

THE EFFECT OF ELEVATION ON OIL BURNER FIRING

The elevation of the installation of a modern high-speed flame retention oil burner affects the performance of the burner. Allowance for elevation must be taken into consideration when choosing an oil burner and operating it above 2000 feet.

It is especially important in high elevation installations to adjust air settings to match the burner nozzle firing rate. As elevation increases above sea level, the ambient air contains less oxygen. Because there is less available oxygen per cubic foot of air, the burner must deliver a greater volume flow (cfm) of air to provide the proper amount of oxygen for the amount of oil being burned. This is the reason that an increase in the burner air setting may be required.

It is also important in high elevation installations to consider the maximum firing rate of the burner, so that the heat input as required by the application and as recommended by the boiler or furnace manufacturer is maintained. Regardless of elevation, the oil burner has a maximum volume flow of air that it can deliver. As a result, the maximum firing rate of the oil burner decreases as the elevation increases, because the combustion air contains less oxygen. An increase in the size of a fixed-type retention head, an adjustment of the head position of a variable-type head (to a higher or more open position), or even the use of an oil burner with a higher maximum firing rate may be necessary.

Note that this **re-rating** is not **de-rating**. This Bulletin addresses re-rating of the burner, not de-rating of the heating appliance. The firing rate (amount of BTU input) of the burner must be maintained to meet the heating load that the appliance has been sized to meet. If a heating appliance is de-rated by reducing the firing rate of the oil burner (as is sometimes done to increase efficiency), the BTU output of the appliance may not be adequate to meet the heating load of the installation.

The effect of elevation up to 2000 feet is minimal, so no re-rate is necessary up to 2000 feet elevation. Above 2000 feet, for every 1000 feet above sea level (including the first 2000 feet), there is a 1.84% rate reduction of the burner. To assist you, we have included the following chart and some examples:

Burner Rating at Sea Level, gph														
	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
Elevation (above sea level)	Burner Rating at Elevation above Sea Level, gph													
500 ft.	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
1000 ft.	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
1500 ft.	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
2000 ft.	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
2500 ft.	0.72	0.95	1.19	1.43	1.67	1.91	2.15	2.39	2.62	2.86	3.34	3.82	4.29	4.77
3000 ft.	0.71	0.94	1.18	1.42	1.65	1.89	2.13	2.36	2.60	2.83	3.31	3.78	4.25	4.72
3500ft.	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.57	2.81	3.27	3.74	4.21	4.68
4000 ft.	0.69	0.93	1.16	1.39	1.62	1.85	2.08	2.32	2.55	2.78	3.24	3.71	4.17	4.63
4500 ft.	0.69	0.92	1.15	1.38	1.61	1.83	2.06	2.29	2.52	2.75	3.21	3.67	4.13	4.59
5000 ft.	0.68	0.91	1.14	1.36	1.59	1.82	2.04	2.27	2.50	2.72	3.18	3.63	4.09	4.54
5500 ft.	0.67	0.90	1.12	1.35	1.57	1.80	2.02	2.25	2.47	2.70	3.15	3.60	4.04	4.49
6000 ft.	0.67	0.89	1.11	1.33	1.56	1.78	2.00	2.22	2.45	2.67	3.11	3.56	4.00	4.45
6500 ft.	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	2.42	2.64	3.08	3.52	3.96	4.40
7000 ft.	0.65	0.87	1.09	1.31	1.52	1.74	1.96	2.18	2.40	2.61	3.05	3.48	3.92	4.36
7500 ft.	0.65	0.86	1.08	1.29	1.51	1.72	1.94	2.16	2.37	2.59	3.02	3.45	3.88	4.31
8000 ft.	0.64	0.85	1.07	1.28	1.49	1.71	1.92	2.13	2.35	2.56	2.98	3.41	3.84	4.26
9000 ft.	0.63	0.83	1.04	1.25	1.46	1.67	1.88	2.09	2.29	2.50	2.92	3.34	3.75	4.17
10000 ft.	0.61	0.82	1.02	1.22	1.43	1.63	1.84	2.04	2.24	2.45	2.86	3.26	3.67	4.08

Note: All examples are for 7000 ft. elevation.

$$1.84\% \times 7 \text{ (for 7000 ft.)} = 12.9\% \rightarrow 100\% - 12.9\% = \underline{87.1\%}$$

EXAMPLE 1

RE-RATING OF THE MAXIMUM FIRING RATE FOR BURNERS @ 7000 FT.

