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Why does my burner keep shutting down?

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Why does my burner keep shutting down? Overview

- Diagnosing the most common problem: Did my burner fail or did my sensor fail? How do I know for sure?
- Checking safety interlocks, and how annunciators can pinpoint the problem area.
- What outside influences could cause the burner to shut down?
- Preventative maintenance that can help avoid or reduce nuisance shut-downs.

Review: Types of Flame Detection

- Flame Rods
  - Uses the principal of flame ionization to pass a current through the flame to verify its presence.
  - Requires proper grounding to work efficiently.
  - Not applicable for all burner designs/operating conditions

- Scanners
  - Photo-eyes are used to detect different spectrums of light energy from a flame to verify its presence.
    - Ultra-Violet – common with natural gas/propane burner applications
    - Infra-Red – common with coal, oil, and manufactured gases

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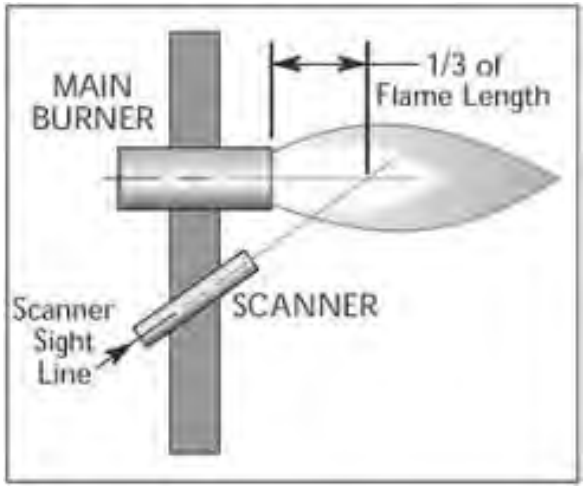
How can my Flame Rod fail?

- Flame Rod Issues
  - In the presence of flame for the entire firing rate
    - If flame starts to lift away from the retention nozzle/orifice, could open the circuit.
  - Grounding Interference
    - Any interference of the current traveling from the flame safeguard, through the flame and to ground could cause flame failures.
  - Drooping Flame Rod
    - Excessive temperature could cause the flame rod to droop and touch the burner internals. This is not a normal current path, and the flame safeguard will lockout.
  - Fouling of Flame Rod
    - Could be from soot of rich combustion or the presence of a foreign material in the process.

How can my UV Scanner fail?

- UV Scanner Issues
  - Dirty scanner lens
    - Dirt and debris from the combustion chamber could accumulate on the lens of the scanner
  - Self-Checking Scanner - Mechanical Shutter Failure
    - Fails to close: Photo-eye still sees flame, creates unique fault code
    - Fails to open: Photo-eye does not see flame, generates “Main Flame Failure” fault code
  - Excessive temperature/vibration on scanner
  - Signal interference or other background noise
    - Disruption in flame signal or shutter command can cause scanner failure
  - Photo-eye burned in (false positive)
    - Will fault out after post-purge, or during safe start check on next cycle
    - Over 24 hours of continuous operation? Use Self-Check UV Scanner



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Did my burner fail or did my sensor fail?

- Fault Code messages sometimes do not pinpoint the source of the problem:
  - Honeywell Fault Code 8 – Flame Amp/Shutter (probably sensor fault)
  - Honeywell Fault Code 17 – Main Flame Failure (could be burner OR sensor fault)
- It is highly recommended to have a spare sensor available to swap out if source cannot be identified.
  - Sensor swapped and problem goes away – original sensor was bad
  - Sensor swapped and problem persists – problem is somewhere else

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How can I improve my flame detection?

- **TIPS for improved flame signal strength**
  - For flame rod applications, consider trying “Extended Distance” Flame Amplifiers
    - Available for most Honeywell RM7800 series flame safeguards
    - Increased sensitivity provides greater flame signal when flame detected
  - Keep your flame rods clean
    - Inspect every 3-6 months, replace as needed
  - For UV Scanner applications, bring purge air into the sight pipe
    - Prevents scanner lens from building up with dirt/debris from combustion chamber
    - Also keep chamber heat away from the scanner
  - Consider upgrading your UV scanner and flame amplifier
    - Honeywell C7061 scanners provide a much better flame strength compared to the C7012 scanners at a much lower price point.
    - Would also need to replace the flame amp card to an R7861
  - Add second UV Scanner in parallel (review your code guidelines before installing)

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My flame sensor is fine, now what?

