



Porter McGuffie, Inc.

Engineering Measurement and Analysis Services

Stoichiometric Firing Damage in Claus Unit

**2016 LAURANCE REID GAS
CONDITIONING CONFERENCE**

Dennis Martens & Mike Porter

Porter McGuffie, Inc.

www.pm-engr.com

Stoichiometric Firing “WHEN?”

■ Main Claus TR burner

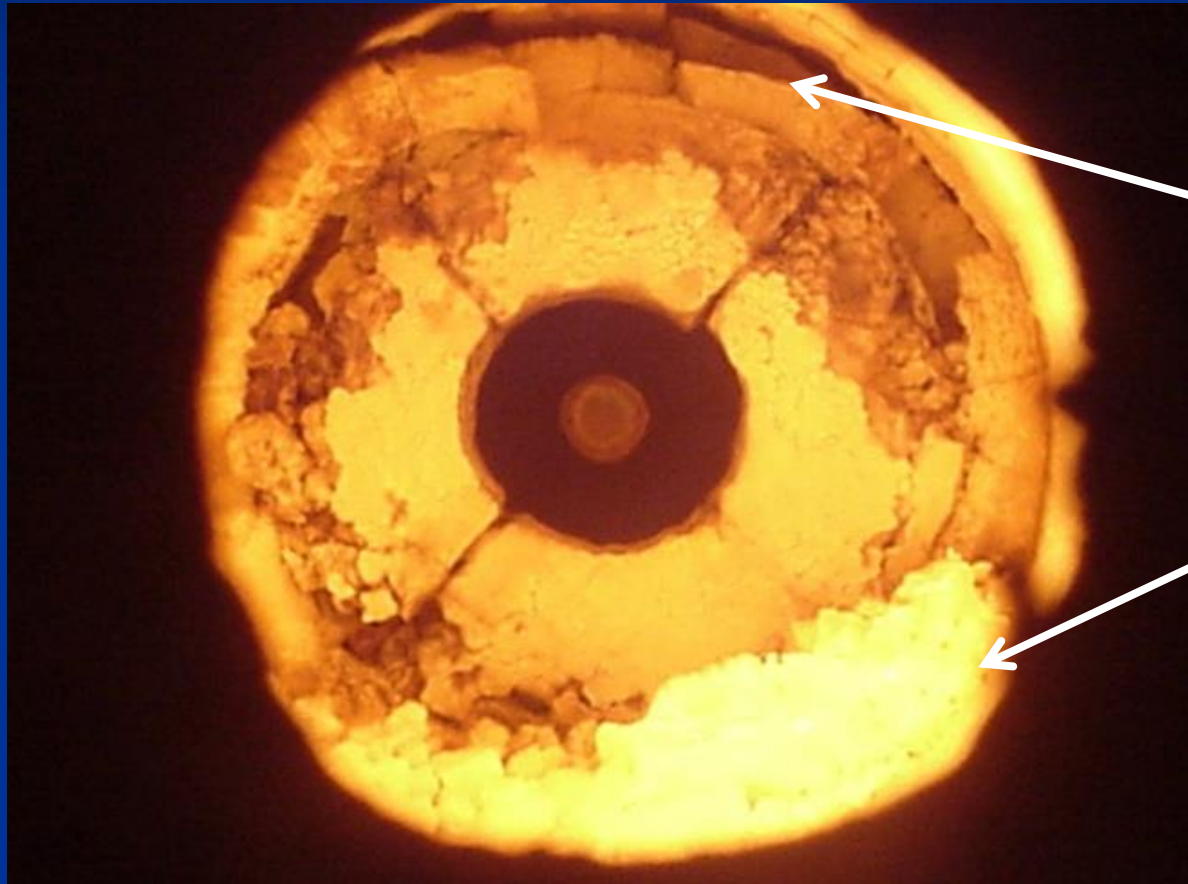
- Normal Operation sub-stoichiometric H_2S
- Abnormal Operation OFF RATIO's
 - Hydrocarbon in feed
 - Incorrect 2 zone operation
- Starting up Near Stoichiometric fuel gas
- Hot Standby Near Stoichiometric fuel gas

■ Inline Burners

- Same Sub Set as Main Burner above



WHAT DAMAGE????



Refractory
Damage

White Hot
Pile Of
Fallen
Refractory
($> 3000\text{ F}$)

WHAT DAMAGE????

