

HEAT STRESS TESTS
DESCRIPTION AND METHODS
STORED PROGRAM CONTROL SYSTEMS (SPCS)

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	2	SET UP OF THE HEATERS	17
2. DEFINITIONS AND RECOMMENDATIONS	3	8. METHOD OF PROCEDURE	19
3. COORDINATION	4	STRESS TEST GENERAL PROCEDURES	19
4. PERSONNEL SAFETY	6	A. Objective	19
5. MATERIALS AND APPARATUS	7	B. Overview	20
6. TEST EQUIPMENT AND SPARES	8	C. General	20
7. TEST PREPARATION	8	D. Final Pretest Equipment Status Check	21
GENERAL CONSIDERATIONS	8	STRESS TEST PROCEDURES	21
A. Network Maintenance Considerations	9	A. No Cool Phase	21
B. Building Engineering Considerations	11	B. Heat Added Test	22
C. Building Operations Considerations	14	C. Cool Down Phase	24
TEST AREA ENCLOSURE WALL INSTALLATION	14	D. Post Test Procedures	24
A. Serving Wire Installation	14	9. TEST SUMMARY AND DISPOSITION OF FAILED EQUIPMENT	25
B. Establishing Plastic Panel Length	15	TEST SUMMARY	25
C. Plastic Panel Hanging Procedure	15	DISPOSITION OF FAILED EQUIPMENT	25
D. Closure of Space Above Panels	17	10. FORMS	25
E. Construction of a Plastic Ceiling	17	11. REFERENCES	26
F. Hanging Plastic Panels From A Plastic Ceiling	17	12. ABBREVIATIONS AND ACRONYMS	27
G. Window Closure	17		

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

	CONTENTS	PAGE
Figures		
1.	SPCS Heat Test—Typical Office Layout	10
2.	Amount of Plastic Sheeting Required for Heat Test Enclosure	12
3.	Heat Required for Test Area	13
4.	Serving Wire Installation	15
5.	Establishing Panel Lengths	15
6.	Hanging Plastic Panels	16
7.	Closure of Space Above Panels	18
8.	Window Closure	19
9.	Work Cycle Log—Sample Form	29
10.	Temperature and Humidity Chart—Sample Form	30
11.	Temperature Recording Log—Sample Form	31
12.	Stress Test Log and Test Summary—Sample Form	32
13.	Heat Stress Test Results—Sample Form	33
14.	Heat Stress Test Trouble Ticket—Sample Form	34

Tables

A.	Work Cycle Guide	6
----	----------------------------	---

1. GENERAL

1.01 This section describes the procedures for heat stress testing in-service Stored Program Control System local central offices (COs). The low-voltage stress testing procedures are covered in Section 201-021-005, Low Voltage Stress Tests, Description and Methods, Stored Program Control System (SPCS). All personnel subject to exposure to heat extremes shall be medically approved per Section 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 Whenever this section is reissued, the reason for reissue will be listed in this paragraph. This section does not affect the Equipment Test List (ETL).

1.03 All new 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.

1.04 The SPCSs installed before 1979 that have not been stressed to at least 105°F shall undergo an initial heat added test (105° to 115°F) as described in this section.

1.05 This section also describes a periodic no cool test (cooling system and fans turned off) to identify, control, eliminate, and prevent marginal equipment from being added or accumulated.

1.06 No cool and heat stress test procedures apply to the following SPCS-type systems:

- No. 1 Electronic Switching System (ESS)
- No. 1A ESS
- No. 2 ESS
- No. 2B ESS
- No. 3 ESS
- No. 5 ESS
- Remote Switching System (RSS)
- Voice Storage Services (VSS)
- Traffic Service Position System (TSPS)
- Digital Multiplex Switch DMS 10
- Electronic Translator System (ETS) (No. 5 Crossbar only)
- Automatic Intercept System (AIS)
- Remote Trunking Arrangement (RTA)

- Position Subsystem (PSS).

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

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

1.08 Abbreviations and acronyms used in the section are listed in Part 12.

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, minimum test interval of 24 hours and;
- (2) No processor diagnostic failures or any other troubles which affects 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 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 (before and after any processor or memory growth). If no growth addition is scheduled, the periodic no cool test should be performed once every 2 years. 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 section.

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—eg, up to 72 hours, no more than five times a year). The operating ranges for equipment are specified in Section 760-555-151, Atmospheric Environment for Telephone Equipment Space. The recommended environment for telephone equipment is covered in Section 800-610-164 (and Bell System Technical Reference Publication 51001), New Equipment Building System (NEBS).

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 in strong recommendation (SR) 80-09-019.

2.10 During the tests prescribed in this section, 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 shall be marked out-of-service when the stress test starts. The heat test should be supported by the switching control center (SCC) and the electronic switching assistance center (ESAC), and the building operations control center (BOCC) technical support group during the test. In addition, the regional technical

assistance center (RTAC) should be notified 2 to 4 weeks prior to the start of the test. RTAC will in turn notify the product engineering control center (PECC). 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.

2.12 Eight to ten weeks prior to a proposed heat test, planning meetings should be conducted to assure that necessary requirements are met; eg, manpower, spare parts, special test gear, and building materials (plastic, heaters, etc). All emergency recovery procedures applicable to the office generic should be reviewed and the appropriate Bell System Practice (BSP) 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, (3) a more reliable system, and (4) reduced preventive maintenance.

3. COORDINATION

3.01 To assure successful implementation of the stress test, cooperation and joint effort are required between several areas (eg, building engineering and building operations forces, equipment and maintenance engineering, network maintenance, medical department, and Western Electric) and the various technical assistance centers. However, 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 are to be reviewed well in advance by ESAC and RTAC. One week prior to the actual test start date for each office, ESAC should reconfirm the scheduled test date with RTAC. It is the responsibility of RTAC to coordinate with PECC. This will enable RTAC and PECC to coordinate the availability of support assistance when

requested by ESAC. Normal escalation procedures for troubles should be strictly adhered to as covered in Section 190-130-147, Stored Program Control System Trouble Escalation Procedures SCC Operation Support System.

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, ESS or non-ESS, 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 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 set up 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 and recording aisle temperatures, and correcting for unequally heated areas (hot spots).
- (f) Make arrangements for the provision of a non-heated control area, ensuring that adequate table space is available.

(2) ***Network Maintenance:***

- (a) Establish a TTY link with the SCC/ESAC diagnostic centers 3 days prior to the test.
- (b) Provide the remote maintenance TTY facility in the nonheated control area.
- (c) Provide intercom set up from the non-heated control area, if utilized.
- (d) Assist building operations in the installation of temporary enclosures and temperature recording instrumentation.
- (e) Provide test equipment, spares, and ensure a complete set of office documentation (refer to paragraph 5.01).

