NEW PRESSURE-BASED WATER-LEVEL SENSOR USED BY THE U.S. GEOLOGICAL SURVEY

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
foot (ft)	0.3048	meter

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$(°F) = 1.8\ (°C) + 32$$

Additional Abbreviations and Symbols

BDR	Basic Data Recorder
DCP	Data Collection Platform
PFC	Portable field computer
PS-2	Pressure-based water-level sensor
SDI	Serial-digital interface

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ABSTRACT

The U.S. Geological Survey's new pressure-based water-level sensor (PS-2) is an intelligent, non-submersible sensor developed for the Survey through the competitive procurement process and built around a commercial pressure transducer. The PS-2 is self-contained and battery-powered, and it interfaces with the USGS new basic data recorder through a serial-digital interface developed by industry for the Survey.

The PS-2 can be used to monitor water levels over an operating range of 0 to 50 feet with an error of less than ±0.02 percent of the full-scale operating range or ±0.01 feet. It operates over the temperature range of -20 to 55 °C, interfaces with satellite data collection platforms (DCP's) through the serial-digital interface, and provides an optional auxiliary output capability for access by non-Survey users. Input to the PS-2 is provided by a gas-purge assembly, which monitors the hydrostatic pressure at a reference elevation in the river, lake, or reservoir. The PS-2 converts that pressure to a water-level data value that represents the elevation of the surface of the specific water body above a user-defined datum.

DESCRIPTION OF THE NEW PRESSURE-BASED WATER-LEVEL SENSOR

Since the 1950's, the principal pressure-based water-level sensor used by the U.S. Geological Survey (USGS) has been the manometer or bubble gage. This electro-mechanical sensor (system) is being rendered obsolete because of its mechanical complexity, high maintenance requirements, and inability to interface directly with electronic data loggers and DCP's. Also, the modern trend is toward intelligent sensors having standard electronic interfaces.

An intelligent or "smart" sensor has the capability of making calibration checks and adjustments automatically, thereby reducing maintenance problems. The sensors can be programmed to make the calibration checks and adjustments at set intervals or during the measurement cycle.

The USGS's new pressure-based water-level sensor (PS-2) is an intelligent, non-submersible, microprocessor-controlled sensor, developed for the Survey through the competitive procurement process and built around a commercial pressure transducer. The PS-2 is self-contained, is battery-powered, and interfaces with the USGS's new basic data recorder (BDR) and (or) a DCP through a serial-digital interface (SDI-12) developed by industry for the Survey. A diagram of the pressure sensor system configuration is shown in figure 1.

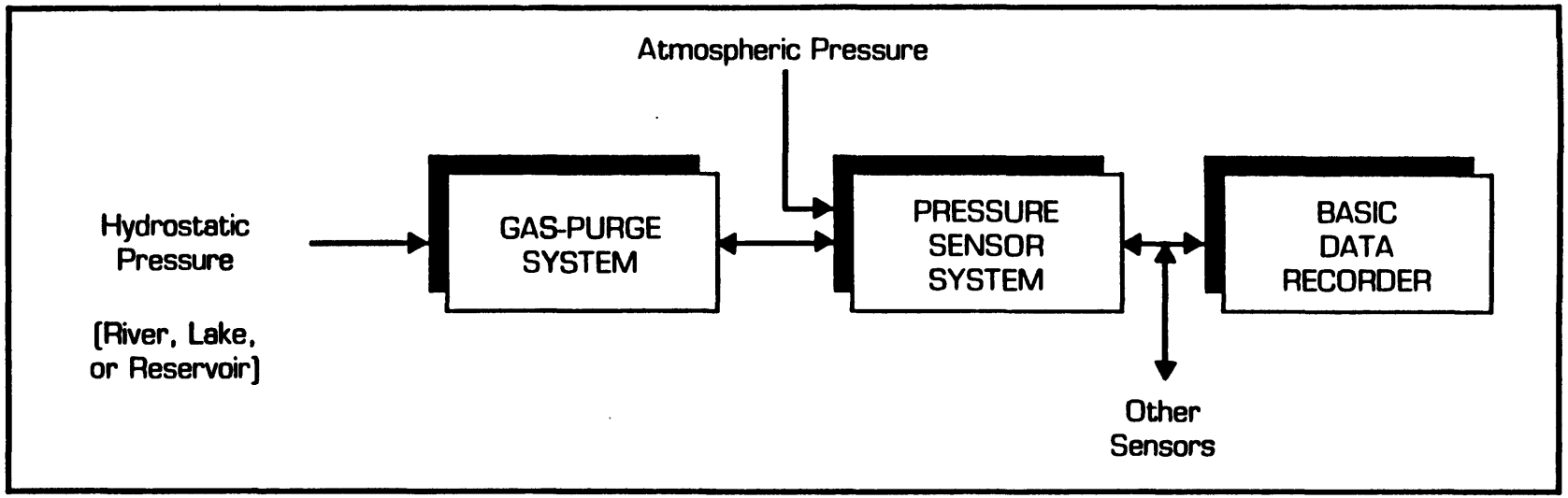

Figure 1.--Configuration of pressure sensor system.

