
Delsar – Seismic/Acoustic Listening Device

Scope

This guidance document details the operational use of the Seismic/Acoustic Listening Device (Delsar) for the detection and location of trapped victims within a collapsed structure.

Description

The Delsar is a dedicated electronic listening system for search and rescue. Its design allows for the use of four seismic sensors and cables connected to a microprocessor (control box), to detect vibration through solid objects or materials. It also has an acoustic probe, which can be connected to the control box via the cables to detect airborne sounds within void spaces.

Use

A Dynamic Risk Assessment (DRA) must be undertaken prior to any Delsar operations being carried out at USAR incidents. Consideration must be given to the environment the search operative is likely to be working in, along with the potential hazards. Dedicated safety officers will be needed for each individual search team when operating in a high-risk area. Hazards include:

- Secondary collapse and stability of the work area
- Unstable ground with the potential for unknown voids
- Hazardous materials, including an oxygen deficient atmosphere
- Live services present, such as gas, electricity, and water
- General dust and debris within the work area

Identification of safe havens and the maintenance of safe access and egress in case of evacuation must be employed at the work site. All personnel must be familiar with the evacuation signal, and be able to respond should action be necessary. Any personnel carrying out a task that involves the loss of audible communication e.g. using ear protection, headsets, high noise operations (drilling etc.), should have a nominated safety officer for that team.

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Assembling the Delsar Ready for Use

- Connect the batteries in the battery compartment and set the toggle switch to internal.
- The set should power up and bleep for two seconds.
- Check the alert light - If it actuates, the batteries are low and should be changed.
- Use the (membrane) on/off switch on the front panel to turn the control box off.
- Connect sensors in any sequence, although a numerical sequence may help with orientation. Start at the sensor input on the control box. Connect the male end of the sensor cable marked (yellow or white) into the sensor input on the left side of the control box.

Note: The cable ends can easily be damaged if dropped. Keep the protective cap on when not in use.

- Connect the first sensor to the female end of the sensor cable
- Connect the next sensor cable to the first sensor
- Connect additional sensors as required.
- Use one of the protective (black) metal caps on the last sensor in the string.
- Place the control box in its protective case
- Connect both headsets by putting the 'Y' connector into the jack point on the control box.

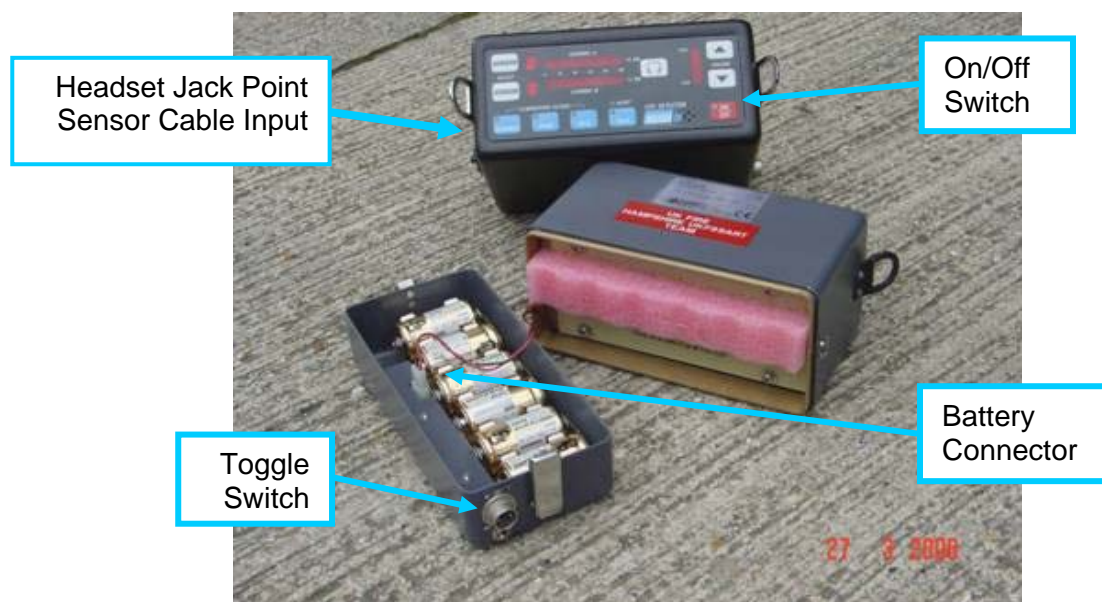


Figure 1: [SOP_SEA003]

