KS-19210 24-VOLT RECTIFIER, ALL LISTS
S1 SWITCH (S3 SWITCH FOR L1 AND L3)
TESTS, INSPECTIONS, CLEANING, AND ADJUSTMENTS

1. GENERAL

1.01 This section provides a maintenance procedure for testing, inspecting, cleaning, and adjusting the S1 switch (S3 switch for L1 and L3) of the KS-19210 rectifier.

Warning: The voltages of this unit exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time as destructive and dangerous short circuits may occur. Disconnect the ac input power to the rectifier before operating the switch except when necessary to make tests.

1.02 This issue does affect the Equipment Test List.

1.03 The S1 switch should be tested and inspected at an interval specified in the Equipment Test List for the Bell System Practice concerned or more often if experience indicates the need.

2. LIST OF TOOLS, TEST APPARATUS, AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
R-1032	Thermometer
R-8950	Syringe, Rubber
KS-14220, List 14	7/16-Inch Socket Wrench
-	Rachet Wrench, 3/8-Inch Drive
-	Torque Wrench (0-150 ft. lb. capacity)
-	Adapter To Fit Torque Wrench
KS-6909	Gauge
TEST APPARATUS	
KS-20538	Volt-Ohm-Milliammeter
	or
-	Digital Multimeter, Weston Model 1240
MATERIALS	
KS-14666 or KS-2423	Cloth, Cleaning
KS-19578 L1	Trichloroethane
KS-16736 L1	Compound
-	Cloth, Crocus
-	Rouge, Jewelers
-	Asbestos
-	Petrolatum

3. TESTS AND INSPECTIONS OF DC OUTPUT SWITCH

3.01 ***Switch Inspection:***

(a) Open all doors on the cabinet to maximum open position. This gives maximum working space plus maximum visibility of the switch.

Caution: The S1 switch has battery potential on it. Unless the battery potential is removed, extreme care must be used

when performing inspections or maintenance to avoid a short circuit between the switch and other metal parts of the rectifier cabinet. The switch should be insulated from surrounding parts using canvas, plastic sheeting, or other appropriate insulating material before cleaning. Use insulated tools and equipment.

(b) Visually inspect the electrical contact surfaces of the switch for evidence of discoloration indicating excessive heat. If the contacts are purple, bluish-gray, or black, clean and lubricate only those switch contacts in accordance with the cleaning procedure in 3.06. Clean remaining contacts using trichloroethane and lubricate them with a light coat of chemically pure petrolatum. Test the switch, fuse, and bus bar arrangements in accordance with the procedures for electrical and thermal tests (see 3.03 and 3.04) if the contacts remain purple, bluish-gray, or black after being thoroughly cleaned. If the contacts are judged to be in good condition, proceed to (c).

(c) Remove the rectifier from service as follows:

(1) Remove the rectifier from plant operation in accordance with the associated power plant Bell System Practice.

(2) Operate the OFF-NOR (S4) switch to the OFF position.

(3) Operate the associated switch and fuse unit in the bus duct or in the power service cabinet to the OFF position.

(4) Operate the DC OUTPUT (S1) switch to the OFF position.

Note: When the rectifier is shut down, the output filter capacitors should fully discharge through discharge resistors in approximately one minute.

(d) Clean the hinge joints using the following procedure:

(1) On a List 1 or 3 rectifier with the S3 (DC OUTPUT) switch in the OFF position, remove the fuse holder containing fuse F17 and fuse F16. Operate the S3 switch from the OFF (open) to the BAT position five or six times. Then operate the S3 switch from the OFF to the GR1 position five or six times and last, operate the S3 switch from the OFF to the GR1 & GR2 position five or six times. With the S3 switch in the OFF position, replace the F16 fuse and the fuse holder containing the F17 fuse. These actions clean the hinge joints.

(2) On a List 2, List 4 through 7, List 9, List 11, or List 12 rectifier with the S1 (DC OUTPUT) switch in the OFF position, remove the fuse holder containing F4 (CAP FUSE) fuse and the fuse holder which contains the F6 (CAP. ALM) fuse. Operate the S1 switch from the OFF (open) to the BAT position five or six times. On the List 2, List 4, List 7, List 9, List 11, and List 12 rectifiers, operate the S1 switch from the OFF to the GR1 position five or six times. Then operate the S1 switch from the OFF to the GR1 & GR2 position five or six times. With the S1 switch in the OFF position, replace the F4 fuse and the fuse holder which contains the F6 fuse. These actions clean the hinge joints.

(e) Charge the output capacitors in accordance with 3.02. Operate the DC OUTPUT switch to the BAT, GR1, or GR1 & GR2 position, whichever is applicable and remove the capacitor charging circuit. Operate the associated switch and fuse unit in the bus duct or in the power service cabinet to the ON position. Return the rectifier to normal operation in accordance with the appropriate power plant Bell System Practice.

