PRINTED CIRCUIT CARDS
MAINTENANCE AND MODIFICATIONS

CONTENTS PAGE

1. GENERAL 1

2. DEFINITIONS AND ACRONYMS. 1

3. IDENTIFYING STATIC-SENSITIVE COMPONENTS AND PRINTED CIRCUIT CARDS. . 1
Precautions. 1
Identification 2

4. MAINTENANCE FACILITIES. 2

5. CARD CONSTRUCTION 4

6. AVOIDING SECONDARY DAMAGE 4
Storing Static-Sensitive Cards and Components 5
Transporting Static-Sensitive Cards and Components 5

7. REPAIR TOOLS AND MATERIALS 6
Solder and Soldering Tools 6
Anti-Static Work Stations. 6
Soldering Aids 6

8. REPAIR TECHNIQUES 6
General Procedures 6
Protective Coating Removal 7
Printed Conductor Repair 7
Component Replacement. 8
Repair Procedures for Static-Sensitive PC Cards 8
Repairing Cards with MOS Components 10
Modification Kits. 10

9. REPORTING MALFUNCTIONS. 10

10. CLEANING GOLD CARD CONTACTS 10

1. GENERAL

1.01 This practice provides information and techniques for printed circuit (PC) card:

- Modifications.
- On-site repairs.

NOTE: Read Paragraph 3.01 before performing any work on PC cards.

1.02 Use proper tools and procedures when working with PC cards to avoid costly secondary damage to the card and its associated components.

1.03 This practice is reissued to include updated information. Refer to Practice, 932-600-008, Repair and Return, Packing and Shipping for information about packing and shipping PC cards.

2. DEFINITIONS AND ACRONYMS

2.01 CMOS - Complementary metal oxide semiconductor.

2.02 FET - Field effect transistor.

2.03 IF - Intermediate frequency.

2.04 MOS - Metal oxide semiconductor.

2.05 PRINTED CIRCUIT CARD - A nonconductive card carrying a circuit composed of:

- Printed wiring on one or both sides.
- Discrete components soldered to the printed wiring.

2.06 REPAIR - Reconditioning, repairing, or modifying PC cards.

2.07 RF - Radio frequency.

3. IDENTIFYING STATIC-SENSITIVE COMPONENTS AND PRINTED CIRCUIT CARDS

Precautions

CAUTION: Before removing any circuit card, switch all power to the unit OFF. If the power is not OFF, serious damage will result. Never handle a circuit card unless anti-static precautions are taken. Circuit cards are easily damaged by static discharge.

3.01 Circuit card handling is explained in greater detail later, however the following procedure includes the essentials:

STEP	HANDLING ELECTROSTATIC-SENSITIVE PC CARDS
	Attach a safe grounding cord to the equipment frame.
2	Wear an anti-static wrist strap (MC578250) connected to ground. WARNING: Never ground yourself directly. The wrist strap is equipped with a one-megohm resistor for employee protection. High static voltages will easily pass through the resistor while potentially lethal line voltages will not. (Continued)

STEP	HANDLING ELECTKOSTATIC-SENSITIVE PC CARDS (Continued)
3	Use a conductive plastic storage bag to remove or insert cards. Do not touch: • Solder connections. • Trimmed circuit leads. • Edge connectors.
4	Place the circuit card in a special conductive plastic bag whenever it is removed from its slot. Always store cards in conductive bags.
5	Perform all repairs or modifications at an anti-static work station. NOTE: Only qualified personnel are authorized to make PC card repairs or modifications.

Identification

3.02 After repairs or rework, printed circuit cards must meet the requirements of their respective:

- Drawings.
- Test specifications.
- Other applicable documents.

3.03 Make on-site repairs only when they are absolutely necessary to switching system operation. Otherwise, return PC cards to the repair center for repair. Except in extraordinary cases, on-site repairs will void tne warranty.

3.04 All cards containing metal oxide semiconductor (MOS) electrostatic-sensitive devices are identified as follows:

THE. . .	ARE IDENTIFIED BY. . .
Cards containing MOS or other electrostatic-sensitive devices	A red stripe of nonconductive ink along one edge.
Hybrid circuits containing MOS components	• Red color. • The letters MOS on the back. This identifies them as static sensitive as compared to other look-alike hybrid circuits.
Card handles on all PC cards containing MOS or other static-sensitive devices	• Labels stamped in red ink, which include the: - Assembly part number. - Function. - Letters "MOS." NOTE: For handles with insufficient area to contain the letters MOS, all labels are printed in red ink.
Assembly view drawings of cards containing MOS or other static-sensitive devices	One or more manufacturing notes describing the card as containing static-sensitive devices.

