AUTOFLAME®
Combustion Management Systems

www.fiammac.com
گروه مهندسی فیاماک
نماینده انحصاری شرکت اتوفلیم
در ایران

AUTOFLAME
TOP BLOWDOWN CONTROL
GUIDE

Fiammac

19 MAY 2020

1. TOP BLOWDOWN

1.1 Overview

1.1.1 Importance of Maintaining TDS

To manage a steam boiler for optimum efficiency and reliability, an important requirement is to ensure that the Total Dissolved Solids (TDS) in the water are measured and controlled to the right level for that boiler. Itis generally accepted that for water tube boilers the level of TDS measured should not exceed 1,500 PPM by volume and for fire tube boilers the TDS should not be higher than 2,500 PPM by volume. The figures stated are not definitive and in all applications the recommendations of the boiler manufacturer or water treatment chemist should be implemented.

It has been established that the conductivity of water is proportional to the measured TDS as long as the temperature remains constant. Any variations in temperature will affect the measured conductivity by nominally 2% per 1°C. It follows that the temperature of the water must be measured, and the conductivity reading must be adjusted before a TDS reading can be extrapolated from this line of data. The Autoflame system incorporates a temperature measurement sensor in the steam drum to establish the steam temperature, this stream data is used to constantly correct the conductivity value.

A second variable that effects the conductivity measurement is polarization of the water sample, this occurs when electrical energy from the probe builds up a relatively tiny offset above or below the earth (0 Volt value). This polarization value is typically noticeable when a continuous frequency is being emitted from the probe as part of the conductivity measurement method.

The Autoflame system deals with the potential problem of polarization in the following manner: The probe measures any build-up of voltage potential above or below earth or 0V in the water sample. The measured polarization voltage data is used to modify the conductivity calculation. The Autoflame system emits electrical energy at a rate of 10 x 300 microsecond pulses every second. This translates into a method where we are emitting electrical energy for 0.6% of the sample time. All other manufacturers who use the frequency method are emitting electrical energy for 100% of the sample time. It follows that the polarization problem in these cases would be 167 times greater.

