

Bosch Therm 660EF & 660EFO

Field Service Manual



BOSCH THERMOTECHNOLOGY CORPORATION

Table of Contents

1 Important Safety Information	4
2 Features	5
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3 Specifications / Performance	6
3.1 Specification Tables3.2 Hot Water Supply Capabilities3.3 Pressure Loss Characteristics3.4 Operational Flow Chart	6 7 8 9
4 Dimensions	10
4.1 Water Heater Dimensions4.2 Remote Control Dimensions	10 12
5 Components	13
5.1 Water Heater Components 5.2 Remote Control Components	13 15
6 Troubleshooting	16
6.1 Error Codes and Checkpoints 6.2 Displaying Maintenance Monitors	16 24
7 Gas Line Requirements	26
7.1 Gas Pressure	26
7.3 Measuring Gas Pressure	26
7.4 Gas Line Sizing 7.5 Manifold Gas Pressure Adjustment	26 28
8 Periodic Inspection	29
9 Periodic Maintenance	30
9.1 Equipment 9.2 Remote Control	30
9.3 Water Drain Valve (With Water Filter)	30
9.4 Descaling	31
9.5 Changing Default Temperature Setting 9.6 Draining The Water For Maintenance Or For Freeze Prevention	32 33
10 Installation Check	34

<u>1 Important Safety Information</u>

To prevent damage to property and injury to the user, the icons below warn of varying levels of risk.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

PROHIBITED

PROHIBITED indicates that the described action is not allowed under any circumstance.

1.1 Safety Tips For Service

🔨 WARNING

Wear the appropriate clothing and protective gear: In order to prevent injury or accident, wear a protective helmet, safety boots and a lifting belt whenever necessary.

Υ DANGER

Use only the appropriate tools and parts:

Only use replacement parts manufactured by Bosch for this model as listed in the Installation Manual Parts List for service on this unit. Use appropriate tools.

PROHIBITED

Modification of the unit is prohibited:

Do not attempt to modify or alter the unit. This will cause a fire hazard and a risk of electrical shock.



When servicing:

To prevent burns or scalding, wait until the equipment cools down before draining the water. The appliance will remain hot after it is turned off.

PROHIBITED

Do not short circuit any safety device on this appliance:

If a safety device is not functioning properly, replace the part. Do not under any circumstances short circuit the part.

🚹 DANGER

Exhaust and gas leakage caution:

Always check for leaks when installing or modifying the exhaust vent or gas piping.

1.2 Post - Service Checks



Check parts for leaks:

Confirm that there are no gas, water, or exhaust leaks regardless of whether the service performed could have caused them.

If the unit is installed indoors, check that the flue collar and vent pipe are installed correctly and that they are in good condition.

🔨 WARNING

Check for combustibles:

After service or maintenance is completed, check that there are no combustibles in the vicinity of the unit.

Check insulation resistance:

After service or maintenance is completed, measure the resistance between the electrical wires and ground. If it is less than 10M, there is a risk of electrical shock.

🕂 DANGER

Properly reconnect the power supply:

Confirm that the power supply has been reconnected properly after service or maintenance is completed. Also confirm that there is no dust or other obstacles that might cause an electric shock or a fire hazard.

2 Features

- 1. Maximum Remote Controller Length (Only one remote controller can be connected.) Remote controller (optional): Cord can be extended up to 300^c with 18AWG wire.
- 2. Temperature Lockout Function The remote controller can be set to restrict the maximum allowable temperature setting for added safety.
- 3. Elevation Adjustment

The water heater can be quickly configured for installations above 2000ft by simply disconnecting a jumper inside of the unit. No additional equipment or adjustments are necessary. See the Installation Manual for details.

3 Specifications / Performance

3.1 Specification Tables

Specifications		Table 1				
Description	660 EF	660 EFO				
Installation Options	Indoor, Wall Mounted	Outdoor, Wall Mounted				
Exhaust Type	Power	Vented				
Ignition	Direct	Ignition				
Recommended Water Pressure	29-7	'0 psi				
Maximum Operating Water Pressure	150) psi				
Minimum Flow Rate	0.5	GPM				
Dimensions	20.5"(Height) x 13.8"	(Width) x 6.7"(Depth)				
Weight	36	lbs.				
Water Holding Capacity	0.2 Gallon					
Water Inlet Connection Size	3/4 "					
Water Outlet Connection Size	3	/4"				
Gas Inlet Connection Size	3	/ 4"				
Power Supply	120 VA	C (60Hz)				
Power Consumption	NG : 54W LP : 59W Freeze Prevention 141W	NG : 51W LP : 52W Freeze Prevention 141W				
Casing Materials	Zincified Steel Plat	e/ Polyester Coating				
Flue Collar Materials	Stainle	ss Steel				
Heat Exchanger Materials	Copper Sheetin	g, Copper Tubing				
Safety Devices	Flame Rod, Thermal Fuse, Lightning Protection Device (ZNR), Overheat Prevention Device, Freezing Protection Device, Fan Rotation Detector					
Accessories	Anchorir	ng Screws				

Performance		Table 2			
Description	660 EF	660 EFO			
Gas Consumption Maximum Performance	140,000 btuh				
Gas Consumption Minimum Performance	20,000 btuh				
Hot Water Capacity @ 45°F Rise	5.3 Gal./min.				
Capacity Range	0.5-6.6 Gal./min.				
Default Temperature Options	120°F, 130°F*, 140°F*, 160°F** (Original is 120°F)				
Temperature Settings (Using the remote controller)	100-150°F (In 5°F intervals), 160°F (12 Options)				

