APPLIED ACOUSTICS
Underwater Technology

DELTASPARK ARRAY
OPERATING MANUAL

CSP-4000-8000/1

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Introduction

The DeltaSpark sparker array is a multi-electrode sound source which produces a broad spectrum signature depending on discharge power. The number of sparker tips can be varied by connection to alter performance and performance will also depend on the energy input.

The DeltaSpark sparker array is designed for use with our range CSP seismic energy sources and is designed to accept power inputs from 1000 Joules to 6000 Joules. Lower power rating, higher resolution sparkers are also available.

WARNING

As a sparker system, the DeltaSparker relies on high voltage high energy electrical discharges. Therefore extreme caution should be observed when handling and towing the sparker. Ensure good earthing between energy source, ship, sparker and the sea. If in doubt of the required 'good practice' then ask!

We have been asked of there is a diver safe distance for these sparkers when a diver is in the water. The answer is that we do not recommend a diver be in the water at the same time.

Do not handle the cables when the sparker is deployed and operational. Ensure that the energy source is switched off and unplugged from AC or the ON/OFF keyswitch has the key removed. (And in your pocket)!

Do not try to operate with the sparker out of water.

Do not operate with the sparker closer than 5 metres to the boat.

Theory of Operation DeltaSpark

A high energy electrical pulse is generated by our CSP range of seismic energy sources which is connected by a heavy duty cable to the sparker. With the sparker immersed in water, the electrical energy is switched into the sparker, a plasma bubble develops between the sparker tips and the frame which produces a high intensity sound pulse. The sparker is usually supplied with 6 single tipped sparker electrodes. The number of these can be reduced to two or four if required. In addition multi-tipped electrodes may be utilised which will produce a higher frequency sound pulse which will produce a higher resolution seabed image.

The sound pulse from the sparker is reflected off the different layers of sediment/seabed and received by hydrophone(s) which are streamed in the water some distance from the sparker. The signals are amplified and processed to produce the usual seismic recording.

With increased energy levels a secondary discharge pulse is generated after the initial discharge. The time delay between initial and secondary is proportional to the level of energy being discharged. The result of the secondary discharge is a ‘ghosting’ effect on the received data usually evident as a secondary seabed return. The secondary pulse is commonly known as the ‘bubble pulse’. This effect can have a desired effect by effectively lowering the frequency of the source pulse by further increasing the energy levels producing further ‘bubble pulses’ thereby increasing penetration.

Assembly Instructions

The DeltaSpark array is constructed in two sections for ease of transportability and storage. Smaller diameter tubing on one half of the array enables the other to slide together providing a strong bracing joint. Slide the array halves together until the six fixing holes show clearance.

Use the fastening hardware supplied to secure the two halves. Insert six sets of M8 x 55mm screws with an external shakeproof washer on each. Use a shakeproof washer on the other side with two nuts as locknuts. Always ensure all fastening hardware used is A4 (316) stainless steel.

Connect the earth link by using a M8 x 55mm hex head screw with a shakeproof washer followed by the link followed by another shakeproof washer, push screw through the frame and secure with another shakeproof washer and two nuts – second acting as a lock nut.

The electrical splices within the sparker frame consist of two inline splices and one terminator-splice. Either one or two inline splices may be used along with the end-splice to make up a 2, 4 or 6 tipped sparker array.

Deployment / Connections

The DeltaSpark is designed to be connected to the Model SQUID 2000/DeltaSpark cable and towed with floats attached, however in certain applications it can be used without floats.

A towing rope should be secured to the array using the single ‘D’ shackle located on the front of the array. It is advised that the shackles should be lock wired to prevent against possible loss of the array.

Ensure that the CSP seismic energy source is switched off and isolated before connecting the cabling or DeltaSpark array. Check that all cables are in good mechanical and electrical condition and are fit for purpose before use.

