STORAGE, HANDLING AND OPERATING PROCEDURES

FOR THE

ARCTIC OCEANOGRAPHIC BUOY

Sparton of Canada Limited

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The Arctic Oceanographic Buoy (AOB) is a special type of sonobuoy designed for Arctic Operations. It is released from an aircraft, lands on the ice surface, penetrates through the ice and deploys a sensor to measures acoustic energy being transmitted below the ice. The acoustic data is transmitted to the Argos satellite for post transmission analysis.

This report provides a brief technical description of the AOB and its potentially hazardous materials, plus recommended procedures for storage, handling, and operational use.

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1.0 GENERAL

The Arctic Oceanographic Buoy (AOB) is a special type of sonobuoy designed for Arctic Operations. It is released from an aircraft, lands on the ice surface, penetrates through the ice and deploys a sensor to measure acoustic energy being transmitted below the ice. The acoustic data is transmitted to the Argos satellite for post transmission analysis.

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2.0 TECHNICAL DESCRIPTION

The AOB consists of 5 major subassemblies:

- Parachute subassembly
- Electronics Subassembly
- Penetrator/Sensor Subassembly
- Expulsion Subassembly
- Energy Absorbtion Subassembly

2.1 Parachute Subassembly

The parachute subassembly is of standard sonobuoy design, except that the release latches are designed to accept opening shock loads in excess of 3000 lbs, but allow expulsion of the buoy contents to occur with internally generated forces of 1750 lbs.

An electronics activation switch is controlled by a pin attached to one of the parachute lanyards. The pin holds the switch open and prevents activation of the buoy electronics until it is pulled out when the parachute opens.

2.2 Electronics Subassembly

The electronics are in a separate watertight housing, and include a Controller, an Argos Satellite transmitter, a sonic amplifier and ant-aliasing filter, an impact sensor, a temperature sensor, an impact sensor and the power supply. The impact sensor generates a low level warning signal when the buoy power is turned on (ie. when the lanyard pin is pulled out), and also detects impact when the buoy strikes the surface. Power is supplied by 12 LiSO2 batteries in series-parallel that produce an output of 18V. In addition to the safety vents in the individual battery cells, the power supply has thermal cut-out fuses for each set of series cells to cut out the power if temperatures within the battery pack exceed 71°C, diodes that prevent reverse charging from one set of series cells to the next, overcurrent protection fuses, and two vents that prevent pressure build-up in the event of venting or excessive heating of any of the cells. Venting gas is routed to the Sonobuoy Launch Container. The power supply has successfully passed NSWC battery qualification tests for limited use in the Arctic Oceanographic Buoy.

2.3 Penetrator/Sensor Subassembly

The Penetrator consists of a solid chemical capable of melting a 4 inch hole through 10 ft of ice in 30 minutes. It is a very strong "base" (pH = 14), and corrodes aluminum, particularly when the chemical has been dissolved. The penetrator is separated from the aluminum housing of the buoy by two layers of polyurethane film from the expulsion bag, which prevents the possibility of corroding the aluminum.

> **Do not under any circumstance expose the skin, mouth, nose or respiratory system to the chemical or dust of the chemical. If it is necessary to handle the chemical wear rubber gloves, a face mask, a plastic apron, and rubbers or rubber boots. The chemical is more active when it deliquesces (begins to dissolve and form into a liquid state).**

2.4 Expulsion Assembly

The Expulsion Assembly consists of three 16 gm CO_2 bottles with their associated firing squib, piercing mechanism, and an expulsion bag. When the bottles are pierced the gas expands into the bag to generate pressure on the buoy contents. At 1750 lbs force, rivets on the parachute housing sheer, and the contents are expulsed onto the ice. **The action can be violent, and observers should stand well clear, particularly from both ends, during the expulsion process.**

2.5 Energy Absorbing Device

The Energy Absorbing Device (EAD) consists of 3 inches of honeycomb aluminum that reduces shock loading when the buoy strikes the ice.

A safety vent has been incorporated in the top of the EAD housing. The vent is always held open until impact with the surface, and the EAD must be partially crushed before the vent will close. Should the CO_2 expulsion bottles be pierced for any reason prior to impact, the gas will be expelled through the vent into the SLC, and the buoy contents will not be expulsed. Gas escaping into the SLC will vent through the SLC finger ports into the grey overpack or the surrounding atmosphere.

3.0 HAZARDOUS MATERIALS

The AOB has four items that are considered to be hazardous materials: Lithium batteries, squibs, compressed CO_2 gas and an ice penetrating chemical.

This section describes the hazardous materials in the AOB, and the features that are incorporated to ensure safe transportation and use.

3.1 Lithium Batteries

The design of the battery pack is based on the well-proven technology used in the SSQ-62. It consists of 12 $LiSO_2$ cells connected in series-parallel (vs. in series with the SSQ-62). The cells have a solid cathode and contain 2.4 grams of Lithium per cell, which is within the limits specified in the Code of Federal Regulations 49 (CFR 49) Section 173.185. The batteries are contained in a housing within the sonobuoy with pressure relief valves that prevent over-pressurization, and have overcurrent, thermal protection and charge protection devices. In addition, the individual cells have the integral protection devices required to obtain UL certification.

