CONVENTIONAL EQUIPMENT COOLING SYSTEMS SERVING NO. 4 ELECTRONIC SWITCHING SYSTEMS

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1. GENERAL

1.01 This section provides standards for the design of conventional air-conditioning systems to serve the No. 4 Electronic Switching System (ESS) toll switching system.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 This practice supersedes General Letter (GL) 77-10-025.

2. EQUIPMENT ENVIRONMENTAL REQUIREMENTS

2.01 Operating limits of the No. 4 ESS toll system, as listed in Section 760-555-151, are:

CONDITION	TEMPERATURE	RELATIVE HUMIDITY
Recommended operating range	40-100°F	20-55%
Short-term condition	35-120°F	20-80%

2.02 The maximum cooling rate to restore normal ambient temperature conditions after an air-conditioning failure is 10°F in an hour. Manual control of the cooling system during restoral operations is the recommended method of meeting this requirement.

2.03 All temperatures and relative humidities are measured in the center of the maintenance aisles, 5 feet above the floor and at least 10 feet from any exterior wall.

2.04 Operation of telephone equipment under ***short-term*** conditions will result in an increase in the normal office error rates. A properly maintained and manned office, with increased maintenance effort, should be able to maintain telephone service.

3. RECOMMENDED HEATING, VENTILATING, AIR-CONDITIONING (HVAC) DESIGN CONDITIONS

3.01 For sizing of the components of the air-conditioning system, the following inside design conditions are recommended:

CONDITION	TEMPERATURE	RELATIVE HUMIDITY
Cooling	80°F	50%
Heating	65°F	20%

3.02 The No. 4 ESS system can operate within wide band temperature limits with constant operation of the HVAC fans. These conditions are:

CONDITION	AVERAGE TEMPERATURE	RELATIVE HUMIDITY
Cooling	80°F	20 to 55% at all times
Heating		
• Occupied	65°F	
• Unoccupied	55°F	

- ***Occupied*** is defined as space in which personnel are assigned to work in excess of 1 hour.
- ***Unoccupied*** is defined as space in which personnel are not present.

3.03 Due to the practical accuracy with which air distribution systems can be balanced, the hottest equipment aisle temperature may exceed the average temperatures recommended in paragraph 3.02 by ± 5°F.

3.04 Provision should be made to temporarily override ***unoccupied*** temperature control settings for occasional unscheduled ***occupied*** periods. This can be accomplished with a timer that will automatically return operation to ***unoccupied*** settings after a 1- to 2-hour period.

A. Support Areas

3.05 The Circuit Maintenance System (CMS) area has operating limits of 60° to 90°F dry-bulb temperature and 20- to 80-percent relative humidity. This system does not have a ***short-term*** operating condition. If the above limits are exceeded, the system will shut down. Recommended design and operating conditions for the CMS area are 75°F dry-bulb temperature and 50-percent relative humidity. Air supply to the CMS area should be provided from an overhead air distribution system. Air outlets should be at least 30 inches above the CMS cabinets. To ensure control within these limits, consideration must be given to redundant air-conditioning systems to protect against both commercial power failures and air-conditioning system failures.

3.06 The following support areas can be designed to general office criteria since no special air conditioning is required.

- Maintenance Operations Center (MOC)
- Machine Administration Center (MAC)
- Trunk Operations Center (TOC).

B. Standby Power

3.07 Standby power should be provided for the equipment area fan systems, chilled water pumps, and all system controls. Standby power should be provided for the equipment area refrigeration system only if it is required to maintain the ***short-term*** environmental conditions. Automatic restart of the equipment area fan systems and chilled water pumps should be provided unless experienced building maintenance personnel can be on site within 1 hour to restart this equipment manually.

3.08 Outside design conditions shall be selected from the 2.5- and 97.5-percent frequency tables of the current American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Fundamentals Guide.

4. INFORMATION REQUIRED FOR DESIGN

4.01 The Equipment Planning Engineer must provide an accurate floor plan of the telephone equipment installation. This plan shall show the initial equipment installation and the subsequent equipment growth additions to the ultimate capacity of the building. The plan shall be marked to show the equipment frame heat release values.

