

**AUTOFLAME**<sup>®</sup>

Combustion Management Systems

[www.fiammac.com](http://www.fiammac.com)

گروه مهندسی فیاماک  
نماینده انحصاری شرکت اتوفلیم  
در ایران



# AUTOFLAME FEED WATER CONTROL GUIDE

**Fiammac**

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## 1 Autoflame Water Level Control

Autoflame Water Level control in the Mk8 MM focuses on safety and accuracy in controlling the water level in a steam boiler. The intelligent water level control includes high water alarms, 1<sup>st</sup> low and 2<sup>nd</sup> low alarms. Alarm level reporting deals with the ability to determine whether the current water level in the boiler is above or below a pre-determined level. These levels vary with each installation and must therefore be programmed on site by a qualified commissioning engineer.

The feedwater flow is managed by 3-element control, in response to the water level measured by the level sensing devices' readings, boiler pressure and the burner's firing rate. The flow is controlled by a fully modulating feedwater/VSD or by using an on/off signal from a feedwater pump. The feedwater going into the boiler can be controlled in the following ways by setting expansion option 2:

- Pump on/off only.
- Pump on/off and servomotor control.
- Pump on/off and VSD control.
- Pump on/off, servomotor and VSD control.

The Autoflame 3-element level control has been granted a worldwide patent; being the only system that can combine firing rate, steam pressure and water level within one controller for the purpose of improving feedwater control. Safety, accuracy and integrity are guaranteed.

The levels which are commissioned when using capacitance probes and/or external level sensing 4-20mA device include high, control point, 1<sup>st</sup> low, 2<sup>nd</sup> low and end of probe.

The level of the water in the boiler should be maintained appropriate to the amount of steam being generated. Should the water level drop below this ideal level by an excessive amount, it is necessary to stop the burner firing. If there is insufficient water in the boiler, damage may occur to its structure, and in extreme cases, an explosion. The water level control herein is designed to maintain a satisfactory level of water in the boiler, whilst controlling and reporting low water level conditions.

Traditional feed water control manages water level in the boiler, steam flow and feed water flow separately, whereas the Autoflame feed water control coordinates the water level, firing rate and steam pressure simultaneously.

## 1.1 Water Valves

### 1.1.1 Specifications

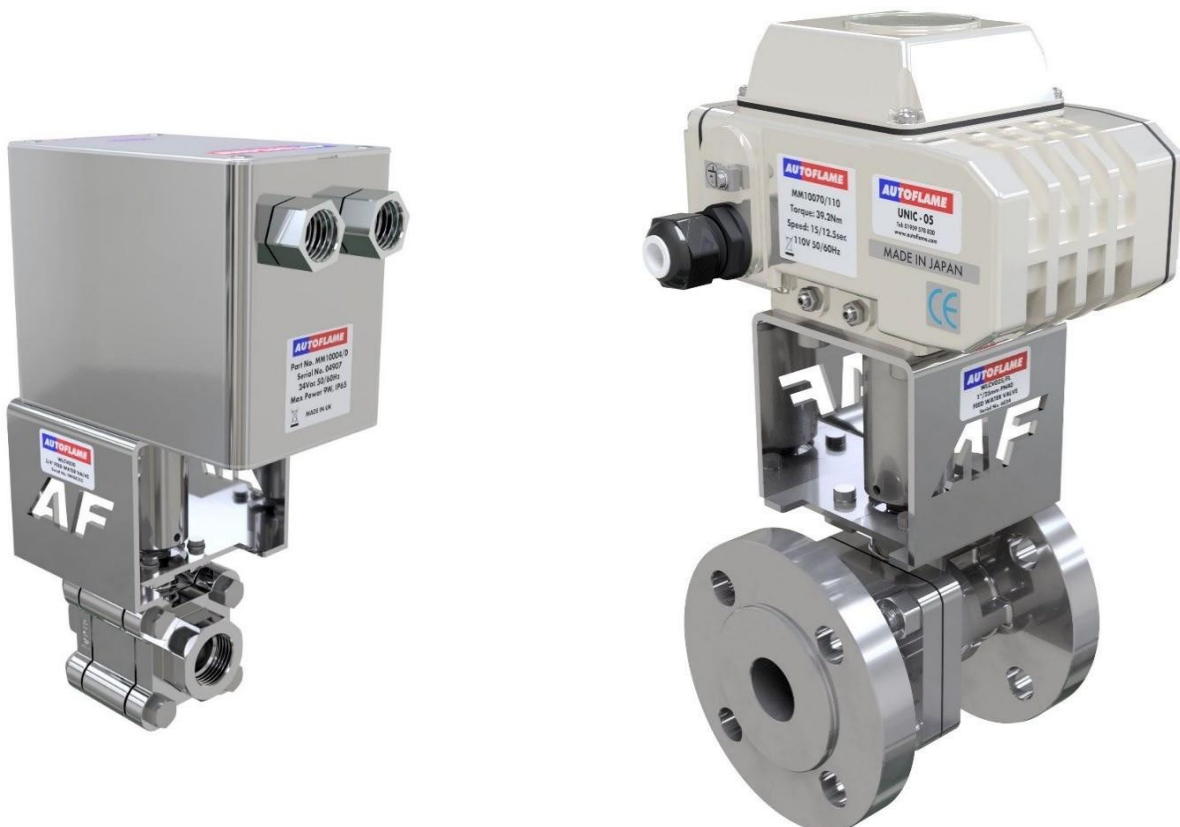
Water valves are universal for feed water, TDS, and bottom blowdown function. The table below lists the feedwater valves and the required servomotor size for each valve.