3.2 Squibs

There are three identical, electrically activated squibs in the AOB which conform to the requirements of 49 CFR 1910.1200. Two squibs are used as lanyard cutters, and are completely contained in steel cylinders that prevent expulsion of components or debris. The third squib initiates release of compressed gas from three CO_2 bottles to expel the buoy contents. Its design is similar to that used in the SSQ-62 and other sonobuoys, is well proven, and has passed USN High Energy Risk to Ordinance (HERO) tests. The squibs have been used in production SSQ-47 sonobuoys.

3.3 Compressed CO_2

Three CO_2 bottles in the AOB are used to expel the payload from the housing after the buoy has struck the ice. Each CO_2 bottle contains 0.564 oz (16 gm) of CO_2, for a total of 1.69 oz, which is well below the 4 oz limit authorized in the International Air Transport Associations (IATA) Dangerous Goods Regulations. The squib and CO_2 bottles are within the outer housing of the sonobuoy, and cannot be fired until the following sequence occurs: First, the buoy must be launched from its Sonobuoy Launch Container; second, the parachute must open to release a pin attached to a parachute lanyard which turns on the buoy electronics; third, an impact switch must sense impact with the ice within a prescribed time window (between 3 and 120 seconds); and fourth the safety vent must close when the EAD strikes the surface. Should the CO_2 be released for ANY reason prior to impact with the surface under the conditions described, the gas will vent harmlessly into the SLC and the grey overpack, or the surrounding air.

3.4 Thermochemical

The thermochemical is highly concentrated Potassium Hydroxide. This chemical is commonly found in household products used to clear plumbing systems, and is very similar to the chemical found in household lye.

When wet the chemical is extremely toxic, and direct contact with the skin, mouth, respiratory system and eyes must be avoided. Wear rubber gloves, a face mask, a plastic apron and rubbers or rubber shoes when handling the chemical, and particularly when observing ice penetration action. The wet chemical will corrode aluminum, and generate hydrogen gas in the process.

The chemical in the housing is separated from the aluminum housing by two walls of polyurethane of the expulsion bag. Water is prevented from reaching the chemical by the urethane bag, and by the SLC and grey overpack, both of which are hermetically sealed.

4.0 PACKAGING

The AOB, as illustrated in Figure 1, is a right circular cylinder, 4 7/8 inches in diameter by 36 inches long. It weighs 37.5 lbs. and the C of G is 16 inches measured from the bottom of the buoy. It is stored within two containers during shipment. The primary package is the Sonobuoy Launch Container which is the same container as is used with the AN/SSQ-53D sonobuoy. It is composed of 3/16 inch thick ABS plastic (sides and base), a removable muzzle cap (made of ABS or polycarbonate plastic), and muzzle cap retention devices that do not release until subjected to a minimum of 900 pounds force. The secondary package is a standard sonobuoy grey overpack made of a high density polyethylene plastic that is 5/32 inches thick. It has a screw cap of identical material. Both primary and secondary containers provide environmental seals that prevent inadvertent exposure of the thermochemical to moisture. When AOBs are shipped in quantity, these containers may also be placed in a wooden pallet or box.

5.0 STORAGE AND HANDLING PROCEDURES

The following storage and handling procedures are recommended for Arctic Oceanographic buoys.

5.1 Recommended Storage Areas

Exposure of the AOB to water should be avoided as it increases the risk of deliquescence of the thermochemical, which makes the chemical more active and can result in the generation of temperatures as high as 400°F.

1. The AOBs should be stored upright in a dry storage area. They should be retained in their SLCs and grey overpacks until use dictates their removal. Buoys that are returned from a mission should be re-stored in their SLCs and grey overpacks.

2. Storage temperatures above 130°F should be avoided.

3. The storage areas should be isolated from other hazardous and combustible materials.

4. The AOBs can be stored amongst other sonobuoys, however, as they are Lithium powered it is recommended that they be stored near an access or exit to allow free and unrestricted access in the event of venting or fire.

5.2 Handling

1. The AOB contains high energy devices and a thermochemical, any of which could cause serious injuries if the buoy is abused or mishandled. Special care shall be exercised when handling or moving the buoys to prevent shocking, crushing, or puncturing. Exposure of the bare buoy to water is to be avoided, as it could result in the thermochemical liquifying and leaking.

2. Should leakage of the thermochemical occur, it can be neutralized with citric acid. The resulting solution consists of citrates of Potassium.

3. Under no circumstances are unauthorized personnel to attempt to disassemble the buoy.

4. Procedures specified in Naval Air Training and operating Procedures Standardization (NATOPS) loading checklist are mandatory, and shall be observed by responsible personnel.

5. Buoys in cracked, punctured or torn SLCs shall not be used.

6. Buoys in SLCs with damaged or out-of-round muzzle rings shall not be used.

7. Exercise care when handling or removing the plastic SLC from the overpack or the aircraft to prevent the possibility of cuts to the fingers and hands in the event that the SLC is damaged. The use of protective gloves is recommended.