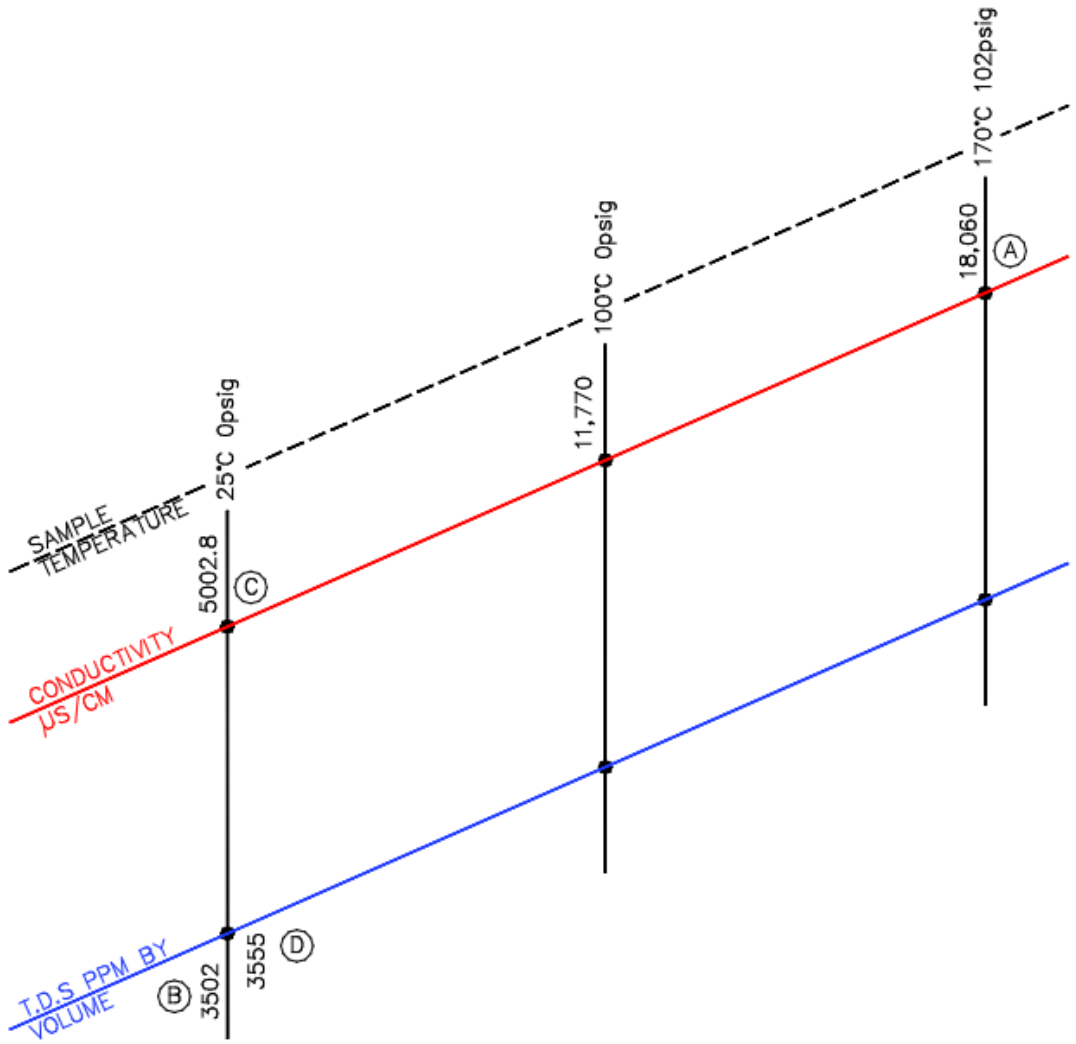
A third problem that affects the accuracy of the TDS measurement is the build-up of scale on the probe electrode. By design the water sampling container has been arranged so that the turbulence created during the blow down sequence will ensure that the probe remains effectively free of scale or deposited solids that could be held in suspension. The probe is self-cleaning.

The sampling container has a known orifice size. From this it is possible to calculate the percentage losses due to surface blowdown. This is possible because the following parameters are known which include hole size, temperature, pressure, pressure drop across the solenoid and the time that the solenoid is open for.

It can be seen from the above that the Autoflame TDS system deals succinctly with three of the main problem areas that are encountered when designing an accurate TDS control solution.

1.1.2 TDS, Conductivity and Temperature

A = These values measured by probe & sensors at steady state operating conditions.
B = This value is the conductivity value multiplied by 0.7 (TDS in PPM).
C = This conductivity value is temperature corrected to 25°C / 77°F.
D = This is measured TDS value entered into the system to affect a user “calibration”.



I. Conductivity measurement corrected at 2% per 1°C.
II. At 25°C TDS in ppm is calculated by multiplying the conductivity value by 0.7 factor.
III. Both above multipliers are user variable to accommodate specific site conditions.

At the time of manufacture, every TDS probe has a “Calibration Correction Coefficient” or CCC embedded into its internal memory. The TDS probe is immersed in a water sample with a known TDS (3500ppm for example) at 25°C (77°F) which would give a reading of 5000 micro-siemens. If the reading from the probe does not agree with this general CCC value, a correction multiplier or divider is entered into this specific probe’s memory. This is its own dedicated CCC value.

1.2 TDS Valves

The valves used for Bottom Blowdown, Feed Water and TDS are universal. See the table below for the valve sizes and servomotor required for each valve. The servomotors are 24VDC version.

Valve Type	Size	Part #	Servomotor Size
Threaded BSP/ NPT	15mm (½")	WLCVO15	Large 25Nm
	20mm (¾")	WLCVO20	Large 25Nm

Maximum operating pressure: 29 Bar (425 PSI)
Maximum operating temperature: 235°C (455°F)

Please check the Autoflame Valves & Servomotors guide for the full details on the bottom blowdown valve and servomotors including dimensions, drawings and information on service and maintenance.

