward. If necessary, use the small pry tool located at the front, right corner of the system.
2. Pull the entire assembly up and out of the system (see fig. 3.29).

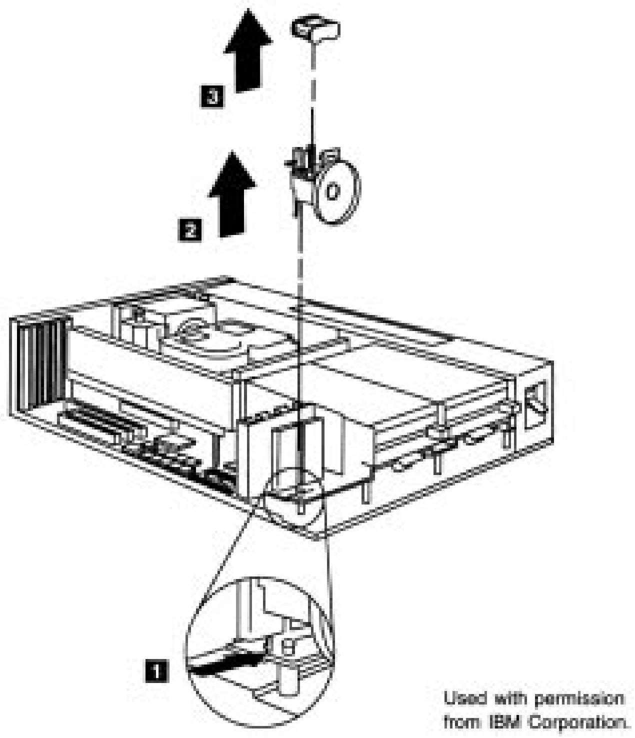


Fig. 3.28
Removing the battery-and-speaker assembly (Models 50 and 70).

Removing Adapters. An important part of removing adapter boards in these systems is to make a diagram of the adapter and cable locations.

Micro Channel bus systems such as the PS/2s remember exactly where each adapter card was located. Because of this, you should put all adapters back in the same slot from which they were removed. Otherwise, the CMOS memory configuration must be run to reconfigure the adapters in their new slots.

To remove the adapters, follow these steps:

1. Make sure that all cables are disconnected.
2. Loosen the retaining thumb screw at the base of the card bracket.
3. Grasp the option adapter and gently pull it up and out of the system unit (see fig. 3.30).

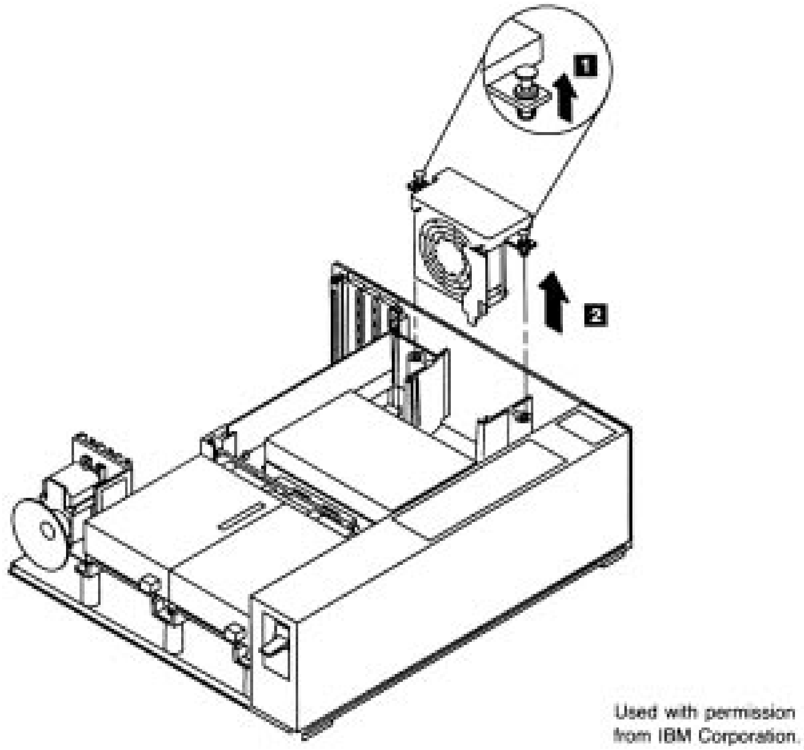


Fig. 3.29
Removing the fan assembly (Models 50 and 70).