Valve Type	Size	Part No.	Servomotor Required		
			Large	UNIC05	UNIC10
Threaded BSP/ NPT	15mm (1/2")	WLCVO15	•		
	20mm (3/4")	WLCVO20	•		
	25mm (1")	WLCVO25/FL		•	
Flanged PN40	40mm (1 1/2")	WLCVO40/FL			•
	50mm (2")	WLCVO50/FL			•
	25mm (1")	WLCVO25/FLU		•	
Flanged ANSI 300lb	40mm (1 1/2")	WLCVO40/FLU			•
	50mm (2")	WLCVO50/FLU			•

Maximum operating pressure: 29 Bar (425 PSI)

Maximum operating temperature: 235°C (455°F)

**Note:** Autoflame water level probes are rated at maximum 16 Bar (232 PSI) and 200°C (392°F).



**Note:** Please check Autoflame Valves and Servomotors Guide for water level valves dimensions, specifications, drawings and information on service and maintenance.

## 1.2 Feed Water Valve Sizing

Feed water valves are available as threaded or flanged. Use the water velocity, pressure drop across the valve, water flow rate and steam flow rate to find the correct valve size.

Autoflame Part No. WLCV015 - ½" feed water valve water flow calculations @20°C								
Water Velocity		Pressure Drop Across Valve		Water Flow Rate			Steam Flow Rate	
Ft/sec	M/sec	ΔP PSI	ΔP Bar	G/hr (imp)	G/M (imp)	G/M (US)	lbs/hr	Kg/hr
6	1.82	1	0.07	160	2.6	3.2	1600	727
9	2.74	2	0.14	235	3.9	4.7	2350	1068
15	4.57	5	0.34	380	6.3	7.6	3800	1727
21	6.40	10	0.68	560	9.3	11.2	5600	2545
26	7.90	15	1.03	700	11.6	14	7000	3182
32	9.73	20	1.38	820	13.6	16.4	8200	3727

Autoflame Part No. WLCV020 - ¾" feed water valve water flow calculations @20°C								
Water Velocity		Pressure Drop Across Valve		Water Flow Rate			Steam Flow Rate	
Ft/sec	M/sec	ΔP PSI	ΔP Bar	G/hr (imp)	GPM (imp)	US GPM	lbs/hr	Kg/hr
8	2.43	1	0.07	460	7.7	9.2	4600	2090
12	3.65	2	0.14	665	11	13.3	6650	3022
19	5.79	5	0.34	1100	18.3	22	11000	5000
28	8.53	10	0.68	1630	27.1	32.63	16300	7409
34	10.34	15	1.03	2000	33.3	40	20000	9090
40	12.16	20	1.38	2400	40	48	24000	10909

