Bell Communications Research

Bellcore Practice
BR 201-021-001
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HEAT STRESS TESTS

DESCRIPTION AND METHODS

STORED PROGRAM CONTROL SYSTEMS (SPCS)

CONTENTS

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1. GENERAL

1.01 This practice describes the procedures for heat stress testing in-service Stored Program Control System (SPCS) local central offices (COs). The low voltage stress testing procedures are covered in Practice BR 201-021-005; Low Voltage Stress Tests, Description and Methods, Stored Program Control System. All personnel subject to exposure to heat extremes shall be medically approved per AT&T Practice 010-130-001; Heat Test Stored Program Control System, Restriction of Plant Activities, Personnel Safety Guidelines and Requirements, General Methods. Low-voltage stress testing should not be performed concurrently with heat stress testing so as to avoid conflicting effects of one test on the other.

1.02 This practice is reissued to clarify procedures and make general corrections throughout. This practice does not affect the Equipment Test List (ETL).

1.03 Any changes or corrections to improve this practice should be requested in accordance with Practice BR 000-010-015.

1.04 This Bellcore Practice is derived from a pre-divestiture AT&T Practice. Although certain specific switch information herein is set forth with reference to AT&T Technologies' switches, this is not to be construed as a recommendation or opinion as to the utilization of these switches or the switches of any other vendor. It is instead intended that the procedures detailed herein may be adapted, with care, for any machine that meets the environment requirements of Technical Reference, TR-EOP-000063; Network Equipment-Building Systems Generic Equipment Requirements. In future issues of this practice and as detailed information on other machines becomes available, they shall also be referenced and similarly discussed.

1.05 All new AT&T SPCSs and retrofit processors are heat tested (116° to 120°F) as a standard requirement during the manufacturing process and/or during the installation period.

1.06 The AT&T SPCSs installed before 1979 that have not been stressed to at least 105°F should undergo an initial heat added test (105° to 115°F) as described in this practice.

1.07 This practice also describes a periodic no cool test (cooling system and fans turned off) to identify, control, eliminate, and prevent marginal equipment from deteriorating and contributing to multiple simultaneous failures.

1.08 No cool and heat stress test procedures apply to the following AT&T SPCS-type systems:

- 1ESS* Switch
- 1A ESS Switch
- 2ESS Switch
- 2B ESS Switch
- 3ESS Switch
- 5ESS Switch

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* Trademark of AT&T Technologies

- Remote Switching System (RSS)
- Traffic Service Position System (TSPS)
- Electronic Translator System (ETS) (No. 5 Crossbar only)
- Automatic Intercept System (AIS)
- Remote Trunking Arrangement (RTA)
- Position Subsystem (PSS)
- AT&T 3B201) computer.

> **Note:** Colocated operational support systems minicomputers (e.g., DEC, HP, and IBM) should be excluded from these test requirements and maintained in their normal operating environment.

1.09 The overall time examples for successful heat testing (including the no cool test interval) should generally be: 1/1A ESS switches—4 to 5 days, 2/2B ESS switches—3 to 4 days, and 3ESS switch—3 days, depending on the size of office peripheral equipment.

1.10 A glossary of abbreviations and acronyms used in this practice are listed in Part 12.

1.11 As used in this Practice the term **Supplier** means the Company from which the equipment under test was purchased. This will usually be the Company that warrants and provides technical support for that equipment.

2. DEFINITIONS AND RECOMMENDATIONS

2.01 Heat tests aid in identifying marginal temperature-sensitive or failure-prone components. Heat stress test procedures verify that the in-service SPCS system can function under high-temperature conditions which could occur due primarily to loss of commercial power or an office cooling system failure.

2.02 The purpose of the test is to clear marginal troubles and verify that the system can operate for at least 4 hours at elevated temperatures. During the final 2 hours of the 4-hour time frame, there should be no processor diagnostic failure or other trouble which could affect system integrity.

2.03 For all recommended heat tests, the tests should be performed during normal traffic loads and in two subsequent portions as follows:

(a) **No Cool:** The air conditioners and fans are turned off and the equipment area is allowed to reach its highest ambient temperature. This will normally require 24 to 48 hours. The no cool test is considered successful and complete by meeting the following criteria:

(1) Highest ambient temperature reached and stabilized for 4 hours during the test period with a minimum test period of 24 hours and;

(2) No processor diagnostic failures or any other troubles which affect system integrity.

With the above conditions met, the heat added test can be started, if scheduled.

> **Note:** The no cool test does not require the use of portable fans and heaters.

(b) **Heat Added:** Through the use of portable heaters, heat is added to allow a maximum 5 °F rate of change per hour, up to an average ambient temperature of 105 ° to 115 °F, performance requirements met, then the office is returned to a normal operating environment at a maximum 5 °F per hour rate of change. The environment for the heat added test is created by enclosing the SPCS and its associated equipment frames with plastic sheeting. The temperature is raised and controlled using strategically placed portable heaters and fans.

2.04 A periodic, routine no cool test is recommended to be performed twice with each major growth addition. If no major addition is scheduled, the periodic no cool test should be performed once every 5 years unless local conditions warrant a more ambitious schedule. Based on local practice, the no cool test may or may not include partial or full segregation of the SPCS area using plastic sheeting. This option is based on the effects the no cool test might have on adjacent non-SPCS equipment and work areas. The no cool test, when performed with the heat added test, must include the use of the plastic enclosure.

2.05 Recommendations for treatment of spare circuit packs is as follows:

- If normal operations include operational testing of spare circuit packs, all spare on-site processor and memory circuit packs should be cycled through the system during the no cool or heat added test after the highest ambient temperature is reached.
- If no operational testing is normally done with spare circuit packs, cycling of on-site circuit packs during the no cool or heat added test is Telephone Company (TELCO) optional (see paragraph 6.01).

2.06 During the no cool and heat added tests, diagnostics are made and system performance is monitored. Marginal components which fail are replaced to assure that the system can operate normally during possible future high temperature conditions. A post test review will afford an opportunity to evaluate failed components and other test results.

2.07 During the test interval of an operating office, special precautions must be adhered to in order to maintain the proper functioning of that office. The objectives during testing are as follows:

- Ensure personnel safety
- Minimize the possibility of machine interruptions
- Ensure no, or minimum, impairment to customer service
- Replace faulty circuit units using standard procedures.

All known special precautions will be covered in this practice.

2.08 In general, SPCSs are designed to operate in an environment of 40 ° to 100 °F (normal) and 35 ° to 120 °F (abnormal or short term—e.g., up to 72 hours, no more than five times a year). The operating ranges for equipment are specified in AT&T Practice 760-555-151, Atmospheric Environment for Telephone Equipment Space. The recommended environment for telephone equipment is covered in AT&T Practice 800-610-164 and Technical Reference, TR-EOP-000063; Network Equipment-Building Systems, Generic Equipment Requirements.

2.09 After no cool and heat added tests, the office should never be subjected to the practice of gradually lowering room temperature to avoid or delay maintenance needed to remove intermittent or thermostatic-type troubles. During periods when air conditioning is needed, the office should be operated within wide band limits described in letter SR 80-09-019.

2.10 During the tests prescribed in this practice, the normal operating temperature and humidity requirements and short term time limitations for central offices do not apply.

2.11 The office to be tested must be in a stable base line control condition. No equipment should be out-of-service when the stress test starts.

The heat test should be supported by:

- Switching Control Center (SCC)
  The office should be closely monitored by SCC prior to the test for office conditions. Special test gear and spares should be obtained and readily available at the time the test is to be started.
- Electronic Switching Assistance Center (ESAC)
- Building Operations Control Center (BOCC)
- Suppliers Technical Support Organization
  The Supplier should be notified 2 to 4 weeks prior to the start of the test.

2.12 Eight to ten weeks prior to a proposed heat test, planning meetings should be conducted to assure that necessary requirements are met; e.g., manpower, spare parts, special test gear, and building materials (plastic, heaters, etc.). All emergency recovery procedures applicable to the office generic program should be reviewed and the appropriate practices and local procedures should be inventoried and readily available.

2.13 In summary, the test provides:

(1) service protection on future air conditioning outages,

(2) tested performance capability through varying temperature ranges to the upper operating design limits, and

(3) a more reliable system.

3. COORDINATION

3.01 To assure successful implementation of the stress test, cooperation and joint effort are required between several areas (e.g., building engineering and building operations forces, equipment and maintenance engineering, network maintenance, medical department, and the Suppliers Technical Support Organization) and the various technical assistance centers. Network maintenance has overall responsibility for coordination, control, and completion of the stress test. A method of procedure (MOP) meeting should be held as the initial step toward preparation of an overall test plan (recommended 8 to 10 weeks in advance of the test).

3.02 Manpower must be medically screened, approved and assigned, procedures and test schedules reviewed and agreed upon, material and equipment ordered ahead of time, and the office surveyed and prepared in advance of the test. Technical coordination is required and test schedules should be reviewed well in advance by ESAC and the Supplier's technical support organization. One week prior to the actual test start date, ESAC should confirm the date with the Supplier. Normal escalation procedures should be adhered to as covered in Practice BR 190-130-147; Stored Program Control System, Trouble Escalation Procedures, Switching Control Centers.

3.03 Network Maintenance and Building Engineering/Operation coordination is strongly recommended throughout the planning and test period to ensure a controlled test environment. Plastic enclosure material and the heaters should be supplied and installed by Building Operations or through outside contract arrangement at local option.

3.04 Pretest coordination and preparation are necessary to prepare the office space for the test. Agreements are needed between Network Maintenance and Building Operations forces to jointly

develop a plan to construct the temporary plastic enclosures. A review of the building and final determinations of the methods to be used to raise and control the temperature should be agreed to and documented in the plans. Control of the temperature is to be handled by Building Operations forces under the direction of Network Maintenance.

3.05 Coordination is required between network maintenance and building operations forces to provide a nonheated, comfortable area as near as practicable to the test area. This space is needed for time spent outside the heated area for trouble analysis and remote terminal surveillance. All operations and trouble analysis that can be done outside the heated area should be encouraged.

3.06 Other special matters for coordination are:

(a) Changes in methods and monitor points, if applicable.

(b) Changes in performance requirements.

(c) Sequence and duration of tests.

(d) Equipment included or excluded, switch, in switchroom.

(e) Test temperature control.

(f) Temperature rate of change control.

(g) Time duration at maximum temperature.

(h) Any parameters or conditions to abort the test.

(i) Treatment of test equipment and spare circuit packs.

(j) Any special handling of faulty circuit packs.

(k) Any other known changes or conditions.

3.07 Coordination of responsibilities among organizations includes the following areas:

(1) **Building Engineers and Building Operations:**

(a) Develop the test setup requirements, temperature control procedures and heating provisions for the stress test.

(b) Coordinate all activities to install the facilities needed for the heating provisions, including adequate power for the heaters.

(c) Provide and coordinate the installation of the thermometers, thermocouple devices, and thermometer/hygrometer.

(d) Supply or arrange for the material needed for the temporary enclosures and heating equipment.

(e) Assume responsibility for producing necessary temperature levels and monitoring, recording aisle temperatures, and correcting for unequally heated areas (hot spots).

(f) Make arrangements for the provision of a nonheated control area, ensuring that adequate table space is available.

(2) **Network Maintenance**

(a) Establish Input/Output (I/O) links with the SCC and ESAC 3 days prior to the test.

(b) Provide a remote maintenance I/O facility in the nonheated control area.

(c) Provide intercom set up from the nonheated control area.

(d) Assist building operations in the installation of temporary enclosures and temperature recording instrumentation.

