RYAN

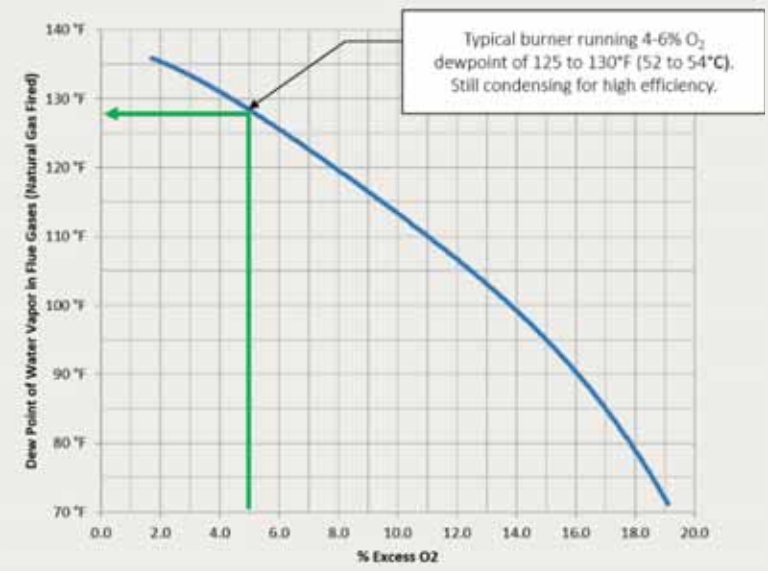
BOILERS/HEATING SYSTEM COMPONENTS

Must-know

Combustion Matters and Not all O2 Trim Systems are the Same.

O2% control is important

Over the last 10 years we have seen the majority of our Hydronic systems now designed around Condensing Boilers with that comes the expectations of efficiencies (above 90%). Many factors affect or have an affect on what that efficiency is but one of the most important factors is air/fuel ratio control of your boiler (combustion system). This system will directly impact the real world application of that boiler's efficiency. This is especially true when it comes to the boilers that claim to have higher turndown with a negative regulation air/fuel control.



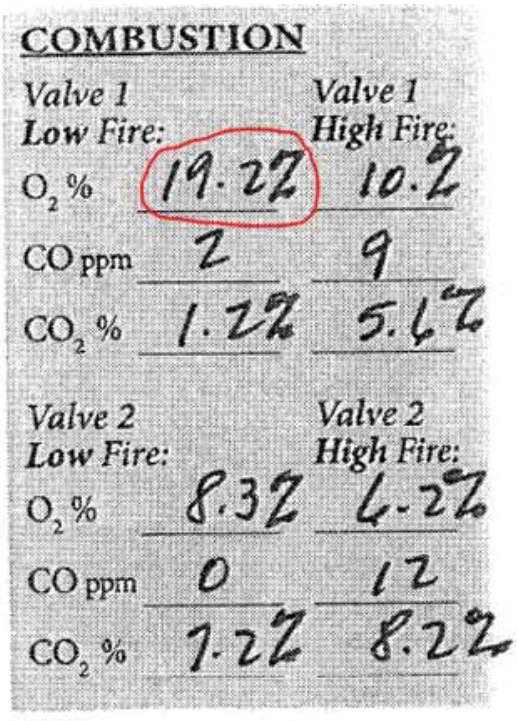
Every burner requires some excess air to maintain flame stability, ensure complete combustion, protect burner components, and limit emissions such as CO and NOx. The actual amount will vary, but for a typical natural gas burner found in a condensing boiler, you want this to be in the range of 4-8% O2 to allow for your boiler to actual condense.

Although excess O2 is required from a realistic standpoint due to the fact that Stoichiometric (perfect) combustion is only theoretical . Having too much will decrease combustion efficiency and lower flue gas vapor dewpoint temperature (condensing potential), causing the end user the cost of a condensing boiler but really only receiving the efficiency of a non condensing boiler Here, a 5% excess O2 ,which is typical of high fire, results in a dewpoint of around 127°F (53°C). Therefore, for a boiler to operate in full condensing mode in this case, the heating system return water must be below 127°F. See image above for graphical representation.