* with supplied jumpers

** with remote control connected

3.2 Hot Water Supply Capabilities



[Spring/Fall] Inlet water temp. 64°F





3.3 Pressure Loss Characteristics



Fig. 1 660EF-EFO Pressure Loss

3.4 Operational Flow Chart



4 Dimensions

4.1 Water Heater Dimensions



Fig. 2 660EF Dimensions



Fig. 3 660EFO Dimensions

4.2 Remote Control Dimensions



Fig. 4 660EF-EFO Optional Remote Control Dimensions

5 Components

5.1 Water Heater Components



|13



Fig. 6 660EFO Components Diagram

5.2 Remote Control Components



Fig. 7 Remote Control Components Diagram





<u>6 Troubleshooting</u>

6.1 Error Codes and Checkpoints (With optional remote control connected)

Error Cod	e List	Table 3				
Display	Description	Diagnosis Point (Trouble Point*)				
10	Combustion Abnormality (BTU Drop) (Unit Continues Working)	Check for abnormal combustion, Check flue for blockage or obstruction. To reset this error code, the power needs to be disconnected and then reconnected.				
11	Ignition Failure (Initial Flame Fault detection)	Check gas supply piping and pressure. Check for igniter spark (8). Check gas solenoid valves (9),(10),(11). Check flame rod (12). Check ground, paying special attention to the ground connection to the circuit board.				
12	Flame Rod Does Not Detect Flame (Secondary Flame Fault Detection)	Check for accidental extinction of the flame. Check for abnormal combustion, check gas solenoid valves, check flame rod (12). Check ground, especially on circuit board.				
14	Thermal Fuse Triggered	Check for melting or damage to the thermal fuse (1). Check for improper connection of thermal fuse.				
16	Abnormally High Output Temperature	Measure the resistance through the outlet thermistor (4). Check for proportional gas valve trouble (11)				
20	High Limit Switch Triggered.	Check if high limit switch is triggered (13). Check for improper connection of high limit switch. To reset this error code, the power needs to be disconnected and then reconnected.				
31	Inlet Thermistor Abnormality	Measure the resistance through the inlet thermistor (3). Check for an open or short circuit. Check for improper connection to the inlet thermistor.				
32	Outlet Thermistor Abnormality	Measure the resistance through the outlet thermistor (4). Check for improper connection or an open or short circuit.				
59	Heat Exchanger Flow Abnormality	Check for scale build-up in heat exchanger. Check for abnormal combustion. Check flue blockage or obstruction. Check that flame ignites all across the burner. ¹).				
61	Fan Motor Abnormality	Check that the fan is rotating. Check the pulse frequency from the fan rotational frequency sensor (6), (7). Check for improper connection of the fan. Check voltage from circuit board.				
70	Circuit board Abnormality	Circuit board failure				
71	Gas Solenoid Valve Drive Circuit Abnormality	Check for damage to the gas solenoid vavle drive circuit on the circuit board.				
72	Flame Rod Circuit Abnormality (Detection of Flame when no flame is present)	Measure the current from the flame rod when there is no flame (5). Check for a ground fault.				
73	Circuit board setting abnormality (High elevation connector, dipswitch, etc)	Check for proper setting of maintenance writers on circuit board. Check the circuit board (microcomputer) for damage. Check the Dip switch. Check the "Control switch connector" (ex. high elevation connector etc.). To reset this error code, the power needs to be disconnected and then reconnected. ¹)				
760	Remote Controller Transmission Abnormality	Check connection from remote controller to circuit board. Check remote controller and circuit board for damage. ¹)				
	Combustion Abnormality (Warning indication)	Check for abnormal combustion. Check flue for blockage or obstruction				
90	Combustion abnormality (Unit shuts off)	Check for abnormal combustion. Check flue for blockage or obstruction. Check flame ignites all across the burner. To reset this error code, the power needs to be disconnected and then reconnected.				
99	Combustion Abnormality (Unit shuts off)	Check for abnormal combustion. Check flue for blockage or obstruction. To reset this error code, the power needs to be disconnected and then reconnected.				

* For trouble point location refer to Sec. 3.4 Operation Flow Chart.

¹) This error code is not mentioned in the flowchart.

6.1.1 How To Reset Error Codes (With optional remote control connected)

If the F	If the Priority lamp does not come on									
Error Code	Possible Causes	Checkpoint	Connector No.	Pin No. & Color Code		Pin No. & Color Code		Pin No. & Color Code		How to Fix Problem and Reset Unit
	A Fuse is Blown	Check whether the 10A fuse on the circuit board is open.					Closed circuit	Remove the cause of excess current, then replace the 10A fuse.		
No error	Remote Control Terminal Voltage Abnormality	Check voltage supply from circuit board to remote controller.	terminal				DC 13 - 16 V	If voltage is abnormal, replace circuit board		
code	Remote Controller Cord Abnormality	Check for open or short circuit					Closed circuit (not open or shorted)	If there is an open or short circuit, or a ground fault is detected, replace the cord		

