

# Water Level Indication



Fossil Power Systems Inc.



## THE COMPANY



**Fossil Power Systems (FPS)** is a Canadian company that was founded in 1981. From humble beginnings as a designer and manufacturer of ignitors, flame scanners and drum level probes, FPS has evolved to become a worldwide leader in the design and manufacturing of firing equipment and safety systems for the power generation, pulp and paper, and petrochemical industries.

FPS developed many of the technologies that are currently being used throughout the industry on flame scanning, gas/oil ignition and water level measurement equipment. Our products are specified on new construction and retrofit projects around the world.

FPS has products installed in over 70 countries, all developed, manufactured and tested in our factory in Nova Scotia, Canada.

FPS is one of very few companies in the world that can provide complete boiler gas conversion expertise, with the ability to provide the correct ignition equipment, flame scanners, natural gas piping design/fabrication, burner management system (BMS), combustion control system (CCS), and manage local approvals.

FPS continues to be the industry leader in technology advancement and we are grateful for the opportunity to **continue making boilers cleaner, safer and more reliable.**



## LOCATION

FPS is located in Dartmouth, Nova Scotia, Canada. A 45,000 ft<sup>2</sup> facility in Dartmouth houses all project management and design engineering, as well as manufacturing/testing of all high pressure columns, fuel piping systems, ignition equipment, valves, control systems and electronic products.

FPS also has an engineering and sales office in Edmonton, Alberta and many authorized sales distributors worldwide.

Since 1987, FPS has maintained an exclusive marketing agreement with Babcock & Wilcox, for all ignition product sales and service in the USA.

## FPS ELECTRONIC LEVEL INDICATION

### AQUARIAN

**Aquarian electronic level products** were specifically designed to meet the industry's growing needs for a reliable, cost effective and versatile means of sensing water levels in a variety of high and low pressure applications. By passing a square wave  $\pm 5$ VDC through the network and processing the resulting signal, a distinction between steam and water is made, even in water conductivities as low as 0.5 micromho.



Aquarian™ 3000Mini

### The Aquarian 3000Mini

The **Aquarian 3000Mini** was developed to satisfy basic level indication requirements utilizing vacuum brazed probes for boiler drum, feedwater heaters and other liquid level applications. The Aquarian system consists of: the column with probes, the detection and verification unit (DEV) and the remote display for the control room. The electronic unit (DEV) is connected to 5, or more probes on the water column. The number of probes can be selected and spaced to indicate liquid level through a desired operating range in a custom manufactured water column to provide the most reliable indication for any application. An individual relay is provided for every probe level to provide versatility in selecting high/low or other system alarm and trip points. A remote LED display panel, customized for the number of probes and their locations is standard. A local display mounted on the DEV door is optional.

Operation of the system is based on measurement of the difference in resistance between water and steam, which is compared with a known reference resistor. The signal output to the probes is a symmetrical source wave  $\pm 5$ VDC current which prevents electroplating of the probe. The Aquarian 3000Mini measures the returning signal to indicate 'water' or 'steam'. System diagnostics perform an ongoing wire continuity check (using optional two wires per probe) to verify the integrity of the cable connecting the probes to the DEV. System fault indication is provided by a relay which monitors the internal power supplies, dock and wire continuity. A second relay for level fault, activates if water is detected above steam.

#### Installation Options

Typical options with these systems include additional level displays. These can be a door mounted local display or remote (feedwater station, blowdown station). The equipment can provide a 4-20 mA output proportional to the indicated level. This signal should not be used for level control, but is suitable for level indication or trend recording.

#### Importance of Maintaining Boiler Water Level

It is critically important that proper steam drum water level be maintained at all times. If the water level is too low, boiler tubes may be damaged. If the water level is too high, damage to the steam separator or steam turbine from water carry over can occur.

#### Boiler Water Level Measurement Options

At least one visual gauge is required for the boiler drum. However, indication from this gauge is often not visible to control room operators. Additional instrumentation is necessary to maintain proper water level. DP transmitters are commonly used for level control because they provide continuous signals. Multiple transmitters can be used to meet redundancy requirements. However, this arrangement is susceptible to common mode failure. Plugged sensing lines, empty reference legs, and improper configuration or calibration are all potential causes of failure. During a common mode failure, the issue may not become apparent to operators until damage has already occurred.

