



**Asnuntuck Community College  
Welding Shop Room 138  
Gas Odor Investigation Assistance**

**170 Elm Street  
Enfield, CT 06082**

---

**Prepared for:**

Mr. Gerald Cotter  
Associate Director of Project Management and Engineering and  
Engineering Facilities and Infrastructure Planning  
Connecticut State Colleges and Universities  
61 Woodland Street  
Hartford, CT 06105

**Prepared by:**

van Zelm Heywood & Shadford, Inc.  
10 Talcott Notch Road  
Farmington, CT 06032

**Date:**

~~December 12, 2022~~  
Revised January 4, 2023  
van Zelm Project #: 2022216.00

TABLE OF CONTENTS

1. Executive Summary.....	1
2. Gas Piping Leak Detection Work.....	4
A. Shaffer Beacon.....	4
B. Findings.....	4
C. Procedure.....	4
D. Air Temp.....	5
3. Make-up Air Units.....	6
A. Make-up Air Unit 1.....	6
B. Make-up Air Unit 2.....	8
4. Recommendations .....	11
5. Appendix A Gas Pipe Pressure Testing Photos.....	12

# 1. Executive Summary

## INTRODUCTION

van Zelm Heywood & Shadford, Inc. (van Zelm) was hired by the Connecticut State Colleges and Universities in December 2022 to assist in the investigation of natural gas odor complaints received from the Asnuntuck Community College Welding Shop Room 138.

The complaints have reportedly been ongoing for some time. The college had engaged a mechanical contractor to investigate and correct the cause of the complaints but a cause was not determined and the complaints persisted.

The welding shop has approximately 30 welding booths. They are exhausted to the outside when the booths are being used by the students. There are 2 associated exhaust fans each serving 15 welding booths.

Each of the 2 exhaust fans has an associated natural gas fired make-up air unit on the roof. These units run anytime the exhaust fans are running. The make-up air unit's purpose is to maintain the proper room pressurization. They "make up" the air being exhausted to the outside of the building.

The intermittent periodic complaints are received when the makeup air units are in operation.

The mechanical contractor, Air Temp Mechanical Services Inc., has made attempts at finding and correcting the issue. Parts have been changed in both units and piping has been replaced external to the units. van Zelm does not have complete details of exactly what has been done or the timeline of the contractor investigation.

There has since been gas leaks reported from some of the new piping that was installed. Identifying the location of the leaks has reportedly been inconsistent, with leaks reported on some days but not others. This work predated van Zelm's involvement therefore we are not able to comment.

With the continued complaints, the college elected to bring in a second mechanical contractor, Shaffer Beacon Mechanical LLC, for the purposes of checking for gas leaks in the piping.

van Zelm's scope of work is evolving but generally includes the following:

1. Observe the work of Shaffer Beacon leak testing the piping for the make up air units on the roof.
2. Assist Air Temp in identifying and correcting operational problems with the makeup air units.
3. Assist the facilities staff with a preventive maintenance procedure and scope for the HVAC equipment in the Welding Shop 138.

This report describes the work performed by van Zelm and others during this evaluation and outlines our findings, recommendations and the corrective measures that were implemented as of the date of this report.

It is our current understanding that the college has made the decision to permanently place the two make up air units out of service and no further work will be performed to get them operating correctly.

## **STATEMENT OF FINDINGS**

Make-up air unit 2 appears to operate as would be expected for normal operation.

We have identified issues with Make-up air unit 1 and this unit is not yet operating in a manner that allows van Zelm to recommend it's continued use while the room is occupied by students welding in the booths.

No gas leaks were detected during the requested gas pressure testing process. However, once the units were turned back on, leakage was detected with the handheld gas detection meter inside the units near the burners. This will need to be corrected before placing the units back into service.

During our time spent inside Welding Room 138, we periodically would notice an odor that we would describe as discernable products of combustion. This is different than a natural gas odor and should be able to be corrected with proper set up of the burners. At no time was carbon monoxide or natural gas detected within the room by the installed metering.

