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RTU Gas Pressure Investigation

Overview

Mechanical Service Corporation was retained to investigate a concern of gas pressures and regulator selections on the natural gas supply for a 50 MPB indirect furnace installed in a packaged rooftop unit. It was reported that the regulator selection and supply gas pressures may be suspect as there were numerous burner failures, alarms, and sporadic burner shutdowns.

Scope of work performed

Install manometers and pressure gauges to read building supply pressure, inlet to unit pressure, and gas train pressures during various firing conditions. Verify field installed piping and selected specialties. Trace out and confirm piping selection and observe the furnaces operation throughout different testing conditions.

Observations and technical notes

- Upon arrival the unit was in unoccupied and the burner was tripped off on a flame detection alarm. Upon occupying the unit and clearing the alarm, the burner continued to cycle through starts and failed to fully light off. It was ultimately determined that there was a loose piece of metal in the burner mixing plate that was making inadvertent contact with the flame sensing probe which would ground it out and shut the burner down. This was temporarily corrected and a replacement part ordered.
- Submittal data on the burner call for a supply pressure of 7" WC to 0.5 PSI (14" WC).
- The initial regulator spring (Blue, rated for 8.5"-12.5" WC) was previously replaced by others with a Black spring kit (6.0"-9.0" WC) as the adjustment nut on the previous spring was almost fully in as reported by others.
- Gas enters the building, goes through a primary regulator with a specified range of 1-2.5 PSIG before passing through a gas meter. The supply then divides into two branches, one dedicated to the RTU in question and one for the remaining 3 RTUs.
- The [redacted] primary regulator is the gas service provider's and is upstream of the gas meter. The building design submitted load worksheet that was sent to the gas service provider on behalf of [redacted] was verified accurate.
- The branch that serves the RTU is nearly 120' of run with 5 ells' comprised of 3" pipe in the runs. The piping is adequately sized for supplying the RTU with the 500 MBH required.
- The reducing tee located at the unit where the piping transitions from a horizontal at the roof to vertical is installed as a high-loss fitting. It is recommended to replace that with a conventional tee fitting at the current pipe size and continue that size to the secondary

regulator. Due to the main piping run being oversized, the current installation of that fitting, although less than ideal, is not of immediate concern.

- The secondary regulator is an [redacted] with a 1.25” valve body and a 6.0”-9.0” spring installed. As found, the regulator was set to 10.7” at the inlet to the unit.
- The regulator has a 5/8” x 3/4” orifice. This regulator and orifice combination is rated for 1180 MBH with an inlet pressure of 1 PSI.
- The listed values are based on a 2” valve body as opposed to the installed 1.25” valve, however there is very little if any difference in the regulator’s capacity between valve body sizes.
- Gas supply pressure at the secondary regulator varied between 25” and 30” throughout high fire and low fire testing.

General Notes

- Gauges were installed on the inlet to the [redacted] regulator, the inlet to the unit’s internal regulator, after the unit’s internal regulator as well as the burner manifold.
- Initial readings during ~33% fire (regulators as found):
  - Inlet to secondary regulator: 28” WC (1 PSI)
  - Inlet to unit: 10.7” WC
  - Leaving units on board regulator: 10.6” WC
  - Burner firing clean and no issues
- Initial readings during high fire (regulators as found):
  - Inlet to secondary regulator: 25”-28” WC
  - Inlet to unit: 9.8” WC
  - Leaving units on board regulator: 9.2” WC
  - Burner firing clean and no issues
- A test was performed to duplicate low supply pressure to the secondary regulator, the supply to the secondary regulator was reduced to 6” WC. The unit was able to start and fire both at low fire and high fire settings at this low inlet pressure condition.
  - Inlet to unit: 6.2” WC
  - Leaving units on board regulator: 5.8” WC
- A concern of elevated gas train pressure was expressed as there was a day where the gas train was at 11” as opposed to the previous recordings of between 8.5” and 9.5”. after consulting the [redacted] tech support, there is a 1” deviation range from the setpoint that is the typical control range the regulator will control within. It is possible that as the regulator was set to 10.7”, that the regulator was operating on the upper threshold (11.7”). [redacted] also indicated that the regulator ahs a safety lockup at between 2-3” meaning that a 10.7” setpoint could potentially yield a 13.7” discharge however according to the

manufacturer, this is not a typical operating condition and is more of a safety aspect of the regulator.

- A test was performed to duplicate high supply pressure to the unit by increasing the secondary regulator. The unit was able to start and fire both at low fire and high fire settings at this high inlet pressure condition however since the burner was set up for a fuel/air ratio at 9" instead, there was a very faint rumbling in the burner. It would not be recommended to run continuously at this condition without adjusting the air dampers however operation of the burner was possible.
    - Inlet to secondary regulator: 28-30" WC
    - Inlet to unit: 12" WC
    - Leaving units on board regulator: 10.8" WC
- A final setup of the secondary regulator was made to reduce the inlet pressure into the unit. The 9.0"-9.2" inlet pressure was agreed upon by the startup technician, it would be recommended but not critical to be mid-range on the regulator spring ~8.0" however the startup technician did not want to go much below 9.0". the furnace was then further tested multiple times to ensure firing both at low fire and high fire as well as startup.
    - Inlet to secondary regulator: 28-30" WC
    - Inlet to unit: 9.0-9.2" WC
    - Leaving units on board regulator: 7.6-7.85" WC

Conclusions

At the time of inspection there were no major concerns regarding the supply gas pressures. Pipe sizing and specialty selections are appropriate for delivering 500 MBH at 7"-14" WC to the inlet of the unit. Testing also confirms that the required pressures and quantities are deliverable. There are two recommendations for corrections, however they are not critical and do not hinder operation as tester. First recommendation is to replace the reducing tee and section of piping at the unit in the area of the secondary regulator in order to reduce pressure drop. Secondly, the ideal burner inlet pressure should be determined and either be reduced to between 6.0"-9.0" or replace the spring kit with the next one (8.5"-12.5") as the current setting of 9.0"-9.2" is at the upper threshold of its design (6.0"-9.0" WC). Prior to this inspection there were no provisions to obtain an inlet pressure reading to the secondary regulator. Should this issue continue a full set of pressure readings are required to further analyze the system including pressures before the secondary regulator and the gas pressure nearest the primary regulator or the meter in the service closet.

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