The Pr	The Priority lamp lights, but an error code appears soon after:											
Error Code	Possible Causes	Checkpoint	Connector No.	Pir Co	Pin No. & Color Code		Pin No. & Color Code		Pin No. & Color Code		Normal Value	How to Fix Problem and Reset Unit
10	Combustion Abnormality (Unit continues burning with error code flashing and drop in heat output)	Check for abnormal combustion. Check flue for blockage or obstruction.						A blinking 10 indicates there has been a loss of gas input, but combustion will continue. In order to reset the unit, the power must be disconnected and then reconnected				
14	Overheat Prevention Device (Thermal Fuse)	Check for melting or improper connection of the overheat protection device (Thermal fuse)	CN-59	1	BĿR	4	2Ω or less	If the overheat prevention device (Thermal fuse) has fused, it has been exposed to temperatures in excess of 372°F. First fix the cause of the high temperature exposure (i.e hole in heat exchanger), then replace the overheat prevention device.				
760	Remote Controller	Check remote controller and circuit board. Check connection of remote control cord.	terminal				DC13 - 16V	If there is a voltage abnormality, replace the circuit board				
700	Abnormality	Check remote control cord for a short or open circuit, or for a ground fault.					Closed circuit (no open or short)	If an open or short circuit or a ground fault exists, replace remote control cord				

The Pr	The Priority lamp lights, but an error code appears soon after (continued):								
Error Code	Possible Causes	Checkpoint	Connector No.	Pin No. & Color Code	Normal Value	How to Fix Problem and Reset Unit			
	Combustion Abnormality	Check for chromol				If abnormal combustion is detected the error code will flash and combustion stops. This error code can be reset by turning the water heater OFF on the operation panel. Remove the cause of abnormal combustion			
90	Combustion Abnormality (Warning Indication) (Unit Shuts Off)	combustion. Check flue for blockage or obstruction.				Check maintenance monitor No. 48, 49. If the fan has increased it's speed by 110% and the unit plunge into input down mode, the error code will flash but combustion continues. If the fan has requested more improvement, the error code will flash and combustion stops.			
99	Combustion Abnormality (Unit Shuts Off)	Check for abnormal combustion. Check flue for blockage or obstruction.				If this error code is displayed and the water heater has been in use for 10 years, the unit has reached the end of its life cycle and should be replaced.			

Fan do	Fan does not begin rotating when hot water is being demanded:									
Error Code	Possible Causes	Checkpoint	Connector No.	Pin Col	Pin No. & Color Code		Normal Value	How to Fix Problem and Reset Unit		
	Water Flow Sensor Abnormality	Check maintenance monitor no. 14					0.5 GPM	If the flow monitor indicates higher than the minimum, the circuit board will need to be replaced.		
No error code	Inlet Water Temperature is too high	Check inlet water temperature	CN-59	13	W-W	14	less than 122°F using thermistor characte- ristics	OK if K > 35.7/Flow Rate (GPM) + inlet water temp (°F), where K = 136°F for 127°F or lower temperature setting, K = Set Temp (C) + 18°F for 127°F or more setting. Also check thermistor temperature characteristics.		
20	High Limit Switch Triggered	Check if high limit switch is triggered or improperly connected	CN-1	1	W-W	3	1Ω or less	Make sure there is no flame left over in the burner. Check for short or open circuit. Reset unit by turning power off and on. Replace high limit if code remains.		
31	Inlet Thermistor Abnormality	Check resistance through thermistor. Check for open, short circuit or improper connection	CN-59	13	W-W	14		Compare to temperature characteristics list on pg. 20. Check for open, short circuit or improper connection.		
32	Inlet Thermistor Abnormality	Check resistance through thermistor. Check for open, short circuit or improper connection	CN-59	13	W-W	14		Compare to temperature characteristics list on pg. 20. Check for open, short circuit or improper connection.		

Fan do	Fan does not begin rotating when hot water is being demanded (continued):									
Error Code	Possible Causes	Checkpoint	Connector No.	Pin Coo	Pin No. & Color N Code V		Pin No. & Color Code		Normal Value	How to Fix Problem and Reset Unit
70	Circuit Board Abnormality	Detection of circuit board abnormality						Disconnect electrical power, then reconnect electrical power to water heater to reset system. If abnormality continues, replace circuit board.		
71	Gas Valve Drive Circuit Abnormality	Check for damage to the gas valve drive circuit on the circuit board						Disconnect electrical power, then reconnect electrical power to water heater to reset system. If the error code "71" is continuous, replace circuit board.		
70	Flame Rod Abnormality (Flame	Measure the current from the flame rod when there	CN 70	1	BL- burner case	GND	75kHz- 92KHz	If the "72" error code is displayed, check the signal from the flame rod (also make sure that there is not a problem with	If the "72" error code is displayed, check the signal from the flame rod (also make sure that there is not a problem with	
12	detected when no flame present)	is no flame. Check for ground fault.	CN-78	1	BL- elec- trode	Elec- trode	DC 0.45µA or less	the grounding of the appliance). If the signal is normal, replace the circuit board. If it is abnormal, replace flame rod.		

