CLEANING AND RESTORATION OF CENTRAL OFFICE AND PBX EQUIPMENT DAMAGED BY FIRE

CONTENTS PAGE

1. GENERAL

1.01 This section provides plans and procedures for restoring central office and PBX equipment after fire related damage. Plans and procedures for restoration following water damage are covered in Sections 010-120-010 and 010-120-011. Detailed procedures for assembly, disassembly, or adjustment of apparatus are provided in sections for the particular apparatus involved.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph. This issue does not affect the Equipment Test List.

1.03 Most telephone equipment can usually be cleaned and restored after a fire if

(a) It has not actually burned or been destroyed by heat

(b) It has not accumulated large amounts of corrosive soots and tars in inaccessible places that will cause circuit failures

(c) The humidity in the equipment locations can be kept low enough

(d) The equipment will withstand the rigors of cleaning.

1.04 The future performance of the equipment will depend on the severity of the fire, the effectiveness of the cleaning and restoration procedures, and the amounts of chlorides and other

corrosive materials in the smoke and soot deposits that remain on the equipment after restoration.

1.05 Restoring a fire damaged system consists of removal and replacement of burned, heat destroyed, or severely corroded components, removal of soots and tars wherever possible, cleaning of electrical contacts, and readjustment of electromechanical and electronic components wherever necessary. Different components and parts may require different cleaning techniques.

1.06 Any fire in which a large amount of polyvinyl chloride insulation has burned may have serious consequences due to the large amounts of hydrogen chloride in its smoke. Corrosive metal chlorides resulting from this agent will continue to cause deterioration of metallic parts unless the relative humidity can be kept at a low level. Most corrosion rates are relatively low, below 30 percent RH.

1.07 The performance of an office in which a fire has occurred must be watched for an extended period of time (typically, several years) for signs of latent adverse affects. The equipment should be checked for signs of corrosion that may continue to develop and the progress of the corrosion noted. Any distinct trouble patterns that develop should be analyzed to pinpoint their origins. Equipment that continues to deteriorate will have to be replaced.

2. RESTORATION PLANNING AND PROCEDURES

2.01 ***Immediate Steps:*** As soon as a fire is under control, estimation of the damage and the organization and planning of the restoration should begin. The steps generally required to accomplish the restoration are summarized in 2.07.

2.02 ***General Considerations:*** Restoration of service involves different procedures with different degrees of difficulty for the different types of equipment that are damaged in a fire. Because of their functions, some equipment types will require cleaning and repair before any service can be restored. Some will have to be partially restored, while work on others, which are not absolutely required for operation, may be deferred to a later time. It is important that such items as traffic and toll measuring and monitoring equipment be working properly when service is restored in order to provide quick identification of remaining trouble areas and malfunctioning equipment. In assigning restoration priorities, the interactions of all equipment must be considered. The age of equipment must also be taken into account. Older equipment, which under normal circumstances would continue to function properly for many years, may not hold up to the rigors of the cleaning, rewiring, readjusting, and testing needed for restoration of service.

2.03 Maintaining low humidity is important even in the early stages of restoration. Once smoke and fumes have been cleared out, efforts should be made to repair or board up broken windows and seal off other damage. The heating and air conditioning plant should be repaired. Polyester or similar primary air filter media should be secured over all air system vents and diffusers before the ventilation system is turned on again to prevent smoke and soots inside the ductwork from being blown onto cleaned or uncontaminated equipment. Relative humidity and temperature must be monitored, and, if the humidity cannot be maintained well below 30 percent RH, temporary dehumidification equipment should be installed in all contaminated areas.

2.04 Equipment with surfaces that continue to appear moist or feel tacky should be surrounded by portable dehumidifiers and enclosed, if possible, in tents. This is particularly true if the frames involved are critical to the restoration. In all Type III and Type IV fires (see 3.02), chemical analyses of smoke deposits from a variety of equipment surfaces in the damaged area are valuable in assessing restoration alternatives and procedures. Failure to deal properly with deposits bearing corrosive substances can have disastrous, short as well as long-term consequences. General housecleaning is not always essential to the immediate restoration of equipment, but it is recommended and can be very helpful psychologically. It will reduce any odors and acrid fumes from the smoke deposits. Vapor phase transfer of corrosive substances to critical surfaces (contacts, relay springs, mechanical interfaces, etc.) will also be minimized by general cleaning.

2.05 The severity of the fire and the density and type of deposits on equipment often determine what procedure will be most advantageous for a given item. Several methods may have to be tried before the most suitable one is found.

Economic considerations frequently determine whether a piece of equipment is worth restoring.

