



**Official iBall Instruments Policy regarding the
Hydrogen Sulfide detector in the Bloodhound system**

iBall Instruments is exceptionally confident in the Bloodhound system gas detection system that it promotes, rents, and sells.

This policy is in regards to (specifically) the Hydrogen Sulfide detector manufactured by e2v that the Bloodhound uses. The EC4-100-H2S e2v sensor has proven to be highly stable, reliable, and functional over a long periods of time.

In all cases, if the Bloodhound detects the presence of Hydrogen Sulfide, it is to be treated as true Hydrogen Sulfide gas extracted directly from the sample drilling fluid.

Overview:

The iBall Instruments gas detection system is connected in line with an enclosed mechanical sample extractor where the most concentrated of sample gasses would reside. From this sample the iBall Instruments equipment would draw from and detect any minute samples of geological Hydrogen Sulfide that would be found.

Hydrogen Sulfide monitoring companies do not always connect a sample extractor to the same said mud flow and their area monitoring equipment is generally set on the "fat" side and slow to react. Further these area monitors would not show such trace gasses in the drilling mud itself. These general detectors are designed to show large formation out gassings but not mud intragasses. These area monitors are normal and expected for hazardous zone monitoring.

The iBall Hydrogen Sulfide detector was designed to and is provided as a reliable secondary detector for any Hydrogen Sulfide that is released by the drilling fluid using a sample extractor.

It is iBall Instruments opinion that if any out gassings of hazardous levels of H2S is suspected or is expected, an outside Hydrogen Sulfide detection company should be on site.

Dangerous Levels Of H2S:

Hydrogen Sulfide is also known as sulfane, sulfur hydride, sour gas, sulfated hydrogen, hydrosulfuric acid, sewer gas and swamp gas. It is a highly flammable and colorless gas that is toxic in low concentrations. It results when bacteria break down organic matter in the absence of oxygen. It is molecularly heavier than air, and may will accumulate in low-lying still areas. It odor smells like rotten eggs at low concentrations and can cause you to quickly lose your sense of smell. Hydrogen Sulfide gas is also very corrosive and causes some metals to become brittle.

Exposure to lower concentrations of Hydrogen Sulfide can result in eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. These symptoms usually go away in a few weeks. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness. Higher concentrations of 700-800 ppm tend to be fatal.

- **0.0047 ppm** is the recognition threshold, the concentration at which 50% of humans can detect the characteristic rotten egg odor of Hydrogen Sulfide
- **10-20 ppm** is the borderline concentration for eye irritation.
- **50-100 ppm** leads to eye damage with long term exposure.
- **150-250 ppm** the olfactory nerve is paralyzed after a few inhalations, and the sense of smell disappears, often together with awareness of danger.
- **320-530 ppm** leads to pulmonary edema with the possibility of death over time.
- **530-1000 ppm** causes strong stimulation of the central nervous system and rapid breathing, leading to loss of breathing with the possibility of death over time.
- **800 ppm** is the minimum lethal concentration for 50% of humans for 5 minutes exposition (OSHA LC50).
- **Concentrations over 1000 ppm** cause immediate collapse with loss of breathing, even after inhalation of a single breath.

As you can see, It would be reasonable to watch for some level of Hydrogen Sulfide even if it is improbable that any would be found. iBall Instruments believes that Hydrogen Sulfide should be at least looked for and recorded if even in a cursory way. That is why all iBall Instruments Bloodhound equipment come with at least minimal Hydrogen Sulfide detection. This gives digital recorded proof of any and all Hydrogen Sulfide activity.

Detail:

The iBall Bloodhound gas detection system is capable of detecting not only natural gas but also CO₂, Oxygen, and Hydrogen Sulfide that is present in the extracted sample. The electrochemical EC4-100-H₂S sensor used within the Bloodhound system is extremely sensitive and capable of detecting less than one part per million (1 PPM) in the extracted sample.

Because of the extreme sensitivity of the Bloodhound, it is important to understand the general sample extraction equipment and how it affects Hydrogen Sulfide readings. A typical set-up at the rig includes some sort of motorized beater within a gas collection chamber that is partially immersed in the drilling mud within the possum belly (vibration spoil separator) on the rig. Within this sample extractor is an electrically rotated shaft with tines churning the mud within an enclosed metal cylinder. This extraction assembly is designed to maximize the release of gases trapped in the drilling mud into a confined space (the metal cylinder) that a sample can then be immediately taken to minimize any dilution or potential contamination by atmosphere.

The sample line collection tube is connected from this metal cylinder directly to the Bloodhound system using a closed vacuum system that ensures maximum collection of gases from the confined space. When functioning as intended (which is generally the case), this setup significantly increases the release of all gases that are trapped within the mud so that they can flow through the sample line to be recorded by the Bloodhound.

Because the sample extractor is designed to maximize the release of entrapped gases from the mud into a closed sampling system, the gas readings from the Bloodhound system will be higher than readings taken in standing air from any other place at the wellsite. This is because everywhere else on the rig, there is immediate gas dispersion into air

The Hydrogen Sulfide gas readings produced by the Bloodhound should not be seen as representative of the general conditions that exist anywhere else at the site. Just as a show of gas units or high CO₂ levels would not determine any immediate hazard. This is because these detected gasses are extracted and concentrated directly from the drilling mud and not from the general location.

iBall Instruments do not in any way want to imply that iBall Instruments Hydrogen Sulfide readings can or should be relied upon for health and safety decisions at the rig. As described above, the extraction and detection of hazardous gasses are inherently different from other health and safety system readings that might be taken at the site.

Because the Bloodhound system is designed to maximize and concentrate the likelihood that any gas trapped in the mud will be released and detected. We insist that health and safety decisions must be based upon equipment that is designed and deployed for that specific purpose rather than equipment such as ours, which is specifically designed for highly accurate gas detection while mud logging and for detection of gasses within the drilling mud.

Cross Sensitivity:

The e2v H₂S sensor in the Bloodhound is highly sensitive and reactive to sulfur. The sensor may also detect other sulfides at the drilling site. These may include sulfur dioxide, hydrogen sulfide fumes, sulfur released while drilling high sulfur content rock, or the sulfur released by the diesel engines if they are using high sulfur bearing diesel fuel. Because of this, the user has to be aware of other materials that may cross contaminate the detection of Hydrogen Sulfide released from the drilling mud.