3.05 Individual static-sensitive components (not yet mounted on cards) can be identified by the type of container used for packaging. Integrated circuits are packaged in either specially-treated anti-static plastic tubes (labeled as such) or metal tubes. Other static-sensitive components and some integrated circuits may have the leads of the devices surrounded by conductive material and packaged in an anti-static plastic bag. The anti-static bags are identified by either their:

- Pale pink color (pink polyethylene).

OR

- A transparent blue-black metallized finish.

3.06 Cards with static-sensitive components are also packaged in anti-static plastic bags.

CAUTION: Keep static-sensitive components and cards in protective anti-static bags until installation.

4. MAINTENANCE FACILITIES

4.01 Make on-site repairs of PC cards only to restore service when spare equipment is not readily available. Otherwise, send the cards to:

- A repair center having repair specialists and complete facilities.

OR

- The factory for repair and return.

4.02 Some advantages of the centralized repair

arrangement are::

- Minimum:
  - Parts stockage.
  - Duplication of expensive, complex repair tools and equipment.
  - Need for repair specialists and associated repair reference material.
- Ease in aetermining whether or not a card is economically feasible to repair.
- Standardized repair results.
- Minimum interference with on-site:
  - Operations.
  - Maintenance routines.

4.03 All cards shipped individually are packed in dedicatea containers. Keep several of each type of container (including inner packing materials) for returning defective cards. If the original container is not available, use one of the containers listed in Practice 992-600-008, Repair and Return, Packing and Shipping.

4.04 The remainder of this practice is limited to on-site:

- Service-restoration repair of PC cards.
- Application of factory-prepared modification kits to PC cards.

4.05 Proper on-site repair techniques assure that:

- Service is restored in minimum time.
- The component can be completely refurbished at a later date and with minimum expense.. The locally-repaired or modified card wil | be completely refurbished at the repair center.

4.06 On-site PC card repairs are usually limited to:

- kemoving and replacing defective components.
- Adding, replacing, or removing components as described in amodification kit.
- Altering a PC card's circuitry, according to a modification kit, using:
  - Discrete, non-printed conductors (wires).
  - Strapping.
- Repairing breaks in printed wiring.
- Cleaning the card to clear:
  - Intermittent malfunctions.
  - High-resistance.
  - Dead shorts.
- Cleaning plug-in contact surfaces.
- Resoldering faulty solder joints.
- Repairing broken component leads.
- Cleaning gold contacts (refer to Part 10).

4.07 Tag printed circuits aamaqec during an on-site repair operation (or requiring conversion from temporary to permanent repair) to indicate the specific problem before returning them to the repair center or factory. This action:

- Reduces expense.
- Assures satisfactory service.
- Saves the repair center or factory time.

4.08 Have the followinq defects repaired only by the repair center or factory:

- Cards that are:
  - Warped.
  - Cracked.
  - Blistered.
  - Charred.
- Cards with:
  - Lifted terminal pads or conductors.
  - Laminate separation or measling.
  - Encapsulated component problems.
- Cards requiring:
  - Contact replating.
  - Eyelet replacement.

4.09 It is often less expensive to replace the card or even the entire circuit unit, than to repair the specific problem. This determination can only be made at the repair center or at the factory, however.

4.10 Do not field repair cards used in:

- Microwave radio equipment for radio frequency (RF) 0r stripline components.
- Tuned intermediate frequency (IF) and eaualization functions.
- Common control logic of electronic switching systems.

4.11 When making repairs, component positioning is critical. Adjust and test the entire circuit card when the repair is completea. This reauires specialized test eauipment and highly detailed procedures.

4.12 For optimum system performance, complete testing or realignment may be required when repaired printea circuitry is returned to service. The function of the repaired circuit, and its performance before realignment is started, will usually determine if a need exists for realignment. Compare actual performance, before and after realignment, with test records made during the initial system alignment.

5. CARD CONSTRUCTION

5.01 Because the unique element of printed circuitry is the card itself, and most repair problems involve the card, a basic understanding of its construction is helpful. This part explains circuit card construction.

5.02 The card is constructed of:

- An insulating base or support material.

WITH

- A thin metal cladding on one or both sides.

5.03 The base is called the laminate and can be made of a number of materials, including phenolic-paper, glass mat-polyester, or ceramic. Of these materials, glass cloth base laminates have the best balance of physical and electrical properties, and are used extensively in the communications industry. The cladding is usually copper foil, with a thickness in the range of one to three thousandths of an inch. The foil is bonded to the laminate with a special adhesive under heat and pressure.

5.04 In processing raw card material into a finished card for a particular circuit, foil is selectively etched away leaving the desired conductor configuration. The copper conductors and associated terminal pads (component connection points) are then tinned so that solder can be used for component attachment. The solder also provides a protective coating for the conductors.