(e) Provide test equipment, spares, and ensure appropriate office documentation. (refer to Parts 5 and 6)

(f) Provide medically approved personnel dedicated to the performance of the test and its activities who will be responsible for trouble-shooting, solving problems as they occur, and recording the appropriate data about the problems. Operations or engineering personnel who are proficient in the maintenance of the office type under test should be selected for this function. The I/O link to the SCC and ESAC should be maintained during the entire test.

(3) **SCC and ESAC Personnel:**

(a) Assist in establishing an I/O link with the Suppliers Technical Support Organization, if needed. Resolve any technical problems in providing the remote maintenance I/O in the nonheated area.

(b) Monitor and analyze maintenance printouts for the 3-day period prior to the start of the test.

(c) Make arrangements for emergency spare stock items and test equipment.

4. PERSONNEL SAFETY

4.01 Employees expected to be directly exposed to the heated test area for more than 2 hours throughout the testing interval, when the room ambient temperature is 100°F or higher, must be medically approved by the company medical director or responsible physician.

4.02 During the rise in temperature, equipment failures may occur which must be repaired before the temperature can be raised to the next level. Due to the many variables involved, it is impossible to predict how long personnel might be working in the heated environment.

4.03 To reduce the likelihood of any employees experiencing health problems related to heat overexposure stress, AT&T Practice 010-130-001 requirements must be followed. This document establishes medical screening practices and work practices to minimize the risks of exposure to heat.

4.04 Table A gives the allowable exposure limits per hour for all personnel.

TABLE A.

WORK CYCLE GUIDE		
TEMPERATURE F	MAXIMUM MINUTES PER HOUR-IN	MINIMUM MINUTES PER HOUR-OUT (NOTE)
100	53	7
105	38	22
110	32	28
115	28	32
120	26	34
Note: The out period should be spent in an environment with a comfortable temperature (less than 88 ° F).		

4.05 A work cycle schedule shall be implemented when the heated test area exceeds 100 ° F. The recording (names, time, and temperature), adherence to the time limits, and logging of time in and out is the responsibility of each person. This recording and the actual time spent in the heated area will be monitored and supervised by management. The manager in charge of the heat test is responsible for enforcing the work cycle and accuracy of the log. A sample of this form is shown in Figure 9 with the work cycle guide repeated for emphasis.

4.06 A warning sign, "**DANGER: HEAT TEST AREA**", shall be posted at all possible entry points in the test area. Only personnel who have been medically screened and approved shall be allowed in the test area.

4.07 All employees involved in the heat test shall be familiar with the contents of AT&T Practice 010-130-001 for safety procedures, medical protocol, work cycle regimen, importance of fluid replacement, heat symptoms and hazards, and record logging responsibility. In addition, all personnel working in the heat test area should wear light weight, loose, and comfortable clothing.

4.08 Any employee who develops a health problem during the test shall be removed from the heated area. Medical attention shall be sought, and a report shall be made to local supervision.

4.09 All personnel should be made aware of fire extinguisher locations.

5. MATERIALS AND APPARATUS

5.01 Additional material and apparatus required for heat testing are listed below. The quantity needed and procurement procedures are based on office needs and local practices. As an aid in determining amounts needed, refer to the test preparation procedures in Part 7. Additional test equipment and spares required are listed in Part 6.

(1) Stepladders (two) that will reach within 3 feet of the ceiling or roof structure.

(2) Polyvinyl chloride (PVC) plastic sheeting, fire retardant, 10 mils thick, clear, polished both sides, roll 54 inches wide, approximately 320 feet long, or alternately, plastic sheeting, fire retardant, at least 6 mils thick, 12 feet wide and 100 feet long. An alternate source of plastic sheeting, available from AT&T Technologies, is R4829 plastic sheeting, fire retardant polyethylene, 6 mils thick, 12 feet wide, and 100 feet long. Because of additional heat loss, the use of the thinner alternate sheeting will require more heaters and power consumption. Figure 3, used to

calculate the number of heaters required, will have to be adjusted.

(3) Duct seal tape rolls (aluminum colored), 2 inches wide, 60 yards long. Four rolls required per roll of plastic sheeting.

(4) Electric resistance heaters, industrial type, with self contained fan, approximately 3.3 to 5.6 kW at 240V 60Hz, 30 ampere plug* and 22-foot cord. Also, thermostat cutoff switch so that at high temperatures the heaters may be manually operated and not be shut down by the controlling thermostat. The heaters should also have safety thermostat limit switches separate from the operating thermostat.

(5) Thermometers, range 70° to 130°F, or thermocouple temperature recording devices as determined by local practice (at least two per equipment aisle).

(6) Vivid-colored ribbon, approximately 1/2 inch wide for use as warning flag on thermometers.

(7) For heat added test only, portable fans, 2- or 3-speed (at least one per two building bays, or per 800 square foot area). For 1A ESS switch offices, a pedestal fan capable of moving 2000 cubic feet of air per minute is required for each file store community during the heat added test.

(8) Insulated servicing wire, approximately 16 gauge, to be used as support for plastic (e.g., "P"-wire, 4-conductor jumper wire, station JK wire, or equivalent).

(9) Wire cutters.

(10) Scissors.

(11) Knife.

(12) Extension cords for heaters and fans, as required.

(13) Seven day thermohumidigraph recorder, wind-up or battery operated, up to 130°F range (Bristol's Recorder, or equivalent with appropriate charts having ranges of at least 60° to 140°F temperature and 0 to 100 percent relative humidity).

(14) Cleaning material for connectors (refer to AT&T Practice 069-350-801).

(15) Water.

(16) Nonalcoholic, sugar-free, commercial thirst quencher.

(17) Fire extinguishers. [normal office complement in accordance with AT&T Practice 760-660-150 (distribution) and AT&T Practice 770-330-120 (maintenance)].

(18) Forms, signs, logs, tags (see Test Preparation, Part 7 and Forms, Part 10):

(a) Work Cycle log

(b) Temperature Recording log

(c) Stress Test Failure form

(d) Stress Test Results form

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* (NEMA Reference Receptacle 6-30R plug: 6-30P, 30A, 250V)

(e) Trouble Report form

(f) Warning signs, "**DANGER: HEAT TEST AREA**", for each possible test area entry point.

(19) Complete set of office documents such as schematic diagrams (SDs), practices, input/output message data manuals, emergency action procedure, etc.

(20) At least four spare copies of current, updated program tape, applicable to the system.

6. TEST EQUIPMENT AND SPARES

6.01 The test equipment and spares listed below, where applicable, should be available in the heated area for the stress test. Any spares (circuit packs, spare modules, etc) which might be used as replacement parts in the SPCS equipment should always be located within the heated test area, preferably at least 2 feet above the floor level for temperature conditioning.

(1) Spare fuses, including large capacity type. All spare fuse holders shall contain fuses.

(2) Oscilloscopes with probes.

(3) Multimeters.

(4) Frequency Counter.

(5) Voltage and Current probes.

(6) Circuit pack test extenders.

(7) Sync cables.

(8) Program address matchers.

(9) Central control (CC) matcher packs (1ESS switch).

(10) For 1/1A ESS switches, 1019A tool-cables for duplicated SP 32K call store (CS) failure.

(11) Wire wrapping and unwrapping tools for 30-gauge wire.

(12) A Biomation 851D Digital Logic Recorder, or equivalent, an installation test equipment (ITE)5511 microcode test set, or equivalent, and a backplane microscope.

(13) For the 2B and 3ESS switch, an ITE 5971 test converter, or equivalent.

(14) Minimum of two spare remreed grids of each type, if applicable.

(15) For the 1/1A ESS switches and 2ESS switch, a program store (PS) memory module.

(16) CS memory module if applicable.

(17) Tape data recorder.

(18) Spare plug-in complement for other systems that are located within the heated test area.

(19) Critical spare parts as determined by local practices, experience, and recommendations as determined during initial planning stages (refer to Coordination, Part 3).

Note: In 1/1A ESS switch offices and early (before 1975) 2ESS switch offices, a known heat-related problem exists in circuit SD-1A172 (customer dial pulse receivers) with the 292A mercury relay. The 292A relays manufactured prior to 1975 are known to fail at high temperatures (failure message SUPF MT 02 L-T Issue PF).

7. TEST PREPARATION

7.01 The planning and effort required to perform the heat stress test involves coordination of several areas which are covered in general in Part 3. The specifics involved in the initial planning and pretest procedures are covered below.

GENERAL CONSIDERATIONS

7.02 Initial planning involves coordination with other organizations in determining the testing schedule, the size of the area to be tested, the number of heaters needed, power requirements, amount of materials and equipment needed, manpower and safety needs. Figure 1 shows a typical SPCS heat test area layout.

7.03 A physical evaluation of all employees who are expected to work in the heated area when the ambient temperature is 100°F or more (see paragraph 4.01) should be completed prior to their assignment in heat test operations. In addition, work schedules should be determined based on the recommended work cycle regimen shown in Table A and Fig. 9. Twenty-four hour personnel schedules (including home or off-hour contact telephone numbers) should be prepared and posted. Tour of duty schedules should overlap by at least 30 minutes to assure continuity of communications during trouble conditions or general status briefing on shift changes.

7.04 Transmission equipment, as well as switching equipment, is designed to operate satisfactorily at elevated temperatures. Colocated non-SPCS equipment frames, miscellaneous equipment frames (carrier bays, repeater bays, power bays, etc.) should be included in the enclosed heated area. It is not necessary to heat test distributing frames and consideration should be given to excluding these frames from the enclosed area due to normal office work requirements, keeping in mind that the test may last up to 5 days. When SPCS switch associated transmission equipment is located in other parts of the building, the heat tests do not have to include this equipment.

7.05 Some of the various kinds of transmission equipment that could be located in an SPCS switch office are digital carrier channel banks, analog carrier banks, F type signaling bays, E-type repeaters, metallic facility terminals (MFT), and range extenders with gain (REG).

Note: D1 and D2 channel bank equipment should be excluded from heat tests.

7.06 Several new digital channel bank developments have tightened the intraoffice cabling restrictions between the banks and the SPCS switch equipment. In many cases this requires the installation of new digital banks within the same lineup as the SPCS switch equipment. Examples of this are the digital interface frame (DIF) used with 4ESS switch, D3 direct interface frames used with 2ESS switch, and digital carrier trunk (DCT) frames used with 1ESS switch.

7.07 Heat range specifications for the various types of transmission equipment should be checked before including them in the heated area.

7.08 It is not necessary to heat test power plants and storage batteries. Some SPCS offices have colocated power plant and storage batteries that may be difficult to exclude from the test area. If

batteries are exposed to the heated area, temperature and electrolyte levels must be closely monitored.

A. Network Maintenance Considerations

7.09 A nonheated control area with a comfortable temperature must be provided for personnel and remote monitor equipment. Control and monitoring of the system temperature and initial analysis will be performed from this area. Temperature control instrumentation, a remote maintenance I/O terminal and telephones should be set up in the nonheated area. It is recognized that some risk of an office failure is associated with this test, therefore the telephones should not be served by the test office. Several large tables will be required for the equipment and documentation. The proximity of office records such as schematic diagrams (SDs), input/output manuals, etc., should be considered in the selection of the nonheated work area. Depending on the location, a simple intercom arrangement may be desirable to improve communications from the nonheated area into the heated area of the office.

7.10 Verify that the most recent copy of backup tapes (e.g., program tape, stand alone and recovery tape) applicable to the office generic program is available and stored in the nonheated area.