Two smaller ‘D’ shackles are provided (see above photo) to enable connection of Squid 2000/Deltaspark cable kellums grip (strain relief). Note: No stress should be applied to the electrical connections whilst the unit is undertow as this may cause failure during operation. As mentioned above, it is also advisable to lock wire the shackles to prevent against possible loss. The electrical splice at the lower end of the HV cable can be ty-wrapped to the frame so as to avoid and stress whilst under tow or whilst being deployed.

Note: The black cables attached to the DeltaSpark connectors are rated at 600 Volts continuous rated load (as stated by the manufacturer on the cable) and 4KV for transient voltage applications.

The electric connectors used are robust and reliable. However they should not be pulled or stressed unduly or they will fail prematurely. The gold plated pin and socket should be clean and free from dirt and grease before assembly. However the rubber sealing face should be lightly lubricated with O-lube or petroleum jelly before mating to ensure a good seal and also to ensure easy disassembly. For correct cable connector type see specification section of this manual.

Always operate the system using a reliable earth bond to the ship and the sea.

The vessel towing the sparker should have the CSP unit earthed to the ship and the ship should be earthed to the sea. This should be at least 10mm². A reliable sea earth can be achieved by using a length of 10mm² copper cable with 1m stripped bare and immersed in seawater. The cable will need to be weighted to ensure constant contact with the seawater.

Do not operate the sparker system until the sound source is fully deployed off the ship and avoid turning sharply (confined areas), which would allow the array to come close in to the vessel.

The DeltaSpark is not designed to operate in fresh water.

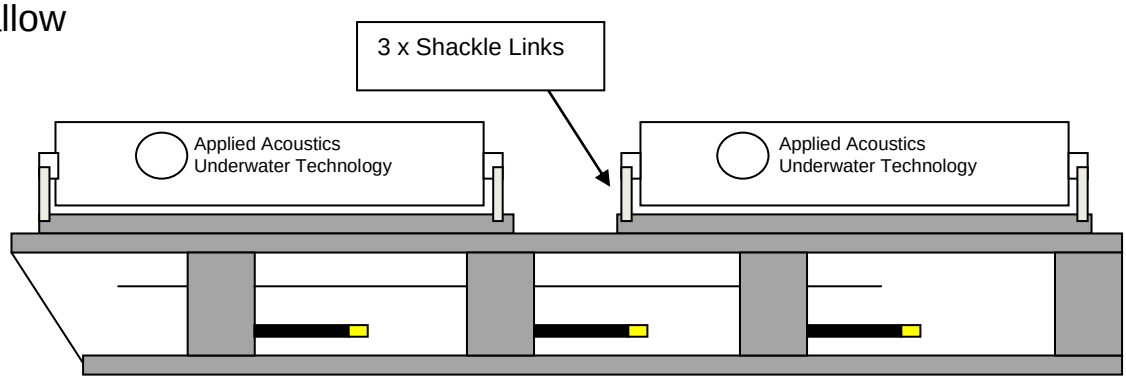
Depth of tow may need to be adjusted by changing the length of the wires connecting the floats to the frame.

Configuration

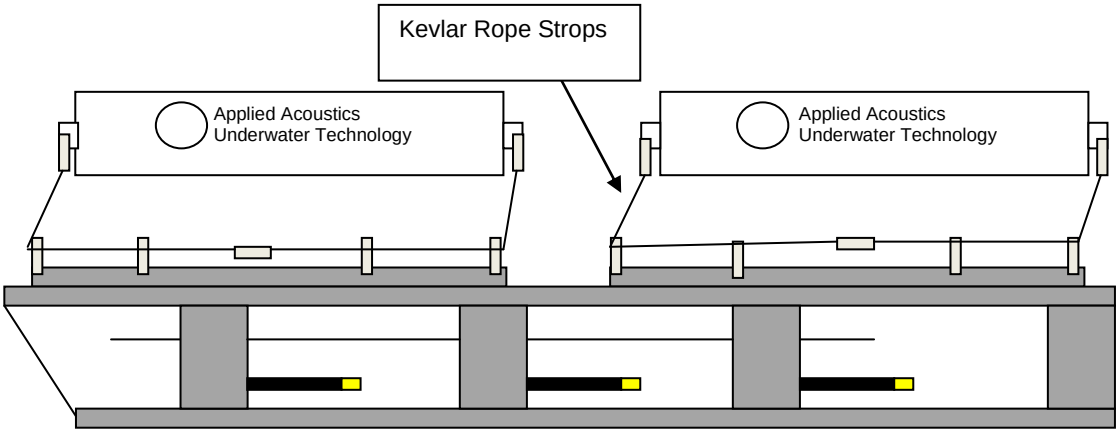
The Delta Spark can easily be configured to operate as a 2, 4 or 6 candle array by separating the interconnect cable and inserting the blanking plug at the desired point.

