APPLIED ACOUSTICS
Underwater Technology

MODEL AA200 SEISMIC SOURCE OPERATING MANUAL INC MODEL AA201

CSP-1000-8001/4

BOOMER PLATE FITTED TO CAT 200

Amended November 2009

Contents

Introduction

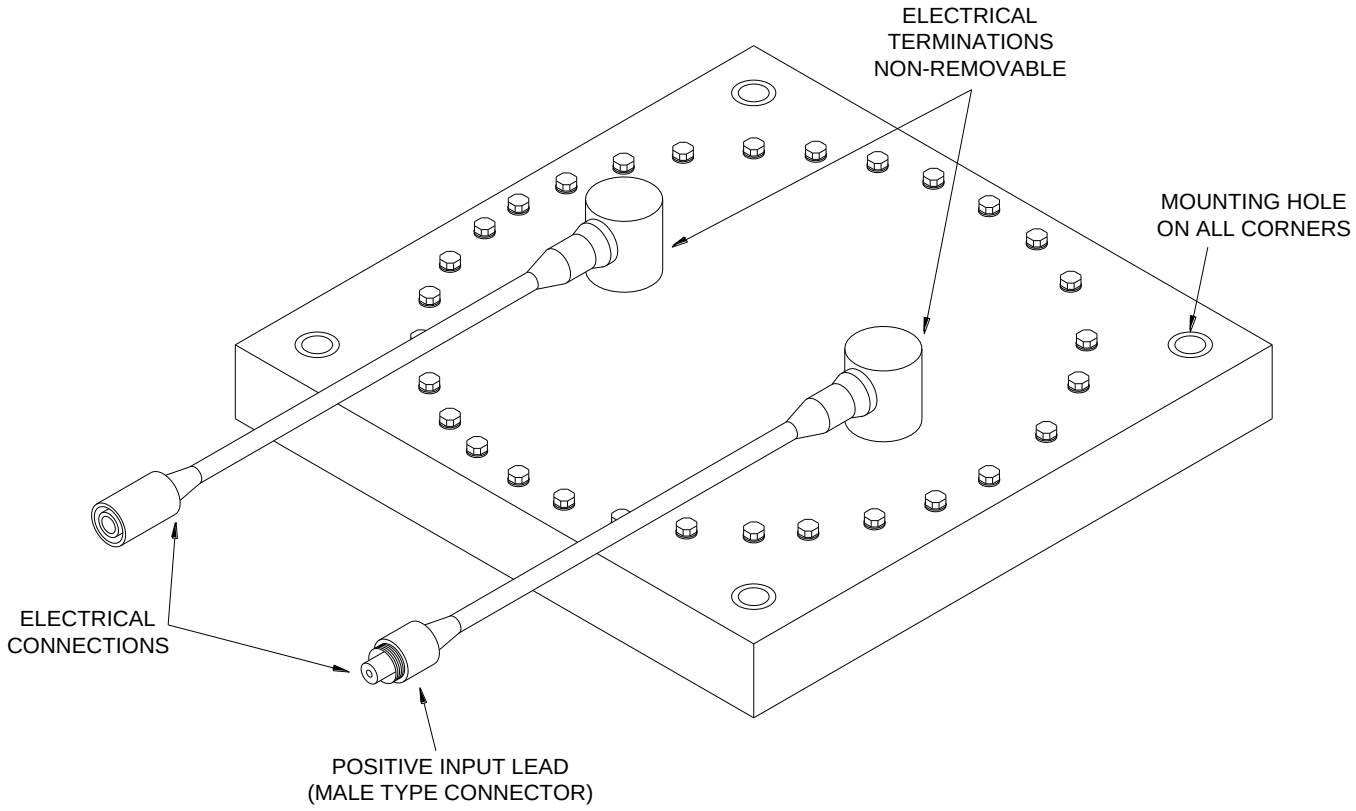
The AA200 transducer or *Boomer Plate* is an electromechanical sound-producing device. The AA200 produces a sharp (short duration) broad spectrum pulse which gives a good trade-off of penetration vs. resolution.

