Hydrastep and Hydratect

Water/Steam Monitoring Systems

Flexible
- *Modular system to match requirements*
- *Choice of 8 to 32 electrode resolution*
- *Multiple remote displays*
- *Up to 16 trips/alarms operable at selected water levels*

Exceptionally reliable
- *Electrodes continuously monitored for open or short circuit condition*
- *Fault indication on all displays*
- *Multi-segment LEDs provides built-in redundancy*
- *All signal path wiring continuously monitored*
- *Dual independent power supplies provide fail operational condition*
- *No junction boxes required - fully tested spliced cable as standard*

Cost effective
- *Zero maintenance – fit and forget*
- *No nuisance trips, no lost revenue*
- *No missed incidents*
- *Approved by insurance companies*

Hydrastep electronic gauging system
Failure to detect low water levels in steam-raising plant can have costly and potentially disastrous consequences. Reliable water level detection is vital to prevent damage to plant and personnel. The Hydrastep electronic gauging system is the ideal 'fit and forget' solution to overcome the problems associated with unreliable, maintenance intensive gauge glasses. Designed for totally reliable operation, Hydrastep is both fail-safe and fault tolerant.

Modern boilers are designed to provide clean, dry steam. Detection of incorrect water level in the drum is essential: too high a level can give wet steam, leading to turbine blade erosion, and if the level is too low, the boiler tubes can overheat, with the danger of explosion. All national legislatures require indication of water level in steam generating plant and drum level indication in the control room is absolutely necessary. Conversely, however, false alarms leading to plant shutdown and loss of revenue are also highly undesirable. Hydrastep offers exceptional levels of security. All measurements are interpreted as water, steam or contamination. Both short and open circuit conditions are detected and indicated as faults. An independent report by Factory Mutual Research concluded that the probability of Hydrastep missing a trip condition is less than 1 in 300 million and that nuisance trips will be less than 1 in 10 million. Hydrastep combines optimum safety indication with virtually no risk of false alarms.

FM APPROVED

STAS TYPE APPROVED

Hydrastep & Hydratect

Hydrastep 2468 Electronic Gauging System

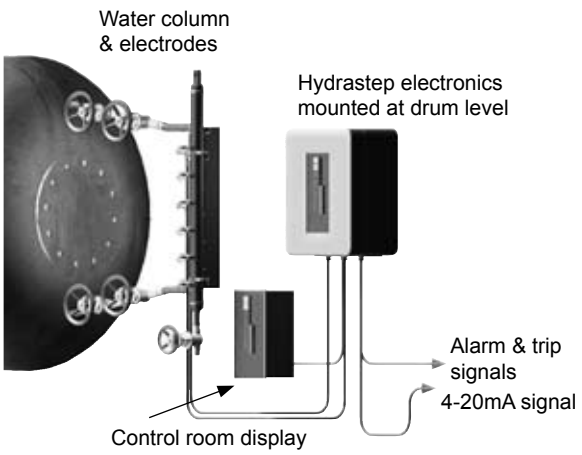
The two interleaved vertical rows of electrodes are installed in a water column attached to the boiler and usually aligned so that half the electrodes are above the normal water level. The water column is attached to the boiler via steam and water connection and should be isolated from the boiler by isolation valves.

Electrodes from each side of the column are connected to the electronics unit by separate cables. Two separate input boards, each powered by its own power supply, measure the signal from each electrode and feed alternate segments of the display. This arrangement provides redundancy against failure in any part of the system. Up to 16 alarm relay outputs (dependant on the number of relay boards installed) can be utilized to operate trips or control audible, visual or other alarm indication. Each relay can be set to operate at any water level. For example, alarms could be set to give outputs on high-high, high , low and low-low levels, with trips on the high-high and low-low levels.

The electronics unit performs a resistance measurement between the insulated tip of each electrode and the wall of the water column. The resistance measured in water is substantially less than that measured in steam. The presence or absence of water is sensed at each point and the level of water is indicated. Fault conditions are also shown on the display.

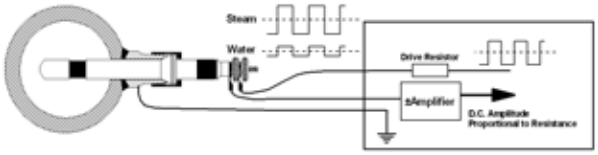
Remote display units are available for control room indication or at other points in the plant.
All functions of the main display unit are repeated on the remote displays, including fault indication.
Up to 6 remote displays can be used.