Negative Regulation Combustion Platform

Most condensing boilers on the market today use negative regulation ("neg-reg") combustion control, where a fan speed signal is the only means of adjusting modulation rate. These systems do not directly control the fuel flow rate; rather, the gas valve is along for the ride, tracking behind blower suction pressure. Neg-reg has the favorable benefit of generally maintaining O2% with minor swings in air density, but the trade-off is sensitivity to changes in combustion air and stack pressures, calorific fluctuations of gas, loose repeatability tolerance, and poor resolution at low fan speeds.

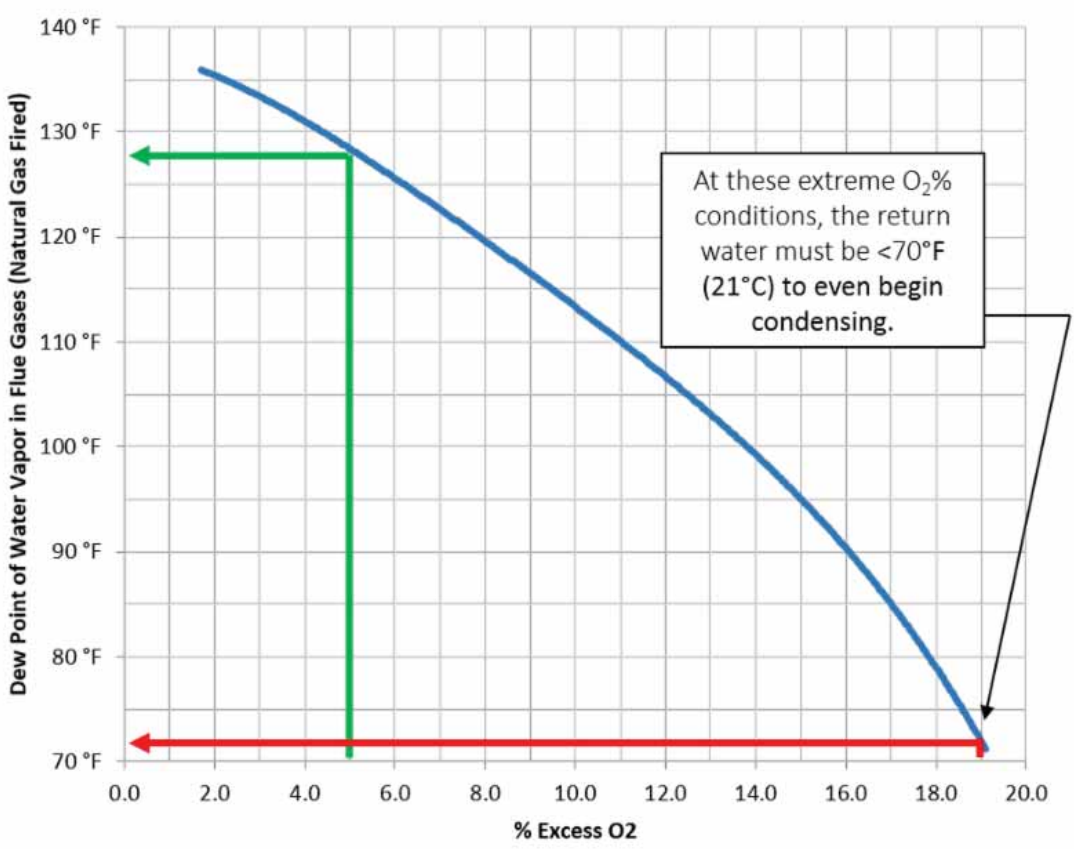
Low fan speeds are a challenge for pressure-sensing neg-reg due to the square root relationship between pressure and flow. At 5:1 turndown, only 1/25th the pressure is measured, while at 15:1 turndown that drops to 1/225th. Such low pressures negatively impact the system's ability to "track" (i.e.maintain) a stable air/fuel ratio. The designer therefore boosts fan speed at low fire to help with combustion reliability; but this leads to higher excess O2%. This will Reduce your ability to actually condense (lower the dewpoint of water) and also reduce your thermal efficiency. Another way to look at it is how come our cars can operate just fine in the desert of Arizona yet also operate just fine in the cold winters of Alaska because you car engine is controlling the O2 in real time. See example below of a commonly used negative regulation boiler with high turndown. See the startup report(common competitors boiler) and where the O2% falls on the graph from up above. This start up report was done per the manufacturer's manual and met their requirements in the manual.