- If the flame sensor checks out, the Flame Safeguard must be turning off the burner because:
- A) It was told to shut-off (lost “Call for Heat” signal) – No Alarm
- B) Running Interlock Opened Up – Lockout with fault code
- C) Genuine Loss of Flame – Lockout with fault code

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Lost “Call for Heat”

- All flame safeguards have a “Call for Heat” input signal that initiates the light-off sequence and keeps the burner running.
- Responds in less than a second after signal is removed.
- Some flame safeguards incorporate the call for heat through the interlock string, others have a separate terminal.
- Check wiring for loose connections.
- Some Call for Heat signals originate from remote panels or have multiple relay contacts in series, make sure all relays are in their correct state and did not momentarily open.

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Running Interlock Opened Up

- Will either cause a safe shutdown or a lockout with appropriate fault code depending on what type of flame safeguard you have.
- Annunciators can help pinpoint which interlock shut the burner down.
  - Need “First Out” capabilities to catch automatic reset interlocks
- Use Manual Reset devices when appropriate to help identify the running interlock that caused the fault.
  - Low Gas Pressure
  - High Gas Pressure
  - Excess Temperature Limit (manual reset by code)

Genuine Loss of Flame

- Combustion Triangle Review:

- In order for combustion to occur, we not only need all three of these elements, but we need the proper **ratio** of oxygen to fuel as well.

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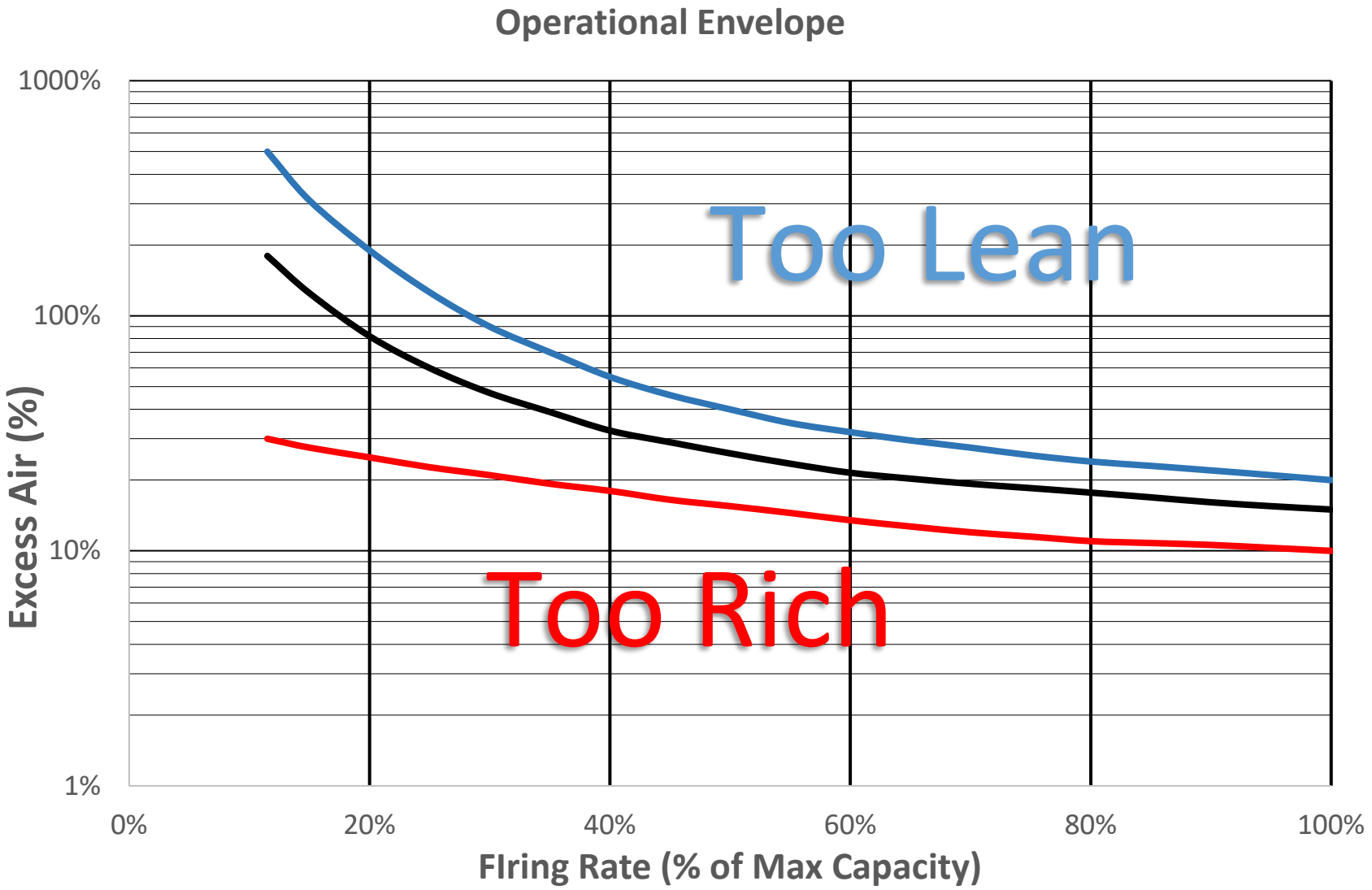
Hydrocarbon Fuel Properties

