TECHNICAL SAFETY BC

Incident Summary #II-882435-2019 (#14204) (FINAL)

SUPPORTING INFORMATION	Incident Date			July 10, 2019
	Location			Richmond
	Regulated industry sector			Gas - Natural gas system
	Impact	Injury	Qty injuries	0
			Injury description	None
			Injury rating	None
		Damage	Damage description	Damage to multiple suites in an apartment building due to an explosion, fire and fire suppression activities.
			Damage rating	Major
	Incident rating			Major
	Incident overview			Work performed during a natural gas fireplace retrofit created a gas leak within a four story apartment building resulting in an explosion and fire. The building was evacuated and the fire department extinguished the fire.
INVESTIGATION CONCLUSIONS	Site, system and components			A four story apartment building that has natural gas fireplaces in each suite. The building gas supply was distributed through a gas pipeline in the parkade level providing gas at 2 PSI pressure. The gas line branched to a number of vertical gas pipes ("risers") in the parkade. Each riser incorporated a line pressure regulator that reduced pressure to under ½ PSI. Each vertical riser provided gas to the 1st, 2nd, 3rd and 4th floor suite fireplaces. The gas supply to the riser and all four suites could be turned off using a gas shut off valve located in the parkade, (Photo 1). Each fireplace was connected to the gas riser using a narrow copper tube (commonly referred to as a "whip") attached to a T-fitting in the riser, (Photo 2). A schematic diagram of the piping system is shown in Figure 1. A company was contracted to replace the existing natural draft fireplace in one suite with a direct vent-type fireplace. The new fireplace required an additional duct serving as an air supply to the fireplace, which fits inside the original exhaust duct. The new direct-vent fireplace's dimensions were larger than the existing fireplace.
	Failure scenario(s)			Gasfitters were replacing the existing fireplace in a 2nd floor suite. They did not turn off the gas supply to the gas riser prior to doing this work. In order to install the new 2nd floor fireplace the gas riser pipe and T-fitting were moved so the larger fireplace would fit into the hearth. This gas riser pipe extended to suites in all four floors and was attached to three other fireplaces. Moving/rotating the riser pipe at the 2nd floor suite caused the copper whips attached in the 3rd and 4th floor suites to break and allow gas to escape. Gas leaked out of the broken whips and was ignited by a fireplace pilot light in the 4th floor suite, resulting in an explosion in the 3rd and 4th floor suites.

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Facts and evidence	The apartment suites involved in this incident on the 1st through 4th floors are referred to as suites #1, #2, #3 and #4, respectively. Gasfitter #1 was replacing a natural draft type fireplace in the 2nd floor (suite #2) with a new high efficiency fireplace. The gas fitter stated that the existing copper whip was too short and brittle (due to age) and was concerned that it would kink if they had to bend it to accommodate the new fireplace. Gasfitter #1 replaced the existing copper whip with a new longer copper whip, (Photos 2 & 4). Doing so with the gas supply still on meant that gas would leak out of the riser pipe during the time the original whip was disconnect and the new whip was connected, which presented a hazard. The gasfitter stated that the location of the gas riser T-fitting blocked installation of the new fireplace (the new fireplace was larger than the original fireplace). Gasfitter #1 stated that they moved the gas riser out of the way and strapped it to an adjacent 2x4 stud. The gas riser was connected to fireplaces in four suites so moving the gas riser in one suite can affect another component in the system, as was the case in this incident where two other whips were damaged. Given that the whip in suite #2 was thought to be brittle then the other three whips may have been brittle as well and subject to damage by moving the gas riser. The effect of moving the gas riser in suite #2 on the rest of the system (e.g. whips in suites #1, #3 & #4) was not verified by the gas fitter. Gasfitter #1 then proceeded to the roof to install a metallic liner down the existing metallic fireplace chimney vent. Gasfitter #1 requested help from Gasfitter #2, who aided in dislodging and installing the vent liner. Gasfitter #2 stated that they detected a gas odour near the vent serving the fireplaces and then a strong gas odour when they opened the roof hatch adjacent to the vent. The gasfitters called the owner of suite #2 and advised them to call the gas utility [to turn off the main gas supply to the building]. Moments later the explosion occurred. The gas utility technician arrived on site shortly after the incident and turned off the main gas supply to the building. The technician reported to have found the gas riser isolation valve in the "on" position, that supplies gas to the four incident suites. The utility technician then turned the gas riser isolation valve off. CCTV security video confirmed that the valve for the gas riser in the parkade had not been turned off prior to the incident. The gasfitter replacing the fireplace in suite #2 confirmed that he had not asked building management to turn off the gas supply to the riser. The building manager stated that he had not been asked by this gasfitter, or any gasfitters who had previously replaced fireplaces in other suites, to make arrangements to access suites with fireplaces attached to a common gas riser in order to turn off and relight fireplace pilot lights. **Evidence Examination** Damage analysis inside the apartment suites determined that the explosion occurred in the 3rd and 4th floor suites. It was apparent that gas leaking in the fireplace hearth of these suites had fueled the explosion. The fireplaces in these suites were found to be dislodged out of the wall as a result of the explosion. The fire investigators reported that burn patterns in the 3rd floor suite indicated that natural gas from