Fan ro	Fan rotates normally, but no flame ignites on the burner:									
Error Code	Possible Causes	Checkpoint	Connector No.	ctor Pin No. & Color Code			Normal Value	How to Fix Problem and Reset Unit		
	Ignition Failure	lgniter failure	CN-1	4	W-BK	2	AC 90V -110V	Replace Igniter		
		Check primary gas solenoid valve (SVO)	CN-10	4	W-BL	6	DC 80V -100V	Gas Solenoid Valve typical resistance: $1.0 k\Omega$ to $2.0 k\Omega$		
11		Check gas solenoid valve 1 (SV1)		1	BK-BL	6	DC 80V -100V	Gas Solenoid Valve typical resistance: $1.0 k\Omega$ to $2.0 k\Omega$		
		Check gas proportioning valve	CN-59	4	R-BL	3	DC 0.3V -15V	Current value changes depending on the load. Proportioning valve resistance: 50Ω to 90Ω.		

Flame	Flame ignites on the burner, but goes out immediately:									
Error Code	Possible Causes	Checkpoint	Connector No.	Pin Coo	No. & Co le	olor	Normal Value	How to Fix Problem and Reset Unit		
	Flame Detecting Circuit abnormality (initial flame fault detection)	Check the flame rod		1	BL- burner case	GND	75kHz- 92KHz	Visually confirm that a flame ignites, check wiring connections to flame rod, and		
11		Check the current from the flame rod	CN-78	1	BL- elec- trode	F-rod	DC 1µA or more	check connections to gas proportioning and solenoid valves. Check for bad contact or a bad connection between flame rod and circuit board, check for ground fault in the unit, especially circuit board groudn		
11		Check for a disconnected ground from circuit board						Check for damage or improper connection of the ground wire between circuit board and metal case of the unit		
	Gas Supply	Check gas supply and manifold pressures					See Sec. 7			
	Pressure or Manifold Pressure abnormality	Check gas proportioning valve	CN-59	4	R-BL	3	DC 0.3V -15V	Current value changes depending on the load. Proportioning valve resistance: 50Ω to 90Ω.		

Flame	Flame goes out while hot water is being supplied:								
Error Code	Possible Causes	Checkpoint	Connector No.	Pin Coc	Pin No. & Color Code		Normal Value	How to Fix Problem and Reset Unit	
	Flame Rod Triggered (Doesn't sense flame during operation)	Check the flame rod		1	BL- burner case	GND	75kHz- 92KHz	Visually confirm that a flame ignites, check wiring connections to flame rod, and	
12		Check the current from the flame rod	CN-78	1	BL- elec- trode	F-rod	DC 1µA or more	check connections to gas proportioning and solenoid valves. Check for bad contact or a bad connection between flame rod and circuit board, check for ground fault in the unit, especially circuit board groudn	
		Check for a disconnected ground from circuit board						Check that the input is proper for the load.	
	Gas Supply	Check gas supply and manifold pressures					See Sec. 7		
	Pressure or Manifold Pressure abnormality	Check gas proportioning valve	CN-59	4	R-BL	3	DC 0.3V -15V	Current value changes depending on the load. Proportioning valve resistance: 50Ω to 90Ω.	

Fan do	Fan does not begin rotating, or the fan rotation is abnormal when hot water is being demanded:									
Error Code	Possible Causes	Checkpoint	Connector No.	nnector Pin No. & Color Code		r Pin No. & Color Code		olor	Normal Value	How to Fix Problem and Reset Unit
				4	BR-BL	2	DC 0V - 43V	Confirm the measured fan speed by Maintenance Monitor		
		Check that the fan is rotating and check the		1	R-BL	2	DC 11V - 13V	(no. 10). If the fan motor does not rotate, but voltage is		
61	Fan Motor abnormality	fan rotational frequency sensor. Check for improper connection to fan. Check voltage from circuit board	CN-27	3	Y-BL	2	120Hz - 387Hz	be replaced. If voltage is abnormal, replace the circuit board. If the fan motor is rotating and if the voltage is normal, but there is a "61" error code, then the fan motor should be replaced.		

Tempe	Temperature control problem:									
Error Code	Possible Causes	Checkpoint	Connector No.	Pin Coo	No. & Co le	olor	Normal Value	How to Fix Problem and Reset Unit		
	Gas supply pressure or manifold pressure abnormality	Check gas supply and manifold pressures					See Sect. 7			
				3	BL-O	4	DC 1 - 16V	During Operation.		
No				3	BL-G	5	DC 1 - 16V	During Operation.		
error code	Flow Control Valve Abnormality	Check flow control valve. Check for improper connection of the valve.	CN-86	3	BL-V	7	DC 1 - 16V	During Operation.		
				3	BL-BK	6	DC 1 - 16V	During Operation.		
				2	Y-BL	1	DC 1V or less	When valve is fully open. (When operation is OFF)		
				8	R-BL	1	DC 14 - 16V	During Operation.		
16	Abnormally High Output (temperature is too hot)	Check resistance of the outlet thermistor	CN-59	14	W-W	15		If the outlet temperature is over 194°F for 0.3 seconds, or over 27°F more than set temp for 25 seconds with the set temperature 125°F or more, or over 140°F for 4 seconds with the set temp 120°F or less, the unit will shut off and error code "16" will flash		
		Check gas proportioning valve		4	R-BL	3	DC 0.3V -15V	Check for short or open circuit or improper connection of wiring to valve.		