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Pre-use Checks (Calibration)

- Connect all sensors
- Place each sensor on the ground in the shape of a square (approx 1 square metre)
- Make sure the surface is level, smooth and clean
- The volume should be set to as high a level as is comfortable
- Filters should be checked for functionality
- Tap on the ground in the centre of the square and check each sensor individually for sound content
- Check both headsets are working correctly
- Compare the sound (listening) and amplitudes (display)
- Ensure all channels are tested (A, B, Both)
- Signals should be nearly the same on all sensors within approx 2 bars on the display
- Operators should spend up to five minutes listening to general background noise before proceeding onto the area to be searched. This will acclimatise the operator to surrounding environmental noise. There must be silence during this acclimatisation.

Filtering

- Use filtering sparingly.
- Only use filters once a sound source has been detected.
- A filtered signal may lose some of its clarity and is harder to recognise. Some interference can be reduced.
- When a filter has been selected an LED will light up on the filter switch to indicate that the selected filter has been activated.

RUMBLE	Reduces low frequencies, and detection range is reduced
POWER	Reduces power line interference of 50Hz and 60Hz. It does not reduce detection range
HISS	Cuts off higher frequencies detected by the sensor. This improves the clarity of the tapping signal, but suppresses sounds of scratching.

Search Techniques

The search techniques used by the Delsar fall into two main phases, these are:

- Detection (Stage One and Stage Two)
- Location

Note: The communications probe can also be used to search by listening in large open voids. However, sensor placement would be the preferred option.

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Detection Phase

Stage One

Hasty search is used to establish if there is a victim inside the collapsed structure. Connect one or two sensors to enable rapid movement over the area being searched. The technique is to place the sensors on to significant/sizeable parts of the remaining structure or steelwork that penetrate deep into the collapse. Stimulate a response. Call out loudly for the victim to tap 3 times. This would give an indication if a victim is inside the collapsed structure.

This method should be used to search the entire site, making note of any possible victim responses. Any responses should be indicated on the site ID cards (USAR204). This phase is used to maximise the chance of survival for the most number of victims, by allowing an accurate triage of the collapse site with regard to victim extrication.

Stage Two

An Operational Sweep is undertaken after a Hasty Search, when it is known that there are victims unaccounted for. Stage Two involves a thorough and systematic search of the area using up to four sensors. In addition a detailed map of the location and area should be developed (SOP SSA002 Mapping Operations).

On detection of a victim, the team should remain, and start the location phase. Where resources permit consider a second Delsar team, to continue with the detection phase of the remaining search area.

Location Phase

The location phase is used to determine the victim location by identifying the sensor with the loudest signal strength, clarity and sound content. Connect as many sensors as practical around the detection site. Stimulate a response by calling out loudly for the victim to tap 3 times. Listen to each sensor, and leave the sensor with the best victim response in place.

Then reposition all other sensors around this sensor, and listen for a stronger response. If a better response is located, repeat the above procedure, until all sensors show almost identical signal content (clarity, sharpness, strength). This will triangulate the position of the strongest signal within an area formed by the sensors.

If a response is heard, ask the victim to knock continuously to assist with location. Tell them when you are relocating sensors, so they can rest.

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Operational Considerations

The position of the strongest signal may not be the exact victim location due to how sound travels through the collapsed structural elements.