The PS-2

- Is certified to measure pressure over an operating range of 0 to 22 pounds per square inch with a total error less than ±0.02 percent of full scale. This corresponds to an operating range of 0 to 50 feet of water with an error of less than ±0.01 foot.

- Is temperature compensated to operate within the specified accuracy over the temperature range of -20 to +55 °C. An optional capability can be provided for use over a temperature range of -40 to 60 °C.

- Interfaces with DCP's and BDR's through the SDI-12.

- Provides an optional auxiliary output capability for access by non-Survey users when used with a modification kit.

- Is equipped with a pressure relief valve for protection from overpressure resulting from a clogged orifice or improper purging of the orifice line.

- Is compatible with the existing USGS gas-purge system, which monitors the hydrostatic pressure at a reference elevation in the water body. The PS-2 converts that pressure by means of an internal pressure transducer to a water-level data value that represents the elevation of the water surface above a user-defined datum.

- Provides the water-level data value upon demand to the BDR or DCP through the SDI-12. The basic pressure transducer along with the intelligent electronics is contained in a metal housing that, in turn, is contained in a weatherproof plastic enclosure. An air vent on the front of the enclosure permits the pressure transducer to be referenced to atmospheric pressure and relieves any pressure buildup inside the system. The PS-2 and pressure sensor/recorder system are shown in figures 2 and 3 respectively.

A hydrologist or hydrographer can use a portable field computer (PFC) to program the BDR to communicate with the PS-2 to retrieve and store data. The PFC can be either a laptop or an environmentally protected hand-held computer. The BDR can be programmed to "wake up" the PS-2 and tell it to make a measurement and then transmit the measurement data to the BDR for storage in memory or transmittal to another device, such as a DCP. In measurement configurations where the DCP is the primary recording device and the PS-2 and DCP are interfaced through an SDI-12, the use of a BDR is unnecessary.

The new PS-2 is much smaller than the manometer it replaces, thereby allowing the instrumentation systems at new stream-gaging installations to be smaller and more cost effective. A typical USGS PS-2 pressure sensor/recorder installation is shown in figure 4.