the broken copper whip sustained the fire until the main gas supply was turned off, (Photo 3).

In suite #4 the standing pilot for the fireplace was found to be in the "on" position indicating that the pilot flame was burning prior to the incident.

The copper whip in suite #1 was found cracked. In suite #3, it was found completely fractured (Photo 6) and in suite #4 the whip was found partially fractured, (Photo 7). In all cases the fractures occurred where the copper whip was connected to the gas riser T-fitting.

The T-fitting in suite #1 was found pointing towards the fireplace. In suite #2, the T-fitting was found pointing away from the fireplace. In suites #3 and #4, the T-fittings were also found pointing away from the fireplace. Examination of similar suites in the building that were not involved in the incident found the T-fittings pointed towards the fireplace in all cases. This indicates that the final positions of the T-fittings found in suites #2, #3 and #4 had changed from their original positions, likely due to manipulation of the riser by gas fitters during installation of the new fireplace. Fire investigators reported finding tool marks on the T-fitting and riser pipe in suite #2.

The riser pipe was clamped to the floor assembly where it penetrated the parkade to the first floor, which could restrain movement/rotation of the T-fitting in suite #1. The riser was not clamped where it penetrated the 2nd, 3rd or 4th floors. It is possible that movement of the threaded fittings in the piping system allowed the T-fitting in suite #1 to remain stationary (as restrained by the riser clamp) while the fittings in suites #3 and #4 rotated as the T-fitting in suite #2 was rotated.

Holes in the concrete floor allow for the riser to pass through each of the four floors. The gap between the riser pipe and hole was filled with a pliable fire stop material. This material did not restrain rotation of the riser pipe given that it was not firmly adhered to the riser at the 2nd, 3rd and 4th floor levels. This material was found broken away from the pipes leaving gaps visible between the pipe and fire stopping material.

Examination of the gas line components for the four fireplaces was conducted by a metallurgical laboratory, refer to the report in Appendix A. The findings included the following:

Examination of the whips found that the tube wall of whip #1 was partially cracked, and completely cracked through the tube wall of whips #3 and #4.

Metallurgical analysis of whips #3 and #4 indicated that both whips had been exposed to a severe bending load that exceeded the mechanical strength of the copper tube resulting in complete separation of whip #3 and partial separation of whip #4.

Analysis of the copper whip in suite #3 determined that it had fractured before the explosion, rather than as a result of the explosion. The copper whip in suite #4 had also partially fractured before the explosion allowing a small amount of gas to maintain the pilot light burning until the explosion. The force of the explosion further opened the fracture in whip #4.

The copper whips broke from being bent 90 degrees and forced in a direction away from the fireplace. This was consistent with the action of turning and pushing the riser T-fitting in suite #2 in a direction away from the fireplace.