(f) Provide medically approved personnel dedicated to the performance of the test and its activities who will be responsible for troubleshooting, 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 TTY link to the SCC/ESAC should be maintained during the entire test.

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

- (a) Assist in establishing a TTY link with the RTAC diagnostic center, if needed. Resolve any technical problems in providing the remote maintenance TTY in the non-heated area.
- (b) Monitor and analyze maintenance printouts for the 3-day period prior to the test start.
- (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, Section 010-130-001 requirements must be followed. This section 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 this time limits, and logging of time in and out is the responsibility of each person. However, 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 Part 10 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 Section 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 lightweight, 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 required). Height required to reach within three feet of 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 Western Electric, is R-4829 plastic sheeting, fire retardant polyethylene, 6 mils thick, 12 feet wide, and 100 feet long. Because of additional heat loss, the use of the R-4829 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, 60 Hz, 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 (at least two per equipment aisle) or thermocouple temperature recording devices as determined by local practice.
- (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 No. 1A ESS 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 (eg, '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 thermo-humidigraph 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 Section 069-350-801).
- (15) Potable water.
- (16) Nonalcoholic, sugar-free, commercial thirst quencher.
- (17) Fire extinguishers. [normal office complement in accordance with Section 760-660-150

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

(distribution) and Section 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
- (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 BSPs, schematic diagrams (SDs), program listings (PRs), input/output message data manuals, emergency and restart procedures, 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 two 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 (No. 1 ESS).

(10) For No. 1/1A ESS, 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 No. 2B and No. 3 ESS, an ITE 5971 test converter, or equivalent.

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

(15) For No. 1/1A ESS and No. 2 ESS, a program store (PS) memory module.

(16) CS memory module (8K or 32K).

(17) Tape Data Recorder.

(18) Spare plug-in complement for other Bell System or outside supplier products for 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 No. 1/1A ESS offices and early (before 1973) No. 2 ESS 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 SUPP 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 pre-test 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, and 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 (see References, Part 11). 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 ESS 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 ESS 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 ESS equipment. In many cases this requires the installation of new digital banks within the same lineup as the ESS equipment. Examples of this are the digital interface frame (DIF) used with No. 4 ESS, D3 direct interface frames used with No. 2 ESS, and digital carrier trunk (DCT) frames used with No. 1 ESS.

7.07 Digital carrier channel banks have been designed to operate satisfactorily (short term) in ambient temperatures ranging from +35° to +120° F. Environmental tests during design are performed by Bell Telephone Laboratories (BTL) on new developments such as D4 channel banks to verify that the banks and associated plug-in circuit packs have the ability to withstand these elevated temperatures.

7.08 It is not necessary to heat test power plants and storage batteries. However, some smaller 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, TTY, or CRT equipment. Control and monitoring of the system temperature and initial analysis will be performed from this area. Temperature control instrumentation, a remote maintenance TTY, or CRT, 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), program listings (PRs), 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 (eg. program tape, stand alone and recovery tape) applicable to the office generic are available and stored in the non-heated area.

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

7.12 Functional operation of peripheral components of the system being tested, using the

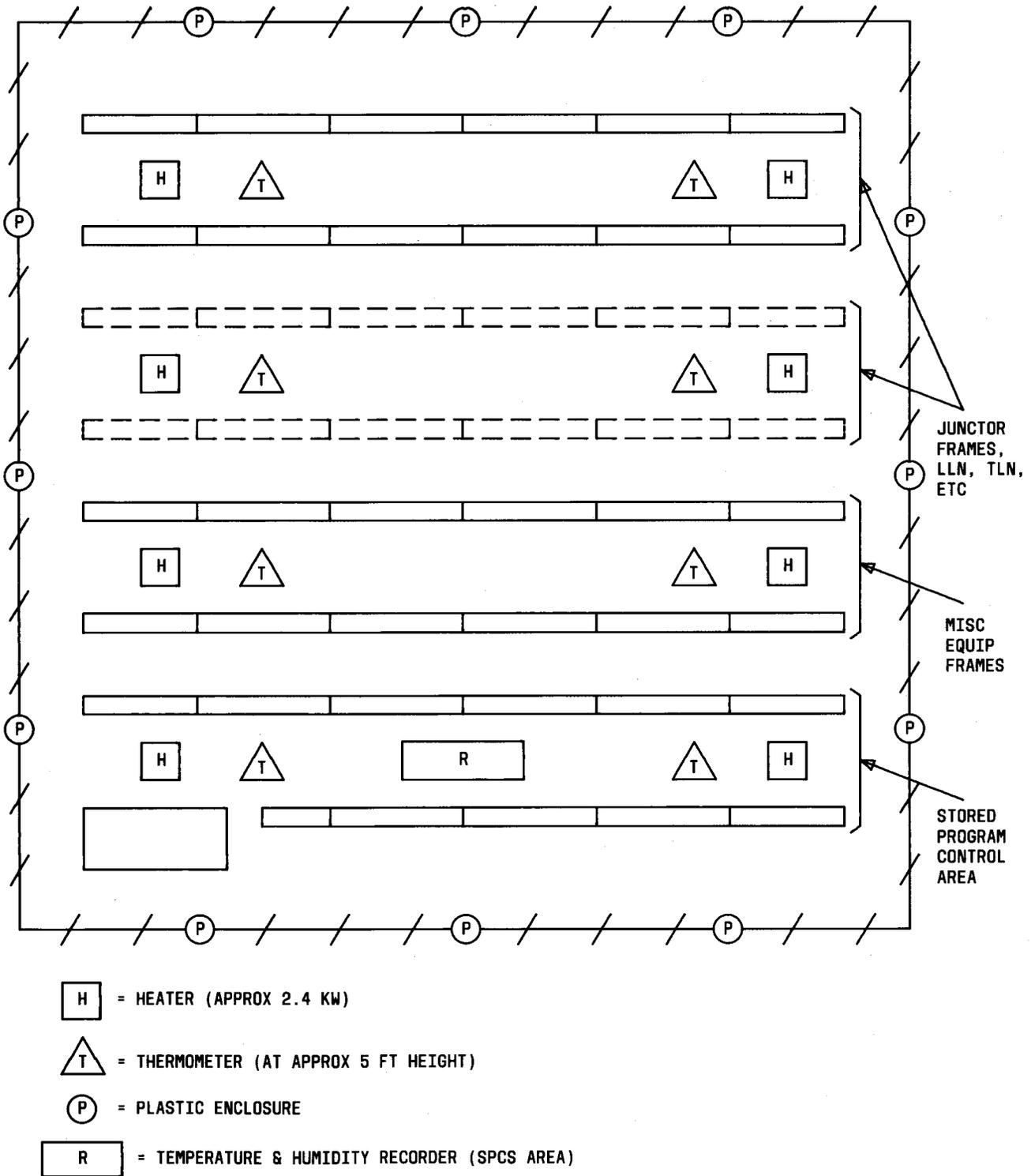


Fig. 1—SPCS Heat Test—Typical Office Layout

appropriate ETL sections, should be completed in advance of the test. A partial list of these components is shown below:

- Peripheral control links (TSPS, as applicable)
- Automatic message accounting (AMA) transport per Section 034-360-701
- TTY, carrier
- Status display
- Remote trunks (as applicable)
- Communications link with SCC/ESAC.