Autoflame Part No. WLCV025 - 1" feed water valve water flow calculations @20°C								
Water Velocity		Pressure Drop Across Valve		Water Flow Rate			Steam Flow Rate	
Ft/sec	M/sec	ΔP PSI	ΔP Bar	G/hr (imp)	GPM (imp)	US GPM	lbs/hr	Kg/hr
13	3.96	1	0.07	1560	26	31.2	15600	7091
21	6.4	2	0.14	2300	38.3	46	23003	10456
32	9.75	5	0.34	3800	63.3	76	38005	17275
46	14.02	10	0.68	5600	93.9	112	56007	25458
60	18.24	15	1.03	7000	116.6	140	70008	31822
70	21.28	20	1.38	8200	136.6	164	82011	37278

Autoflame Part No. WLCV040 – 1 ½" feed water valve water flow calculations @20°C								
Water Velocity		Pressure Drop Across Valve		Water Flow Rate			Steam Flow Rate	
Ft/sec	M/sec	ΔP PSI	ΔP Bar	G/hr (imp)	GPM (imp)	US GPM	lbs/hr	Kg/hr
17	5.17	1	0.07	4700	78.3	94	47005	21366
25	7.60	2	0.14	6700	11.6	134	67007	30458
39	11.86	5	0.34	11200	186.6	224	112015	50916
60	18.24	10	0.68	16500	275	330	165022	75010
75	22.80	15	1.03	20000	333.3	400	200028	90922
90	27.36	20	1.38	24000	400	480	240033	109126

Autoflame Part No. WLCV050 - 2" feed water valve water flow calculations @20°C								
Water Velocity		Pressure Drop Across Valve		Water Flow Rate			Steam Flow Rate	
Ft/sec	M/sec	ΔP PSI	ΔP Bar	G/hr (imp)	GPM (imp)	US GPM	lbs/hr	Kg/hr
21	6.38	1	0.07	10000	166.6	200	100014	45461
31	9.42	2	0.14	15000	250	300	150020	68191
46	13.99	5	0.34	24000	400	480	240033	109106
72	21.89	10	0.68	36000	600	720	360049	163659
85	25.84	15	1.03	44000	733	880	440061	200028
110	33.44	20	1.38	51000	850	1021	510072	231851

### 1.3 Feed Water Control

The boiler feed water can be controlled using:

- Pump on/off only
- Pump on/off and servomotor control
- Pump on/off and VSD control
- Pump on/off, servomotor control and VSD output

The table below shows the terminals on the MM allocated for the feed water control parts.

Terminal	Description
P-	0V supply to top blowdown and feed water servomotors
P+	+12V supply to top blowdown and feed water servomotors
TW	Signal from feed water servomotor, indicating position
I+	Current output, 0-20mA or 4-20mA to feed water VSD or servomotor
V+	Voltage output, 0-10V or 2-10V to feed water VSD or servomotor
IV	Common terminals for I+ and V+
BFW	Feed water pump contactor

The table below shows the expansion options relating to feed water control.

Expansion Option	Description
2	Feed water control element
10	Pump turn off point
11	Pump turn off percentage
12	Pump turn on percentage
13	Feed water control proportional band
14	Feed water control integral time
15	Feed water control derivative time
16	Feed water servo open angle
20	Burner operation on feed water control fault



The feed water pump can be set so that it turns off and on at percentages above and below the controlpoint/high water, via the feed water pump contactor on terminal BFW.

If the feed water control is set with servomotor or VSD, then the 3-term PID control will operate. The proportional band set in expansion option 13 is the percentage between the control point and 1<sup>st</sup> low level where corrections are made to the servomotor/VSD to maintain the control point; outside of the p-band, the servomotor/VSD will remain fully open. The integral time set in expansion option 14 will set how fast the system responds to feed water changes; for a slower response increase time, and vice versa for a faster response. The derivative time set in expansion option 165 is used when a quick response is required but where overshoot is undesired; the water level should not rise too high above the control point, so the derivative element will need to be enabled.

