

## LEAD-ACID TYPE STORAGE BATTERIES VOLTAGE RELAY CHARGE-DISCHARGE OPERATION

### 1. GENERAL

1.01 This section describes the voltage relay controlled charge - discharge operation of lead-acid type storage batteries. With this system, the charge is usually started by a time clock or starts when a call comes in to the board. The charge is cut off by a voltage relay. The charging rate while on, varies with line voltage, battery voltage, and load changes. For operation of batteries in 420B power plants, see 167-645-306.

1.02 This section replaces similar information previously in another section. The information is brought up to date, and individual cell readings omitted. Changes from the previous information are marked with arrows.

1.03 Excessive charging increases the water loss and shortens the life of positive plates and separators. On the other hand, insufficient charging results in run down (over sulfated) plates and impaired battery capacity.

1.04 The state of charge of a battery is indicated by the relation of the corrected specific gravity of the electrolyte to the full charge corrected specific gravity, assuming the level of the electrolyte to be the same at both readings. In other words, a drop of 10 per cent of the gravity range indicates approximately 10 per cent discharge and 90 per cent remaining capacity. Height of the electrolyte in eights of an inch below maximum level should be recorded whenever hydrometer readings are recorded. Do not discharge beyond the gravity range and do not allow cells to remain fully or nearly discharged.

1.05 Water should be added after, rather than before taking specific gravity readings. The electrolyte in the pilot cell should be maintained in the upper quarter of the allowed range so that specific gravity readings will be comparable.

1.06 Except where special corrective action has been recommended for a particular battery, these routines apply at all room temperatures between electrolyte freezing temperature and 100F and for any cell with a full charge corrected specific gravity not in excess of 1.225. Temperatures below 80F are preferred and where average temperatures for the 24 hour day exceed 100F, special operating methods may be necessary.

1.07 For information on 253-type relays, see 040-250-701.

1.08 This type of operation is not generally applicable to plants with emergency cells. If, however, there are emergency cells, they should be operated as outlined in 157-601-302 for emergency cells.

1.09 See 157-601-701 for nominal charging rates, gravity ranges, maximum and minimum levels, 8-hour discharge rates, ampere-hour rated capacities, electrolyte specific gravity and voltage requirements, method of reading hydrometers, method of correcting specific gravity readings for temperature, approved water, precautions against explosions, spilled electrolyte, etc.

Caution: Avoid the creation of sparks, including those from static electricity, or the use of an open flame near batteries since the gas given off by the battery is explosive.

1.10 Information is arranged under the following headings:

1. GENERAL
2. OPERATION
3. RECORDS

### 2. OPERATION

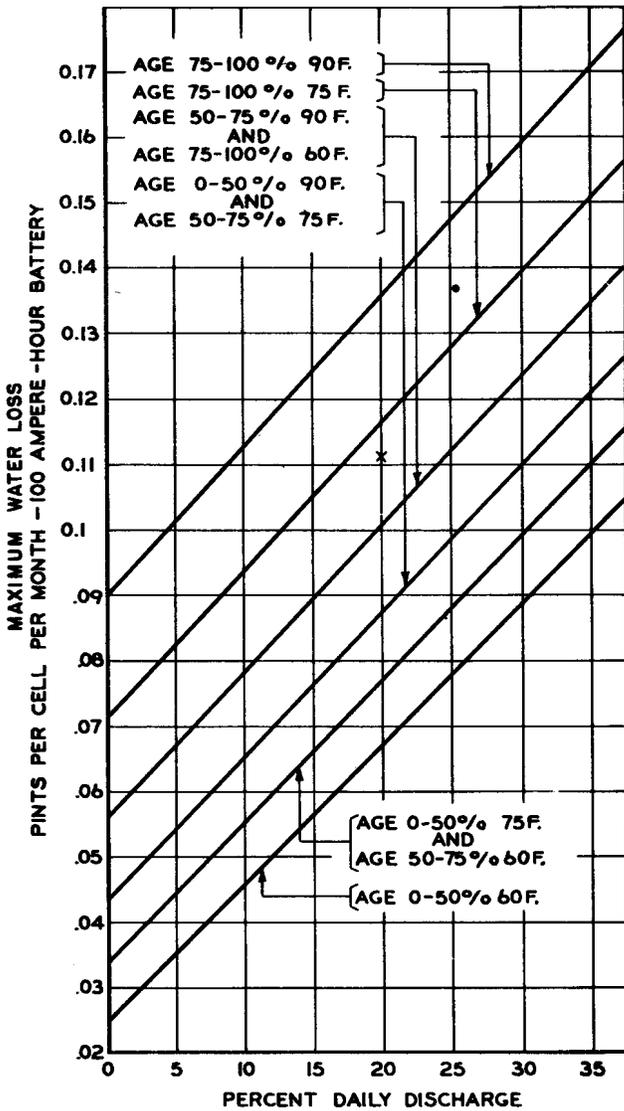
2.01 Where charger settings are not specified in circuit descriptions or other job information, set the charger initially as follows:

