

# **A WHITE PAPER**

**Subject: What Aspects Should Be  
Considered When Selecting A**

**Gas Bubbler System**

**Part I**

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“The **WATERLOG**<sup>®</sup> Gas Bubbler Experts”

*We have more than 30 person years  
of technical experience with bubblers.*

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## **Introduction:**

Over the years we have had many requests from our customers to produce a white paper on the subject of selecting and applying gas purge bubbler systems for fluid level measurement. Part I of this paper deals with what specific things should be considered when selecting an automated Gas Bubbler System.

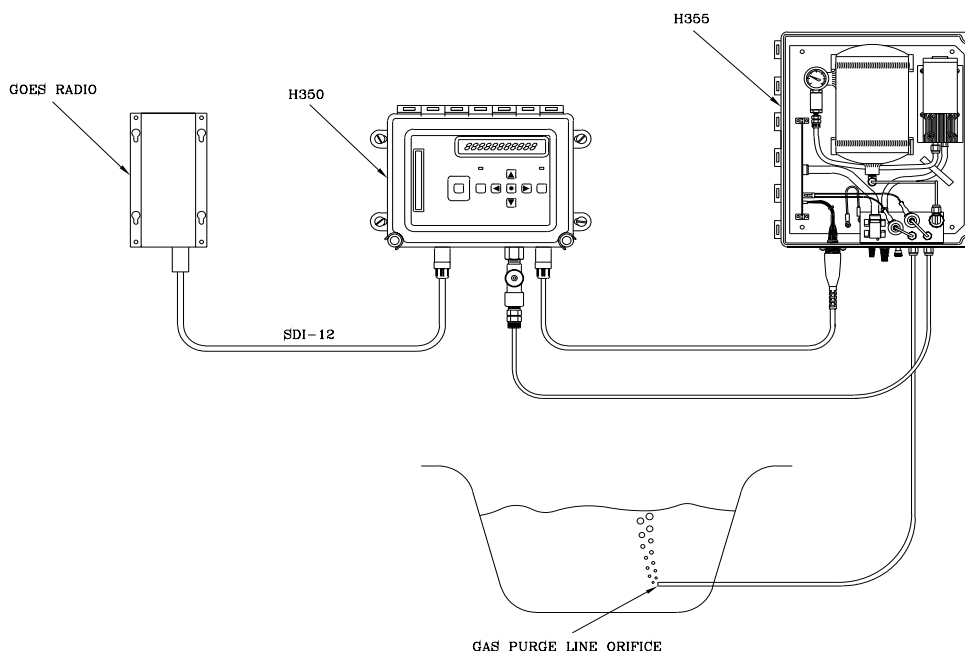
Gas bubbler systems have been used for many years in many different applications, basically to determine fluid depth or elevation. To the first approximation, the basic theory of operation is based on the following relationship derived from the physics of fluids.

$$p = \rho g h$$

Where **p** is the hydrostatic pressure at a depth of **h** in a fluid with a specific density of  **$\rho$**  at any location where **g** is the gravitation effect.

The early gas bubblers were based on the theory of determining the pressure (**p**) required to force bubbles of gas into the measurant fluid. This high pressure gas was provided from compressed gas bottles, like nitrogen, CO<sub>2</sub>, etc. In many industrial locations, the gas source was and is compressed air delivered from an electro-mechanical air compressor.

The older version of purge bubbler systems were pretty much manually operated. A good example of this would be the nitrogen bottle fed system of a Conoflow and Mercury Manometer System used by the U.S. Geological Survey in the United States and around the world for that matter. In the last few years, due primarily to the introduction of the Design Analysis Associates, Inc., automatic gas bubbler (known as the “SMART-GAS System”), there has been a huge migration away from the old traditional bubbler systems toward the automatic bubbler system. See Figure 1.



**Figure 1. WATERLOG® Combo System**

Figure 1. shows a diagram of the **WATERLOG**<sup>®</sup> Combo System that does far more than the bubblers of old. This product was *co-developed* by Design Analysis' **WATERLOG**<sup>®</sup> instrument division and many of DAA's customers. The major contributor being the Corps of Engineers.

The "SMART-GAS System" H-355 has led the way for all other bubblers and still remains the most versatile bubbler available today. Because of this, people use it as a standard to judge other systems. This must be true because our competitors have constantly visited our web site hundreds of times to look at our spec's.

### **Things to Consider When Selecting An Automatic Bubbler System:**

Since the primary reasons for shifting away from the older bubbler systems to the new automated systems are: (1) cost of operation, (2) safety, and (3) better quality data, then the list of considerations should be:

- (1) Cost and Reliability – Can your vendor provide reliability data and histories of practical applications from steamy tropical rain forests to the frigid climates of Alaska and Norway? Can your vendor provide testimonies of customers testifying of large cost savings ratios?
- (2) Does your vendor have an in-depth knowledge of bubbler physics and can they demonstrate a practical scientific depth?
- (3) Since safety is an issue, can your vendor talk to the issues of the standards set forth by ASME? You know, it is a fact that even low pressures can present safety problems.
- (4) Can your prospective vendor talk to the issues of reaction or measurement response times? Can their bubbler give reliable, quick results when used with long orifice lines (>500 ft.)?
- (5) Does your prospective vendor talk to the issues of the power required to operate their system when sample times are 5 minutes or less?