We have not witnessed conditions in the days we have been involved that we believe can be quantified by the metering as unsafe but we have identified problems that we believe are not consistent with the normal operation of the units.

## **EVALUATION PROCESS**

### **1. Building Walkthrough / Staff Interviews**

A tour of the area was conducted to become familiar with the installed equipment and verify it was consistent with the available documentation. This was also an opportunity to observe the method of installation for each piece of equipment to ensure it is correctly installed.

van Zelm interacted with the staff during our inspection in order to obtain historical information related to past operation, building occupancy patterns, etc.

During the course of this investigation van Zelm spent many hours on different days inside Welding Lab 138. This was done to maximize the likelihood of sensing the gas odors that were the source of the complaints. There were no doubts that there was a problem but we were trying to get a better sense as to the nature of the problem as it would be perceived by the occupants.

### **2. Equipment Testing**

An important part of the evaluation involved performance testing of the installed equipment and systems. This consisted of a physical inspection and testing of the associated HVAC systems and controls. This included the following tasks:

1. Visual inspection of the make-up air units, exhaust fans, gas piping, air ducts and room layout.
2. Testing of portions of the gas piping on the roof specific to the two makeup air units and two adjacent units.
3. Monitoring of the building control system remotely and while on site.

4. Monitoring of temporary cameras installed by van Zelm to observe the burners while firing.
5. Utilizing the handheld gas detection meter provided by the college.

### **3. Equipment Review with Manufacturer**

Air Temp contacted Buckley Associates, the representative for the make-up air unit manufacturer, Greenheck. The representative has visited the site on three occasions but after inspecting the units, van Zelm feels further involvement by Greenheck is needed to confirm the units are operating as designed.

## **2. Gas Piping Leak Detection Work**

### **A. SHAFFER BEACON**

It had been agreed by the college and the contractors that the units would not be started until the gas pipe testing had been completed.

It should be noted that a portion of the gas pipe inside the unit called the “gas train” was not tested by Shaffer Beacon. This section of piping is typically tested while the unit is in operation which is when there is gas in the pipe. The units were not operating at the time of this testing.

This section of pipe was tested the following day by Air Temp after the equipment representative indicated the two make-up air units could be safely operated.

On Thursday December 8, 2022 van Zelm observed the testing of gas piping which was performed as completely as was practical by Shaffer Beacon at the time the work was performed.

### **B. FINDINGS**

No leakage was identified in the sections of the piping that were tested.

### **C. PROCEDURE**

The testing criteria was based on the NFPA 54/ANSI Z223.1 2018 National Fuel Gas Code. The actual testing exceeded the requirements of the code. In the sections of pipe that could be subjected to a higher pressure, 5 PSI was used for a duration of 4 hours.

#### Test Pressure

Section 8.1.4.1 of the 2018 revision requires a pressure of not less than 1 ½ times the working pressure but not less than 3 PSI.

The highest working pressure of the system is 2 PSI so the test pressure of 5 PSI exceeded the required minimum pressure of 3 PSI.

#### Test Duration

Section 8.1.4.3 requires a duration of not less than ½ hour for each 500 cubic feet of volume. When the volume is less than 10 cubic feet, the duration shall be a minimum of 10 minutes.

The section with the highest volume was approximately 300 cubic feet so the 4 hour testing duration far exceeded the requirement.

Some of the piping needed to be tested in sections because section 8.1.1.5 does not allow for a single isolation valve to be used to separate gas in one section of the piping system and the test medium in another section of the piping system. Additionally, the installed gas pressure regulators have a maximum inlet pressure rating of 2 PSI for the main regulator and 3 PSI for the pilot regulator which is below the requested test pressure of 5 PSI.

### Test Medium

Nitrogen was used to pressurize the piping. During the 4 hour testing period, a soap solution was also periodically used to look signs of leakage. No leaks were identified using soap solution.

