

AUTOFLAME[®]

Combustion Management Systems

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گروه مهندسی فیاماک
نماینده انحصاری شرکت اتوفلیم
در ایران



AUTOFLAME

BOTTOM BLOWDOWN CONTROL

GUIDE

Fiammac

19 MAY 2020

1 **BOTTOM BLOWDOWN**

1.1 **Overview**

The purpose of Bottom blowdown is to remove solids which build up at the bottom of a steam boilers. In the Autoflame system, there are options to either manage the blowdowns through automatic timings, or to manually trigger them. The programmable electronic automatic blowdown ensures repeatable blowdown timings without the need of a compressed air supply. A pulsed bottom blowdown is used to disturb settled solids at the bottom of the boiler, making the evacuation effect more efficient. The timings and intervals of the bottom blowdowns are user configurable.

The Bottom Blowdown function on the Mk8 MM can be configured in two ways:

- Bottom blowdown using solenoid.
- Bottom blowdown using Autoflame controller.

The benefits of the Autoflame Bottom Blowdown system include:

- Options for solenoid blowdown of fully modulating blowdown
- Full stainless-steel valve construction
- 24V DC Autoflame industrial type servomotors for control and repeatability
- Electronic proof of open/close end switches
- Lithium-Ion battery technology ensures guaranteed closure on power failure
- Total electronic operation – no compressed air supply required
- Timed blowdown with manual/automatic operation
- Bottom blowdown sequence logging
- Up to 10 timed blowdowns over a 24-hour period are possible
- Repeatable up to 10 times from 1 to 60 seconds for each blowdown cycle
- ‘Parked’ position to reduce valve opening time
- Quick servomotor disconnect facility for manual actuation
- Rotary operation ensures watertight shutoff
- Sealing design concept ensures no leaks

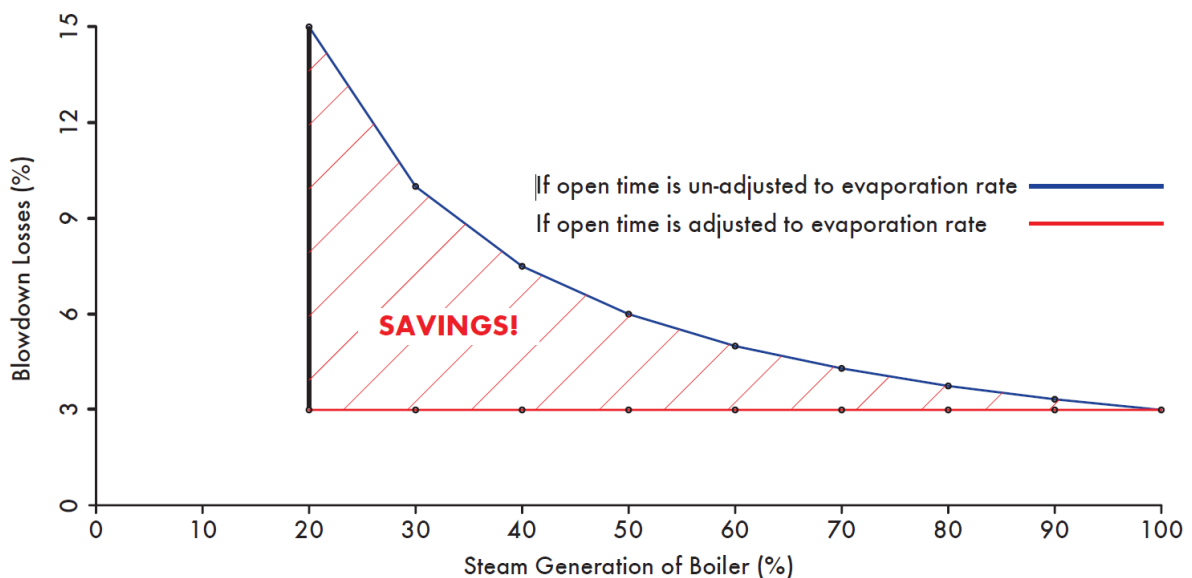
1.2 Bottom Blowdown Reduction

1.2.1 Blowdown Energy Savings

With a typical loss in steam generation of 3% from the conventional bottom blowdown management, Autoflame have developed a Bottom Blowdown Time Reduction feature to minimise these losses which occur when keeping the boiler heat transfer surfaces clean.