The AA200 transducer is primarily a high resolution source designed to be used in conjunction with our range of Hydrophone arrays (AH Series) and our range of Seismic Power Sources (CSP Series).

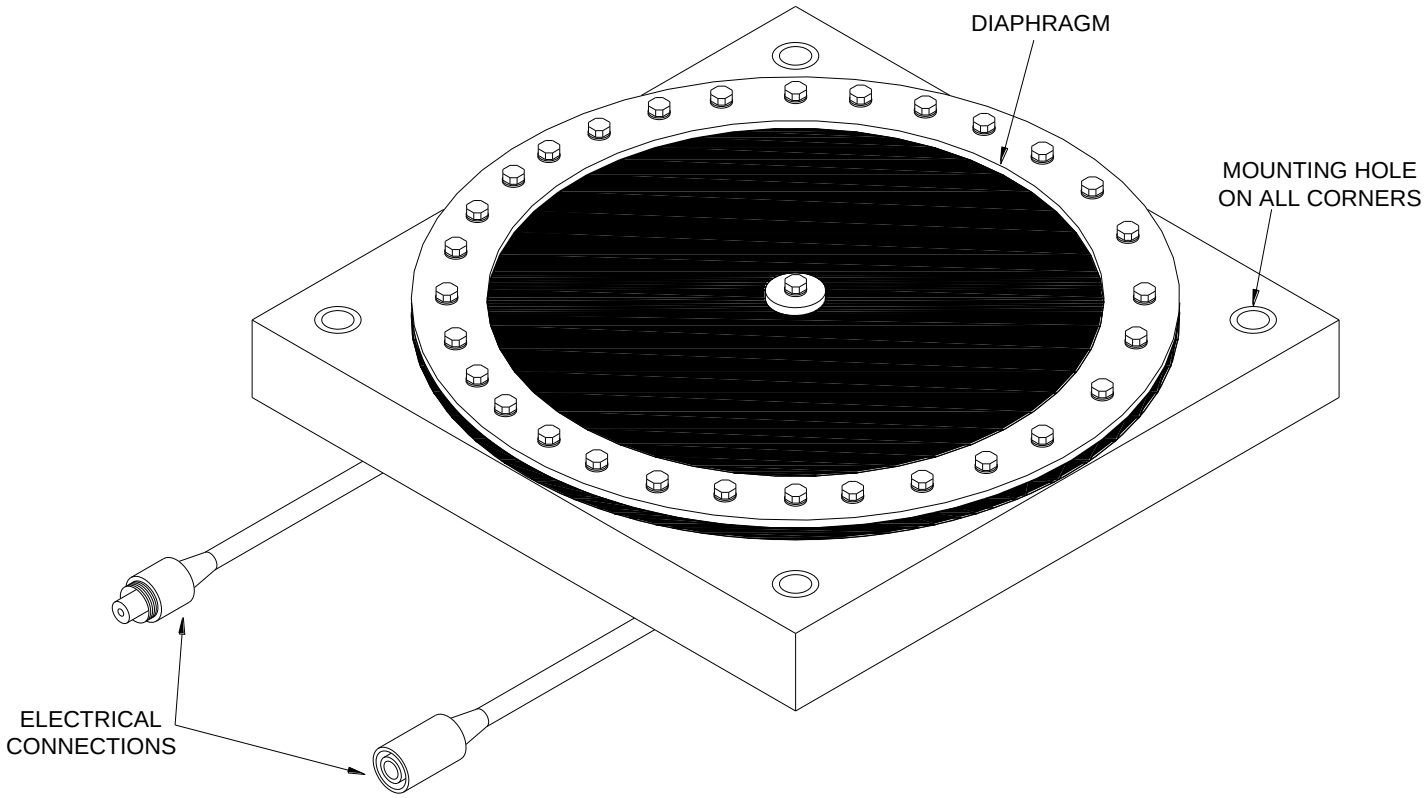
The AA200 is a 'traditional' boomer design. The transducer has been manufactured to be lightweight, reliable and versatile.

