

**KS-19213, 48-VOLT RECTIFIER  
DC OUTPUT SWITCH  
TESTS, INSPECTIONS, CLEANING, AND ADJUSTMENTS**

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**1. GENERAL**

1.01 This section provides a maintenance procedure for testing, inspecting, cleaning, and adjusting the DC OUTPUT (CHG or BAT DISC) switch.

*Note:* The AC TAP (CS) switch is a sealed unit and should not be taken apart for cleaning. If the switch is defective, it should be replaced.

***Danger:*** The voltages in 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 working on the unit except when necessary to make tests.*

1.02 This section is reissued to add information concerning the cleaning of the KS-19213 48-volt rectifier dc output switch. Revision arrows have been used to emphasize the more significant changes. This issue does affect the Equipment Test List.

1.03 The CHG or BAT DISC switch (see Fig. 1) should be tested and inspected at an interval specified in the Equipment Test List or more often if experience indicates the need.

**2. LIST OF TOOLS, TEST APPARATUS, AND MATERIALS**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
R-1032	Thermometer
R-8950	Syringe, Rubber
KS-14220, L14	7/16-Inch Socket Wrench
—	Ratchet Wrench, 3/8-Inch Drive
—	Torque Wrench (0-150 ft lb capacity)
—	Adapter to fit Torque Wrench
KS-6909	Gauge

**NOTICE**

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

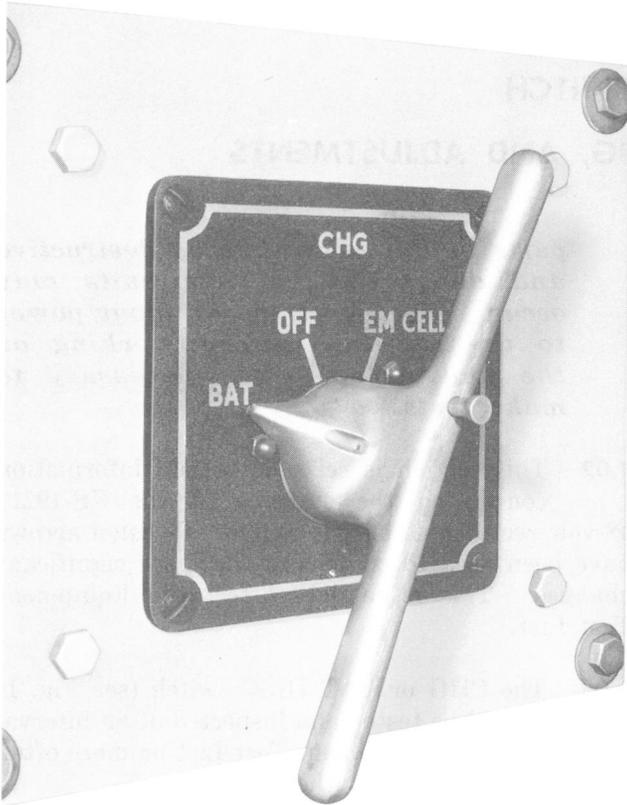


Fig. 1—DC Output Switch (Q Option)

TEST APPARATUS

- KS-20538 Volt-Ohm-Milliammeter
- Simpson, Model 388-3L Temperature Meter (or equivalent) or
- ♦Fluke Model 8030A Digital Volt-Ohm-Milliammeter equipped with optional 80T-150 Temperature Probe (or equivalent)♦

MATERIALS

- KS-14666 or Cloth, Cleaning
- KS-2423
- KS-19578, L1 Trichloroethane
- KS-16736, L1 Compound
- Cloth, Crocus
- Rouge, Jewelers

♦Refrasil\*♦

- Chemically Pure Petrolatum
- ♦NO-OX-ID♦
- KS-7860 Petroleum Spirits
- KS-19589, L2 Lubricant

\*Registered Trademark of Hitco Materials Division.

**Danger: Do not use asbestos. Refrasil is a recommended substitute for asbestos and produces no known harmful effects when used as a heat barrier.**

3. TESTS AND INSPECTIONS OF DC OUTPUT SWITCH

A. Switch Tests

3.01 **Removing Rectifier From Service:**  
Prior to beginning switch tests, proceed as follows.

