CIVIL AVIATION AUTHORITY OF BOTSWANA

AIRWORTHINESS ADVISORY CIRCULAR

CAAB Document AAC-019

AIRCRAFT BATTERY CHARGING ROOMS

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1. PURPOSE

This Airworthiness Advisory Circular (AAC) provides guidance on the setting-up and operation of rooms equipped for the purpose of charging aircraft batteries.

2. STATUS OF THIS ADVISORY CIRCULAR

This AAC is an original issuance.

3. EFFECTIVE DATE

This AAC becomes effective immediately.

4. APPLICABILITY

This AAC is applicable to air operators, maintenance organizations, and other entities involved in setting up, operation and maintenance of aircraft battery charging workshops.

5. RELATED REGULATIONS

Copies may be obtained from the Government Printer.

- Civil Aviation (Approved Maintenance Organisations) Regulations, 2012: Regulation 17

6. RELATED PUBLICATIONS

- CAP 562 – Civil Aircraft Airworthiness Information and Procedures (UK CAA)

7. DEFINITIONS AND ACRONYMS

7.1 The following definitions are used in this circular:

Authority means the CAAB, unless otherwise specified.

7.2 The following acronyms are used in this circular

AMO Approved Maintenance Organization

CAAB Civil Aviation Authority of Botswana

UK CAA United Kingdom Civil Aviation Authority

8. BACKGROUND

Regulations 16, 17, and 18 of the Civil Aviation (Approved Maintenance Organizations) Regulations, 2012 require an approved maintenance organization to always have the necessary equipment, tools, material and personnel to perform the approved scope of work. The AMO is also required to have, among others, appropriate housing and facilities. These requirements also apply to workshops/rooms used for the purpose of charging aircraft batteries.

9. BUILDING AND EQUIPMENT

9.1 General

9.1.1 In no circumstance should the same facility be used for both nickel-cadmium and lead-acid battery charging; and the ventilation arrangements shall be such that no cross contamination can occur.

9.1.2 Buildings and rooms used for the purpose of charging batteries should be well lit and cool and should have a ventilation system which is capable of exhausting all the gases and fumes which may be present during the servicing and charging operations. The floor surface should be of a material which is impervious to acid and alkali, has nonslip qualities and is quick drying and able to be washed down easily. Examples of such materials are dustless concrete, bituminous compound or tiling. Adequate and suitable drainage should be provided for washing down purposes. Because of the fire risk, it is strongly recommended that doors should be fitted so that they open outwards, thus facilitating easy evacuation from the building in the event of fire. To permit free and easy movement of batteries, steps and thresholds should, where possible, be eliminated. If, however, different levels are unavoidable they should be linked by inclines.

9.2 Water Supply

At least one tap in each room where battery charging is carried out should be connected to a mains fresh water supply. Sinks and draining boards and a hot water supply should also be provided.

9.3 Lighting

The level of lighting within the charging rooms should be sufficient to enable the level of the electrolyte in individual cells of batteries to be easily determined without additional lighting. To prevent accidental ignition of gases all electrical fittings should be of a spark-proof design.

9.4 Ventilation

Hydrogen is given off at all stages of lead-acid battery servicing; the highest concentration being at the end of the charging cycle. Hydrogen is also produced when nickel-cadmium batteries reach the fully charged state; i.e. at the 'overcharge' point and for a 24 hour period thereafter. Heavy corrosive fumes are also emitted when mixing of electrolytes takes place. Therefore, a ventilation system is required which is capable of extracting all gases and fumes, whether heavier or lighter than air.

9.5 Temperatures

9.5.1 Electrolyte Temperature

The maximum permissible electrolyte temperature during charging is normally 50ºC (122ºF), but some batteries of special design, however, have lower limits; for such batteries the temperature limitations will be specified in the manufacturer's publication for that battery.

9.5.2 Environmental Temperature

Environmental temperatures exceeding 27ºC (81ºF) for lead-acid batteries and 21ºC (70ºF) for nickel-cadmium batteries impose time penalties in reaching the fully charged state and may also be deleterious to the batteries. The temperature of battery charging rooms should, therefore, be maintained at a temperature consistent with specified limitations and with a free air flow around each battery or cell.

10. CHARGING BOARDS AND BENCHES

10.1 Detailed differences exist between the various types of charging board, but in general each board consists of a pair of terminals, to which the rectified a.c. supply is connected (or in the case of a board which has a built-in rectifier unit, to which the mains supply is connected), together with a number of pairs of output terminals, to which the batteries are connected for charging.

10.2 All the output circuits are internally connected in parallel and are, therefore, independent of each other, with the level of charge being controlled separately for each output circuit. Each pair of output terminals is normally designed to have one group of batteries or cells connected in series.

NOTE: Parallel connection of batteries to one pair of output terminals is not permitted.

10.3 Charging boards should be mounted directly above the rear of the benches so that the necessity for long connecting cables is avoided.