Note the AA201 boomer plate is a variant of the AA200 by using RMK connectors instead of Joy Plugs.

Parts Designation AA200



Topside of AA200 Boomer plate

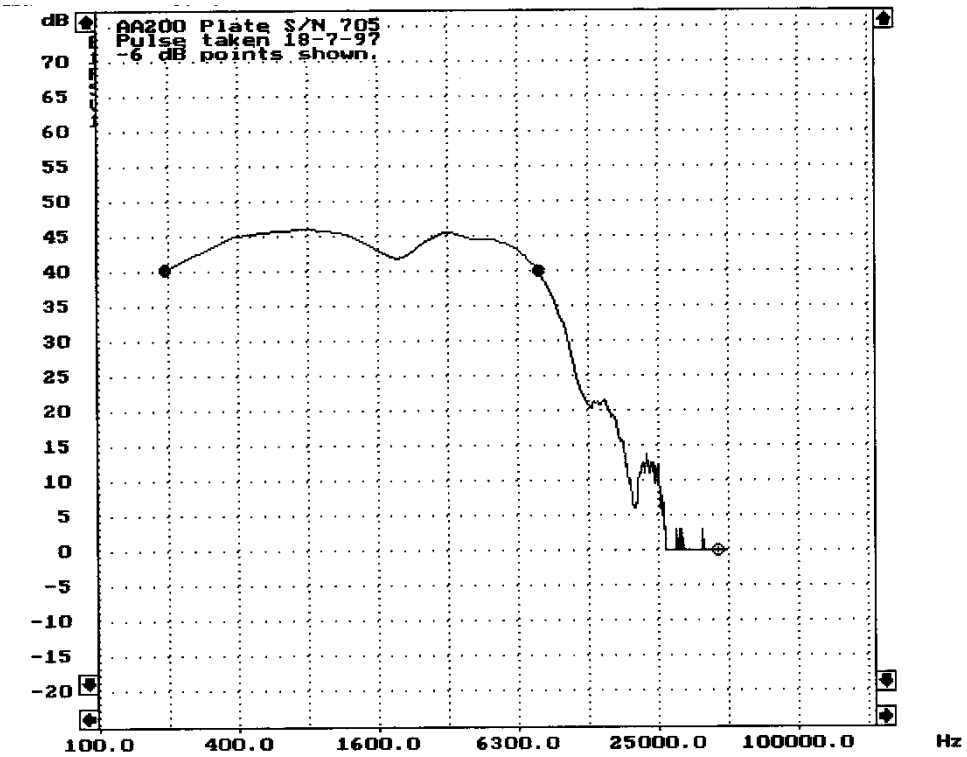


Bottom side of AA200 Boomer plate

Theory of Operation AA200

It consists of an electrical coil, which is magnetically coupled to the plate (metallic disc) situated behind the rubber diaphragm. Energy contained in the electrical storage capacitors in the *CSP* unit is discharged into the Boomer plate coil. This creates a mechanical response on the diaphragm plate due to eddy currents on the plate. The resultant acoustic pressure pulse is broad spectrum in nature. The spectral response and the pulse shape are shown below As a general rule, more energy into the plate will result in a longer and hence lower frequency sound pulse.

Initial Acoustic Pulse shape and reverberation is controlled by the diaphragm and the clamping arrangement.



Deployment

The Boomer plate can be mounted on both of our lightweight catamarans; Models CAT200 and CAT100. These have been specifically designed for this application.

Rubber vibration isolators should be used to mount the Boomer plate to the catamaran framework. When installed correctly on the catamaran, the Boomer plate diaphram should sit in the water at a depth of roughly 15cm. The catamaran should be adjusted to achieve this if required.

