



## Swept Impact Piezoelectric Borehole Source for high resolution seismic surveys

### DESCRIPTION

The VIBSIST-SPH54 is based on the Swept Impact Seismic Technique (SIST), which is a combination of the Vibroseis swept-frequency and the Mini-Sosie multi-impact ideas.

The seismic signals are produced as a series of pulses, according to a specific pre-programmed sequence, which makes the system similar to a smaller Vibroseis. The accurate control of the impact rate makes this source coherent and repeatable.

The SPH borehole piezoelectric sources are designed for investigation ranges of tens and hundreds meters and for depths of 1000 m and more. The seismic signals are produced by applying high voltage (6000 V) to a stack of piezoelectric crystals. The minimum borehole diameter 60 mm. The frequency band is 500 - 3500 Hz.

### APPLICATIONS

The VIBSIST-SPH 54 can be used in a wide range of applications, they include:

- **Single hole or crosshole surveys**
- **tomographic imaging**
- **location of fractured zones**
- **assessing the constructability of the rock and earth**
- **ore bodies delineation**
- **monitoring of the excavation works**
- **rock engineering**

The tools consist of three modules connected by steel-armoured cable: the power supply & controller (out-of-the-hole), the high voltage generator (down-hole) and the piezoelectric actuator (down-hole) equipped with an acoustic impedance converter or a motor-driven sliding wedge clamping mechanism.

The down-hole high voltage generator and the piezoelectric actuator are shown below, while getting prepared for lowering in a deep hole.



### MAJOR BENEFITS

**EXCELLENT SOURCE FOR HIGH RESOLUTION BOREHOLE SEISMIC SURVEYS**

**INCREASED PRODUCTIVITY**

**OPERATES IN CONFINED SPACES**

**HIGHER DATA QUALITY**

### ADDITIONAL BENEFITS

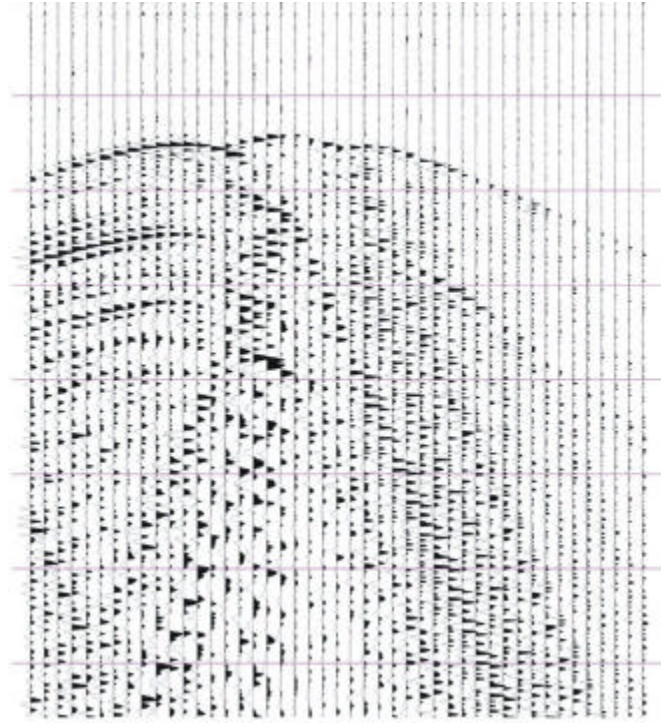
**ENVIRONMENTALLY FRIENDLY**

**COMPATIBLE WITH MANY SEISMOGRAPHS**

**Internationally patent protected**

## EXCELLENT SOURCE FOR HIGH RESOLUTION SEISMIC SURVEYS WITH HIGHER DATA QUALITY

The Borehole Seismic Source produces high frequency content (up to 3500 Hz) while achieving significant depth penetration. The high frequency content of the signal emitted by a seismic source tends to decrease when the power of the source increases, which makes higher resolution and wide investigation range difficult to achieve simultaneously. The investigation range can however be increased with little or no expense of resolution if the signal energy is built over time, rather than being emitted as a short high-power burst (i.e. using the Swept Impact Technique). The VIBSIST-SPH54 described here couples to the borehole through the water. The fluid coupling allows the source to be run in a more or less continuous mode.



*High resolution receiver gather measured by a receiver located at a depth of 691.5 m*

### INCREASED PRODUCTIVITY

Significant productivity gains are obtained because the VIBSIST-SPH54 is not dependent on the energy of single high energy pulse that has to be armed in a lengthy period of time.