2.06 After service has been restored, there will be a larger than normal trouble rate. Consequently, it is essential that as much attention be paid to restoration of traffic monitoring and measuring equipment as to restoring switching equipment. These monitoring systems allow rapid identification of the system parts in trouble and indicate areas where more work or equipment replacement is needed.

2.07 ***General restoration plan for fire damaged equipment is:***

(1) As soon as possible after the onset of the fire, all power should be removed from the equipment involved or which may be wetted.

(2) Assess the extent of damage. Apparatus experts and chemists familiar with contamination by corrosive substances should be consulted for large fires.

(3) If foams or similar fire extinguishing compounds that contaminate equipment are still wet, these compounds should be flushed off the equipment with water before they dry. This must be done with minimum wetting of other equipment.

(4) Dry wet equipment before making any attempts to restore power. In the case of burned equipment, determine whether to rebuild it or transfer the services provided by it to other equipment at the same or another location.

(5) Arrange for the necessary personnel, equipment, and test sets to undertake the restoration, including portable tape cartridge recorders for keeping records.

(6) Clean floors, ceilings, and walls and perform necessary building and window repairs to seal the building after smoke has been removed.

(7) Begin power restoration and contact and equipment cleaning, with first emphasis on alarm, test frames and lighting. In crossbar systems, attention should subsequently be directed to markers and registers and then to the remaining frames and equipment. Traffic and toll monitoring and measuring equipment should also be restored promptly.

(8) Monitor humidity and temperature, and operate available heating and air conditioning facilities to minimize humidity. If humidity cannot be maintained consistently well below 30 percent, portable dehumidification equipment may be necessary, particularly near heavily contaminated equipment.

(9) Clean moving parts in switching equipment as necessary and lubricate.

(10) Make operational tests, paying particular attention to the performance of contacts and textile insulated cabling and wiring.

(11) Place equipment back in service. Measure and monitor the operation or traffic, toll, and switching equipment.

(12) Assess long term needs and provisions for special humidity control equipment.

(13) Continue general housecleaning of equipment frames, cabinets, covers, and accessible surfaces of switching equipment.

(14) Make periodic post-restoration inspections for a reasonable time, looking particularly for corrosion products which may have picked up moisture during humid periods.

2.08 ***Safety Precautions:*** Adequate ventilation must be provided for areas where personnel are using solvents, such as KS-19578 L1 trichloroethane, ammonia solutions, or other cleaning fluids. Rubber gloves should be worn when handling solvents or ammonia solutions. Water and ammonia solutions should not be used on powered equipment. Further details and other precautions may be found in Section 065-330-320. Hard hats, gloves, and similar safety equipment must also be provided. If there are any questions, local safety engineers or the Bell Laboratories Environmental Health and Safety Department should be consulted.

3. ASSESSING DAMAGE

3.01 Initial appraisal of damage to equipment to determine whether reconditioning is possible or replacement is necessary is a very critical phase of the service restoration effort. A thorough

appraisal should be made by experienced plant and engineering personnel as early as possible.

3.02 The extent of damage depends on the type of equipment involved, as well as the severity of the fire. The severity of a fire may be classified as shown in Table A.

TABLE A

FIRE CLASSIFICATION	EQUIPMENT AFFECTED	EFFECT ON SERVICE
Type I	A few components (relays, capacitors, etc.)	Little to none
Type II	Several components or a major part of an equipment frame	A few circuits disrupted
Type III	Several equipment frames	Substantial
Type IV	Major part of an office or switching center	Severe or total loss

3.03 In order to assess damages, it is necessary to know the types of damage that may occur and the effects of each on the various types of equipment.

3.04 The types of fire induced damage in increasing order of seriousness are:

(a) Damage from smoke and soot that have been produced by combustion of paper products, building construction materials, wooden furniture, purely hydrocarbon plastics (polyethylene), floor wax, textile insulation, tarpaper insulation, phenol fiber, and Bakelite (the last two can produce a slightly acidic, mildly corrosive smoke)

(b) Damage from water used as fire extinguishing material and corrosive substances, dusts, dirts, and other particles that are carried by the water

(c) Damage resulting from exposure to heat (in the absence of combustion)

(d) Damage from foam, dry powder, and similar fire extinguishing substances

(e) The accumulation on surfaces of corrosive substances in the tars and other combustion products in the smoke and fumes

(f) The pyrolysis, carbonization, or combustion of materials in the equipment.

3.05 ***Damage and Effects:*** The types of damage often vary for the different sections and floors of an office. Smoke and soot deposits are common to nearly all fires, and the extent of damage from these will be largely dependent on the concentration of corrosive substances in the contamination. If the burned materials are primarily those associated with light smoke and soot [3.04(a)] damage, the deposited soot will generally not promote aggressive corrosion. Electromechanical switching equipment can generally be restored after this type of damage.