Figure 1.2.i TDS Valve installation example

The table below shows the available TDS probe and valve assembly part numbers.

Type	Part Number	Parts Supplied
TDS management, on/off control 230V	TDS70001	TDS probe, 230V solenoid valve,
TDS management, on/off control 110V	TDS70001/110	TDS probe, 110V solenoid valve,
TDS management, modulating 230V, ½"	TDS70001/M15	TDS probe, ½" valve, 230V large servomotor
TDS management, modulating 230V, ¾"	TDS70001/M20	TDS probe, ¾" valve, 230V large servomotor
TDS management, modulating 24V, ½"	TDS70001/M15/D	TDS probe, ½" valve, 24V large servomotor
TDS management, modulating 24V, ¾"	TDS70001/M20/D	TDS probe, ¾" valve, 24V large servomotor
TDS solenoid valve 230V	TDS70002	230V solenoid valve
TDS solenoid valve 110V	TDS70002/110	110V solenoid valve
TDS probe	TDS70003	TDS probe

1.3 TDS Probe

1.3.1 Specification

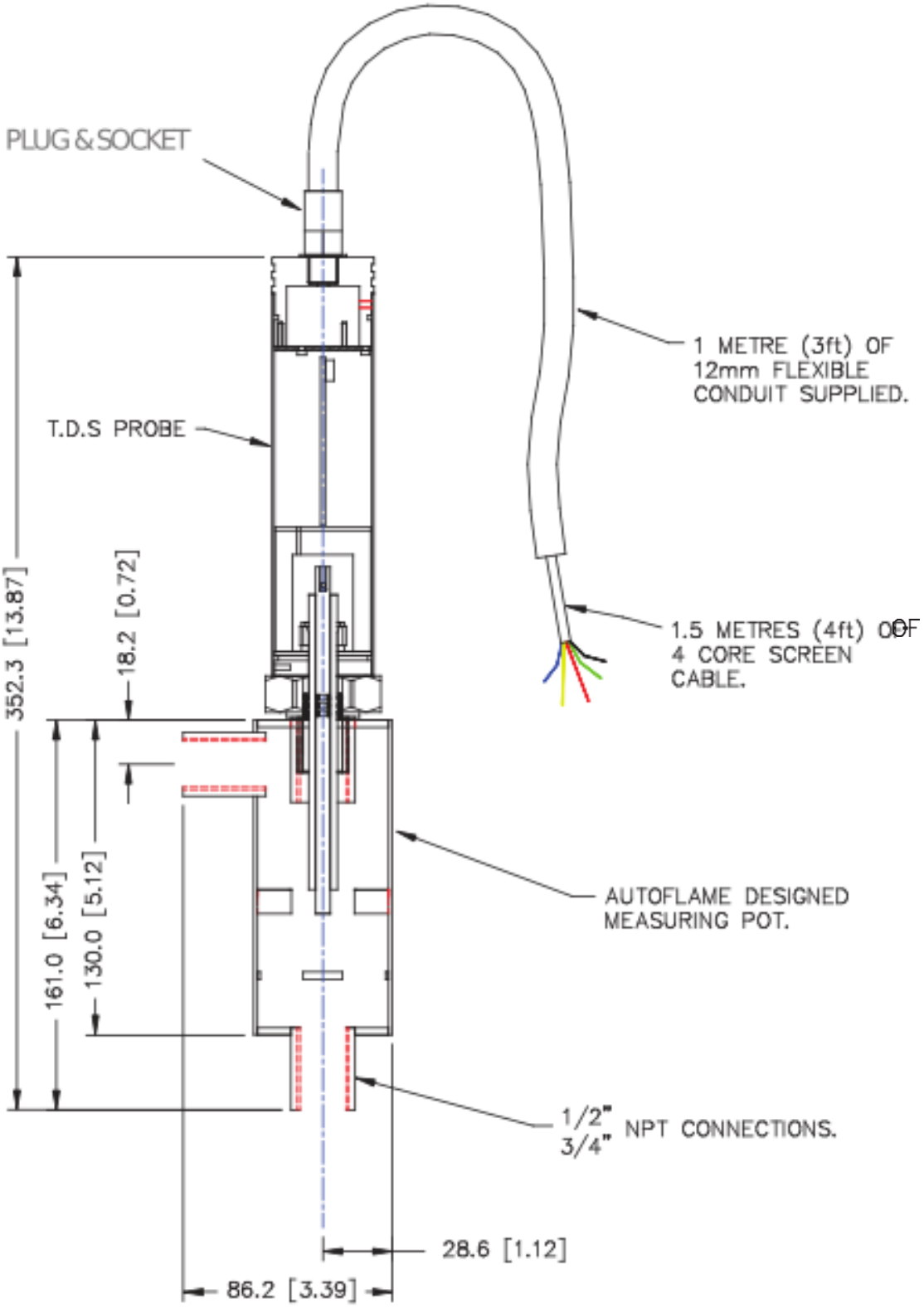
Figure 1.3.1.i TDS Probe

The TDS probe part number: TDS70003

- Timed pulsed top blowdown or continuous top blowdown operation selectable on the Mk8 MM.
- Self-cleaning design. Turbulence created during the blowdown sequence ensures that the probe remains effectively free of scale or deposited solids that could be held in suspension.
- Stainless steel housing.
- PTFE coated.

Specifications	Metric	Imperial
Supplied flying lead length	2	6ft
Probe connection (quick connect)	½" BSP Parallel Tread	
External temperature rating	0 - 70°C	32 - 158°F
Ingress Protection	IP68	NEMA 6P
Nominal Size of Line	15mm	½"
Maximum Allowable Pressure (with modulating valve)	16 Bar	392 PSI
Maximum Allowable Pressure (with solenoid valve)	10 Bar	145 PSI
Maximum Allowable Temperature	200°C	392°F
Test Pressure	40 Bar	580 PSI

1.3.2 Dimensions



1.3.3 Installation

The diagram below shows the installation method for the TDS probe incorporating Autoflame's sampling system, (all dotted components are to be supplied by the customer).

Note: There must be a minimum of 3ft (0.9m) straight pipe installed from the valve, of the same diameter as the actual valve.