It follows that blowdown time can be reduced as a function of the rate of steam generation. Silt and sludge formation within the boiler is always in ratio to work done or steam generation. Therefore, the reduction in the blowdown valve open time can be made, as long as the reduced open time is in ratio to the evaporation rate or steam generation rate.

- Blowdown savings in the region of 1-2% are possible on total fuel usage (dependant on boiler load).
- Blowdown timing automatically reduced in ratio to steam generation.
- Blowdown timings set by users.
- Operators may only trigger pre-set timings, eliminates excessive blowdown by operator.
- Ensures minimal blowdown to satisfy removal of solids, silt and sludge.



For time reduced bottom blowdown, steam flow metering and fuel flow metering is required. Steam flow metering can be set through expansion option 120, please see section 16 for more information. Fuel flow metering can be set through option 57.

1.2.2 Calculation for Bottom Blowdown Reduction

For timed reduced bottom blowdown with Mk8 MM, the maximum steam production used to base how the bottom blowdown time is scaled down to is set through expansion option 64. The blowdown time is reduced according to the ratio of the actual steam production to the maximum steam production for that period. If the blowdown is calculated above the stored blowdown time set by the user in the bottom blowdown screen, then the extra time will get carried over to the next timed blowdown. This extra time will remain getting carried over to the following blowdowns until the steam production has lowered and the blowdown is therefore lowered.

There can be up to 10 blowdowns over a 24-hour period, with each blowdown:

Blowdown Time	BD ₁	BD ₂	BD ₃	BD ₄	BD ₅	BD ₆	BD ₇	BD ₈	BD ₉	BD ₁₀
Time between Blowdowns	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀

The configured blowdown time for that period x which has been set by the user is:

$$BD_x = \text{Blowdown time (sec)}$$

The time between the blowdowns which is sent by the user is:

$$T_x = \text{Time between Blowdowns (hours)}$$

Therefore over a 24 hour period:

$$T_1 + T_2 + T_3 + T_4 + T_5 + T_6 + T_7 + T_8 + T_9 + T_{10} = 24 \text{ hours}$$

The blowdown time for that 24-hour period is then:

$$BD_1 + BD_2 + BD_3 + BD_4 + BD_5 + BD_6 + BD_7 + BD_8 + BD_9 + BD_{10} = BD_T$$

The maximum blowdown period can be calculated as:

$$BD_{max}(\text{seconds}) = \left(\frac{BD_T}{24}\right) \times T_x$$

The maximum steam flow which is set in expansion option 64 is:

$$SF_{max}$$

The average steam flow for that period which is given from steam flow metering is:

$$SF_x$$

The calculated steam flow ratio for that period is then:

$$SF_{c_x} = \frac{SF_x}{SF_{max}}$$

The adjusted blowdown time according to steam production is then:

$$BD_A = \frac{SF_{c_x} \times T_x \times BD_T}{24}$$

If the adjusted blowdown time is calculated higher than the maximum blowdown time, the time is carried over to the next scheduled blowdown operation:

$$BD_A > BD_{max} \quad \text{Extra time is carried over to next blowdown operation}$$

If the calculated adjusted blowdown time is lower than the minimum blowdown time set in expansion option 63, and expansion option 62 is set for minimum blowdown enforced, then:

$$BD_A < BD_{min} \quad \text{Minimum blowdown time is enforced}$$

Example

The maximum steam flow rate, which is set through expansion option 64 as 20,000lb/hour.