3.06 If the soot was produced by the combustion of halogenated hydrocarbons or similar substances, the damage is of the type listed in 3.04 (e) and is more serious. The resulting deposits may be highly corrosive. The most common halogenated contaminant is hydrogen chloride, which is produced by the thermal degradation of polyvinyl chloride (PVC) insulation. Moist hydrogen chloride rapidly attacks such base metal surfaces as zinc, copper, iron, and aluminum to form the metal chlorides. When moist, these salts can form electrically conducting solutions leading to insulation breakdown and electrolytic corrosion. Thus, even a Type I or Type II fire can cause trouble at a later time.

3.07 The chloride salts formed on base metals are often sticky, thereby impeding mechanical operation of switches and relays. Hydrogen chloride will also attack calcium oxide and calcium carbonate in masonry and chalk-filled insulating materials to form calcium chloride. This salt becomes wet readily at relative humidities greater than about 35 percent. Under these conditions, water droplets may form on ceilings, extract acidic components

from soot, and fall on equipment. Chalk-filled insulation materials may become wet, which may lead to shorts or cause permanent opens by electrolytic dissolution of conductors. Without complete removal of chlorides, it is impossible to entirely arrest such corrosion processes, but the rate of degradation can generally be reduced to tolerable levels by keeping the relative humidity low.

3.08 It is important to distinguish between electrolytic and chemical corrosion. Electrolytic corrosion occurs when energized equipment is wet with water. The anodic (positively biased) metal components are corroded and copious amounts of white or colored corrosion products are deposited in the immediate vicinity. Electrolytic corrosion will not occur unless both an applied potential and water are present. Chemical corrosion is an attack on all surfaces of susceptible metals by corrosive chemical agents in the presence of moisture. An applied electrical potential is not necessary. Zinc coated and aluminum parts are susceptible to chemical corrosion caused by smoke containing hydrochloric acid. Nickel brass and other brass parts are less susceptible, and precious metal contacts are not susceptible at all to chemical corrosion.

3.09 Electronic equipment, computers, sensitive control systems, etc. that cannot tolerate increases in electrical leakage or dielectric loss will be seriously affected by all types of deposits. If the deposits are rich in corrosive substances, permanent restoration of service is generally not possible without substantial equipment replacement.

3.10 Damage of the types described in 3.04 (b) and (d) from the residues of fire extinguishing materials may be confined primarily to equipment in and around the burned area. However, if water was used with these materials, damage from these residues may spread to adjacent sections or lower floors. If these substances are not removed and the equipment is not thoroughly dried, secondary damage from electrolytic corrosion is apt to occur when power is applied. In many instances, electrolytic corrosion is an unavoidable consequence of extinguishing a fire in powered equipment. Equipment with severe electrolytic corrosion will require replacement.

3.11 Exposure of equipment to intense heat can produce damage [3.04(c)] through dimensional changes, wax seepage, plastic degradation, and similar effects even though actual combustion of the parts may not have occurred. Mechanical readjustment of some parts may be sufficient, while others may need to be replaced.

3.12 The decision as to whether replacement of equipment is necessary in cases where substantial contamination and corrosion has occurred should be based on the type of equipment involved, visual observations of external damage, and consultation with apparatus experts and chemists. Brief on-the-scene evaluations of mechanical performance, contact integrity, and electrical leakage will be useful in assessing possible cleaning procedures.

4. CONSIDERATIONS FOR RESTORATION AND RECONDITIONING OF EQUIPMENT

GENERAL

4.01 In restoring fire damaged equipment, one must retain flexibility and adapt to the particular situations that arise. BSP methods of cleaning and readjustment of the various components should be the first things tried in equipment exposed to a fire.

4.02 The ease of cleaning and restoration depends on the type of equipment involved, as well as the severity of the fire. In most cases, light coatings of non-sticky soots can be removed by merely vacuuming. Power blowers should not be used. The procedures that are effective for more heavily contaminated items vary with the types of parts involved. The general restoration steps are:

(a) Cleaning soot and smoke residues from accessible surfaces

(b) Clearing high resistance deposits from electrical contacts

(c) Freeing sticking mechanical operating parts

(d) Replacing damaged components that cannot be repaired

(e) Controlling corrosion by maintaining low humidity.

4.03 It is frequently impossible to remove all the tarry soots and deposits from the smoke of burning polyvinyl chloride insulation. These

may contain chlorides and other corrosive substances. In these cases, corrosion rates must be kept low by maintaining the relative humidity less than 30 percent.