Hydrastep Installation

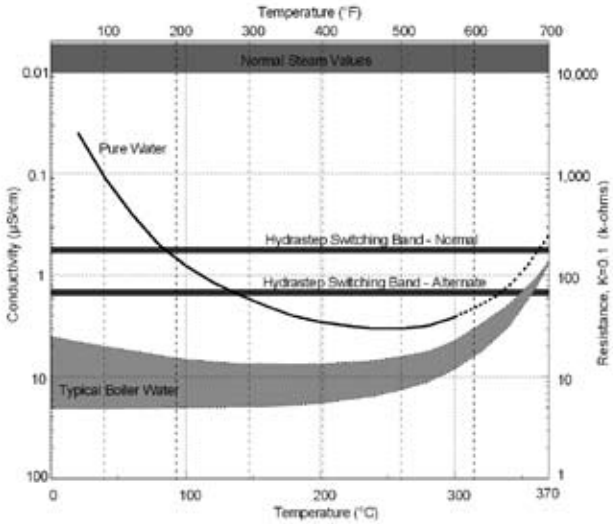


Operation

Two wires are connected to each electrode, one for the signal drive and one for the signal return. A low frequency square wave is used to drive the electrodes through drive resistors. Additional wires are used for the ground connection.



When the electrode is in steam a high resistance to ground (column wall) is presented, and therefore a large signal is returned. When the electrode is in water a low resistance to ground is presented and therefore a small signal is returned. If no signal or only a very small amplitude is returned then either a short circuit to ground is present or a wire has been broken or disconnected.



The Hydrastep system consists of a water column fitted with up to 32 electrodes, an electronic measuring unit, local and remote displays and connecting cables.

Each of these components is available with a specification to provide reliable, cost effective protection in any application.

Density Error

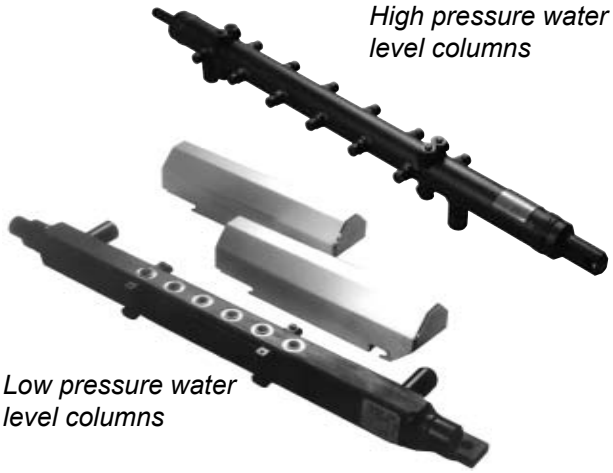
All side arm level measuring systems experience an effect called density error. Errors can be as much as 6inches (150mm). Correct installation of the Hydrastep system reduces this error to less than 0.8inches (20mm) – well below that obtainable with most other side arm systems.

Density error occurs because temperature loss causes water in the measurement system to be cooler that the water in the drum or vessel. Since cooler water has greater density a depression of the water in the side arm occurs.

Density error is dependent on both water level and operating conditions, so that simply offsetting the water column cannot compensate for density error. Correct installation of the Hydrastep system (see diagram) reduces the density error to the smallest possible by minimising the difference in temperature between the water column and the drum. Partially insulating the steam leg encourages condensation which transfers latent heat from the steam to the water in the water column. Loss of heat from the water leg is prevented by correct insulation. Such a scheme is not practical with other side arm systems where condensate flow would create flooding or saturation and therefore incorrect level indication.

Hydrastep Water Level Columns

The Hydrastep water level columns are designed and manufactured to match the reliability of the rest of the Hydrastep system. They offer plant operators the ideal answer for water level measurement on both HRSG drums and feedwater heaters.
All design calculations, manufacturing and test are carried out to ASME 'Boiler and Pressure Vessel Code' and B31.1 Power Piping Code. In addition, columns can optionally be provided with full certification to customers requirements.

