

BATTERY CHARGING GUIDELINES FOR GLOBAL/DAVIDSON TUBULAR PLATE BATTERIES

Introduction – Your Global/Davidson battery set has been specially formulated for long cycle life and has unique voltage and specific gravity characteristics. The battery charging set points specified in this guide are for these batteries only, and should not be assumed appropriate for other batteries.

It is far easier to discharge a battery than to recharge it. Both the charge and discharge of batteries involve significant inefficiencies. As a rule of thumb for each amp hour of power taken out of a battery 1.5 amp hours must be replaced. In order to complete the chemical process, which recharges a battery the electrolyte, must reach 104^o F. The method used to ‘heat up’ the electrolyte is the application of charging current (amps) to a discharged battery. If insufficient charge is applied to bring the electrolyte to this temperature the batteries will never fully recharge, and over time, their capacity will be reduced.

Minimum Charging Requirements –The ideal charging current, which would be applied to recharge your battery, is 10% of the 20 hour rated capacity of the battery. For example a 1065 amp/hour battery (85T-17 @ 72 hour rate¹) will require an initial start up rate of 85 amps (850 amp/hours @ 20 hours) to be supplied by the selected battery charger. A combination of charging sources such as generator/PV array can be used to achieve the initial charge .

As you get into larger battery banks, such as a 24V bank of 85T27's (1795 amp hours @ 24v) you may find that you need a very large charger & generator to achieve the above settings. This is not possible in all system configurations.

In general, you need a larger generator than you might think you do to charge these batteries.

Voltage and Time Settings – In addition to minimum charge rates there are charging voltage settings, which are specific to your Global/Davidson battery set.

Bulk Charge Voltage is the voltage at which the batteries will receive most of the charging. When the battery has reached its bulk voltage level the charge current will slowly decrease as batteries become more charged. As a battery becomes more charged it presents more resistance to the flow of current than when discharged, hence the rate of amps declines during a charging cycle. This part of the charging cycle is called the ‘absorption’ stage. We recommend 30 minutes of absorption time per 100 amp hours of battery bank rated capacity (72 hour rate).

All batteries will self-discharge over time, even if they are not used. In stand-by applications where utility power is available batteries are often finish charged at float voltage. This is the voltage level, which can be applied to the batteries to maintain their charged state and, at the same time, minimize loss of electrolyte. In generator cycle charging applications it is rare to “float” the batteries as it represents a costly and inefficient use of fuel.

Regular ‘equalization’ charging is required as part of a battery maintenance routine. An equalization charge is an intentional overcharge, which causes rapid bubbling of the electrolyte, which in turn helps dislodge sulfation, which occurs naturally during normal charge/discharge cycling. Equalization charge settings involve both voltage and time specifications.

Table 1 shows the appropriate settings for Bulk, Absorption, Float and Equalization stages of charging. Many programmable chargers and inverter/chargers have provisions for custom voltage, current, and time settings. Your Global/Davidson batteries will perform best if charged at the settings shown in Table 1.²

¹ The “@ X hour” rate refers to the length of time it would take to discharge the battery. Most batteries are rated at the 6, 20 and 72 hour rates. The 72 hour rate is appropriate in most residential applications.

² Charger should be temperature compensated and adjust all voltage values accordingly.

Table 1: Recommended Voltage and Current settings for recharging Global/Davidson Batteries

Stage	Vdc per cell	Current	Time
Bulk	2.475 Vdc	10% rated Amp Hour capacity	Until voltage setting is reached which automatically initiates Absorption stage
Absorption	2.475 Vdc	Will taper as batteries recharge	30 minutes per 100 Amp Hour of rated capacity ³
Float	2.35 Vdc	1% rated Amp Hour capacity	Time continuous ⁴
Equalization	2.65 Vdc	Battery will self regulate current	15 minutes per 100 Amp Hour of rated capacity

Specific Gravity - The specific gravity of your Global/Davidson battery is somewhat different from other brands of battery. They are actually fully charged at a lower specific gravity than most batteries and as a result they will actually be charged before most hydrometers will indicate full charge. The most accurate way to use a hydrometer to measure state of charge is to take note of when the specific gravity stops rising. Take readings every ½ hour during the last part of Absorption Stage, when the hydrometer does not rise from your last reading the batteries are fully charged.

**The correct fully charged specific gravity of your Global/Davidson battery is:
1.265 – 1.275 (will vary dependent on battery age, condition and ambient temperature)**

Safe Operating Voltage - Another result of the special formulation and design of these long lasting deep cycle batteries is that they tend to operate at lower voltages than most higher specific gravity batteries, thus the safe operating voltage range of Global/Davidson batteries is lower than most other batteries.