Two towing ropes should be secured to the catamaran using two stainless shackles on the two points (see diagram). These towropes can provide a degree of steerage by adjusting the tension on each rope. Other adjustments include altering the towing point position (fore and aft) to increase stability of the catamaran. Note: No stress should be applied to the electrical connections whilst the unit is undertow as this may cause failure during operation.

Ensure that the CSP power source is switched off and isolated before connecting the cabling or Boomer plate. Check that all power cables are in good mechanical condition and are fit for purpose before use (this includes the mains power supply lead and earth cable).

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

Tape all Boomer cable connections together with self-amalgamating tape to prevent the connections becoming separated if locking collars are not available. 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 catamaran itself does not require an earth cable. However, the vessel pulling the catamaran 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.

A quick sea trial should be undertaken to check the floatation characteristics of the catamaran underway at roughly 2-3 Knots. If this proves successful, the unit should be checked for electrical continuity before power is supplied to the boomer system.

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

Pulse Testing

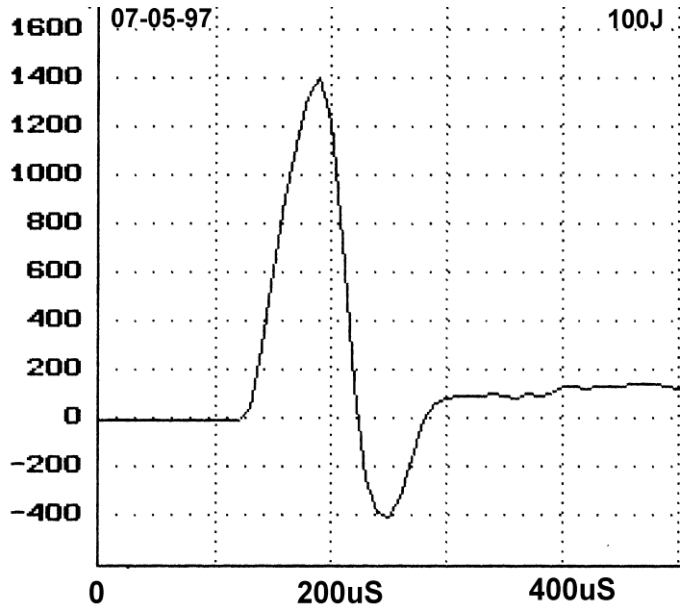
- The minimum distance between the boomer plate and receiving hydrophone should be 1 metre.

- The plate should be just below the water (15cm is a good starting point).Please note that the pulse shape will change during an initial ‘warm up’ period. Ensure that the plate is not over driven – especially in still waters as water flow is required for cooling. See specifications elsewhere in the manual.

- Use a storage oscilloscope synchronised to the trigger pulse which is operating the CSP unit. The signal from the receiving hydrophone may be observed a short while after the trigger pulse. This time delay will be (0.5 mS +Td) where Td is the time delay corresponding to the distance between the boomer plate and the hydrophone. The 0.5 mS delay in inherent in all CSP units.

- A calibrated hydrophone should be used to verify source level else the test will only verify functionality of the source.

- See below for typical pulse signature.



Pulse Testing Continued.

Analysis of Pulse

- The pulse should have no kinks or spikes present on either rising or falling edges.
- The positive amplitude should be greater than the negative by an approximate ratio of 2:1.
- The total pulse width should be <0.5mSec.(typically 0.2mSec)
- Any reverberations should be <10% of the initial V peak to peak.
- Source level can be calculated by:

$$\text{Source Level} = \frac{\text{V peak to peak X Distance apart (1M)}}{\text{Hydrophone Sensitivity (V/Bar)}}$$

N.B. Hydrophone sensitivity is normally quoted in uV/Pa to convert into V/Bar simply divide uV/Pa by 100,000: as 100,000Pa = 1Bar. E.G. A hydrophone with a sensitivity of 50.2uV/Pa = 5.02V/Bar.

Maintenance Procedures

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 plate.
- **Bi-annual:**
  It is recommended that the plate is pulse tested to verify operation.
- **Annual:**
  It is recommended that the plate is pulse tested and maintained annually.