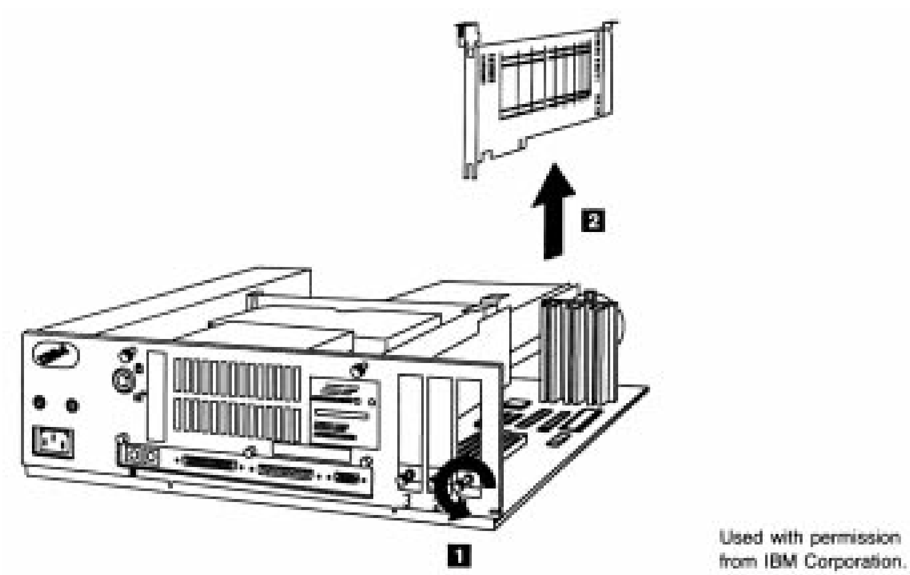


Fig. 3.30
Removing an adapter (Models 50 and 70).

Removing the 3 1/2-Inch Floppy Disk Drive. Removing floppy drives from 3 1/2-inch floppy disk drive systems is a simple task. Just push up on the tab underneath the floppy drive, and slide the drive out toward you.

Removing Fixed Disk Drives. Removing the hard disk from a fixed disk drive is almost as easy as removing a floppy drive. Before removing the hard disk, make sure that you've backed up all the information on the fixed disk and parked the heads. Follow these steps:

1. Press down the two plastic tabs on the side where the power supply is located.
2. Slide the fixed disk drive toward the power supply and up.
3. Grasp the adapter at each end, and gently pull the adapter up (see fig. 3.31).

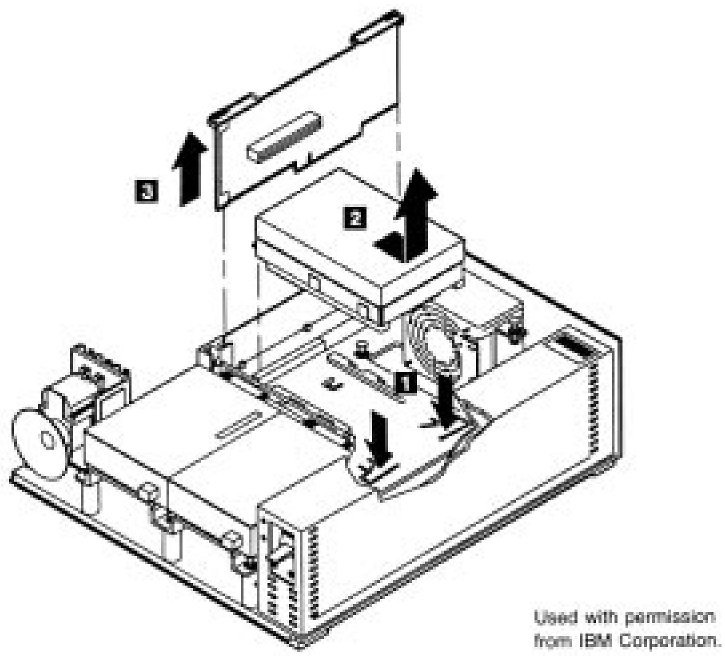


Fig. 3.31
Removing the fixed disk drive (Models 50 and 70).

Removing the Drive-Support Structure. To remove the support structure from the system unit, you first must remove these components:

Cover

Battery-and-speaker assembly

Fan assembly

Adapters

Floppy disk drives

Fixed disk drives

When these items have been removed, pull up all six white plastic push-button lock tabs, and lift the assembly up (see fig. 3.32). If necessary, you can use the small pry tool on the front, right side of the system to pry up the lock tabs.

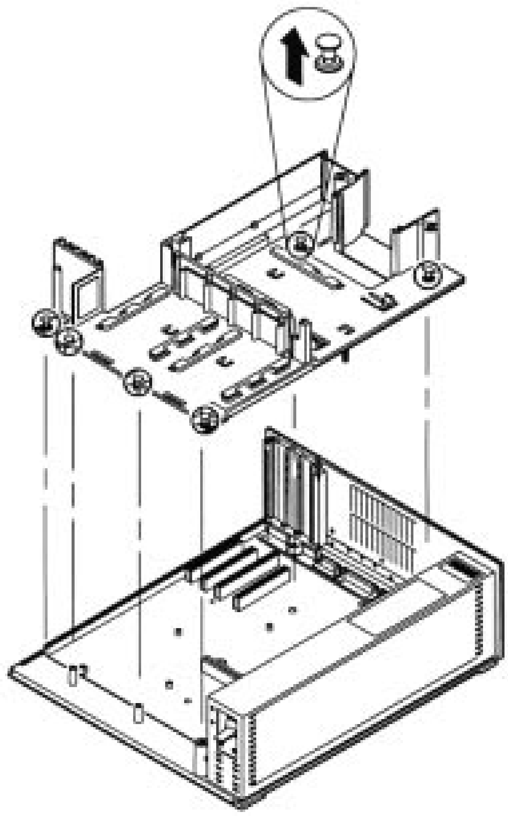


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Fig. 3.32
Removing the drive-support structure (Models 50 and 70).