7.13 Low-voltage stress testing (see Section 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/ESAC with Western Electric RTAC alerted before and during the test. In order to allow better support (see paragraph 3.02), RTAC should be notified initially 8 to 12 weeks and again at 4 weeks, prior to the start of the test. The office should be closely observed by SCC/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 listings. All Broadcast Warning Messages (BWMs) 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, or from Western Electric on an emergency basis or from nearby offices in the event they are required.

7.16 Select a storage area designated for defective equipment resulting from the test. This equip-

ment 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

WARNING: Ensure the availability of proper fire-fighting equipment. Refer to Sections 760-660-150 and 770-330-120.

7.18 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.

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.

7.19 Determine the size of the heat test area enclosure required from building or office "T" drawings 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 paragraph 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.

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

7.21 It is the building engineers' responsibility to ensure that sufficient utility power is avail-

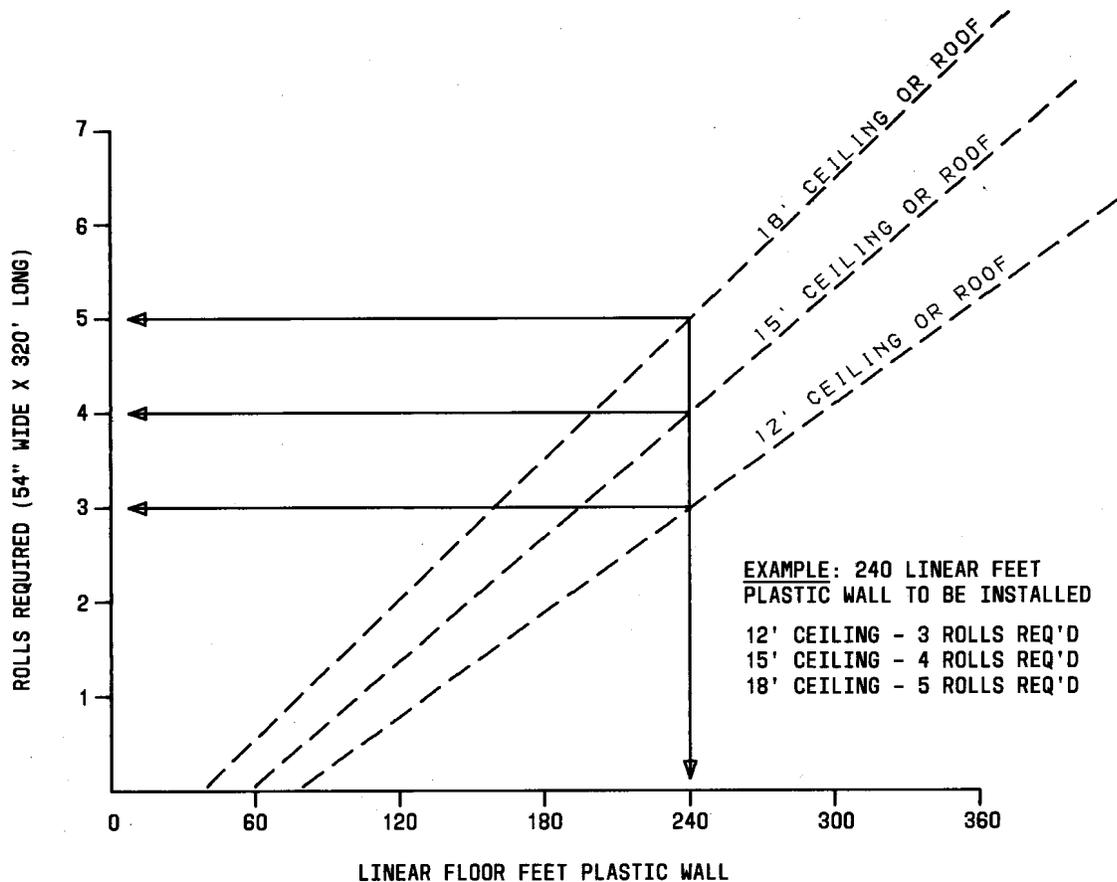


Fig. 2—Amount of Plastic Sheeting Required for Heat Test Enclosure

able 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.

7.22 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.

7.23 Heaters **must** be placed on the floor and not suspended from the ceiling (see paragraph 8.10). 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 sug-

gested 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.

7.24 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 60 kW of additional heat for the enclosed test area. The heater capacities should be between 3.3 kW to 5.6 kW operating on the office utility power. Sixty kW of heat would require 14 heaters, each having 4.22 kW capacity. A heater which has a capacity

