

Executive Summary

Steam Boiler with Premixed Gun-Type Power Burner

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 the 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 8 (middle heating value and middle Wobbe Number). The major objectives of the study during these two tests were as follows:

- Evaluate each 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, combustion and output stability.
- Collect NO_x emissions data during testing.

2. Selection Criteria

This unit was selected due to the following factors:

- It uses a premixed gun-type power burner that several industry experts indicated might be sensitive to richer gases.
- Both the boiler manufacturer and the burner system are commonly used in our service territory.
- To evaluate how it will react to the different test gases after tuning it with two different set up gases - Base Gas (low heating value and low Wobbe Number) and Gas 8 (middle heating value and Wobbe Number).
- Difficulty 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.

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.

3. Test Results and Findings

The 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), NO_x emissions were more stable than when tuned with Base Gas (low heating value and low Wobbe Number).
- CO emissions were negligible for all tests.
- NO_x emissions and equivalence ratio followed the same pattern as the Wobbe Number.

The manufacturer's representative tuned this appliance with both Base Gas and Gas 8 to approximately 350,000 Btu/hr; which is 11.8 percent below the rated input.

After the manufacturer reviewed the test results, they expressed concerns with high NO_x emissions and low O₂ percentages when the unit operated with richer gases.

4. Equipment Specifications

- **Description:** 9.5 (boiler) HP Low NO_x Steam Boiler
- **Burner:** Premixed gun-type power burner
- **Input rate:** 397,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 7 - 14 in. w.c.

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.