Removing the Power Supply. To remove the power supply, follow these steps:

1. Remove the screw on the front, left side of the system.
2. Remove the two screws on the back of the power supply.
3. Slide the power supply to the right, and remove from the system unit (see fig. 3.33).

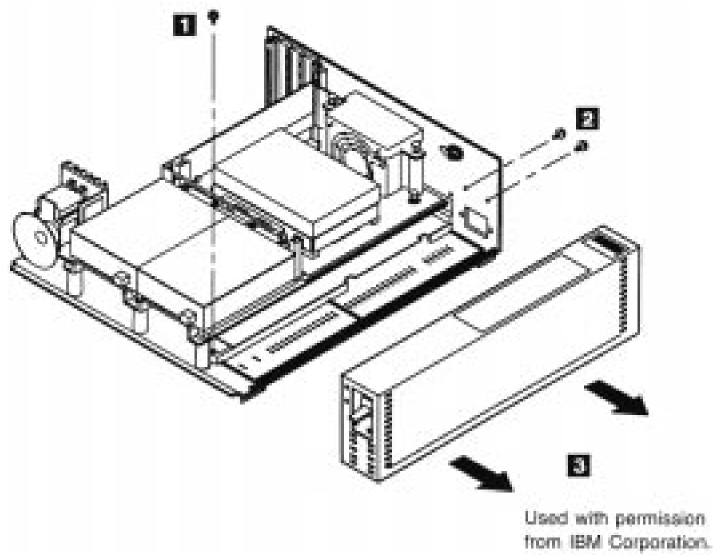

Fig. 3.33
Removing the power supply (Models 50 and 70).

Removing the Motherboard. To remove the motherboard from the system unit, you first must remove these components:

Cover

Battery-and-speaker assembly

Fan assembly

Adapters

Floppy disk drives

Fixed disk drives

Disk-support structure

Power supply

After you remove all these components from the system unit, removing the motherboard requires only these two steps:

1. Remove all six retaining screws (three on the back of the system unit and three on the motherboard).
2. Gently lift the motherboard up and out of the system (see fig. 3.34).

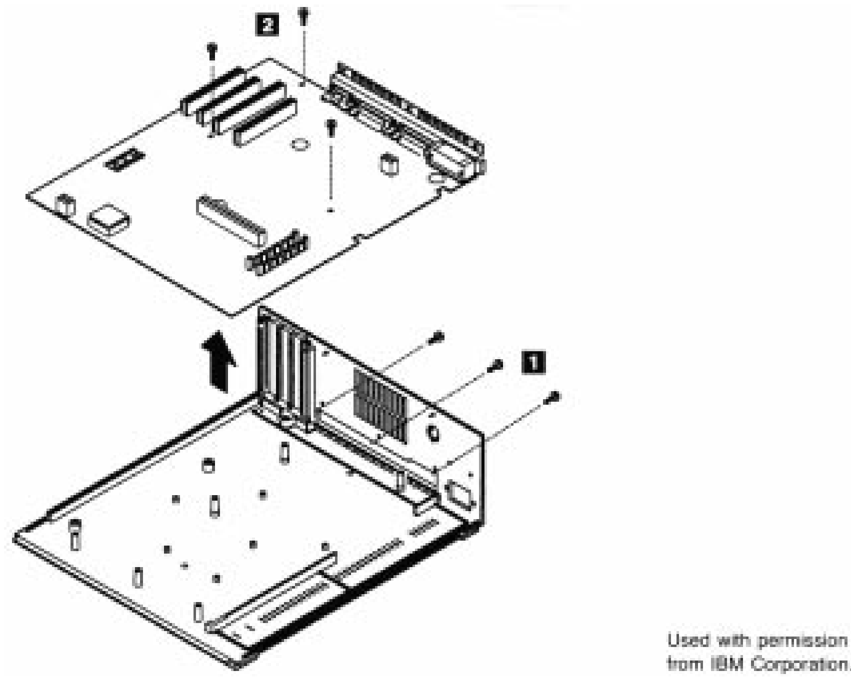

Fig. 3.34
Removing the motherboard (Models 50 and 70).

Removing Single In-Line Memory Modules (SIMMs). A benefit of using single in-line memory modules (SIMMs) is that they are easy to remove or install. When you remove memory modules, remember that, because of physical interference, you must remove the memory-module package closest to the disk drive bus-adapter slot before removing the package closest to the edge of the motherboard. To remove a SIMM properly, follow the steps shown for the 30, 30-286, and 55 SX (see fig. 3.35).