(a) If office peak load in amperes is less than 20 per cent of the battery 8-hour discharge rate, set charger output at approximately 20 per cent of the battery 8-hour discharge rate.

(b) If peak is from 20 to 35 per cent, set at peak value.

(c) If peak is from 35 to 50 per cent and a supplementary charger is not readily available, set charger at 35 per cent. If operation is not satisfactory, follow (d).

(d) A supplementary charger is recommended where the peak load is more than 50 per cent of the battery 8-hour discharge rate or where the working day minimum load is more than



NOTES:

1. PINTS-ARE PER CELL PER MONTH AND SHOULD BE MULTIPLIED BY THE NUMBER OF MONTHS AND NUMBER OF CELLS. VALUES ARE FOR A 100 AMP-HOUR BATTERY. DIVIDE BY 100 AND MULTIPLY BY RATED 8 HOUR CAPACITY OF THE BATTERY FOR OTHER SIZES.
2. PERCENT DAILY DISCHARGE-IS IN PERCENT OF 8 HOUR CAPACITY.
3. TEMPERATURES-ARE OF ELECTROLYTE AND ARE THOSE AVERAGING OVER THE PERIOD FOR WHICH WATER LOSS WAS MEASURED.
4. AGE-IS IN PERCENT OF THE ANTICIPATED LIFE GIVEN IN THE REQUIREMENT SECTION.
5. EXAMPLE-IF LOSS FOR 3 MONTHS AT 75F. ON A 12 CELL KS-5361 L.150 BATTERY IS 4 PINTS, THE LOSS PER CELL PER MONTH IS  $4 \div 36 = 0.111$  PINTS. SINCE THIS FALLS BELOW THE 75-100% 75F. DIAGONAL IT IS SATISFACTORY. ASSUMING 20% DISCHARGE AND 80% AGE.

Fig. 1 - Maximum Water Loss For Sealed Type Cells With Specific Gravity Below 1.225

5 per cent of the battery 8-hour rate. The supplementary charger may also be necessary where peak is from 35 to 50 per cent. See (c). The supplementary charger should be set at 75 per cent of the working day minimum load and its output should be subtracted from totals in order to apply (a) or (b) to the first charger.

Note: The above may be modified in order to avoid operating at less than 25 per cent of charger rating, particularly on chargers rated at more than 12 amperes. 100 per cent of charger rating should not be exceeded.

2.02 Under-charge would be indicated if the pilot cell corrected specific gravity dropped faster than 5 points a year after the initial drop of 5 to 10 per cent of the gravity range. Under-charge may be due to a voltage relay setting that is too low. It may also be due to a charging rate that is either too low or too high. If the rate is too low, the charger may stay on continuously without recharging the battery. If too high, the charger will probably operate less than 10 minutes per cycle because the voltage rises faster than the state of charge of the battery causing early cut off. Cycles resulting in operation of the charger for 8 to 16 hours in each 24 hours usually give best results.

2.03 Water loss in excess of values in Fig. 1 or excess gassing indicate too much charging, possibly due to relay setting that is too high.

2.04 These plants are not generally arranged for equalizing charges. If, however the full charge corrected specific gravity falls more than 20 per cent of the full gravity range below that at the initial (or last equalizing) charge, the supervisor should be notified. If an equalizing charge is ordered, it may be by the "constant" voltage or the "constant" current method, as convenient, in accordance with 157-601-302, but using average instead of constant values of voltage and current.

3. RECORDS (Form 2006)

3.01 Record the date and time of taking any recorded readings.

3.02 When water is added to all cells, record the amount of water added to the battery and which cell, if any, required appreciably more water than other cells. The water added at more frequent intervals to the pilot cell to maintain its level in the upper quarter of the range need not be recorded.

