Official iBall Instruments Policy regarding the Carbon Dioxide detector in the Bloodhound system

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

This policy is in regards to the Infrared Carbon Dioxide detector that the Bloodhound uses. The IR15TT-M sensor has proven to be highly stable, reliable, and functional over long periods of time. Specifically for more than two years.

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 Carbon Dioxide that would be found.

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

Carbon dioxide (chemical formula CO2) is a colorless, odorless gas vital to life on Earth. This naturally occurring chemical compound is composed of a carbon atom covalently double bonded to two oxygen atoms. Carbon dioxide exists in the Earth's atmosphere as a trace gas at a concentration of about 0.04 percent (400 ppm) by volume. It is emitted from volcanoes, hot springs and geysers and is freed from carbonate rocks by dissolution in water and acids. Since carbon dioxide is soluble in water, it occurs naturally in groundwater, rivers and lakes, in ice caps and glaciers and in seawater. It is present in deposits of petroleum oil and natural gas.

Toxicity:

CO2 is an asphyxiant gas and not classified as toxic or harmful in accordance with Globally Harmonized System of Classification and Labelling of Chemicals standards of United Nations Economic Commission for Europe by using the OECD Guidelines for the Testing of Chemicals.

In concentrations up to 1% (10,000 ppm), it will make some people feel drowsy and give the lungs a stuffy feeling.

Concentrations of 7% to 10% (70,000 to 100,000 ppm) may cause suffocation, even in the presence of sufficient oxygen, manifesting as dizziness, headache, visual and hearing dysfunction, and unconsciousness within a few minutes to an hour.

The physiological effects of acute carbon dioxide exposure are grouped together under the term hypercapnia, a subset of asphyxiation.

Because it is heavier than air, in locations where the gas seeps from the ground (due to sub-surface volcanic or geothermal activity) in relatively high concentrations, without the dispersing effects of wind, it can collect in sheltered/pocketed locations below average ground level, causing animals located therein to be suffocated.

Higher CO2 concentrations are associated with occupant health, comfort and performance degradation. ASHRAE Standard 62.1–2007 ventilation rates may result in indoor levels up to 2,100 ppm above ambient outdoor conditions. Thus if the outdoor ambient is 400 ppm, indoor concentrations may reach 2,500 ppm with ventilation rates that meet this industry consensus standard. Concentrations in poorly ventilated spaces can be found even higher than this (range of 3,000 or 4,000 ppm).

Dangerous Levels Of Carbon Dioxide Symptoms:

- **250-400ppm Normal background concentration in outdoor ambient air**
- **400-1,000ppm Concentrations typical of occupied indoor spaces with good air exchange**
- **1,000-2,000ppm Complaints of drowsiness and poor air.**
- **2,000-5,000 ppm Headaches, sleepiness and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.**
- **5,000 Workplace exposure limit (as 8-hour TWA) in most jurisdictions.**
- **>40,000 ppm Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death.**

As you can see, It would be reasonable to watch for some level of Carbon Dioxide even if it is improbable that any would be found. iBall Instruments believes that Carbon Dioxide 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 Carbon Dioxide detection. This gives digital recorded proof of any and all Carbon Dioxide 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 infrared IR15TT-M sensor used within the Bloodhound system is extremely sensitive and capable of detecting less than one hundred part per million (100 PPM) in the extracted sample.

To test for this sensitivity, breathe into or in the direction of the inlet of the Bloodhound. You should see the CO2 level go up to as high as 5%.

Because of the extreme sensitivity of the Bloodhound, it is important to understand the general sample extraction equipment and how it affects Carbon Dioxide 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 Carbon Dioxide 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 high gas units 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 Carbon Dioxide readings can or should be relied upon for health and safety decisions at the rig. As described above, the extraction and detection of 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 IR15TT-M sensor in the Bloodhound is highly sensitive and reactive to oxides of Carbon or Oxocarbons. The sensor may also detect other Carbon-oxide molecules at the drilling site. These may include Carbon Monoxide released by the diesel engines if they are close by as well as more rare compounds such as Carbon Suboxide, Oxalic Anhydride, 1,2-Dioxetane-dione, and Ethylene-dione. Because of this, the user has to be aware of other materials that may cross contaminate the detection of Carbon Dioxide released from the drilling mud.