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Investigators conducted tests at the apartment building and found that the new fireplace would not fit in place in suite #2 unless the riser pipe was pushed to the left and T-fitting pointed away from the new fireplace. Whereas in the undamaged suites having original fireplaces, the T-fittings pointed towards the fireplace as originally installed. This indicates that the riser pipe and T-fitting in suite #2 were moved and rotated to fit the new fireplace. In suite #3, investigators found an indentation on a wood stud caused by the T-fitting being rotated to the left with enough force to create a depression in the wood.

Moving the gas riser pipe at suite #2 also moved the T-fittings connected to fireplaces in suites #1, #3 and #4 which caused the whips in suites #3 and #4 to break because they were too short to accommodate this movement. The copper whip was not ductile enough (i.e. too brittle) to bend without breaking and hence fractured when gas riser movement forced the whips to bend 90 degrees.

Following the incident a pressure test on the gas riser confirmed that no leaks were present in the black iron riser pipe itself. This finding limits the source of the gas leak to the copper whips in suites #3 and #4. The leaking gas migrated up through the wall cavity that housed exhaust ducts for the fireplaces on all four floors. The explosive fuel mixture was present within the wall cavity of the 3rd and 4th floors when it was ignited at the 4th floor.

Discussion

The regulations and codes that apply when replacing an appliance (fireplace) and gas piping (e.g. copper whip) include the Gas Safety Regulation and CSA B149.1:20 Natural Gas and Propane Installation Code.

CSA B149.1:20, clause 4.4.1 requires that careful attention must be paid to both the execution of the work and how the work may affect the arrangement of the installation. In this incident, two key aspects had required careful attention, the fact that the three attached whips could be affected by moving the gas riser in suite #2, and that these other whips may be brittle like the whip in suite #2 was assumed to be.

CSA Code B149.1:20, section 6.22 Testing of piping, tubing, hose, and fittings, requires that a pressure test be conducted before an appliance is connected. If the fireplace had been replaced and the original whip remained in place, the gas supply could be isolated by turning off the gas shut off valve attached to the whip. The pressure test would be for the new fireplace connection to the whip. The Code allows for a liquid solution (e.g. soapy water) to be used to locate a leak in this case, (a gas pipe less than 20 ft. long and under 0.5 psig).

Given that the whip was replaced, the gas supply would be isolated by turning off the gas riser isolation valve in the parkade. The gas riser isolation valve was not turned off before disconnecting the whip suite #2, which allowed gas to leak from the gas riser T-fitting, which presented a hazard. Although clause 6.22.1 of CSA Code B149.1:20 implies that the gas supply be isolated, the Code does not explicitly state that the gas supply be turned off before the whip is removed. The fireplace manufactures' certified instructions and certified gas fitter training are expected to provide instruction on isolating gas supply for replacing a fireplace and whip.

The gas riser T-fitting in suite #2 was moved/turned during this gas fitting work which affected the entire system of whip connections on the gas riser. Therefore, the entire

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		system should be pressure tested to check for leaks as defined by CSA Code B149.1:20. This pressure test would have been achieved using a pressure gauge installed downstream of the gas riser isolation valve in the parkade. Clause 6.22.2 of the Code requires using either air, inert gas, or carbon dioxide as the test gas. There is no provision in the Code for natural gas to be used as the test gas in this case. Testing for leaks in the system would have provided an opportunity to detect and repair leaks (suites #3 and #4) before connecting the fireplace in suite #2 and before relighting pilot flames in all four suites.
	Causes and contributing factors	The gas riser pipe was moved at the 2nd floor suite which in turn fractured copper whips supplying gas to the 3rd and 4th floor suite fireplaces. This work was conducted on an energized system which caused a gas leak in the presence of an active pilot flame in the 4th floor suite that ignited the gas resulting in a significant explosion. A primary contributing factor was the natural gas supply valve not being turned off before disconnecting a fireplace gas line from the gas supply riser in an apartment suite.