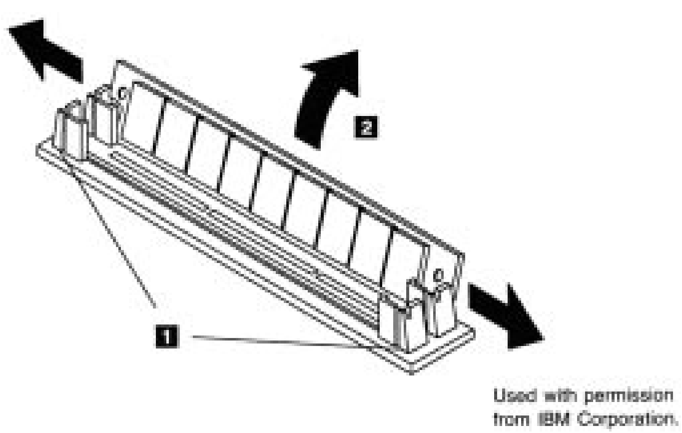

Fig. 3.35
Removing a SIMM (Models 50 and 70).

Caution

Be careful not to damage the connector. If you damage the motherboard-SIMM connector, you could have an expensive repair. Never force the SIMM; it should come out easily. If it doesn't, you are doing something wrong.

Models 60, 65 SX, and 80. This section describes the disassembly procedures for the PS/2 Model 60, Model 65 SX, and Model 80, These floor-standing PS/2 systems are not as easy to work on or as modular as the desktop systems, but they're still easy to service compared with the earlier PC- and AT-type systems. Most repair procedures do not even involve using any tools.

Removing the Cover. To remove the system-unit cover, follow these steps:

1. Park the hard disk. Because all Model 60, 65 SX, and 80 systems delivered from IBM include self-parking hard disks, no manual parking operation is necessary. The reference disks for these systems do not include a head-parking program or menu selection because they are unnecessary with self-parking drives.
2. Turn off the system, and unplug the power cord from the wall socket.
3. Disconnect all external options.
4. Unlock the cover lock.
5. Loosen the two cover screws on the side of the system.
6. Tilt the cover toward you.
7. Lift the cover up (see fig. 3.36).

Removing Adapters. An important part of removing adapter boards in these systems is to make a diagram of the adapter and cable locations.

Because Micro Channel bus systems remember where each and every card is located, you should put all adapters back in the same slot from which they were removed. Otherwise, the CMOS memory configuration must be run.

To remove the adapters, follow these steps:

1. Make sure that all cables are disconnected.
2. Loosen the retaining thumb screw at the base of the card bracket.
3. Grasp the option adapter, and gently pull it up and out of the system unit (see fig. 3.37).

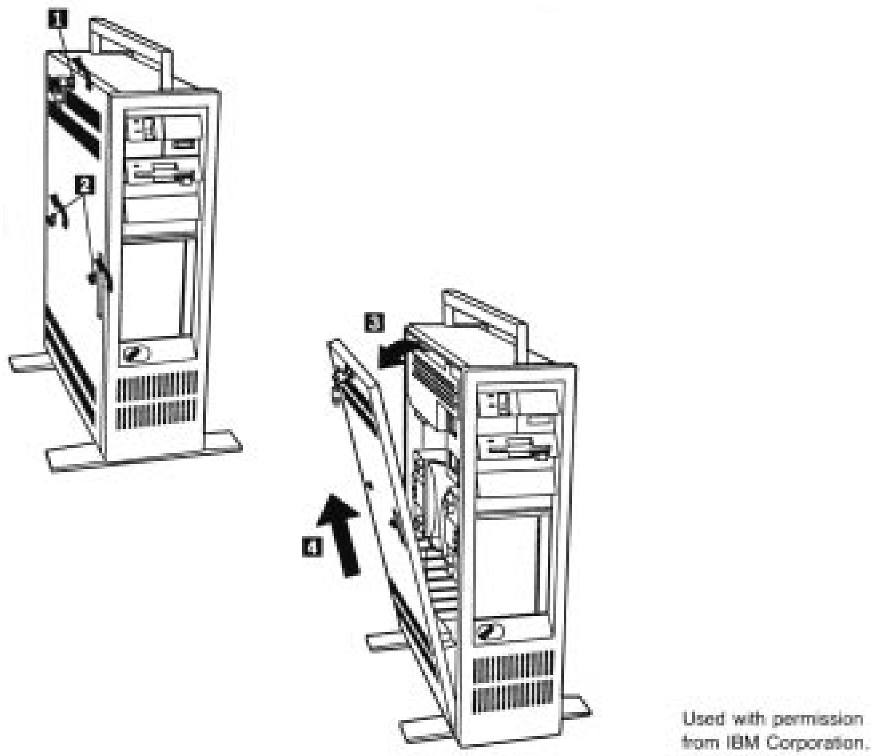

Fig. 3.36
Removing the cover (Models 60, 65 SX, and 80).