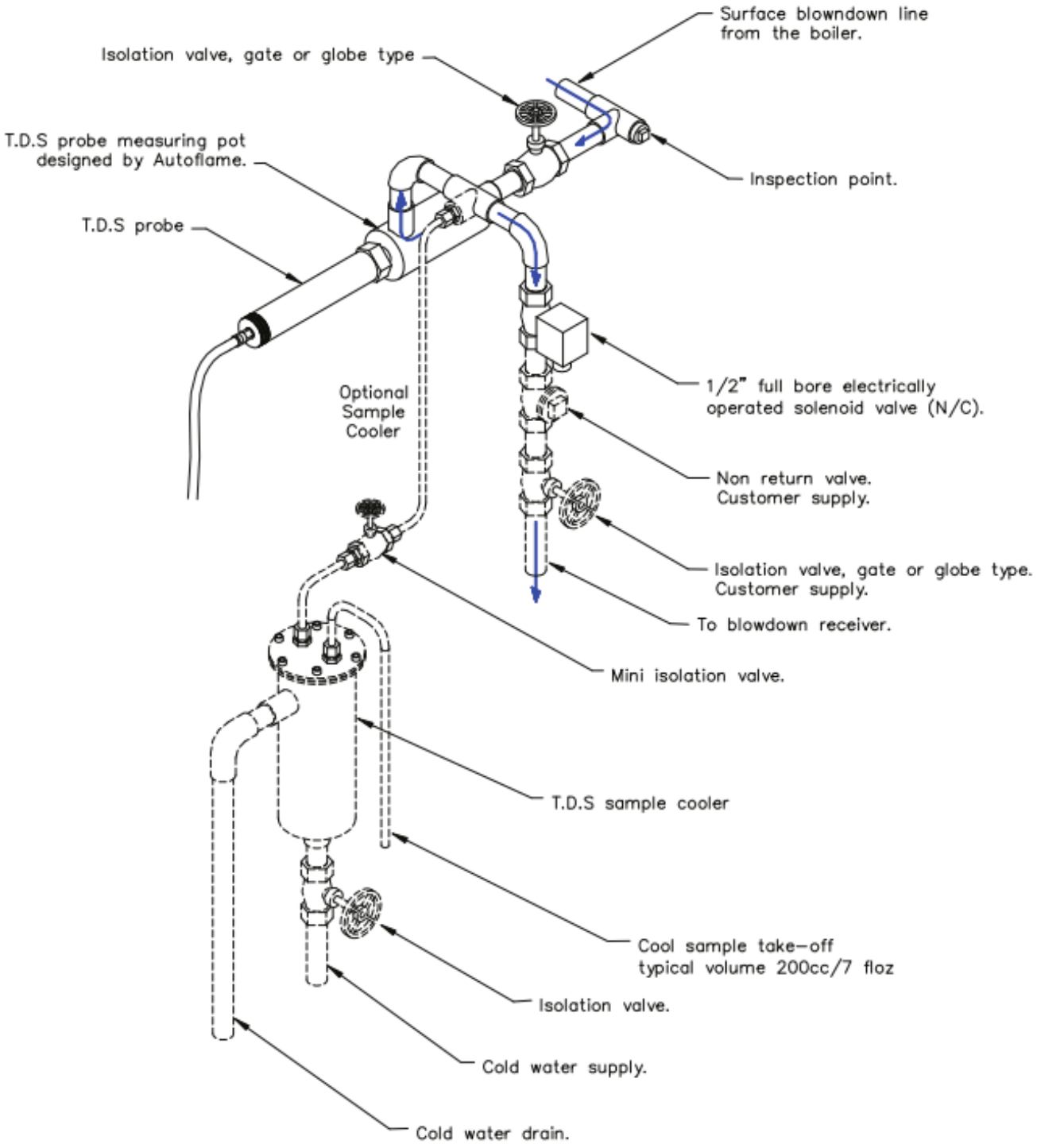


Figure 1.3.3.i TDS Probe Installation

1.4 Ways of Controlling TDS Level

1.4.1 Continuous TDS Control

1. The first stage of the TDS control cycle is the sample time where the valve is fully opened to take a fresh sample for a time period set in expansion option 48.

2. After a fresh sample has been taken and the sample time elapsed, the second stage is the settle time. In the settle time, the valve fully closes to let the sample settle, for a time period set in expansion option 49.

3. Once the settle time is over, the valve will remain closed for another time period called measurement time, set in expansion option 50. The TDS probe will measure this sample and this is the reading in the TDS control.

4. If the measured value is less than the target value set in expansion option 42 minus 100ppm, the valve will not blowdown, and remain fully closed for the blowdown. For example, if the target TDS value was set as 2200pppm, the measured value was 2099ppm or less the valve would not blowdown. At the end of the blowdown time, the cycle will repeat and the TDS control will progress to the sample time.

5. If after the settle time the measured value is above the TDS target value minus 100ppm, the valve will drive open to a position determined by the PI loop to blowdown the valve and try to maintain the TDS target value. For example, if the target value was set to 2200ppm, the measured value would need to be 2100ppm or more for the valve to blowdown. At the end of the blowdown time set in expansion option 51, the valve will go to fully open for the sample time, to repeat the TDS control loop.