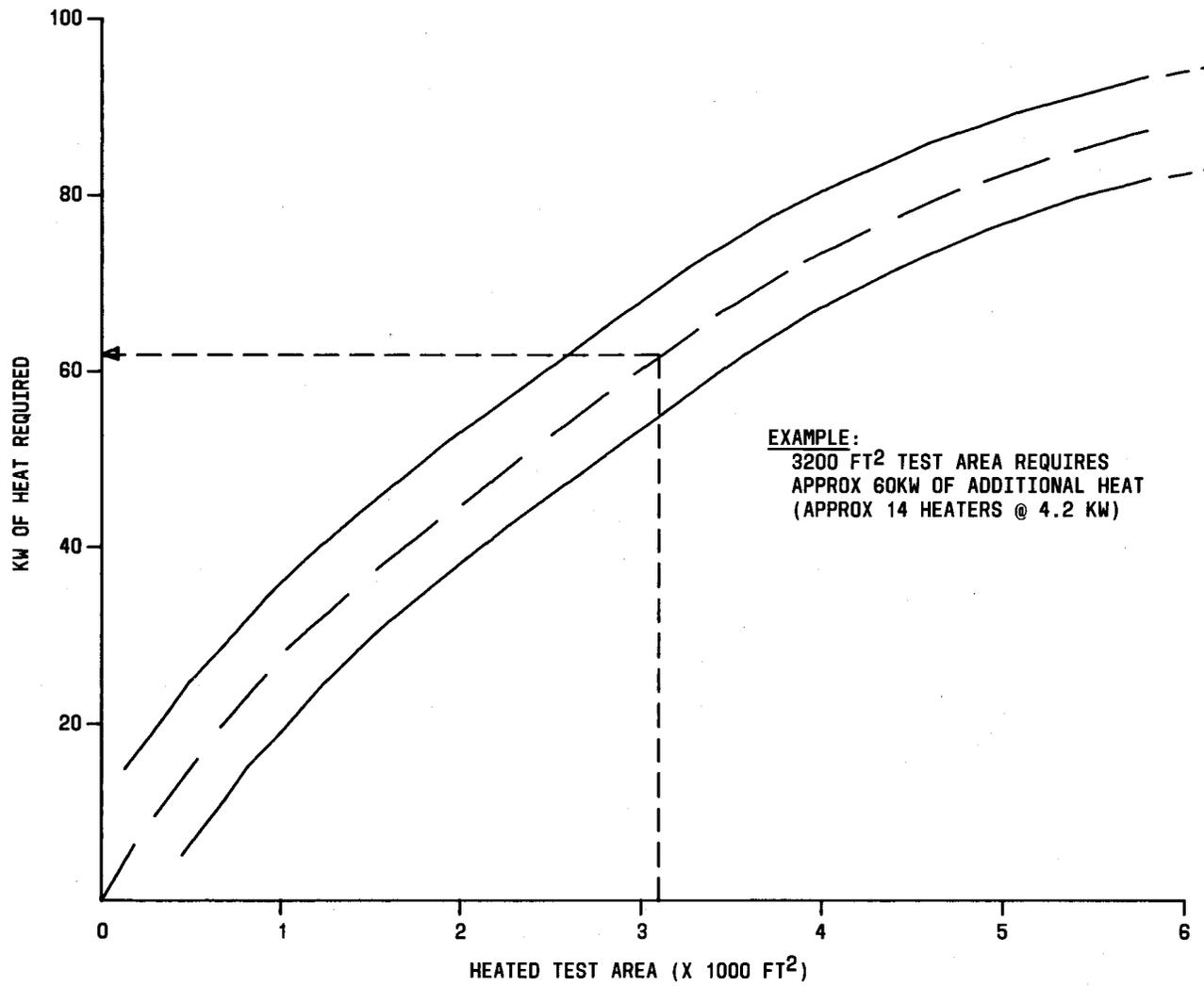


Fig. 3—Heat Required for Test Area

of 5.6 kW 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:

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

7.25 Thermometers or thermocouples will be needed in every front equipment aisle halfway between the frames, 5 feet above the floor in at least two locations in each aisle, and 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, ie, central processor aisle or program store, file store, or call store aisle.

7.26 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 (see paragraph 3.03). 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

7.27 After the area to be tested has been determined and materials and test equipment are available (see Parts 5 and 6), the installation and pre-test 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.

7.28 Make an operational review of heating, ventilating, and air conditioning (HVAC) systems 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.

7.29 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 or cross aisles (see Fig. 1). The thermometers should be placed no more than 25 feet apart. The point used for the office reference (measured along the CS/CU aisle center line at a height of 5 feet above the floor) should be provided with a thermometer/hygrometer (temperature and humidity recorder) and placed 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:

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

7.30 For 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

7.31 Install the temporary plastic enclosures as follows:

Note 1: The following procedures describe the methods of hanging plastic partitions. However, final taping of the plastic wall should not be performed until the day of start of test. 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

7.32 In preparation for hanging the plastic enclosure walls for containing the heat within the test area, an insulated serving wire (see Fig. 4) shall 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 (eg, telephone 'P' wire) may be used.

7.33 This serving wire may be suspended from installed threaded rods, ceiling inserts, or build-

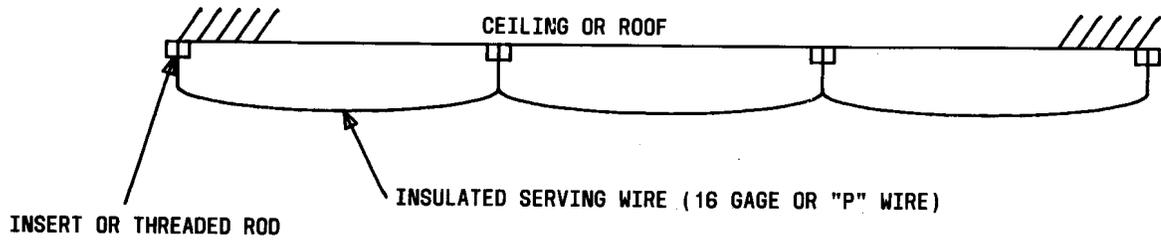


Fig. 4—Serving Wire Installation

ing 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.

B. Establishing Plastic Panel Length

7.34 The plastic panels (see Fig. 5), when hung over the serving wire, shall overlap the wire by at least 6 inches. Hang the plastic panels with the sides as true to vertical as possible. The plastic panels shall touch the floor and have a minimum of 1 to 1-1/2 feet of plastic lying on the floor.

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

7.35 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.

