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TECHNICAL BULLETIN

Subject: Maintenance Charging

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This technical bulletin provides recommendations for maintenance charging of Concorde RG® series aircraft batteries.

What is Maintenance Charging?

When an aircraft is operating, the aircraft's electrical system takes care of charging the battery. The charging equipment on board the aircraft can be an alternator, transformer/rectifier, or dedicated battery charger. A battery can also be charged using an external power unit connected to the aircraft electrical system when the aircraft engines are off.

Maintenance charging can be defined as charging a battery while the aircraft is not operating and not connected to an external power unit. The purpose of maintenance charging is to prevent the battery from losing charge due to either self-discharge or a parasitic load. If a battery is allowed to discharge to a low state of charge, the plates become sulfated which can lead to premature failure. The longer the battery is allowed to self-discharge, the worse the sulfation effect becomes. Many aircraft operate frequently enough that there is minimal time for self-discharge and therefore maintenance charging is not necessary. When an aircraft operates infrequently (e.g., only once or twice a month) or when the aircraft has a parasitic load, then maintenance charging is an effective method to protect the battery from sulfation. Maintenance charging is generally done with the battery installed on the aircraft, but can also be done when the battery is not installed on the aircraft (i.e., in storage).

Which Maintenance Chargers are recommended for Concorde aircraft batteries?

Concorde aircraft batteries are classified as valve-regulated lead acid (VRLA) batteries and employ absorbed glass mat (AGM) technology. There are many different makes and models of battery chargers designed for use with VRLA/AGM batteries. The most important characteristic of a good maintenance charger is that the absorption voltage and float voltage be tuned to the correct settings. The correct voltage settings for Concorde aircraft batteries have been established based on many years of testing experience. The correct voltage settings are given in the following table:

Table 1

Battery Nominal Voltage	12V	24V
Absorption Voltage at 25°C	14.0 – 14.2V	28.0 – 28.4V
Float Voltage at 25°C	13.1 – 13.3V	26.2 – 26.6V

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Another important characteristic of a good maintenance charge is that the absorption voltage and float voltage be temperature-compensated. If the battery is below room temperature the charging voltage needs to be higher and if it is above room temperature the voltage needs to be lower. If the charging voltage is not temperature compensated, the battery will be undercharged in cold conditions and overcharged in hot conditions, causing shorter life. Preferred temperature coefficients are given in the following table:

Table 2

Battery Nominal Voltage	12V	24V
Below 25°C	0.024 – 0.030V/°C	0.048 – 0.060V/°C
Above 25°C	0.008 – 0.010V/°C	0.016 – 0.020V/°C

What is the best way to use a Maintenance Charger?

There are two cases that need to be considered when using a Maintenance Charger:

A. The aircraft does not have a parasitic load that drains the battery, or
B. The aircraft has a parasitic load that drains the battery.

NOTE: To determine if the aircraft has a parasitic load, refer to Technical Bulletin No. 10.

A. Aircraft without a Parasitic Load

If there is no parasitic load on the battery, the battery will only lose charge due to self-discharge. The rate of self-discharge is approximately 4% per month at 25°C. This rate will double for every 10°C rise of the battery temperature (e.g., 8% per month at 35°C, etc). To compensate for the battery's self-discharge, the recommended schedule for maintenance charging is given in the following table:

Table 4

Battery Temperature*	Charging Frequency	Charging Duration
Below 15°C	Once every 4 months	72 - 96 hours
15 - 35°C	Once every 2 months	48 – 72 hours
Above 35°C	Once every month	24 – 48 hours

* Battery temperature can be estimated using average daytime high of air temperature.

To assure the battery is fully charged prior to use, it is best to schedule completion of the maintenance charging 1-2 days in advance of starting the aircraft.

An alternative to the maintenance charging schedule shown in Table 4 is to periodically check the open circuit voltage (OCV) of the battery. Once the OCV falls to approximately 25.0 volts (12.5 volts for 12-volt batteries), a maintenance charge should be applied to bring the state of charge back up to 100%. The duration of the maintenance charge should be as shown in Table 4. As stated with the first method, to assure the battery is fully charged prior to use, it is best to schedule completion of the maintenance charging 1-2 days in advance of starting the aircraft.

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Although it is possible to keep the battery at full charge by continuous maintenance charging (24/7), this practice is not recommended. This is because even under float charge conditions, there will still be some loss of water due to electrolysis and some electrochemical corrosion of the grids. If continuous maintenance charging is applied over a long period of time, these adverse effects can accumulate and shorten the life of the battery.

B. Aircraft with a Parasitic Load

If there is a parasitic load on the battery, first determine how much charge will be removed in a 30-day period using the following formula:
Capacity Loss (%) = 100 × (Parasitic load (amperes) x 24 hours x 30 days) ÷ C1 Rating (Ah)

For example, if the parasitic load is 0.5 mA (0.0005A) and the battery C1 rating is 46Ah, then the capacity loss in 30 days is: 100 x 0.0005A x 24 x 30/46 = 0.8% Since this is far less than the self-discharge rate of 4% per month at 25°C, it can be ignored and the same procedure as given in Part A can be used.

If the capacity loss due to the parasitic load is more than 4% per month, then there are two options for maintenance charging:

Option 1 – Disconnect the battery when the aircraft is not is use and use the same procedure as given in Part A. This is the preferred option to avoid the adverse effects discussed above.

Option 2 – Keep the battery connected and apply continuous maintenance charging (24/7). This option should only be used if it is not practical to disconnect the battery when the aircraft is not in use. Keep in mind that continuous maintenance charging over a long period of time can shorten the life of the battery for the reasons discussed above.