Removing the Battery-and-Speaker Assembly. The battery and speaker are contained in a single assembly. To remove this assembly, follow these steps:

1. To avoid accidentally discharging the battery, remove the battery from its holder before removing the battery-and-speaker assembly: bend the tabs on the holder toward the rear, and pull the battery straight up. Remember to install this assembly before replacing the battery.
2. Disconnect the battery-and-speaker assembly cable.
3. Push the tab on the bottom of the speaker unit to disengage the speaker assembly from the support structure (see fig. 3.38).
4. Lift the entire battery-and-speaker assembly up and out of the system.

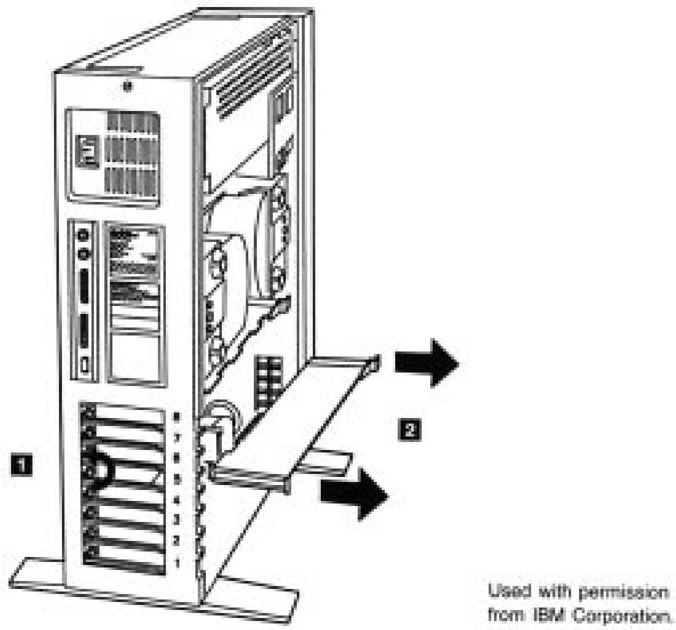

Fig. 3.37
Removing an adapter (Models 60, 65 SX, and 80).

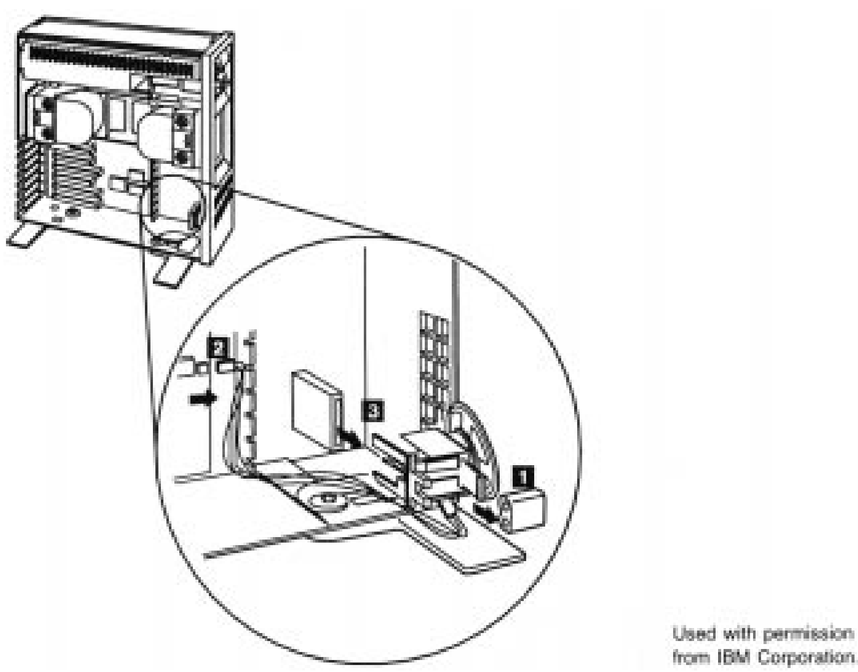

Fig. 3.38
Removing the battery-and-speaker assembly (Models 60, 65 SX, and 80).

Removing the Front Bezel. These models have a large front panel, or bezel, that you must remove to gain access to the floppy disk drives. The panel snaps off easily if you follow this procedure:

1. Grasp the bottom near the feet of the unit.
2. Pull out (see fig. 3.39). The bezel should snap off freely.

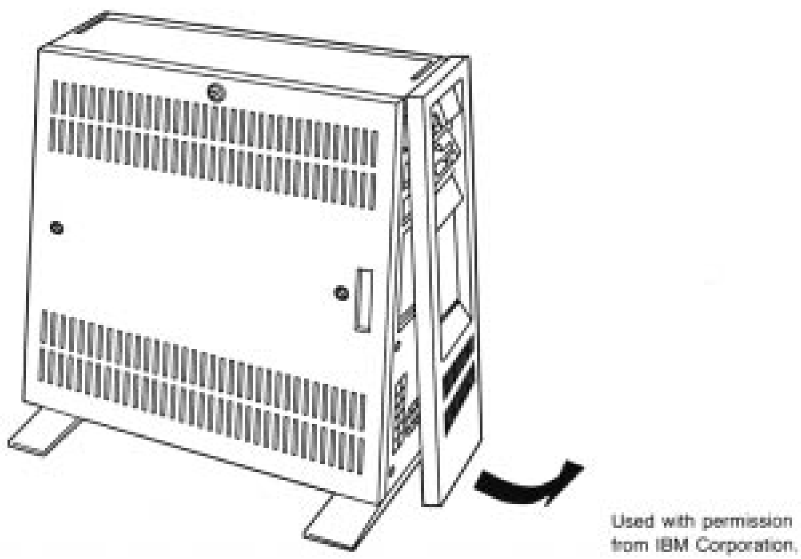

Fig. 3.39
Removing the bezel (Models 60, 65 SX, and 80).