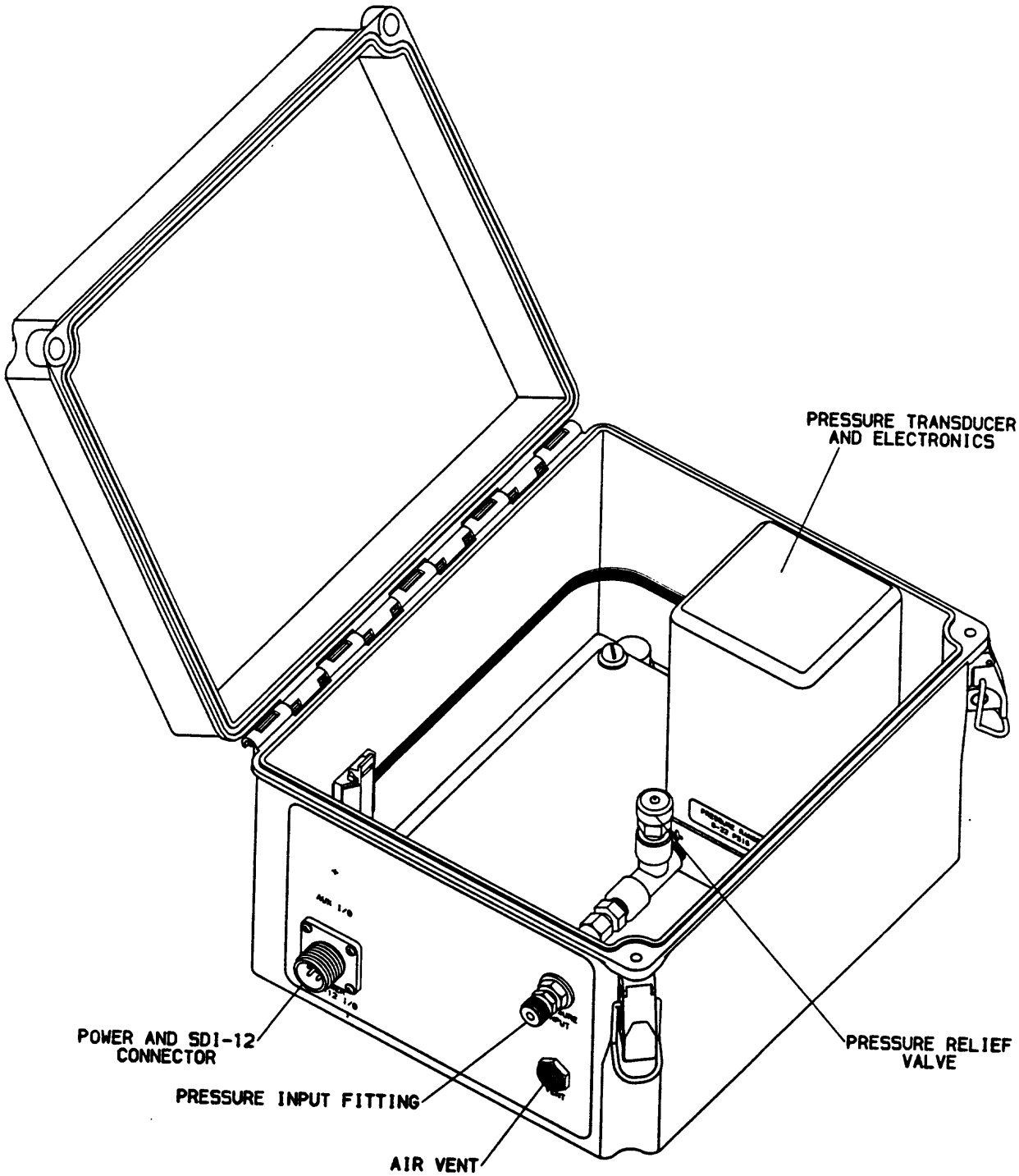

Figure 2.--PS-2 with lid opened.