### OPERATES IN CONFINED SPACES

The reduced number of modules makes the VIBSIST-SPH54 portable and highly mobile. It allows jobs to be done faster in difficult conditions. It can be used in boreholes with a diameter higher than 60 mm. Easy to operate, available in a rugged configuration, the source can be used by one person.

### ENVIRONMENTALLY FRIENDLY

The VIBSIST-SPH54 is an environmentally friendly seismic source. It is a non-destructive alternative that does not create environmental pollution such as chemicals, sound, etc. Legal risks frequently associated with using explosives are eliminated.

## COMPATIBLE WITH MANY SEISMOGRAPHS

The VIBSIST can be used with many seismographs. A large enough record length would be an asset. Compatible seismographs include either the GEODE or StrataVisor NZ with their Windows NT operating system for real-time analysis and preferably their 64,000 samples per channel capability. A StrataView or a Terraloc with a networking capabilities for on-line deconvolution could be another good example.

## OPERATING SOFTWARE

**Controller Interface** (installable on a computer with a RS 232 port)

- flexible sweep control function shape (up to a 3-rd order polynomial)
- RS 232 uploads and downloads for parameter programming
- diagnostic acknowledgements for all the operations

## PROCESSING SOFTWARE

**Signal Decoder** (installable on a computer with a network card linked to the seismograph)

- performs online or offline deconvolution of the signal
- for seismographs with less memory, may perform concatenation between adjacent files
- includes signal conditioning ( before or after the deconvolution) package directly calling several routines: band pass or reject , notch , and median filters; Predictive deconvolution, Envelope (Hilbert) , Resampling;
- deconvoluted data file translated into ASCII an SEG2 formats;

**Signal Display Interface** (runs with Signal decoder)

- displays of the signals in different stages: original, conditioned, deconvoluted, post-conditioned

Note: all the software packages above are using hardware encryption key, installed on the LPT (printer port). The need for an additional computer is justified only if the seismograph does not have an appropriate operating system (Windows 98, 2000, ME, XT) .

## VIBSIST-SPH CONTROLLER

The controller has the next attributes:

- programmable, using RS485 interface, using a desktop or a laptop (an additional RS232/RS485 converter will be supplied)
- standalone operation— once programmed, the functional parameters are stored into a nonvolatile memory. The basic operations can be initiated from its console.
- has a self test display (LED) for correct operation acknowledgement.

# SYSTEM COMPONENTS

## SYSTEM MODULES

1. The **power supply & controller** transfers to the piezoelectric actuator the sweep control sequence provided by the computer
2. The down-hole **high voltage generator** is feeding the piezoelectric actuator the necessary energy, which is produced near the actuator, rather than to be transported through a long cable.
3. The **piezoelectric actuator** generates the seismic signal according to the programmed sweep sequence.
4. The borehole **tripod mount assembly** used for positioning and fixing and clamping accessories.
5. A variety of **seismographs** can be used, they include Geode, StrataVisor and StrataView.
6. A **laptop** is required, with most seismographs, but not provided with the VIBSIST-SPH54.

## SOFTWARE

Four software modules are included as part of the VIBSIST-SPH54 system, they are:

- **Controller interface**, an enhanced way to access to the controller resources.
- **Signal Decoder**, performs the deconvolution of the long sweeps. It may be used for On Line monitoring or Off Line batch processing.
- **Signal Conditioning**, includes a collection of filtering routines used for signal processing before or after deconvolution
- **Signal Display Interface** allows the operator to visualize the data.

## SPECIFICATIONS

**Power supply:** 115 V/60 Hz - 230 V/50 Hz

**Maximum consumption:** 3.5/7A

**Maximum operating depth:** 1000m

### Sweep characteristics

**Repetition rate:** programmable between 2ms to 70ms

**Impact energy:** approximately 2-4 J / impact

**Impact frequency band:** approximately 100 to 3500 Hz

**Programmed sweep characteristics:** computer programmed (linear shape) or preset sweep.

**Pause between sweeps:** 100ms ... 60s

**Max no of sweeps:** 100

**Sweep time adjustment:** 2 to 70 seconds (this is restricted by the number of samples available per channel).

**Synchronization signal:** rectangular +0.5V

### Controller

*Dimensions:* 300 x 120 x 60 mm

*Weight:* 7 kg

### Electronic module

*Weight:* 5Kg

### Operating module

*Weight:* 18 Kg

### Lead in cable

*Length: upon request up to 1000 m*