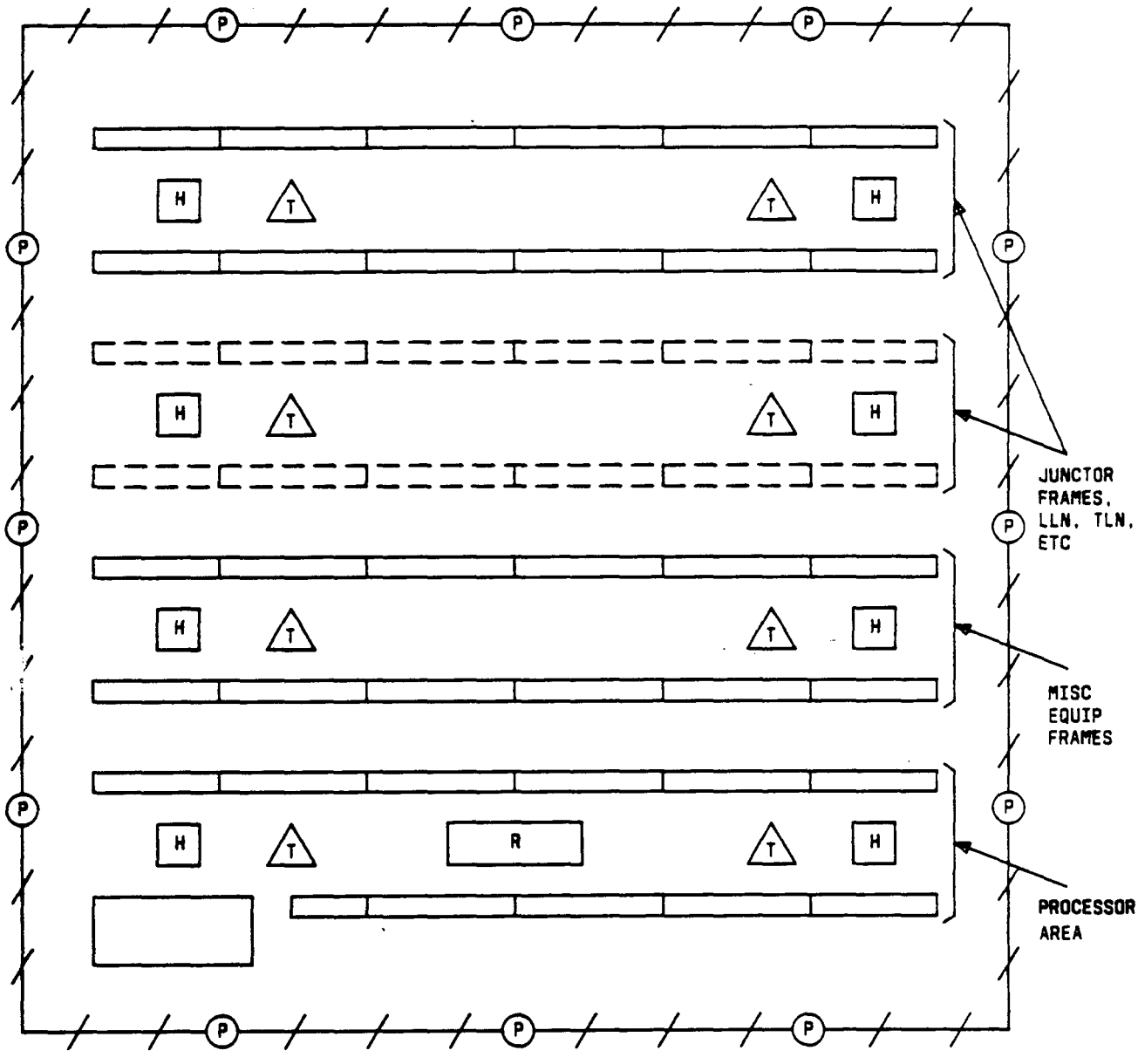


Figure 1. SPCS Heat Test - Typical Office Layout

7.11 The office to be tested must be in a stable base line control condition. No equipment shall be out of service when the actual stress test starts. Exceptions may be minor quantities of trunk, link, or service circuits that are maintenance busy. (If so, they should be recorded on an outage log.) Prior to the test, system evaluation test procedures should be performed per the applicable practice to ensure system operation and recovery integrity.

7.12 Functional operation of peripheral components of the system being tested, using the appropriate ETL sections, should be completed in advance of the test. A partial list of these components is shown below:

- Peripheral control links (TSPS)
- Automatic Message Accounting (AMA) transport per AT&T Practice 034-360-701
- TTY, carrier
- Status display
- Remote trunks
- Communication links with SCC and ESAC.

7.13 Low voltage stress testing (see Practice BR 201-021-005) performed in advance of heat testing will provide a high degree of assurance of service continuity while minimizing the potential of multiple problems.

7.14 The heat test should be supported by SCC and ESAC with the Suppliers Technical Support Organization alerted before and during the test. In order to allow better support, the Supplier should be notified initially 8 to 12 weeks and again 1 week, prior to the start of the test. The office should be closely observed by SCC and ESAC for at least 3 days prior to the test for monitoring office printouts and to determine test readiness.

7.15 The availability of a complete set of office documentation should be ensured including the proper issue of the program documents. All program overwrites that are applicable to the office must be installed. The normal office complement of spare packs should be available and stored in the heated portion of the office. Spare circuit packs, etc., as determined to be required for use in the stress tests should be ordered and obtained in advance and also should be available in the heated portion of the office. Availability status should be determined and arrangements made for obtaining replacement packs or equipment units from:

- plug-in inventory control system (PICS),
- other centralized stock,
- from the Supplier on an emergency basis,
- from nearby offices.

7.16 Select a storage area designated for defective equipment resulting from the test. This equipment will be tagged and administered as prescribed in Part 9.

7.17 An ample supply of applicable test equipment such as oscilloscopes with probes, sync cables, logic recorders, program address matchers, etc., should be available in the office in the heated area (refer to Parts 5 and 6).

B. Building Engineering Considerations

7.18 **Warning: Ensure the availability of proper fire-fighting equipment. Refer to AT&T Practices 760-660-150 and 770-330-120.**

7.19 A review of the building and final determinations of the method to be used to raise and control the temperature should be completed and controlled by building engineering and building operations forces. Control of the temperature is required and necessary to assure that at most, the maximum rate of change is 5 °F per hour. The temperature will be raised (105 ° to 115 °F) and held to meet the 4-hour test requirement. The temperature should not be allowed to exceed 115 °F. Temperature will then be controlled and reduced to normal (65 ° to 80 °F) in a near linear fashion, also at a maximum rate of 5 °F per hour.

7.20 **Caution: To avoid thermal shock, under no circumstance should the air conditioning equipment be turned on until the ambient air temperature has been at 90 degrees or less for at least 1 hour.**

7.21 From building or office drawings, determine the size of the heat test area enclosure required in square feet of floor space and linear feet of enclosure wall (plastic). Note particularly what equipment is and is not to be included in the heated area as discussed in paragraphs 7.04 through 7.08. Based on linear feet of plastic as measured on the floor and ceiling height, use Fig. 2 to determine the number of rolls of plastic sheeting required. For each roll of plastic sheeting used, four rolls of duct tape are required.

7.22 Determine the number of heaters required from the number of square feet of office area enclosed, using Fig. 3.

7.23 It is the building engineers' responsibility to ensure that sufficient utility power is available for the test. First, determine the total amount of power required to operate the heaters. Then, a preliminary survey should be made of the office to be tested to determine if sufficient utility power is available to operate the heaters, where the power is located, and the length of heater supply cables required.

7.24 If a building scheduled for heat testing is on a commercial power demand charge basis, waiver arrangement should be made with the power company to exclude the demand peak reading during the test interval. An alternative is to have the office load on emergency power for the week of the test.

7.25 Heaters **must** be placed on the floor and not suspended from the ceiling. The building engineer shall review each test location and arrange to supply AC power to the proposed power center in an economical way. It is suggested that a transportable power center be made consisting of a power panel equipped with twenty 30-ampere circuit breakers and twenty 30-ampere receptacles [each of the heaters used will take about 5 kilowatts (kW)]. In 480-volt buildings, it might be necessary to include a bucking autotransformer to step down 277 volts to 240 volts. This power center could be moved to each test site, as required, to be the interface connection for the heat test.