5.05 Single-sided cards usually have components installed on the side opposite the printed wiring. Component leads either:

- Fasten to terminal posts, which run through the card and connect with the wiring pads.

OR

- Project through holes drilled in the card and connect directly with the wiring pads.

5.06 Double-sided cards (i.e., with printed wiring on both sides) use eyelets or plated through-holes to interconnect the wiring on both sides. Component leads terminate, as required:

- In the eyelets or plated holes.
- To terminal pads on single-sided cards.

5.07 Regardless of the laminate material used, repair techniques for each are fundamentally the same and the same amount of care must be taken during the repair process. Repair techniques are slightly altered to meet the specific requirements of each component attachment method, however.

6. AVOIDING SECONDARY DAMAGE

6.01 Improper repair methods can result in additional card or component malfunctions. This is known as secondary damage.

6.02 Applying excessive heat while desoldering and soldering is a major cause of PC card damage. Heat can damage components and char or blister laminates. Damaged laminates, in turn, may require card or complete equipment replacement.

6.03 An additional problem concerns the bond between the copper cladding and the laminate. Bond strength is quickly reduced by excessive heat; printed conductors and pads may actually lift from the laminate. This action results in brittle or broken conductors and poor solder joints, which in turn, cause circuit failure.

6.04 To avoid this problem, use the minimum heat required for the job and apply the heat for the minimum time necessary. This can be accomplished by:

- Using the correct tools and materials.
- Planning the repair operation.

6.05 Another major problem is damage to PC cards with MOS components due to electrostatic discharge. This can be avoided by using the required grounding procedures during card handling and repair (see Parts 3 and 8).

6.06 Repair planning must include knowing:

- Whether or not the card is static-sensitive (see Part 3).
- The specific steps for removing a component.
- The heat sink requirements.
- The solder removal method.
- The cleaning procedures to assure a quick, solid solder joint.

CAUTION: If the PC card contains MOS components, the repair operation must follow the procedures described in Part 8.

6.07 Follow proper handling procedures at all

times wnen repairing PC cards. Do not:

- Flex the card, as this may cause damage to the solaer joints which may result in circuit failure.
- Handle the card roughly.
- Handle cards with MOS components without following the grounding procedure explained in Paragraphs 8.22 to 8.32.

6.08 Other defects resulting from poor repair and hanaling techniques often go unnoticed during the repair process. These defects can cause subsequent circuit failure, however. Defects in this category include:

- Cracked laminates.
- Weakened solder joints.
- Weakened component leads.
- Physically damaged components (especially static-sensitive MOS components).
- Broken scratched, or nicked printed conduc tors.
- Scratched or nicked plug-in contact surfaces.
- Loose solder particles or foreign matter left on the card.

6.09 Cracked or charred laminates absorb moisture and suffer a subsequent reduction in insulation resistance. Charred spots and cracks joining two or more conductors usually require eventual replacement of the card.

6.10 After completing repairs to a card, inspect the repaired area for:

- Inadvertent solder bridges; bridges short the circuitry by joining conductors.
- Solder projections; projections can break off or be forced into contact with a conductor to form a short circuit.

Storing Static-Sensitive Cards and Components

6.11 Static-sensitive units are shipped from the factory in anti-static packaging. These cards and components must remain in their protective packaging during storage.

6.12 Maintain environmental storage conditions as explained in Practice 808-210-072, Environmental Control Guidelines, Electronic Equipment Storage.

6.13 Instruct tne following personnel in the correct way to handle static-sensitive units when tne components are outside of their protective packaging:

- Stock handlers.
- Maintenance personnel.
- All others wno may have occasion to handle stock.

6.14 Repackage subaividea lots of static-sensitive units in protective containers. Repackaging must be done at an anti-static work station by properly grounded personnel as explained in Part 7. Clearly label each container after repackaging.

Transporting Static-Sensitive Cards and components

6.15 Two carrying cases are available for transporting small quantities of cards in an environment that protects the cards from possible static-discharge damage and physical abuse:

- A wood-frame case.
- A two-piece molded fiberglass shell containing a card frame.

NOTE: Each type of case has a distinct procedure for inserting and removing cards.

6.16 The card frame within the fiberglass case can be thought of as a large anti-static bag; thus, when inserting or removing cards, take the appropriate grounding precautions (refer to Paragraphs 8.22 to 8.32). Cards must not be touched by:

- Ungrounded personnel.
- Clothing.
- Ordinary plastics.

6.17 Touch the carrying case card frame prior to removing a card to discharge any possible static charge. These techniques obviously require that the unloading or loading be done in very close proximity to the system framework.