7.36 Tape the horizontal edge of the overhang to

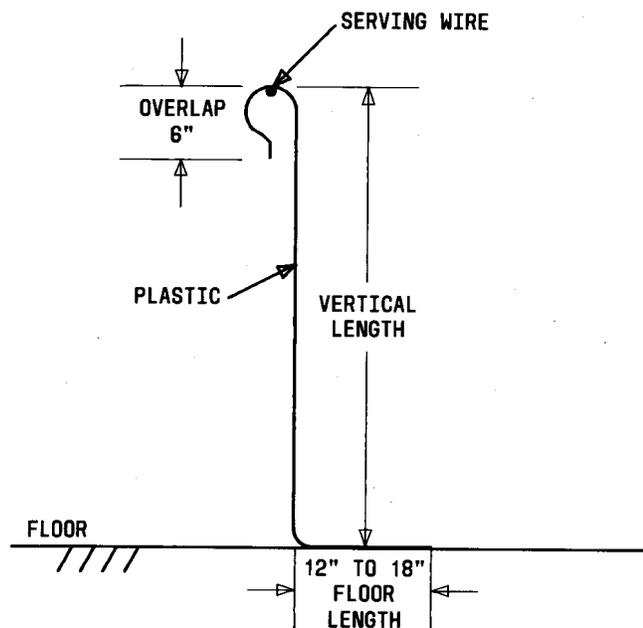
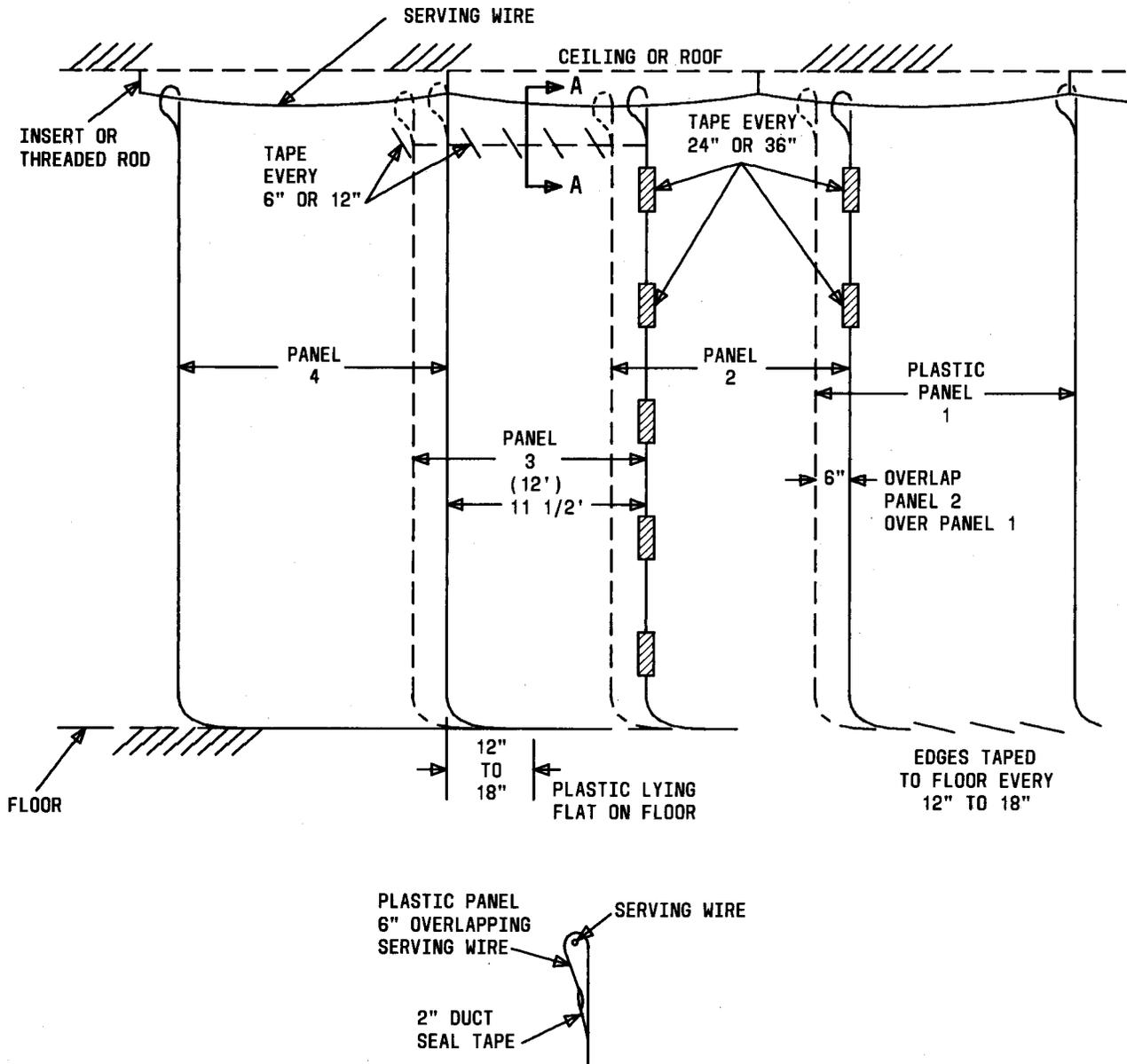


Fig. 5—Establishing Panel Lengths



SECTION A-A

Fig. 6—Hanging Plastic Panels

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

7.37 Hang the next panel so that it overlaps the previous panel by 6 inches along the vertical edge. This vertical overlapped seam shall 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.

7.38 Tape the bottom edges to the floor on the outward side with short lengths of tape every 12 to 18 inches.

7.39 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

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

7.41 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 shall be 6 to 10 inches *inside* the vertical surface of the plastic enclosure.

7.42 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

7.43 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 (eg, 2 by 2 inch or 2 by 4 inch wood, etc).

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

7.45 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.

7.46 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 sealed tight 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

7.47 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.

7.48 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.

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

7.50 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.

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

7.52 A door may be made by not taping one of the vertical seams (see paragraph 7.39).

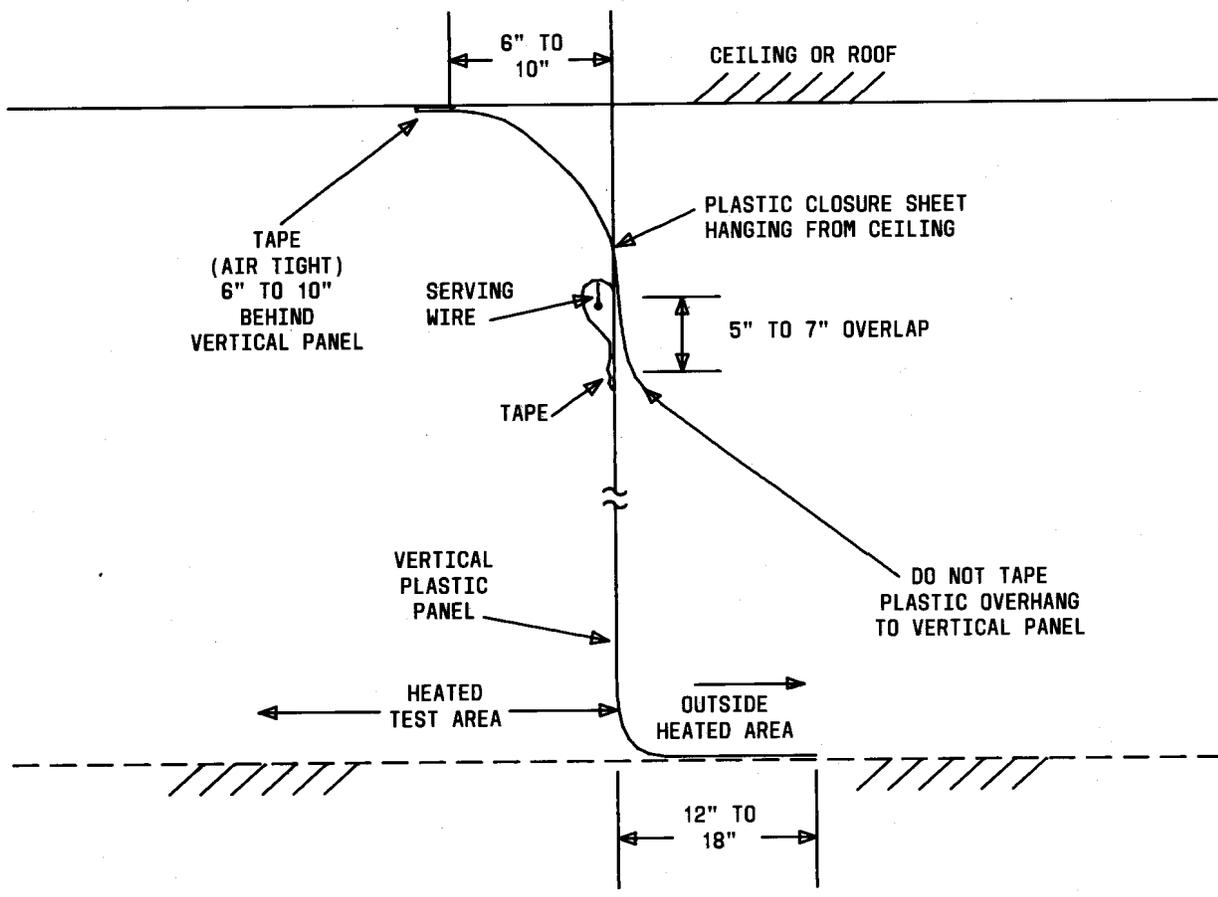
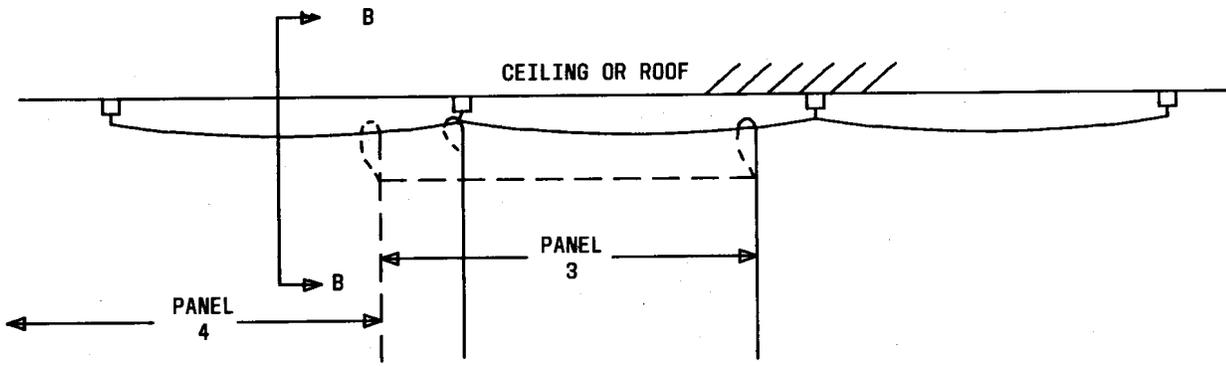
G. Window Closure