It is important to note that the pressure fluctuated during the test period. Nitrogen is an inert gas which means it is not subject to the effect of temperature on the pressure. However, the piping has air in it when the nitrogen is introduced and the pressure of air does in fact change as the temperature changes. The combination of nitrogen and air in the pipe did allow for some variation of the pressure which was observed on the gages.

The test pressure started at 5 PSI but then dipped to about 4.5 PSI as the nitrogen air mixture acclimated to the piping temperature. As the sun came out and the piping warmed, the pressure then rose above the maximum gage reading of 5 PSI which we estimated as about 6 PSI.

### **D. AIR TEMP**

The following day Friday, December 9, 2022, while evaluating the operation of the units, the portions of piping that were not checked the previous day were checked by Air Temp under normal operating pressure with a soap solution.

Again, no signs of leakage were observed.

### **E. Van Zelm**

On Saturday, December 10, 2022, while evaluating the operation of the units, van Zelm used the handheld gas detection meter provided by the college and found signs of gas leakage on the inside of the units near the burners. MUA 1 seemed to have more leakage than MUA 2.

### 3. Make-up Air Units

On Friday, December 9, 2022, van Zelm met with Air Temp Mechanical to continue their evaluation of the unit operation. The representative from Buckley Associates was present in the morning before the units were started. The representative indicated the units had been set up to their satisfaction and could be started but they had to leave shortly after the units were started. van Zelm worked with Air Temp for the remainder of the day and also returned on Saturday December 10, 2022 to continue and follow up with both units.

Before the work with the contractors began, van Zelm installed cameras in each make-up air unit so that the burner could be observed remotely when lighting and firing.

After the first day, the college made the decision to have Shaffer Beacon investigate the units and Air Temp was asked to stop. The following does not necessarily differentiate between the work performed by each contractor.

#### A. Make-up Air Unit 1

##### 1. Irregular Flame Pattern

Before starting the unit, we visually inspected it and saw the burner was discolored. This was a distinct difference from unit 2.

When the burner was started, the flame appeared to be somewhat wild. Unit 2 had a tighter more confined flame pattern that looked normal and completely different from unit 1. The flame pattern seems to match the discoloration of the burner with the top two ends and center matching up with the video of the flame pattern.

van Zelm was able to measure the air pressure drop across the burners which should be between .625" wc and .675" wc. Unit 1 was slightly low at .57" wc to .6" wc.

We adjusted the fan speed which did not improve the pressure. Upon closer inspection we saw that the burner was not plumb. It was out of vertical alignment which resulted in an uneven distance between the burner and the top and bottom baffles.

Air Temp was able to adjust the burner position to what looked to be straight. The pressure drop across the burner changed and is now at a stable .65" wc which is where it should be as described in the operation manual.

This did not improve the flame pattern even though it is now operating with the required pressure drop across the burner.

We adjusted the high fire gas pressure setting which also did not improve the flame pattern.

While there was no appreciable improvement in the visible flame pattern, the adjustments may have improved the burner operation. There is little noticeable gas odor in the welding shop and the air seems to be much better than the last time there was a reported incident of gas leakage.

A short video of the burners firing and photo of the burners when off has been sent to Buckley Associates with a request for the manufacturer, Greenheck, to comment on the flame patterns. There has been no feedback from Greenheck.



van Zelm measured the airflow for the 2 make-up air units. Surprisingly, unit 1 which is a smaller unit had more airflow than the larger unit, make-up air unit 2. All airflows, including the 2 exhaust fans, should be verified by a testing and balancing contractor. Air Temp is trying to schedule this.

This was later confirmed by Trueflow Testing and Balancing working under Shaffer Beacon.

The high airflow and velocity may be contributing to the irregular flame. It has the appearance as though the flame may be blowing away from the burner.

