

Executive Summary

Low NO_x Steam Boiler

1. Gas Quality and LNG Research Study Objectives

This research study was designed to assess how residential and small commercial/industrial end-use equipment responded to changes in gas quality and to determine if Southern California Gas Company (SCG) needs to modify its current Gas Quality Standards (Rule 30).

Two main tests were conducted to evaluate how the appliance will react to different test gases when (a) tuned to the rated input while using Base Gas (low heating value and low Wobbe Number) and (b) tuned to the rated input using Gas 3 (highest heating value and highest Wobbe Number). The major objectives of the study during these tests were as follows:

- Evaluate the selected unit to determine any issues relating to equipment safety and performance. Equipment safety includes changes in carbon monoxide (CO) levels, flame lifting, flame stability, flashback and yellow tipping. Equipment performance includes ignition and combustion stability.
- Collect NO_x emissions data during testing.

2. Selection Criteria

This type of boiler (with a premix power surface burner operating on blue flame mode) was selected for a second test to verify the results obtained during the first phase of testing (September 2004) and to evaluate how the appliance would react to the test gases after tuning it with two different setup gases – Base Gas (lowest heating value and Wobbe Number) and Gas 3 (highest heating value and Wobbe Number).

Tuning the appliance included adjusting the input rate by changing the orifice and/or adjusting the manifold pressure and adjusting the primary air until the emissions matched the ones when tuned with Base Gas or recommended by the manufacturer

Although this boiler is not the same input rate as the one tested last year, it uses the same burner, controls and heat exchanger technology. Originally, this type of appliance was selected because:

- The boiler manufacturer and the burner system are widely used in our service territory.
- Industry experts and boiler manufacturers' concern with safety of the unit when operating with rich gases.

- Complexity for boiler and burner manufacturers in meeting SCAQMD Rule 1146.2 while adhering to the Gas-Fired Low Pressure Steam and Hot Water Boilers Standard (ANSI Z21.13) and/or Underwriters Laboratory Commercial - Industrial Gas Heating Equipment Standard (UL-795)¹.

3. Test Results and Findings

The Low NO_x Steam Boiler was tested over a wide range of operating conditions and gas compositions according to developed test protocols². Results obtained from all tests conducted revealed that:

- There were no operational, ignition, flame stability, flame lifting, flashback, yellow tipping or safety problems with the different gases or during transitioning.
- After tuning the appliance with Gas 3 (highest heating value and Wobbe Number) CO emissions averaged 325 ppm (corrected to 3% O₂) with Base Gas.
- Flame temperature, partial orange tinting of the flame, NO_x emissions and equivalence ratio followed the same pattern as the Wobbe Number
- Results while boiler was tuned with Base Gas corroborate results from testing conducted in September 2004.

After the manufacturer reviewed the data, they expressed concerns with higher NO_x emissions observed with richer gases when tuned with Base Gas and the higher CO emissions observed with Base Gas when tuned with Gas 3.

4. Equipment Specifications

- **Description:** 15 Boiler HP Low NO_x Steam Boiler
- **Burner:** Premix power surface burner operating on blue flame mode
- **Input rate:** 645,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 7 - 14 in. w.c.

¹ SCAQMD Rule 1146.2 limits the NO_x and CO emissions for Type 1 boilers (from 75,000 Btu/hr up to and including 400,000 Btu/hr). The ANSI and UL standards cover safety, construction and performance, with each having combustion tests that limit CO emissions.

² Testing protocols used in this program were derived from industry standards and regulatory test procedures. Note, however, that based on the needs of this program and the operating and design characteristics of equipment tested, adherence to the industry and regulatory testing standards was not literal. The reader is cautioned that no inference can nor should be drawn as regards certification of these devices to the industry or regulatory requirements as a result of this program.