7.53 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.

7.54 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.

SET UP OF THE HEATERS

7.55 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 quan-



SECTION B-B

Fig. 7—Closure of Space Above Panels

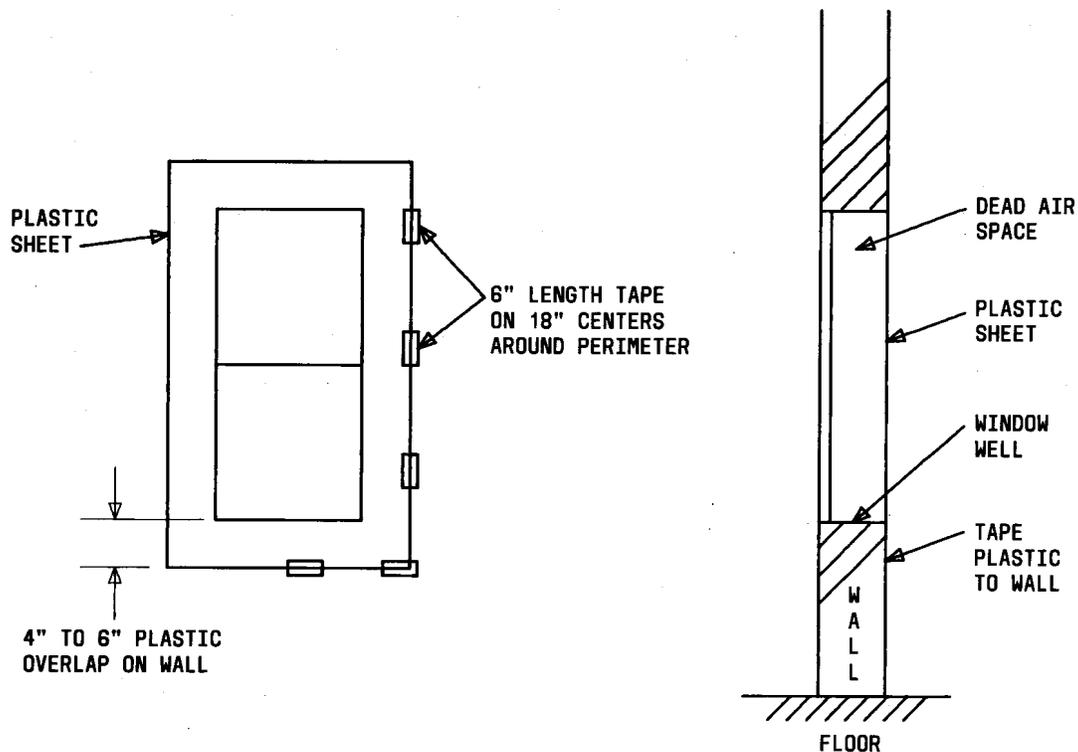


Fig. 8—Window Closure

tity 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.

7.56 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.

CAUTION: *Never direct heated air flow toward the equipment.*

7.57 Connect the heaters to the AC 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 Section 032-173-301).*

A. Objective

8.01 The objective of the test is to verify that the system can operate for at least 4 hours at a

SECTION 201-021-001

maximum elevated temperature of between 105° and 115°F prior to cool down. 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's 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 BSP 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 temperature rate of change 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 BSPs. 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 regu-

lar 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 Section 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 BSP shall be located at the maintenance center.
- (7) Verify that all communication 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 marked in trouble or out-of-service prior to starting the heat test. If so, it should be recorded on a maintenance busy log available at the test site.
- (9) A remote maintenance TTY 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 No. 1A, No. 2B, and No. 3 ESS, verify the following:
 - (a) A Biomation 851D Digital Logic Recorder or its equivalent should be 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 should be on site or its availability for on-site use determined.
- (14) For No. 2B and No. 3 ESS, verify the following:
- (a) Just prior to the test, an off-line Bootstrap initialization and verification (BWM No. IS4-316) should be 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 Convertor, 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 that the latest CNs (BWMs) are applied.
- (16) 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 (Section 190-130-147) should be reviewed and agreed upon. Procedures for outage study and reporting problems and deficiencies per RL 80-11-401, SPCS Operational Trouble Reports, should be utilized.
- (18) Verify system operation in the following areas, using the applicable BSP:
- (a) Alarms
 - (b) Peripheral control links
 - (c) TTY, 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 should be reviewed and the appropriate BSPs 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 marked in trouble or out-of-service, excepting minor quantities of trunks, links or service circuits that are maintenance busy and recorded on the make-busy log. Also for the duration of the test:

- (a) All TTY 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 TTY 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 No. 1 ESS, enter:

"NO COOL TEST START

DATE xx-xx-xx

TIME xxxx &".
- (7) Make initial entries in test forms (eg, 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.