## 2. Delay In Burner Firing

Unit 1 has a delay in calling for the burner to fire. The delay is of varying time and not predictable. We checked the unit interlocks and found nothing that seemed irregular. It appears that the make-up air unit's Carel controller is preventing the burner from starting when expected and this is again different from unit 2. This is another item for which we will be requesting support from Greenheck.

## 3. Combustion Analyzer Measurements

Air Temp used a combustion analyzer to check for carbon monoxide. This was done in the welding shop with the analyzer sensing tube near the beginning of the supply air duct. The carbon monoxide (CO) levels were reading 0 PPM which is good.

Shaffer Beacon also used a Bluetooth equipped combustion analyzer inside the makeup air units and measured negligible levels of CO.

The ANSI Z8 3.4 permissible level of CO within a non-recirculating unit is less than 5 PPM and less than 25 PPM in the room.

## 4. Gas Detection

The college has had a temporary data logging combustible gas meter installed in the welding shop. We have been able to access it remotely and it has not shown any detection of gas. It is an average reading over time and may not detect a quickly dissipating reading. We will review the report when it is available but indications to date are that the air in the room is normal.

After further investigation on Saturday December 10, 2022, van Zelm checked for gas leaks using an electronic combustible gas leak detector provided by the college. The meter allows for an instantaneous reading as opposed to an average over time reading.

With make-up air unit 1 off, we were detecting levels of gas within the unit near the burner. We have seen small levels of leakage from closed gas valves in the past which has been considered as accepted by the gas valve manufacturers. This could be confirmed with Greenheck.

With the unit operating, we detected levels of gas at the inlet of the burner and around the portion of the gas pipe that is not visible from the piping of the gas train. We attempted to test this piping on Friday with the soap solution but with the unit operating, the solution would not adhere to the pipe fittings due to the airflow within the unit.

We also used the same meter to test for combustible gas in the supply duct in the welding shop. We again would intermittently sense some natural gas in the supply duct.

At this time, while the levels we were measuring do not seem to indicate a safety concern, we do not feel this is normal.

Our recommendation is to develop a method and further leak check the small amount of piping near the burner. If the joints are not able to be tested removing the burner assembly, refitting it and reinstalling it may be necessary. Once this has been done the airstream can be checked for gas again.

The readings we measured in the supply duct of make-up air unit 1 were varying intermittently from 1001 up to 1486 PPM. 1486 PPM equals approximately .15% at the time we tested them on Saturday afternoon.

The Lower Explosive Limit (LEL) value for methane/natural gas is 5% (50,000 PPM). This is the minimum concentration of vapor in the air below which flame does not occur in the presence of an ignition source.

Natural gas is comprised mostly of methane. It is considered a simple asphyxiant and not toxic and as such does not have a permitted exposure limit (PEL) set by the Occupational Safety and Health Administration (OSHA). The level for asphyxiation is 500,000 PPM or 50%.

The National Institute for Occupational Safety and Health (NIOSH) does have a Threshold Limit Value (TLV) of 1000 PPM or .1%. The TLV is the long term maximum daily exposure limit.

All of these values should be confirmed with the gas detection consultants.

## **B. Make-up Air Unit 2**

### **1. Flame Pattern**

Before starting the unit, we visually inspected it. The burner looked normal and did not have the same discoloration pattern that unit 1 does. There was a distinct difference from unit 2.

Unit 2 has a tighter more concise flame pattern that looks normal and completely different from unit 1 throughout its modulation from low to high fire.

van Zelm was able to measure the air pressure drop across the burners which should be between .625" wc and .675" wc. Unit 2 was very close at .66" wc to .71" wc. No changes were made.

A short video of the burners firing and photo of the burners off has been sent to Buckley Associates with a request for the manufacturer, Greenheck to comment on the flame patterns.

van Zelm measured the airflow for the 2 make-up air units. Surprisingly, unit 1 which is a smaller unit had more airflow than the larger unit, make-up air unit 2. All airflows will need to be verified by a testing and balancing contractor that Air Temp is trying to schedule.