6.1.2 Circuit Board Checkpoints

Circu	Circuit Board Checkpoints								
Ref	Part	С	ircuit l	Board Check	points				
No.		CN & Pin	No.	Harness color	CN & P No.	Pin	Normal Value	Remarks 1	Remarks 2
1	Thermal Fuse	CN59	1	BL-R	CN59	4	2Ω or less		
			4	R-BL		6	DC14 - 16V		
2	Water Flow Sensor	CN59	5	Y-BL	CN59	6	DC0.5 – 15V more than 1440 pulse/min. (more than 24Hz)	YI (+) BI (–)	
3	Inlet Thermistor	CN59	13	W-W	CN59	14	DC0.6 – 4V	32°F – 212°F	see pg. 23
4	Outlet Thermistor	CN59	15	W-W	CN59	14	DC0.6 – 4V	32°F – 212°F	see pg. 23
			1	BL-		-	75kHz – 92kHz		
5	Flame Rod	CN78	1	BL- electrode	-	-	DC0.45 µA or less	When no flame is detected	
	- M.		4	BR-BL	0107	2	DC0 – 43V		
6	Fan Motor	CN27	1	R-BL	CN27	2	DC11 - 13V		
7	Fan Motor	CN27	3	Y-BL	CN27	2	7200 – 23200pulses/ min. (120Hz – 387Hz)		
8	lgniter	CN1	2	BK-W	CN1	4	AC90 - 110V	When igniter is sparking	
9	Primary Gas Solenoid Valve	CN10	4	W-BL	CN10	6	DC80 – 100V 1.0 – 2.0kΩ	Measure coil resistance	
10	Gas Solenoid Valve 1	CN10	1	BK-BL	CN10	6	DC80 - 100V 1.0 - 2.0kΩ	Measure coil resistance	
11	Gas Proportioning Valve	CN59	4	R-BL	CN59	3	DC0.3 – 15V 50 – 90Ω	Measure coil resistance	
12	Flame Bod	CN78	1	BL-			75kHz – 92kHz		
12			1	BL- electrode			DC1 µA or more	At flame detection	
13	High Limit Switch	CN1	1	W-W	CN1	3	less than 1Ω	Measure contact resistance	
14	Gas Solenoid Valve 2	CN10	2	GY-BL	CN10	6	DC80 - 100V 1.0 - 2.0kΩ	Measure coil resistance	
			8	R-BL		1	DC14 -16V		
			2	Y-BL		1	DC1V or less	When valve is fully open. (ON/OFF switch OFF)	
15	Water Control Value	CNRC	3	W-G		5	DC1 -16V		
15	water control valve	0100	3	W-V	CIVOD	7	DC1-16V		
			3	W-O		4	DC1-16V		
			3	W-BK		6	DC1 -16V		
-	Power supply	CN92	1	W-BK	CN92	2	AC90 - 110V		
_	Remote Controller	Terminal	–	-	_	-	DC13 - 16V		1

Temperature characteristic of inlet / outlet thermistor									
Temperature (°F)	32	50	68	86	104	122	140	158	176
Temperature (°C)	0	10	20	30	40	50	60	70	80
Resistance (kΩ)	23.7	15.5	10.3	7.0	4.9	3.5	2.5	1.9	1.4

6.2 Displaying Maintenance Monitors

Display Procedure

 Press and hold both the up [▲] and down [▼] buttons simultaneously for more than two seconds. This can be done regardless of whether the power has been turned on or the unit is operating.

Indications

- 1. The maintenance monitor data no. will appear on the display for two seconds, and then the data will appear.
- In order to switch to other maintenance monitor data, press either the up or down button once. The data no. will then reappear, then different data nos. can be selected using the up [▲] and down [▼] buttons. When the maintenance monitor data no. is changed, the data no. will be displayed for two seconds, after which the data will appear.
- 3. With the remote controller in maintenance mode, the hot water set temperature and flow meter alarm cannot be adjusted.

Returning to Normal Mode

 To exit maintenance monitor mode, press and hold both [▲] and [▼] buttons simultaneously for more than two seconds, or leave it alone for more than 10 minutes.

Clearing Error Codes from Memory

When the power is OFF, press and hold the down
 [▼] button for more than 5 seconds.