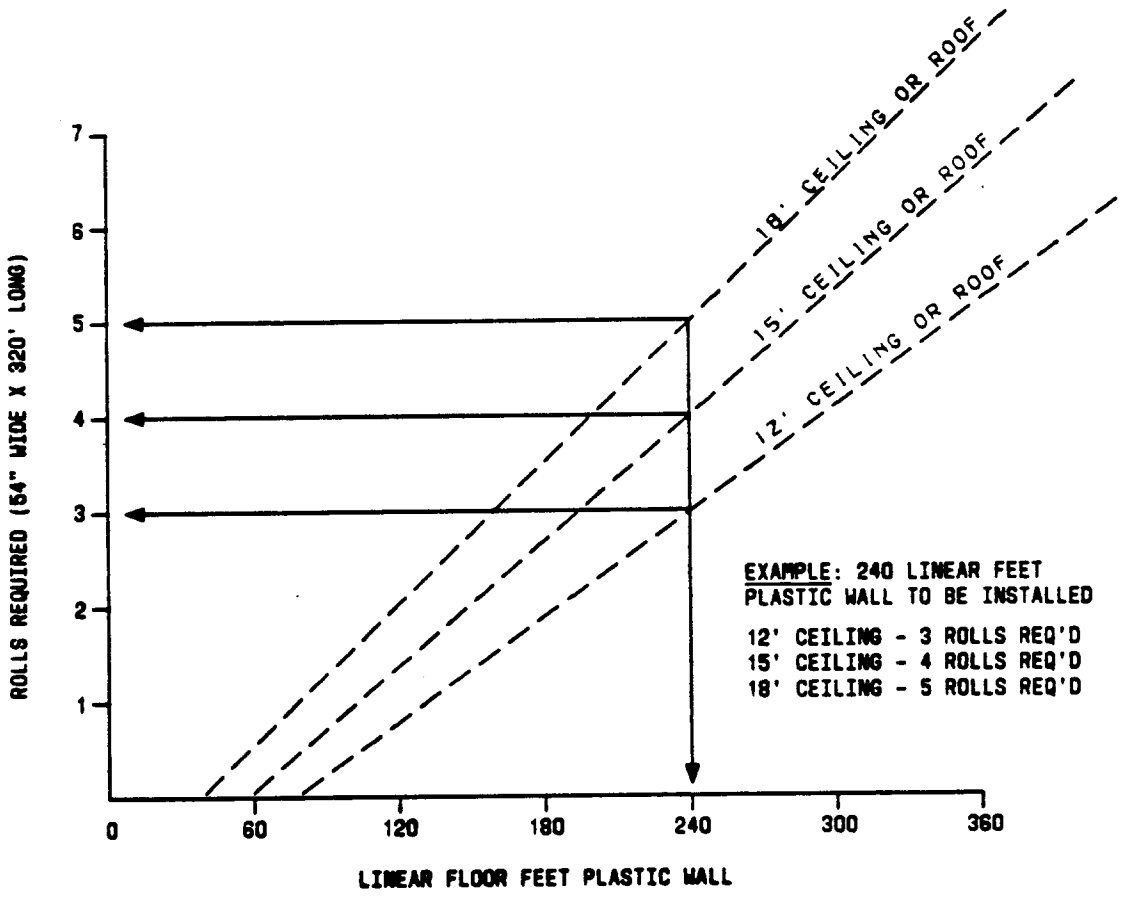


Figure 2. Amount of Plastic Sheeting Required for Heat Test Enclosure

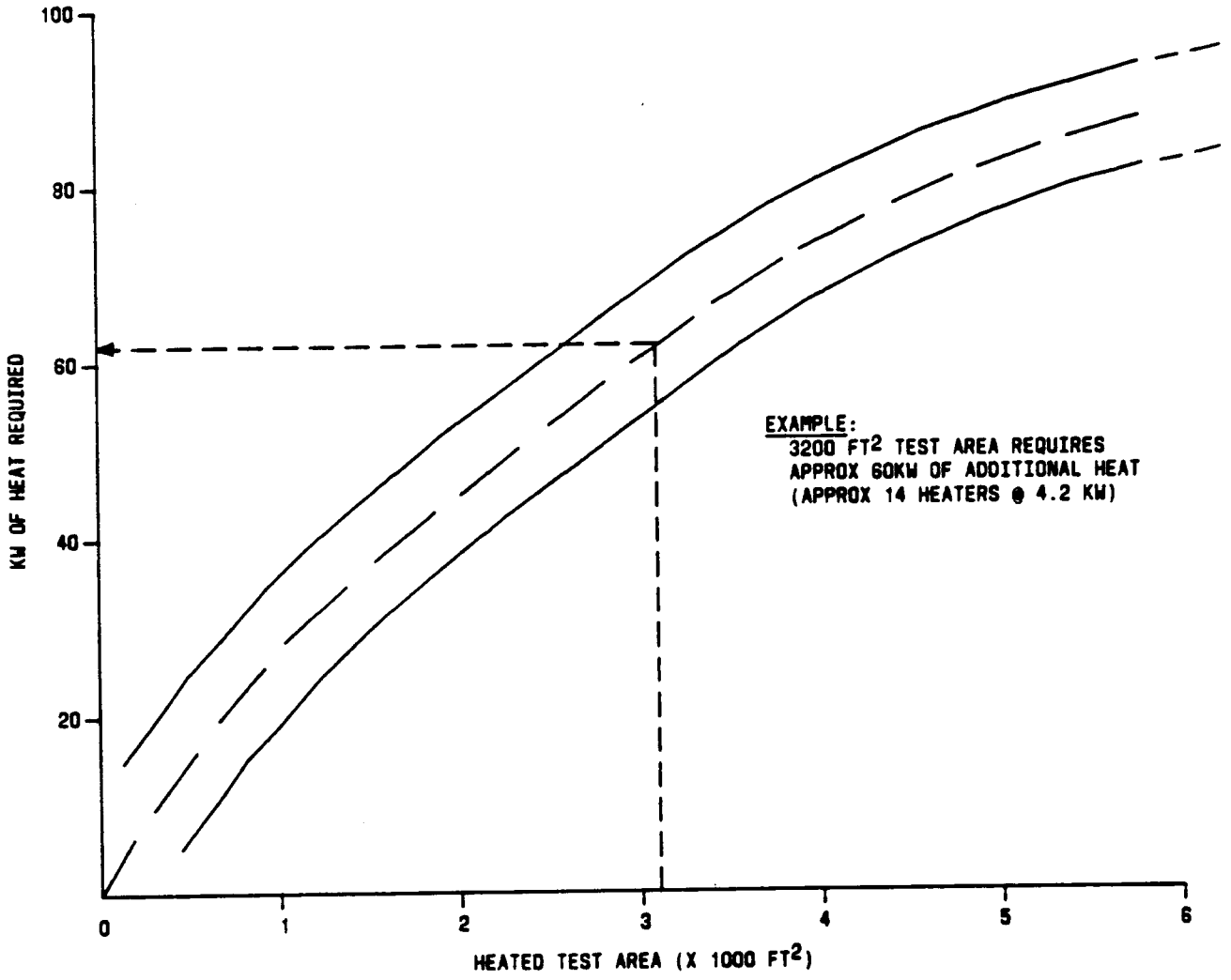


Figure 3. Heat Required for Test Area

7.26 If the heaters are to be operated from 208 volts, instead of 240 volts, heater efficiency will drop by approximately 30 percent. Therefore, when 208-volt circuits are used, more heaters will be required. For example, a 3200 square foot area requires approximately 60kW of additional heat for the enclosed test area. The heater capacities should be between 3.3kW to 5.6kW operating on the office utility power. Sixty kW of heat would require 14 heaters, each having 4.22kW capacity. A heater which has a capacity of 5.6kW at V_1 of 240 volts and is operated at a lower voltage V_2 of 208 will only produce a capacity equal to the voltage ratio squared times the capacity at the higher voltage, or capacity C_2 at:

$$C_2 = \left(\frac{V_2}{V_1}\right)^2 5.6kW = 4.2kW.$$

7.27 Thermometers or temperature recording devices will be needed in every front equipment aisle:

- halfway between the frames,
- 5 feet above the floor,
- at least two locations in each aisle,
- 10 feet in from the cross aisles.

The thermometers or thermocouples should be located no more than 25 feet apart. A thermometer/hygrometer recorder will be needed in the normally hottest area.

7.28 Determine the number of man-hours required to install and remove the plastic enclosure, to locate and install heaters and associated cables, and temperature/humidity instruments. If it is planned that building operations will perform the work, it is advisable that building operations estimate the effort and costs.

C. Building Operations Considerations

7.29 After the area to be tested has been determined and materials and test equipment are available (see Parts 5 and 6), the installation and pretest procedures below may be performed in time to assure completion on the day before the start of test. Refer to Fig. 1 for a typical office layout and placement of devices.

7.30 Make an operational review of heating, ventilating, and air conditioning (HVAC) system components for proper operation and to assure familiarity with operating procedures by personnel assigned to the heat test. In addition, personnel experienced and familiar with the HVAC systems should be available on a standby basis throughout the test.

7.31 In the test area equipment aisles, hang thermometers from cross aisle troughs with cord and locate them in the center of the aisles. Tie approximately 1 foot lengths of vivid-colored ribbon to each thermometer as a warning flag. Install the thermometers and temperature recording forms in every aisle 5 feet above the floor, halfway between the frames in at least two locations in each aisle and 10 feet in from the end of cross aisles (see Fig. 1). The thermometers should be placed no more than 25 feet apart. The point used for the office reference should be provided with a thermometer/hygrometer (temperature and humidity recorder) and be in the normally hottest aisle. At least one thermometer should be located and taped on the processor frame iron work. If Celsius thermometers are used, temperature must be converted to Fahrenheit. Use the following formula:

$$F^\circ = (9/5\ C^\circ) + 32.$$

7.32 For the heat added test only, place at least one 2- or 3-speed portable fan for each 800-square foot area of the test area. This will be used during the heat added test to aid in the equal distribution of heat.

TEST AREA ENCLOSURE WALL INSTALLATION

7.33 Install the temporary plastic enclosures as follows:

> **Note 1:** The following procedures describe the methods of hanging plastic partitions. Final taping of the plastic wall should not be performed until the day the test begins. After the plastic partitions are hung, the panels should be rolled up and secured to allow normal air flow and ventilation until start of the test.
>
> **Note 2:** If a plastic ceiling is to be constructed over the cable rack, the serving wire is not required.

A. Serving Wire Installation

7.34 In preparation for hanging the plastic enclosure walls for containing heat within the test area, an insulated serving wire (see Fig. 4) should be strung horizontally in a catenary fashion (linked and hanging freely from two points) as close as possible but not more than 2 feet below the ceiling. This wire will support the weight of the plastic sheeting. Insulated 16 gauge or large twisted pair (e.g., telephone "P" wire) may be used.

7.35 This serving wire may be suspended from installed threaded rods, ceiling inserts, or building appendages on columns. If threaded rods are not available and inserts are located in the ceiling, cap screws may be installed into the inserts for attaching the serving wire. The spacing between attachment points should not exceed 6 feet so that drooping or slack does not become a problem.

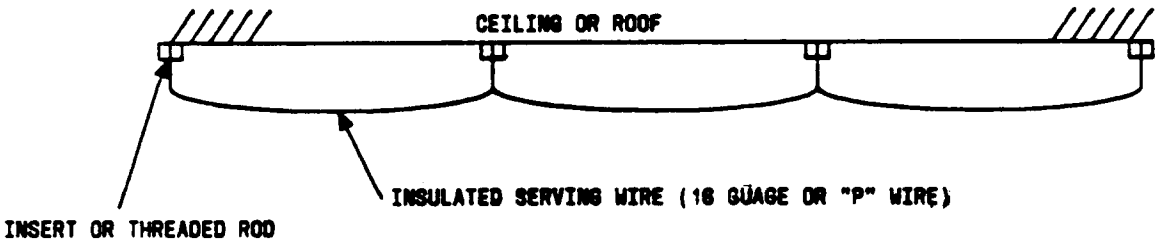


Figure 4. Serving Wire Installation

B. Establishing Plastic Panel Length

7.36 The plastic panels (see Fig. 5), when hung over the serving wire, should overlap the wire by at least 6 inches. Hang the plastic panels with the sides as true to vertical as possible. The plastic panels should touch the floor and have a minimum of 1 to 1-1/2 feet of plastic lying on the floor. Adding up the overhang distance, the vertical distance from the floor to the serving wire, and the plastic length lying flat on the floor give the true length of the plastic panel. One panel should be cut and hung to establish the correct cut length. After this, all panels may be precut on the floor and then hung in the sequence required.

C. Plastic Panel Hanging Procedure

7.37 Hang the top of the plastic panel (see Fig. 6) over the supporting serving wire with an overhang of at least 6 inches, making sure that the panel edges are as true to vertical as possible.

7.38 Tape the horizontal edge of the overhang to the inside of the enclosure plastic panel every 9 to 12 inches with a 4- to 6-inch length of duct seal tape.

7.39 Hang the next panel so that it overlaps the previous panel by 6 inches along the vertical edge. This vertical overlapped seam should be taped with 4- to 6-inch long strips of duct tape every 2 to 3 feet along the seam. Do this on both the inside of the panels as well as the outside. If the adjacent panels are not parallel, the seams may have to be taped more often.

7.40 Tape the bottom edges to the floor on the out-ward side with short lengths of tape every 12 to 18 inches.

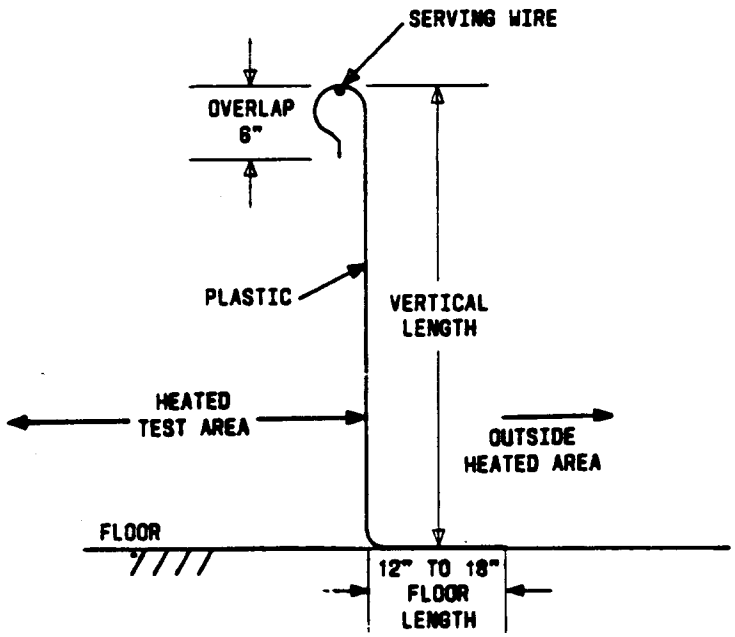


Figure 5. Establishing Panel Lengths

7.41 Create doors at minimum strategic locations by not taping one of the vertical seams. Overlap at least 12 to 18 inches to assure a good seal in the normal closed position. A short piece of 1/2- or 3/4-inch conduit or piping, 2 to 3 feet long, rolled up from the bottom to clear the floor and duct taped in place will provide a self closing action. Form a door handle by making a loop out of duct tape and securing it to the movable plastic panel.