Visual Inspection (Pre Deployment)

- Check condition of diaphragm.
- Check condition of electrical connectors.
- Check for mechanical damage / insecure fastenings.
- Ensure that the plate securely mounted in its catamaran and anti-vibration mounts are in good condition.

Bi Annual Inspection

- Perform pulse test verification.
- Check condition of diaphragm.
- Check condition of electrical connectors.
- Check for signs of excessive oil loss on external seals. If excessive check oil level.
- Check for mechanical damage / insecure fastenings.
- Plate securely mounted in catamaran and anti-vibration mounts in good condition.
- Coil continuity.

Annual Inspection

- Perform pulse test verification.
- Check condition of diaphragm.
- Check condition of electrical connectors. Consider replacement.
- Check for mechanical damage / insecure fastenings.
- Plate securely mounted in catamaran and anti-vibration mounts in good condition.
- Coil continuity.

Product Recycling / Disposal

Within the EU all electronic components and batteries must be taken for separate collection at the end of their working life under EU WEEE directives. Applied Acoustics as a manufacturer within the EU will responsibly dispose of any returned end of life Applied Acoustics components / batteries through a registered WEEE scheme. In order to prevent uncontrolled waste disposal and promote re-cycling please return any end of life Applied Acoustic components postage paid by sender to our UK head office. Please contact Tech Support for a RMA number prior to shipping.

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, whilst conducting pulse signature verification or whilst acquiring sub bottom data.

Periodic replacement of the diaphragm is considered to be part of the 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

- Distortion of pulse upon pulse test.
- Excessive reverberation of pulse.
- Poor data quality.
- Poor data quality- analysis of first return.
- Loose / stretched diaphragm.

Possible Causes

- Excessive power discharge /repetition.
- Mechanical damage.
- Environmental conditions.
- Measuring hydrophone incorrectly aligned.

Solution

Ensure all possible causes are investigated.
Following the assembly procedures replace the diaphragm assembly and test.

Symptoms

- Drop in output power or no output upon CSP discharge.
- Poor response of pulse signature verification – dramatic reduction in source level.
- Open circuit or short circuit when measured with a digital volt meter set to resistance.
- Electrical leakage to earth between coil and sea.

Possible Causes

- Excessive power discharge /repetition.
- Mechanical damage / Water Ingress to transducer.
- Mechanical damage / Water Ingress to HV cable / connectors.
- Mechanical damage / Water Ingress to transducer mouldings.

Solution

Ensure all possible causes are investigated by inspection and electrical measurement.

Fault Identification and Rectification Continued.

Electrical Connection (Joy Plugs/RMK) Failure

Symptoms

- Burn out or open circuit connections – resulting in dramatic reduction of source power.
- Loss of high frequency component of data as source is effectively a sparker.

Possible Causes

- Connections not cleaned or worn.
- Connections not secured by either locking collar or tape.
- Mechanical failure.

Solution

- Splice new connector's inline using suitable insulators and sealants.
- Contact factory if new mouldings are required on the transducer.

Tips:

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

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

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

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).

Ensure that there is no air under the boomer plate. This can be checked by gently rocking or tipping the plate to liberate any trapped air.

In still or calm water, reduce power output from the CSP unit, as heat cannot be dissipated effectively from the Boomer plate when stationary.

AA200 Diaphragm Replacement

Equipment Required:-

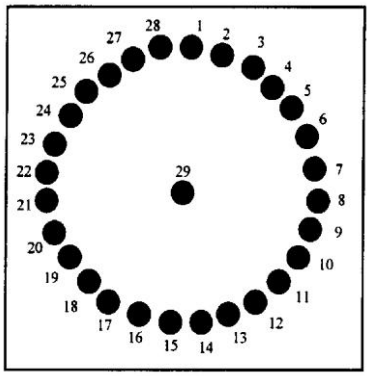
A Replacement Diaphragm
B 2 x 10mm Spanners
C Adhesive
D Adhesive Spreader
E Solvent Cleaner and Cloth
F Sharp Knife
G Marker Pen
(Components Available As Kit)

Method of Replacement:-

1 Ensure boomer plate is disconnected from high voltage supply, place on a sturdy workbench and clean any foreign matter off the plate.