The feed water servomotor closed position is set by zeroing the potentiometer in Commissioning mode, however the open position is set in expansion option 16.

## 1.4 Related Item Part Numbers

Item No.	Water Control Valves Suitable for Feed Water, Bottom Blow Down & TDS Applications	Kgs	Part No
1	Threaded Feed Water Valve BSP/NPT (0.5"/15mm) <i>0.5" Feed water valve with bracket &amp; coupling</i>	4.00	WLCV015
2	Threaded Feed Water Valve BSP/NPT (0.75"/20mm) <i>0.75" Feed water valve with bracket &amp; coupling</i>	5.00	WLCV020
3	Flanged Feed Water Valve PN40 (1"/25mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	7.00	WLCV025/FL
4	Flanged Feed Water Valve PN40 (1.5"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	8.00	WLCV040/FL
5	Flanged Feed Water Valve PN40 (2"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	9.00	WLCV050/FL
6	Flanged Feed Water Valve ANSI 300lb (1"/25mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	7.00	WLCV025/FLU
7	Flanged Feed Water Valve ANSI 300lb (1.5"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	8.00	WLCV040/FLU
8	Flanged Feed Water Valve ANSI 300lb (2"/50mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	9.00	WLCV050/FLU
Complete with Coupling and Mounting Assembly. Valves listed are not supplied with servomotors. For the 0.5" and 0.75" valves, large servomotors must be used. For 1" valves a UNIC05 servomotors must be used and for 1.5" & 2" valve a UNIC10 must be used.			
<b>Water Level Spares</b>			
11	0.5" Feedwater Valve Repair Kit <i>Replacement parts for New Style feedwater valve fitted with Tekfil Seats. Excludes Mounting Bracket</i>	0.00	WLCV015/KIT
12	0.75" Feedwater Valve Repair Kit <i>Replacement parts for New Style feedwater valve fitted with Tekfil Seats. Excludes Mounting Bracket</i>	1.00	WLCV020/KIT
13	1" Feedwater Valve Repair Kit <i>Replacement parts for New Style feedwater valve fitted with Tekfil Seats. Excludes Mounting Bracket</i>	0.00	WLCV025/KIT
14	1.5" Feedwater Valve Repair Kit <i>Replacement parts for New Style feedwater valve fitted with Tekfil Seats. Excludes Mounting Bracket</i>	1.00	WLCV040/KIT
15	2" Feedwater Valve Repair Kit <i>Replacement parts for New Style feedwater valve fitted with Tekfil Seats. Excludes Mounting Bracket</i>	2.00	WLCV050/KIT
16	Water Level Probes Flying Leads <i>Replacement Flying Leads for Water Level Probes, Length 2m (6ft)</i>	0.05	AUTO/0005
17	Water Level Probes Flying Leads <i>Replacement Flying Leads for Water Level Probes, Length 10m (32ft)</i>	0.05	AUTO/0005/10
18	Mounting Bracket & Coupling for 1/2" & 3/4" Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30011
19	Mounting Bracket & Coupling for 1" PN40 Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30012
20	Mounting Bracket & Coupling for 1.5" PN40 Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30013
21	Mounting Bracket & Coupling for 2" PN40 Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30014
23	Mounting Bracket & Coupling for 1" ANSI 300lb Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30012/U
23	Mounting Bracket & Coupling for 1.5" ANSI 300lb Feed Water Valve <i>includes fixing screws &amp; washers</i>	0.00	SP30013/U
24	Mounting Bracket & Coupling for 2" Feed Water Valve ANSI 300lb <i>includes fixing screws &amp; washers</i>	0.00	SP30014/U