The Aquarian 3000Mini provides a completely independent point to point level indication which acts as a reliable backup for the level control device. Since the 1980s, Aquarian probe systems have consistently proven their value by protecting equipment when other instruments fail.

#### FEATURES

- NEMA 4X (IP65) Stainless Steel Enclosure.
- Solid state electronics and Bi-Color Remote display.
- Three way adjustment for water conductivity.
- Power source: 120 or 240 VAC, single phase, 50-60 Hz, 1/2 - 1/4 A.
- 5 amp contact output for electronic level faults.
- Electronic self-monitoring and indication in the DEV unit, power supply failure (redundant power supplies), clock failure (DC detection circuit).
- Swaged Style Probes Rated for 3000psi @ 1200° F (649°C) maximum.
- 2000 & 3000psi (138 & 207bar) Carbon Steel Water Columns.
- Nema 4X Column Mounted Junction Box.
- $\pm 5$ VDC to (prevents electroplating).

#### OPTIONS

- Stainless Steel, Chrome Moly P1.1, P2.2 & P9.1 Water Columns.
- Vertical Style Probe Columns.
- Bi-Color Enclosure Door Mounted Local Display.
- 4-20mA with RS485 output.
- RS-485 Serial Remote Bi-Color Remote Display.
- Explosion Proof enclosure for hazardous area applications.
- Zener barriers for intrinsically safe probe connections.







**ASME TDP-1** for the "Prevention of Water Damage to Steam Turbines" covers design, operation, inspection, testing, and maintenance to prevent water induction from: motive steam systems, steam attenuation systems, feedwater heaters, and related equipment. The Aquarian 1000Plus and Single Probe Alarm Module are designed to detect the presence of water and initiate control actions that protect steam turbines from damage.



## The Aquarian Single Probe Module and Aquarian 1000Plus

The **Aquarian 1000Plus** represents the standard in electronic level detection. Based on the widely accepted conductivity probe technology, it was specifically designed to meet industry's growing needs and demand for a reliable, cost effective and versatile means of sensing water levels in a variety of applications.

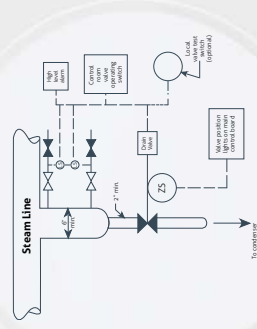
The Aquarian 1000Plus is equipped with one to four probes and the Aquarian Single Probe Alarm Module has one probe. The Aquarian systems measure the difference in resistance between high purity water and steam. These level switches are available with a 1 1/2" Swaged style fitting for welding in a 1 1/2" SW Tee or with a water column using the Swagelok™ fitting.

The **insulated probe** and the pressure vessel, in which it is mounted, form a resistivity cell. Coupled with a reference resistor, the cell forms a resistor divider network. By passing a square wave dc voltage through the network, and processing the resulting signal, a distinction between steam and water is made, even in water conductivities as low as 0.5 micromho. To provide maximum

system reliability and diagnostics, redundant power supplies were incorporated to maintain system operation while alarming operators of system service requirements. In addition to level indication, the Aquarian 1000Plus provides relays for each probe, enabling it to serve as a system trip, alarm or on-off control device. The system is completely field configurable to provide maximum versatility.



The **proven Aquarian probe and pressure vessel** connect directly to the pressure vessel, by welding the probe connector in a Tee, or column. Its Swagelok™ metal to metal seal assures a leakproof installation. These systems are an effective electronic replacement for mechanical float switches. These Aquarian systems can be conveniently located up to 180 feet away from the probe with low conductivity water, and 500 feet away with high conductivity water. The LED indicators provide visual verification, showing "WATER", "STEAM" AND "POWER/CLOCK". The normally open and normally closed contacts provide relay outputs for control circuits or remote indicators.



**Aquarian system installation** to meet the ASME requirements for Turbine Water Induction Protection (TWIP).

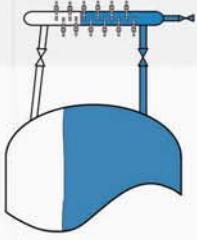
## FEATURES AND BENEFITS

- Brazed High Pressure Swaged Style Probe.
- Level fault, Power Supply failure and Clock fault monitoring.
- Economical alternative to float level switches.
- Conductivity Capability: 0.5 micromho and up.
- Detects presence of water throughout entire range of operating temperatures.
- Relay can be set as "fail safe" in case of power failure.