**Warning: The CHG or BAT DISC 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.**

- (a) Open all doors on the cabinet to maximum open position and remove the guards. This gives maximum working space plus maximum visibility of the switch.
- (b) Remove the rectifier from service in accordance with the following section which applies:

SECTION	TITLE
♦169-715-301	Rectifier, KS-19213, L2, 48 Volts, 800 Amperes Operating Methods

SECTION	TITLE
169-717-301	Rectifier, KS-19213, L5 and L9, 48 Volts, 800 Amperes, Operating Methods
169-718-301	Rectifier, KS-19213, L6 and L7, 48 Volts, 800 Amperes, Operating Methods
169-718-312	Rectifier, KS-19213, L11 and L12, 48 Volts, 800 Amperes, Operating Methods

- (1) Operate OFF-NOR switch to OFF to shut down the rectifier, and then disconnect the ac input.
- (2) Operate the CHG (Q option) or BAT DISC (R option) switch to the OFF position and wait approximately 10 seconds.
- (3) Remove the following fuses: A, B, C1, C2, C3, C4, C1 ALM, C2 ALM, C3 ALM, C4 ALM, and VM ALM.
- (c) Visually inspect the electrical contact surfaces of the CHG switch or BAT DISC switch, CHG fuse, bus bars, etc, for evidence of discoloration indicating excessive heat.

### 3.02 Exercising CHG or BAT DISC Switch:

- (1) Operate the CHG or BAT DISC switch four or five times through all its positions. The wiping action will aid in cleaning the switch contacts.
- (2) Return the switch to the OFF position.

### 3.03 Exercising CS Switch:

- (1) Operate the CS switch (if furnished) through all its positions.
- (2) Return the CS switch to the BAT position.
- (3) Test the switch, fuse, and bus bar in accordance with the procedures for electrical and thermal tests.

**Note:** When the rectifier is shut down, the output filter capacitors should fully discharge

through discharge resistors in approximately one minute.

### 3.04 Returning the Rectifier to Service:

- (1) Replace all the fuses removed in sub-subparagraph 3.01(b)(3).
- (2) Open the meter and relay panels and connect a jumper from terminal 1 of the OFF-NOR switch to the 11B contact of the LO relay in the rectifiers with G option. In rectifiers with H option, connect the jumper from terminal 5 of the OFF-NOR switch to the 11B contact of the LO relay. This bypasses the interlocks on the CHG switch. No interlock is furnished when the rectifier is equipped with a BAT DISC switch.
- (3) Operate the CHG or BAT DISC switch to an intermediate position between the OFF and BAT positions or between the OFF and F positions, depending upon the option. Verify the position by checking the contacts on the rear by sight.
- (4) Maintain the switch in the intermediate position and start the rectifier to charge the output filter capacitors C1A-F and C4A-F.

**Requirement:** The VM voltmeter on the rectifier should indicate approximately the battery voltage or battery voltage plus end-cell voltage.

- (5) If the VM voltmeter does not indicate approximately battery voltage, or battery voltage plus end-cell voltage, adjust the FLT ADJ.
- (6) When the VM voltmeter indicates approximately the battery voltage, or battery voltage plus end-cell voltage, operate the OFF-NOR switch to OFF to shut down the rectifier.
- (7) Operate the CHG or BAT DISC switch to the BAT or F position.
- (8) Remove the jumper connected in (2).

- (9) Return the rectifier to service in accordance with the appropriate plant practice if the rectifier is connected to a plant or the associated operating methods if the rectifier is not associated with a plant.

**DC Output Switch Voltage Drop**

**3.05 ♦ Measuring Voltage Drops:♦**

**Caution:** *The millivoltmeter should be isolated from ground. Do not use a meter with a 3-wire cord without first disconnecting the ground wire. If possible, use a 3-wire to 2-wire adapter.*

**Warning:** *Isolation of the millivoltmeter produces a potentially hazardous condition and care should be exercised. Avoid direct bodily contact between the test instrument and other components or ground.*

- (1) Operate the rectifier at full load for approximately 1 hour with the CHG or BAT DISC switch in BAT or ♦F♦ position.
- (2) Measure the voltage drop across the points shown in Table A.