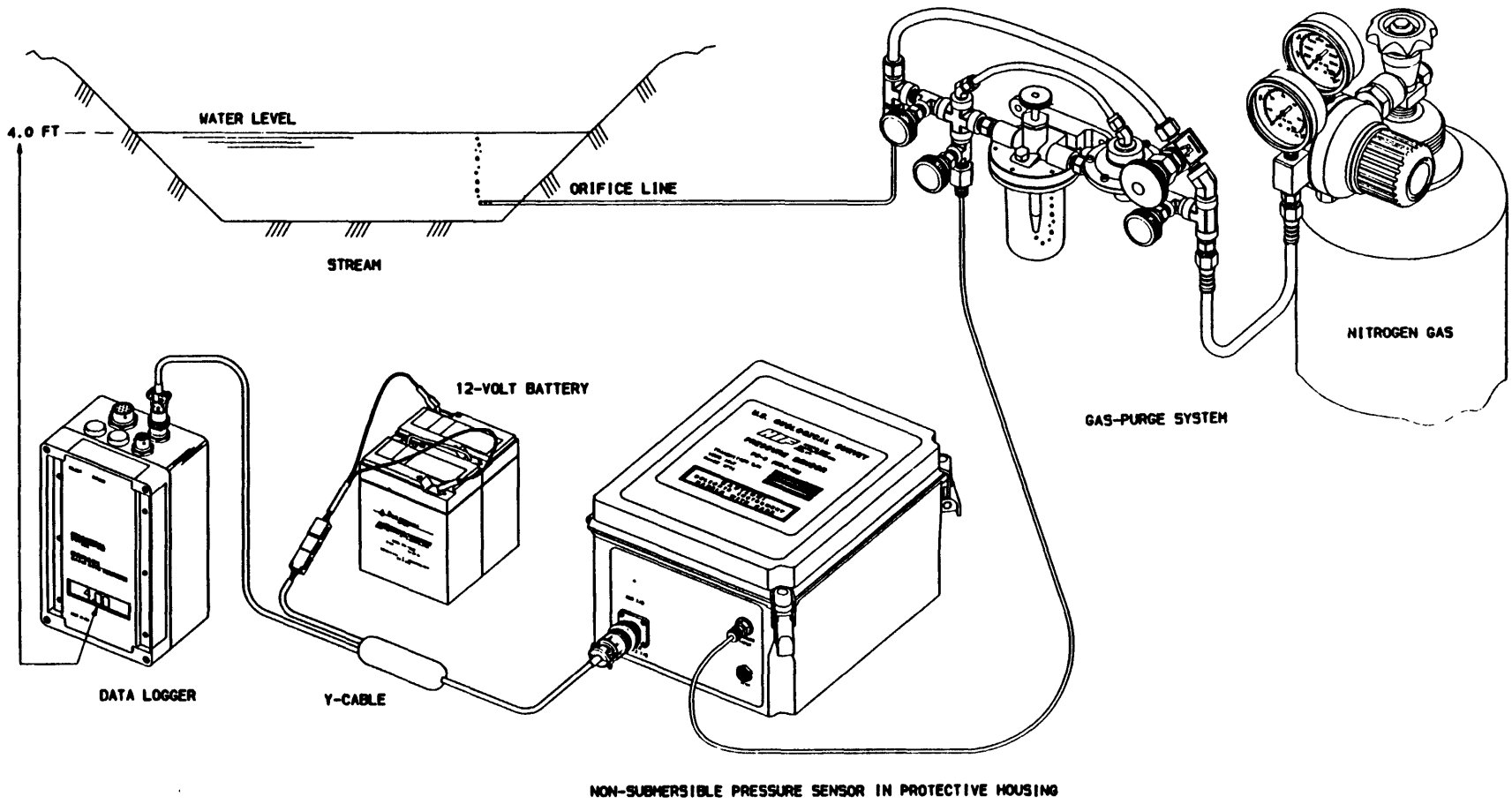

Figure 3.--Pressure sensor/recorder system.

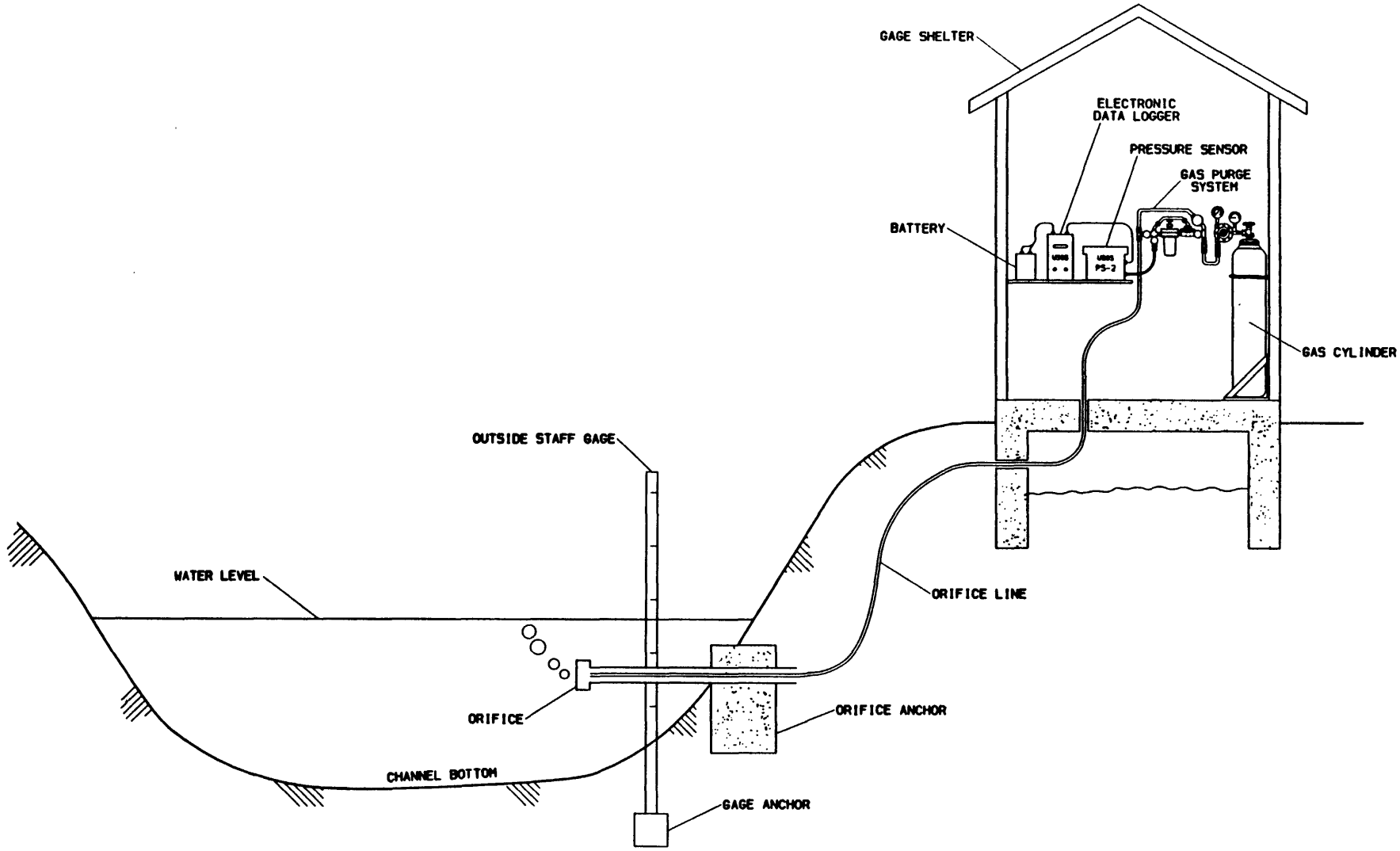

Figure 4.--Typical pressure sensor installation.