List of appendices:

Appendix A: Diagrams and Photographs
Appendix B: Natural Gas Copper Piping Fracture Analysis
Appendix C: Regulations and Codes
Appendix D: Recommendations

Appendix A: Diagrams and Photographs

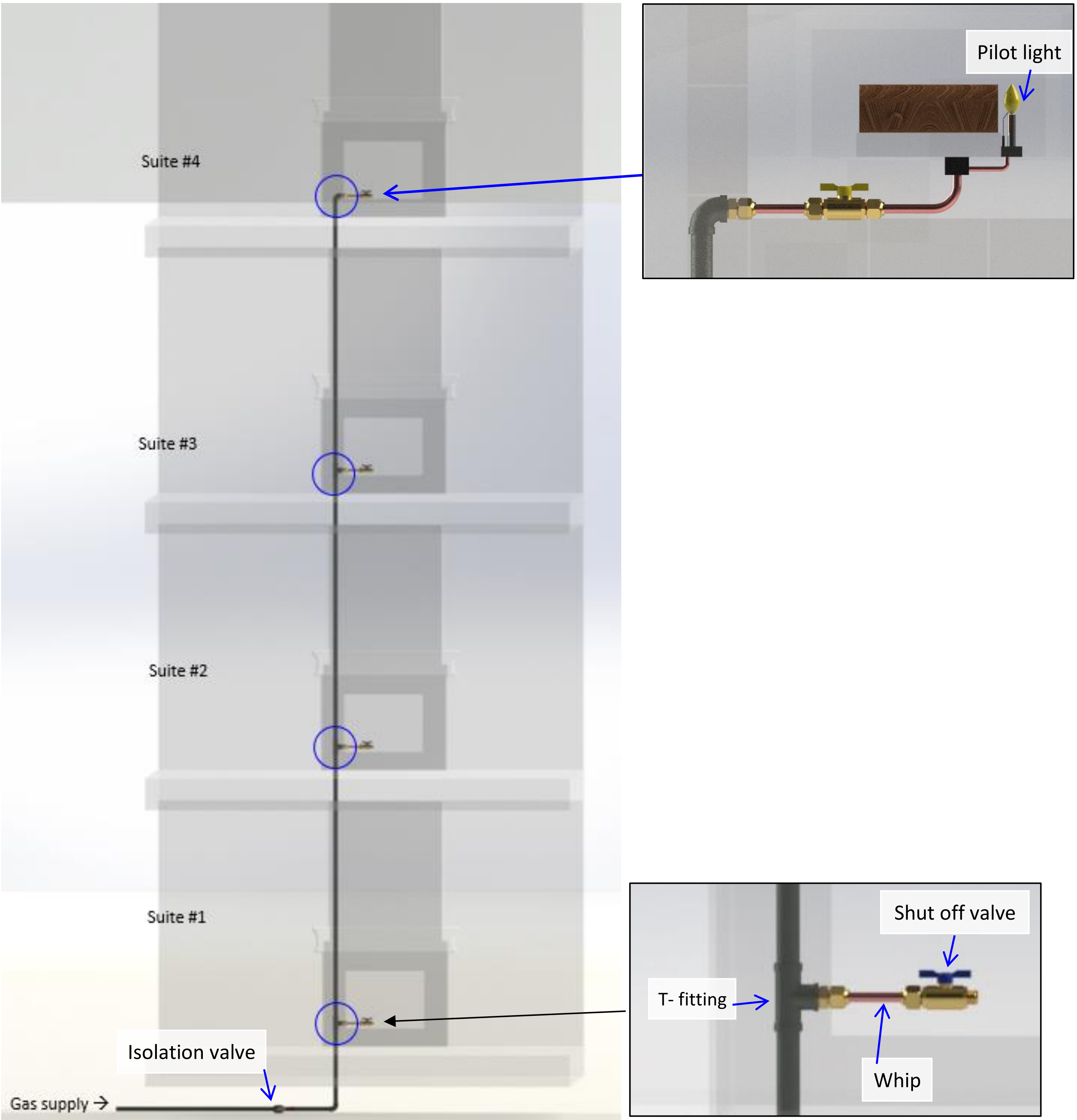

Figure 1: Schematic diagram of the gas piping system. Horizontal gas pipe in parkade connects to vertical gas riser that extends to all four floors. A T-fitting (blue circle) in the riser at each floor connects to a copper whip that supplies gas to the fireplaces.