**DC Output Switch Temperature Rise Tests**

**3.06 ♦ Temperature Rise Test Using the R-1032 Thermometer♦**

**Note:** The rectifier doors should be closed for half an hour before taking the following measurements. The measurements should be taken as quickly as possible upon opening the rectifier doors. The temperature of the switch contacts will decrease when the doors are opened. If the measurements cannot be taken within 2 minutes, close the doors for half an hour and then repeat the following procedures.

- (1) With the rectifier operating as per subparagraph 3.02 (1), and using a suitable insulating material, ♦such as Refrasil,♦ cover the thermometer, leaving only the bulb exposed.

TABLE A

**DC OUTPUT SWITCH VOLTAGE DROP MEASUREMENTS**

MEASURE		MAXIMUM ALLOWABLE MILLI-VOLTS DROP
FROM	TO	
Tang on the load side of the CHG fuse	Bus bar approx 1/2 inch from the fuse tang	15
Tang on the line side of the CHG fuse	Bus bar approx 1/2 inch from the fuse tang	15
Common stud of CHG or BAT DISC switch	Bus bar approx 1/2 inch from the stud	15
Common stud of CHG or BAT DISC switch	F stud of switch	30
F stud of CHG or BAT DISC switch	F bus bar approx 1/2 inch from F stud	15

- (2) Hold the thermometer bulb against each of the check points listed in Table B.

**Note 1:** Make sure none of the ♦Refrasil♦ comes between the thermometer bulb and the surface being checked. Otherwise, the ♦Refrasil♦ would act as a thermal insulator and inaccurate readings would be obtained.

**Danger:** *Do not use asbestos. Refrasil is a recommended substitute and produces no known harmful effects when used as a heat barrier.*

**Note 2:** The temperature rise (temperature read minus the room ambient in the vicinity of the rectifier cabinet) of each shall not exceed 30°C for the copper, unplated surfaces,

◆ TABLE B ◆

DC OUTPUT SWITCH  
TEMPERATURE MEASUREMENTS

MEASUREMENT POINT	LOCATION
Tang	Load side of CHG fuse
Tang	Line side of CHG fuse
Bus Bar	Approximately 1/2 inch from the common stud of the CHG or BAT DISC switch
Bus Bar	Approximately 1/2 inch from the F stud of the GHG or BAT DISC switch

or 55°C, for the silver plated surfaces. If the temperature rise is very close to maximum, measure switch temperature following the procedure in paragraph ◆3.07 or 3.08.◆

**Note 3:** This rectifier is not designed to operate in a room in which the temperature of the ambient air exceeds 40°C.

**Example:** If the ambient room temperature is 25°C and the contacts are silver plated, the temperature of the switch shall not exceed 80°C, that is 25°C +55°C. If the contacts are bare copper, the temperature of the switch shall not exceed 55°C, that is 25°C +30°C. If the room ambient temperature is 40°C, the silver plated contacts shall not exceed 95°C and, if unplated, copper shall not exceed 70°C. These temperatures are equivalent to the following Fahrenheit temperatures [using °F = 9/5 (°C) +32°]: 80°C = 176°F, 55°C = 131°F, 40°C = 104°F, 95°C = 203°F, and 70°C = 158°F.

**Note 4:** Do not convert the two Centigrade readings separately to Fahrenheit and add the separate Fahrenheit readings since this gives an incorrect value.

3.07 ◆ *Temperature Rise Test Using the Fluke Volt-Ohm-Milliammeter:*

- (1) Set the Fluke meter to the 200 mV scale; attach the temperature probe to the meter.
- (2) Measure the temperatures at the points listed on Table B. The readings on the Fluke meter are interpreted as 1°C/mV.

**Note:** With the Fluke meter and temperature probe, the temperature may be read directly. However, if all points cannot be monitored within 2 minutes, close the door and wait 30 minutes before continuing to take the readings.