Airflow was later confirmed by Trueflow Testing and Balancing working under Shaffer Beacon.

### **2. Combustion Analyzer Measurements**

Air Temp used a combustion analyzer to check for carbon monoxide. This was done in the welding shop with the analyzer sensing tube near the beginning of the supply air duct. The carbon monoxide (CO) levels were reading 0 PPM which is good.

We do not believe that Shaffer Beacon has yet had the opportunity to use a combustion analyzer on MUA 2.

### 3. Gas Detection

The college has had a temporary data logging combustible gas meter installed in the welding shop. We have been able to access it remotely and it has not shown any detection of gas. It is an average reading over time and may not detect a quickly dissipating reading. We will review the report when it is available but indications to date are that the air in the room is normal.

After further investigation on Saturday December 10, 2022, van Zelm checked for gas leaks using an electronic combustible gas leak detector provided by the college. The meter allows for an instantaneous reading as opposed to an average over time reading.

With make-up air unit 2 off, we were detecting levels of gas within the unit near the burner. We have seen small levels of leakage from closed gas valves in the past which has been considered as accepted by the gas valve manufacturers.

With the unit operating, we did not detect levels of gas at the inlet of the burner and around the portion of the gas pipe as we did on unit 1. We attempted to test this piping on Friday with the soap solution but with the unit operating the solution would not adhere to the pipe fittings due to the airflow within the unit.

We also used the same meter to test for combustible gas in the supply duct in the welding shop. We noted very brief very intermittent low readings as compared to unit 1.

These levels were negligible and do not seem to indicate a safety concern with unit 2.

### **C. General Make-up Air Unit Comments**

As indicated earlier, Shaffer Beacon was asked to step in after Air Temp to review and investigate the unit operation but the work was discontinued because the units are to be taken out of service. The following is a summary of some of what was found.

The gas pressure seemed to be somewhat unstable. It may be related to the airflow and possible to the external gas pressure regulators. Based on the unit nameplate and operation manual, van Zelm has determined the external gas pressure regulators are not required for the two make up air units. They can be removed if it is found they are contributing to the problem.

The adjacent RTU 1 was observed to have natural gas odors when it fired which may be drawn into the intake of the make up air units. RTU 1 was reported to have been found to have the gas pressure incorrectly set. The unit requires the gas valve to be set at a negative 2" wc. The pressure has been reported to be found set to positive 2" wc. This has reportedly been corrected by Shaffer Beacon. Further testing indicated the burner differential pressure seemed to be set to operate between .5" wc and .8" wc. The operation manual indicated these were normal values consistent with an

variable airflow unit. While these units are operated as constant volume units, they are in fact equipped as variable airflow units.

