TESTING GAS FURNACES

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ENERGY OutWest
A Holistic Approach

70+ Furnace: *Sample flue gases in the draft diverter. Measure draft in the vent connector above the furnace.*

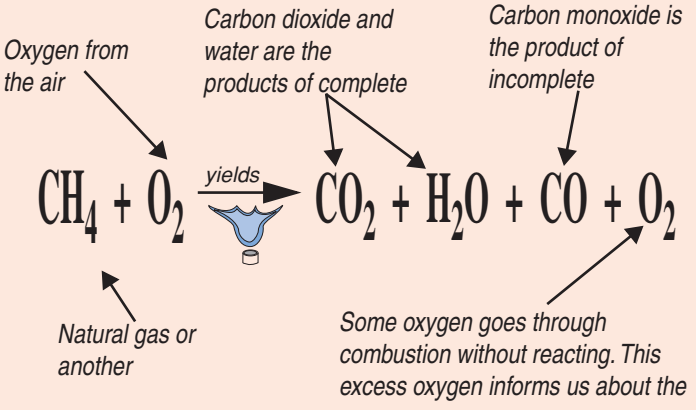
80+ Furnace: *Measure draft and sample flue gases in the vent connector above the furnace.*

90+ Furnace: *Measure draft and sample flue gases in the plastic vent pipe outside the furnace.*

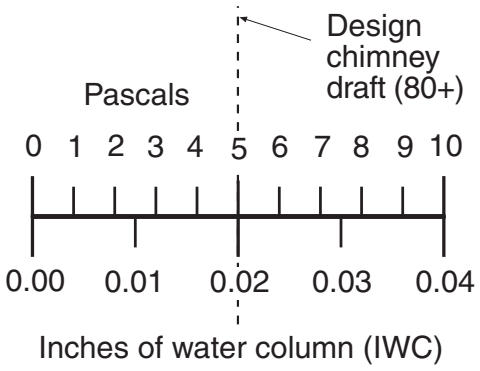
Where to sample combustion gases

Combustion testers: *The most common combustion testers are electronic instruments. The simplest ones measure only CO. The most capable measure O_2, temperature, CO, and draft.*

Combustion gases and their significance



Measuring draft–American and metric



Combustion Problems and Solutions

Problem	Possible causes and solutions
Depressurized combustion zone	Return leaks, clothes dryer, exhaust fans, other chimneys. Seal return. Provide make-up air.
Carbon monoxide	Mixture too rich or too lean. Adjust gas pressure. Check chimney and combustion air for code compliance.
Stack temperature or heat rise too high or low	Adjust fan speed or gas pressure. Improve ducts to increase airflow.
Oxygen too high or low.	Adjust gas pressure, but don't increase CO level.

Combustion Standards for Gas Furnaces

Performance Indicator	70+	80+	90+
Combustion-zone pressure (Pa)	–4 Pa.	–5 Pa.	–10 Pa.
Carbon monoxide (CO) (ppm)	≤ 100 ppm	≤ 100 ppm	≤ 100 ppm
Stack temperature (°F)	350°–475°	325°–450°	≤ 120°
Heat rise (°F)	40–70°*	40–70°*	30–70°*
Oxygen (%O2)	5–10%	4–9%	4–9%
Gas pressure Inches (IWC)	3.2–3.8 IWC*	3.2–3.8 IWC*	3.2–3.8 IWC*
Steady-state efficiency (SSE) (%)	72–78%	78–82%	92–97%
Draft (Pa)	–5 Pa	–5 Pa	+25–60 Pa

* pmi = per manufacturer's instructions

Determining gas input

Input in Thousands of Btu/hr for Natural Gas (1000 Btu/cu. ft.)