1.4.2 Solenoid and Servomotor 2-State TDS Control

1. The first stage of the TDS control cycle is the sample time where the valve is fully opened to take a fresh sample for a time period set in expansion option 48.

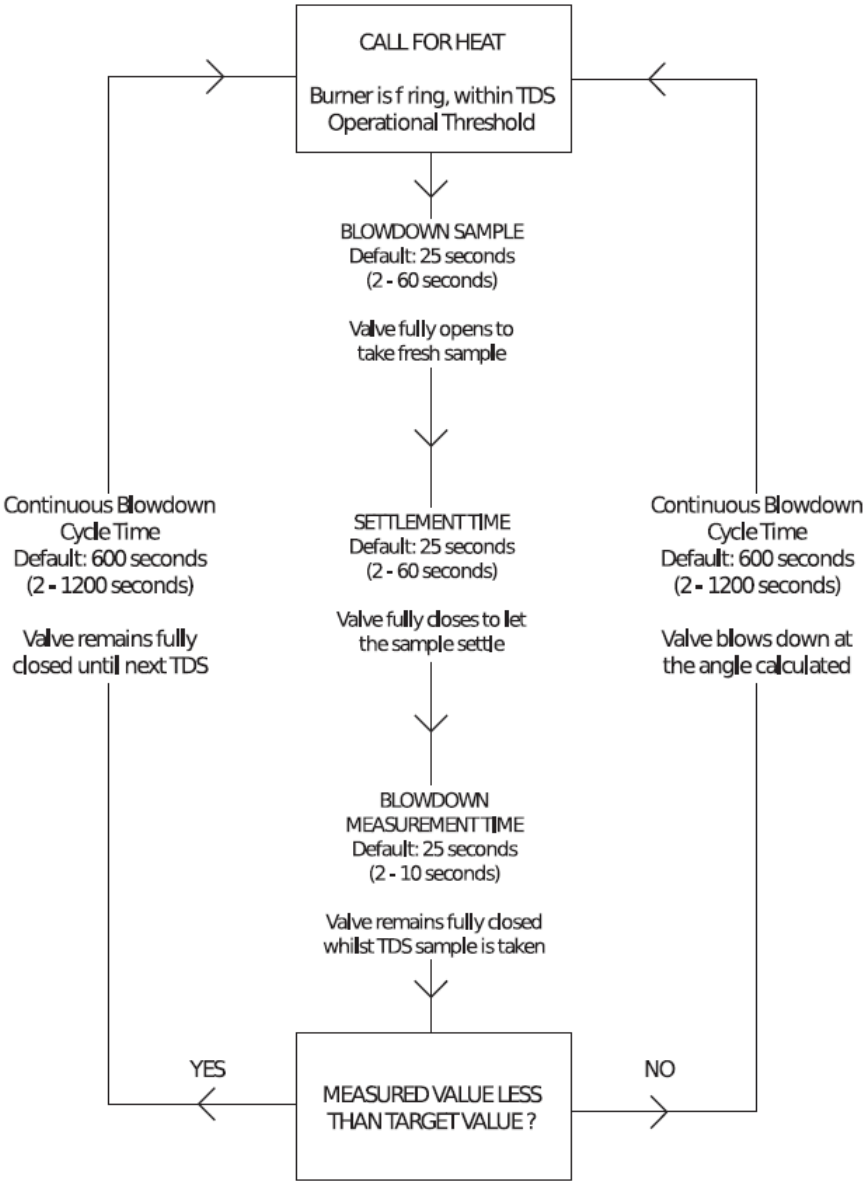
2. After a fresh sample has been taken and the sample time elapsed, the second stage is the settle time. In the settle time, the valve fully closes to let the sample settle, for a time period set in expansion option 49.

3. Once the settle time is over, the valve will remain closed for another time period called measurement time, set in expansion option 50. The TDS probe will measure this sample and this is the reading in the TDS control.