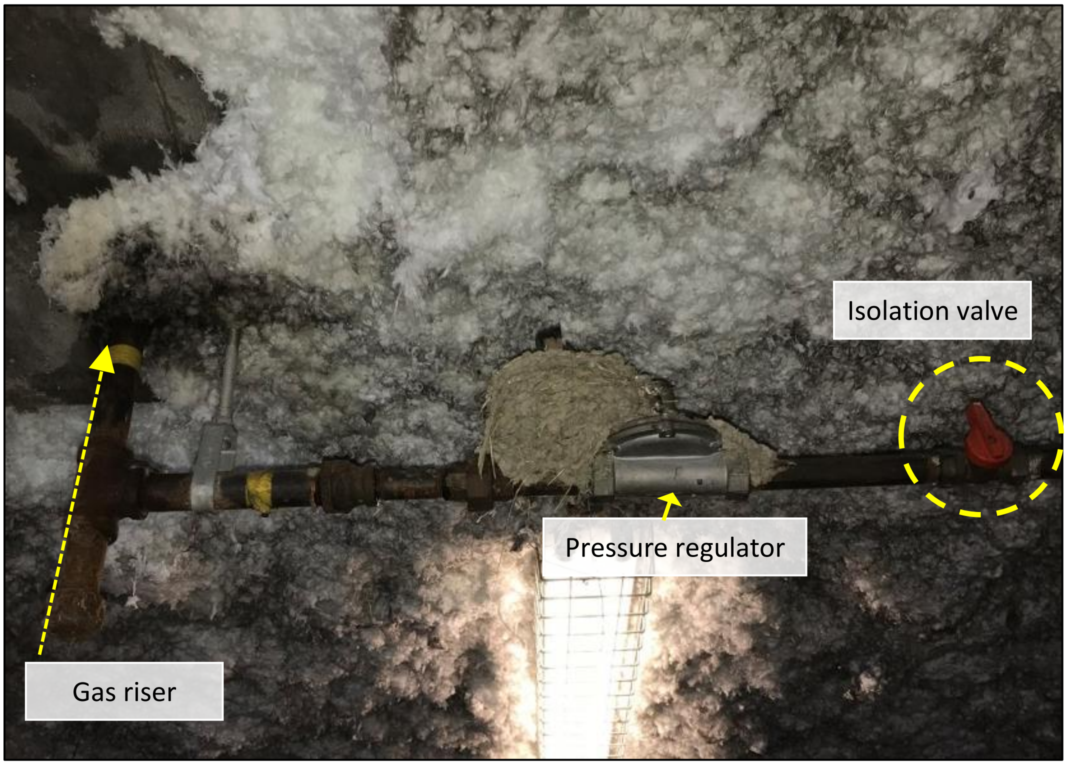

Photo 1: Gas line components located in the parkade: gas riser, pressure regulator and isolation valve which was turned "off" after the incident (as shown in photo).