Item No.	Large Servo Motors	Kgs	Part No
25	Large 4-20mA Servo Motor, 110V/230V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off Metal Glands</i>	1.85	MM14204
26	Large Servo Motor, 230V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10400
27	Large Servo Motor, 230V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 1off PG11 - 1/2" NPSM and 1off Blanking Plug</i>	1.85	MM10400/NPSM
28	Large Servo Motor, 110V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10400/A
29	Large Servo Motor, 24V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 1off PG11 - 1/2" NPSM and 1off Blanking Plug</i>	1.85	MM10400/D
30	Large Servo Motor, 230V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10004
31	Large Servo Motor, 230V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 1off PG11 - 1/2" NPSM and 1off Blanking Plug</i>	1.85	MM10004/NPSM
32	Large Servo Motor, 110V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10004/A
33	Large Servo Motor, 24V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 1off PG11 - 1/2" NPSM and 1off Blanking Plug</i>	1.85	MM10004/D
<b>Large Servo Motors with ATEX Approval</b> 			
34	Large Servo Motor, 230V 50/60Hz <i>25Nm, 18ft lbs. Ex nA nL IIC T4</i>	1.85	MM10004/EXP
35	Large Servo Motor, 24V 50/60Hz <i>25Nm, 18ft lbs. Ex nA nL IIC T4</i>	1.85	MM10004/D/EXP
<b>Industrial Unic Servo Motors</b>			
36	Industrial Servo Motor 05, 230V 50/60Hz <i>40Nm, 30ft lbs</i>	4.00	MM10070
37	Industrial Servo Motor 05, 120V 50/60Hz <i>40Nm, 30ft lbs</i>	4.00	MM10070/120
38	Industrial Servo Motor 10, 230V 50/60Hz <i>98Nm, 72ft lbs</i>	6.00	MM10072
39	Industrial Servo Motor 10, 120V 50/60Hz <i>98Nm, 72ft lbs</i>	6.00	MM10072/120
40	Industrial Servo Motor 20, 230V 50/60Hz <i>200Nm, 148ft lbs</i>	6.00	MM10074/B
41	Industrial Servo Motor 20, 110V 50/60Hz * Limited Availability* <i>200Nm, 148ft lbs</i>	6.00	MM10074/B/110
42	Industrial Servo Motor 20, 120V 50/60Hz <i>200Nm, 148ft lbs</i>	7.00	MM10074/B/120
43	Industrial Servo Motor 40, 230V 50/60Hz <i>400Nm, 295ft lbs - to be used with Solid State Relays</i>	8.00	MM10078
44	Industrial Servo Motor 40, 110V 50/60Hz * Limited Availability* <i>400Nm, 295ft lbs - to be used with Solid State Relays</i>	8.00	MM10078/110
45	Industrial Servo Motor 40, 120V 50/60Hz <i>400Nm, 295ft lbs - to be used with Solid State Relays</i>	8.00	MM10078/120
46	Industrial Servo Motor 10, 230V (4-20mA) 50/60Hz <i>98Nm, 72ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	6.00	MM10073
47	Industrial Servo Motor 20, 230V (4-20mA) 50/60Hz <i>200Nm, 148 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	6.00	MM10079
48	Industrial Servo Motor 40, 230V (4-20mA) 50/60Hz <i>400Nm, 295 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	8.00	MM10080
49	Industrial Servo Motor 20, 110V (4-20mA) 50/60Hz * Limited Availability* <i>200Nm, 148 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	6.00	MM10079/110
50	Industrial Servo Motor 40, 110V (4-20mA) 50/60Hz * Limited Availability* <i>400Nm, 295 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	8.00	MM10080/110
51	Industrial Servo Motor 10, 120V (4-20mA) 50/60Hz <i>98Nm, 72ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	6.00	MM10073/120
52	Industrial Servo Motor 20, 120V (4-20mA) 50/60Hz <i>200Nm, 148 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	6.00	MM10079/120
53	Industrial Servo Motor 40, 120V (4-20mA) 50/60Hz <i>400Nm, 295 ft lbs (for use with the Mk7/Mk8 M.M. on channel 5/6)</i>	8.00	MM10080/120
<b>Industrial Unic Servo Motors with ATEX Approval</b> 			
54	Industrial Servo Motor 10, 230V <i>98Nm, 72ft lbs. Ex nA nL IIC T4</i>	6.00	MM10072/EXP
55	Industrial Servo Motor 10, 120V <i>98Nm, 72ft lbs. Ex nA nL IIC T4</i>	6.00	MM10072/110/EXP
Please note voltage and frequency (Hz). Servo motors are not supplied as standard with mounting kits.			

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