8. The SLC provides protection from humidity and rain; however, the SLC outside of its overpack, on or off the bayonet base pallet, is susceptible to physical damage. Use protective ground support equipment for transportation to the aircraft loading area.

9. Handle the plastic SLC with care. If dropped on its muzzle end, the resulting shock can sheer or crack the breakout cap. If the sonobuoy is dropped on the breech end, damage may occur to the locking lugs.

10. Should a buoy be inadvertently launched on or near a runway or in or near an inhabited area, do not approach for a minimum of 10 minutes. To disarm, cut through the tape at the bottom of the buoy, cut the two wires that are then exposed (these lead to the squib that pierces the CO_2 bottles), and cut through the urethane bag surrounding the two wires. The expulsion mechanism has now been disabled, and should the CO_2 bottles fire for any reason, the gas will vent through the hole that has just been cut in the expulsion bag. Insert the buoy in an SLC and grey overpack, and remove to a dry area designated for storage of hazardous materials.

6.0 SHIPPING

Table 1 is a summary of the hazardous materials contained in the AOB, their UN or ID numbers, Classes or Divisions, and Packaging Groups. The buoys may be shipped via commercial cargo aircraft when packed in their grey overpacks.

7.0 RECOMMENDED LITHIUM INCIDENT PROCEDURES

In the event that lithium battery venting or fire occurs, the following procedures should be followed by emergency response personnel.

1. Remove all personnel from the storage area or building containing the venting or burning sonobuoy.

2. A three man safety team consisting of a principal worker, a worker assistant and a non-participating observer should be used.

3. All three members of the safety team should wear full face protective shields, rubber gloves, rubber shoes, and plastic or rubber aprons.

4. Do not remove the sonobuoy from its SLC and grey overpack. Use water to control the temperature of the SLC/Grey Overpack.

DO NOT ATTEMPT TO FLOOD THE BARE BUOY WITH WATER, AS IT INCREASES THE RISK OF DISSOLVING THE THERMOCHEMICAL, WHICH MAKES IT MORE ACTIVE.

8.0 CHEMICAL INCIDENT PROCEDURES

BLINDNESS CAN RESULT IF THE EYES ARE EXPOSED TO THE CHEMICAL. IF EXPOSURE OCCURS, WASH EYES IMMEDIATELY WITH A COMMERCIAL EYEWASH SOLUTION FORMULATED FOR ALKALI BURNS, OR COPIOUS QUANTITIES OF WATER.

8.1 Dry Chemical

Wear rubber gloves, eye protection, a face shield and other protective clothing as needed to prevent contact. With a clean shovel, carefully place broken material into a plastic bag, seal, and place in a clean, dry plastic or steel container. Store the material in a dry corrosion-free area, approved for holding defective or hazardous material that is awaiting disposal.

8.2 Wet Chemical

The wet chemical can be extremely corrosive to some metals (eg, aluminum). It can be stored in steel or plastic containers. Should it be necessary to clean a spill of wet chemical, it can be neutralized with a caustic neutralizer, such as Citric Acid.

* A private company, JT Baker Inc., 222 Red School Lane, Phillipsburg, NJ, (908 859-2151), produces a commercial neutralizer called NEUTRACIT-2, that is designed SPECIFICALLY for clean-up of caustic solutions.

9.0 OPERATIONAL USE

Great care has been taken to ensure that the AOB is safe for operational use; however, it must be remembered that it is a development product, containing a large amount of stored energy, and must therefore be handled with respect.

1. Care shall be exercised, both on the ground and when airborne, to prevent accidental sonobuoy launches and intentional launches which may endanger personnel, land objects, or ships.

2. Should it be necessary to clean up pieces of the chemical, it should be swept up with a dry broom and placed in a dry plastic bag that is tightly wrapped. Wear rubber gloves, rubber shoes, a plastic apron and a face mask when undertaking the clean-up. Store clean-up materials in the same plastic bag; do not discard in a container used for disposal of combustible materials or water. Do not expose the chemical to water.

3. If the bare sonobuoy has been exposed to water, it is possible that the chemical could deliquesce (start to liquify) and leak out. Do not handle buoys in this condition without equipment that will protect the eyes, nose and skin (ie, wear rubber gloves, a face mask, and a plastic apron). Place the buoy in a plastic bag, seal, replace it in its SLC, install the breakout cap and (if available) insert it into a grey overpack. Store in an upright position in a secure, dry area.

4. Buoys may be CAD launched from the external or internal launch tubes in the P3 aircraft using standard Naval Air Training and Operating Procedures. Tests indicate that it is also safe to hand launch AOBs from the General Purpose Chute using standard NATOPS; however, it is recommended that buoys that are carried internally be retained in their SLCs and grey overpacks until immediately prior to launch.

   Launch Limits

   - 500 ft to 5000 ft altitude
   - 180 to 250 Knots IAS
   - Air Temperature -40°C to +55°C