Removing the Power Supply. To remove the power supply, you first must remove the cover and front bezel. Follow these steps:

1. Disconnect all cables from the power supply.
2. Remove the three screws that retain the power supply. One screw is near the power switch, and the other two are near the back of the supply.
3. Lift the power supply out the side of the unit (see fig. 3.40).

Removing Floppy Disk Drives. The floppy drives are located next to the power supply. Removing floppy drives from these systems requires only these two steps:

1. Push the tab underneath the floppy drive up while you simultaneously press a tab on the rear of the drive sideways.
2. Slide the drive out the front of the unit (see fig. 3.41).

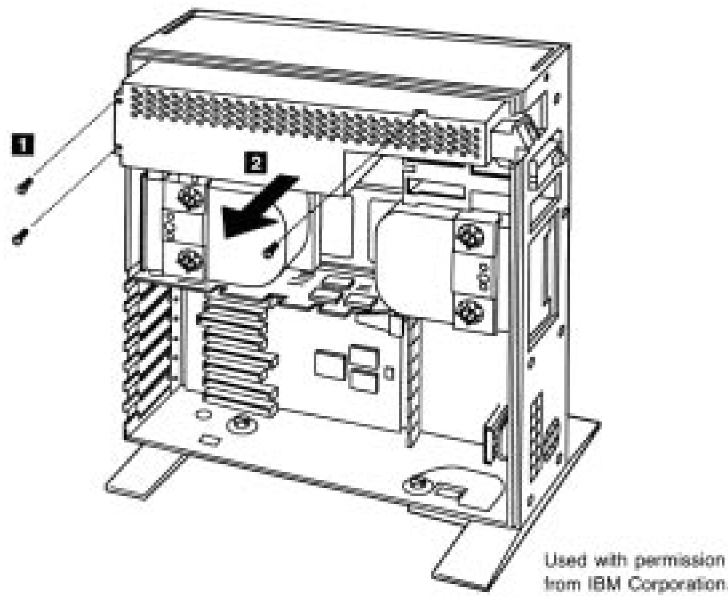

Fig. 3.40
Removing the power supply (Models 60, 65 SX, and 80).

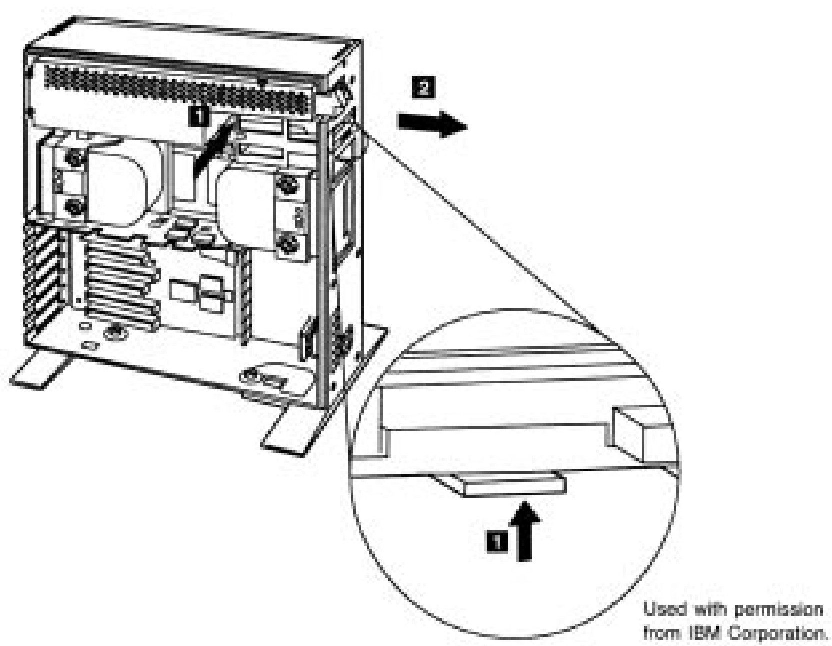

Fig. 3.41
Removing a disk drive (Models 60, 65 SX, and 80).

Removing the Floppy Disk Drive Cable Retainer. Floppy disk drive systems use a retainer to hold cables in place when the floppy drives are plugged in. To remove this cable retainer, follow these steps:

1. Press the tabs located on the side of the cable retainer.
2. Rotate the retainer out toward the back of the system unit.
3. Pull off the retainer (see fig. 3.42).