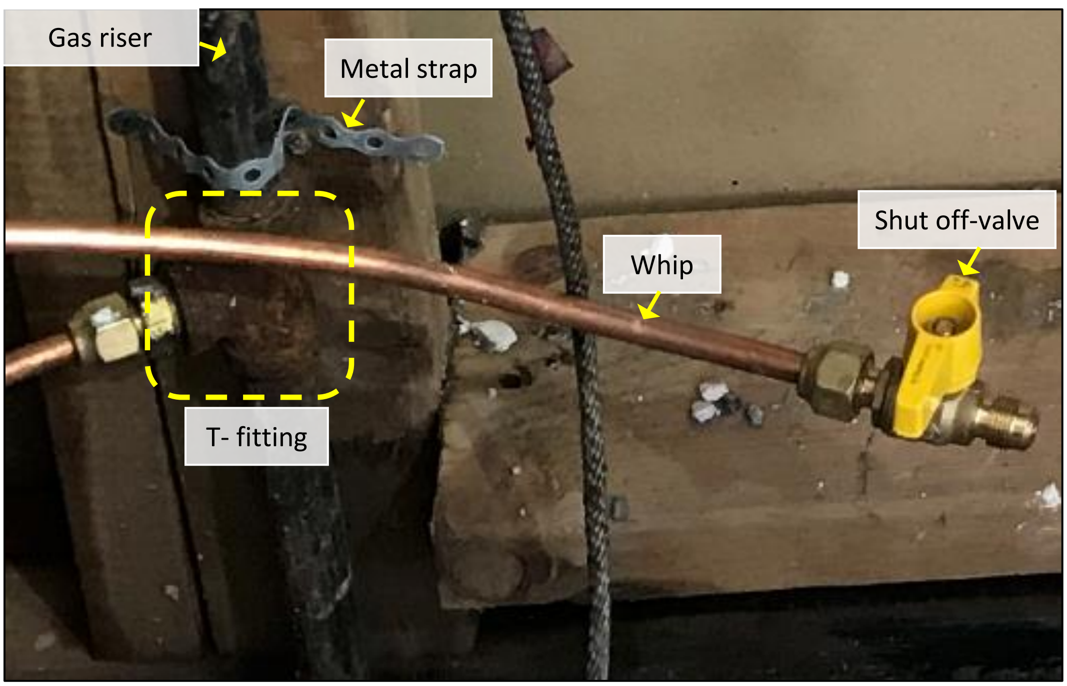

Photo 2: Gas riser pipe, T-fitting, copper whip and shut off valve in suite #2.

Photo 3 (a & b): (a) Fireplace in suite #3 partially blown out of wall. (b) Fire damage due to gas burning from broken whip.

Photo 4: Gas fitting work completed to replace fireplace in suite #2 with a new whip and T-fitting moved left.