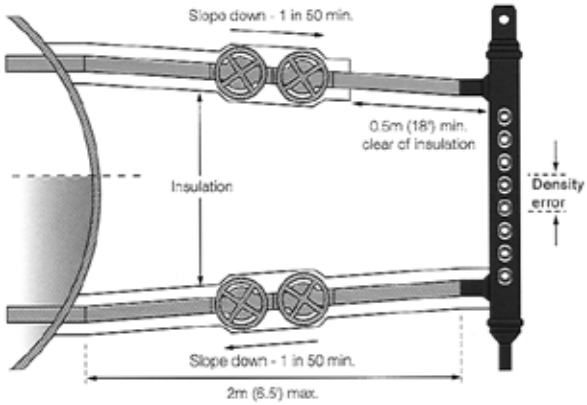


High pressure water level columns

Low pressure water level columns

Typical Installation

For optimum performance and to minimize density error, Hydrastep water columns should be installed as shown here.
For columns longer than 3'3" (1m), it may be necessary to insulate the column itself.



General
ASME B31.1 design code
Custom manufacture
Stainless steel covers

Low pressure water level columns
Design pressure: 1740 psi (120 bar)
Design temperature: 650°F (343°C)
Threaded electrode fixing
Helicoil protected threads
Metaflex gasket seal
1" (25mm) Sch.80 SA106 connections

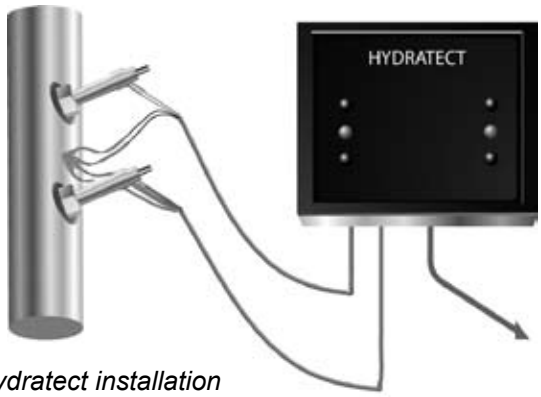
High pressure water level columns
Design pressure: 210 bar (3045 psi)
Design temperature: 698°F (370°C)
Union-style electrode fixing
Metal to metal pressure seal
1" (25mm) Sch 160 SA106 connections

Super critical pressure columns
Mobrey water columns and electrodes can be specified for super critical pressures and temperatures. This means that level indication is provided during subcritical operation and the need for valving off when the boiler goes supercritical is eliminated.
Design pressure: 4350 psi (300 bar)
Design temperature: 1040°F (560°C)
Union-style electrode fixing
Metal to metal pressure seal
1" (25mm) XXS SA312-TP316 connections

Hydrastep & Hydratect

Hydratect 2462 Steam / Water Detection System

The Hydratect electronic water detection system is designed as an electronic alternative to conventional water level switches on steam raising plant. It can be used in a wide variety of situations wherever the detection of water or steam is vital for safe and efficient operation. Designed to use the same water or steam detection system as Hydrastep, Hydratect provides much higher levels of reliability than conventional devices, and can be used in conjunction with Hydrastep level detection for ultimate protection. Hydratect provides local indication and configurable alarm / trip outputs.



Hydratect installation

The 2462 Hydratect is designed for:
- Fault tolerance
- Fail-safe operation
- Fully validated trips
- Detection of electrode contamination
- Detection of open circuit electrode connections
- Detection of fault ground connections

The 2462:
- Makes routine testing unnecessary
- Conforms to all existing standards and legislation
- Continuously verifies measurement integrity
- Is the most economical solution for all installations

The Hydratect 2462 system consists of electrodes, an electronic unit and a manifold or water column. Alternatively, inserts can be provided so that the electrodes can be fitted directly into existing pipework. Hydratect is a fault detection system designed for maximum reliability. At installation, each electrode is specified as being either normally in steam or normally in water. Under normal operating conditions, Hydratect's alarm/trip relays remain energized and no alarm is triggered.
An alarm/trip output is given if:

- The electrode detects a 'not normal' condition
- A fault occurs within the Hydratect system or associated wiring
- Power to the Hydratect system fails

'Water normal' is used for low water level detection
'Steam normal' is used for high water level detection in steam drums, feedheaters and in turbine water induction prevention systems (TWIPS) on steam lines.

Hydratect and Hydrastep
For ultimate protection. Hydratect and Hydrastep can be combined in a single column

Typical applications
- Steam normal
- Turbine water induction prevention
- Steam line drain control
- Boiler water high level protection
- Stator winding cooling circuits
- Water Normal
- Feedwater heater low level protection
- De-aerator level protection

Turbine Water Induction Protection
A Hydratect Level Switch installed on the drain pot in the super-heated steam line will detect the level of condensed water in the pot. A single electrode can be used, but for better protection a two electrode, dual power supply system ensures trouble free, fault tolerant water detection. This can also be utilized for automatic operation of the drain valve.

