COUNTERCELLS
ALKALINE
REQUIREMENTS AND PROCEDURES

1. GENERAL

1.01 This section covers KS-5170 alkaline-type countercells.

1.02 This section has been reissued to provide correct references to other Plant Series sections. In this process marginal arrows have been omitted.

1.03 Reference shall be made to Section 020-010-711 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

> ***Caution: The gas given off by the passage of current through a countercell is explosive and the amount of gas is proportional to the current rate. An explosion may result from sparks, including those from static electricity, from open flames near the cell, or from the arc caused by solution dropping below the bottom of the plates under load. Rooms and enclosures having loaded countercells should be well ventilated. Wrenches or other tools used on or above countercells should be insulated. Connections should be changed only while cells are not gassing and if possible, while adjacent cells are not gassing.***

1.04 When countercells are located in ***cabinets*** which do not have at least 4 square inches of vent at both top and bottom of cabinet and it is impractical to increase venting; as for example, by removing knockouts, it is suggested that cabinet doors or covers be left open during battery overcharge or other time when the countercells are heavily loaded.

> ***Caution: Petroleum products, such as petroleum spirits, kerosene, petrolatum, oil, and grease, cause crazing if permitted to come into contact with plastic containers. Scratches on plastic containers are harmful.***

1.05 ***If the solution drops below the bottom of of the plates,*** breaking circuit under load, an arc is quite likely to be drawn and a fire and/or an explosion occur. Since a cracked jar might allow the solution to leak out and uncover the bottom of the plates, a cell with a cracked jar should be switched or otherwise promptly shorted out of the circuit. In case of explosion of one cell, cracked jars in other cells are to be expected. It is not anticipated that a cell will be neglected to the point that the solution uncovers the bottom of the plates in service or that an attempt will be made to remove the solution while the cell is carrying load.

1.06 ***Sufficient explosive gas*** is given off while the cell carries load to cause an explosion if a flame or spark comes too close to a vent. Provide as much ventilation in the room and the area near the cells as feasible. To do any work on the cell other than adding water or taking readings, the following additional precautions should be taken. To protect the workman and the adjacent cells, cover the aisle side of the cell being worked on and, as far as feasible, the space between it and adjacent cells with several thicknesses of wet cloth. This cloth should not be permitted to cover or otherwise interfere with venting from the vent hole or from under the cover. The electrolyte in adjacent cells and the cell being worked on should be at the high level to reduce the volume available for explosive gas. The cell being worked on and, if feasible, other cells, especially those adjacent to it, should be carrying no load. Open or close a shunt around a cell or cells carrying load at a point several feet from the cells. (See 1.08.)

1.07 ***Static*** electricity may be generated on the body when walking across the floor. This is more likely to occur if the floor is covered by rugs, linoleum, rubber tile, or asphalt tile, and the atmosphere is dry. Synthetic materials such as nylon and dacron should not be worn while working on countercells as they tend to promote the generation of static. Wool clothes have some tendency to produce static. Cotton

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clothes are the least likely to produce static and are preferred when working on countercells. Shoes with rubber soles should never be worn while working on countercells. Wiping of cells during cleaning should be done with a cloth slightly moistened with water. A dry cloth if used for wiping will promote the formation of static. If the static is discharged as a spark near a vent hole or if the spark is delivered to the surface of the solution, as is quite possible with a thermometer, an explosion may occur. Unless it is known that local conditions are not likely to build up static charges on the person of the attendant, the static should be discharged before touching the cell. Just before inserting a thermometer into a cell or when adding water, touch the instrument or hand to an intercell connector or terminal on a cell near the grounded end of the associated storage battery. If a ground or a low-voltage terminal is not available, a higher voltage terminal may be touched with the hand protected by two thicknesses of dry cleaning cloth.

1.08 Whenever cell connections are to be opened, take precautions to ***maintain the circuit.*** If the plant has switches for shorting the countercells, block the switches so that the office will not be lost by accidental opening of the shunt while the countercell connections are open. If the plant does not include switching facilities, a suitable shunt may be constructed. As a suggestion, this shunt may be made up with two 6-foot lengths of wire (see Section 171-123-101 for proper wire size). One end of each wire should be equipped with a solderless or spring-type connector for fastening to the cell post. The other ends should connect to a KS-5780, List 204 fuse unit in which, instead of a fuse, a 6- by 1/8- by 3/4-inch copper or aluminum bar, such as a piece of bus bar, is used. (See 1.06.)