- All fuels have a lower and upper flammability limit.
- Combustion can only occur between these limits.
- When changing the firing rate of a burner, both the air and fuel need to travel together to stay between these limits.

Type of Gas	LFL	UFL	Stoich
Natural Gas (CH_4)	5.0%	15.0%	(10:1) - 9.1%
Propane Gas (C_3H_8)	2.1%	9.5%	(25:1) - 3.8%
Butane Gas (C_4H_{10})	1.8%	8.4%	(32:1) - 3.0%

Limits of Flammability – Typical Industrial Burner

- Air-fuel ratio typically described with respect to excess air percentage for industrial burner applications.
- Need to be above the red line and below the blue line to stay within the limits of flammability.
- Deviation outside of these lines can result in flame failure.



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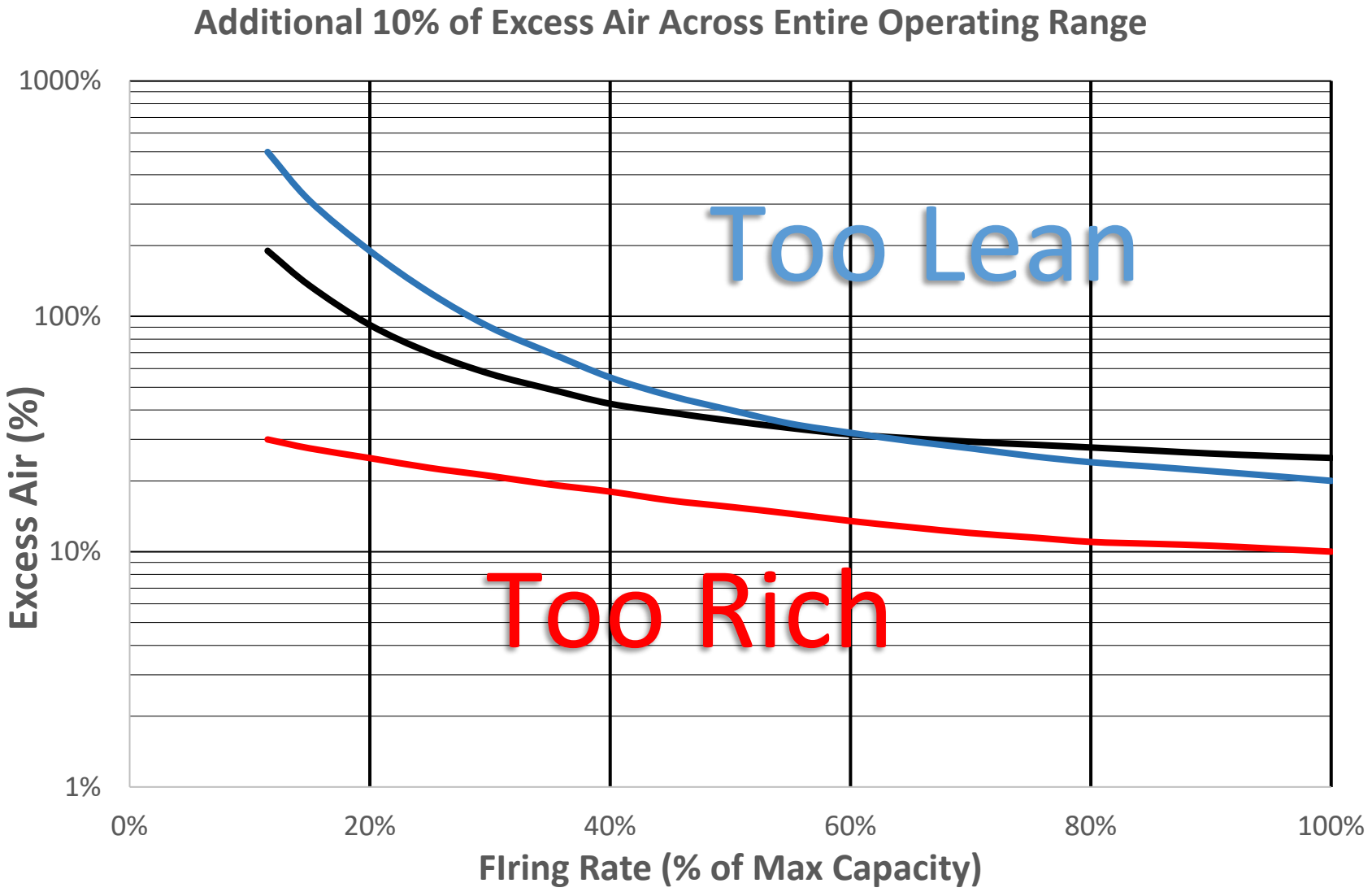
Additional Excess Air