10.4 Battery connecting cables should be well insulated and should be of a sufficient capacity to carry the charging current required. The free ends of connecting cables should be fitted with suitable connectors, which should be firmly secured to the battery and charging board before commencing charging operations. Connections to the charging boards should not be made or broken when power is switched on. On completion of the charging cycle, power should be switched off and the charging cables should be disconnected, first from the battery and then from the charging board.

10.5 Benches

10.5.1 Benches and associated equipment should be sited so that the need for personnel to lean over batteries is kept to a minimum. It is recommended that the height of battery charging benches be approximately 0·5 m (20 in) from the floor. At this height, lifting strain is minimised and a more effective visual inspection of the batteries can be made.

10.5.2 The surfaces of battery charging benches should be acid and alkali resistive and should facilitate cleaning. It is generally considered that batteries should not be allowed to stand directly on wood or concrete, but should rest on suitable grids.

11. POWER SUPPLIES

Transformer/rectifiers which normally provide rectified a.c. for charging board supplies should be sited in a fume free, dry and cool position, preferably in a separate room, located as near as possible to the charging boards. Charging boards which require 240/115 volts mains supply, should be supplied from a ring main system.

12. STORAGE

12.1 **Batteries**

In order to preserve an orderly flow of work through a battery charging room, storage facilities should be provided such that incoming unserviceable batteries may be separated from those ready for issue, preferably in clearly placarded areas. The storage facilities should be further grouped for those batteries requiring initial charge and those awaiting routine servicing. Batteries which are serviceable and awaiting issue are best stored in an area which is not subjected to excessive vibration. It is essential that whilst in store, lead-acid batteries be segregated at all times from nickel-cadmium batteries; preferably in separate store rooms.

12.1.1 Storage Guidelines for Lead Acid Batteries

A charged lead–acid battery which is to be stored for any length of time should be in the "fully charged" condition. Before storing, the electrolyte levels should be checked and the battery bench-charged in accordance with manufacturer's instructions. When fully charged, the battery should be stored in a cool, dry, well ventilated store on an acid resistant tray. Batteries may also be stored in the dry, uncharged state. Additional points to note are as follows:

(a) Every 4 to 6 weeks (depending on manufacturer's instructions) the battery should be removed from storage and fully recharged, i.e. until voltage and specific gravity readings cease to rise.

Note: Damage to the battery will occur if it is allowed to stand idle beyond the period for charging specified by the manufacturer.

(b) Regardless of periodic check charges, the battery should be given a complete charge and capacity check immediately before being put into service.

(c) For new batteries, a complete capacity test to the manufacturer's instructions should be made every 6 months, but if the battery has been in service this test should be made every 3 months.

(d) Every 12 months, or earlier if a leak is suspected, an insulation resistance test should be carried out to the manufacturer's instructions.

(e) If the conditions mentioned in the previous paragraphs are observed, a battery may remain in storage up to 18 months. A battery should not be allowed to stand in a discharged condition, and electrolyte temperatures should not exceed 48.8ºC.

Note: Trickle charging at low rates is not recommended as damage will occur if idle batteries are subjected to this form of charging.

12.1.2 Silver-Zinc Batteries and Silver-Cadmium Batteries

These batteries should be stored in clean, dry, cool and well ventilated surrounds, not exposed to direct sunlight or stored near radiators.

(a) New batteries will normally be supplied in the dry condition with the electrolyte contained in polythene ampoules. If possible, new batteries should be stored in their original packaging together with the related ampoules of electrolyte. For storage periods of more than 2 years, special instructions should be requested from the manufacturers.

(b) Filled and formed batteries required for use at very short notice may be stored in the charged condition. Manufacturers normally recommend that such batteries should be discharged and recharged every 4 to 6 weeks. The manufacturer's schedule of maintenance should be applied to batteries stored in the charged condition.

(c) Batteries to be stored out of use for protracted periods, should be discharged at the 40-hour rate until the voltage level measured while discharging, falls below the equivalent of 0·8 volt per cell.

(d) Before storing batteries, the electrolyte level should be adjusted to near the maximum specified by topping up, using a potassium hydroxide solution of 1.300 sg.

(e) The need for care in handling potassium hydroxide, because of its caustic content, is stressed.

After topping up or filling, the top of the batteries should be cleaned and the connections and terminals lightly smeared with white petroleum jelly. In no circumstances should sulphuric acid or acid contaminated utensils be used in close proximity to silver-zinc or silver-cadmium batteries.

12.1.3 Nickel-Cadmium Batteries

This type of battery can be stored for long periods without damage, in any state of charge, provided the storage place is clean and dry and the battery is correctly filled.

(a) For the battery to be ready for use in the shortest possible time, it should be fully charged, correctly topped up and then discharged at normal rate for a period of 1 hour before storage.

(b) The battery should be cleaned and dried and the terminals and connectors lightly smeared with pure mineral jelly.

(c) The battery should be inspected at intervals of 6 to 9 months and topped up if necessary.

(d) Before going into service, the battery should be given a double charge and capacity check as recommended by the manufacturer of the particular type of battery.