4.04 The methods of cleaning soots and smoke residues from precious metal contact surfaces vary from vacuuming the component to scrubbing crossbar and flat spring relay contacts with a stiff bristled brush and solvent.

Warning: Brushes must be selected to assure that handles and other parts are not dissolved in or softened by the solvent.

4.05 As previously stated, ease of cleaning depends on the type of equipment and surfaces affected. The following paragraphs describe various types of equipment and surfaces classified according to their ease of cleaning.

4.06 ***Surfaces and Materials Which Can Usually Be Cleaned:***

(a) Floors, walls, ceilings, and painted metal surfaces, including structural framework and equipment cabinets and covers, can be cleaned with a solution of 4 ounces of ***clear*** household ammonia in one gallon of water. If this solution is not sufficient to remove very heavy deposits of soot and smoke residues, stronger detergents can be used.

Warning: Contact of such water solutions with powered equipment must be avoided.

(b) To avoid removing the paint, strong detergents should not be used on painted cabinets and equipment framework.

(c) Precious metal contacts (stationary and nonstationary) can generally be cleaned with KS-19578 L1 trichloroethane and a stiff-bristled brush, such as a typewriter brush.

Danger: Adequate ventilation or suitable masks should be provided when using trichloroethane.

Warning: Brushes must be selected to assure that handles and other parts are not dissolved in or softened by the solvent.

4.07 ***Surfaces Which Can Sometimes Be Cleaned:***

(a) Base metal contacts on rotary switches, step-by-step switches, etc., can often be satisfactorily restored by BSP cleaning procedures followed by strict continuous humidity control.

(b) Some mechanical interfaces, such as hinges, armatures, and backstops, may require the removal of sticky chlorides and other types of corrosion products. This can be done with moistened, heavy bond, or stiff blotting paper. It may be desirable to wipe accessible base metal surfaces with a lint-free cloth lightly moistened with a solution of 4 ounces of ***clear*** household ammonia in one gallon of water. The amount of solution should be the minimum needed, and the solution must not come into contact with powered equipment.

4.08 ***Surfaces Which Are Difficult to Clean:***

(a) Base metal terminals, springs, armatures, and structural components of relays and switches are usually not accessible and hence are difficult to clean if the component cannot be readily removed from its frame.

(b) Cabling, wiring, and insulation materials of components are often inaccessible, and it is usually not possible to remove contamination without disassembling equipment. If these items are severely contaminated, the only option, if low humidity will not adequately control problems, is to replace the affected components.

(c) Zinc plated surfaces on various parts may become very sticky in humid air. Maintaining the humidity at low levels (preferably below 30 percent RH) will generally keep surfaces dry enough to prevent electrical troubles and control corrosion. In some cases, it may be necessary to clean those surfaces which are accessible with a cloth dampened with the ammonia-water solution. A prewash with trichloroethane to remove organic tars and residues may also be necessary.

BUILDINGS, EQUIPMENT STRUCTURAL FRAMEWORK, CABINETS, AND EQUIPMENT COVERS

4.09 The following procedures should be followed in the cleaning of buildings, equipment structural framework, cabinets, and equipment covers:

(a) Vacuum loose, fluffy, or light deposits of soot particles ***(do not wipe).***

(b) For thick or sticky and tarry deposits, clean using a cloth moistened with a water-ammonia solution (1 gallon of water to 4 ounces ***clear*** household ammonia).

(c) For heavier smoke and soot deposits on ceilings, walls, and floors, use a strong detergent and then reclean with the water-ammonia solution and allow to dry.

(d) For heavier deposits on painted equipment frames, covers, and cabinets, clean using a cloth moistened with a water-ammonia-isopropyl alcohol solution (80 ounces water - 3 ounces ***clear*** household ammonia - 17 ounces isopropyl alcohol containing no nonvolatile additives).

Danger: Undiluted alcohol is flammable.

(e) Reclean using a solution of 4 ounces of ***clear*** household ammonia in a gallon of water.

(f) Prepare walls and ceilings for painting by normal procedures and paint with a latex paint.

(g) Structural repairs to the building should be carried out under the supervision of building engineers.

(h) Ventilation and air handling equipment should be restored as soon as possible.

WIRING AND CABLING

4.10 The following procedures should be followed in the cleaning of the wiring and cabling:

(a) Remove burned or charred wires and cabling

(b) Clean walls, frames, etc., near wiring and cable runs per 4.09

(c) Dry wet wiring and cabling per Section 010-120-011

(d) Remove loose dry fire extinguishing residues and electrolytic corrosion products by dry brushing into a vacuum nozzle using a stiff brush

(e) Remove light or fluffy soot deposits by vacuuming, using an upholstery type nozzle

(f) Clean plastic insulated wiring and cabling, using a cloth moistened with KS-19578 L1 trichloroethane.