It is quite normal and safe to operate your batteries as low as 2 Vdc per cell⁵. They should always be recharged when they reach a standing voltage of less than 1.975 per cell⁶. Table 2 shows the conversion of Volts per cell settings to 12, 24 and 48 Vdc values.

Table 2: Converting Volts per cell to battery bank voltage.

Stage	Per Cell	@ 12 Vdc	@ 24 Vdc	@ 48 Vdc
Bulk/Absorption	2.475	14.85	29.7	59.4
Float	2.35	14.1	28.2	56.4
Equalization	2.65	15.9	31.8	63.6
Safe operating	2.0	12	24	48
Should Recharge (standing voltage)	1.975	11.85	23.7	47.4

BATTERY WARRANTY MAY BE VOIDED IF THESE GUIDELINES ARE NOT FOLLOWED

³ This is a rule of thumb estimate of time, confirm with hydrometer (see recommended specific gravity).

⁴ Float charging is usually only done when utility power is available. Please note that if batteries are continuously held at a float charge they will loose capacity, regular charge/discharge and equalization cycles are recommended for Yuasa/Davidson batteries.

⁵ Battery voltage will drop significantly below this point during application of large loads but should recover quickly if batteries are in good condition.

⁶ In this reference standing voltage is defined as the voltage of a battery after it has neither been charged nor discharged for an eight-hour period. The most practical time to assess battery state of charge is early morning as nighttime current draw is usually minimal.

Configuring a DR series inverter for Global Batteries:

For normal operation, the battery type selector should be set to # 2 – Deep cycle lead acid 2. This is not the factory default setting so must be changed.

For an Equalize charge, set the battery type selector to # 8 – NiCad 1. This setting has a higher voltage than either of the Equalize settings on that inverter and thus will allow a proper EQ charge for these cells.

We highly recommend the use of a BTS – Battery Temperature Sensor which is an option for DR inverters and C-series controllers, included with SW series inverter. This sensor will allow the controller to automatically compensate charge rate according to the temperature of the battery. Colder batteries require significantly higher charge rates. The BTS should be mounted such that it will give an accurate reading of the battery temperature.

Programming a SW or PS series inverter for Global Batteries:

The SW inverter is configured through the digital menu or on the SWRC remote panel or laptop via SWCA interface. Instructions below assume familiarity with the operation of this inverter. More detailed instructions are available in the user manual.

The factory default settings on the SW inverter are not adequate for charging global batteries. If the unit is disconnected from the batteries it will lose all settings & revert to factory defaults. The new SW Plus inverter will retain settings. The factory EQ setting is 28.8 which is in effect not an equalize charge at all.

Below are the ideal settings. Each installation may have its own variables and thus these are a general guideline only:

Menu 10 – Battery charging:

Set Bulk Volts DC	29.7
Set Absorption Time	3 – 9 hours depending on capacity of battery bank (30 min per 100 a/h of battery capacity).
Set Float Volts DC	28.2
Set EQ Volts DC	31.8
Set EQ time	1.5 – 4.5 hours depending on capacity of battery bank (15 min per 100 a/h of battery capacity).

How to equalize Global batteries:

Bring batteries to a full normal charge. Test with Hydrometer & record all cells. Ensure electrolyte levels are proper (you will add more during the charge cycle).

Initiate an equalization charge according to your inverter type.

During the final hour of equalize charge, make sure you top up the electrolyte with clean, distilled water. Ensure no debris enters into the battery. Battery tops should always be very clean – moisture and debris on the top can cause the batteries to self-discharge. Exercise extreme caution during this process. Goggles & rubber gloves are recommended.

After the EQ charge, the tops of the batteries will likely have some mist on them. Wipe carefully with a disposable cloth. Keep this away from clothes, etc. Acid on clothes does not necessarily show immediately – next morning or next week you realize the problem and by then it's too late. Dispose of cloths properly.

If batteries have not been equalized for a long time, or have been severely discharged and left in a state of discharge for an extended period, it may take several attempts to achieve a proper equalization charge. Repeat this process daily until you are achieving proper EQ voltage.

Have baking soda on hand to neutralize any spills on ground, clothes, etc. Do not allow baking soda inside the batteries!

Programming a C-series (C35/C40/C60) controller for Global Batteries:

The C-series controllers unfortunately do not offer the ideal adjustments for some settings. We generally don't recommend that the automatic-EQ feature be used; as it's unlikely you will achieve a proper equalization charge. Instead, control this manually by depressing the reset switch for 10 seconds. Some sites such as unattended sites may benefit from the automatic EQ feature.

The following settings are made via the adjustments accessed by removing the front cover of the c-series controller. The manual describes this process in detail. A digital volt meter is required to properly calibrate these settings.

Bulk: 29.7 VDC

Float: 28.2