## OPTIONS

- Nema 4X enclosure for SP Module.
- Probe wiring continuity monitor (wire) failure.
- Explosion Proof enclosure for hazardous area.
- Zener barriers for intrinsically safe probe connections.
- Tee or Water Column materials: Carbon Steel, Stainless Steel, Chrome Moly P11, P22 & P91.

**Genuine Aquarian probes** are designed by FPS for high performance and reliability. Aquarian Probes are ONLY manufactured by FPS in Dartmouth, Nova Scotia, Canada and will proudly display the FPS logo.



Aquarian™ High Pressure Braze Probe System

### The Aquarian High Pressure Braze Probe P/N 9300-0002

The **Aquarian probe** has set the industry standards for high performance and reliability. Designed for use with a Swagelok™ fitting, the seal profile is machined to the probe body, eliminating the need for gaskets.

Every Aquarian probe is gas tested and hydrostatically tested to ensure the probe will provide reliable water/steam indication. The OEM Genuine Aquarian probe will proudly display the FPS logo, part number 9300-0002, rating 3000psi (207bar) @ 1200°F (649C) and the Aquarian™ name.

Aquarian Probes are only manufactured by FPS using proprietary vacuum in house brazing at the FPS facility in Nova Scotia, Canada. Contact FPS to learn who the local sales representative is for your area. [SALES@FOSSIL.CA](mailto:SALES@FOSSIL.CA)

For horizontal probe column arrangements, the same probe is used for all Aquarian models.



Aquarian™ Level Probe P/N 9300-0002

### The Aquarian Vertical Probe P/N 9300-0023 & 9300-0024

The **Aquarian Vertical Probe** uses the same braze technology as the horizontal probe and is designed for boiler steam drum water level indication based on water conductivity. The level probe and electronics sense the difference in conductivity between water and steam.

The primary difference for the vertical style column is that the probe is inserted in the top of the probe column keeping the probe insulator out of the high conductivity water environment. Each probe has a stainless steel rod of various lengths to detect specific water levels in the steam drum. The signal from the probe is sent to the electronic unit for local and remote indication, alarm and trip.



Aquarian™ Level Probe P/N 9300-0023 & 9300-0024



The FPS logo is proudly displayed on all products.

#### FEATURES

- High density zirconium oxide ceramic wetted insulator improves Steam/Water detection through minimized contaminant build-up and enhanced water shedding.
- Manufactured from ASME approved materials.
- Body & Tip are in house vacuum brazed to the probe insulator.
- 100% gas tested.
- 100% Hydro tested to 6000psi (414bar).
- Rated for 3000psi (207bar) @ 1200°F (649C).
- Two year unconditional warranty.
- Swagelok™ seal profile machined in the probe body.
- No gaskets.
- Genuine Aquarian Probes are ONLY manufactured at the FPS facility in Nova Scotia, Canada.



## FPS VISUAL LEVEL GAUGE (SIGHT GLASS)

### AQUARIAN

**Visual Gauge**, commonly referred to as a Sight Glass or Level Gauge, is the only technology available to provide "Direct" indication of steam drum water level thus satisfying the ASME Boiler and Pressure Vessel Code requirements.



#### Aquarian 3000Visual Bi-Color Ported Gauge

The **Aquarian 3000Visual** is a 3000psi (207bar) ported water level gauge that produces a red/green image to indicate the water level in high-pressure boiler steam drums.

The ASME Boiler and Pressure Vessel Code states "ported gauges or reflex gages that use refraction of light to aid ready determination of the liquid level, may omit the requirement for overlapping sections."

The Solid State Bi-Colour Gauge Illuminator and Display attach to the ported gauge to produce a red or green image on the display. A red image indicates that steam is present and a green image indicates that water is present. The red/green image is produced by an array of solid-state light emitting diodes (LED's) and precision lenses that focus the image through the gauge body onto the display. The LED's replace the unfocused incandescent light bulb and colored glass that are currently used in conventional bi-colour illuminators.