Caution: Avoid loss of office due to opening countercell connections not properly jumpered.

1.09 Precautions which may be deemed necessary, such as the use of goggles, rubber gloves, rubber apron, and glass or glazed earthenware utensils shall be employed in the handling of dry sodium hydroxide or the alkaline solution after mixing. Rubber apron and goggles should be worn for all work including taking readings and adding water. Do not wear rubber gloves when working on cell connections. If it is necessary to use tools or utensils previously used in storage batteries, they should first be thoroughly rinsed with water. Aluminum should not be used for handling sodium hydroxide or alkaline solution. If either should accidentally get on the skin or clothing, it should first be flushed with water and then neutralized with boric acid solution.

Caution: For eyes, flush with plenty of water for at least 15 minutes and get medical attention.

1.10 When construction work is done near countercells, use some protecting medium such as roofing paper or similar material for covering the countercells. Be sure that it does not block vents or interfere with diffusion of gas after it leaves the cell.

1.11 In the rare occurrence of flood waters overflowing countercells, see Section 167-790-811.

1.12 Renewal of alkaline solution is called for herein only in case of high cell voltage. With parallel strings, however, on continuous load approaching the combined ratings of the cells, it may be necessary to have alkaline solution of the same age and at the same relative level in all strings to reduce the current unbalance between strings. Unbalance would be indicated by faster loss of solution in cells having newer alkaline solution.

1.13 For the purpose of this section, a group of countercells shall be all the cells that can be connected into the circuit by one switching operation, or all the cells permanently connected in series.

1.14 The rated full-load continuous amperes and the approximate number of ampere-hours required to drop the solution from the maximum level to the minimum (see Fig. 1 and 2) are shown in Table A. With countercells used only during charging, water loss can be reduced by scheduling the charge during a light load period of the day. This will also be of advantage when load unbalance between strings is resulting in overload on one string.

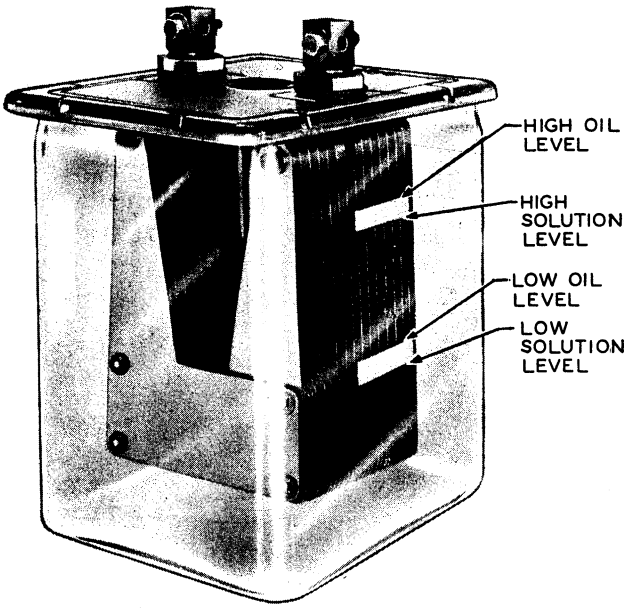

Fig. 1 – Typical 2-post Alkaline-type Countercell

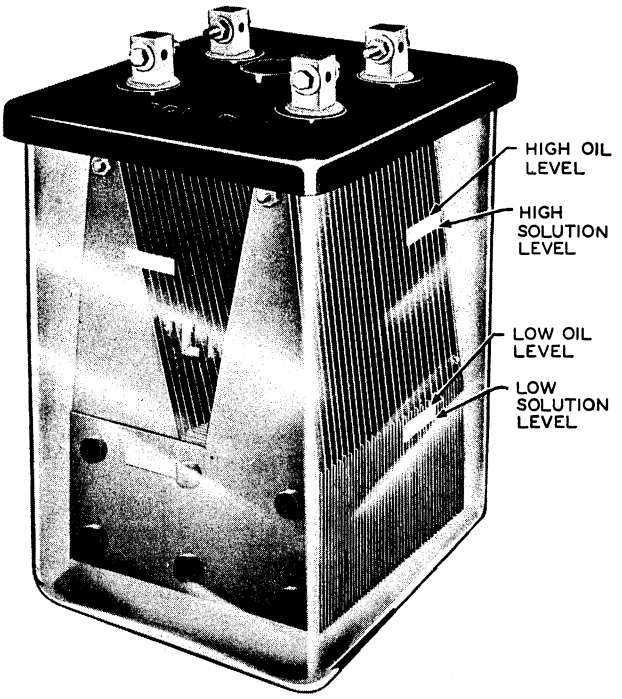

Fig. 2 – Typical 4-post Alkaline-type Countercell

2. REQUIREMENTS

2.01 The level of alkaline solution shall be between

Max — Bottom of upper level marking
Min — Bottom of lower level marking

See Fig. 1 and 2.