4. If the measured value is less than the target value set in expansion option 42 minus 100ppm, the valve will not blowdown, and remain fully closed for the blowdown. For example, if the target TDS value was set as 2200pppm, the measured value was 2099ppm or less the valve would not blowdown. At the end of the blowdown time, the cycle will repeat and the TDS control will progress to the sample time.

5. If after the settle time the measured value is above the TDS target value minus 100ppm, the valve will remain fully open for part of the blowdown time; this fully open interval is determined by the P element, and then the valve will go to fully closed for the remainder of the blowdown time. For example, if the target value was set to 2200ppm, the measured value would need to be 2100ppm or more for the valve to blowdown. At the end of the blowdown time, the valve will go to fully open for the sample time, to repeat the TDS control loop.

1.4.3 TDS Timing Diagram

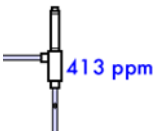


For continuous TDS control the valve blows down at an angle calculated by the PI loop. For solenoid or servomotor 2-state TDS control the P band determines how long the valve remains open before closing during the blowdown time.

1.5 Water Hardness Monitoring

Feed Water Hardness can be continually monitored using Water Hardness Monitoring feature, to enable this feature, Expansion Option 40 must be set to 4 – Water Hardness Monitoring. When this option is selected, the TDS probe will continually measure the feedwater hardness and will output live readings on the home MM screen.

The use of a TDS probe is required with a TDS probe pot, this is mounted directly into the feedwater flow to allow the TDS probe to measure the hardness level in the feed water.

To enter the Water Hardness information screen, press on the TDS probe 

on the home MM screen, this displays information about the current water hardness reading as well as a graph which records the water hardness history for the past 24 hours.

A water hardness warning level can be set in Expansion Option 46 so that an MM alarm will be triggered if this threshold is reached. An alarm level can also be set in Expansion Option 56, this information will also be displayed in the water hardness screen.