3.02 ***Capacitor Charging Procedure:*** To charge the output filter capacitors, continue as follows.

(a) ***List 1 and 3 Rectifiers:***

(1) Verify that the OFF-NOR (S1) and the DC OUTPUT (S3) switches are in the OFF position.

(2) Remove the fuse holder which contains the F17 (CAP. FUSE ALM) fuse and remove fuse F16.

(3) Operate the DC OUTPUT (S3) switch to the desired position (BAT, GR1, or GR1 & GR2).

(4) Connect a 10-ohm, 50-watt minimum resistor; a 6-ampere, 125-volt dc rated fuse; and a 15-ampere, 125-volt dc rated switch (operated to the off position) in series.

(5) ***Caution: When connecting or disconnecting the resistor, fuse, and switch combination to or from the rectifier, always connect or disconnect both ends of the combination at the same time to avoid dangerous or destructive short circuits.***

Connect the resistor, fuse, and switch combination across the (1) battery and (2) load terminals on the back of the F16 fuseblock.

(6) Operate the switch of the resistor, fuse, and switch combination to the on position.

(7) Read the voltage across the filter capacitors using a portable voltmeter to ensure they are charged and then replace fuse F16 and the fuseholder which contains the F17 fuse.

(8) Operate the switch of the resistor, fuse, and switch combination to the off position. Remove the combination from the rectifier circuit.

(b) ***List 2, 4, 5, 6, 7, 11, and 12 Rectifiers:***

(1) Connect a 10-ohm, 50-watt minimum resistor; a 6-ampere, 125-volt dc rated fuse; and a 15-ampere, 125-volt dc rated switch (operated to the off position) in series.

(2) Verify that the OFF-NOR (S4) and the DC OUTPUT (S1) switches are in the OFF position.

(3) Remove the fuse holder which contains the CAP ALM (F6) fuse and also remove the CAP FUSE (F4) fuse.

(4) Operate the DC OUTPUT (S1) switch to the desired position (BAT, GR1, or GR1 & GR2).

(5) ***Caution: When connecting or disconnecting the resistor, fuse, and switch combination to or from the rectifier, always connect or disconnect both ends of the combination at the same time to avoid dangerous or destructive short circuits.***

Connect the resistor, fuse, and switch combination across the (1) battery and (2) load terminals on the back of the CAP FUSE (F4) fuseblock.

(6) Operate the switch of the resistor, fuse, and switch combination to the on position.

(7) Read the voltage across the filter capacitors using a portable voltmeter to ensure they are charged and then replace the fuse holder which contains the CAP ALM (F6) fuse and replace the CAP FUSE (F4) fuse.

(8) Operate the switch of the resistor, fuse, and switch combination to the off position. Remove the combination from the rectifier circuit.

3.03 ***DC Output Switch Electrical Tests:***

Caution: The millivolt meter should be isolated from ground. Do not use a meter with a 3-wire cord without first disconnecting the ground wire. Always use a 3-wire to 2-wire adapter.

Remove the plastic guards (if equipped) from the top and sides of the switch. After the rectifier has been delivering full load for 4 hours or more with the DC OUTPUT switch in either BAT, GR1, or GR1 & GR2 position, the maximum allowable voltage drop (as measured with the KS-20538 volt-ohm-milliammeter) between the rotary contact blade on the DC OUTPUT switch and the stationary clip representing the switch position on the base shall be 12 millivolts dc (with ambient temperature stabilized).

Note: If the rectifier is delivering less than full load, reduce this value by the same percentage that the observed load is less than the rated load. For example, if the load is 300 amperes instead of 400 amperes, the value should be reduced to 9 millivolts.

3.04 ***DC OUTPUT Switch Temperature Rise Tests:***

(a) Using a suitable insulating material, hold and secure the R-1032 thermometer (or equivalent) against the following points: (1) stationary clips on the base representing BAT when the switch is in the BAT position, GR1

when the switch is in the GR1 position, and GR1 & GR2 when the switch is in the GR1 & GR2 position; (2) switch arm blade when in full contact with BAT, GR1, or GR1 & GR2 stationary clips on the base; and (3) the rotor blade contact stud on the hinge post. Cover the exposed part of the bulb with asbestos and hold the thermometer against each of the check points. Make sure none of the asbestos comes between the thermometer bulb and the surface to be checked. If this should happen, the asbestos would act as a thermal insulator and improper readings would be obtained.

(b) The temperature rise (temperature obtained from check point minus the ambient temperature in the area of the rectifier cabinet) of each check point shall not exceed 30°C for the copper, unplated surfaces, or 55°C for the silver-plated surfaces.

