

# **Lead Acid Aircraft Battery Airworthiness**

## **The Four Pillars of Awareness**



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# Agenda

- History of Concorde
- Safety
- Pillar One - Installation
- Pillar Two – #1 and #2 Battery Killers
- Pillar Three – Capacity Testing
- Pillar Four - BatteryMinders



# Concorde History / Accomplishments

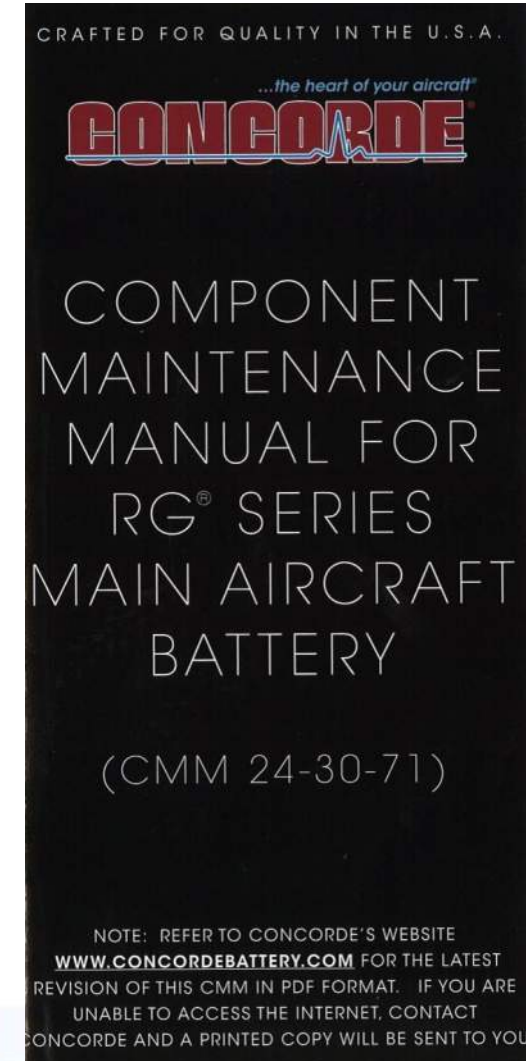
- Founded in 1977 – **48 years of experience** manufacturing certified batteries
- Concorde obtains first Government Mil Spec
- Qualified Product Listing in 1979
- Concorde's first FAA-PMA in 1981 (CB Series)
- Concorde's first FAA-PMA for the sealed, recombinant gas aircraft battery, RG® Series, in 1987
- King Air, F-117 and F/A-18 among first approvals

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# Battery Safety

- Refer to Concorde Battery  
**Component Maintenance Manual**  
<http://batterymanagement.concordebattery.com/BatteryDocs/5-0171.pdf>
- Proper lifting techniques
  - Two person lift (as appropriate)
- Shock hazard
  - Capable of high current discharge



# Pillar One - Installation

What is required to commission a valve regulated, recombinant gas (RG®) battery?





# Installation

- 70 in-lbs is fully torqued
- 155 in-lbs will crack epoxy
- 205 in-lbs will crack the brass



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# Pillar Two – Battery Killers - VR's and Parasitic Loads

When should you check the aircraft charging voltage?

- Annually?
- In the Summer?
- In the Winter?
- When your wife tells you to?



# Voltage Regulator Settings

Optimize your Batteries' Life

Battery Temperature	Voltage Regulator Setting (Volts DC)	
	12 V System	24 Volt System
Below 0°C (32°F)	14.5 – 14.75	29.0 – 29.5
0 to 15°C (32 to 59°F)	14.25 – 14.5	28.5 – 29.0
16 to 30°C (60 to 86°F)	14.0 – 14.25	28.0 – 28.5
31 to 45°C (87 to 113°F)	13.75 – 14.0	27.5 – 28
Above 45°C (113°F)	13.5 – 13.75	27.0 – 27.5



# Parasitic Loads

## Test Procedure

- Remove negative battery cable
- Connect meter lead to negative cable
- Connect meter lead to negative terminal
- Check your meter. If it moves...



## Pillar Three – Capacity Testing

- What is the open circuit voltage (OCV) of a fully charged lead acid battery?
- State of health (SOH) and state of charge (SOC) are NOT the same?
- DON'T BE FOOLED!