6.18 If the cards must be unloaded away from the system, remove the cards from the carrying case and place them in anti-static bags for transporting to the system. Do not carry cards without enclosing them in anti-static bags. GTE recommends that the cards be removed from the case and enclosed in anti-static bags at an anti-static work station (refer to Part 7). If this is not possible, attach a ground strap between the carrying case card frame and a convenient ground point.

6.19 Attach a wrist strap between the card frame and the person unloading the frame. Cards can then be transferred from the case to the anti-static bags. Once in anti-static bags, the cards can be safely transported to the system.

WARNING: A ground wrist strap must include a l-megohm resistor in series, rendering it a ground to static potentials but not a hard ground which could allow hazardous and potentially lethal currents to flow through the worker in the event of accidental electric shock.

6.20 The wood-frame case carries cards enclosed in anti-static bags. Since the anti-static bag and the enclosed card are removed from the case at the same time, many of the problems associated with loading and unloading cards in the fiberglass case are eliminated. However, caution must still be used when removing the cards from this case so that the card being removed is pulled out by grasping the exterior of the anti-static bag enclosing the card, not just the card itself. Similarly, contact should not be made to exposed areas of adjacent cards.

CAUTION: At no time should unprotected cards come in contact with the carrying case shell, clothing, carpeting, plastic materials, floor tile, or any other non-conductive materials that may be carrying a static charge.

7. REPAIR TOOLS AND MATERIALS

7.01 This part describes the tools and materials recommended for on-site card repairs. Equivalent or substitute items are listed and their use explained in Exhibit 3 on Page 11. Use standard items when and where available; otherwise, use locally-approved items.

Solder and Soldering Tools

7.02 The soldering iron must not develop a tip temperature exceeding 6000F. The most effective iron for printed circuit work is the temperature-controllable type that can be set for any desired soldering temperature.

7.03 Leakage current is sometimes present at the tip of electric irons and can destroy certain components on contact. If such a current exists, grouna the tip using a ground wire and clip. The simplest approach is to bring the iron up to temperature and then unplug it long enough to do a particular job. However, since extra care must be taken when working with static-sensitive cards, GTE recommends using a special grounded soldering iron.

7.04 Low-temperature (361^{0}F) eutectic solder, consisting of 63 percent tin and 37 percent lead, is occasionally used in PC card repair work. Special solder with a two percent silver content is used on cards having thin silver or silver-plated conductors. This keeps the conductor silver from forming an alloy with the solder. These solder types are not usually required for repairing conventional communication equipment.

7.05 A number of devices are available for removing molten solder while detaching a component from a card. Use a:

- Solder sucker (a spring-loaded tool for picking up molten solder) with non-MOS cards.
- Special static-free desoldering tool with static-sensitive cards.

7.06 A solder gobbler is a plastic syringe for sucking or blowing solder out of a hole or eyelet. Braided copper wicks are also used to pick up hot solder. Devices of this type are particularly helpful when all terminals of a multi-terminal component with rigid leads must be completely freed of solder in order to remove a component. A dual in-line integrated circuit package is an example of such a component.

WARNING: Wear eye protection during soldering or desoldering operations.

Anti-Static Work Stations

7.07 An anti-static work station is required for repairing static-sensitive cards. A typical work station consists of an anti-static:

- Bench mat l/4 inch by 36 inches by 48 inches with a ground strap connected to a grounding point.
- Floor mat l/8 inch by 4 inches by 8 inches witn a ground strap connected to a grounding point.

7.08 A ground wrist strap and ground strap must be used to properly ground personnel. Also available are anti-static heel protectors. All repair work and inspection operations on static-sensitive cards must be performed at anti-static work stations by properly grounded personnel.

Soldering Aids

7.09 Soldering aids have many functions, such as:

- Cleaning out eyelets.
- Lifting component mounting tabs.
- Positioning parts.
- Chipping away bonding compound.
- Lifting components after desoldering to remove them from the pads.

7.10 Soldering aids and their uses are listed in Exhibit 4 on Page 13.

8. REPAIR TECHNIQUES

General Procedures

8.01 The following paragraphs apply to PC card general repair procedures.

8.02 Keep the soldering iron tip clean and well tinned. Do not attempt a repair until the iron has attained proper temperature.

8.03 Once cleaned, do not touch the area requiring repair. Skin oils and moisture will prevent a good, rapid soldering job. Wash your hands before starting the repair job.

8.04 Refer to the 300-901 division of GTE Practices for information on:

- Checking transistors.
- Troubleshooting transistor circuitry.

8.05 Open circuits in PC cards can usually be found by visual inspection and by point-to-point electrical measurements. Intermittents can often be located by making an electrical check of the circuit while tapping or heating the area being inspected. Use a 40- or 60-watt light bulb as a source of heat.

8.06 Do not use solder as a bridge to repair a broken printed conductor. This makes subsequent visual inspection difficult (location of the defective spot for permanent repair) and may affect the current-carrying capacity of the conductor.