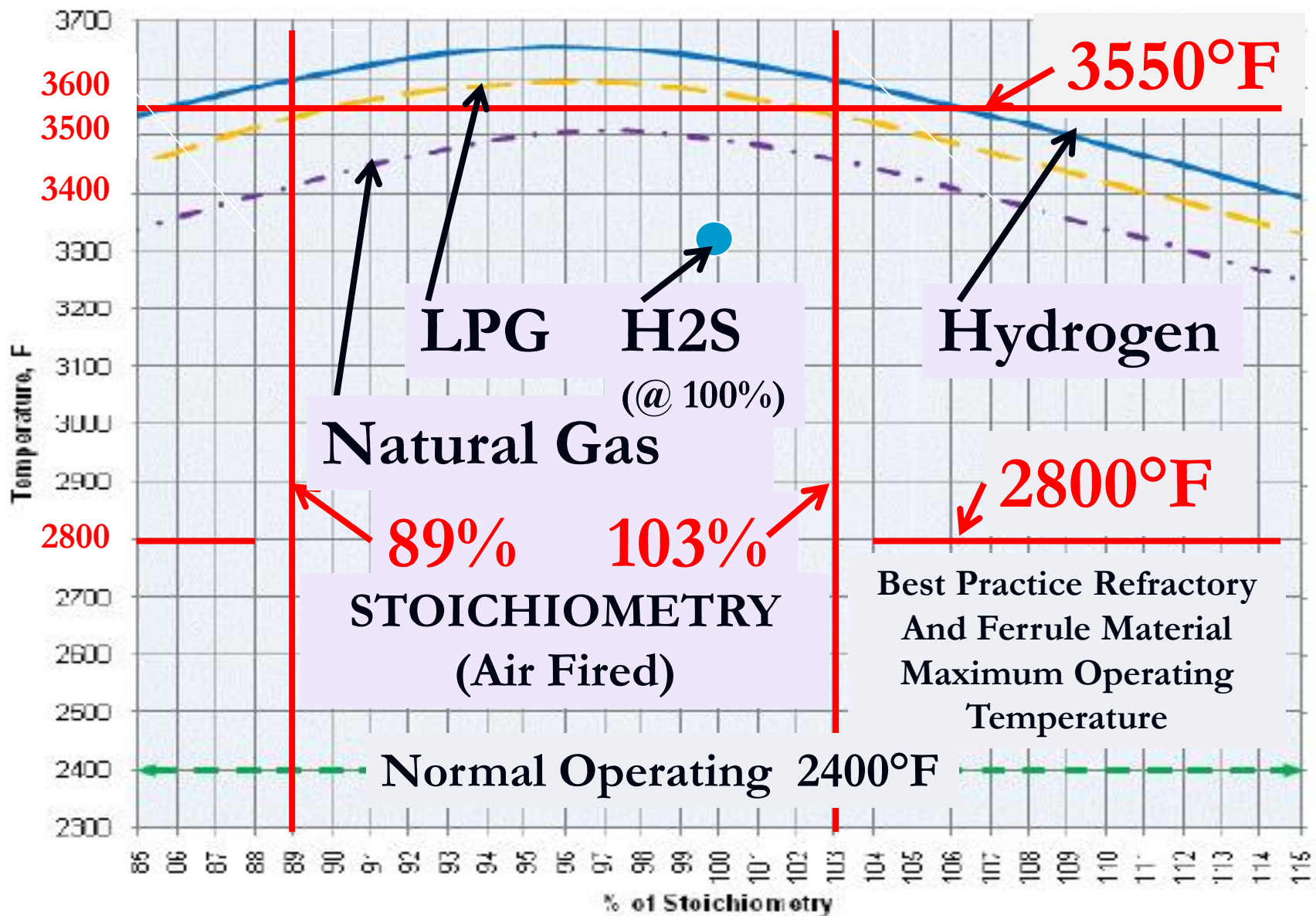


Ferrule
Damage

Melted
Ferrules
(>3000 F)