Burner Model	Maximum Firing Rate of Burner @ Sea Level	X	Elevation Re-rate Factor @ 7000 ft.	=	Adjusted Maximum Firing Rate
AFG	3.00 gph	X	87.1%	=	2.61 gph
AF	3.00 gph	X	87.1%	=	2.61 gph
AFII 150	1.50 gph	X	87.1%	=	1.31 gph
AFII 85	0.85 gph	X	87.1%	=	0.74 gph
SF	5.50 gph	X	87.1%	=	4.79 gph
SR	2.00 gph	X	87.1%	=	1.74 gph
CF375	3.75 gph	X	87.1%	=	3.27 gph

TO PROVIDE ADEQUATE OXYGEN IN THE COMBUSTION AIR TO MAINTAIN THE FIRING RATE FOR THE HEATING LOAD:

- If after the re-rate factor is used the required firing rate input exceeds the Adjusted Maximum Firing Rate for the burner model being applied, a burner model with a higher Adjusted Maximum Firing Rate will be required.

For this example: If an appliance operating at 7000 ft. elevation requires a firing rate input of 2.75 gph, an SF or CF375 burner may be required instead of an AFG burner.

EXAMPLE 2

RE-RATING OF THE MAXIMUM FIRING RATE FOR **FIXED-TYPE BURNER HEAD @ 7000 FT.**

Burner Model	Head	Maximum Firing Rate of Head	X	Elevation Re-rate Factor @ 7000 ft.	=	Adjusted Maximum Firing Rate of Head
AFG	F3	1.25 gph	X	87.1%	=	1.09 gph
AFG	F6	1.65 gph	X	87.1%	=	1.44 gph
AFG	F12	2.00 gph	X	87.1%	=	1.74 gph
AFG	F22	2.50 gph	X	87.1%	=	2.18 gph
AFG	F31	3.00 gph	X	87.1%	=	2.61 gph
AFG	L1	1.10 gph	X	87.1%	=	0.96 gph

TO PROVIDE ADEQUATE OXYGEN IN THE COMBUSTION AIR TO MAINTAIN THE FIRING RATE FOR THE HEATING LOAD:

- If after the re-rate factor is used the required firing rate input exceeds the Adjusted Maximum Firing Rate for the burner head being applied, a burner head with a higher Adjusted Maximum Firing rate may be required.

For this example: If an AFG burner operating at 7000 ft. elevation requires a firing rate input of 1.15 gph, an F6 head may be required instead of an F3 head.

EXAMPLE 3

RE-RATING OF THE MAX. FIRING RATE FOR **ADJUSTABLE-TYPE BURNER HEAD SETTING @ 7000 FT.**

Burner Model	Head	Head Setting	Max. Firing Rate at Head Setting	X	Elevation Re-rate Factor	=	Adjusted Max. Firing Rate at Head Setting
AFG	V1	1	1.50 gph	X	87.1%	=	1.31 gph
AFG	V1	2	1.75 gph	X	87.1%	=	1.52 gph
AFG	V1	3	2.25 gph	X	87.1%	=	1.96 gph
AFG	V1	4	2.50 gph	X	87.1%	=	2.18 gph
AFG	V1	5	2.75 gph	X	87.1%	=	2.40 gph

TO PROVIDE ADEQUATE OXYGEN IN THE COMBUSTION AIR TO MAINTAIN THE FIRING RATE FOR THE HEATING LOAD:

- If after the re-rate factor is used the required firing rate input exceeds the Adjusted Maximum Firing Rate for the head setting, a head setting for a higher Adjusted Maximum Firing rate may be required.

For this example: If an AFG burner using a V1 head operating at 7000 ft. elevation requires a firing rate input of 1.40 gph, a change of head setting from 1 to 2 may be required.

EXAMPLE 4

RE-RATING OF THE MAX. FIRING RATE FOR **ADJUSTABLE-TYPE BURNER HEAD SETTING @ 7000 FT.**

Burner Model	Head	Head Setting	Max. Firing Rate at Head Setting	X	Elevation Re-rate Factor	=	Adjusted Max. Firing Rate at Head Setting
CF375	SL1	0	1.65 gph	X	87.1%	=	1.44 gph
CF375	SL1	1	1.75 gph	X	87.1%	=	1.52 gph
CF375	SL1	3	2.00 gph	X	87.1%	=	1.74 gph
CF375	SL1	4	2.50 gph	X	87.1%	=	2.18 gph
CF375	SL1	5	3.00 gph	X	87.1%	=	2.61 gph
CF375	SL1	6	3.75 gph	X	87.1%	=	3.27 gph

Note: The above settings are approximate, and can vary depending on actual job conditions and overfire pressure.

TO PROVIDE ADEQUATE OXYGEN IN THE COMBUSTION AIR TO MAINTAIN THE FIRING RATE FOR THE HEATING LOAD:

- If after the re-rate factor is used the required firing rate input exceeds the Adjusted Maximum Firing Rate for the head setting, a head setting for a higher Adjusted Maximum Firing rate may be required.

For this example: If a CF375 burner using an SL1 head operating at 7000 ft. elevation requires a firing rate input of 2.25 gph, a change of head setting from 4 to 5 may be required.

Remember--it is important to maintain the BTU input as required by the installation and specified by the furnace or boiler manufacturer. If you need further assistance, please contact Beckett Technical Service at **1-800-645-2876** or e-mail our Technical Service Department at **techservice@beckettcorp.com**.