The LED arrays and precision Plano-convex lens provide a bright, clear and unmistakable image in the presence of steam and water. The high intensity narrow beam LED's are mounted on an electronic printed circuit board with current limiting resistors. A precision 24VDC power supply provides the Illuminator with the exact current that is required for a constant clean image.



Aquarian™  
3000 Visual  
Bi-Color Water  
Level Gauge

#### Port Kit P/N 9300-0109

The **Aquarian 3000 Visual Bi-Color Water Level Gauge** is designed to reduce the frequency of maintenance.

The Belleville Spring Washers eliminate the need for hot re-torque and two pieces of high quality mica in the glass kit allow this gauge to operate for longer periods of time. Step by Step instructions are provided with each kit.

The clarity of the three RED or three GREEN LED's in each port will indicate the operating condition of the gauge.



#### FEATURES

- Designed for 3000psi (207bar) and 696°F (369C) steam service.
- One piece type 304L stainless steel body and covers provide corrosion resistance and long service life.
- Belleville spring washers maintain gasket loading under thermal and pressure cycles.
- Precision tempered and ground Aluminosilicate glass provides clear visibility.
- Laminated and die formed graphophill sealing gasket.
- Two discs of premium V-1, quality clear ruby mica protect the glass from the steam and extend the service life.
- Constructed to the ASME Boiler and Pressure Vessel Code requirements for design, materials and construction.
- LED's are immune to failure from vibration.
- Average LED life is 11 years, resulting in reduced maintenance and service costs.
- Display and Illuminator can be installed on either side of the gauge to provide viewing flexibility.
- 6 LED's per port produce extremely bright image visible at more than 100ft. away and various angles.
- Level Display enables operator to view the image clearly.
- Adjustable end plate for exact placement of viewing screen, provides an unmistakable steam and water image.

Ported Gauge  
Components

## FPS LEVEL GAUGES (FOR STEAM & PROCESS APPLICATIONS)

### AQUARIAN

**(PG-60.1.1) Boilers** having a maximum allowable working pressure of 400psi (27bar) or less shall have at least one gage glass in service at all times.



#### Aquarian 650R Reflex Gauge

The **Aquarian 650R Reflex Gauge** is rated for 975psi (67bar), and 350psi (24bar for steam) and provides excellent visibility of liquid level. Light refracting grooves in the glass cause the liquid to appear black and steam to appear white. The high contrast between water and steam allows this style gauge to be stacked on top of one another without concern for blind spots between gauges. Recessed gasket surfaces in both the cover and body facilitate glass and gasket alignment and also help prevent gasket blowout. Belleville spring washers maintain constant gasket loading under thermal and pressure cycles.

Aquarian™ 650R  
Reflex Gauge



Aquarian™ 1000T High  
Pressure Flat Glass Gauge

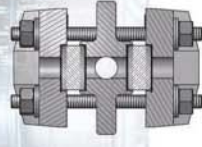
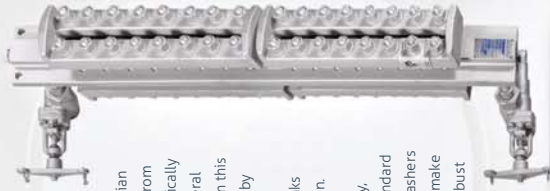
#### Aquarian 1000T Transparent Flat Glass Gauge

The **Aquarian 1000T Transparent Flat Glass Gauge** is rated for 1000psi (69bar) and is structurally designed with a thicker and wider body to resist deflection. The design meets the recent changes of the ASME Boiler and Pressure Vessel Code, which no longer permits the use of cross webbing. For longer ranges of visibility, this style gauge must have a min. of 1" for overlapping sections. Belleville spring washers maintain constant gasket loading under thermal and pressure cycles. Precision tempered and ground Borosilicate glass provides high strength and clear visibility, while a mica shield protects the glass from the effects of erosion for an extended service life.

#### Aquarian 2000T Transparent Flat Glass Gauge for NON-ASME Section 1 Applications

**Most transparent gauges** are machined from bar stock that is only slightly wider than the glass itself. The Aquarian 2000T is manufactured from an extruded shape specifically designed to improve lateral strength. The wide body on this gauge reduces deflection by 75% compared to other gauges, which reduces leaks caused by body deflection.