Blowdown Time	BD ₁	BD ₂	BD ₃	BD ₄
Time between Blowdowns	T ₁	T ₂	T ₃	T ₄

In this example the 4 blowdowns are configured with the total blowdown timings (Repeats x Duration) as:

$$\begin{aligned}
 BD_1 &= 10s \text{ at } T_1 \text{ 00:00} \\
 BD_2 &= 10s \text{ at } T_2 \text{ 06:00} \\
 BD_3 &= 10s \text{ at } T_3 \text{ 14:00} \\
 BD_4 &= 10s \text{ at } T_4 \text{ 18:00}
 \end{aligned}$$

For period 2, if the average steam flow rate for that period from the Mk8 MM steam flow metering is 12,000lb/hour, then the calculated steam flow ratio is then:

$$\begin{aligned}
 SF_{c_2} &= \frac{SF_2}{SF_{max}} = \frac{12,000lb/hr}{20,000lb/hr} \\
 SF_{c_2} &= 0.6
 \end{aligned}$$

The total configured blowdown time over the 24 hours is:

$$\begin{aligned}
 BD_T &= BD_1 + BD_2 + BD_3 + BD_4 = 10s + 10s + 10s + 10s \\
 BD_T &= 40s
 \end{aligned}$$

The maximum blowdown time for period 2 is:

$$T_x = T_2 - T_1 = 06:00 - 00:00 = 6 \text{ hours}$$

Therefore, the adjusted blowdown time is:

$$\begin{aligned}
 BD_A &= \frac{SF_{c_x} \times T_x \times BD_T}{24hours} = \frac{0.6 \times 6hours \times 40secs}{24hours} \\
 BD_A &= 6s
 \end{aligned}$$

The Maximum blowdown time for period 2 is 13s. Therefore, a full 6s blowdown will be carried out.

The maximum blowdown time for period 3 at full steam rate of 20,000lb/hr is:

$$T_x = T_2 - T_1 = 014:00 - 06:00 = 8 \text{ hours}$$

Therefore, the adjusted blowdown time is:

$$\begin{aligned}
 BD_A &= \frac{SF_{c_x} \times T_x \times BD_T}{24hours} = \frac{1 \times 8hours \times 40secs}{24hours} \\
 BD_A &= 13.3s
 \end{aligned}$$

The Maximum blowdown time for period 3 is 10s. Therefore 3.3s is carried over to period 4.

Time Reduced Bottom Blowdown for Standalone

When using the time reduced bottom blowdown in standalone operation, the maximum steam flow rate and the average steam flow rate are taken from the 4-20mA input to the Bottom Blowdown Module. Please see Autoflame PC Software Guide for more information.

1.3 Installation Guidance

The Bottom Blowdown valve must be sized appropriately for the size of the boiler and blowdown rate required, which will be affected by the boiler pressure, size of blowdown line and blowdown line length from the boiler to the bottom blowdown vessel. The blowdown rate that is required for that boiler will vary according to the operating conditions, contaminants in the feed water and boiler design.

In multi-boiler systems where a bottom blowdown valve is fitted to each boiler, enabling Autoflame sequencing in option 16 will ensure that only boiler in that loop blows down at a given time. If a blowdown time is set the same on all the MMs in a sequencing loop, the MM with the lowest ID complete its blowdown first, followed by the rest of the MMs, sequentially. If Autoflame sequencing is not used for multi-boiler system requiring bottom blowdown in the UK, then valves must be interlocked; this ensures that only boiler can be blown down at one time. Please see local code and regulation on bottom blowdown in multi-boiler systems.

The Autoflame Bottom Blowdown Module (part number BBC70004) has a built-in, rechargeable Lithium-Ion battery, so should a power failure to the module occurs, a Bottom Blowdown fault or MM error will be triggered, and the servomotor will drive the blowdown valve to the closed position using battery power. The servomotor is powered by 24VDC from the bottom blowdown module.

Note: The bottom blowdown valve must be installed along the blowdown pipeline according to local code and regulations. It is the responsibility of the factory trained technician or engineer to configure the bottom blowdown timings according to the specifications given by the boiler manufacturer.

