



## How Search and Rescue Teams find survivors after earthquakes ?

*Following a disaster, such as the earthquake in Turkey and Syria in February 2023, every second counts! Urban Search And Rescue (USAR) teams **must act quickly and efficiently within the first few hours / first few days** following the disaster to save entombed victims as quickly as possible.*

### RAPID SEARCH AND RESCUE

In the early hours after a major disaster, when many areas need checking, emergency teams conduct **rapid searches to maximize the opportunities for saving lives**. Rescuers are usually finish searching at a site within a few hours, then move to the next area. They can use this stage to identify zones where a deeper search would be worthwhile. Specially trained search and rescue dogs (K9 teams) are employed to move quickly in the rubble in order to sniff out signs of life. Indeed, these trained dogs detect live human scent, even when a victim is buried deep in rubble.

### FULL SEARCH AND RESCUE

This phase of operations, also called "technical search" **locates, and rescues deeply trapped survivors**.

The search and rescue of entombed victims requires the involvement of search and rescue specialists with **very specific USAR equipment to detect and locate victims, communicate with them** and then extract and rescue them.

USAR teams often use victim location dogs, but they also use **electronic victim search equipment**:

- With **seismic sensors/acoustic sensors**,
- **UWB rescue radar** (Ultra-Wide Band – Ground penetrating radar)
- **USAR search cameras**.

These 3 technologies complement each other and allow rescue teams to go faster.

## LIFE DETECTORS WITH SEISMIC SENSORS (SEISMIC / ACOUSTIC LISTENING TECHNOLOGY) - SEARCH

Seismic detectors (also called listening device) are designed to **detect and locate the position of conscious buried survivors** under the rubbles following a collapse.

Ultra-sensitive, [seismic sensors](#) use seismic technology to detect the **smallest sounds/vibrations** caused by survivors buried under rubbles (scratching, hitting, shouting, etc.) and help pinpoint their location.



### What is seismic technology?

Seismic detectors, like a wave receiver, sense **vibrations which resonate and circulate in the different materials of the collapsed building and amplify them via a control box.**

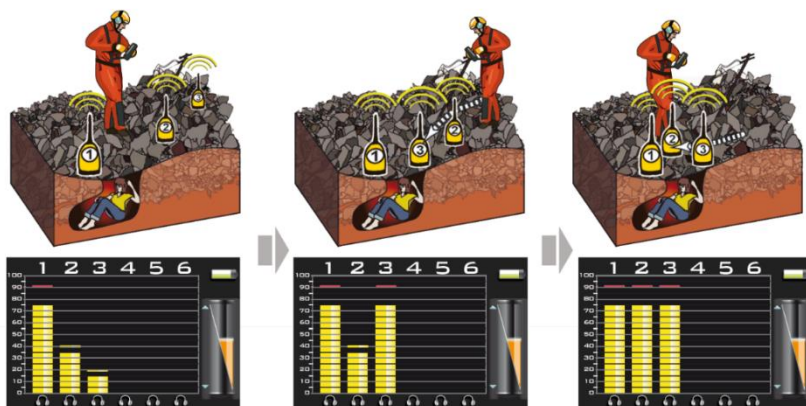
The technical search specialist can **"listen" via audio headsets** and **"view" the audio signal** via a bar graph on the control box for vibrations made by victims under the rubble.



LEADER SEARCH Seismic detectors in use on the field

### How to use seismic sensors?

1. First of all, placed on the same line, the team LEADER **deploy the seismic sensors by placing them on the surface of the rubble.**
2. Then, a long whistle sounds to demand **total silence**. One of the rescuers **hits the ground with a heavy metal bar** and an interpreter asks out loud **"Is anyone there? We're the rescue teams."**
3. They listen in total silence and **wait for the victim's "response"** (scratching, hitting, shouting, etc.) to help locate them.
  - 3.1. **If no response and no vibrations detected: rescuers continue through the zone to be covered, repeating the same method.** The objective is to map the zone by identifying the location of buried victims.
  - 3.2. **If the sensors receive a signal** (represented by sounds in the audio headset and via an active bar graph on the control box): The intensity of the signals received by each sensors is compared. **It is then necessary to focus on the sensor which receives the strongest signal and gradually bring the two others closer in a triangle, until they all display the same intensity. The position of the victim is identified when all sensors have a signal at the same intensity.**



Drawings showing how to use LEADER seismic sensors to find a victim under rubble.