# Capacity Testing

- What is a capacity test?
- How do you capacity test a battery?
- What are the parameters?



# Capacity Testing

## Capacity Testing: Minimum capacity for airworthiness

- What is the minimum lead acid battery capacity for airworthiness according to the FAA?
- What is the FAA recommended minimum required capacity to return to service **per AC 43.13-2B**?
- What is Concorde's minimum battery capacity requirement to return to service?

# Capacity Testing

## Capacity Testing Procedure

1. Start with a fully charged battery
2. Discharge at the C1 rate
3. At EPV (20 volts), check the time and your done!
4. 51 minutes to EPV is 85% capacity. Minimum for Airworthiness







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# TECHNICAL BULLETIN

**Subject: Capacity Testing of Aircraft Batteries at Non-C1 Rates**

February 20, 2014

Number: 13

When using BC-5000 and BC-6000 Battery Capacity Testers, the minimum discharge current setting is 10 amperes, and the current is only adjustable in 1 ampere increments. Several of Concorde's RG series aircraft batteries cannot be tested at the C1 rate with these battery capacity testers because:

- a) The C1 rate is less than 10 amperes, or
- b) The C1 rate is not a whole number.

For these batteries, the following table provides test settings to obtain results that are equivalent to testing at the C1 rate:

Battery Type	Rated C1 Capacity (Ah)	Test Rate (A)	Equivalent Capacity at Test Rate (Ah)	100% C1 Capacity at Test Rate		90% C1 Capacity at Test Rate		85% C1 Capacity at Test Rate	
				Minutes	Percent Capacity	Minutes	Percent Capacity	Minutes	Percent Capacity
RG24-9	8.5	10	8.2	49	82	44	74	42	70
RG24-10	8.5	10	8.2	49	82	44	74	42	70
RG24-15	13.6	14	13.5	58	97	52	87	49	82
RG24-15M	13.6	14	13.5	58	97	52	87	49	82
RG24-16	13.6	14	13.5	58	97	52	87	49	82

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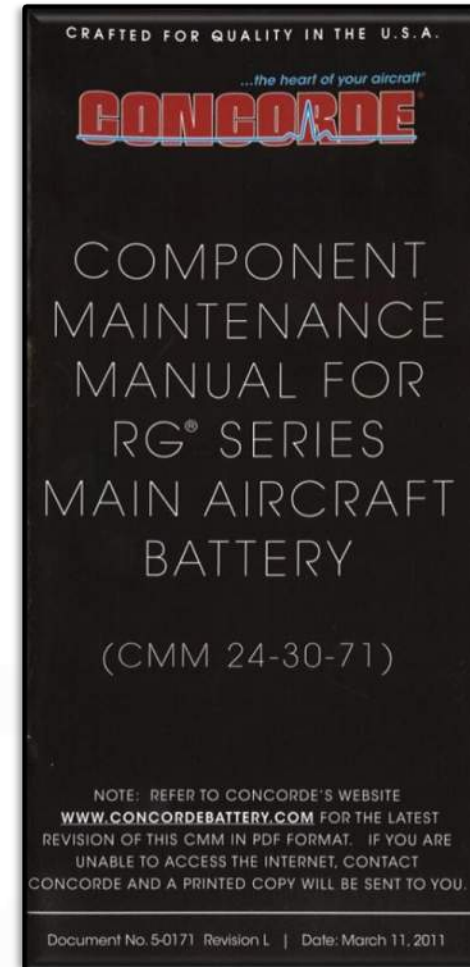




# Capacity Testing

## Capacity Test Intervals

- Piston engine batteries
- First check – 12 months
  - If above 90% - 12 months
  - If 85-90% - 6 months



# Capacity Testing

- Capacity Test
  - CMM Document No. 5-0171, Page 101, Note 1,
    - “The capacity check intervals specified above are general recommendations suitable for most applications. The intervals may be adjusted for a specific aircraft or fleet once the average battery life is established”.
  - <http://batterymanagement.concordebattery.com/BatteryDocs/5-0171.pdf>
- Concorde Technical Bulletin 14 - capacity check interval adjustment
- Available at [www.concordebattery.com](http://www.concordebattery.com)

# Capacity Testing

When should an aircraft battery be replaced?