1.3.1 Bottom Blowdown Valve

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

Valve Type	Size	Part No.	Servomotor Size	
			UNIC05	UNIC 10
Flanged PN40	25mm (1")	WLCVO25/FL	•	
	40mm (1 1/2")	WLCVO40/FL		•
	50mm (2")	WLCVO50/FL		•
Flanged ANSI 300lb	25mm (1")	WLCVO25/FLU	•	
	40mm (1 1/2")	WLCVO40/FLU		•
	50mm (2")	WLCVO50/FLU		•

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.



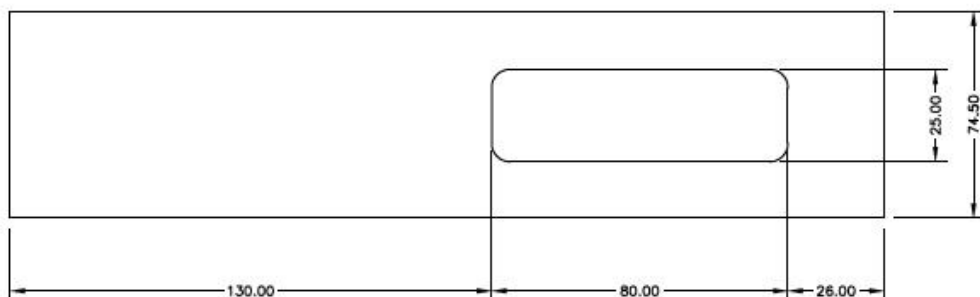
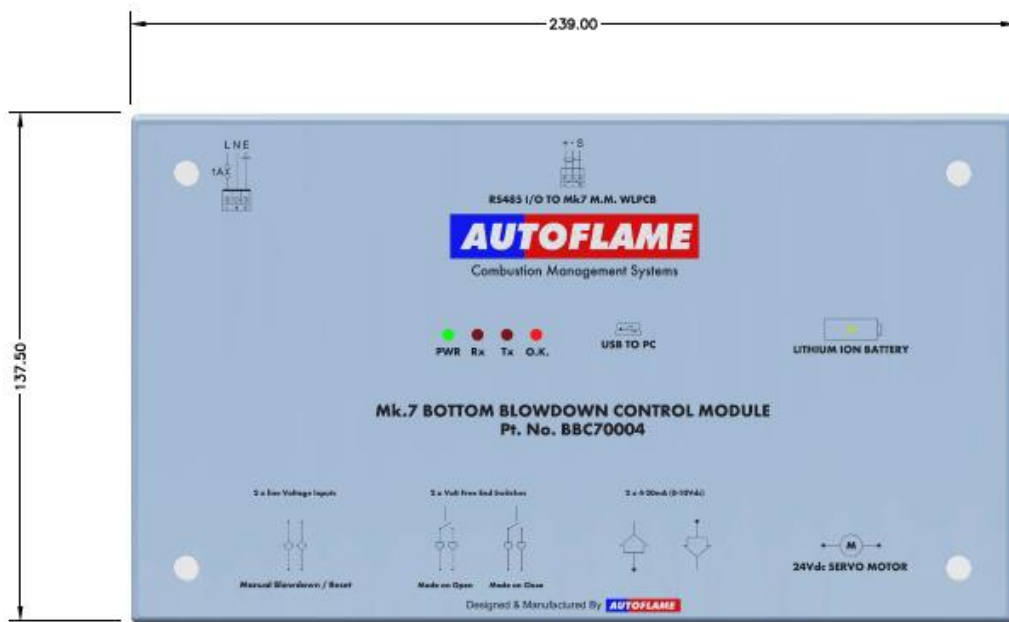
1.3.2 Bottom Blowdown Using Solenoid Valve

Terminal BB (switched neutral) on the Mk8 MM expansion board can be used to energise a bottom blowdown solenoid valve through a contactor.