2 By using two 10mm spanners, slacken off all the nyloc nuts from the 29 screws in numerical sequence as follows:-

29, 1, 15, 8, 22, 2, 16, 9, 23, 3, 17, 10, 24, 4, 18, 11, 25, 5, 19, 12, 26, 6, 20, 13, 27, 7, 21, 14, 28.



3 Remove all the nuts and washers. The outer fibre glass ring and the middle fibre glass washer can then be removed, remove the rubber diaphragm and plate completely.

4 Peel the diaphragm off the plate carefully, discard old rubber diaphragm once free.

5 All traces of adhesive on the surface of the plate should be removed by using a clean rag and solvent cleaner.

6 Ensuring that the top surface of the plate and the mating side of the diaphragm are clean and dry, spread a liberal film of Dunlop Thixofix across the joining surfaces with the plastic spreader ensuring no lumps of adhesive are present.

7 Wait for 10-15 minutes until adhesive is tough dry. Re-fit the diaphragm to plate. Press down firmly working from the centre out as to expel excess air bubbles.
Allow diaphragm and plate to dry, under pressure, for 24 hours.

8 Place the replacement diaphragm over the 28 perimeter screws, which should be a stretch fit. Mark screw number 1 on the diaphragm so the diaphragm can be refitted in the same orientation. Push the centre screw through the plate and mark the diaphragm with it. Remove the diaphragm and by using a sharp knife, carefully cut a hole to accommodate the centre screw. Reassemble.

9 Refit fibre glass ring, washers and nylocs.

10 Tighten the outer nuts on the screws in a reverse sequence to the sequence followed in section 2. Do not over tighten. Finally tighten the centre nut and screw making sure not to twist the diaphragm rubber.

11 Use solvent cleaner to remove any excess adhesive

Health & Safety

Ensure the above procedure is carried out in a well-ventilated area.

The adhesive is harmful by inhalation. Avoid contact with skin and eyes.
Do not use near flames / heating appliances.

Please read Health and Safety Information on the tin

Technical Specifications AA200 Plate

Mechanical:

Boomer plate size	: 38 X 38 cm depth 9 cm (including connectors)
Weight in air	: 19 kg
Weight in water	: 11.4 kg
Depth rating	: 10 metres
Hole fixing centres	: 31.5 cm
Connector types	:Joy plug male and female (AA200) :RMK male and female (AA201)

Dynamic:

Recommended duty cycle	: 50 Joule @ 6 PPS : 100 – 200 Joule @ 3 PPS
Maximum	: 300 Joule @ 2 PPS : 200 Joule @ 3 PPS : 100 Joule @ at 5 PPS : 50 Joule @ 8 PPS
Static operation duty cycle	: 200 Joule @ 1 PPS : 150 Joule @ 2PPS : 100 Joule @ 3 PPS : 50 Joule @ 5 PPS

PPS = Pulse per Second

The settings apply to seawater temperatures up to a maximum of 18 deg C.

Seawater temperatures above 18 deg C, de-rate the power input by 25%.

Seawater temperatures above 24 deg C to a Maximum of 30 deg C, de-rate the power input by 50%.

Maximum input voltage	: 4000 volts
Male connector input	: Positive
Female connector (ground)	: Negative

Warning for static (non towed operation), reduce maximum energy input by a factor of 50% after 30 minutes of continuous operation.

Source Level at 200J is 215 dB at 1m acoustic pressure (re 1 μPa)
(approx 0.5bar metre), although it will vary with cable type/length.

Typical pulse length : 150 μS
Reverberation time : < 1/10 X initial pulse

Specifications can change without notice and are only correct at time of going to press.

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