4.11 Sticky or tarry deposits that cannot be cleaned on plastic insulated wiring and cabling will usually not cause insulation problems under ordinary environmental conditions. Humidity control will be effective in minimizing corrosion of copper at the terminals.

4.12 In the case of textile insulated wire and cabling, it usually is not possible to remove sticky or tarry soot and smoke deposits. In this case, damaged wiring must be replaced. If wiring is not initially defective but smoke deposits are known to contain corrosive chlorides, the humidity in the building must be maintained at low levels (preferably less than 30 percent RH). This is particularly true for cables which have the old gray sheathing, which contains linseed oil, carbon black, and calcium carbonate. The last of these, in combination with acidic chlorides in smoke residues, forms calcium chloride. This salt dissolves in moisture which it absorbs. The resulting electrolytic solution will cause shorts and opens in the cable when it is powered. For wiring on large distributing frames that has been excessively contaminated, contingency plans for replacement should be made in the event humidity control is not sufficient to prevent troubles. Textile insulation materials should not be washed with solvents or other cleaners, as these will not remove chloride salts and may drive the salts further into the insulation.

DISTRIBUTION FRAMES AND TERMINALS

4.13 The following procedures should be followed in the cleaning of distributing frames and terminals:

(a) Remove burned or unused frame wiring

(b) Clean remaining wiring per 4.10

(c) Clean framework, etc., per 4.09

(d) Clean frame jack contact pins with 4 ounces of ***clear*** household ammonia in one gallon of water. If such cleaning is not suitable or effective, replace the jack contact pins

(e) Replace questionable heat coils

(f) Clean base metal contacts for the pins and heat coils using a stiff brush moistened with KS-19578 L1 trichloroethane. Abrade if necessary

> ***Note:*** When using a solvent for cleaning contacts, etc., care should be taken to prevent using a solvent that has built up a concentration of dissolved residues from repeated dippings of the cleaning brush into the liquid. To prevent this, solvent should be issued in small quantities. The brush should be wiped on a clean rag to remove residue before it is redipped in the solution. Solvent should be discarded when it becomes noticeably discolored.

(g) Clean contacts on jack springs using a stiff, long bristle, artist's brush moistened with KS-19578 L1 trichloroethane. Any fibers or bits of paper left from cardboard strips or other materials that may have been used to hold the contacts open before customer service is restored must be removed. When springs and contacts are cleaned with a stiff brush and solvent, blotting paper should be placed underneath to catch drippings and prevent possible contamination of contacts and components below

(h) Clean framework per 4.09.

TEST AND CONTROL FRAMES

4.14 If the test and control frame is functioning, damages negligible, residues light and not sticky, vacuum the frames and wipe outer surfaces and structural parts with a dry cloth.

4.15 If the test and control frame is not functioning, residues are too heavy or too sticky to vacuum:

(a) Remove power

(b) Remove damaged components

(c) Remove, if possible, components that malfunction because of clinging residues, clean, adjust, and replace

(d) Remove, clean, and adjust plug-in and other easily removed parts, replace if necessary

(e) Clean accessible surfaces by vacuuming or with 4 ounces of ***clear*** household ammonia in a gallon of water

(f) Clean tarry deposits on plugs and connectors using KS-19578 L1 trichloroethane or the water-ammonia solution

(g) Dry corrosion products and residue not removed by the above method may be removed by abrasive cleaning

(h) Clean jack and lamp sockets using small pipe cleaner brushes or twill jean cloth on orange sticks moistened with KS-19578 L1 trichloroethane

(i) Clean precious metal contacts on keys, jacks, etc., per Section 069-386-801

(j) Remove tar and smoke deposits from contacts as described below for specific equipment types

(k) Clean 200-type rotary switches per Section 069-330-801.

RELAYS

4.16 The following procedures should be followed in the cleaning of the relays:

(a) Vacuum loose soot and debris using an upholstery brush

(b) Remove heavy smoke and tar residues using cloth or brush moistened with KS-19578 L1 trichloroethane

> ***Warning: When brushing or spraying with solvents, equipment below must be protected from the drippings by a piece of blotting paper.***

(c) If practical, relays with heavy smoke and soot concentrations may be removed from frame and cleaned in an ultrasonic bath

(d) Clean relay terminals and wiring using long, stiff, bristled artist's brush wet with KS-19578 L1 trichloroethane

Note 1: When using a solvent for cleaning contacts, etc., care should be taken to prevent using a solvent that has built up a concentration of dissolved residues from repeated dippings of the cleaning brush into the liquid. To prevent this, solvent should be issued in small quantities. The brush should be wiped on a clean rag to remove residue before it is redipped in the solution. Solvent should be discarded when it becomes noticeably discolored.