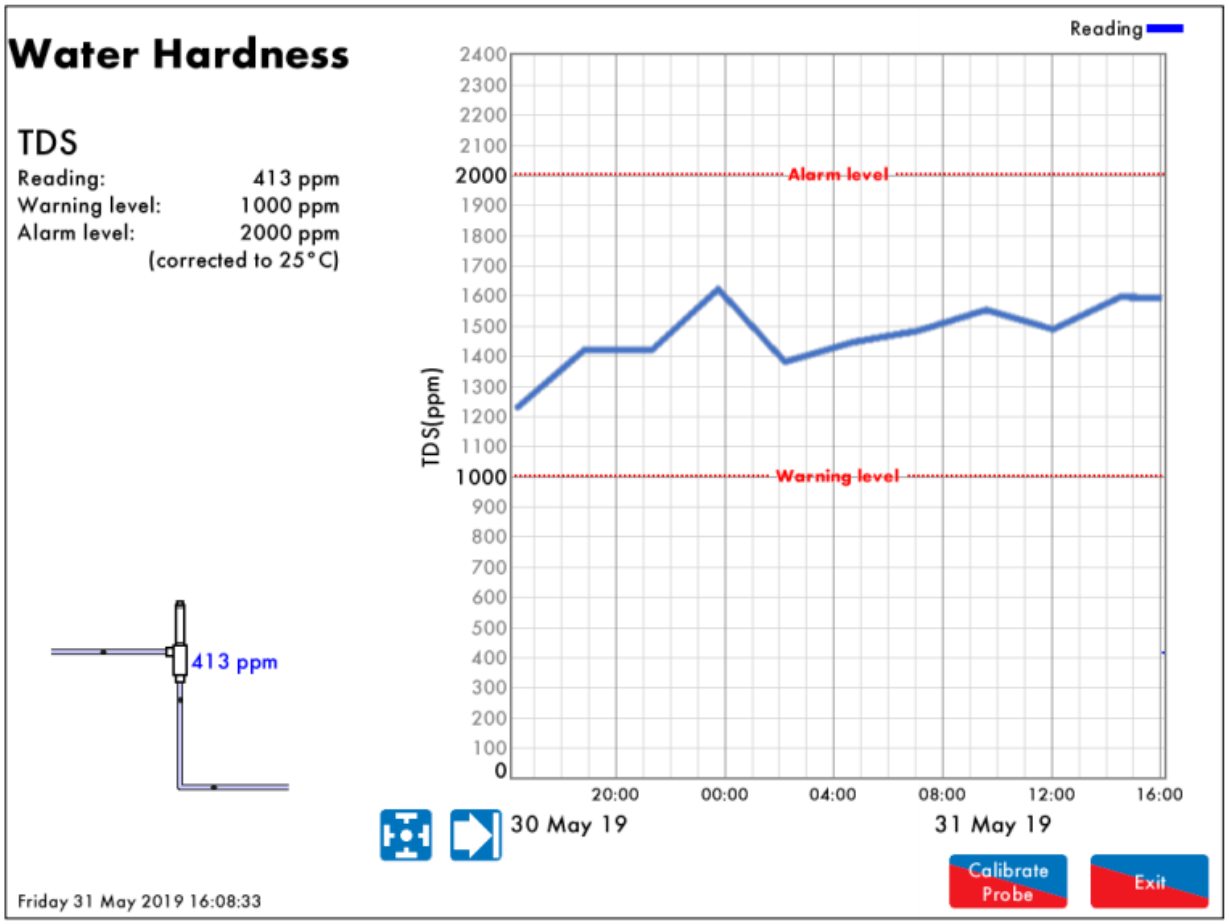


Figure 1.5 – Water Hardness Monitoring Screen

1.6 Related Item Part Numbers

Item No.	Mk8 MM Unlockable Software Features	Kgs	Part No
1	Top Blowdown		MK8003
	Total Dissolved Solids Equipment		
2	TDS Management, On/Off Control 230V *Supplied with complete assembly, including probe and solenoid valve*	3.00	TDS70001
3	TDS Management, On/Off Control 110V *Supplied with complete assembly, including probe and solenoid valve*	3.00	TDS70001/110
4	TDS Management, Modulating, 230V, 1/2" *Supplied with complete assembly, including probe, 1/2" modulating valve, 230V servomotor*	3.00	TDS70001/M15
5	TDS Management, Modulating, 230V, 3/4" *Supplied with complete assembly, including probe, 3/4" modulating valve, 230V servomotor*	3.00	TDS70001/M20
6	TDS Management, Modulating, 24V, 1/2" *Supplied with complete assembly, including probe, 1/2" modulating valve, 24V servomotor*	3.00	TDS70001/M15/D
7	TDS Management, Modulating, 24V, 3/4" *Supplied with complete assembly, including probe, 3/4" modulating valve, 24V servomotor*	3.00	TDS70001/M20/D
8	TDS Management, Modulating, 110V, 1/2" *Supplied with complete assembly, including probe, 1/2" modulating valve, 110V servomotor*	3.00	TDS70001/M15/A
9	TDS Management, Modulating, 110V, 3/4" *Supplied with complete assembly, including probe, 3/4" modulating valve, 110V servomotor*	3.00	TDS70001/M20/A
10	TDS Solenoid Valve only, 230V *230V solenoid*	1.00	TDS70002
11	TDS Solenoid Valve only, 110V *110V solenoid*	1.00	TDS70002/110
12	TDS Probe only (Includes Flying Lead)	2.00	TDS70003

AUTOFLAME
TOP BLOWDOWN CONTROL GUIDE
19 MAY 2020

Fiammac Group (Engineering & Procurement)

Tel: +98 913 007 4090 (Technical consultation)
+98 913 007 5090 (Commercial, Sales)
+98 913 007 8050 (Service, Installation)
+98 912 007 6045 (Supervisor)

Email: info@fiammac.com
Supporting Email: G.fiammac@gmail.com
Website: www.fiammac.com

AUTOFLAME®
Combustion Management Systems