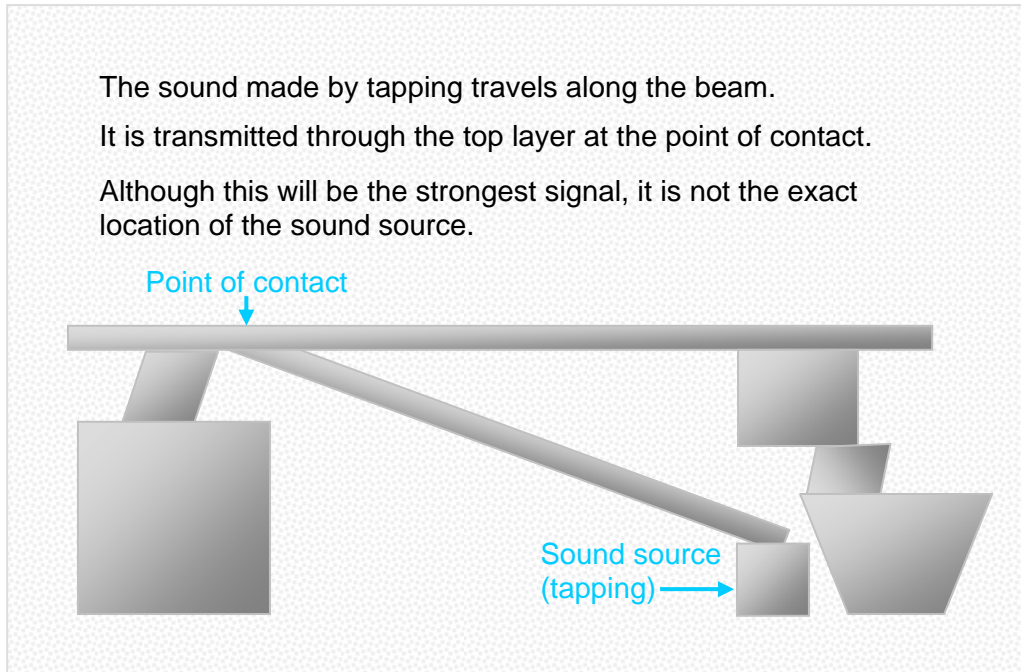


Figure 2: [SOP_SEA003]
 Sound and source of tapping

The location phase is a more detailed search of a specific area identified by the detection phase and requires more time and resources.

Circle of Detection

Sounds emanating from the source spread in ever-increasing circles. The maximum distance over which a signal can be heard will depend on how well the medium transmits sound. For example, steel, reinforced concrete, and brick are good transmitters.

Operators will have to determine a circle of detection before starting operations. They do this by testing the coverage of each sensor, to ensure it overlaps any adjacent sensors. This will determine the distance between sensors laterally and vertically for that type of ground/medium.

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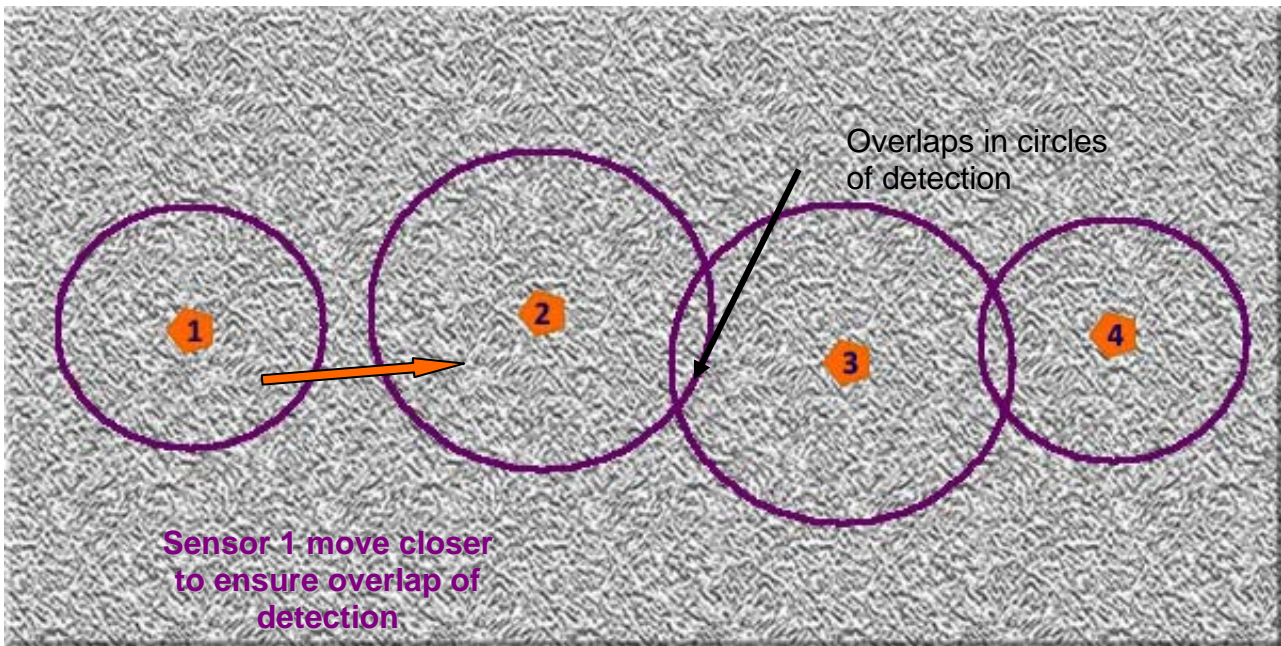