3.08 *Temperature Rise Test Using the Simpson Temperature Meter:*

- (1) Affix sensors to the test points designated on Table B.
- (2) Run attached flexible leads to the outside of the enclosure.
- (3) Close the rectifier door and wait 30 minutes before taking readings.◆

3.09 *Requirements and Corrective Actions (if needed)*

**Requirement 1:** If all the voltage drop and temperature rise tests are within limits, no further action is necessary. However, the contacts should be cleaned annually even if the ◆voltage drop and temperature rise tests◆ are within limits.

**Requirement 2:** If any of the ◆voltage drop or temperature rise tests◆ exceed the specified limits, clean and lubricate only the switch contacts without removing the switch from the rectifier. Then repeat the ◆voltage drop and temperature rise tests.◆

**Requirement 3:** If after performing Requirement 2, the voltage drop and/or temperature rise measurements are not within limits, the CHG or BAT DISC switch must be removed, disassembled, cleaned, and adjusted.

Check that: (a) the surfaces of each rotor arm contact exerts pressure on the stationary contacts to insure good electrical contact on each side of the stationary contact, (b) the rotor moves smoothly and positively from one position to another, and (c) the rotor arm and stationary contacts are so aligned that when in contact the radial center lines are within 1/16 inch of each other.

**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.

#### B. Inspection, Cleaning, and Lubrication of DC Output Switch Contacts

**3.10** ♦Inspect, clean, and lubricate DC output switch as follows:♦

- (1) Remove the rectifier from service in accordance with the sections ♦listed in subparagraph 3.01(b).♦

**Caution:** *Make sure the OFF-NOR switch is in the OFF position.*

- (2) Operate the CHG or BAT DISC switch to the OFF position.

**Warning:** *If the switch is to be removed from the rectifier, the rectifier should be disconnected from the main plant battery bus bars. This is a supervisory decision. If it is not disconnected, proceed with extreme caution as destructive and dangerous short circuits may occur.*

**Note:** The requirements listed in this section shall be gauged by eye or feel.

**3.11** ♦**Preliminary Visual Inspection:**♦

- (1) Remove the top panel located on the rear of the rectifier.
- (2) Inspect the fuse tangs and both bus bars, especially the areas at the fuse tang and

the switch terminal connections. Inspect the F bus bar especially at the switch terminal connection. If the copper is still bright or dull copperish, the switch is probably functional. Purple, bluish gray, or black is an indication the switch has been subjected to excessive heat.

**3.12** ♦**Detailed Inspection:**♦

- (a) Remove the CHG or BAT DISC switch as follows.

- (1) Remove handle from nameplate.
- (2) Disconnect switch from all bus bar connections.
- (3) Remove the four outside bolts on the mounting plate.
- (4) Remove switch from rectifier.

- (b) If the phenolic material about any terminal is charred, discolored, or black, the switch should be replaced; if not, proceed to (c).

- (c) Clean the switch contacts per subparagraph 3.12(e) or (f), and check the color. If the contacts are still purple, bluish gray, or black, the switch should be replaced. If the contacts are judged to be in good condition, proceed to (d).

- (d) Check the spring action of the rotor contacts. Apply both thumbs, one on each side of the rotor contact and spread apart. If the blades spread apart easily and do not spring back when released, the switch should be replaced. If the blades of the rotor contact are bright or dull copperish in color, hard to force apart, and spring back when released, the switch is good and replacement is not warranted.

- (e) Clean the copper contact surfaces as follows:

- (1) Wipe all accessible contact surfaces with KS-7860 petroleum spirits removing any accumulated dirt and old lubricant. Use a soft, clean, nonlint cloth such as KS-2423 or KS-14666. Then apply KS-16736 compound liberally to the contact surfaces with a circular scrubbing motion.