BEWARE OF ANSWERS LIKE THESE: "That doesn't really matter," and "Nobody does that." Just remember, these are standard answers to any question that is embarrassing to address. The true answer should be, "Why pay more for less?" If you can get extra functions free, go for it; even if you can't use it now, you may want it in the future.

### **Power Issues:**

Beware of statements like: "Continuous Bubbler Systems *USE MORE POWER.*" This simply is NOT TRUE. We ask you to compare power requirements of your prospective vendor and the H-355 which is a continuous Bubbler System. The H-355, as of November 1997, offers a near constant 10 mA over the true temperature and sample range it also offers both SDI-12 and RS-485 interfaces. Wouldn't it be more of an advantage to be able to operate the bubbler and data logger on a power budget of less than 20 mA?

Beware of power requirements made without regards to sample rates: Doesn't it raise a question in your mind if a vendor states a specific power requirement *without stating the purge cycle timing*? If the "purge on measurement demand" is the technology, doesn't it seem logical that if the measurement demand goes up (sample rate goes up) so does the electrical power to support this increased sample rate? We find it curious that there is no mention of the actual power required as it relates to sample time. A good question to ask is, "If I want to make a depth measurement every minute and my system has 500 ft. of orifice line, what will the power requirements be?" Watch out, this is a trick question, so don't be surprised if you get the old answer, "Nobody does that." Oh yes they do!

- (6) Can your vendor offer simple upgrades which will allow you to monitor multiple orifice lines with the same unit and the same primary pressure transducer?
- (7) Can your prospective vendor offer you the function and flexibility of the **WATERLOG®** Combo at a better price?
- (8) Does your prospective vendor offer quick turn repairs and maintenance with friendly people who make office calls and provide friendly technical support?
- (9) Can your prospective vendor offer a bubbler system that will operate in water depth greater than 100 ft.? Can they offer a system that can be taken to depths of greater than 250 ft. and offer 0.02% of the basic unit accuracy?

When you are reviewing specifications for bubbler equipment, beware of the "Specmanship Techniques" used. Look for honest, real answers. To this end we offer a list of "Beware Issues."

- Beware of outrageous Resolution Statements. Anybody that knows anything about data acquisitions and measured techniques knows any Resolution Spec is pure B.S. Ask your prospective vendor to talk about *accuracy* and *precision*. If you can get 0.02% accuracy for the same price or less than 0.1% accuracy, why even think about it.
- Beware of an operational spec of -25°C. That sounds good, but that is only about -13°F. It gets that cold in Texas and Oklahoma. If you can get -40°F for the same or less money, why even consider it?
- Beware of systems that integrate the primary measurement transducer into the bubbler unit. We started our original bubbler this way. Our customers with experience quickly convinced us not to do this. It is simply good engineering practice to separate the electro-mechanical portions of the system from the more precise and more reliable electronics. Generally the rule is: Never integrate systems that have widely different reliability numbers! This is simply a good rule to follow. A good example of this principle is a vendor that has a primary reliability problem with their GOES Radio and the GOES is integrated into their logger. Now when the radio fails, the whole system, logger and all, must be replaced. We choose to use the modular approach. Keep things modular, then you can add as needed or

get upgrades without having to tear down the whole system. Look for modular add-as-you-go features that offer field upgrades without laptop computers being required.

- Beware of systems that DO NOT offer a high pressure ( $\geq 60$ psi) line purge. It is a fact that orifice lines require a “good blow” every once in a while. This is basically a standard procedure with the old nitrogen systems. Wouldn't it be nice to have an option for a pre-programmed and/or an automatic real good ole honest line clearing hard blow?
- Beware of systems that simply state they are *controlled* with an SDI-12 interface. Yes, SDI-12 is important, but the ease of setup with bright displays and keyboards that allow for easy bubbler setup is even more important. Wouldn't it be better to have your vendor offer **both** SDI-12 and RS-485 interface? Yes, SDI-12 is the standard with the U.S.G.S., but RS-485 is the industry standard. Look for flexibility and ease of use.

Finally, as I was talking with one of our customers the other day, and explaining to him what I was trying to do with this paper, his comment was, “You guys wrote the book on bubblers, and I know you have a huge number of systems in the field. I think your paper should be short and simply say ‘Compare the Combo spec's with any other in terms of fit, form, and function and the answer is obvious!’ ” I want to thank this fellow for his suggestion. To that end, I am providing the spec sheet for our H-355 ”SMART-GAS System” so all can compare any bubbler system to this ad hoc standard. Also, we encourage you to stay tuned for new system offerings, and Part II.