Figure 3: [SOP_SEA003] Overlaps in Circles of Detection

Sound travel will vary due to the type of materials the sound is being conducted through:

Excellent	Steel, concrete, solid brick and glass
Good	Loose concrete, rubble, brick, wood
Fair	Wet soil, compacted soil
Poor	Dry sand, snow, acoustic tiles, carpet

Sensor Spacing

The position of the sensors for victim location will be determined by:

- The material the sound is travelling through (refer to Circle of Detection)
- The strength of the sound source (knocking, scratching, etc.)
- The extraneous noise interference of the surrounding environment
- The type of collapse

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Sensor Placement

- When moving/placing sensors, turn the unit off using the membrane on/off switch. This will save all previous settings ready for the next listening phase i.e. volume, filters, channels and sensor selection.
- When placing sensors always consider the sensor location carefully, and ensure good mechanical contact using magnets, spikes, tape or placing a rock on the sensor (see Figure 4).
- The use of the spikes and magnets in no way affects the performance of the sensors, provided they are screwed in fully, and the base of the sensor is in full contact with the material.
- Where possible, all sensors should be placed in an upright position for maximum sensitivity. If a sensor has to be positioned on its side due to insufficient height, the Delsar operator must be informed, as that sensor will be less effective. If this is the case, then all sensors must be positioned in the same way.
- On an open area site, ensure the cables are managed to prevent wind noise or cable movement. If it is raining, cover the sensors with a cloth to reduce the interference caused by the rain coming into direct contact with the sensor.
- Avoid placing sensors on soft materials, carpet, insulation, soft dry sand, etc.



Figure 4: [ND_USAR_OG_SEA 003]

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Use of Intercom Probe (Acoustic)

- This is used to detect airborne sounds in void spaces (acoustic) or to talk to victims.
- Connect the probe to any sensor input, or the last sensor in the string with a sensor cable.
- With the probe connected, the display will show '0'. The signal from the sensor is turned off. Only the signal from the microphone is heard.
- All filtering is automatically turned off (filtering can be used but it may reduce the signal)
- The probe will emphasise high frequency sound such as breathing and voice.

After Use Care

- Wipe off cable with damp cloth
- Clean sensors in the same way
- Spray cable connectors with WD40
- When used in wet weather, dry out the equipment.

Disconnect the battery pack. Take off protective caps from sensors and cables. Leave lid of the storage case open. Allow to dry for 48 hours.

Note: Do not force dry the equipment

Equipment Testing

After use test

Carry out a full visual check of all equipment. Pay special attention to the cables for cuts and abrasions and all connections for damage or distortion (see after use care).

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