D. Closure of Space Above Panels

7.42 The vertical space between the plastic panels on the serving wire and the ceiling must be sealed with a plastic sheet (see Fig. 7).

7.43 Tape a 48-inch wide piece of plastic to the ceiling. Run the tape the full length of the plastic sheet at the ceiling in order to make an airtight seal. In order for this closure to have a tight seal at the vertical panels, the taped edge should be 6 to 10 inches **inside** the vertical surface of the plastic enclosure.

7.44 Hang the closure sheet on the **outside** of the vertical plastic walls with a 6-inch overlay. Do not tape this joint.

E. Construction of a Plastic Ceiling

7.45 Under certain conditions, when duct work and other overhead structures make it difficult to hang plastic from the ceiling, it may be easier to construct a plastic ceiling along the top of the cable rack or other temporary nonconductive support structure (e.g., 2- by 2-inch or 2- by 4-inch wood, etc.).

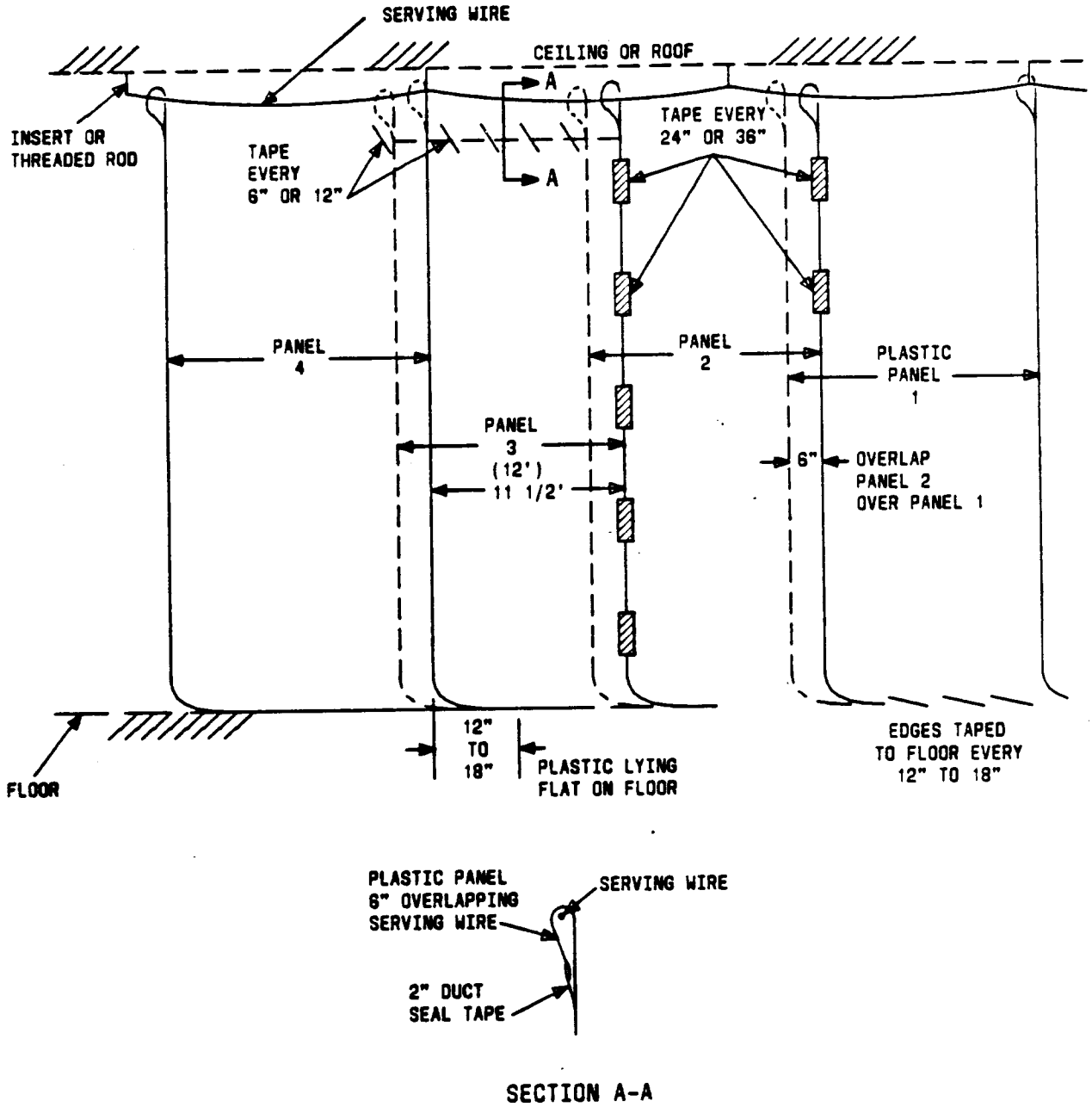


Figure 6. Hanging Plastic Panels

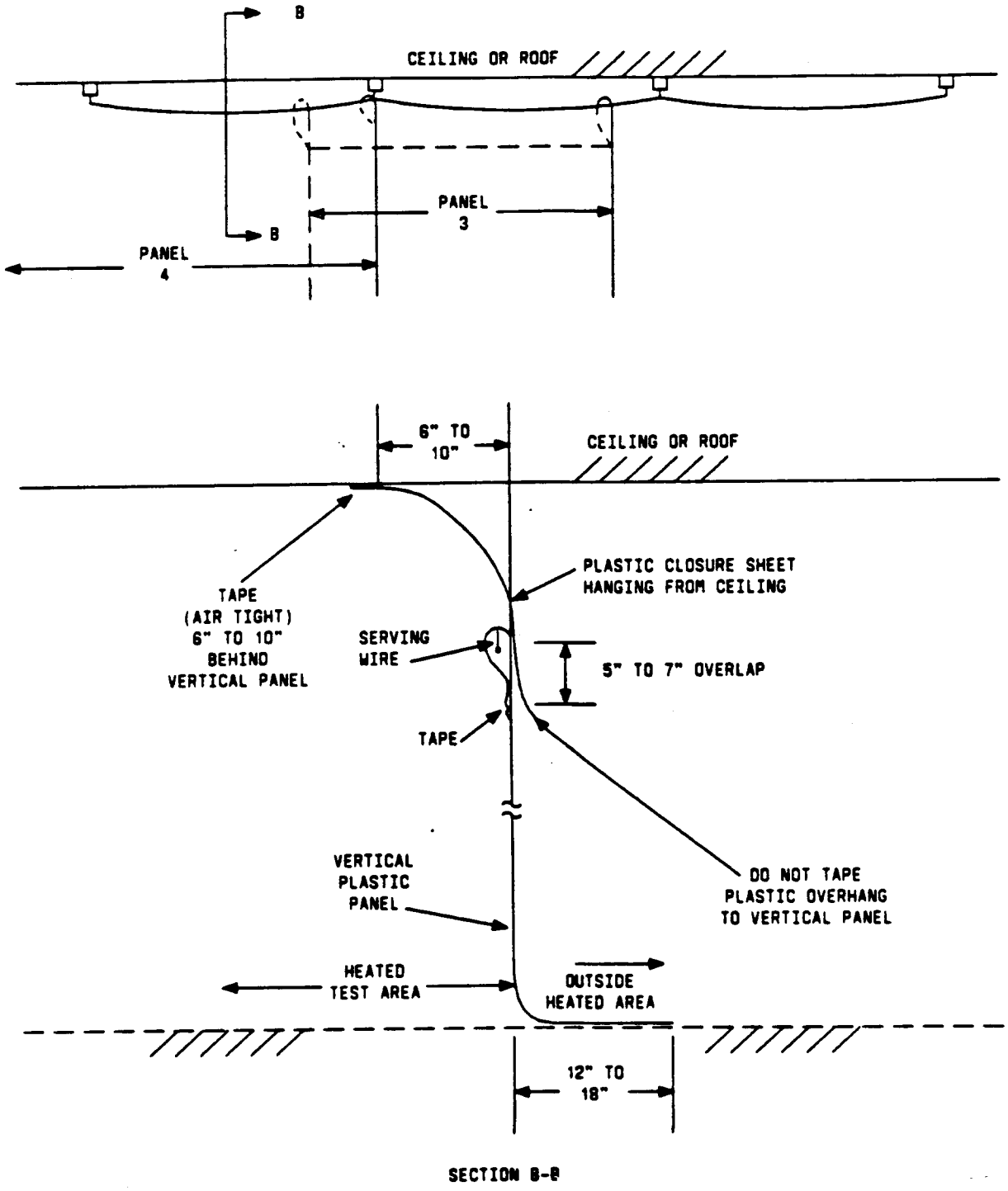


Figure 7. Closure of Space Above Panels

7.46 If a plastic ceiling is to be constructed over the cable rack, the serving wire is not required.

7.47 The plastic sheeting used as a ceiling must extend the full length and width of the area to be enclosed with an overhang 1-1/2 to 2 feet long at each end and on each side of the frames.

7.48 Adjacent ceiling panels should overlap by 6 inches. This overlap should be sealed on both sides with 6-inch long pieces of duct tape every 12 inches. Holes may be cut in the plastic to allow for conduit, support bars, and other vertical structures and should all be tightly sealed using duct tape to reduce/eliminate leakage. It is important that all potential air leaks at the ceiling be blocked. If this is not done, chimney action will occur, making it difficult to reach high temperatures.

F. Hanging Plastic Panels From a Plastic Ceiling

7.49 When a plastic ceiling over the cable rack is constructed, the plastic wall panels may be taped directly to the 1-1/2 to 2-foot ceiling overhang.

7.50 Panels should be taped to the ceiling panels with a 12 inch overlap. Tape this overlap with 4- to 6-inch pieces of tape every 12 inches on both the inside of the panels as well as the outside.

7.51 Hang panels as close to vertical as possible. Hang adjacent panels so that they overlap by 6 inches.

7.52 Tape the vertical overlapping seam with 4- to 6-inch long strips of duct tape every 2 to 3 feet along the seam. Do this on both the inside of the panels as well as the outside. If adjacent panels are not parallel, the seams may have to be taped more often.

7.53 Tape the bottom edges to the floor with short lengths of tape every 12 to 18 inches on the outward side (see Fig. 6).

7.54 A door may be made by not taping one of the vertical seams (see paragraph 7.41).

G. Window Closure

7.55 Windows exposed to any ambient temperature, except equipment conditions, must be covered with plastic. A window on an outside wall must be covered with plastic (see Fig. 8) in such a manner as to produce a dead air insulating space so the equipment test temperature may be more easily controlled.

7.56 Hang a plastic sheet having a 4- to 6-inch perimeter overlap greater than the window well size over the window or window well. Tape the edges of this plastic sheet with 6-inch lengths of duct tape every 12 to 18 inches.

SETUP OF THE HEATERS

7.57 As a general guideline, the heaters should be located at both ends of each front equipment aisle, depending on the equipment heat dissipated into that aisle. Usually the network areas will need the most heat, and the call store, signal processor, and central control areas the least heat. Ceiling height and aisle length will also influence the quantity and placement of the heaters. A short aisle may require only one heater, but a long aisle with a high ceiling may require three heaters.

7.58 Locate the heaters in the center of the aisle and orient so that the hot air blows slightly upward and down the length of the aisle. Heaters **must** be placed on the floor, not suspended from the ceiling.

7.59 **Caution: Never direct heated air flow toward the equipment.**

7.60 Connect the heaters to the power source, taking care not to overload any circuit. Temporary power cables should always be placed on the floor, not in cable racks. Route the power cords so as

not to present a safety hazard. Tape cords to the floor with duct tape whenever they cross aisles or when in high traffic areas.

8. METHOD OF PROCEDURE

STRESS TEST GENERAL PROCEDURES

Caution 1: Proper restraints should be made if, during this stress test period, serious customer service impairment or system performance hazards are detected.