Note 2: Trichloroethane generally will not remove corrosion products or arrest further corrosion. Maintaining a low humidity (preferably less than 30 percent RH) will hold electrical leakage and further corrosion of relay parts to a minimum.

Note 3: Where the deposits on contacts are not particularly thick and the relay operates with satisfactory contact resistance, exercising the relay may be all that is needed for restoration. Ultimately, the contacts should be cleaned by the procedures described in Section 069-306-801 when time is available. If the contacts have high resistances or show erratic behavior on operation, they will have to be cleaned before the equipment can be fully restored. The BSP cleaning methods are normally satisfactory, particularly if a small number of relays are involved.

Warning: Brushes must be selected to assure that handles and other parts are not dissolved in or softened by the solvent.

(e) Clean contacts on flat spring relays by brushing or scrubbing with a short bristled brush dampened with trichloroethane. The brushes should be inserted so that the bristles are parallel to the contact surfaces, and the contacts are cleaned with a gentle scrubbing motion so as not to distort the supporting springs. For additional information refer to Section 069-306-801

(f) Clean surfaces of armatures, backstops, etc. that are sticky by inserting a stiff bond paper strip moistened with KS-19578 L1 trichloroethane, and then gently closing the armature by hand and sliding the paper back and forth between the surfaces. If stickiness persists, an ammonia-water solution may be a more effective cleaning method. For additional information refer to Section 069-306-801. Armature pivot hinges should be flushed with clean KS-19578 L1 trichloroethane

(g) Clean wire spring relays by the methods in Section 069-306-801. The wire spring relay armature hinges may be attacked by acidic chlorides in the smoke and develop corrosion or rust. Since these chloride deposits are virtually impossible to remove, the only recourse is to maintain low humidity to retard the progress of the corrosion. Such hinge springs should be checked periodically, and if the corrosion is found to be progressing at a substantial rate, the relays should be replaced

(h) Polarized relays and other similar types of relays are normally enclosed in cans that tend to protect them from smoke. The methods described in Section 069-306-801 should be followed in cleaning and restoring these relays to service.

STEP-BY-STEP SWITCHES AND BANKS

4.17 The following procedures should be followed in the cleaning of the step-by-step switches and banks:

(a) Vacuum loose debris from framework and switch covers and wipe these with a solution of 4 ounces of ***clear*** household ammonia in a gallon of water

(b) Inspect switches for corrosion and other debris

(c) Evaluate performance

(d) Clean switch banks, bank wipers and commutators per Section 069-501-801 using KS-16436 L2 washing fluid

(e) Remove corrosive products by abrasive cleaning followed by nonabrasive cleaning per Section 069-501-801. If contamination is especially thick, more frequent replacement of the KS-10365 wiper cleaners, the KS-16062 rotors, and the drying pads for the rotor flushing units than is called for in the BSP is advisable. More

frequent flushing of wiper cleaners and rotors with the KS-16297 flushing unit may also be necessary

(f) Clean control relay contact surfaces, if required, by gently pulling a KS-10365 wiper cleaner moistened with clean KS-19578 L1 trichloroethane through gently closed contact pairs. They may also be cleaned using the flat spring relay method 4.16(e)

(g) For heavier smoke penetration, remove control relays and switch mechanism for ultrasonic cleaning. Immerse switch mechanism and relays in Freon TF. Then clean in Freon TWD, and rinse in Freon TF

(h) To control electrolytic corrosion on zinc plated parts that have been attacked by corrosive smoke containing chlorides, lower humidity to 30 percent RH and clean accessible metal surfaces using a solution of 4 ounces of ***clear*** household ammonia in a gallon of water. Power must be off and not reapplied until the equipment is dry.

CROSSBAR SWITCHES

4.18 The following procedures should be followed in the cleaning of the crossbar switches:

(a) Vacuum loose debris and soot from framework

(b) Wipe down accessible surfaces using lint free cloth moistened with water-ammonia solution

(c) Examine for contact integrity. If power has been restored and crosspoint test boxes are available, switches should be exercised for several minutes, and contact resistances should be checked. A battery powered milliohmmeter can be used to monitor contact resistance while contacts are manually held closed if the test boxes are not available

Warning: Brushes must be selected to assure that handles and other parts are not dissolved in or softened by the solvent.