- An increase of 10% excess air across the entire operating range of the burner will cause the burner to lean out as firing rate approaches 65% firing rate.



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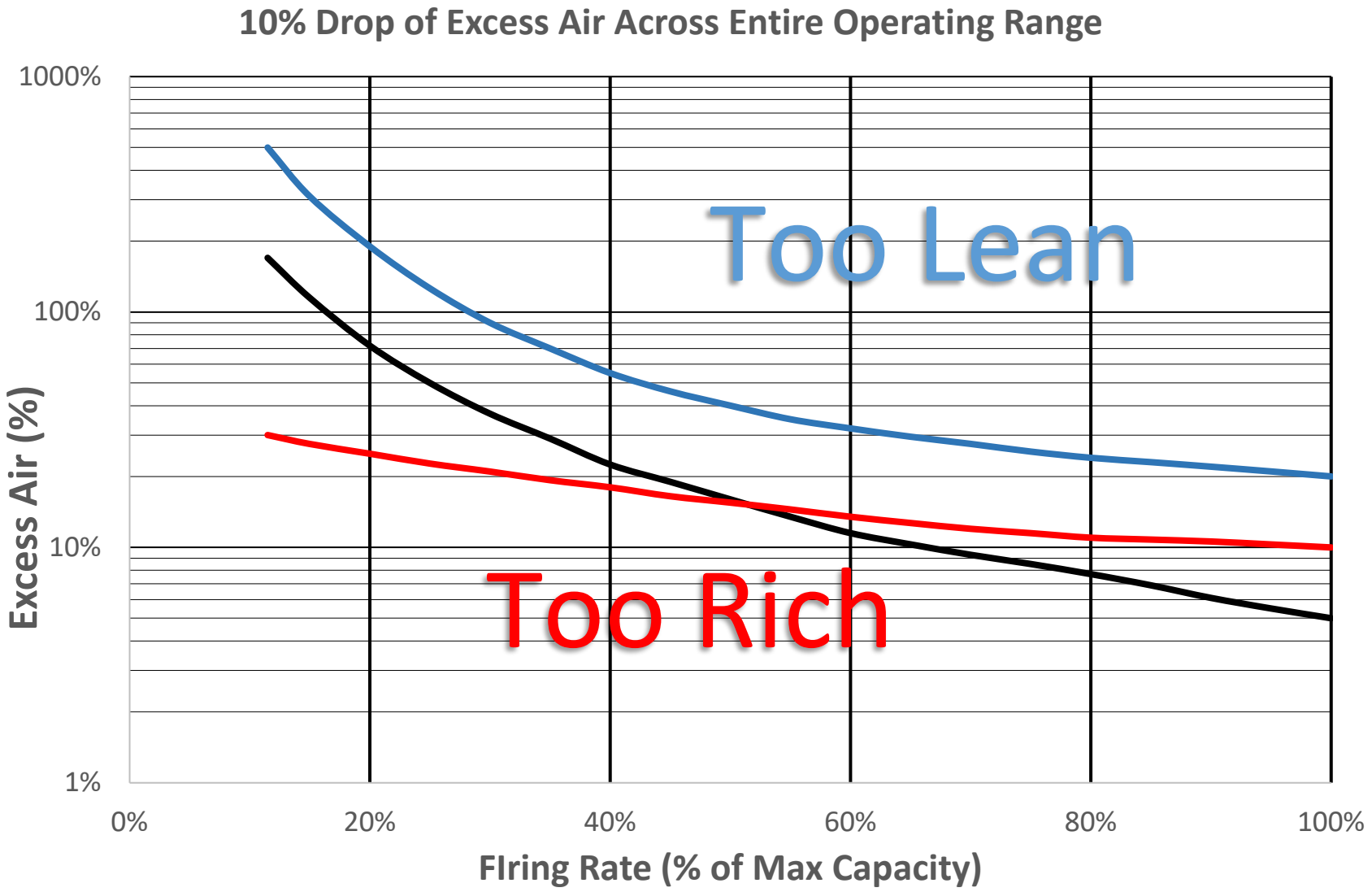
Excess Air Reduction