2.02 ***Temperature of Alkaline Solution***

Note: Sufficient ice crystals start to form at 15F to cause rapid increase in the resistance and counter voltage of the cells. The solution freezes at approximately +4F.

(a) The temperature of the solution, except during mixing of new solution, shall be within the limits of

Max +60C (140F)
Min −9C (15F)

Use thermometer.

(b) This requirement should be checked only if it is thought that the temperature is out of limits. If the hand can be held on the side of the jar, the temperature can be assumed to be under the high limit. If room temperature is not below −9C (15F), the temperature may be assumed to be above the low limit.

2.03 ***The depth of oil*** on top of the alkaline solution shall be

Nominal — 1/2 inch

Gauge by eye.

2.04 ***The condition of the cell,*** including all parts, shall be satisfactory.

2.05 ***All connections*** of the cell shall be satisfactory electrically and shall be free from corrosion.

2.06 The counter ***voltage*** under usual office loads and with room temperature above 50F shall not exceed

	MAX
Individual cell	2.6 volts
Average for group	2.5 volts

Use voltmeter.

Note: Circuit design is usually based on the above voltage limits. There may be cases, particularly in older unregulated plants, where higher voltages can be tolerated without introducing service reactions, excessive

alarms, or control circuit hunting. Where higher voltages are known to be satisfactory, the supervisor may defer renewal but in no case should the individual cell voltage be allowed to exceed 3 volts. If there are cases where even lower maximum voltages seem to be desirable, the supervisor should decide after checking alarm and control circuit adjustments whether or not the cost of replacing solution at the lower voltage is justified. In offices where battery individual cell voltage readings are taken periodically, it is suggested that countercell voltages be read at the same time. While no minimum voltage is specified, voltages, particularly with new electrolyte and extremely light loads, may be so low as to effect office alarms. In such case, artificial loads (see Section 171-123-101) may be necessary for a few weeks.

TABLE A

OLD DESIGNATIONS	KS-5170, LIST	FULL LOAD CONTINUOUS AMPERES	AMPERE-HOURS HIGH TO LOW LEVEL	NaOH LB	NaOH OZ	OIL PT	DEPOLARIZER GRAMS	WATER GALS.
NAK2	100	5	1700	—	6	0.3	0.25	0.35
NAK4	101	15	3000	—	12	0.6	0.50	0.75
NAK8	102	30	5100	1	—	0.9	0.875	1.25
NAK30	103	60	7200	1	12	1.2	1.375	1.75
NAE26A	106	100	20,000	4	—	2.3	3.50	4.5
NAE50	110	200	20,000	4	—	2.0	3.50	4.5
NAF58	120	300	43,000	10	—	4.2	8.75	12.5
NAK2A	130	5	3000	—	12	0.6	0.50	0.75
NAK4A	131	15	8000	1	12	1.2	1.375	1.75
NAE6A	140	30	21,000	4	—	2.0	3.50	4.50
NAF10A	150	75	54,000	10	—	4.2	8.75	13.00
NAF14A	151	100	53,000	10	—	4.2	8.75	13.00

Note 1: Old designations may also have the letter S in place of the letter N.

Note 2: Tray-mounted groups per lists 202 to 504, inclusive, are made up of various numbers of cells per list 100.

3. ADJUSTING PROCEDURES

3.001 ***List of Tools, Gauges, and Materials*** (Equivalents may be substituted)

Tools

Goggles, coverall, clear lenses

Knife, putty, R-1060

Picks and cords, test, Weston D-79650 and D-79651

Pliers, P-long-nose, 6-1/2 inches

Rod, rubber, black, synthetic, RM-636333

Wrench, adjustable, R-2512

Note: Wrench should be insulated with tape, plastic, or rubber tubing. A double-ended wrench is acceptable only if entire unused end is thoroughly insulated.