4.02 Equipment heat release values are obtained from Floor Plan Data Sheets and the Telephone Office Planning and Engineering System (TOPES). Twenty-four hour average or planning value heat release figures should be used for design purposes. Unlike many other engineered systems, using higher than actual heat release does not result in safer air-conditioning systems. An oversized air-conditioning system will not produce the intended ambient conditions, will be uneconomical to operate, and will have increased maintenance costs.

5. EQUIPMENT COOLING SYSTEM RECOMMENDATIONS

5.01 The heat release of the various segments of the No. 4 ESS system is highly variable but the total heat release of the office is relatively constant. It does not vary with the traffic load. For this reason, single zone air-conditioning systems that are properly balanced to reflect the various heat densities are recommended. Since the various heat densities do not vary with time or traffic, they do not require different air-conditioning zones. Instead, they should be provided for by air balance.

A. Dual Fans

5.02 To prevent a complete failure of air circulation, it is recommended that the required design air circulation capacity be provided with at least two fans. Arrangement of the fans must allow either of the two fans to distribute air through the common duct system. The use of discharge dampers for each fan will be required so air is not returned to the fan plenum when one fan has failed.

B. Distribution Duct Work

5.03 The dual fans shall supply air to a common air distribution system so failure of one fan does not eliminate air circulation to any area of the equipment space. This provision will provide the ability to provide 60 to 70 percent of the design air quantity in the event of a single fan failure; this together with an operating refrigeration system or increased use of outside air should maintain the short-term operating conditions.

5.04 During the air distribution duct design phase, selection of a plan shall consider the growth plan of the office. One of the objectives should be to operate the minimum amount of fan equipment at any stage of office growth. Do not interweave duct runs in a manner that requires the operation of a fan system to serve a very minor load.

C. Refrigeration

5.05 Provide the required refrigeration capacity using at least two refrigeration units. Refrigeration units cannot reliably operate from no load up to rated capacity. There is a minimum capacity, generally in the range of 25 percent of rated capacity, below which a particular unit will not operate reliably. The system capacity must be designed to match both initial and ultimate system requirements. This will require economic and operational evaluations to determine the size, number, and installation date of the refrigeration units for a particular office.

D. Air Outlets

5.06 Supply air outlets should be sized to provide the required quantity of air into each maintenance aisle. It is not recommended that air be supplied into the wiring aisles unless the required quantity cannot be supplied in the maintenance aisles. Air supply should not impinge on the central office equipment.

5.07 Successful air distribution has been accomplished by the use of many different types of commercial air outlets. Additional information is contained in Section 760-230-101, Equipment Room Air Distribution, and Section 760-550-218*, KS-21344 Air Diffuser Performance Data and Application Guidelines.

E. Controls

5.08 System controls should be as simple as possible so repairs and adjustments do not become major problems. A recommended sequence of controls for wide band temperature operation is contained in RL 80-10-230. This information will be incorporated into Issue 2 of Section 760-550-208, "Engineering Guide for Ventilation and Air-Conditioning Design Parameters and General Planning Information," which will be available by July 1983.

5.09 When possible, depending on local weather conditions, the system should be arranged to

*Check Divisional Index 760 for availability.

utilize an air or water economizer cycle. When a chilled water system is utilized, the chilled water circulating pump should be on standby power and the controls arranged so the pump continues to operate if the water chiller loses power. Fans and components required for economizer operation and system controls should be on standby power so ***short-term*** operating conditions can be maintained during commercial power outages. To prevent overhumidification, it is recommended that a high limit humidistat be provided to close both minimum and maximum outside air openings when space relative humidity exceeds 60-percent relative humidity. Review refrigeration system controls to ensure the chiller downtime, due to momentary commercial power outages, is kept to a minimum. Some control systems will keep the water chiller off the line for periods greater than 30 minutes after restoration of commercial power. Make sure the control sequence does not keep the chiller off the line any longer than necessary for protection of mechanical equipment.

