Case Study: **Proper Selection of Gas Regulators for CAMUS High Efficiency Boilers**
FFC Ref: 12030519

Job Site: Taunton High School

Customer: Columbia Gas of MA / Bay State Gas Company

Date of Service: March 5, 2012

Boilers: CAMUS DynaFlame Series, Model DFNH 3001-MGI

BTU Input: 3000 CFH Nat Gas

Delivery Press. from Gas Co.: 2 PSIG

Line Regulator: See Issues

Issue: The gas company was called repeatedly to job site due to "pressure control" issues. New CAMUS boilers were shutting off repeatedly due triggering of high pressure limit switch on each boiler. CAMUS boilers are high efficiency boilers and have extremely tight pressure regulation requirements. (See Notes 1). Issue was traced to the line regulator upstream of each boiler. The line regulators that were initially installed were Maxitrol RV Series. These were deemed non- code compliant and non functionally compliant because they were non-lock-up regulators: meaning when the flow stopped, the pressure would equalize across the regulator and overpressurize the downstream equipment.

<u>Repair/Remediation</u>

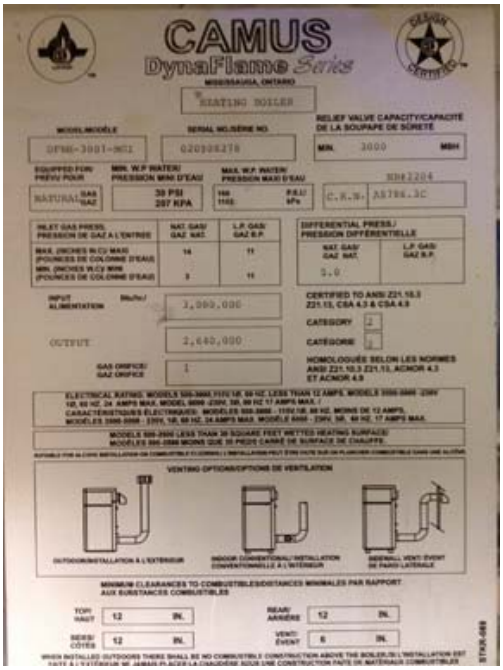
1st Attempt: The gas company attempted to replace the RV series regulators with Maxitrol 210-D regulators. While the factory literature stated that the 210 series was a "***Lockup Type***" regulator, the problem persisted. Pressure would spike each time boiler turned off and trip the high pressure limit switch. Maxitrol confirmed that the phrase "Lockup Type" does NOT mean True bubble tight lock-up as defined by ANSI Z21.80 (See Note 2) Maxitrol confirmed that "lockup type" as it relates to the 210 series, simply means that the regulator will close bubble tight at a some pressure less than the inlet pressure. With the regulators set at 7" w.c, the lock-up pressure was not repeatably below 12.5" w.c. and would often creep up well above 1 PSIG. The Maxitrol 201's were deemed non- code compliant and non functionally compliant because they were non-lock-up regulators and were removed and replaced.

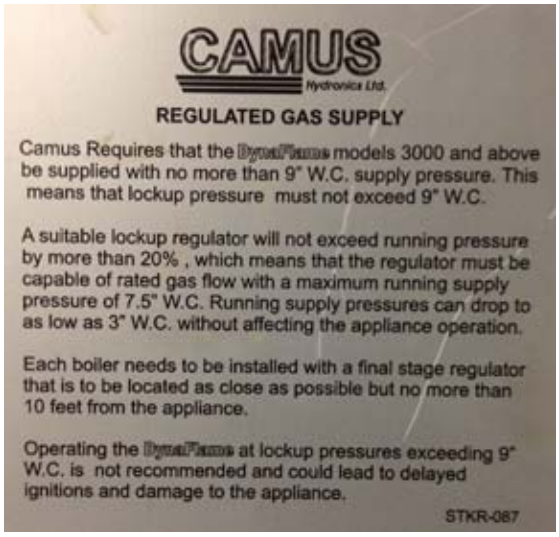
2nd Attempt: The gas company replaced the Maxitrol 210 series regulators with Itron B34R service style regulators. These regulators were true bubble tight lockup regulators. The regulators controlled the pressure under flowing and no flow conditions within a few inches water column. However, when the existing 50 feet of 1" vent line was connected to B34R regulator, the lock-up pressure shifted up close to the 12.5" w.c. threshold. The CAMUS boilers closed with such speed that the line packed with gas and pressure would spike slightly. This occurred because of a vent line effect: the B34R (sensing rising pressure), would attempt to close, but could not push the air in the upper diaphragm case out of the vent through the convoluted 50 foot vent line. It was determined that the vent lines could be upsized to 1.5" and speed of response would be improved, but this would be cost prohibitive. It was decided that a third regulator design would be tested

3rd Attempt: The B34R Regulator was replaced with a Pietro Fiorentini Governor Model 30154-DC Regulator. This design incorporates an Over pressure Protection device in the form of an Operator/ Monitor configuration and is suitable for inlet pressure up to 5 PSIG. The OPD version was not actually required by code for this particular application because the inlet pressure was 2 PSIG or less. However, this design has an added benefit when used on fast on/off loads. Because the CAMUS boilers closed with such high speed, the dual regulator design created a shock absorber effect – and minimized the spike that was occurring at when the boilers shut off. Furthermore, because the PF Govenors are ANSI Z21.80 approved for installation without a vent line, the vent line effect was removed as a variable in the response time. The PF Governors kept the pressure within a few ".w.c of set pressure and locked up below 12" w.c. The rest of the boilers were converted and the system was successfully commissioned and handed over to the owner without further incident.

Summary: None of the regulators installed were defective. The issue was actually the speed at which the boiler turned off (less than 125 mS from full open to full closed). Regulator selection ultimately had to made based on a variety of site specific requirements and variables which for this site included a 2 PSIG inlet pressure, fast on/off valve requiring rapid regulator response, long vent lines, and gas line velocities resulting in line pack and pressure spikes. The Pietro Fiorentini Model 30154-DC was best suited for this particular application.

Note 1: Badges off CAMUS Boiler show the extremely tight pressure control requirements demanded by the manufacturer. The manufacturers original badged lock-up requirements were 50% more stringent than code. (They have since then loosened this requirement)





Note 2: ANSI Z21.80 Section 2.9 Regulator Lockup Pressure: A regulator shall "lock – up" under no flow conditions to limit the downstream pressure as indicated…None of the lock up pressure readings shall exceed the following:

Class 1 Regulator: 150% of the initial outlet pressure or the initial outlet pressure + 5 inches of water column, whichever is greater

Example: If line pressure regulator set for 7" w.c. the lock-up pressure at no flow conditions should not exceed 7" x 1.5 = 10.5" or 7" + 5" = **12" w.c.** The latter being greater is the limit for a Class 1 Line Pressure regulator.

Class 2 Regulator: 150% of the initial outlet pressure

Example: If line pressure regulator set for 7" w.c. the lock-up pressure at no flow conditions should not exceed 7" x 1.5 = **10.5" w.c**

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