For site fabrication pre-threaded inserts are available for welding into standard pipework. The insert is designed to maintain the integrity of the basic pipe.

Custom manifolds can be supplied for up to four electrodes.

Specification: Hydrastep electronic gauging system 2468			
Electrode channels:	8 to 32, in pairs		
Water/steam threshold:	0.6µS/cm (normal) or 1.6µS/cm (alternate) depending on water purity.		
Electrode cable length:	10ft (3m), 33ft (10m), 60ft (18m), 98ft (30m)		
Fault detection:	Electrode connection	Open circuit	
		Short circuit to ground	
Channel fault indication:	Flashing display segment		
General fault indication:	Amber LED		
Local display:	Red/green bar graph, 32 LED segments		
	Display blanking from the bottom with less than 32 electrodes in use		
Outputs:			
Drive to remote displays, maximum 6 units			
Opto-isolated fault output			
Analog output (proportional to water level):			
Range:	0-20mA or 4-20mA, forward or reverse		
Accuracy:	± 0.2mA		
Drive capability	600Ω at nominal supply voltage		
	500Ω at minimum supply voltage		
Optional output boards (for alarm indication)			
No. of output boards:	Up to 4		
Relay board 24680504C			
Relays:	4 Independent change-over		
Relay contact rating:	ac	dc	
Maximum voltage:	250V	125V	
Maximum current:	8A	8A	
Max. switching power:	1500VA		
	240W <30V	5A at 12Vdc	Type N safety
	65W <60V	100mA at 30Vdc	Type N safety
	25W <125V	20mA at 125Vdc	Type N safety
Delayed relay board 24680509B (Specification as 24680504C)			
Delay range	0 to 25s ±1s		
Opto-coupled board	24680505A		
Solid state relays:	Four independent outputs		
Rating:	30V dc 1A		
Max. voltage drop:	1.1V @ 1A		
Max. leakage current:	1mA @ 30Vdc		
Power supplies			
Power supply (ac)	94V to 130V or 187V to 256V, 48Hz to 65 Hz, 60 VA maximum		
Power supply (dc)	20V to 40V negative ground or isolated		
General			
Operating temp:	-4°F to 158°F (-20°C to +70°C)		
Relative humidity:	up to 100%		
Enclosure:	Stainless steel wall mounting (four point) NEMA4X (IP65)		
	16.73" x 12.8" x 7.28" deep (425mm high x 325mm wide x 185mm)		
Weight	26.4lb (12 kg)		
Approvals			
LVD:	EN 61010-1		
ATEX:	II3 G EEx nA IIC T4 (-20°C < ta < +70°C)		
CSA:	(Canada) Ex nA [nL] nL IIC T4		
	(USA) Cl. 1 Zn. 2 AEx nA IIC with relay output connected only to energy limited circuits		
EMC:	EN 61326		
PED:	Safety accessory		

Hydrastep & Hydratect

Remote displays	
Indication:	Red/Green bar graph, 32 LED segments
Power supply:	From 2468 unit (1 display only)
Local power for additional displays:	20V to 54V dc, 240mA
2468 3B	
Case style:	Panel mounted
Dimensions:	5.67" x 2.38" x 7.87"deep (144mm x 72 mm x 200mm)
Panel cutout:	5.41" x 2.60" (137.5mm x 66mm)
2468 3C	
Case style:	Panel mounted
Dimensions:	7.56" x 3.78" x 8.23"deep (192mm x 96mm x 209mm)
Panel cutout:	7.32" x 3.62" (186mm x 92mm)
2468 3D	
Case style:	Rugged enclosure, NEMA 4X (IP65)
Dimensions:	11.89" x 7.32" x 6.89"deep (302mm x 186mm x 175mm)

Water columns

Parameter	**LP Rectangular section**	**HP Series 3**	**HP Super 3**
Design pressure	1740 psi (120 bar)	3045 psi (210 bar)	4350 psi (300 bar)
Test pressure	2610 psi (180 bar)	4567 psi (315 bar)	6525 psi (450 bar)
Design temperature	650°F (343°C)	698°F (370°C)	1040°F (560°C)
Design code	ASME B31.1	ASME B31.1	ASME B31.1
Protective covers	18 SWG Stainless steel (17 AWG Stainless steel)	18 SWG St. St (17 AWG St. St)	18 SWG St. St (17 AWG St. St)
Gross weight*	26.5lb (12kg)	37.5lb (17kg)	37.5lb (17kg)
Electrode types	459600602 or 459600802	2467 81Z or 2467 82A or 2467 84A	2467 85A

* Typical (610mm (24") steam/water range, 12 port, with electrodes and covers.