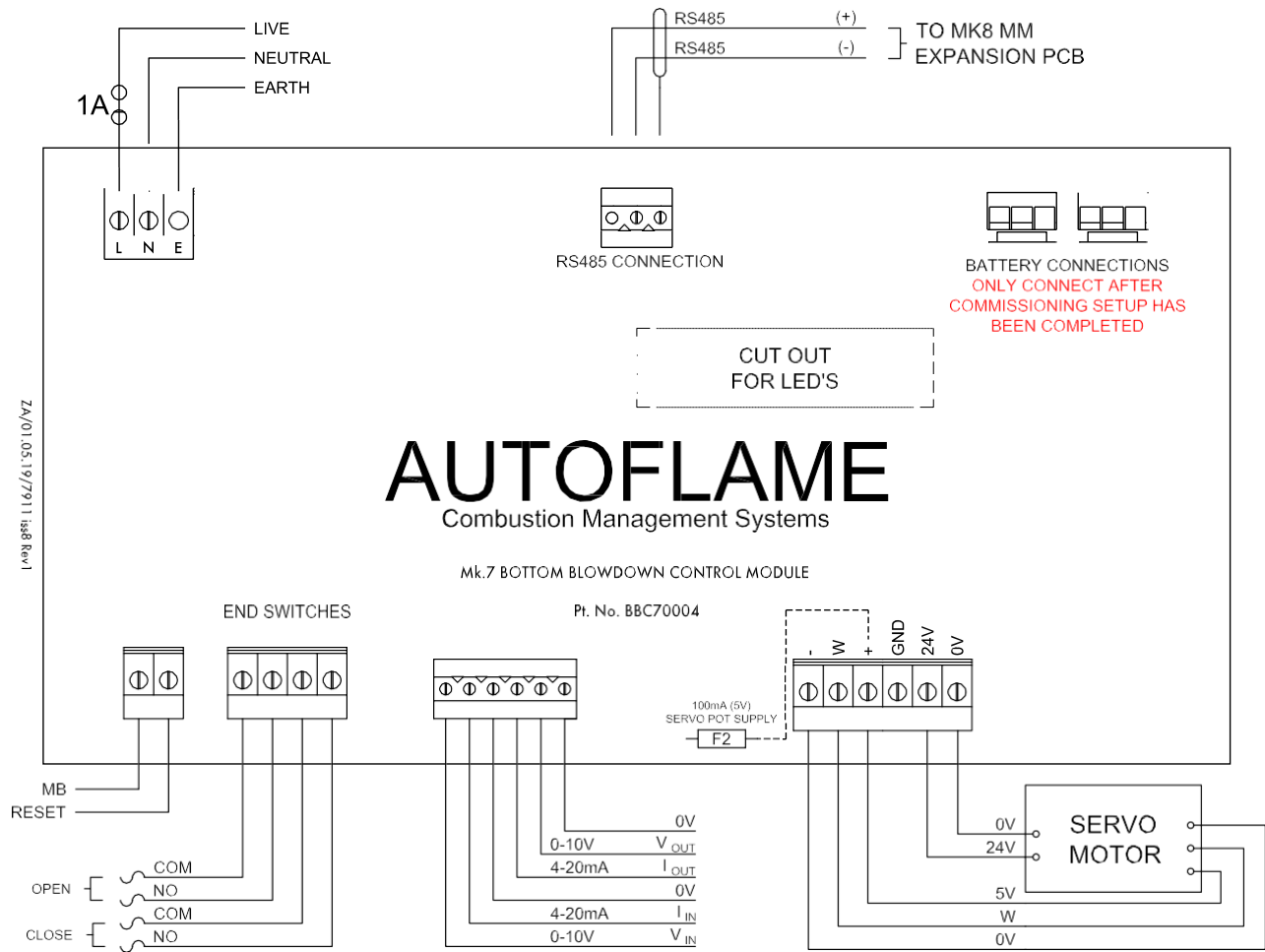
1.3.3 Bottom Blowdown Module

If the bottom blowdown module is used with the MM, please follow the commissioning and blowdown timing configuration steps in section 12.5. If the bottom blowdown module is used as a standalone unit, please refer to the PC Software Guide for instructions on using the Bottom Blowdown Board Configurator software.