Gauges

Thermometer — R-1032, Detail 1

Voltmeter, dc, Weston, Model 931, 0-3 volts

Voltmeter, dc, Weston, Model 931, 0-3 volts

Materials

Apron, rubber, R-3043

Can Opener, obtained locally

Cloth, cleaning, KS-14666

Compound, silicone, R-3126, DC, No. 4

Container, glass, glazed porcelain, or eathenware (aluminum must not be used for handling sodium hydroxide or alkaline solution)

Materials (Contd)

Funnel, glass, obtained locally

Fuse Unit, flat base, KS-5780

Gloves, Goodrich 2921, size 10, R-3034, for installation and heavy work

Gloves, neoprene, Charleston Rubber Co, style N-140-R (size 9) or style N-141-R (size 10) for light work

Oil, mineral, for countercells

Sandpaper, 4/0 commercial

Solution, acid, boric

Sodium Hydroxide with nickel depolarizer, KS-14500, 1-pound or 6-ounce containers, or Sodium Hydroxide, KS-14422

Water, distilled, or approved for storage battery use

3.01 ***Level of Alkaline Solution*** (Rq 2.01)

(1) If the level of the alkaline solution is approaching the allowable minimum level, raise the level by adding distilled water, or water known to be suitable for use in storage batteries, through the vent opening. It will usually be easier to insert a glass funnel through the vent opening and add the water through this funnel. Do not fill above the bottom of the upper level mark (see Fig. 1 and 2). Any nonmetallic container approved for battery electrolyte water is also satisfactory for countercell water.

(2) If any alkaline solution gets on the outside surfaces of a cell, or on the stand or other cell supports, rinse off with clean water and dry with clean cloth.

3.02 ***Temperature of Alkaline Solution*** (Rq 2.02)

(1) If the temperature rises above the specified limit, improve ventilation, if feasible, check other requirements, and see that cell-rated full-load amperes (see Table A) are not being exceeded. Should the cells meet the requirements and the temperature continue to be excessive, discuss with supervisor.

(2) In case of low temperature, discuss through supervisory channels. It may be desirable to provide heating for the room or for an enclosure around the cells.

3.03 ***Depth of Oil*** (Rq 2.03)

(1) Add new mineral oil as necessary to give the specified layer above the alkaline solution. The oil should be added through the vent hole. The level line being 1/2 inch gives convenient scale for estimating thickness of oil. (See Fig. 1 and 2.)

3.04 ***Condition of Cell*** (Rq 2.04)

(1) If practicable, cells should be off circuit for a time before inspection to allow solution to clear and reduce chance for explosion.

(2) Replace any cell or parts that are damaged or not in a satisfactory condition.

(3) On Philco-Gould List 110 and 140 cells, it is possible to incorrectly assemble the posts and plates resulting in a loose assembly of plates and the danger of sparks which might cause an explosion. The posts just below the cover are offset and one shoulder is wider than the other. The wide shoulder of either one of the posts and the narrow shoulder of the other post should face towards the center of the cell. If both wide shoulders face in or both face out, a tightly clamped assembly is impossible. To correct, with cells shorted out of the circuit, partially withdraw the tie bolt, lift out one post, rotate it 180 degrees, replace it, and retighten the tie bolt.

(4) The covers of countercells should be raised from the cell slightly for permanent ventilation at this point. This feature is built into the largest sizes of Gould cells and all C&D and Exide cells. It has been added for some time to other sizes of Gould cells. Rubber saddles are available for raising the covers of older Philco and Gould cells. These saddles (Gould part No. X-701) are U shaped and about 1 inch long. They are slipped over the edge of the cell container, two or three to a side, and result in lifting the cover to improve ventilation.

(5) Discoloration of solution or plates or the presence of sediment or precipitate in the solution or on jar or plates is not objectionable, if other requirements are being met.

3.05 ***Connections*** (Rq 2.05)

(1) If the terminal connections are corroded or otherwise damaged, clean and repair.

Note precautions with regard to preventing explosions. When terminal connections are corroded or loosened, scrape clean the terminal posts and contact surfaces with a putty knife and smooth with sandpaper. The inside of the unused bolt hole shall be filled with R-3126 Silicone Compound and the surface of the bolt going across it shall also be covered with R-3126 Silicone Compound.