F. High Humidity Control

5.10 The No. 4 ESS system has a relatively constant heat release. A system that has its capacity matched to the space load will not require special dehumidification control circuits. If system capacity cannot be matched to the load, or if extremely high outside relative humidity loads exist, dehumidification may be required when space dry-bulb conditions are satisfied. In the past, this was accomplished by placing a heating coil downstream of the cooling coil. The cooling coil then operated under control of the space humidistat to perform the dehumidification function. The heating coil would operate under control of the space thermostat to prevent subcooling of the space. This method is inefficient and not recommended. It is recommended that the use of new energy for reheat be reduced or eliminated. This can be accomplished with a split coil or face and bypass dampers. Face and bypass dampers cause a large quantity of air to bypass the cooling coil. The small quantity of air passing through the cooling coil is cooled and dehumidified then reheated by the air quantity that bypassed the cooling coil. It is also possible to split the cooling coil thereby reducing the coil surface area that is activated for dehumidification. The required reheat is obtained from the air that has passed through the inactive coil area. When using a split coil, make sure the active coil surface area is the lowest part of the cooling coil so condensate is not reevaporated off inactive coil areas.

G. Alarms

5.11 Due to the rapid changes in environment that can take place in No. 4 ESS systems due to the failure of building equipment, the following alarms are recommended.

(a) Provide a high chilled water temperature alarm to indicate failure of the refrigeration system.

(b) Provide an alarm which will indicate the failure of supply air. Differential pressure indicators across the fan, sail switches, or space high temperature thermostats can be used.

5.12 Exercise care in the selection and application of the alarm sensors to ensure they sense and alarm partial failure of the system. These alarms should activate audible and visual indications. The alarms should have appearances in the MOC area to alert central office maintenance forces and in a constantly attended area occupied by building maintenance force personnel who have responsibility for operation and maintenance of the building air-conditioning systems.

H. Air Balance

5.13 Local air distribution is the key to having a good, efficient air-conditioning system. The most expensive and sophisticated air-conditioning system is only as good as the quality of the air balance job done. Do everything right but the air balance, and the system will not give proper performance. It is necessary to get the proper quantity of conditioned air supply into the maintenance aisles to absorb the heat generated by the equipment lineups forming the aisle. Where there is a significant variation in the heat release values of the frames forming the aisle, the air balance should take this into account by providing more air in the higher heat release areas of the aisle.

5.14 The supply air system should be balanced for the initial equipment installation and for the anticipated growth which will occur in the 1 to 2 year period following cutover. The future growth period, which can be provided by the initial system balance, will depend on the specifics related to each installation. It is recommended that the balance be checked during the Western Electric testing interval to ensure the initial telephone equipment installation plan, used to design the balance, was actually installed. If the equipment layout has been rearranged, it will be necessary to relocate air outlets. It is recommended that air not be supplied to unoccupied equipment growth floor areas. Growth of the equipment installation beyond that used for the initial balance will require subsequent rebalance of the fans and duct work.

5.15 The balance should not be obtained by establishing ultimate fan operating speeds and dampering down the duct system to reduce air flow. This wastes too much energy. The fans in an air-conditioning system can consume more energy than any other single component. The balance should be obtained by establishing fan operating speeds to produce the required operating cubic feet per minute (CFM) capacity, changing sheaves as required to increase the capacity as the system grows to ultimate capacity. This will require coordination to ensure that the Building Engineer is notified of telephone equipment additions sufficiently in advance to initiate the required rebalance work.

6. EMERGENCY OPERATING PROCEDURES

6.01 Emergency operating procedures should be developed for each office. The following are considerations to be included in the development of these procedures.

(a) In the event of failure of the refrigeration system, do not switch over to the ventilation cooling mode of operation until the interior space temperature is 10°F above the outside ambient temperature. This is to prevent over-humidification and/or condensation of moisture on the equipment. Due to the mass of the building and equipment, the rate of temperature rise is not a problem providing air circulation is maintained.

(b) Since multiple fans, with access to standby power are recommended, complete failure of the fan system should not occur. During partial failure of the fan system, it may be necessary to circulate room air, using floor fans, to prevent excess temperature rise in the higher heat release areas.

(c) When restoring an office to normal operating conditions, the rate of temperature change must not exceed the limit specified in paragraph 2.02. Emergency operating temperatures generally will exceed the operating range of the space thermostats so it will be necessary to control the system manually to ensure the rate of temperature change does not exceed the specified limits during the restoration period.

(d) Western Electric conducts a ***no cool*** test on all new No. 4 ESS systems. The test is described in Section 234-182-001. It is recommended that the building engineer, the building operations, and network maintenance groups be involved in these tests to check the performance of the environmental control system and to develop documented methods of procedure to cover emergency operation of the environmental control system and the No. 4 ESS system to ensure continuance of telephone service during emergency conditions.