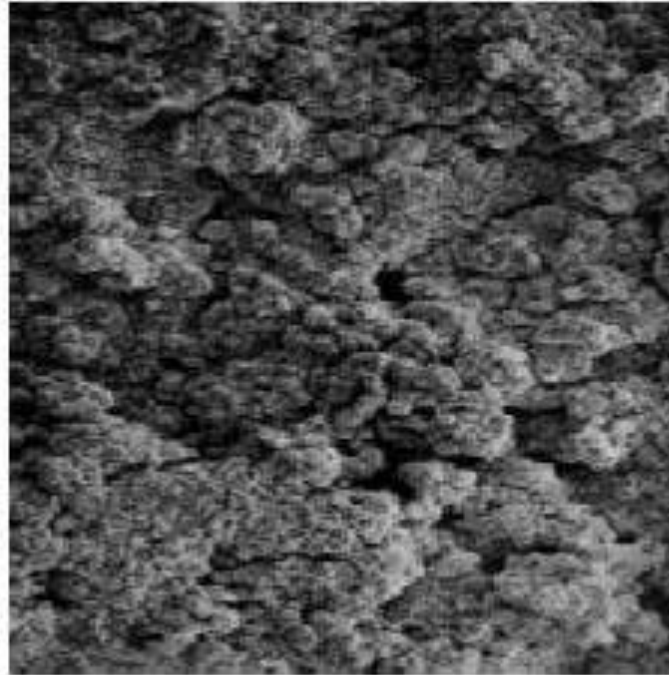


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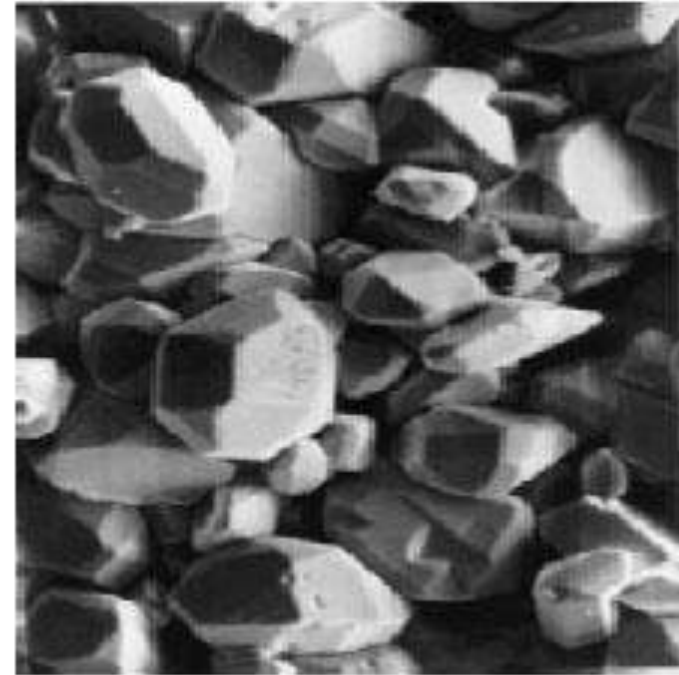
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## Pillar Four - BatteryMinders

What is  
Sulfation?



New and spongy plates



Hardening Lead Sulfate Crystals

# BatteryMinders

- Sulfation is caused by:
  - Leaving a battery discharged for a long time before recharging
  - Repetitive undercharging (short legs, many starts per day)
  - Parasitic loads that slowly drain the battery
  - Extended dormant periods
- The longer these conditions persist, the harder it is to reverse.
- If the plates are heavily sulfated, the battery may not be recoverable and must be scrapped.



# BatteryMinders

“The simple key to making aircraft batteries last is to keep them fully charged when not in use”

- Skip Koss





# BatteryMinders

## What is the best way to use a BatteryMinder?

- Technical Bulletin 15 pg.2



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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:

- The aircraft does not have a parasitic load that drains the battery, or
- 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.

# Summary

- Pay attention to OCV before installation
- Check VR's annually and parasitic loads if necessary
- Capacity tests are the only way to determine Airworthiness
- Keep the battery **fully charged** when not in use



Thanks for using Concorde Batteries!