Tow Depth Arrangements

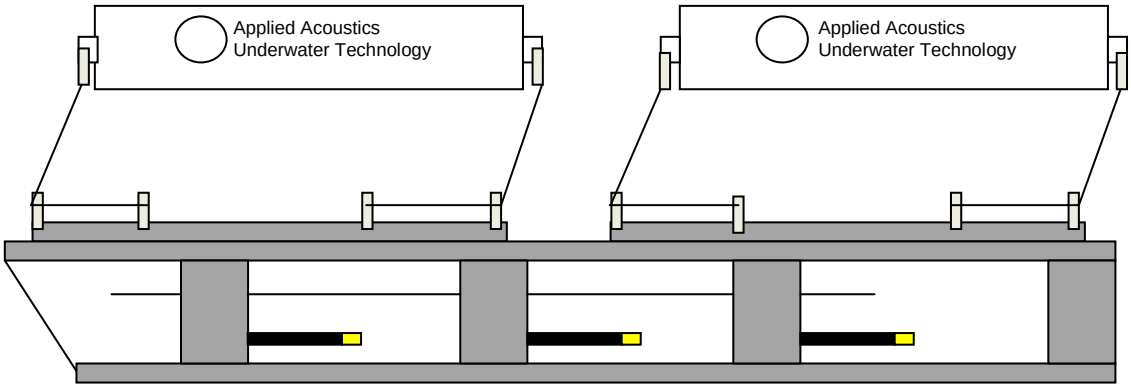
Shallow



Medium



Deep



Note
Front buoy strop is shorter than rear to allow for towing from frame.

Operational Maintenance

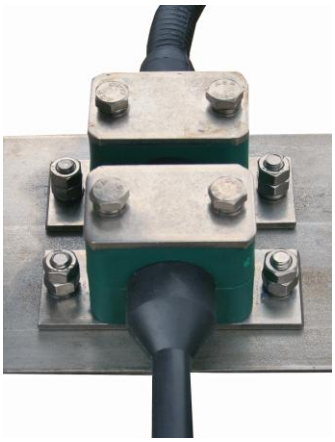
During the course of a survey the sparker tips will require trimming or replacement, the interval is dependant on repetition rate and power level.

When tips are eroded, isolate from or switch off the energy source. Trim the sparker tips with a pair of electrical side cutters or hacksaw to equal length before testing.

NB As soon as one or a few tips start to wear down, these tips will then were down even faster so equal tip length is important.

TIP Replacement.

Once the tips have worn down they will need to be replaced. The tips are clamped in place by the clamps as shown in the attached photographs. The two clamps are used to hold both sides of the electrical connector. Simply undo and remove the top cover of the clamps, unplug the sparker tips and replace with new. Note that all tips should be replaced as a set rather than individually to ensure even wear. Ensure that the electrical connections are clean and free from grease and dirt. Spare splices can be supplied if required.



Maintenance Procedures

Sparker tip trimming and replacement are considered to be consumable items, please contact factory for replacement.

The below procedures are advisory guidelines that are recommended.