Fig. 9 Remote Control Maintenance Monitors

Mainten	ance Monitor List (using optiona	al remote controll	er)		Table 4		
Data No.	ltem	Dat (Display Readin Multiplier	a g x Multiplier)	Minimum Value for Indication	Remarks		
03	Total Plug-in Time	X 100 hour		100 hours	Disp. Range [000] - [1310]		
04	Total Combustion Time	X1 hour		1 hour	Disp. Range [000] – [999]		
05	Total Combustion Time	X 1000 hour		1000 hours	Disp. Range [000] – [65]		
07	Number of Ignition Times	X 10 time		10 times	Disp. Range [000] - [999]		
08	Number of Ignition Times	X 10000	time	10000 times	Disp. Range [000] - [65]		
10	Fan Rotational Frequency	X 10	rpm	25 rpm			
		X 0.1	gal/min.	0.1 gal/min.	When remote control (BRC US) is used		
14	Iotal Flow Rate	X 0.1	L/min.	0.1 L/min.	When remote control (BRC CA) is used		
18	Output (%)	X 1	%	1%			
20	Calculated Fan Speed	X 10	rpm	25 rpm			
28	Calculated Fan Speed (no correction)	X 10	rpm	25 rpm			
20	Inlet Thermistor Temperature	X 1	°F	1°F	When remote control (BRC US) is used		
30	Reading	X1 °C		0.5 °C	When remote control (BRC CA) is used		
21	Outlet Thermistor Temperature	X 1	°F	1°F	When remote control (BRC US) is used		
31	Reading	X 1	°C	0.5 °C	When remote control (BRC CA) is used		
39	Fan Motor Current Value	X 10	mA	10mA	Disp. Range [000] – [1999]		
47	Simple self-diagnosis counter	[0 : xy]	Decimal		[000] – [255]		
48	Initial Fan Speed Correction	X 1	%	1%	[100] – [118]		
49	Final Fan Speed Correction	X 1	%	1%	[100] – [118]		
50	FF No.	X 0.1		0.1			
51	FF+FB No.	X 0.1		0.1			
52	Output	X 0.1		0.1			
60	Position of Main Water Control valve	X 2	step		[000] (open)- [1350](close)		
87	Circuit Board ID1: Product 1	[1:xy]			A=101,B=102,C=103,Z=126		
88	Circuit Board ID2: Product 2	[2:xy]			A=201,B=202,C=203,Z=226		
89	Circuit Board ID3:Version	[3 : xy]			A=301,B=302,C=303,Z=326		
91	Error Code History 1	Most Recent Erro	r Code				
92	Error Code History 2	Next Most Recen	t Error Code				
93	Error Code History 3	Next Most Recen	t Error Code		If the same error code is repeated, it will		
94	Error Code History 4	Next Most Recen	t Error Code		appear in the history list twice. If it is		
95	Error Code History 5	Next Most Recen	t Error Code		repeated more than twice, it will only		
96	Error Code History 6	Next Most Recen	t Error Code		appear twice.		
97	Error Code History 7	Next Most Recent Error Code					
98	Error Code History 8	Next Most Recent	t Error Code		I		

7 Gas Line Requirements

All Tankless Water Heaters must be provided with a sufficient supply of gas in order to function properly. An undersized gas line could result in under heated water temperatures and an error code displayed on the operation panel. To verify that the gas line is sized properly, follow the below procedures. The gas line must provide at least the minimum stated pressure at the maximum firing rate. If the unit is being supplied gas from other than a dedicated line, it is recommended that the other appliances be turned on to ensure an adequate supply is available for the unit.

7.1 Gas pressure

Size the gas line according to total BTU/H demand of the building and length from the meter or regulator so that the following supply pressures are available even at maximum demand:

660EF-EFO Gas Pressure Requirements Table 5									
Natural Gas S	upply Pressure	LP Gas Supply Pressure							
Min:	4" W.C.	Min:	8" W.C.						
Max:	10.5" W.C.	Max	14" W.C.						

Select a gas meter capable of supplying the entire BTU/H demand of all gas appliances in the building.

7.2 Gas Connection

- Do not use piping with a diameter smaller than the inlet diameter of the water heater.
- Gas flex lines are not recommended unless they are rated for max BTU/H of the heater (see below).
- Install a gas shutoff valve on the supply line near the water heater.
- Use only approved gas piping materials.

7.3 Measuring Gas Pressure

In order to check the gas supply pressure to the unit, a tap is provided on the gas inlet (see Fig. 10). Remove the hex head Phillips screw from the tap, and connect a manometer using a silicon tube.

In order to check the gas manifold pressure, a pair of taps are provided on the gas valve inside the unit. The pressure can be checked either by removing the hex head Phillips screw and connecting a manometer with a silicon tube, or by removing the 1/8" NPT screw with an allen wrench and connecting the appropriate pressure gauge.



Fig. 10 Inlet Gas Pressure Tap

7.4 Sizing Gas Line

- 1. Size each outlet branch starting from the furthest using the BTU/H required and the length from the meter (see Fig. 11).
- 2. Size each section of the main line using the length to the furthest outlet and the BTU/H required by every-thing after that section (See Fig. 11).



Fig. 11 Sample Gas Line

Sample Calculation (refer to Fig. 12)

- Outlet A: 45' (Use 50'), 50,000 BTU/H requires 1/2"
- Outlet B: 40', 65,000 BTU/H requires 1/2"
- Section 1: 45' (Use 50'), 115,000 BTU/H requires 3/4"
- Outlet C: 30', 35,000 BTU/H requires 1/2"
- Section 2: 45' (Use 50'), 150,000 BTU/H requires 3/4"
- Outlet D: 25' (Use 30'), 25,000 BTU/H requires 1/2"
- Section 3: 45' (Use 50'), 175,000 BTU/H requires 1"
- Outlet E: 25' (Use 30'), 180,000 BTU/H requires 3/4"
- Section 4: 45' (Use 50'), 355,000 BTU/H requires 1-1/4"

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Fig. 12 Gas Line Sizing Chart

7.5 Manifold Gas Pressure Adjustment

- NOTE: Use the following procedure to adjust the manifold gas pressure only if it can be done with a high flow rate through the unit.
- NOTE: When the manifold gas pressure is adjusted, the front cover will be off. Adjust the manifold gas pressure to the value of "Cover Off" in the table below (because it is not possible to adjust the manifold gas pressure with the front cover on).
- 1. With a manometer or pressure gauge connected to the manifold pressure tap, press and hold the maximum manifold gas pressure set button. Use the manifold gas pressure increase and decrease buttons to adjust to the correct pressure.
- 2. Press and hold the minimum manifold gas pressure set button. Use the manifold gas pressure increase and decrease buttons to adjust to the correct pressure.
- 3. Repeat steps (1) and (2) until both are at the correct pressure.