Dimensions



Bottom Blowdown Module Wiring



Terminal	Description
L	Live
N	Neutral
E	Earth
RS485 +	Connection MM terminal 5T+
RS485 -	Connection MM terminal 5T-
S	Screen at module
MB	Manual Blowdown
RESET	Reset bottom blowdown module error
OPEN COM/NO	Volt-free connection for open position
CLOSE COM/NO	Volt-free connection for closed position
V _{IN}	Voltage 0-10V input for steam production rating (standalone use)
I _{IN}	Current 4-20mA input for steam production rating (standalone use)
0V	Common for terminals V _{IN} or I _{IN}
V _{OUT}	Voltage 0-10V output for bottom blowdown valve position
0V	Common for terminals V _{OUT} or I _{OUT}
-	0V supply to servomotor from MM
W	Signal from servomotor indicating position
+	+5V supply to servomotor from MM
GND	Ground/Earth
24	+24V supply to servomotor from battery
0	+0V supply to servomotor from battery

1.4 Set-up

For a new installation, after checking the wiring, performing safety installation checks, and settings the options, parameters and expansion options, the servomotor closed position can be set in password protected Commissioning Mode or Online Changes for an already commissioned system.

When the bottom blowdown module is used as standalone, it must be configured using the bottom blowdown configurator PC software. Please see the Autoflame PC Software Guide for more information.

The battery connectors on the bottom blowdown module must remain disconnected during the commissioning of bottom blowdown, these can be reconnected after the commissioning process is completed.

1.4.1 Bottom Blowdown Settings

The bottom blowdown function can be set using an external solenoid valve or the bottom blowdown module, see expansion option 60.

When a bottom blowdown time is due, the blowdown can be set to occur automatically, or by a pressing the manual trigger on the bottom blowdown screen, see expansion 61.

Bottom blowdown reduction allows the timing of the blowdown to be adjusted according to the steam production, see expansion option 62.

If there is no steam production when a blowdown time is due, the MM/module will ignore the blowdown or blow down the valve for a minimum duration, see expansion option 63.

If using bottom blowdown reduction, the boiler steam production rating must be set and the fuel flow metering must be set and commissioned, see expansion option 64 and option 57.

The industrial UNIC servomotors which are used with the water valve for bottom blowdown are factory set with the closed position at 0.0° and open position at 90.0°.

However please do physically check the servo position manually and also check the potentiometer reading on the servo, this should read 0V at closed position. Please refer to section 3.3 for servomotor checks and adjustments.



The default parked position is set the same as the closed position 0.0°, however this can be adjusted using the Bottom Blowdown Board Configurator software; refer to the PC Software Guide. The parked position is a near closed position. During a bottom blowdown event, the servomotor will move to the parked position rather than the closed position during the valve closed interval. This allows a not fully closed position to be set for the parked position, reducing the time take for the servomotor to drive to 90.0° for the valve open interval.

The table below shows a summary of the bottom blowdown expansion options.

Expansion Option	Description
60	Bottom blowdown function
61	Bottom blowdown triggering
62	Bottom blowdown reduction
63	Minimum blowdown duration
64	Boiler steam production rating