(d) If contacts show high resistance or heavy deposits, clean, using toothbrush or stiff, short-bristled brush and KS-19578 L1 trichloroethane. With toothbrush style brushes, the brush should be inserted at the bottom of the switch between the vertical armatures and under the horizontal select bars. The brush should be gently stroked with an up and down motion over all contacts in a vertical unit and then rinsed, and the process should be repeated as necessary. With a paintbrush style brush, the contacts at only one crosspoint location are cleaned at one time by wiping with the brush in such a way that the bristles are aligned parallel to the contact springs. Trichloroethane will remove most tars and soots present on contacts, as long as clean solvent is used.

(e) Cleaning should always begin at the top of the frame and drippings should be collected on blotting paper placed immediately below the switch being cleaned. After contact cleaning is completed, the switches should be exercised as much as possible prior to restoration of service. In instances where repeated cleaning of troublesome contacts does not clear the problem, burnishing may be necessary as a last resort.

(f) Cleaning of inaccessible zinc or chromated zinc surfaces is generally not possible. If corrosive deposits bearing acid chlorides are present, zinc chloride, which is an extremely hygroscopic substance, will form. Moisture will be seen on such surfaces on humid days. When this occurs, several measures will be necessary:

(1) Humidity should be kept at the lowest level practically attainable (preferably below 30 percent RH). Surfaces which appear even slightly moist will cause problems in the mechanical operation of the switch, and if moisture collects near pile-ups, extensive electrolytic corrosion may occur and the insulation resistance will be drastically reduced.

(2) All pivots should be cleaned by wiping with bond paper moistened with KS-19578 L1 trichloroethane. They should then be lubricated by standard procedures.

(3) The interfaces between vertical armatures and their backstops will serve as collection points for moisture on humid days. When the humidity decreases sufficiently to dry the interface, any zinc chloride collected there will become sticky or perhaps even form a hard bond. This situation can be cleared by inserting water moistened bond paper in the interface

and then drawing it out while holding the armature against the backstop. The process should be repeated until the paper remains clean.

ROTARY SELECTOR SWITCHES

4.19 The following procedures should be followed in the cleaning of the rotary selector switches:

(a) Vacuum loose ash and soot from framework

(b) Wipe down tarry surfaces using lint-free cloths moistened with a solution of 4 ounces of ***clear*** household ammonia in a gallon of water

(c) Assess contamination levels on the phosphor bronze terminals and wipers.

4.20 Cleaning may not be necessary if contacts appear bright. If contacts appear fogged or show corrosion products and other debris on them, cleaning per Section 069-330-801 is recommended. If the combustion products are not corrosive, brushing of the contacts with a stiff artist's brush moistened with KS-19578 L1 trichloroethane may be effective. Rotors should be removed from the frame and cleaning should begin at the top of the frame. Drippings should be collected below each component on blotter paper. After cleaning with trichloroethane, contacts should be generously lubricated by standard procedures. Finally, the rotors should be remounted and the wipers rotated through several cycles.

4.21 In cases of severe attack by smoke containing corrosive chlorides, the zinc plated parts of the switch may exhibit a speckled white salt pattern and appear moist in humid weather. If this condition is found, humidity levels must be kept low (preferably below 30 percent RH) or electrolytic corrosion will occur and shorts will develop through insulation materials.

CIRCUIT PACKS

4.22 The Bell System has had little experience in dealing with fire-contaminated circuit packs, and the reliability of circuits restored by the means described below is uncertain.

4.23 In the event of a Type III or Type IV fire, Western Electric and Bell Laboratories should be contacted for methods of checking the operation of cleaned and reconditioned packs if the operating company does not have such information available. Section 032-173-301 and 231-020-301 give information on handling and testing circuit packs.

4.24 The manufacturer of circuit packs used in outside suppliers equipment, such as special circuitry, computers, or other peripheral equipment and devices, should be contacted for advice in restoring such units.

4.25 The following procedures should be followed in the cleaning of the circuit packs:

(a) Remove contaminated packs for cleaning and checking

(b) If the number of contaminated packs is small, it may be advantageous to replace them to avoid future questions of component reliability

Warning: Using halogenated hydrocarbons (such as trichloroethane, trichloroethylene, perchloroethylene, and most of the Freon types (Freon TE, TF, TES, TMC, and TMS)) and other such solvents to clean equipment and circuit packs containing WECo integrated circuits or aluminum electrolytic capacitors will cause delayed failures.