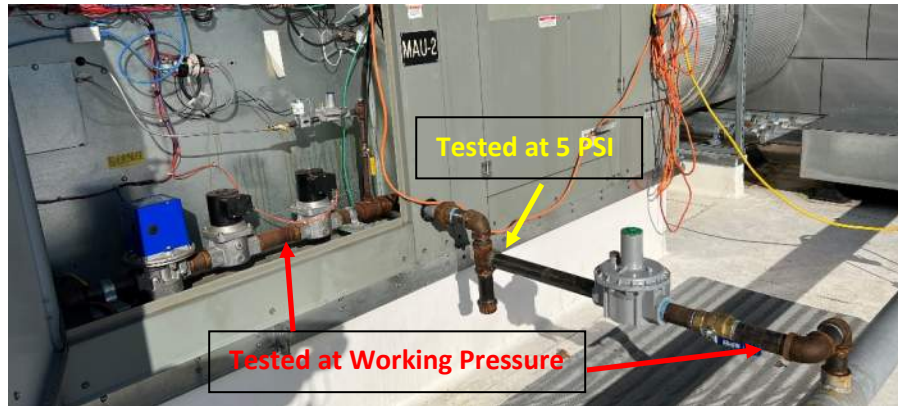
## 4. Recommendations

1. Contact Greenheck to discuss the issues identified with make-up air unit 1.
  - a. Irregular flame pattern
  - b. Delayed call for heat
  - c. Potential for gas valve leakage
  - d. Potential for gas not being burned while the burner is firing
  - e. Confirm airflow requirements/limitations for each unit
2. Have Greenheck comment on the operation of make-up air unit 2.
3. Have a contractor perform additional leak testing/correction on the concealed burner piping of make-up air unit 1 and 2.
4. Follow up with the gas detection consultant to confirm the logged meter readings and their interpretation of the readings.
5. Follow up on Greenheck comments/recommendations to questions items above.
6. Review the airflows measured by the testing and balancing contractor.
7. Determine if the measured airflows are appropriate for the equipment and system application.
8. Adjust the airflows as needed.
9. Implement meaningful preventive maintenance of the units. (van Zelm is working on developing a procedure for a contractor to follow)
10. Follow up with the installation of a gas detection system which includes at a minimum carbon monoxide (CO) and methane (natural gas) sensing.
11. Monitor the operation of the system and equipment by regularly checking for the detection of combustible gas and CO in the welding shop and visually inspecting the roof top equipment. This should be on a daily basis in the short term.
12. Monitor the operation of RTU 1.
13. Review and follow up with any related reports including the gas detection consultant and mechanical contractors.
14. Solicit continued feedback from the welding instructors on their perception of the system operation.