8.07 Once it is determined that a multi-terminal component (e.g., an integrated circuit package) is defective, use extreme care removing it from the card. In the case of flat pack devices, the leads can be sheared using a razor blade or X-ACTO knife. Carefully remove any remaining portion of each lead from the card using the soldering iron and solder sucker.

8.08 If the device case is of the plug-in variety, either round or rectangular, or is only suspected of being defective (as a result of component substitution troubleshooting), use a:

- Multipoint solder heater and sucker to remove it.

  OR

- A single-point solder sucker. In this case, added care must be taken to completely free each lead of solder before going on to the next. Where possible, heat sink component leads while desoldering. Work carefully and quickly.

8.09 Clean and inspect all work after completing a repair.

8.10 Do not put a protective coating (such as Humiseal™) on the card after repair. This will interfere with future permanent repair work.

8.11 Wnen applying modification kits, follow the step-by-step instructions supplied with the kit. Use only included or recommended install ation materials.

Protective Coating Removal

8.12 Some cards are given a protective coating as the last step in circuit manufacturing. The coating may be thick (conformal) for physical and environmental protection or thin for fungus- or humidity-proofing. Do not attempt on-site repairs of cards with thick coatings.

8.13 Remove the coating on thin-coated cards in the immediate area of the repair before the repair process is started. If not removed, subsequent soldering operations may not be satisfactory. The removal process may entail mechanical or chemical means, or both. No one removal process will be equally suitable for all.

8.14 Generally, remove coatings by:

- Carefully heating conductors and oads with a 300°F to 400°F soldering iron tip and brushing them witn a wire brush.
- Brushing the area, if necessary, with a nonflammable solvent after it cools.
- Scraping the area with an X-ACT0 knife.

NOTE: Always reclean the area with a general solvent such as isopropyl alcohol.

Printed Conductor Repair

8.15 The following procedures apply to printed conductors that have been broken, scratched, nicked, or contain pinholes. The basic procedure is usually restricted to conductor damage that does not exceed a 1/16-inch distance along the conductor length.

8.16 Make basic repairs to printed conductors according to the following procedure (illustrated in Exhibit 1 on Page 8):

STEP	REPAIRING PRINTED CONDUCTORS
	Clean the conductor for at least 3/8 inch on both sides of the break (or damaged area). Use the ink eraser and then solvent.
2	Cut a piece of 22-gauge, solid, tinned strapping wire to a length 1/Z-inch longer than the Dreak. This allows a 1/4-inch soldered overlap on either side of the break.
	Hold the wire on the centerline of the conductor, across the break, and solder it in place. For fast, effective soldering, have a second person hola the wire in place with a soldering aid.
4	Clean the repaired area with solvent and inspect the work.

8.17 Alternatively, repair a broken printed conductor as illustrated in Exhibit 2 on Page 9. Follow the same general instructions given in Paragraph 8.16.

Component Replacement

8:18 The most common method of repairing PC cards is by replacing defective components. This can entail either of two procedures. Either:

- The leads of the defective component can be unsoldered (after the component has been clipped from the card).

  OR

- The component body can be clipped out of the circuit, leaving the leads soldered to the card. The replacement component is then attached to these leads. Though not possible with certain components (some canned transformers and integrated circuit packages), this approach is the safest procedure. It keeps the soldering operation away from the printed wiring.

8.19 Completely remove and replace a defective component according to the following procedure:

STEP	REMOVING AND REPLACING A DEFECTIVE COMPONENT
1	Clip the clinched leads at least 1/16-inch from the card surface on the component side.
2	Free the lead ends from the card, using the iron and solder sucker.
3	Probe and brush the card carefully to open the holes in the laminate and pad.
4	Insert the new component.
5	Clinch the leads to the printed conductors and solder them to meet the original standards of workmanship. NOTE: Use a heat sink wherever applicable. The outline of each clinched lead must be visible when soldering is completed.
6	Clean and inspect the job.

8.20 When using old leads to attach replacement components, clip the leads close to the body of the defective component. To analyze the reason for component failure, the failed component must not be destroyed.

8.21 The preceding techniques generally apply to components attached to the card's terminal posts. Take care not to weaken the bond between the terminal post and the printed wiring.

Repair Procedures for Static-Sensitive PC Cards

8.22 Static electricity is a major source of damage to cards with MOS/complementary metal oxide semiconductor (CMOS) field-effect transistor (FET) devices. This damage can occur at any point in the handling of the devices or the cards. People are the greatest hazard to these devices.