## LIFE DETECTORS WITH UWB RADAR (UWB TECHNOLOGY) - SCAN

One of the latest innovations in terms of victim location equipment is the [UWB \(Ultra-Wide Band\) radar detector](#) (also called GPR - Ground Penetrating Radar). This radar detector is designed to **detect and locate the position of entombed victims** following a collapse. It uses the **Ultra-Wide Band technology** (highly sensitive stabilized band) to **detect the movements** of a buried victim. **It can detect the smallest movements - even the breathing of an unconscious person!**



*LEADER SCAN - UWB radar sensor in used on the field.*

### What is UWB technology?

UWB is a radio modulation technique based on the transmission of very short impulses. The UWB sensor is a transmitting/receiving device with an ultra-sensitive UWB sensor producing **electromagnetic waves that can pass through construction materials**. **It can scan/probe through 50 cm of dense concrete or any other construction material** such as bricks, asphalt, sand, wood, tiles, plastic, plaster and glass. (Note that electromagnetic waves cannot pass through metal surfaces, damp surfaces (clay), or water).... **and can detect the movement of**

buried victims.

### How to use the UWB rescue radar?

- The UWB sensor must be placed in contact with the rubble by a rescuer and **should be regularly moved according to a virtual search grid** so that the radar can survey below the surface. The objective is to map the zone by identifying the location of buried victims.
- During this time, a second search and rescue specialist **monitors progress on the remote wireless control box** in real time.
  - The UWB detector **scans the ground by sending waves that pass-through building materials**. If these waves return with a gap in length, this indicates that there is movement and it may be a buried victim. **When the UWB radar sensor detects a movement under the rubble, the screen displays an icon indicating the depth at which the movement is found**, as well as the **frequency of the movements** (strong/weak) to determine whether it is a human or not. This means survivors can be detected very quickly in real time. Its high sensitivity and the stability of its signal allow detection with precision down to 1 meter:
    - **strong and irregular movements such as the movement of a conscious victim's arm** up to 30 meters in free field conditions.
    - Or **regular weak movements, such as the chest movements/breathing of a victim**, even if unconscious, up to 10 meters in free field conditions

## SEARCH CAMERAS - CAM / TIC / RD90

Once the survivor is detected and located, a second step involves **visually verifying that it is a human** with search camera. Equipped with a microphone/speaker module, it can also be used to **communicate with the person** to determine their assistance needs.



### What is a search camera?

A [victim search camera](#) is a **miniature camera** (47 mm in diameter for LEADER models) **designed to slide into very narrow spaces** such as cracks, gaps and standard 51 mm holes drilled by USAR teams to inspect behind a wall or inside a confined space.

The USAR search camera is **connected to a control box with an extra-large color screen** to inspect the area/confined space and identify potential survivors.

*Search cameras allowing to inspect confined spaces...*



*...Behind walls,....*

### How to use a search camera?

The search and rescue camera is designed to be used "anywhere you cannot see".

For this purpose, it can be fastened to two mounts:

- **EXTENDIBLE TELESCOPIC POLE VERSION:**  
Search camera are most often used with a telescopic pole (which can be extended to 3 or 4 meters in length) allowing to inspect:
  - **Confined spaces** by simply inserting the camera through a gap/hole.
  - **Inaccessible areas at height** by inserting a camera through a window or gap in the wall,
  - **Behind walls.** The camera (47 mm in diameter) is inserted into a hole (with a standard diameter of 51 mm) which has been previously drilled by USAR teams (using a corer or drill) to view the cavity where the survivor is located.
- **CABLE REEL VERSION:**  
Reel-mounted cable versions are also available. Equipped with several tens of meters of cable the search camera is used to inspect very deep areas such as cavities, crevasses, pipes, very deep wells in very damp or underwater environments.



*....Inaccessible areas at height...*



*...And very deep areas !*

In addition, there are several types of search cameras to cover different types of situations :

## **COLOUR SEARCH CAMERA FOR VISUAL SEARCH AND COMMUNICATION WITH THE VICTIM - CAM**

The color search camera provides the ability to **visually inspect inaccessible/confined, difficult-to-access spaces**. Once the victim is located, it is then possible to communicate with them thanks to the microphone and speaker built into the camera head.



## **THERMAL IMAGING SEARCH CAMERA TO LOCATE VICTIMS BY DETECTING HOTSPOTS AND COMMUNICATE - TIC**

The USAR thermal imaging camera provides the ability to locate survivors by **detecting hotspots** (the heat of a victim's body). The Thermal Imaging Camera (TIC) **supplements and accelerates searches to focus on hotspots and contrasts in temperature to find survivors or their heat signature in dark, confined spaces, dusty environments, smoky areas**, etc. Fitted with a microphone and speaker, the camera head can be used to communicate with the victim.



## **WATERPROOF SEARCH CAMERA FOR VISUAL SEARCHES IN EXTREME SITUATIONS - RD90**

The waterproof search camera provides the ability to inspect **inaccessible/difficult-to-access confined spaces** such as crevasses, cavities, wells, etc. and allows searches in very damp or underwater environments to several tens of meters deep.