1.5 Related Item Part Numbers

Item No.	Mk8 MM Unlockable Software Features	Kgs	Part No
1	Bottom Blowdown		MK8004
Water Control Valves			
Suitable for Feed Water, Bottom Blow Down & TDS Applications			
2	Threaded Feed Water Valve BSP/NPT (0.5"/15mm) <i>0.5" Feed water valve with bracket & coupling</i>	4.00	WLCV015
3	Threaded Feed Water Valve BSP/NPT (0.75"/20mm) <i>0.75" Feed water valve with bracket & coupling</i>	5.00	WLCV020
4	Flanged Feed Water Valve PN40 (1"/25mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	7.00	WLCV025/FL
5	Flanged Feed Water Valve PN40 (1.5"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	8.00	WLCV040/FL
6	Flanged Feed Water Valve PN40 (2"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	9.00	WLCV050/FL
7	Flanged Feed Water Valve ANSI 300lb (1"/25mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	7.00	WLCV025/FLU
8	Flanged Feed Water Valve ANSI 300lb (1.5"/40mm) <i>Stainless Steel Body, fitted with Tek-Fil seat</i>	8.00	WLCV040/FLU
9	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.			
Bottom Blow Down Control Modules			
10	Bottom Blow Down Control Module <i>110V/230V 50/60Hz - Batteries not included, please contact Autoflame</i>	0.00	BBC70004
11	Bottom Blow Down Industrial Actuator 05 <i>24V DC Only, 39NM 37ft lbs IP65, -25 to 55°C (-13 to 131°F)</i>	0.00	BBA10070
12	Bottom Blow Down Industrial Actuator 10 (For usage with 1.5" & 2" Bottom Blow Down Valve) <i>24V DC Only, 68NM 37ft lbs IP65, -25 to 55°C (-13 to 131°F)</i>	0.00	BBA10072
13	1" (25mm) Bottom Blow Down Valve <i>Complete with 24V DC Actuator and Control Module</i>	0.00	BBV025 System
14	1.5" (40mm) Bottom Blow Down Valve <i>Complete with 24V DC Actuator and Control Module</i>	0.00	BBV040 System
15	2" (50mm) Bottom Blow Down Valve <i>Complete with 24V DC Actuator and Control Module</i>	0.00	BBV050 System

Item No.	Large Servo Motors	Kgs	Part No
16	Large 4-20mA Servo Motor, 110V/230V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off Metal Glands</i>	1.85	MM14204
17	Large Servo Motor, 230V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10400
18	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
19	Large Servo Motor, 110V 50/60Hz, Polycarbonate Housing <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10400/A
20	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
21	Large Servo Motor, 230V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10004
22	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
23	Large Servo Motor, 110V 50/60Hz <i>25Nm, 18ft lbs - Supplied with 2off PG11 Glands</i>	1.85	MM10004/A
24	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
Large Servo Motors with ATEX Approval 			
25	Large Servo Motor, 230V 50/60Hz <i>25Nm, 18ft lbs. Ex nA nL IIC T4</i>	1.85	MM10004/EXP
26	Large Servo Motor, 24V 50/60Hz <i>25Nm, 18ft lbs. Ex nA nL IIC T4</i>	1.85	MM10004/D/EXP
Industrial Unic Servo Motors			
27	Industrial Servo Motor 05, 230V 50/60Hz <i>40Nm, 30ft lbs</i>	4.00	MM10070
28	Industrial Servo Motor 05, 120V 50/60Hz <i>40Nm, 30ft lbs</i>	4.00	MM10070/120
29	Industrial Servo Motor 10, 230V 50/60Hz <i>98Nm, 72ft lbs</i>	6.00	MM10072
30	Industrial Servo Motor 10, 120V 50/60Hz <i>98Nm, 72ft lbs</i>	6.00	MM10072/120
31	Industrial Servo Motor 20, 230V 50/60Hz <i>200Nm, 148ft lbs</i>	6.00	MM10074/B
32	Industrial Servo Motor 20, 110V 50/60Hz * Limited Availability* <i>200Nm, 148ft lbs</i>	6.00	MM10074/B/110
33	Industrial Servo Motor 20, 120V 50/60Hz <i>200Nm, 148ft lbs</i>	7.00	MM10074/B/120
34	Industrial Servo Motor 40, 230V 50/60Hz <i>400Nm, 295ft lbs - to be used with Solid State Relays</i>	8.00	MM10078
35	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
36	Industrial Servo Motor 40, 120V 50/60Hz <i>400Nm, 295ft lbs - to be used with Solid State Relays</i>	8.00	MM10078/120
37	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
38	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
39	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
40	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
41	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
42	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
43	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
44	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
Industrial Unic Servo Motors with ATEX Approval 			
45	Industrial Servo Motor 10, 230V <i>98Nm, 72ft lbs. Ex nA nL IIC T4</i>	6.00	MM10072/EXP
46	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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