Fig. 13 Manifold Gas Pressure Adjustment On Circuit Board

Manifold Gas Pressure Maximum and Minimum Values										
Model	Gas Type	Supply Pressure	Manifold Pressu Cove	ıre (inches W.C) er on	Manifold Pressure (inches W.C) Cover off					
		(inches W.C)	Max. Value	Min. Value	Max. Value	Min. Value				
	NG	7.9	2.20	0.60	2.73	0.88				
000 EF	LP	11.0	2.75	0.70	3.09	1.00				
	NG	7.9	2.20	0.60	2.69	0.88				
660 EFO	LP	11.0	2.80	0.70	3.09	1.00				

8 Periodic Inspection



WARNING

When servicing:

To prevent burns or scalding, turn off the power button and wait until the equipment cools before performing maintenance.



Fig. 14 Periodic Inspection Checks

9 Periodic Maintenance

9.1 Equipment

Wipe the outside surface with a wet cloth, then dry the surface. Use a neutral detergent to clean any stains.

9.2 Remote Control

Wipe the surface with a wet cloth.

PROHIBITED

When cleaning the remote control:

Do not use benzene, oil or fatty detergents to clean the remote controller; deformation may occur.

PROHIBITED

Do not submerge remote control:

The remote controller is water resistant but not water proof. Keep it as dry as possible.



If the water filter is covered with debris, the hot water may not run smoothly, or the unit may put out cold water. Check and clean the filter as explained below:



When servicing:

To prevent burns or scalding, wait until the equipment cools down before draining the water. The appliance will remain hot after it is turned off.

- 1. Close the water supply valve.
- 2. Open all hot water fixtures and allow for the water pressure to completely dissipate.
- 3. With a bucket ready, remove the inlet and outlet drain plugs (about 0.2 gal. will drain out).
- 4. Take the water drain valve (with water filter) out of the inlet. (See Fig. 15).
- 5. Clean the water drain valve (with water filter) with a brush under running water.
- 6. Replace the water drain valve (with water filter) and close the drain plugs. (Take care not to lose the packing).
- 7. Open the water supply valve.
- 8. Close all hot water fixtures.
- 9. Ensure that water does not leak from the drain plugs or water drain valve (with water filter).



Fig. 15 Water Drain Valve With Water Filter

9.4 Descaling

If the unit becomes saturated with lime or scale build-up, the hot water may not run smoothly, or the unit may put out cold water. In addition, damage can occur resulting in failure of the unit if lime or scale deposits are left untreated within the unit. To remove these deposits from the unit, follow the procedure as explained below. To ensure full warranty coverage, hard, acidic, or otherwise impure water should be treated with approved methods.

- **Note:** Isolation valves will need to be installed in order to perform this procedure.
- 1. If not already on, turn the unit on with the Power Button on the Remote Controller.
- 2. Close the gas supply valve.
- 3. Close both the hot and cold water valves with a quarter turn of the main valve wing handle. The handle will be perpendicular to the main valve body.
- 4. Ensure the drain valve lever handles are closed on both the hot and cold valves (the lever will be perpendicular to the drain portion of the body) and slowly remove drain caps. Be sure to retain the rubber washer inside of the drain cap.
- 5. Connect the pump outlet hose to the cold water drain valve of the isolation valve as shown in Figure 16.
- 6. Connect a drain hose to the hot water drain valve outlet of the isolation valve as shown in Figure 16.
- 7. Fill bucket with descaling solution so both lines inside are submersed. We recommend a straight white vinegar solution. If using a commercial descalant, refer to manufacturer's instructions for proper dilution ratio.
- 8. Place both the pump inlet hose and the drain outlet hose into the pail.
- 9. Open both drain valve lever handles on the isolation valves.
- 10. Turn the pump on. The unit will attempt to ignite (make sure that the gas has been turned off) and a number "11" should flash on the remote controller after about 1 minute. Do not reset the unit. Allow solution to circulate for 45 minutes.
- **Note:** It may take a few minutes to clear air out of the heater and hoses.
- 11. Turn pump off and close the cold water drain valve of the isolation valve.
- 12. Remove the hose from the cold water drain valve and replace cap and washer onto the drain valve outlet.
- 13. Remove the pump and hose from the bucket and empty the solution.
- 14. Put the hot water drain hose end back into the empty bucket and open the cold water main valve wing handle. This procedure will flush out the heater with fresh cold water. Flush for at least 5 minutes or until 20 gallons of water has passed through the heater.

- 15. Close the cold water main valve wing handle and clean the water inlet filter. Place the filter back into the unit.
- 16. Close the hot water drain valve lever handle, remove the drain hose and replace cap and washer onto the hot water drain valve outlet.
- 17. Open both the hot and cold water main valve wing handles. Wing handles should now be (OPEN) parallel to the main valve body and lever handles should be (CLOSED) perpendicular to the drain portion of the body, which is the normal operating position.
- 18. Open the gas supply valve and reset the unit by turning the power off and then on again using the Power Button on the Remote Controller.



Fig. 16 Descaling Procedure

9.5 Changing Default Temperature Setting

The water heater has been factory set to allow a maximum temperature setting of 120°F. To access higher temperature settings with the optional remote controller installed, follow the below steps. The unit can only be set to temperatures in the range of 145-160°F when the optional remote controller is installed.