3.06 ***Voltage*** (Rq 2.06)

(1) Check voltages with test picks at cell terminals while load is being carried.

(2) If the voltage exceeds the maximum, renew the solution unless high voltage is due to low temperature, in which case, cause of low temperature should be corrected, or is due to corroded plates or lugs, see 3.04(2) or corroded connections, see 3.05.

(3) To renew the solution and oil, first take precautions to maintain the circuit (see 1.06 and 1.08). Note precaution with regard to preventing explosions. (See 1.06.) Pour off solution or use siphon, if available. Refill with water and re-empty or remove cover and elements and rinse elements and jar with water. If elements are taken out, sediment in the jar can be removed with a cleaning cloth. Only clean water or soap and water should be used on jars. Avoid scratches or other marring of surfaces both inside and out. Check the condition of the beads or other provision for keeping the plates apart. Touching plates destroys the functioning of the cells and could cause an explosion.

(4) The approximate number of pints of oil and gallons of water required for each cell and the exact amount of sodium hydroxide (NaOH) required to make up the alkaline solution for each cell are shown in Table A.

(5) With elements removed, fill to from 1 inch to 1-1/2 inches below the high level line, with approved water; that is, distilled water or water approved for storage battery use. The cells should be in final location if there is headroom for later installation of elements. If mixing cannot be done with cells in final location, it is desirable when filling larger cells, such as lists 120, 150, and 151, to build a temporary platform or to use battery lifting device, if available, to support the cell at shelf level and adjacent to the stand to facilitate moving into place after mixing solution and inserting elements. Mixing in separate containers (see 3.001) instead of the cells is not described herein, but is acceptable if in accordance with local practice. It will be necessary to mix in separate containers if cell containers are made of plastic. The use of the water values given in Table A should result in slightly less solution than required. In such case, fill all cells as nearly as possible to the same level and add water to bring to maximum. If the values given result in a slight excess of solution, the excess may be discarded.

(6) Open one sodium hydroxide can using a can opener for sealed cans and a putty knife for cans with lids. Lay aside or discard [see (7) and (8)] the nickel depolarizer, if any. (See 1.08.) Wear goggles. Pour the sodium hydroxide from the plastic bag into the water while stirring with a hard rubber rod. Avoid splashing. Stir steadily or the sodium hydroxide will form a cake on the bottom instead of dissolving. During mixing, special ventilation, other than windows and turning on nearby fans, is not necessary but standing at arms length from the cells is recommended to avoid breathing spray. When the contents of the first container are dissolved, repeat with additional containers, as necessary. (See Table A.)

(7) Prior to 1951, Exide countercells had nickel plates and carried lead nameplates. Exide cells now have stainless steel plates and carry plastic nameplates. All countercells furnished by other manufacturers have stainless steel plates. Since nickel plates are no longer available and mixing of nickel and stainless steel plates in the same cell is objectionable, replacement of one or more nickel plates will necessitate replacing all the plates in that cell with stainless steel plates. In such cases, it is recommended that the lead nameplate be painted red in order that the presence of stainless steel plates may be recognized.

(8) On cells with nickel plates, the life of the solution can be appreciably increased by the addition of a depolarizer when changing solution. The correct amount of such nickel depolarizer in powder or pellet form will be included with each can of KS-14500 sodium hydroxide furnished for making up new solution. Depolarizer is not required with cells having stainless steel plates and should be discarded, if furnished. When depolarizer is

required, dissolve it in a small quantity of water. Stir well, pour into countercell, and stir again.

Note: Sodium hydroxide per KS-14422 is the same as that per KS-14500, except that nickel depolarizer is furnished with the latter. Either is satisfactory for use in cells with stainless steel plates, and either may be furnished for use with them, depending on supply conditions.

(9) When all the sodium hydroxide is dissolved and nickel depolarizer (if necessary) added, insert the elements. After cells have cooled enough to permit comfortable handling, move the cells into their final location, if not already there.

(10) Fill with approved water to the bottom of the high level line. (See Fig. 1 and 2.) Add oil to the top of the high level line. Where convenient, there is some slight advantage to reversing the cell connections when reconnecting the cell but such reversal is not required. Within 4 days after adding nickel depolarizer, subject the cells to a mixing current at as high a rate as convenient, the total number of ampere hours to equal 1 hour at the full-load continuous ampere rating (see Table A) of the cell, for example, 1 hour at rated amperes, 2 hours at half rate, etc.