Seconds per Revolution	Size of Meter Dial			Seconds per Revolution	Size of Meter Dial			Seconds per Revolution	Size of Meter Dial			Seconds per Revolution	Size of Meter Dial		
	.5 cu. ft.	1 cu. ft.	2 cu. ft.		.5 cu. ft.	1 cu. ft.	2 cu. ft.		.5 cu. ft.	1 cu. ft.	2 cu. ft.		.5 cu. ft.	1 cu. ft.	2 cu. ft.
15	120	240	480	32	56	113	225	51	35	71	141	80	22	45	90
16	112	225	450	33	55	109	218	52	35	69	138	82	22	44	88
17	106	212	424	34	53	106	212	53	34	68	136	84	21	43	86
18	100	200	400	35	51	103	206	54	33	67	133	86	21	42	84
19	95	189	379	36	50	100	200	55	33	65	131	88	20	41	82
20	90	180	360	37	49	97	195	56	32	64	129	90	20	40	80
21	86	171	343	38	47	95	189	57	32	63	126	94	19	38	76
22	82	164	327	39	46	92	185	58	31	62	124	98	18	37	74
23	78	157	313	40	45	90	180	59	30	61	122	100	18	36	72
24	75	150	300	41	44	88	176	60	30	60	120	104	17	35	69
25	72	144	288	42	43	86	172	62	29	58	116	108	17	33	67
26	69	138	277	43	42	84	167	64	29	56	112	112	16	32	64
27	67	133	267	44	41	82	164	66	29	54	109	116	15	31	62
28	64	129	257	45	40	80	160	68	28	53	106	120	15	30	60
29	62	124	248	46	39	78	157	70	26	51	103	130	14	28	55
30	60	120	240	47	38	77	153	72	25	50	100	140	13	26	51
31	58	116	232	48	37	75	150	74	24	48	97	150	12	24	48
				49	37	73	147	76	24	47	95	160	11	22	45
				50	36	72	144	78	23	46	92	170	11	21	42

How to measure input

1. Carefully count how long it takes for one revolution of 1/2, 1, or 2 cubic-foot dial. Find that number of seconds in the columns marked "Seconds per Revolution." Follow that row across to the right to the correct column for dial you timed. Note that you must multiply the number in the table by 1000. Record the input in thousands of Btus per hour
2. If the measured input is higher or lower than input on the name plate by more than 10%, adjust gas pressure up or down within a range of 3.2 to 3.9 IWC.
3. If the measured input is still out of range, replace the existing orifices with orifices sized to give the correct input.

The gas-input table shown here assumes that gas is 1000 Btu per cubic foot. Where Btu values differ from this figure—especially at high elevations—obtain the correct Btu value from the gas supplier, and apply the formula below the table.

(Btu value from supplier ÷ 1000) X Btu/hr input from table = Actual Btu/hr input of appliance

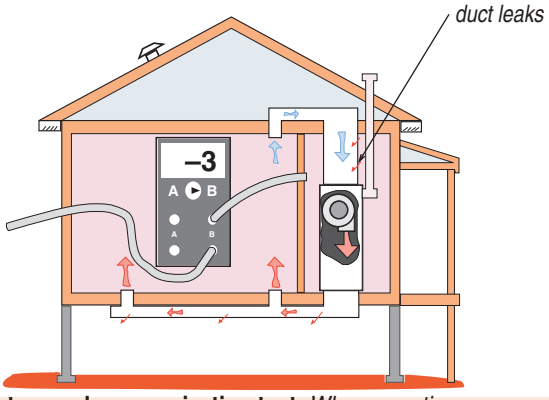
Worst-case draft and pressure testing

Start the testing by turning on combustion appliances and exhaust fans. The air handler should be off initially. With exterior doors and windows closed, connect a digital manometer to read the pressure difference between combustion zone and outdoors. Then take the following steps and measurements.

1. Record the CAZ-to-outdoors pressure difference with the CAZ door open. Then close the door and measure the pressure difference again. Whatever negative pressure you measure is caused by the combustion appliances and exhaust appliances.
2. Next, turn on the air handler; measure the CAZ-to-outdoors pressure difference again—first with the CAZ door closed, then with it open. Negative pressure or increased negative pressure (compared to Step 1) is caused by the furnace blower and return ducts.
3. Now, close all interior doors; measure the CAZ-to-outdoors pressure difference again—first with the CAZ door closed then with it open. Negative pressure or increased negative pressure (compared to Step 2) is caused by imbalanced airflow between supply and return registers.
4. Finally, recreate the conditions observed in steps 1 through 3 above that produced the highest negative pressure. Measure worst-case draft under these conditions. When there are multiple combustion appliances, operate them separately and together. Measure draft in each appliance and compare the negative draft to the values in the table shown here.

Minimum Worst-Case Draft

Outdoor Temperature (Degrees F)				
<20	21-40	41-60	61-80	>80
–5 Pa. –0.02 IWC	– 4 Pa. –0.016 IWC	–3 Pa. –0.012 IWC	–2 Pa. –0.008 IWC	–1 Pa. –0.004 IWC



Worst-case depressurization test: *When negative pressure haunts the combustion zone, the chimney may backdraft. Worst-case conditions do occur—hence the need for safety testing.*