Caution 2: During normal operation ambient room relative humidity is normally maintained between 20 and 55 percent. It is not necessary to maintain this requirement during no cool and heat added test intervals. Low humidity will be experienced and all known precautions to reduce static discharge should be followed (see Practice BR 010-170-005).

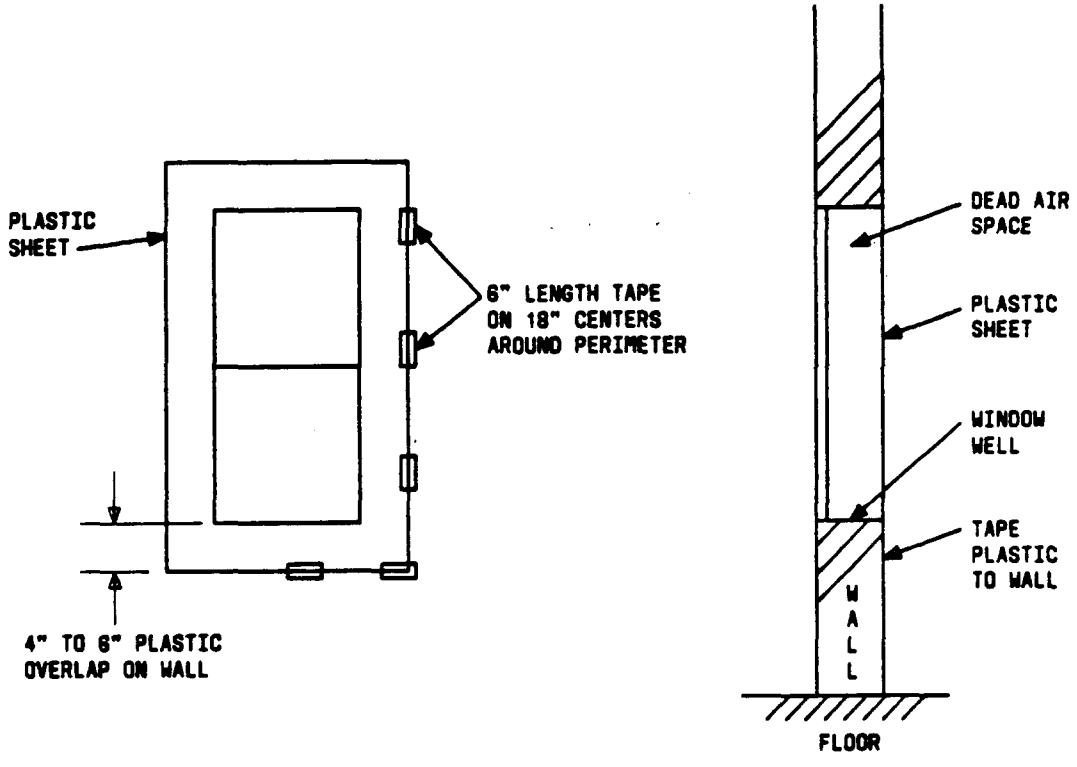


Figure 8. Window Closure

A. Objective

8.01 The objective of the test is to verify that the system can operate for at least 4 hours at a maximum elevated temperature of between 105° and 115°F. There must be no processor diagnostic failure or any other trouble which could affect system integrity for the last 2 hours at the elevated temperature.

B. Overview

8.02 The heat test consists of three parts—(1) no cool, (2) heat added, and (3) cool down phases. The no cool phase consists of turning off the air handling equipment serving the equipment area and allowing the temperature to reach its ambient limit from the machine heat release and the enclosure heat retention. Diagnostics will be run and equipment troubles are expected to be cleared as the no cool heat test progresses. Assuming the machine is stable and trouble free with no major equipment out of service, external heat will be applied for the heat added phase until the maximum heat of 105° to 115°F is reached. When 100°F is reached, the work cycle regimen shall be started and observed until the test area is later reduced to below 100°F. Diagnostics are to be continued and again, assuming a stable machine condition, the 4-hour test run will start in order to meet the performance requirement standards. With successful recovery, the cool down phase will begin (with diagnostics continuing) until a normal ambient temperature (65° to 80°F) is reached, terminating the test. Throughout the test, the maximum change of temperature is to be controlled at 5°F per hour.

8.03 As stated in paragraph 3.01, it is the responsibility of network maintenance to coordinate and control the heat test MOP. At a minimum, the MOP should address the items presented in this part.

C. General

8.04 The following general procedures and practices apply to all phases of the heat test (no cool, heat added test, and cool down).

(1) Perform system evaluation tests per applicable Practices. These procedures test the hardware and software capability of the office to sustain call processing in other than normal duplex system operation. System evaluation tests also determine if any faulty conditions exist. These tests must be successfully completed before the week scheduled for the heat test.

(2) Verify that two oscilloscopes are on site, equipped with the proper complement of regular and current probes for each scope. These are to be located in the heat test area, turned on with minimum intensity when the test starts, and are to remain on for the duration of the test.

(3) Verify that test extender boards applicable to system maintenance are available.

(4) Inventory and verify that the correct complement and series of spare circuit packs are on site and located within the heat test area.

(5) Ensure that cleaning materials for connectors per AT&T Practice 069-350-801 are available.

(6) Verify that emergency procedures, contacts and telephone numbers are established for technical assistance and spare equipment back up. The emergency action Practice shall be located at the maintenance center.

(7) Verify that all communications links to SCC and technical assistance groups are operational. This includes TTY, E2A, and FX lines which must be verified and established prior to the test.

(8) There should be no equipment in trouble or out of service prior to starting the heat test. Exceptions could be minor quantities of trunks, links or service circuits which must be recorded on an

outage log.

(9) A remote maintenance I/O device must be on line in the non-heated portion of the office during the test.

(10) Medically approved and trained switching equipment maintenance personnel shall be scheduled throughout the test interval and should have at least a 30-minute tour overlap to ensure continuity of communicating trouble conditions.

(11) Assure that HVAC personnel are available for the duration of the test who are experienced and familiar with the building system.

(12) Wire wrapping and unwrapping tools for 30-gauge wire should be on site.

(13) For 1A, 2B, and 3ESS switches, verify the following:

  (a) A Biomation 851D Digital Logic Recorder or its equivalent is on site during the heat test. An ITE 5511 Microcode Test Set is recommended to be on site during the test.

  (b) A backplane microscope is on site or its availability for on-site use determined.

(14) For 2B and 3ESS switches, verify the following:

  (a) Just prior to the test, an off-line bootstrap initialization and verification (BWM No. IS4-316) is given to ensure the integrity of the machine to recover. The emergency action panel circuitry should be exercised during light traffic.

  (b) Using the ITE 5971 test converter, perform the main store (MAS) marginal test on all JL2 circuit packs per BIT 78-12, dated 7-31-78. Spare JL2s should also be tested.

(15) Assure that the recommended number of spare program tapes applicable to each system are available in the non-heated area. A spare tape data controller (TDC) should be available in the heated area. Verify the latest CNs (BWMs) are applied.

(16) If applicable, complete a recent change update the day before the test.

(17) Verify the procedures to be followed during the test with the maintenance personnel including the heat safety procedures, record keeping and general method of procedures. Local, company, and system escalation procedures (Practice BR 190-130-147) should be reviewed and agreed upon. Procedures for outage study and reporting problems and deficiencies per Practice BR 010-200-001, Procedures for Operational Trouble Reports on Stored Program Control System, should be utilized.

(18) Verify system operation in the following areas, using the applicable practice:

  (a) Alarms

  (b) Peripheral control links

  (c) I/O devices, carrier

  (d) Status display

  (e) Remote trunks

  (f) Communications link with SCC and local technical assistance groups.

(19) All emergency recovery procedures applicable to the office generic program should be reviewed and the appropriate documents and local procedures should be inventoried and readily

available. Test procedures, safety precautions, and record keeping practices should be discussed with all TELCO maintenance personnel.

(20) As applicable, centralized automatic reporting on trunks (CAROT) and/or remote office test line (ROTL) exercise testing should be scheduled during and throughout the test interval.

D. Final Pretest Equipment Status Check

8.05 All combinations of processors, stores, and all bus systems must be operational, trouble free, and available for normal traffic. Prior to starting the no cool phase, there should be no equipment in trouble or out-of-service, excepting minor quantities of trunks, links or service circuits that are maintenance busy and recorded on the outage log. Also for the duration of the test:

(a) All T-PEST messages shall be normal.

(b) Interrupt printouts shall not be inhibited.

(c) Audits and data validations shall not be inhibited.

(d) Variable destination messages shall be flagged to the maintenance channel.

(e) Supervisory failure (SUPF) printouts shall not be inhibited.

(f) Program store error trapping shall be initiated.

8.06 Traffic load on the machine should be the normal switching load.

STRESS TEST PROCEDURES

A. No Cool Phase

8.07 Perform the following:

> **Note:** All scheduled personnel are to be on site at the start of the test. Full 24-hour coverage must be provided for the duration of the test.

(1) Verify operation of I/O channels to SCC and other technical assistance groups.

(2) Begin full monitoring and logging.

(3) Verify that the Bristol Recorder, or equivalent, is operating for the test record. The recorder should be mounted 5 feet off the floor in the center of the processor aisle and is considered to be the standard heat reference point for the office under test. This recorder should be started about 24 hours before the test start time.

(4) Advise building operations to turn off air conditioning equipment and fans and to start air circulating fans.

(5) Lower and secure the plastic panels to enclose the heat test area. Inspect for air leaks and seal/repair as needed.

(6) Input on the TTY a test start entry, the date, and time. For example, for the 1ESS switch, enter:

"NO COOL TEST START

DATE xx-xx-xx

TIME xxxx $".

(7) Make initial entries in test forms (e.g., Temperature Logs and Trouble Log). Hourly TTY inputs should be made throughout the test period to record time, temperature (reference point and average) and out-of-service equipment units.

(8) Monitor system operation and perform system diagnostics.

(9) **Caution: Implement proper restraints on temperature if any hazards to system performance or customer service are detected.**

(10) Allow temperature to reach its natural ambient level without external heat. The no cool test period should be a minimum of 24 hours, dependent on the highest attainable ambient temperature, and stabilized for 4 hours with no processor diagnostic failures or any other troubles which affect system integrity.

B. Heat Added Test

8.08 Advise building operations to turn on the auxiliary heaters in each aisle of the test area. Input on the TTY a test start entry, the date, and time. For example, for the 1ESS switch, enter:

"HEAT ADDED TEST START

DATE xx-xx-xx

TIME xxxx $".

Heat Control

8.09 For the office temperature control point, use a point 5 feet above the floor along the center line of the processor aisle or the normally hottest spot.

8.10 Portable heaters and fans may be moved as necessary to provide the required (105° to 115°F) equalization of temperature within the test area.

> **Note:** For the 1A ESS switch, direct floor fans directly down file store aisle and at the file store equipment throughout the test to avoid excessive heat build up. Any known hot spots in other switches should be treated the same.

8.11 If a plastic ceiling has been constructed over the top of the cable rack, the heater temperature controls may need to be adjusted more often because air movement between aisles will be limited.

Record Keeping and Data Recording

8.12 In addition to normal trouble records and procedures, a heat test office log for recording pertinent details, such as time, temperature, the trouble indication and when it occurred, and action taken is extremely helpful for tracking and pattern analysis. The office maintenance TTY printouts of troubles and time of occurrence should be included as part of the log. A record of all aisle temperatures

must be taken at intervals no greater than 60 minutes. Refer to Part 10 for examples of these forms and logs.

8.13 Temperature measurements (including rise and fall time) from each temperature sensing unit shall be recorded in at least 1-hour intervals when the system is running normally. When the heat level is being held for the duration of the test or when the system is experiencing troubles, this interval should be shortened to 1/2 hour.