CAUTION: Implement proper restraints on temperature if any hazards to system performance or customer service are detected.

- (9) 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 No. 1 ESS, 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 No. 1A ESS only, direct floor fans directly down file store aisle and at the file store equipment throughout the test to avoid excessive heat build up.

- 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, trouble indication 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 shall 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 Section 032-173-301, Testing, Replacing, Handling, Storing and Shipping Circuit Packs and Semiconductor Devices.

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

- (a) Turn off power and reseal 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 pack passes diagnostics, tag it and leave it in the equipment.

8.19 All circuit packs being replaced shall 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 shall 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). 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 No. 1A ESS, system audit of stores from tape (SAST) audit.

8.23 For No. 2B and No. 3 ESS, 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 No. 1A ESS, file stores should be removed and restored every 15°F change (up or down) in temperature.

Heat Added Procedures

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 shall 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 No. 3 ESS, 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) Continue system surveillance and diagnostics until ambient temperature reaches 90°F or less for at least 1 hour. Advise building operations that air conditioning equipment and fans may be restarted.

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) When the temperature has stabilized at 80°F, remove trunk test diagnostic inhibits, if activated, and so advise SCC and technical assistance groups.
- (5) All plastic enclosures should be removed.
- (6) 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 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 TTY 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 shall 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. In addition to BTL field representatives, Western Electric RTAC and PECC, if requested, and local SCC and ESAC, copies of this summary should be addressed to:

- 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 Failed components may be sent to BTL or WE for further evaluation, if requested. Units under warranty may be processed for repair, replacement, or credit via the DEFECTIVE TAG ROUTINE. To avoid billing for NO TROUBLE FOUND (NTF), failed components must be returned using Form 5141 marked "Heat Test Failure" in the "Add'l Information" space (see BSP 010-700-030). All others may be processed on normal repair and return procedures. Engineering complaints may be applied when determined to be appropriate. If there is an abnormally high failure rate of any types of circuit pack and series or apparatus, it may warrant a special test and analysis at WE or BTL.

10. FORMS

10.01 Examples of forms and charts associated with heat 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 Section 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

SECTION 201-021-001

each thermometer's 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. Document type identification is as follows:

BSP—Bell System Practices (Section ____)

EL—Engineering Letter

HB—Handbook

SL—AT&T System Letter

GL—General Letter

IL—Information Letter

RL—Recommendation Letter

SR—Strong Recommendation

- EL 5842/RL 79-02-043—Revised Temperature and Low Voltage Tests for New Installations of Local Office Stored Program Controlled 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 Controlled Systems
- EL 6745/RL 80-08-389—Recommends In-Service Stress Test—Local ESS and TSPS Offices—Heat and Low Voltage Tests on Stored Program Controlled Systems (SPCS)
- EL 6755/RL 80-03-449—No. 1A ESS—Guidelines for Recovery Tape Management
- GL 78-04-112—Tape Cartridge Procedures for No. 2B and 3 ESS.
- HBO—Installation Engineering Handbook 0, Section 44A, Safety and Health Procedures—Heat Stress Tests—ESS Offices
- HB 261—Installation Engineering Handbook 261, Section 940, ESS Stress Testing, High Temperature, Heating the Office
- HB 274—Installation Engineering Handbook 274, Section 637, High Temperature Tests
- HB 275—Installation Engineering Handbook 275, Section 630.6, Low Voltage, Heat, and Integrated Load Tests
- 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
- Section 010-130-001, Heat Test, Stored Program Control System Restriction of Plant Activities, Personnel Safety Guidelines and Requirements, General Methods
- Section 032-173-301, Testing, Replacing, Handling, Storing and Shipping Circuit Packs and Semiconductor Devices
- Section 034-360-701, Recorder KS-19125, L3 Requirements and Adjusting Procedures
- Section 069-350-801, 946-/947- and 970-/971-Type Connectors—Cleaning Procedures
- Section 190-130-147, Stored Program Control System Trouble Escalation Procedures SCC (Switching Control Centers) Operation Support Systems

- Section 201-021-005, Low Voltage Stress Test, Description and Methods, Stored Program Control System (SPCS)
- Section 231-300-010, Acceptance Test Plan, Description, 2-Wire No. 1A Electronic Switching System
- Section 760-555-151, Atmospheric Environment for Telephone Equipment Space
- Section 760-660-150, Distribution of Portable Fire Extinguishers
- Section 770-330-120, Maintenance of Portable Fire Extinguishers
- Section 770-200-000, Building Mechanical Equipment Inventory, Inspection and Preventive Maintenance Procedures
- Section 800-610-164, New Equipment—Building System (NEBS)
- Section 800-630-180, Performance Requirements, General Equipment Requirements
- Section 820-001-180, Performance Requirements, No. 1 ESS Arranged with 2-Wire Features, Electronic Switching Systems
- Section 820-600-180, Performance Requirements, No. 2 ESS Arranged with 2-Wire Features, General Equipment Requirement, Electronic Switching System
- Section 820-600-180, Performance Requirements, No. 2B ESS General Equipment Requirements
- Section 820-650-180, Performance Requirements, No. 3 ESS General Equipment Requirements
- Section 820-720-180, Performance Requirements, No. 1A ESS Arranged with 2-Wire Features, Electronic Switching Systems
- Section 820-740-180, Performance Requirements, No. 4 ESS General Equipment Requirements
- Section 821-100-180, Performance Requirements, Traffic Service Position System No. 1.

12. ABBREVIATIONS AND ACRONYMS

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
BTL	Bell Telephone Laboratory
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
ESS	Electronic Switching System
ETL	Equipment Test List
ETS	Electronic Translator System
GL	General Letter
HB	Handbook
HVAC	Heating, Ventilating, Air Conditioning

SECTION 201-021-001

IL	Information Letter	RL	Recommendation Letter
ITE	Installation Test Equipment	ROTL	Remote Office Test Line
kW	Kilowatt	RSS	Remote Switching System
MAS	Main Store	RTA	Remote Trunking Arrangement
MFT	Metallic Facility Terminal	RTAC	Regional Technical Assistance Center
MOP	Method of Procedure	SCC	Switching Control Center
MRF	Maintenance Reset Function	SD	Schematic Diagram
NEBS	New Equipment Building System	SP	Signal Processor
OOS	Out of Service	SPCS	Stored Program Control System
PECC	Product Engineering Control Center	SR	Strong Recommendation
PICS	Plug-in Inventory Control System	SUPF	Supervisory Failure
PR	Program Listing	TDC	Tape Data Controller
PS	Program Store	TSPS	Traffic Service Position System
PU	Peripheral Unit	TTY	Teletypewriter
PVC	Polyvinyl Chloride	VSS	Voice Storage Services
REG	Range Extenders with Gain		