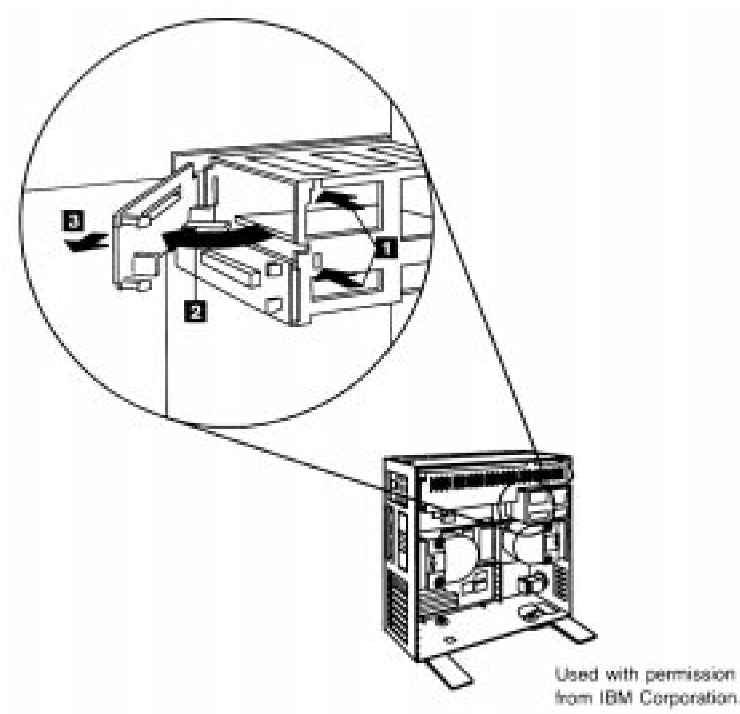

Fig. 3.42
Removing the disk drive cable retainer (Models 60, 65 SX and 80).

Removing the Second Hard Disk Drive. Make sure that you have a backup of the information on the drive before removing the disk. Follow these steps:

1. Disconnect the ground wire and all cables from the fixed disk drive.
2. Turn both thumb screws counterclockwise.
3. Remove the front bezel.
4. Slide the fixed disk drive out the front of the system unit (see fig. 3.43). Note that drive D must be removed before drive C because of physical interference.

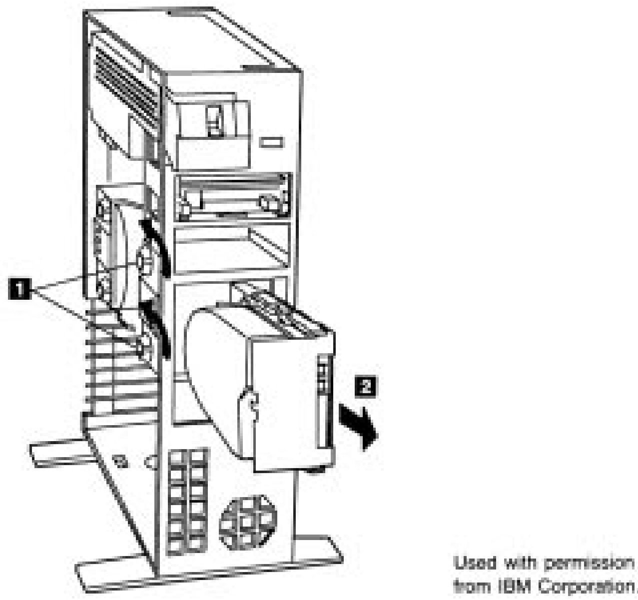

Fig. 3.43
Removing the second hard drive (Models 60, 65 SX, and 80).

Removing the Primary Hard Drive. Make sure that you have a backup of the information on the drive before removing the drive. Proceed as follows:

1. Disconnect the ground wire and all cables from the fixed disk drive.
2. Turn both thumb screws counterclockwise.
3. Remove the front bezel.
4. Slide the drive a little toward the front and lift the fixed disk drive sideways out of the system (see fig. 3.44). Note that drive D must be removed before drive C because of physical interference.

Removing the Hard Disk Drive-Support Structure. A large, metal hard disk drive support structure is used to clamp the hard disks in place. You must remove this structure in order to remove the motherboard. Follow these steps:

1. Remove the four screws located on the front portion of the structure.
2. Slide the structure forward, and lift it up and sideways out of the system (see fig. 3.45).

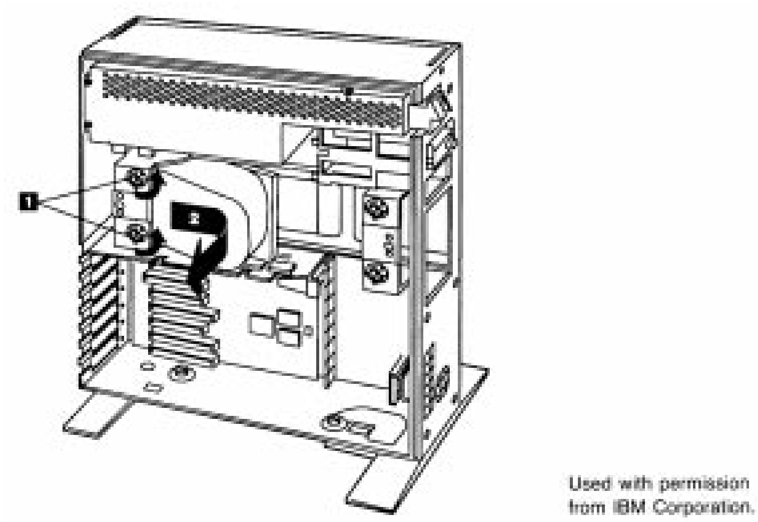

Fig. 3.44
Removing the primary hard drive (Models 60, 65 SX, and 80).