**Near 100%
Stoichiometric Firing
Temperatures can get
real hot
ESPECIALLY IF
OXYGEN FIRED**





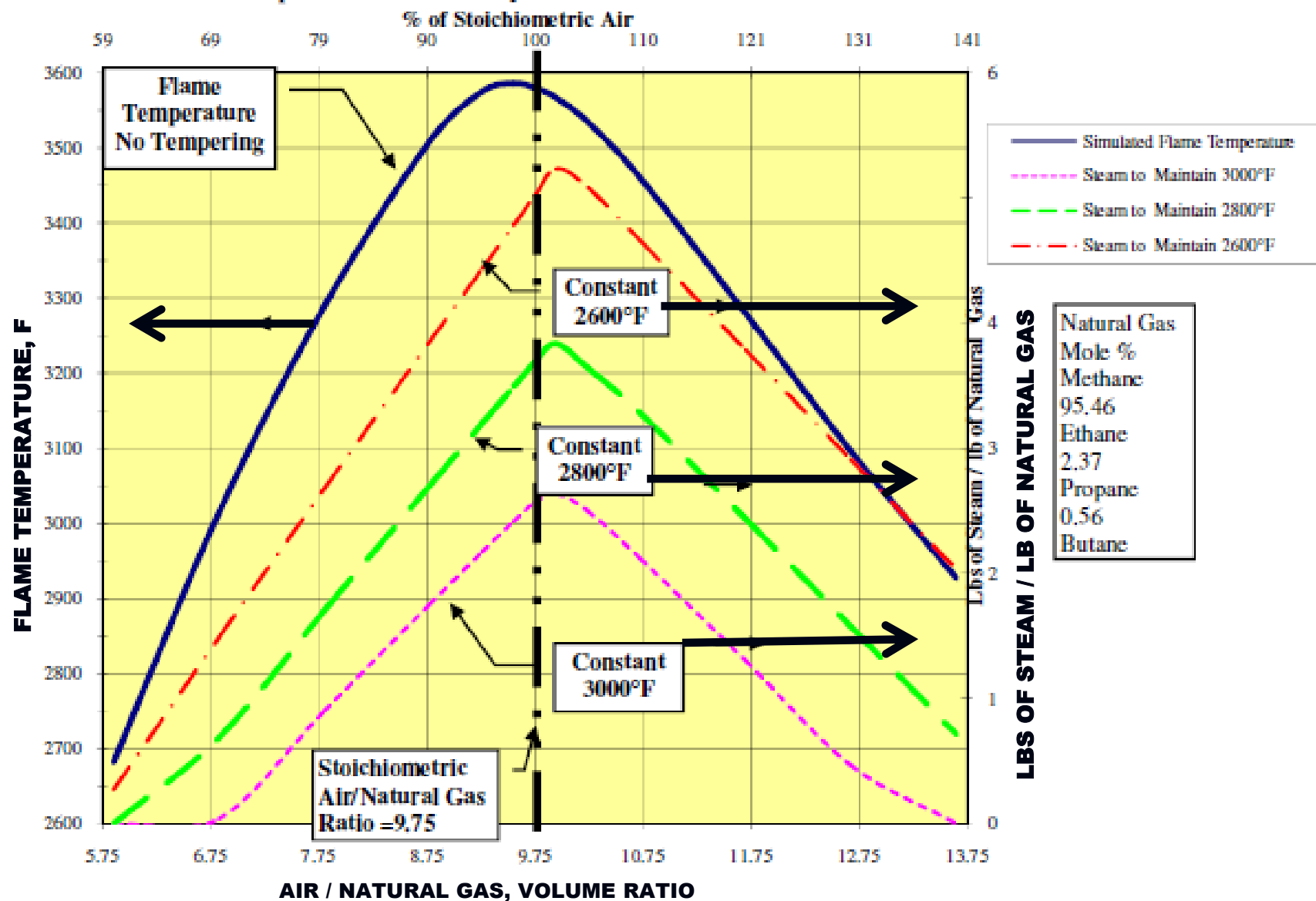
**So what do you do to keep from
destroying the equipment?**

**Temper the combustion temperature with
inerts; steam or nitrogen or recycled tail
gas/process gas**

**Example graph of a Natural Gas steam
tempered combustion temperature**



Flame Temperature and Steam Requirements for Various Air to Natural Gas Ratios



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Excessive Temperature

Moral OF THIS STORY!!

KEEP YOUR COOL BY TEMPERING!!

References:

- **Burner Flame Temperature During Warm Up And Hot Standby by Alan D. Mosher Presented at 2011 Brimstone Vail Conference**
- **Designing A Robust Waste Heat Boiler by Dennis Martens and Mike Porter Presented at 2015 Laurance Reid Gas Conditioning Conference**

Both of these papers have additional references listed