Conductor Repair Using a Wire Bridge

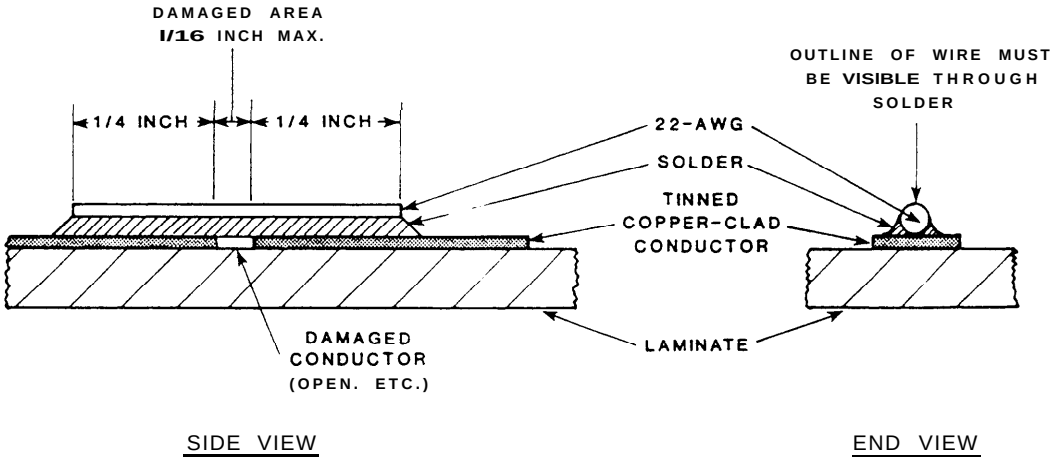

Exhibit 1

Alternate Method of Conductor Repair

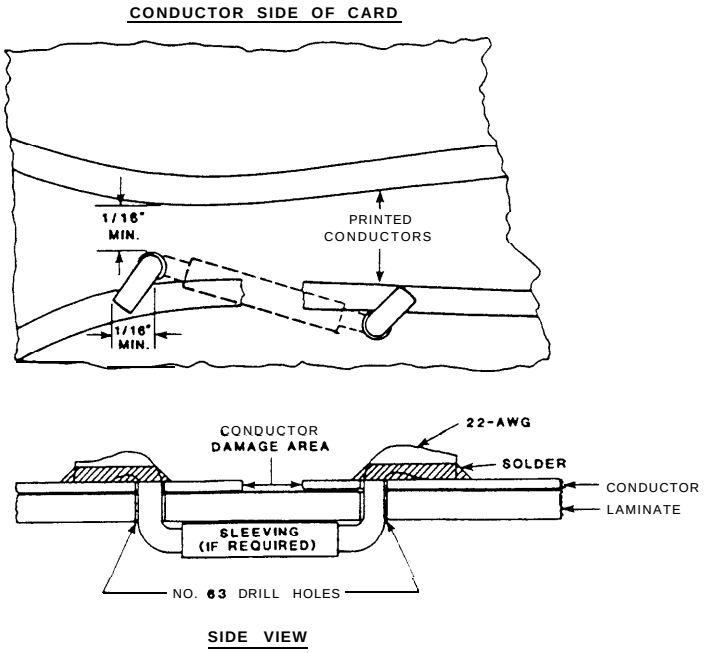

Exhibit 2

8.23 Do not remove static-sensitive components from their protective packages until they are ready to be used. Remove them from their protective packaging only:

- At an anti-static work station.
- While properly grounded.

8.24 Once the components have been removed from the protective packaging, use extreme caution to prevent them from making direct contact with possible sources of static charges such as:

- Ungrounded personnel.
- Common plastics.
- Clothing.

8.25 Use a conductive shunt bar across the card connector tabs after removing a card from its frame or when a card is stored. This does not protect devices on the card that are not directly connected to the connector tabs. If personnel handling the card are not properly grounded at all times, use a conductive bar when moving the card from one area to another.

8.26 Remove static-sensitive cards from their protective bags and/or cases immediately before inserting them into their frame. To dissipate any static charges that may have been generated, wear a wrist strap grounded to a bare metal portion of the equipment frame supports when removing the cards from either the protective bags or from the system card files.

WARNING: The ground wrist strap must include a series 1 megohm resistor, rendering it a ground to static potentials but not a hard ground which could allow hazardous and potentially lethal currents to flow through the worker in the event of accidental electric shock.

8.27 A less desirable alternative to using the wrist strap is the touch-ground technique. The touch-ground technique requires that bare skin contact be made to a bare metal portion of the equipment frame just prior to handling the cards. The touch-ground technique is offered only as an alternative for those situations where the use of the wrist strap is impractical. It is less effective than the wrist strap but is better than taking no precautions at all.