(c) Clean per BSP cleaning methods when available and appropriate

(d) If BSP procedures are not available, loose sooty deposits can often be removed by vacuuming with small nozzles or small upholstery type attachments. If vacuuming does not remove the smoke and soot residues, a solution of specially denatured alcohol (SDA), which contains 5 to 30 percent methyl alcohol, the balance consisting of only ethyl alcohol, may be applied by a moderately soft bristle brush, to both component and printed wiring sides of the circuit pack, with a total exposure time of not more than ten minutes.

Warning: This alcohol mixture is flammable and must be used carefully. It is also toxic if ingested or its fumes inhaled.

4.26 Ultrasonic cleaning of circuit packs with solvents such as Freon TF, Freon TWD 602, or KS-19578 L1 trichloroethane should be tried only on those circuit packs that do not have solid state devices such as transistors, integrated circuit chips, aluminum electrolytic capacitors and the like, since such parts can be permanently damaged by ultrasonic energy. If these solvent methods are unsuccessful in removing corrosion products and other deposits, dry brushing followed by several rinses in distilled water and baking out at moderate temperatures may be worthwhile. The gold contact fingers on restored circuit packs must be cleaned and relubricated by the methods described in Section 010-120-011, 2.51.

4.27 After testing the cleaned packs, they should be tagged with an identifying mark before putting them back into service so that such units may be easily identified in case they should fail due to corrosion or incompletely removed residues.

FERROD, FERREED SWITCHES, AND SIMILAR COMPONENTS

4.28 Loose soots and particles are best removed from such parts by vacuuming with nozzles or hose attachments with long, soft bristled brushes. Residues which cannot be removed by this procedure are best left in place if they do not interfere with the operation of the equipment and are not corrosive. If the residues are heavy and tarry and contain acidic chlorides, the components may have to be replaced eventually. Bell Laboratories should be contacted regarding evaluations of any visible soot residues that cannot be vacuumed from such components.

MEMORIES, PROGRAM STORES, PROCESSORS, AND SIMILAR COMPONENTS

4.29 If there are visible smoke and soot residues on such components of an Electronic Switching System after a fire, the groups responsible for the equipment design at Bell Laboratories should be immediately contacted.

CONNECTORS FOR CIRCUIT PACKS AND OTHER PLUG-IN EQUIPMENT

4.30 Connectors that were in use at the time of a fire will usually show little damage due to smoke and deposits. It is best to vacuum loose material away before attempting any method that involves a brushing or wiping action, as such procedures may smear otherwise loose deposits. Material which cannot be vacuumed can often be removed with a "Cobra" spray brush (Miller-Stephenson Chemical Co. Inc., Danbury, Conn.). The "Cobra" brush, after being attached to a spray can, is inserted into the connector, pressed lightly on the contacts to release the spray, and rubbed gently up and down inside the connector to clean the contacts and interior. A piece of blotting paper should be placed under the immediate work area to catch the drippings. The Miller-Stephenson spray can of Freon TP-35 (MS-160) is probably the most effective material to use with the "Cobra", but their 1, 1, 1-trichloroethane (MS-170) may also be effective.

4.31 A small pipe cleaning brush (about 1/8 inch diameter) having fairly stiff bristles, wet with KS-19578 L1 trichloroethane, may be inserted into the connector if necessary. The interior of the connector is then cleaned by gently rubbing the brush up and down in the slot. Solvent drippings should be caught on blotting paper. After cleaning the connector by this method, its interior should be sprayed with KS-20406 L1 spray cleaner to remove any loose particles or debris.

4.32 Another method that can be tried is to fold a piece of clean, lint-free cloth (such as twill jean) over a strip of thin stiff fiberboard or similar material having a thickness less than 25 mils. The cloth and strip are cut to a appropriate width for the connector slot, moistened with KS-19578 L1 trichloroethane, and inserted into the connector. The contacts are cleaned by gently sliding the fiberboard strip back and forth. In this case, as in the above methods, it is necessary to take care not to exert too much force or clean too vigorously where there are contact springs that may be damaged. Fibers that remain can be flushed off with the KS-20406 L1 spray.

COMPUTERS, DATA HANDLING MACHINES, AND OTHER PERIPHERAL EQUIPMENT

4.33 The manufacturers of computers, data handling machines, and other similar peripheral equipment should be contacted if their product suffers smoke or fire damage. They will usually be able to provide information on cleaning and suggest test programs for their equipment that will determine if there has been serious damage to the units involved.

4.34 Special attention should be given to traffic and toll monitoring and measuring equipment. The individual parts of these systems, such as relays, circuit packs, frames, and connectors can be cleaned by the methods described above, which are appropriate for these items. For other parts, Bell Laboratories or the manufacturer should be consulted.