High pressure water level columns

Low pressure water level columns

2462 Hydratect steam / water detection system					
Electrode channels	Two				
Water/steam threshold	0.6µS/cm (normal) or 1.6µS/cm (alternate) depending on water purity				
Electrode cable length	10ft (3m), 33ft (10m), 60ft (18m), 98ft (30m)				
Fault indication	Electrode connection open circuit Short circuit to ground				
Indicators	One Red LED for indication of steam One Green LED for indication of water One Amber LED for indication of fault				
Status relay output (one per channel)					
Modes:	Water normal:	Energized in water			
	Steam normal:	Energized in steam			
Contacts	Separate normally open and normally closed Changeover relays are also available (2462E)				
Relay contact rating	ac	dc	Changeover:	ac	dc
Maximum voltage	250V	125V		250V	225V
Maximum current	8A	8A		8A	0.25A
Max. switching power *(resistive load)*	1500VA	240W(<30V) 65W (<60V) 25W (<125V)			
Opto-coupled:					
Output rating “off”	30V dc max, leakage <1mA				
Output rating “on”	1A dc, voltage <1.1V @ 1A				
Fault relay output (one per channel):	Energized during normal operation (fail-safe) *Specification as status relay above*				
Power supply (ac)	94V to 130V or 187V to 256V 48Hz to 65Hz 2 x 10VA maximum				
Power supply (dc)	20V to 60V				
Operating temperature	-4°F to 158°F (-20°C to +70°C)				
Relative humidity:	up to 100%				
Enclosure:	7.48" x 7.48" x 3.54"deep (190mm x 190mm x 90mm) Stainless steel grade 304 wall mounting (two point). Finish - natural				
Rating:	NEMA4X (IP65)				

Manifolds
Available with 1 to 4 electrode ports.
Various materials depending on required pressure and temperature rating.
Design sheets available on request.

Hydrastep & Hydratect

Electrodes for Hydrastep and Hydratect
A selection of electrode types are available for pressures up to 4350 psi (300 bar) at 1040°F (560°C). Electrodes are available in two basic body styles. The low pressure type, up to 1740 psi (120 bar) has a threaded style fitting: The high pressure type, up to 4350 psi (300 bar) uses a union fitting.

Low pressure up to 1740 psi (120 bar)
Choice of PTFE or ceramic insulator
Threaded style fitting
Metaflex gasket seal

High pressure up to 4350 psi (300 bar)
Choice of insulators
Union style fitting
Metal to metal to seal

Electrode Cables
At drum level, steam generating plant has ambient conditions which are hot and humid and in coal and oil fired plants there are often sulphurous fumes present. This environment adversely affects crimped copper cables, with the formation of copper sulphate. In addition, the temperature at the screw connection to the electrode can exceed the maximum operating temperature of PVC insulation used on copper cables.

To overcome these problems, pure nickel conductors with PTFE insulation can be used. However, PTFE insulated cable is expensive and is only required in the immediate vicinity of the drum. The cables supplied with the Hydrastep system have a 6.6" (2m) tail of PTFE covered nickel cable joined to the required length of PVC covered copper. The junction between the two cables is by 'High Performance Environment Resistant Sealed Crimp Splice', to meet the requirements of MIL-S-81824, providing a join of the highest possible integrity. (More information, with detailed specification, is available on request).

In applications where a junction box is preferred, this can be supplied with the appropriate cables.

Part No.	Style	Material	Max pressure PSI (Bar)	Max temp. °F (°C)	ph range
459600802	Threaded L.P col	PTFE	725 (50)	500 (260)	7 to 13.5
459600602	Threaded L.P col	Zirconia	1740 (120)	698 (370)	7 to 11
2476 82A	Union H.P col	PTFE	725 (50)	500 (260)	7 to 13.5
2467 84A	Union H.P col	Ceramic PTFE coated	4350 (300)	500 (260)	7 to 13.5
2467 81Z	Union H.P col	Zirconia	3045 (210)	698 (370)	7 to 11
2467 85A	Union Hydratect insert	ZTA	4350 (300)	1040 (560)	7 to 11
2467 85Z	Union Hydratect insert	Zirconia	4350 (300)	698 (370)	7 to 11
2467 85P	Union Hydratect insert	PTFE	725 (50)	500 (260)	7 to 13.5

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