8.28 When removing static-sensitive cards from frames, follow the precautions explained in Paragraphs 8.23 through 8.27. Ensure that proper grounding precautions are followed before removing the card from the file. After the card is removed from the file:

- Attach a conductive shunt bar to the card connector tabs.
- Place the card in an anti-static plastic bag.

8.29 In removing faulty cards, follow all anti-static precautions in order to prevent further damage to static-sensitive components. Do not fasten any common plastic envelopes directly to

the cards as they may carry or could generate high static charges.

8.30 All repair work must be done at anti-static work stations by properly groundea personnel. With a wrist strap, only the worker's body is grounded; therefore, short sleeve or sleeveless garments are preferred while repairing static-sensitive cards.

CAUTION: At no time allow a naked or unbagged device to contact clothing, textiles, plain plastic, or ungrounded skin since these are, for all practical purposes, the only sources of static electricity.

8.31 Ground all equipment on or about the work station. On an optional basis, a nuclear ionized air blower may be used to prevent static buila-up on nylon smocks or other nonconductive material.

Repairing Cards With MOS Components

8.32 Repair cards with MOS devices using the following procedure:

STEP	REPAIRING CARDS WITH MOS COMPONENTS
1	Before handling the card at the repair station, connect a grounding wrist strap to your wrist. Connect the wrist strap ground lead to a grounding point (include the series 1-megohm resistor).
2	Remove the card from the bag.
	Remove the shunt bar from the tabs.
	Isolate the defective device using properly grounded fault-analyzing equipment.
5	Remove solder from each lead of the defective device using' an anti-static desoldering tool and a groundea soldering iron. NOTE: Do not let the soldering iron contact the device leads or card pad longer than 5 seconds.
6	When device leads and pads are free of solder: • Lift the defective device from the card. • Tag the device with the nature of the defect. • Place the device in a conductive bag or container to prevent further damage if a failure analysis is to be performea.
7	Remove a new device from its protective container, position it on the card, and solaer it in place.
8	Remove solder flux from the repair zone using a brush and isopropyl alcohol. Blot the area ary with a lint-free tissue.
9	Make any necessary electrical tests using properly grounded equipment while still at the grounded work station.
10	Install a shunt bar on the card tabs and place the card in a conductive bag or container for reassembly into the card frame or for storage.
11	Remove the wrist strap ground lead and transfer the assembly.
12	Use the same precautions for installing the repaired card into the files as for removing it.

Modification Kits

8.33 Add circuit components and wires to a card during circuit modification using techniques similar to those presented in this practice. Specific instructions are contained on the specific modification drawing.

9. REPORTING MALFUNCTIONS

9.01 Report all cases of component failure on cards to the manufacturer, either individually or in summary form, according to Practice 007-009-001, Unsatisfactory Condition Report.

9.02 In case of isolated and random component failures, the failed components need not be sent to tne card manufacturer for analysis. If the failure is representative of repeated failures of tne same component on identical cards, tag the component and send it to the card manufacturer for failure analysis.

9.03 Tags on components submitted for analysis must reference the Unsatisfactory Condition Report issued to cover the malfunction.

10. CLEANING GOLD CARD CONTACTS

10.01 This part covers the requirements and procedures for cleaning gold contacts on cards when cleaning is required. Clean dirty or tarnished gold contacts using a nonabrasive cleaning method only.

10.02 As required, clean gold contacts with 1, 1, 1 trichloroethane (GTE AE Specification 8344

or equivalent), applied with a:

- Lintless cloth.
- Firm back-ana-forth motion.

NOTE: This solvent has no corrosive effect on gold contacts and dries rapidly after application.

10.03 Tarnished gold contacts can be cleaned with an Eberhard Faber "Van Dyke" 8000 eraser, size 80, or equivalent. Use a minimum number of strokes (10 or less), stopping as soon as the tarnish is removed. After cleaning, remove the residue with a clean soft-bristle brush or a lint-free cloth.

CAUTION: The Van Dyke 8000 eraser is mildly abrasive and must be used at the card owner's risk. Never use a pencil eraser on gold contacts. Repeated use of a pencil eraser leaves grinding contamination and scratches the gold plate.

Recommended Tools and Materials

QUANTITY	MATERIAL CODE	DESCKIPT ION
1		HEXACON ① electric soldering iron; approximately 50 watts (or equivalent) approved for use on electrostatic-sensitive devices.
	588610	HEXACON soldering tip.
1		Spool of solder, l/32-inch diameter, 60 percent tin - 40 percent lead, with noncorrosive, nonconductive resin core.
1		Solder sucker.
1		Solder sucker, anti-static (for static-sensitive cards).
1		Small diagonal pliers.
1	576459	Large diagonal pliers.
1		Small needle-nose pliers.
1	587265	Heat sink, clip type.
1		Heat sink, weizer (hemostat) type.
1		Probe and split-end alignment soldering aid tool.
1		Brush and scraper soldering aid tool.
1		Spade-end soldering aid tool.
1		X-ACTO ② knife with package of No. 11 replaceable blades.
1	579080	Tweezers (regular or clamping type).
1		Pin vise and No. 63 drill.
1		Ink eraser (non-soiling composition or rubber).
1	571493	Small wire brush (brass wires set in a wood or plastic 3/4 x 3/4 x 2-1/2 inch block).
1	577686	Electrician's (cable splicer's) scissors.
1		Adjustable jig (circuit-board holder).