\*\*\*\*

## 5. Appendix A Gas Pipe Pressure Testing Photos

Make-up Air Unit 2





**Make-up Air Unit 2 Test Pressures**



**Start**

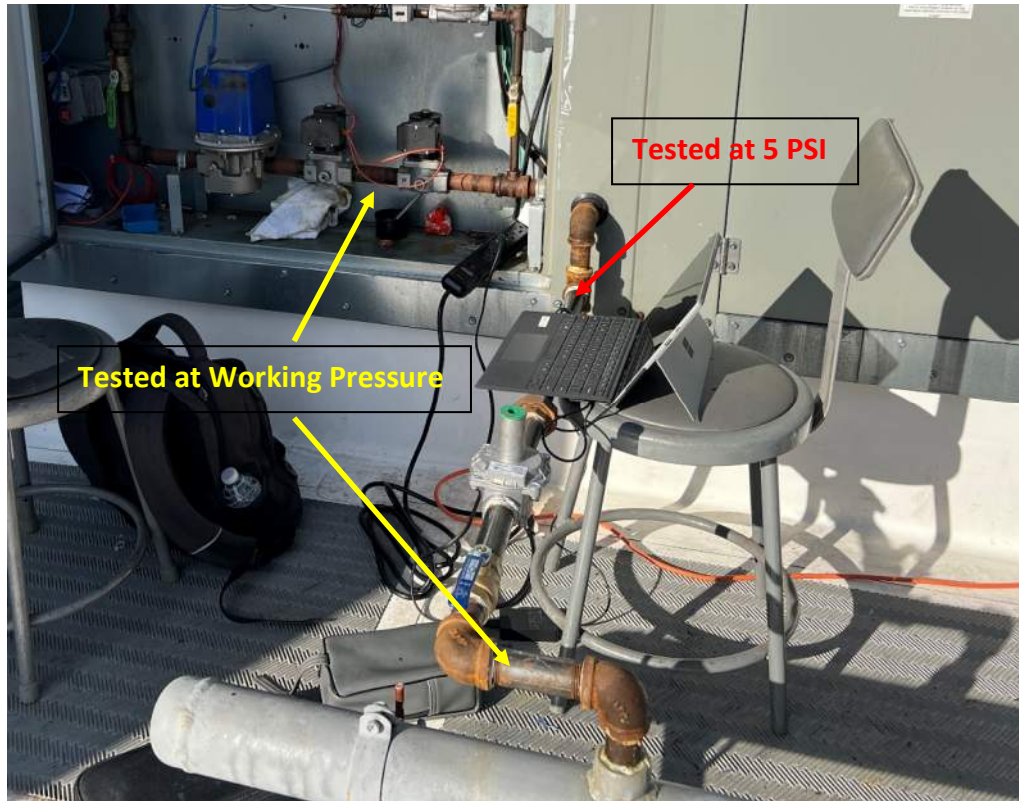


**Low**



**High**

### Make-Up Air Unit 1







**Make-up Air Unit 1 Test Pressures**



**Start**

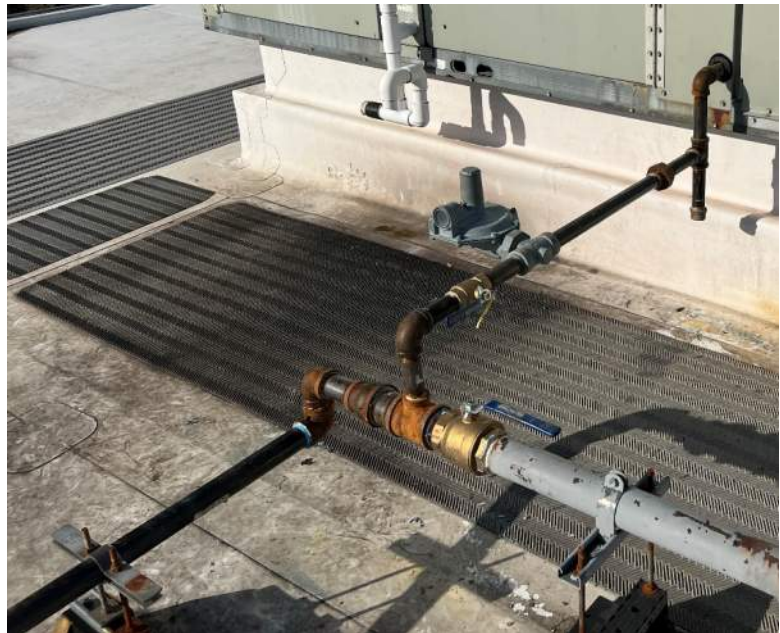
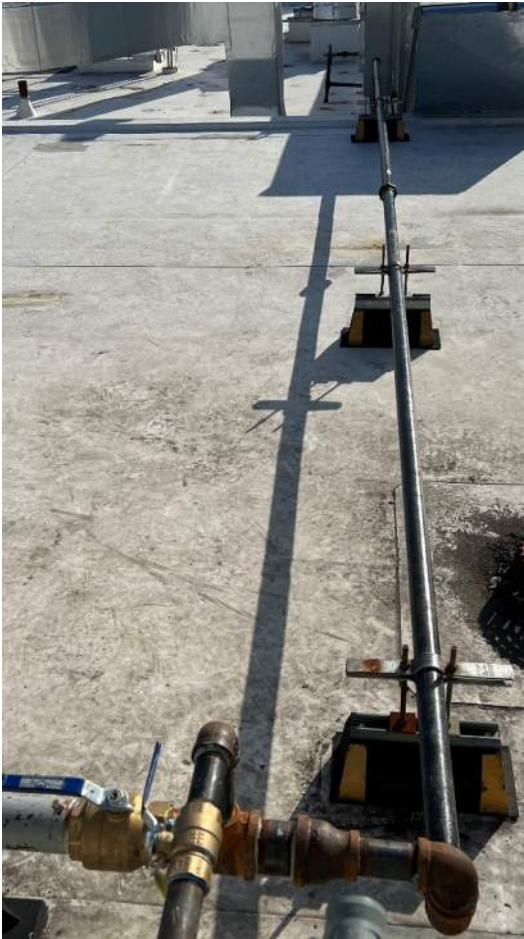


**Low**



**High**

**RTU 1 and Other MUA**



**Start**



**High**



**Typical locations where gas leakage was detected inside the unit**

**This piping can only be checked with the burner firing**