Inspection Intervals

- **Pre-Deployment:**
  The recommended interval for a visual inspection is on every deployment of the sparker.
- **Monthly:**
  It is recommended that the sparker system is electrically checked.

Visual Inspection (Pre Deployment)

- Check condition of RMK connectors verify locking collars are secure.
- Check for mechanical damage / insecure fastenings.
- Check tips are even in length to ensure that the burn is even.

Monthly Inspection (Pre Survey)

- Check condition of HV power cable – electrical isolation and continuity of both earth and live connections.
- Check condition of RMK connectors for signs of arcing / damage.
- Check for mechanical damage / insecure fastenings.

The Applied Acoustic Engineering DeltaSpark unit does not require regular servicing with the exception above operational inspections.

When storing for long periods it is recommended the unit first is cleaned with fresh water.

Fault Identification and Rectification

Loss of data quality and electrical failure are the main faults that occur as a result of mechanical damage or component failure. These are generally identified by inspection or whilst acquiring sub bottom data.

Periodic replacement of the sparker cluster is considered to be part of the operation maintenance procedure. Exact timing of servicing cannot be predicted as it is dependant on operational conditions.

Below is a simple guide to identifying common faults that can occur.

Symptoms
- No data received on hydrophone.

Possible Causes
- Hydrophone damage.
- Mechanical damage / Water Ingress to HV cable / connectors.
- DeltaSpark cabling failure.

Solution
- Verify operation of hydrophone by tap test / check battery.
- Inspect tow cable for mechanical damage. Test for electrical isolation and continuity.
- Inspect cabling and connections. Test for electrical isolation and continuity.

Symptoms
- Drop in output power or no output upon CSP discharge.

Possible Causes
- Mechanical damage / Water Ingress to HV cable / connectors.
- Mechanical damage / Water Ingress to transducer mouldings.
- DeltaSpark cabling failure.

Solution
- Inspect tow cable for mechanical damage. Test for electrical isolation and continuity.
- Inspect cabling and connections. Test for electrical isolation and continuity.

Fault Identification and Rectification Continued.

Symptoms
- Loss of data resolution.

Possible Causes
- Uneven tip wear.
- Hydrophone fault.

Solution
- Trim sparker tips to ensure even burn and bubble.
- Verify operation of hydrophone by tap test / check battery.
- Contact factory if new mouldings are required on the DeltaSpark.
- Contact factory if new clusters are required for the DeltaSpark.

Tips:

If performance is poor, check that all cables or cable connections are electrically secure and sound.
(Note: Switch off CSP unit and disconnect before checking).

Ensure that all electrical connections are not arcing or breaking down to water.
(Note: Switch off CSP unit and disconnect before checking).

Check that the unit is sitting in the water at the recommended depth (see deployment).

Rough sea conditions will cause signal deterioration.

Check that the CSP unit power level is set correctly (Do not over drive the unit beyond its rated specification). For high resolution applications, tip numbers should go up and power levels should go down.

Please quote the serial number of the unit and model number of the sparker when contacting the factory for any technical advice / spares.

Technical Specifications: DeltaSpark

Maximum energy rating	: 6000 J
Number of electrodes	: 6 (replaceable)
Source level	: 210dB typically. (Note: 220dB = 1 Bar Metre).
Pulse width	: 2 mS at 1 kJ typically with 6 tips utilised.
Maximum overall length	: 2500mm (98.5 inches)
Maximum overall width	: 400mm (15.75 inches)
Maximum height	: 310mm (12.2 inches)
Weight in air	: 40 Kg (88 Lbs)
Material	: A4 (316) Stainless Steel Tubing & Fixings : Other parts plastic
Fixings	: All A4 (319) Stainless Steel 'D' Shackles / Hardware

Spares:-

The following spares are available which are held in stock.

- Single tip electrode.
- Multi-tip electrode
- Earth Link
- Hardware as required
- Sparker splice In-line
- Sparker terminator splice
- Earth Lead
- Individual connectors.

Sparker Splice - Inline

Sparker splice - Terminator.

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