The extruded gauge body, combined with FPS's standard use of Belleville spring washers to maintain bolt loading, make the AQ2000T the most robust stackable transparent gauge in the industry.



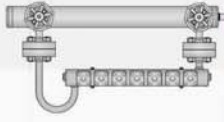
AQ2000T  
Cross Section

#### FEATURES

- AQ 650R and AQ 1000T Gauges**
  - Full length visibility with no obstructions gives definitive readings and conforms to the latest ASME code for sight glass gauges.
  - Reflex Gauge is Rated for 975psi (67bar) on process applications and 350psi (24bar) for steam applications.
  - AQ 1000T is Rated for 1000psi (69bar) for steam applications.
- AQ 2000T Gauge**
  - AQ 2000T is Rated for 2000psi (137bar) CWP for process applications.
  - Wide Gauge body design resists deflection, which prevents gasket failure.
- AQ 650R, AQ 1000T and AQ 2000T Gauges**
  - Belleville spring washers maintain constant gasket loading under thermal and pressure cycles.
  - Precision tempered and ground Borosilicate glass provides high strength and clear visibility.
  - Optional aluminosilicate glass available for some designs.



FPS offers a variety of high quality valves designed for visual level gauge isolation. All valves are forged steel and constructed to meet the rigorous demands of high pressure steam boiler service. The valves meet the requirements of ASME Boiler and Pressure Vessel Code, Section 1.



AQUARIAN



GV 3100 Angled Globe Valve

**GV 3100 Angled Globe Valve**

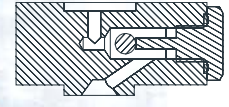
- 1" angled globe valve.
- Rated Class 2155.
- Stellite seat and disc, free rotating.
- 1/2" handle or Chainwheel Operator.
- 3/4" flanged gauge connections.
- Conval Clampseal® body construction.
- Pressure seal threaded bonnet/yoke.
- Outside screw and yoke (OS&Y) construction.
- SA-105 Forged Steel body and Yoke, Nickel Plated.
- Pressure actuated fixed leak-tight backseat.
- Standard SW Drain, Optional SW Vent.
- Integral packing gland wrench.
- In-line repairable seat.
- Optional ball check.



GV 3200 Angled Globe Valve

**GV 3200 Angled Globe Valve**

- 1" angled globe valve.
- Rated Class 1500.
- Stellite seat and disc free rotating.
- Handwheel or Chainwheel Operator.
- 3/4" flanged gauge connections.
- Bolted bonnet/yoke.
- Outside screw and yoke (OS&Y) construction.
- SA-105 Forged Steel body and Yoke.
- Standard SW Drain, Optional SW Vent.
- In-line repairable seat.
- Optional Ball Check.



Ball Check Cross Section

**VALVE SUMMARY**

When engineering your project, FPS will select the corresponding valve to satisfy the requirements for your particular application.

With Ball Check Valve on the lower gauge connections and the Flow Restrictor Valve on the upper gauge connection, these optional valves are designed to be used with the visual level gauges to prevent excessive discharge from the gauge in case of glass failure.

Contact FPS to discuss valve options for your level gauges.



**GV 3110 & GB 3121 Angled Globe Valve**

- 3/4" offset angled globe valve.
- Handwheel or Chainlever Operator.
- 3/4" pipe nipple gauge connections (GV3110).
- Union gauge connections (GV3121).
- Outside screw & yoke (OS&Y) construction.
- Forged Steel body and bolted bonnet.
- Rated 1500 psi (103bar), and 597°F (313C).
- Non-rotating Stainless Steel stem and hardened seat.
- 1/2" NPT Vent 3/4" Drain (Standard).
- In-line replaceable seat.
- Optional Ball Check.



GV 3110 Angled Globe Valve

**Series 3500 Ball Check & 3501 Flow Restrictor**

- Forged steel body, stainless steel ball.
- Meets ASME section 1 and appendix A-18 requirements.
- Reduces steam discharge in case of gauge glass failure.
- Rated for 3000psi (206bar) steam service @ 696°F (368C).
- Can be inspected in-line.



3501 Flow Restrictor

Series 3500 Ball Check



## Steam Power Industries Hardware/Software Systems



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