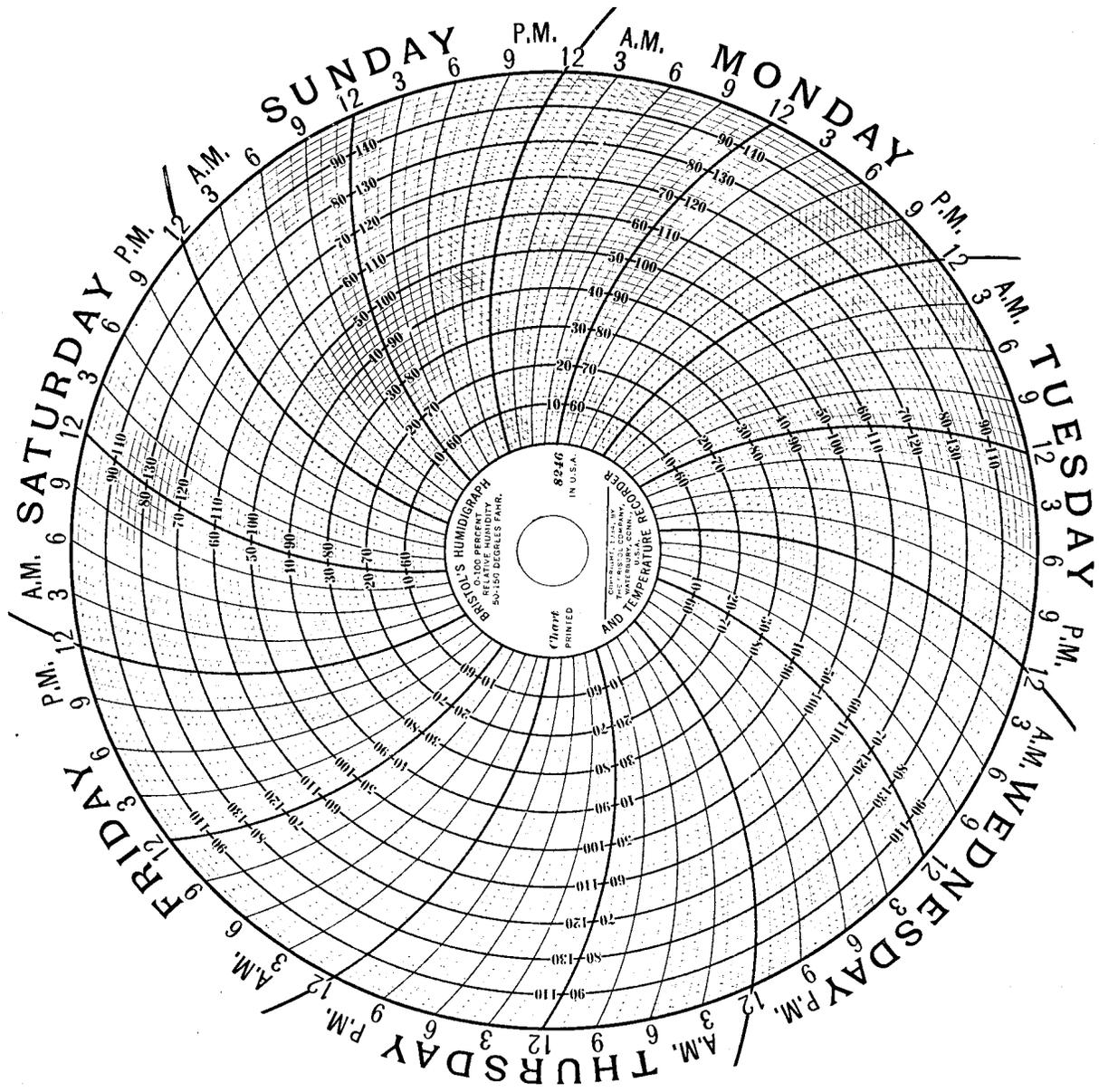
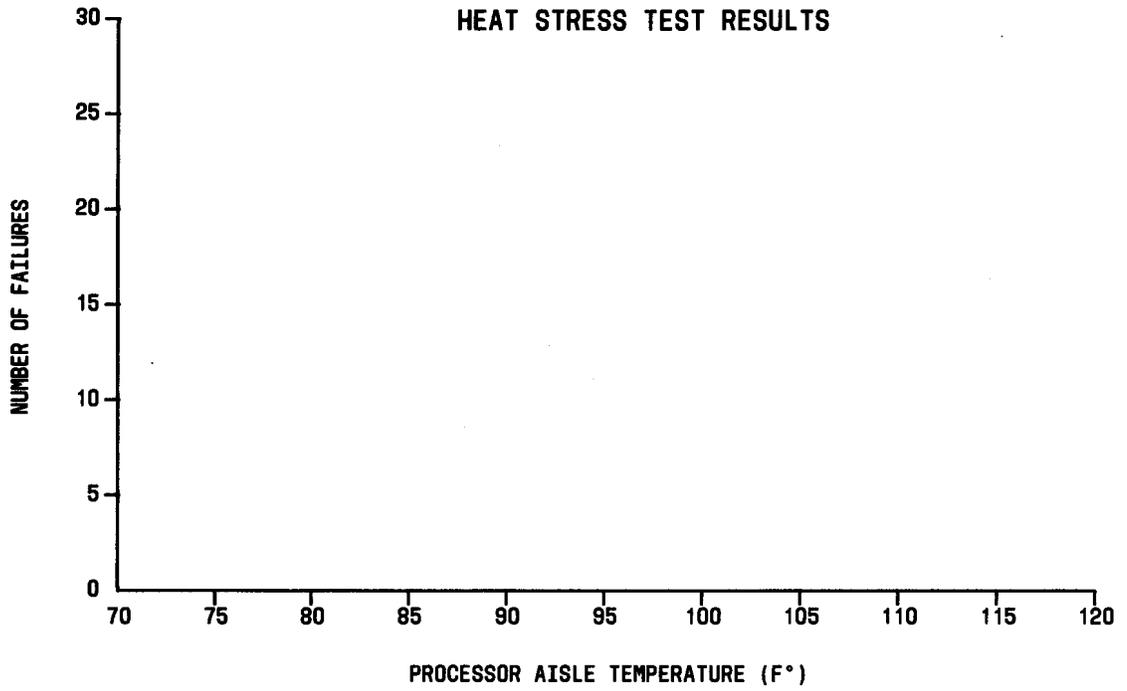


Fig. 10—Temperature and Humidity Chart—Sample Form



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						

Fig. 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		DATE	TIME	TRBL	OOS
		BY	TO			MEMO	
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							

Fig. 14—Heat Stress Test Trouble Ticket—Sample Form