Exhibit 3 (Continued)

Recommended Tools and Materials (Continued)

QUANTITY	MATERIAL CODE	DESCRIPTION
1		Small brush for cleaning solvent (stiff, nonmetallic bristles in wooden handle).
		Epoxy cement.
		Teflon insulation sleeving (various sizes).
1		Spool of No. 22 gauge strapping wire (solid, tinned copper).
	677264	Disposable paper cleaning tissues.
		Solvents: • Locally-approved printed circuit card cleaning solvent. • Locally-approved solvents for removing card and component protective coatings.
1	439192	Can of 1, 1, 1 trichloroethane (for cleaning gold contacts).
1	748126	VELOSTAT ③ conductive bench mat and floor mat.
1	578250	Wrist strap and ground cord with l-megohm isolation resistor.
	749253	Disposable heel protectors.
	FM-688	Static-sensitive warning labels.
	F-6008-Rl	3M 2100 static-shielding bags for 13-inch PC card.
	F-6008-R3	3M 2100 static-shielding bags for matrix size PC card.
	F-12098	VELOSTAT shunt bars (8 inch).

① Registered trademark of Hexacon Electric Company.

② Registered trademark of X-ACT0 Crescent Products, Incorporated.

③ Registered trademark of 3M Company.

NOTE: The HEXACON soldering iron, for example, features a grounded heating element case and properly suppressed switching transients in a temperature controlled design. Periodic tip removal and reattachment should be performed to break down insulating oxides in its connection to the heater, reestablishing the ground connection to the tip itself.

Exhibit 3

Soldering Aids

USE. . .	FOR. . .
Small diagonal and needle-nose pliers	Routine car-a work.
Large diagonal pliers	Cutting a defective component into parts. This may, in some cases, expedite removal when components are closely packed. A rapid, temporary repair can often be made by soldering the new components to the leads remaining from the dismembered, defective components.
Heat sinks of many kinds	Shunting soldering heat away from thermal-sensitive components, i.e., semi-conductors. Place the heat sink on the lead, between the component and the soldering point.
Clamping-type tweezers	• Positioning small items. • Heat sinks. • Temporary clamps.
Pin vises	Holding small metal drills. The arill is used for printed-conductor repair (some of the permanent wire-bridging methods) and for terminating laminate cracks. Though not normally undertaken on site, a hole drilled at each end of a crack and filled with epoxy cement will stop the crack from lengthening.
Conventional ink erasers	Cleaning: • Component leads (cut a slot in the eraser and pull the leads through the slot). • Printed wiring at a point that requires soldering.
A wire brush	Removing hot solder from conductors, terminals, and eyelets. Care must be taken not to splatter hot solder on skin or clothing. Wear eye protection during this operation. When the brush is used, extra care must be taken during the card cleaning phase when the repair is completed.
Adjustable jigs having a weighted, screw-down, or vacuum base	Holding the card during repairs. The jig protects the card and components from physical damage during repair and holds the card in the desired work position. Both hands are left free for the repair operation. Adjustable jigs are manufactured by: • The Technical Devices Company. • Wilton (e.g., Wilton PC Board Holder, Model 371). • Other companies.
Epoxy cement	• General bonding: it adheres to metal, glass, and ceramic. It may be used for repairing loose printed wiring and pads, but must be kept from surfaces that require soldering. Epoxy will not adhere to many plastic materials. Hardening time runs from a few minutes to 24 nours, depending on the compound type and drying temperature. The card should not be oven-dried after bonding with epoxy. The oven temperature may damage heat-sensitive components. • GTE recommends using a general-purpose two-part (resin and hardener) epoxy. WARNING: Wash epoxy compounds immediately from the skin.

Exhibit 4 (Continued)

Soldering Aids (Continued)

USE. . .	FOR. . .
Solvents	Applications appropriate to each aspect of printed circuit work (isopropyl alcohol may be used for light cleaning jobs). Due to the fire and health hazards associated with the use of solvents, some are approved for use locally and others are not. Use only approved solvents and, with any solvent, provide ample ventilation. Keep solvent containers closed when not in actual use. Do not permit smoking or open flames in the work area while a solvent is being used. Wear eye protection and protective gloves.

Exhibit 4