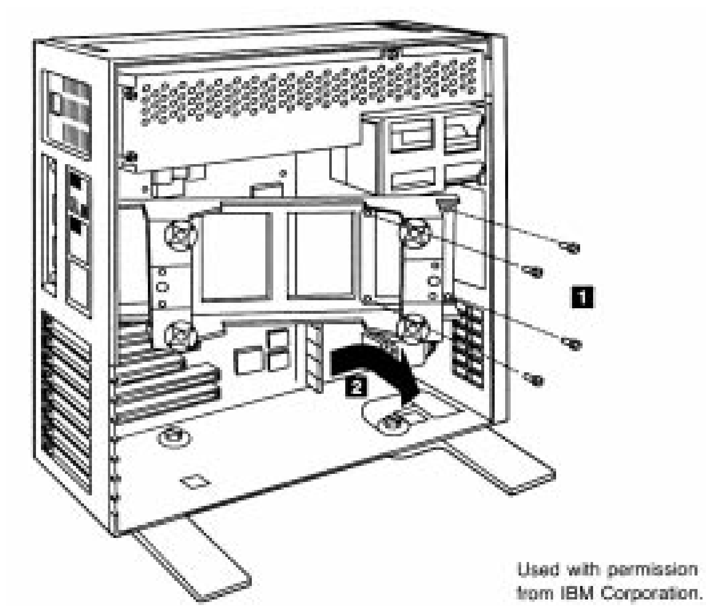

Fig. 3.45
Removing the fixed disk drive support structure (Models 60, 65 SX, and 80).

Removing the Motherboard. To remove the motherboard from the system unit, you first must remove the cover, any adapters, the fixed disk drives, and the fixed disk support structure. With these components removed from the system unit, removal of the motherboard requires these steps:

1. Disconnect all cables from the motherboard.
2. Remove all eight retaining screws.
3. Gently lift the motherboard up and out of the system (see fig. 3.46).

Now that you've examined the procedures for disassembling a system, let's move on to Chapters 4–8, which examine the different components that make up a system.

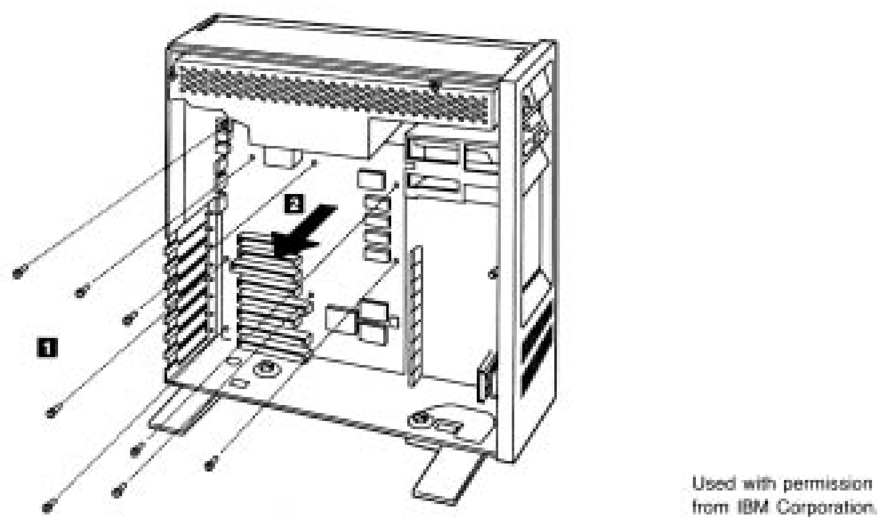

Fig. 3.46
Removing the motherboard (Models 60, 65 SX, and 80).

Summary

This chapter has discussed the initial teardown and inspection of a system and looked at the types of tools required, from simple hand tools to meters for measuring voltage and resistance. It mentioned some of the problems you might encounter with the actual hardware (screws, nuts, bolts, and so on) in a system.

The chapter also has discussed the physical-disassembly procedure and how to recognize the different components that make up a system. Emphasis was made on the preliminary steps taken before and during disassembly such as ESD protection and the recording of system setup information to ensure that the system works properly again when reassembled.

Different disassembly procedures were discussed based on the type of case used for the system. Most systems built using a particular style case such as AT and Tower cases, for example, are constructed in a similar fashion. Once you have worked on a system with one particular type of case design, most others with the same type of case are almost identical.