Example: With an ambient room temperature of 25°C, the temperature of the silver-plated switch shall not exceed 80°C, that is 25°C + 55°C. This temperature (80°C) is equivalent to a temperature reading of 176°F allowable under these conditions [using °F = 9/5 (°C) + 32°].

Note: Do not convert the two Centigrade readings separately to Fahrenheit and add the separate Fahrenheit readings since this gives an incorrect value.

3.05 ***Requirements and Corrective Actions (if needed):***

Requirement 1: If all measurements in 3.03 and 3.04 are within limits, no further action is necessary. However, the contacts should be cleaned annually in accordance with 3.06 even if the checks in 3.03 and 3.04 are within limits.

Requirement 2: If any of the measurements in 3.03 and 3.04 exceed the specified limits, clean and lubricate only the switch contacts in accordance with 3.06 without removing the switch from the rectifier. Then repeat the tests in 3.03 and 3.04.

Requirement 3: If after performing Requirement 2, the voltage drop and temperature rise measurements are not within limits, the DC OUTPUT switch must be disassembled, cleaned, and adjusted in accordance with 3.08 through 3.10. Repeat 3.03 and 3.04.

Requirement 4: If after performing Requirement 3, the voltage drop and temperature rise measurements are not within limits, the defective switch must be replaced and the defective unit handled in accordance with local instructions.

3.06 ***Cleaning and Lubrication of DC OUTPUT Switch Contacts (Fixed and Rotary):***

(a) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practices.

Caution: Make sure the OFF-NOR switch is in the OFF position. Operate the associated switch and fuse unit in the bus duct or in the power service cabinet to the OFF position.

(b) Operate the DC OUTPUT switch to the OFF position.

Caution 1: The DC OUTPUT switch has battery potential on it. Extreme care must be used when performing inspections or maintenance to avoid a short circuit between the switch and other metal parts of the rectifier cabinet.

Caution 2: The switch clips representing the BAT, GR1, and GR1 & GR2 positions have battery potential on them. It is preferred to clean the switch with no battery potential on it. This can be accomplished by removing the charge leads. If it is impracticable to remove the battery power, exercise extreme caution when cleaning the switch. Surround live parts with canvas or other insulating material.

(c) Clean the ***copper*** switch contact surfaces as follows:

(1) The mating surfaces of the contacts should be shiny-bright for cool operation. If the rotating member is plain copper (not annealed) both it and the fixed mating contact should be degreased and cleaned of all tarnish. The copper members become oxidized through

lack of use or because of corrosive atmosphere. The copper members should be cleaned with KS-16736 compound to improve current carrying-capacity since copper oxide is an insulator.

(2) Check the contacts for discoloration. If they are discolored (blue to black), check to make sure that all the connecting nuts are securely tightened. Check and, if necessary, tighten all lock nuts to make sure that the fixed contacts are tight against the base plate.

(3) Wipe all accessible contact surfaces clean with a clean KS-14666 cleaning cloth moistened with KS-19578 L1 trichloroethane. It may be necessary to place a cloth under the switch to keep dirt off the parts under the switch. Apply KS-16736 L1 compound liberally to all accessible contact surfaces with a scrubbing motion.

Caution: If battery potential was not removed from the DC OUTPUT switch, the output filter capacitors must be charged as in 3.02 before operating the switch to a closed position.

(4) Clean the contacts by operating the switch as in 3.01(d).

(5) Apply the KS-16736 compound to all accessible contact surfaces to replace the compound removed by the operation of the switch.

(6) After a half-hour interval, remove all of the cleaning compound from the switch using a clean KS-14666 cloth. Then using a cloth moistened with KS-19578 L1 trichloroethane, wipe clean all accessible contact surfaces.

(7) Apply a light coat of chemically pure petrolatum on the contact surfaces of the switch.

(8) A light-weight oil should be used sparingly on the other noncurrent carrying moving parts of the switch.

(d) Clean the ***silver plated*** switch contact surfaces as follows:

(1) Operate the DC OUTPUT switch to the OFF position.

(2) Using a clean KS-14666 cloth soaked with KS-19578 L1 trichloroethane, wipe all contact surfaces clean. Using a clean cloth, wipe all surfaces dry. Continue cleaning until all surfaces are clean.

(3) If black (sulfated) tarnish is present, remove with crocus cloth or jeweler's rouge. Wipe all surfaces clean and dry.

(4) Using a clean cloth, apply petrolatum to the inner surfaces of the contact clips.

(5) If the switch is connected to battery potential, charge output capacitors in accordance with 3.02.

(6) Operate the DC OUTPUT switch to the BAT position. Wipe the excess petrolatum from the BAT clips.