8.14 Time, temperature and out-of-service data should be recorded hourly on the TTY printout by outputting the clock and then typing in the temperature as read from the office reference thermometer (5 feet above the floor along the center line of the processor aisle). A log record should be maintained for equipment out of service other than for diagnostic purposes.

8.15 The personnel work cycle log (see Fig. 9) **must be** carefully maintained and supervised. Use the thermometer/hygrometer recorder as the standard heat test reference point for maintaining work cycles.

Troubleshooting and Circuit Pack Replacement Procedures

8.16 As the test progresses, equipment troubles should be cleared as soon as possible and practicable as each occurs. When major duplex problems are experienced or actual or potential serious customer service equipment or system performance hazards are detected, the heat rise shall be stopped and temporarily suspended (heaters turned off and temperature held at that point) until after the trouble has been eliminated.

> **Note:** The temperature will usually increase a few degrees after the heaters are turned off, but should stabilize after about 1 hour.

8.17 Network maintenance and building engineers should carefully monitor temperature rise and the type and severity of troubles that occur. Building maintenance, on advisement of network maintenance, will stabilize and hold the temperature when duplex equipment is in trouble and until troubles are cleared.

> **Note:** Refer to AT&T Practice 032-173-301; Testing, Replacing, Handling, Storing and Shipping Circuit Packs and Semiconductor Devices; and Practice BR 010-170-005; Electrostatic Discharge.

8.18 The following procedures should be used for determining circuit pack replacement as necessary during the heat test.

(a) Turn off power and reseat all identified and suspected packs one at a time.

(b) Restore power and diagnose. If failure persists, replace indicated packs **one at a time,** until all-tests-pass (ATP) results. During replacement operations, temporarily place all packs on the equipment frame or a cart. To prevent the pack from cooling unnecessarily, circuit packs should never be placed on the floor.

(c) After ensuring that the replacement pack passes several diagnostics, reinsert the original pack and diagnose.

(d) If the original pack still fails, replace it and consider it the faulty pack.

(e) If the original passes diagnostics, tag it and leave it in the equipment.

8.19 All circuit packs being replaced should be kept in the designated area. All defective equipment must be tagged to agree with the trouble ticket form entry.

8.20 A trouble ticket (see Part 10) should be completely made out for each trouble. Include the time recorded and attach the associated TTY printout.

Test Diagnostics

8.21 Throughout the entire test procedure, appropriate system tests and diagnostics should be administered with close observation of TTY printouts.

8.22 The following system tests and diagnostics should be administered hourly/periodically:

(a) Processors [CC/CU and signal processor (SP)] (recommended every even hour).

(b) CS/PS (recommended every even 1/2 hour).

(c) Peripheral unit (PU) exercise tests (recommended every odd hour).

(d) Trunk and service circuit diagnostics (as often as possible without service interference). The CAROT/ROTL testing should be in process.

(e) Automatic line insulation test (ALIT) (if applicable).

(f) Tape cartridge exercises (if applicable).

(g) Tape-to-tape audit (if applicable).

(h) TTY exercises.

(i) For the 1A ESS switch, system audit of stores from tape (SAST) audit.

8.23 For the 2B and 3ESS switches, diagnose the tape data controllers (TDCs) and, with each 10 degree rise in temperature, audit and retension the tapes for the program tape action unit.

8.24 For the 1A ESS switch, file stores should be removed and restored every 15 °F change (up or down) in temperature.

Heat Added Procedure

8.25 Perform the following:

(1) Continue monitoring system operation and temperature rise to assure a linear rise at a maximum rate of 5 °F per hour to a stabilized level of 105 ° to 115 °F, with a minimum of temperature differential as is practical and possible throughout the test area.

(2) Start the 4-hour high temperature testing period when the minimum 105 °F is reached in the coolest measured area. No recorded area should be allowed to exceed 115 °F.

(3) Continue system diagnostics started in the no cool phase.

(4) During the 4-hour period, the following configuration changes should be made, as applicable:

(a) Switch central controls.

(b) Switch PU answer buses.

(c) Switch PU address buses.

(d) Perform checkerboard test on all call stores.

(e) Perform midnight routines.

(f) Perform simplex test in remreed networks.

(g) For the 3ESS switch, perform daisy chain routine.

(h) For TSPS, schedule CAROT, ROTL, or manual transmission testing exercises during the test period in addition to requesting the midnight routines periodically, as time permits.

(5) At least once during the final hour of the heat test, diagnose emergency action circuitry.

(6) Verify that the system runs for at least 4 hours at the maximum elevated temperature (105 ° to 115 °F). During the last 2 consecutive hours, there must be no processor diagnostic failures or any other troubles which affect system integrity.

C. Cool Down Phase

8.26 Perform the following:

(1) Advise building operations to turn off heat and to start cool down at a maximum rate of 5 °F per hour.

(2) Raise selected plastic panels to dispel the heat on a carefully controlled basis while maintaining the temperature rate of change limit.

(3) **Caution: To avoid thermal shock, under no circumstance should the air conditioning equipment be turned on until the ambient air temperature has been at 90 degrees or less for at least 1 hour.**

(4) Continue system surveillance and diagnostics until the ambient temperature reaches 90 °F or less for at least 1 hour. Advise building operations that air conditioning equipment and fans may be restarted.

(5) When the temperature has stabilized at 80 °F, remove trunk test diagnostic inhibits, if activated, and so advise SCC and technical assistance groups.

(6) All plastic enclosures should be removed.

(7) Continue monitoring the system for an additional 24 hours.

D. Post Test Procedures

8.27 Forty-eight hours after completion of cool down (80 °F), perform a system evaluation test.

8.28 Remove the chart from the Bristol Recorder, or equivalent, and gather trouble tickets and all test data in preparation of test summary.

8.29 Remove thermometers/temperature sensing devices and heaters, etc.

8.30 Perform housekeeping as needed to restore the office to the pretest condition.

9. TEST SUMMARY AND DISPOSITION OF FAILED EQUIPMENT

9.01 During the administration of the heat test, standard operating company and system practices cover abnormal service condition reporting for catastrophic failures. However, individual cases, such as heat-related circuit pack failures, shall be compiled from data accumulated from the Heat

Stress Test Log and Test Summary form used during the test. This form provides input for completion of the Heat Stress Test Results and Heat Stress Test Trouble Ticket forms. Refer to Part 10 for examples of these forms.

TEST SUMMARY

9.02 A review team should meet following completion of the test to discuss and tabulate results of data derived from the test. Representatives of the following groups should be considered for the review:

- Network headquarters
- District switching manager
- Building operations
- Building engineering
- Maintenance engineering
- Equipment supervisor
- Operations forces involved in the test.

Also to be evaluated should be data from maintenance trouble printouts and audit messages. Any trouble printouts resulting from defective test equipment, maloperation of test equipment, or interference from other sources should be discounted.

9.03 The following items should be resolved:

(a) Completion of a test summary

(b) Disposition of failed equipment.

9.04 Maintenance engineers should prepare a summary of the test results which includes the number of plug-in devices, by type, which failed and any special and unusual service-affecting failures. Copies of the summary should be directed to:

- The Suppliers support organization
- The local SCC
- ESAC
- Division manager—network maintenance
- Division manager—network administration
- Division staff supervisor—switched services
- Division manager—operator services
- Division manager—network engineering and transmission.

DISPOSITION OF FAILED EQUIPMENT

9.05 If requested by the Supplier, failed components may be sent to them for evaluation. If there is an abnormally high failure rate of any types of circuit pack or apparatus, they should also be sent to the Supplier for test and analysis. The Defective Circuit Pack Tag, form EO-669, should be marked "heat test failure". All other failure data should be included. Engineering Complaints should be originated if appropriate (See Practice BR 010-700-010; Engineering Complaints, Originating and Processing).

9.06 Units under warranty should be processed under the contract in effect with the Supplier. In order to minimize the incidence of "no trouble found", the Defective Circuit Pack Tag should be marked "heat test failure".

10. FORMS

10.01 Examples of forms and charts associated with heat stress testing are as follows:

- **Work Cycle Log** (See Fig. 9)—This form provides a record of the time spent in the heated area for all personnel participating in the test. Refer to AT&T Practice 010-130-001 for specific use of this form.
- **Temperature and Humidity Chart** (See Fig. 10)—This form presents a graphic record of heat test temperature and humidity obtained from a Bristol Recorder, or equivalent.
- **Temperature Recording Log** (See Fig. 11)—This form is used to periodically record each thermometer reading in the heat test area. Note that each thermometer must be labeled according to its location.
- **Stress Test Log and Test Summary** (See Fig. 12)—This form provides a sequential record of test-related reports and failures.
- **Heat Stress Test Result** (See Fig. 13)—This form is optionally available for use in relating failures to temperature conditions for future study and post test analysis.
- **Heat Stress Test Trouble Ticket** (See Fig. 14)—This form is used to record reported troubles and their disposition. In addition, the lower portion of the form is designed to be used for post test analysis.

11. REFERENCES

11.01 References should be made to the following documents for additional information concerning stress tests. All documents listed herein may be ordered by your company documentation coordinator. Document type identification is as follows:

A. AT&T Documentation

(Pre-divestiture)

Engineering Letter (EL)

Systems Letter (SL)

General Letter (GL)

Information Letter (IL)

Recommendation Letter (RL)

Strong Recommendation (SR)

AT&T Practices (BSP)

- EL 5842/RL 79-02-043—Revised Temperature and Low Voltage Tests for New Installations of Local Office Stored Program Control Systems
- EL 6196/SR 78-11-070—Personnel Safety and Guidelines for Heat Testing
- EL 6410/IL 79-05-350—Supplemental Information on Stress Tests for Local Office Stored Program Control Systems
- EL 6745/RL 80-08-389—Recommends In-Service Stress Test—Local ESS Switch and TSPS Offices—Heat and Low Voltage Tests on Stored Program Control Systems (SPCS)
- EL 6755/RL 80-03-449—1A ESS Switch—Guidelines for Recovery Tape Management
- GL 78-04-112—Tape Cartridge Procedures for 2B and 3ESS Switches
- IL 83-03-079—Identification and Testing of Circuit Packs Which Fail at Elevated Temperatures
- RL 80-11-401—Stored Program Control Systems (SPCS) Operational Trouble Reports
- SR 78-11-069—Medical Evaluation for Employee Placement on Heat Testing of SPCS
- SR 80-09-019 Wide Band Temperature Operation—Telephone Equipment Space
- BSP 010-130-001, Heat Test, Stored Program Control System Restriction of Plant Activities, Personnel Safety Guidelines and Requirements, General Methods
- BSP 032-173-301, Testing, Replacing, Handling, Storing and Shipping Circuit Packs and Semiconductor Devices
- BSP 034-360-701, Recorder KS-19125, L3 Requirements and Adjusting Procedures
- BSP 069-350-801, 946-/947- and 970-/971-Type Connectors—Cleaning Procedures
- BSP 231-300-010, Acceptance Test Plan, Description, 2-Wire 1A ESS Switch
- BSP 760-555-151, Atmospheric Environment for Telephone Equipment Space
- BSP 760-660-150, Distribution of Portable Fire Extinguishers
- BSP 770-330-120, Maintenance of Portable Fire Extinguishers
- BSP 770-200-000, Building Mechanical Equipment Inventory, Inspection and Preventive Maintenance Procedures
- BSP 800-610-164, New Equipment—Building System (NEBS)
- BSP 800-630-180, Performance Requirements, General Equipment Requirements
- BSP 820-001-180, Performance Requirements, 1ESS Switch Arranged with 2-Wire Features
- BSP 820-600-180, Performance Requirements, 2ESS Switch Arranged with 2-Wire Features, General Equipment Requirement
- BSP 820-600-186, Performance Requirements, 2B ESS Switch General Equipment Requirements
- BSP 820-650-180, Performance Requirements, 3ESS Switch General Equipment Requirements
- BSP 820-720-180, Performance Requirements, 1A ESS Switch Arranged with 2-Wire Features
- BSP 820-740-180, Performance Requirements, 4ESS Switch General Equipment Requirements

- BSP 821-100-180, Performance Requirements, Traffic Service Position System No. 1.