- A decrease of 10% excess air across the entire operating range of the burner will cause the burner to go fuel rich as firing rate approaches 55% firing rate.



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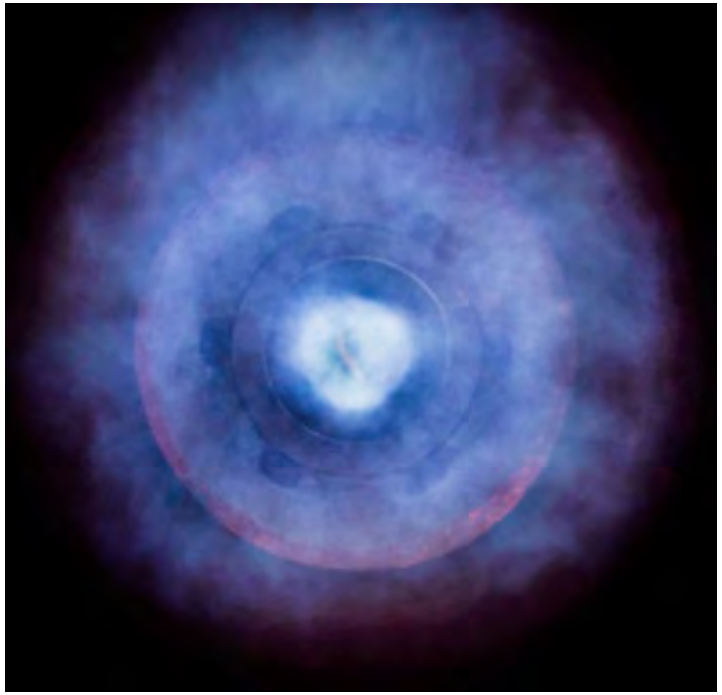
Reasons for Air-Fuel Ratio Change

- Seasonal changes
  - If pulling in outside air for combustion, the mass flow increases as temperature decreases due to the higher density of colder air.
- Combustion Chamber Fluctuations
  - Drastic changes in combustion chamber pressure can skew the air-fuel ratio on a burner that has different air and fuel differential pressure requirements.
- Hysteresis on Mechanical Linkage
  - Sloppy mechanical linkage could cause changes to the air-fuel ratio over time.
- Inconsistent Inlet Pressure to the fuel train
  - Natural Gas regulators should override most inlet pressure fluctuations, but severe fluctuations could change the outlet pressure and alter the air-fuel ratio.



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How can I maintain the proper air-fuel ratio?

- Frequently check the air and fuel pressures to the burner against the manufacturer's recommendations.
  - Burners typically have test connection ports on the air and fuel inlets, which you would measure against the chamber pressure and compare to the chart that the manufacturer supplies.
- Measure the products of combustion with a combustion analyzer
  - Amount of NOx, CO, and O2 in the exhaust stream can indicate if the burner is at the proper air-fuel ratio.
- Consider upgrading from mechanical linkage to electronic linkage
  - Eliminates mechanical hysteresis
  - Can program a "summer" and "winter" operating curve
- Install/maintain your sight glasses and learn what a good flame looks like
  - Each burner and application is different, over time you can know what to look for and how to adjust based on sight.

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Interested in learning more about Air-Fuel ratio?

- Introduction to Air-Fuel Ratio Control
  - http://www.lesman.com/train/webinars/Webinar-Air-Fuel-Ratio-Control-Intro.htm
- Advanced Air-Fuel Ratio Control
  - http://www.lesman.com/train/webinars/Webinar-Air-Fuel-Ratio-Control-Advanced.htm

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