When setting the maximum temperature to 125-140°F

- 1. Turn the water heater off by pressing the ON/OFF button on the remote controller.
- 2. Press and hold the FLOW METER ALARM SET button until a sound is heard (2 sec.) and "120°F" appears on the display.
- 3. Set the upper limit of the hot-water supply temperature to 125°F, 130°F, 135°F or 140°F using the UP and DOWN setting buttons.
- 4. To put the water heater back into operation, press the ON/OFF button on the remote controller. To keep the water heater off, let the unit sit for 30 sec. to return to the original display.

When setting the maximum temperature to 125-160°F

- Turn the water heater off by pressing the ON/OFF but-1. ton on the remote controller.
- 2. Disconnect electrical power to the water heater.
- 3. Remove the front cover of the water heater (4 screws).
- Locate the bag of temperature selection wires 4. attached to the inside of the unit in the bottom left corner
- Connect the temperature selection wire labeled 5. "160°F" to the circuit board as shown on the right.
- 6. Replace the front cover of the water heater (4 screws).
- 7. Reconnect electrical power to the water heater, but do not turn it on.
- 8. Press and hold the FLOW METER ALARM SET button until a sound is heard (2 sec.) and "120°F" appears on the display.
- 9. Set the upper limit of the hot-water supply temperature to 125°F, 130°F, 135°F, 140°F, 145°F, 150°F, 160°F using the UP and DOWN setting buttons.
- 10. To put the water heater back into operation, press the ON/OFF button on the remote controller. To keep the water heater off, let the unit sit for 30 sec. to return to the original display.



Fig. 17 Circuit Board Connection

9.6 Draining the water for maintenance or for freeze prevention

MARNING

When servicing:

To prevent burns or scalding, wait until the equipment cools down before draining the water. The appliance will remain hot after it is turned off.

Note: Drain water into a bucket to prevent water damage.

- 1. Close the gas valve.
- 2. Turn the power on/off button "On".
- 3. Turn and leave open the hot water fixtures for more than 2 minutes and close.
- **Note:** An 11 Error Code may appear on the remote controller. This is not a malfunction of the unit. Do not turn Power ON/OFF Button OFF.
- 4. Close the water supply valve and disconnect the electrical power supplied to the unit.
- 5. Fully open all hot water fixtures.
- 6. Open all drain plugs & drain the water out of the unit.
- 7. When the water is completely drained, replace all drain plugs and close the hot water fixtures.

10 Installation Check

Installation problems can cause the unit to work unsatisfactorily. If the unit is not working properly, but there are no error codes or evidence of malfunction, check the following in regards to the installation:

Altitude

1. If this water heater is installed in a location where the altitude is greater than 2000 ft., the combustion may become abnormal because of the thinness of the air. The unit must be configured for high elevation installations by disconnecting the "High Elevation Disconnect" jumper located inside of the water heater. Refer to the "Installation Manual" for detailed instructions.

Air Supply/Exhaust

- 1. Make sure that the installation location provides sufficient combustible air and enough space for an exhaust vent.
- 2. Install the venting only as outlined in the installation manual.
- 3. Install a condensate drain when required.

Installation Environment

- 1. If this unit will be installed in a factory, salon, or laundry service, install it in a location where it will not be exposed to steam, ammonia, sulfur, chlorine, ethylene compounds, or acids.
- 2. If this unit will be installed in a restaurant, locate it so that it will not be affected by steam.
- 3. Avoid any installation that will expose the unit to steam or moisture.

For Multiple Floor Water Supply

 If the unit will be installed on the lower floor of a multiple story building, in order to get the maximum flow rate through the unit, there must be at least 29 PSI of water pressure at the inlet to the unit. If this supply water pressure cannot be maintained, install pumps to increase the pressure and install a pressure gauge to adjust the supply pressure to the desired level. If the supply pressure to the water heater falls below this level, boiling may occur in parts of the heat exchanger, causing an abnormal sound and possibly damaging the water heater.

Installation of Strainer

 If the unit will be installed in a system with a circulating or pressure increasing pump, install a strainer with a #50 or greater mesh to protect the unit from damage caused by debris in the plumbing line. This is especially important for older piping.

Gas Supply Piping

1. Because a large quantity of gas is used with these appliances, make sure to size the gas meter and supply piping to match the maximum Btu rating of the heater.

Air Supply and Vent Pipe

Before installation, note the following:

1. Vent pipe diameter: $\cdot \emptyset$ 3 inches

Maximum vent length:	\cdot 35 feet with 1 - 90° elbow
_	\cdot 25 feet with 2 - 90° elbows
	\cdot 15 feet with 3 - 90° elbows

- 2. Make sure the installation location allows for a flue to be built that will be shorter than the maximum allowable vent length. A longer vent will cause a danger of explosion.
- 3. Do not penetrate the vent pipe through a fire wall.
- 4. Extend the vent pipe all the way to the outdoors.
- 5. Steam and condensed water may exit the vent pipe. Be sure to install the vent pipe so that the steam and water droplets will not harm anything.

Electrical

- 1. The electrical power supply (120VAC, 60hz) to the unit should be installed by a qualified technician.
- 2. Allocate 2A on the circuit for this water heater.



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