COMBUSTION

	Valve 1 Low Fire:	Valve 1 High Fire:
O_2 %	19.2%	10.2%
CO ppm	2	9
CO_2 %	1.2%	5.6%

	Valve 2 Low Fire:	Valve 2 High Fire:
O_2 %	8.3%	4.2%
CO ppm	0	12
CO_2 %	7.2%	8.2%



What this example shows is that although higher turndown is nice to have it is not practical to expect theses boilers to achieve this turndown if your combustion platform is wrong. In that we must control O2% in real time to actually make sure that these condensing boilers are actually condensing. As you can see from the example that the vast majority of the condensing boilers with high turndown are not actually condensing at all. **So my question to you is Why use or allow these boilers into projects at all as they are not meeting the standards or expectations of your customer or end user?**

Another item to consider is that most heating boilers are commissioned in warm weather at the end of summer. As the cooler weather of fall and winter rolls in, air density increases, which causes excess air to increase. This negatively impacts combustion efficiency and flue gas condensation dew point. It also causes a lot of these boilers to not light on during the winter months on the coldest of days when we really need the boilers to be working and thus we have an unhappy customer. Controlling our O2 will eliminate this problem and create the highest reliability of light off and keep our customers HAPPY AND WARM!

WHICH IS THE MOST IMPORTANT ITEM OF THEM ALL!!

SOLUTION

The Endura+ with Fulton's PURE Control™ completely solves all of these concerns by eliminating neg-reg, instead using high-precision discrete air and gas servo motor control with 0.2° accuracy optimized across ten combustion points. This system allows the boiler to achieve reliable turndown as high as 15:1 without resorting to excessively high O2% levels. Additional benefits include dependable ignition, and an integrated O2 Compensation system that automatically tunes the air/fuel ratio during operation.

This produces a boiler that will be more forgiving for changing operation conditions. A reliable boiler that will always start up during the winter months. Most importantly it gives you a boiler that actually is a Condensing Higher Turndown boiler as advertise. **Thus creating energy savings and happy customers!!**

See below for other Manufacturers that offer an o2 trim system on their boilers(or so they claim) but as you can see not all of them are the same or even adjust your o2 at all. Major points to look are if they actually have air/fuel action (adjusting o2 in real time not just monitoring) and Duty cycle(how many times throughout the day they actually re-adjust the o2). Monitoring is not adjusting for seasonality and in real time. Monitoring is just given you a value its not changing the value for performance.

AS YOU CAN SEE FULTON REALLY DOES OFFER THE BEST AND TRUE O2 adjustment 100% of THE TIME!!!

LETS FOCUS OUR SPECS TO SAY O2 TRIM NOT MONITORING!!!

The Competition (Stainless Steel Firetube)

Boiler Model	Trade Name	Combustion Control	Air/Fuel Ratio Action (Trim Type)	Duty Cycle
Fulton EDR (PURE)	O2 Compensation	Dual Servo	Blower Speed Shift	100%
Fulton EDR+	O2 Compensation	Dual Servo	Main Gas Valve Pressure	100%
Aerco BMK Platinum	AERtrim	Proprietary Air-Fuel Valve	Blower Speed Shift	25%
Lochinvar Crest	O2 Feedback	Negative Regulation	None (Monitoring only, function performs no actions)	n/a
Cleaver-Brooks ClearFire	"Inherent O2 Trim"	Negative Regulation	None (No monitoring or trim system of any kind)	n/a
RayPak Xvers	HO2T	Negative Regulation	Neg-Reg Shutter Mod Motor (Imprecise Method)	Not Specified

New Product Alert:

PURE Control Package now available on all Endura models.
Model sizes included with the option for PURE control:

- **750,000 btu/hr**
- **1 million btu/hr**
- **1.5 million btu/hr**
- **2 millions btu/hr**

PURE Control comes standard on the Endura + boilers
Model sizes include:

- **2.5 million btu/hr**
- **3 million btu/hr**
- **4 million btu/hr**
- **5 million btu/hr**
- **6 million btu/hr**
- **8 million btu/hr (now available)**
- **10 million btu/hr (now available)**
- **12 million btu/hr (now available)**

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