B. Bellcore Documentation

Technical Reference (TR)

Bellcore Practices (BR)

- TR-EOP-000063—Network Equipment-Building Systems, Generic Equipment Requirements
- BR 010-170-005, Electrostatic Discharge
- BR 010-700-010, Engineering Complaints, Originating and Processing
- BR 190-130-147, Stored Program Control System Trouble Escalation Procedures SCC (Switching Control Centers) Operation Support Systems
- BR 201-021-005, Low Voltage Stress Test, Description and Methods, Stored Program Control System (SPCS)

12. GLOSSARY OF ABBREVIATIONS AND ACRONYMS

12.01 The following abbreviations and acronyms are used in this practice.

AIS	Automatic Intercept System
ALIT	Automatic Line Insulation Test
AMA	Automatic Message Accounting
ATP	All-Tests-Pass
BIT	Broadcast Information Tape
BOCC	Building Operations Control Center
BWM	Broadcast Warning Message
CAROT	Centralized Automatic Reporting on Trunks
CC	Central Control
CO	Central Office
CS	Call Store
CRT	Cathode Ray Tube
CU	Control Unit

DCT	Digital Carrier Trunk
DIF	Digital Interface Frame
DMS	Digital Multiplex Switch
EL	Engineering Letter
ESAC	Electronic Switching Assistance Center
ETL	Equipment Test List
ETS	Electronic Translator System
GL	General Letter
HVAC	Heating, Ventilating, Air Conditioning
IL	Information Letter
I/O	Input Output
ITE	Installation Test Equipment
kW	Kilowatt
MAS	Main Store
MFT	Metallic Facility Terminal
MOP	Method of Procedure
MRF	Maintenance Reset Function
NEBS	New Equipment Building System
NTF	No Trouble Found
OOS	Out of Service
PICS	Plug-in Inventory Control System
PR	Program Listing
PS	Program Store

PSS	Position Subsystem
PU	Peripheral Unit
PVC	Polyvinyl Chloride
REG	Range Extenders with Gain
RL	Recommendation Letter
ROTL	Remote Office Test Line
RSS	Remote Switching System
RTA	Remote Trunking Arrangement
SAST	System Audit of Stores from Tape
SCC	Switching Control Center
SD	Schematic Diagram
SP	Signal Processor
SPCS	Stored Program Control System
SR	Strong Recommendation
SUPF	Supervisory Failure
TDC	Tape Data Controller
TSPS	Traffic Service Position System
TTY	Teletypewriter

WORK CYCLE LOG*

NAME	DATE	TIME		RECORDER TEMPERATURE
		IN	OUT	

* FOR USE WHEN HEAT IN TEST AREA IS 100°F OR GREATER

WORK CYCLE GUIDE

RECORDER TEMP (F°)	MAXIMUM TIME IN	MINIMUM TIME OUT
100	53 MIN.	7 MIN.
105	38 MIN.	22 MIN.
110	32 MIN.	28 MIN.
115	28 MIN.	32 MIN.
120	26 MIN.	34 MIN.

Figure 9. Work Cycle Log—Sample Form

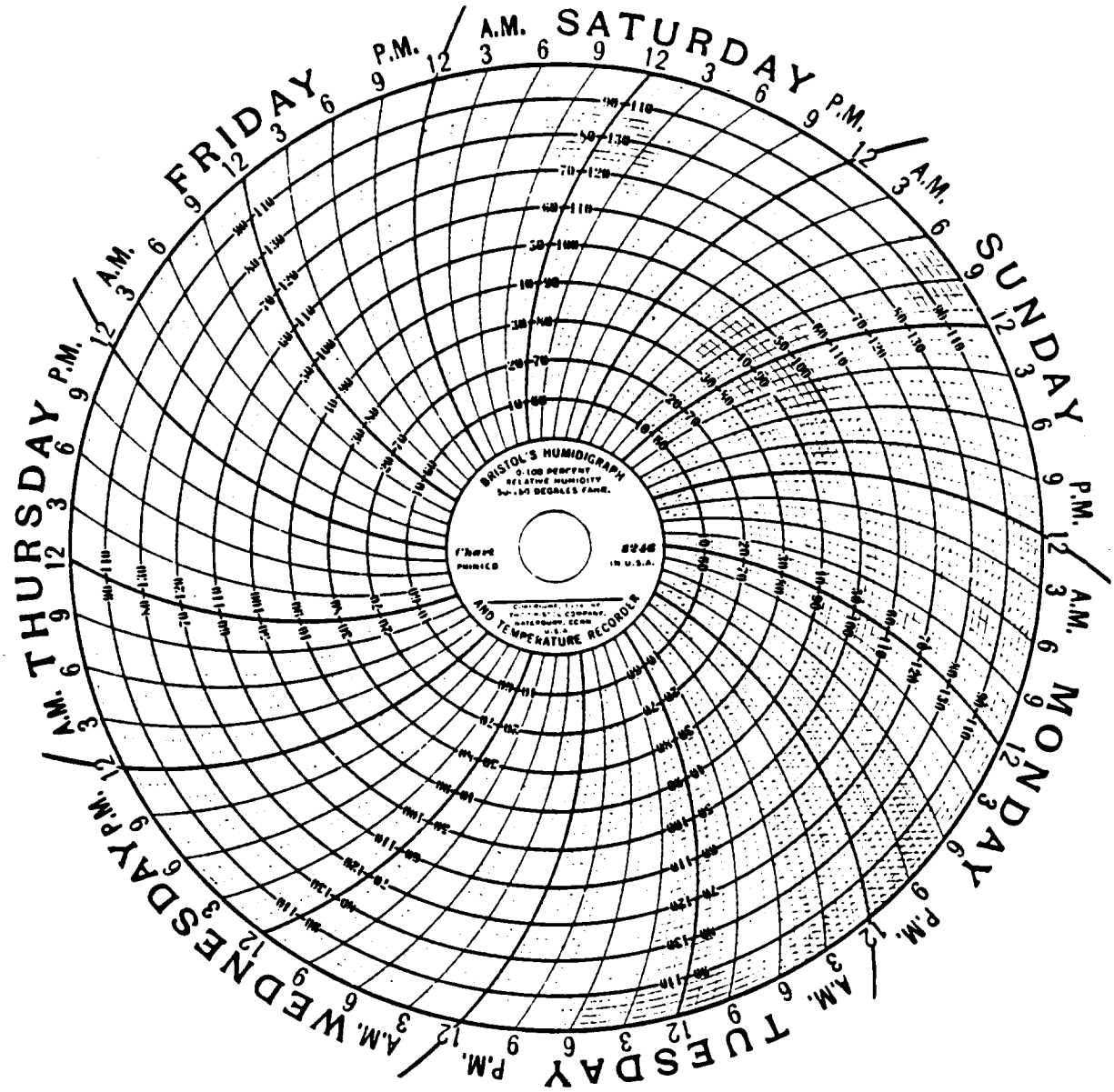


Figure 10. Temperature and Humidity Chart—Sample Form

DATE

TEMPERATURE LOG

THERMOMETER DESIGNATION	TIME											

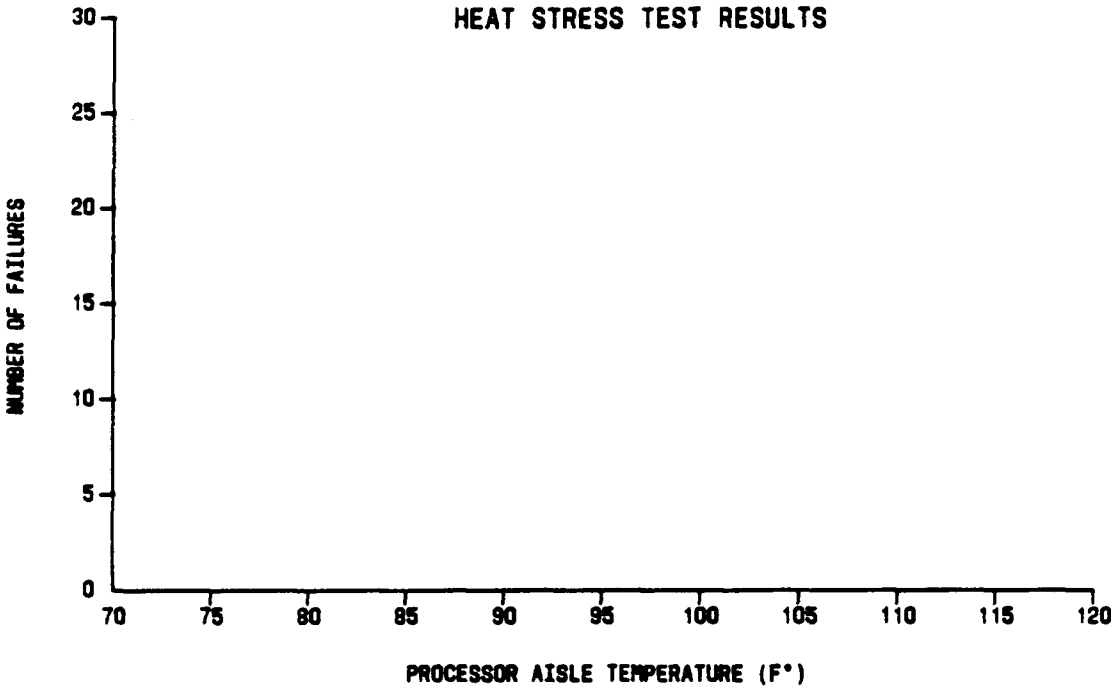
Figure 11. Temperature Recording Log—Sample Form

HEAT STRESS TEST LOG & TEST SUMMARY

OFFICE _____

DATE	TICKET NO.	TIME RCVD	REPORT/FAILURE	TIME CLEARED	FAILED COMPONENT	TEMP	REMARKS

Figure 12. Heat Stress Test Log and Test Summary—Sample Form



FAILURES	TEMPERATURE (F°) AT TIME OF 1ST TTY FAILURE REPORT					TOTALS
	70/79	80/89	90/99	100/109	110/120	
PROCESSOR						
MEMORY						
OTHER						
TOTAL						

Figure 13. Heat Stress Test Results—Sample Form

SPCS Trouble Ticket
ENVIRONMENTAL STRESS TEST

OFFICE	TICKET NO.	REPORTED BY:	LOCATION	DATE	TIME	RECEIVED BY	
CABLE & PAIR/ASSOC EQUIP	FRAME	CLEARED BY	TO	DATE	TIME	TRBL / MEMO	OOS

DETAILS OF TROUBLE	DEGREES (F°) IN PROCESSOR AISLE
	DEGREES (F°) NEAREST FAILED EQUIP

ACTION TAKEN & RESULTS OBTAINED		
	SOFTWARE	
	PROCESSOR	
	PERIPHERAL	
	DIST FRAME	
	NETWORK	
	TRUNK	
	MISC	
	NO TRBL FOUND	
	REFERRED OUT	

UNIT INFORMATION	FAILED UNIT INFO	REPLACEMENT UNIT INFO
TYPE		
LIST OF SERIES		
SERIES NUMBER		
MANUFACTURER'S DATE STAMP		
REPAIR DATE STAMP		

Figure 14. Heat Stress Test Trouble Ticket—Sample Form