(7) Operate the DC OUTPUT switch to the GR1 position (making sure the output capacitors are charged as in 3.02). Wipe off the excess petrolatum from the GR1 clips.

(8) Operate the DC OUTPUT switch to the GR1 & GR2 position (making sure the output capacitors are charged as in 3.02). Wipe off the excess petrolatum from the GR1 & GR2 clips.

(9) Operate the DC OUTPUT switch in accordance with 3.01(d) to clean the hinge joints.

(10) Restore the rectifier to normal operation in accordance with the appropriate Bell System Practice.

3.07 ***Cleaning the Rotating Arm—Center Connection:***

(a) Clean the joint using KS-19578 L1 trichloroethane. With the DC OUTPUT switch disconnected from battery potential as in 3.01(d) (1 or 2), rotate the joint back and forth through its complete excursion while applying

the cleaner. It may be necessary to place a cloth under the switch to keep dirt off the parts under the switch.

(b) After cleaning, lubricate the joint with KS-19589 L2 lubricant. Rotate the switch again to facilitate oil penetration.

(c) The switch will operate without trouble for longer periods of time between cleanings if it is operated [with the power off and the switch disconnected from battery potential as in 3.01 (d) (1 or 2)] through its complete excursion six times at intervals of every six months.

3.08 ***Disassembly of the DC OUTPUT Switch:***

Note: In general, disassembly of these switches at operating locations is not recommended. Switches requiring disassembly should be replaced and sent to the factory. However, should disassembly for any model become necessary, proceed as follows.

The stationary contacts are tightened against the plastic panel via studs and nuts. Separate the switch by removing the four nuts, one at each corner, from the screws through the mounting supports. The rotor nut must be removed from the drive shaft. An insulated spacer is used to separate the front plate from the base. Clean the holes through which the drive shaft passes and lubricate with petrolatum. Do not ream or enlarge the hole in the base. This will increase the shaft clearance and allow unneeded axial movement.

3.09 ***Working on Disassembled DC OUTPUT Switches:***

(a) ***Cleaning the Rotary Contact Surfaces:*** The rotary contact surfaces may be cleaned when the decks have been separated. First, loosen the nut that is compressing the spring that applies force to the contacting surfaces. This nut is prevented from turning by a set screw. Remove the nut, washers, and spring. This will allow the contacting surfaces to be separated and cleaned. Clean the unplated copper contact surfaces using KS-16736 L1 cleaning compound. When the switch has silver-plated areas, use crocus cloth to clean the areas. If the surfaces are galled or have a burr raised by the seizing action, use a fine flat file to remove the peaks of the burrs so that nothing projects above the average plane. Lubricate the contact surfaces with chemically pure petrolatum.

(b) ***Inspecting, Adjusting, and Lubricating the Switch:*** Check the condition of the contact clips on the end of the rotary arm. They should be shiny bright and free of arc burn projections. A requisite of a proper operating switch is alignment and proper fit on the contacts. The blades must be parallel with the surface of the base and the clip should be flat and parallel with the center line of rotor blade leaves and free of pitting or burn marks. If the rotor blades or clip are mistreated and become distorted, the blades should be checked at the point of entry to the clip. The opening at the outer end of the rotor blade should be approximately 1/16-inch less than the thickness of the clip. The rotor blade should engage the clip so that each leaf of the blade deflects approximately 1/32-inch. The blade leaves should be evenly spaced to allow uniform contact pressure on both sides of the clip leaves. If a clip leaf is not parallel with blade alignment, the leaf may be adjusted by tapping it down toward the base surface with a plastic tip hammer, or pulling it upward from the base surface by placing the point of a screwdriver between the clip leaf end and the base. A practical method of inspection is to attempt to pass a nonmetallic feeler gauge (0.003 inches) between the blade leaf and the clip. The maximum depth reached around the perifery of the blade and clip should be 1/8-inch with the gauge. Adjustment is considered good when both leaves of rotor blade make contact with the clip. Spring washers on the blades provide an even pressure on the clips and take up the wear. The rotary and stationary clips should be lubricated with petrolatum.

3.10 ***Switch Reassembly:*** After the switch decks have been cleaned and inspected, reassemble the switch in the reverse order of disassembly. Rotate the final assembly to see that all decks engage their respective contacts at the same time. When the rotary clips of each deck are engaged, they should completely cover their fixed contact. It is allowable if the rotary contact is 1/16-inch ahead or behind the fixed contact. The complete assembly may now be replaced in the rectifier and the harness wires securely reconnected.

3.11 ***Preventive Maintenance For DC OUTPUT Switch:*** To prevent gradual build-up of oxides or other nonconductive materials that may cause switch failure, operate the switch [with the power off and the switch disconnected from battery potential as in 3.01(d) (1 or 2)] through its entire range about six times at intervals of every six months.