**Caution: If the switch is still in the rectifier, remove the following fuses before operating the switch: A, B, C1, C2, C3, C4, C1 ALM, C2 ALM, C3 ALM, C4 ALM, and VM ALM.**

- (2) Operate the switch to all positions and again apply compound to all accessible contact surfaces to replace compound removed by the operation of the switch. Where movable contact surfaces are not accessible, operation of the switch will apply compound to the moving contact.
  - (3) After a half-hour interval, remove all compound possible using a clean, nonlint cloth such as KS-2423 or KS-14666. Then, finish wiping using a similar cloth moistened with KS-7860 petroleum spirits. Change cloths when dirty and continue cleaning. Operate the switch until all the compound is removed from the contact surfaces. Wipe all contact surfaces clean.
  - (4) If the switch has been removed from the rectifier, clean the current carrying threaded studs and the hexagonal nuts which project from the rear of the switch using first the KS-16736 compound and then the KS-7860 petroleum spirits. Wipe all contact surfaces clean by removing any accumulated dirt and old lubricant.
  - (5) Lubricate the switch with petrolatum as follows: Wipe a thin film on the contact surfaces, taking care not to lubricate other parts. Avoid an excess of petrolatum as it will collect dust and dirt.
- (f) Clean the silver-plated contact surfaces as follows.

**Caution: If the switch is still in the rectifier, remove the following fuses before operating the switch: A, B, C1, C2, C3, C4, C1 ALM, C2 ALM, C3 ALM, C4 ALM, and VM ALM.**

- (1) Flush all accessible contact surfaces with KS-7860 petroleum spirits using the R-8950 rubber syringe. Operate the switch to all

positions and similarly flush the surfaces not previously treated.

- (2) Operate the switch to all positions and again flush all accessible contact surfaces if required. Operation of the switch will apply petroleum spirits to the moving contact.
- (3) Wipe all accessible contact surfaces clean using a soft, clean, nonlint cloth such as KS-2423 or KS-14666. Change the cloth when dirty and continue cleaning, operating the switch as required, until all contact surfaces are clean. If present, the black (sulphated) tarnish will not be removed by this procedure. Use crocus cloth or jewelers rouge as required.
- (4) If the switch has been removed from the rectifier, clean the current carrying threaded studs and hexagonal nuts which project from the rear of the switch with KS-7860 petroleum spirits. Wipe all contact surfaces clean removing any accumulated dirt and old lubricant.
- (5) Lubricate the switch with petrolatum as follows: Wipe a thin film on the contact surfaces, taking care not to lubricate other parts. Avoid an excess of petrolatum as it will collect dust and dirt.

### 3.13 Connecting the Switch:

- (1) Mount the switch in the rectifier and replace the four outside bolts on the mounting plate.
- (2) There should be four nuts, a flat washer, and a lock washer on each terminal stud on the rear of the switch. One nut, flat washer and lock washer are used to secure the switch post to the phenolic board and the remaining three are used to make the electrical connection. If the switch does not have four nuts, a flat washer and a lock washer on each stud, obtain the proper hardware from the manufacturer of the rectifier. Do not furnish additional nuts indiscriminately. The nuts and terminal studs must be similar metals; for example, stud and nuts copper or stud copper and nuts brass.
- (3) Insure the terminal stud is in place. Make sure the nut which fastens the terminal stud to the phenolic board is snug against the lock

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washer. Do not overtighten as this will crush the phenolic underneath.

(4) If the switch contacts are not lubricated, lubricate per subparagraphs 3.12(e) or 3.12(f), whichever applies.

(5) Replace handle on nameplate.

(6) Replace the top panel removed per subparagraph 3.11(1).

**Note 1:** All switch connections shall be snug and tight.

**Note 2:** Except on the switch contacts, where petrolatum is specified, NO-OX-1D

"A" or Alcoa No. 2 inhibitor compound may be used as a substitute. Petrolatum shall be used on the switch contacts. Never mix compounds; clean the old compounds off before applying a different type.

**Note 3:** If the switch has been removed, apply NO-OX-1D "A" or Alcoa No. 2 inhibitor compound on the contact (mating) surfaces if the bus bars are unplated. Silver plated mating surfaces require no inhibitor compound.

(7) Return rectifier to service in accordance with the section listed in subparagraph 3.01(b) which applies.