

## Shear Wave Borehole Geophones

- 3-component tri-axial sensors
- Motor-driven clamp mechanism
- Fits in 2-inch (51-mm) boreholes (BHG-2 and BHG-3)
- Automatic orientation of horizontal geophones to any azimuth (Model BHG-3)
- Cable disconnects for convenient surface handling and extending depth

BHG series, 3-component borehole geophones are designed for shallow seismic velocity measurements. Both units include a motor-driven clamp to hold the sensor in position in the borehole.

These geophones are applicable to a wide variety of shallow surveys, including shothole logging, downhole shear wave measurements, and static corrections for petroleum shear-wave reflection surveys, cross-hole, tomographic, seam wave, and shallow VSP surveys for coal, minerals, and rock mechanics.

Model BHG-3 includes a fluxgate compass and servo mechanism which automatically orients the horizontal geophones to any magnetic azimuth selected by the operator. Thus, the longitudinal sensor can be aligned with the polarization of the shear wave source.

While downhole shear wave surveys have traditionally been done with random orientation, being able to precisely align one of the horizontal geophones with the plank or energy source provides significant

advantages. Anisotropy appears to be much more common than originally thought, and the velocities of horizontally polarized shear waves vary with azimuth.

With an orientable geophone, these velocity variations may be measured or simply avoided. By maintaining orientation of the source-receiver combination all the way down the borehole, the user can maintain better control and recognition of shear wave arrivals. The clamping mechanism is a steel leaf spring, compressed by a

motor-driven piston. When compressed, the spring expands, forcing the geophone against the borehole wall.

The tool may be used in soft-wall, uncased holes as well as cased holes. In the unlikely event of a failure to release, the tool can be dragged up the hole against the spring friction. The motor-driven spring is faster, more reliable, and less cumbersome than the common alternative using an inflated bladder.





### **Control Electronics:**

The BHGC-1 controller directs the voltages to control the clamping mechanism and servo mechanism.

A meter monitors motor current to indicate the clamping action and force. Switches direct the geophone signals to different seismic channels. This unit requires an external DC supply, and is usable with either model, but is not required if the customer prefers to build his own controller (schematic drawings are provided).

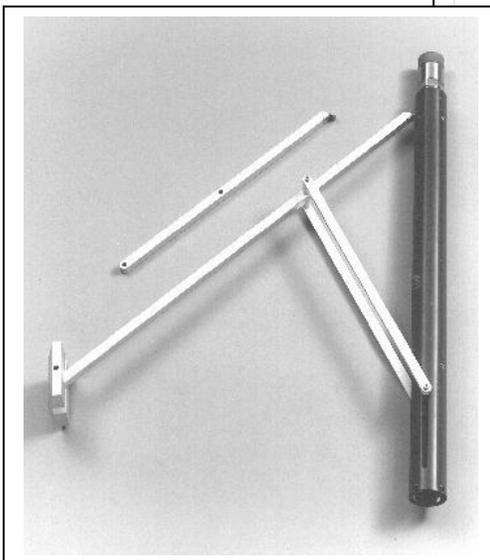
A Model BHGC-4 which can control up to four borehole geophones is also available.

An internal, rechargeable 24-volt battery pack is available as an option for either unit.



### **Removable connector:**

The cable is connected to the geophone by a high-pressure, underwater connector. The ability to disconnect the sensor makes it easier to handle and use. A male-female extension cable can be used to temporarily extend the length of the cable.



### **Big Hole Adaptor:**

An optional mechanical arm and pressure foot (shown here on the BHG-2) can be substituted for the spring to clamp the tool in large diameter boreholes. Conversion is easily done by the user in minutes.

Multiple arms provide for various diameter holes. Largest arm extends diameter up to 480 mm (19 inches).

When retracted, will fit inside a 75-mm (3-inch) diameter borehole

### **Common Specifications**

*Number of geophones:* 1 vertical and 2 horizontal in an X-Y-Z configuration

*Natural Frequency:* 14 Hz standard; 10, 28 and 40 Hz optional

*Pressure rating:* 300 meters (1000 ft) water depth, consult factory for deeper options

*Clamp mechanism:* DC motor. Requires 24 volts DC on surface (or more, depending on cable length). Requires ½ amp when moving spring (1amp peak at mechanical stops)

*Expanded diameter:* 18 cm (7 in) total diameter including probe body.

### **BHG-2 Borehole Geophone**

*Diameter:* 48 mm (1.9 in)

*Length:* 700 mm (27.5 in)

*Weight:* 2 kg (4 lb)

### **BHG-3 Borehole Geophone**

*Diameter:* 48 mm (1.9 in)

*Length:* 1.1 m (44 in)

*Weight:* 3.4 kg (7 lb)

*Compass:* fluxgate sensor, powered from same DC voltage as clamp mechanism.

*Maximum inclination:* +/- 30 degrees from vertical

*Accuracy:* better than 5 degrees  
*The flux gate compass will not function in steel-cased boreholes.*

### **Cable**

7-conductor, with two copper and 5 copperweld conductors, Kevlar-reinforced, polyurethane-jacket cable, with Reed Products SU-8 female connector molded on wet end.

*Specifications are subject to change without notice for product improvement or other considerations.*