(e) The battery should be stored on a shelf or rack, protected from dirt or dust, and where metallic objects such as bolts, hand-tools, etc., cannot drop onto the battery or touch the cell sides.

Note: The above refers to pocket plate nickel-cadmium cells and not to sintered plate nickel-cadmium cells, for which reference should be made to the manufacturer's instructions.

12.1.4 Storage Precautions

It should be noted that sulphuric acid will destroy alkaline batteries; therefore, utensils which have been used for this acid should not be used with such batteries. It is also important to avoid any contamination from the fumes of lead-acid types of batteries.

12.2 Electrolytes

12.2.1 The handling and storage of electrolyte materials should always be in accordance with the manufacturer's instructions. It is, however, essential that when undertaking the mixing or breaking down of these chemicals, separate areas are provided. Glass, earthenware or lead-lined wood containers are suitable for the storage of lead-acid battery electrolyte (sulphuric acid), whilst plain iron, glass or earthenware containers are suitable for the storage of nickel-cadmium battery electrolyte (potassium hydroxide). Galvanised containers or containers with soldered seams must not be used. Each container should be clearly marked as to its contents and should be stored accordingly. Waste or surplus materials should be disposed of in accordance with locally approved instructions. If, however, doubt exists, all electrolytes should be neutralised prior to disposal (*paragraph 12.4*). All mixing vessels, mixing rods and other similar items should be clearly marked with 'acid only' or 'alkaline only' and their use should be restricted accordingly.

12.2.2 Stocks of electrolyte materials which are retained in a battery charging room should be restricted to the quantities required for immediate use. The storing of electrolytes mixed ready for use should be avoided as far as possible.

(a) Sulphuric acid containers should be kept tightly sealed when not in use, to prevent contamination. Only the container which is required for immediate use should be retained in the charging room.

(b) Potassium hydroxide is supplied in solid form contained in steel drums. Once a drum has been opened the contents are liable to carbon dioxide contamination. The entire contents should, therefore, always be mixed as soon as a drum has been opened. Any unused mixture should be stored in a stoppered glass container.

12.3 De-mineralised and distilled water are generally supplied in carboys and should be stored separately from the electrolytes, so as to avoid contamination. Carboys should be firmly stoppered when not in use and should be clearly marked as to the contents. Only the water container used for 'topping up' should be kept in the charging room and the stopper should be refitted immediately after use.

12.4 The neutralising agents for the two types of electrolytes are given below, together with the action that should be taken in the event of contamination and/or spillage.

12.4.1 Sulphuric Acid

The neutralising agents are:

(a) Saturated solution of bicarbonate of soda.
(b) Ammonia powder.
(c) Borax powder.

The acid should be soaked up with sawdust which should then be removed and buried. The affected area should be treated with one of the above, followed by washing down with copious amounts of fresh water.

12.4.2 Potassium Hydroxide

The neutralising agents are:

(a) Boric acid solution.
(b) Boric acid crystals or powder.

The alkali should be soaked up with sawdust, which should then be removed and buried. The affected area should be treated with one of the above, followed by washing down with copious amounts of fresh water.

12.4.3 Containers of sawdust and neutralising agents should be clearly marked with their contents and use and sited in readily accessible positions.

13. PROTECTION

13.1 To prevent the risk of burns, such personal items as rings, metal watches, watchstraps and identification bracelets should be removed, to avoid contact with connecting links and terminals.

13.2 In general, smoking should only be permitted in rooms which do not have a direct access to battery charging rooms or chemical mixing areas. Naked lights, non-safety matches and automatic lighters should not be taken into battery charging rooms.

13.3 Fire extinguishers of the CO_2 type and buckets of sand should be placed at strategic points inside the building for use in the event of any chemical fires.

14. DOCUMENTATION

Records of battery servicing should be maintained.

15. SERVICING AND TEST EQUIPMENT

15.1 Servicing of aircraft batteries should be carried out in accordance with the instructions contained in the manufacturers' Maintenance Manual.

15.2 In addition to the general engineering hand tools which may be required for aircraft battery servicing, the following specialised items will also be required:

(a) Hydrometers.
(b) Thermometers.
(c) Battery kits (as supplied by battery manufacturers).
(d) Capacity test sets.
(e) Leakage tester (lead-acid batteries).
(f) Filler pumps (for transferring of liquids from one container to another).
(g) Calibrated test equipment:
    i. Insulation resistance tester.
    ii. Universal test meter.
    iii. Digital voltmeter

15.2.1 To prevent cross-contamination between the two types of aircraft batteries, two sets of equipment should be held, each being contained in separate cupboards and clearly marked 'acid only' or 'alkaline only' as appropriate to the application. Wherever possible, tools and equipment comprising the sets should be those manufactured of an insulating material. Each item should be identified as to its application and in the case of hydrometers and thermometers, this is usually best done on the instrument case.

CIVIL AVIATION AUTHORITY OF BOTSWANA
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2013 -12- 17
DIRECTOR
FLIGHT SAFETY

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For/**Civil Aviation Authority of Botswana**

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