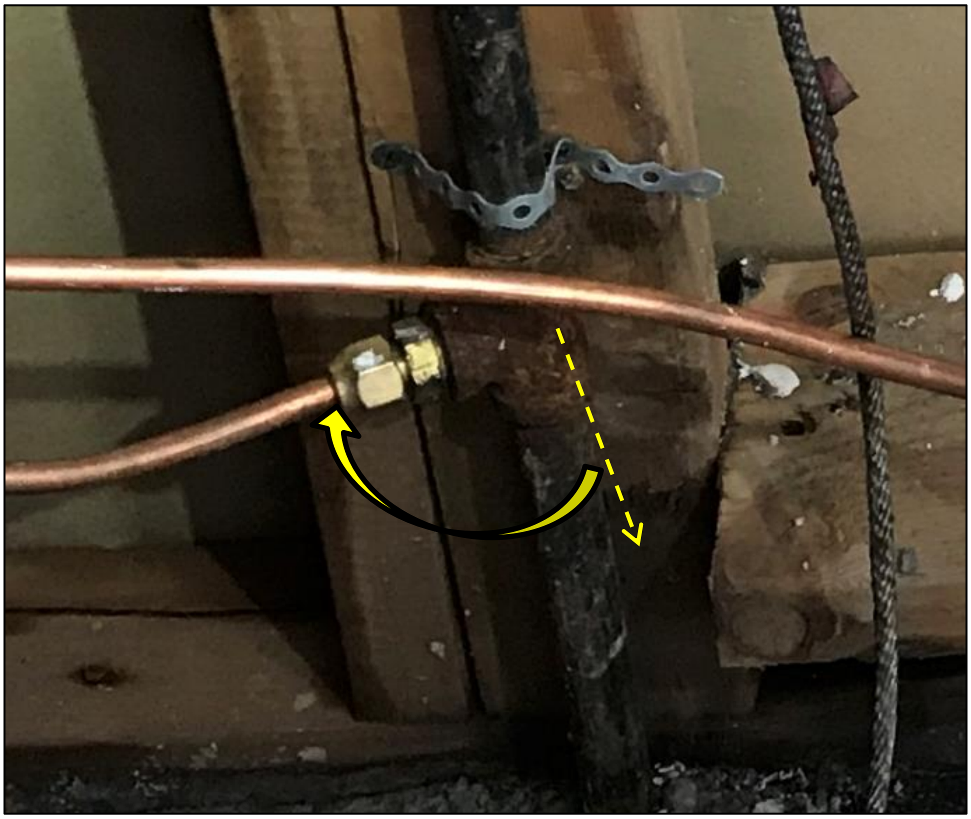

Photo 5: Gas riser T-fitting found moved and rotated in suite #2, as shown with new whip attached. The metal strap had been added by the gas fitter to restrain the riser pipe in its new position.

Photo 6: Copper gas whip in suite #3 was bent ~90 degrees and completely fractured. The leaking gas ignited, burning the wood structure. The original position of the T-fitting is estimated by the white dashed line in the photo.

Photo 7: Copper gas whip in suite #4 was bent ~90 degrees and partially fractured (yellow line) then fully fractured due to the explosion, as shown above. The original position of the elbow fitting is estimated by the white dashed line.

Appendix B: Natural Gas Copper Piping Fracture Analysis

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A Higher Level of Reliability

NATURAL GAS COPPER PIPING FRACTURE ANALYSIS

Prepared for:

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Attention: Eric Lalli, P.Eng.

File Number: 60515166
Date: September 18, 2019

[redacted]
Materials Engineer
[redacted]@acuren.com
[redacted]

1.0 INTRODUCTION

An explosion occurred during fireplace replacement [redacted] in Richmond. Acuren Group Inc. was asked by Technical Safety BC to conduct a series of metallurgical examinations on the copper whips removed from the explosion site. The tests were performed in the presence of interested parties investigating the explosion.

The parties involved attended at Acuren Group Inc. Richmond office on August 7, 2019, August 8, 2019, and August 23, 2019.

The parties attended on August 7, 2019, were [redacted] (whip #328), [redacted] (whip #228) and [redacted] (whip #428), [redacted] (whip #128), [redacted] strata, and Eric Lalli from Technical Safety BC (TSBC).

The parties attended on August 8, 2019, were [redacted] (whip #328), [redacted] (whip #228) and [redacted] (whip #428), [redacted] (whip #128), [redacted] strata, and [redacted] from Fireplace Warehouse.

The parties attended on August 23, 2019, were [redacted] (whip #328), [redacted] Envista, [redacted] (whip #128), [redacted] strata, Eric Lalli from Technical Safety BC (TSBC) and [redacted] Fireplace Warehouse.

2.0 INVESTIGATION

Based on the request of the involved parties, the investigation was nondestructive. It consisted of visual examination and fractography with the stereomicroscope and scanning electron microscope (SEM). All of the submitted whips were examined visually. Fractography was only performed on whip #328.

2.1 Visual Examination

Four copper whips were submitted for investigation. The whips were identified as #128, #228, #328, and #428. Each whip consisted of a copper pipe with flared ends. Based on the information provided by involved parties, one side of each whip was connected to a natural gas supply pipe, called a riser.

Other sides of whips were connected to a fireplace through a valve. The valve was still connected to whip #128, #228, and #328 in the as-received condition. Whip #428 did not have the valve attached.

Figure 1 to Figure 7 show the condition of whip #128 in the as-received condition. The valve side of the copper pipe was straight. Shallow flaring marks were noted near the valve. A flaring mark is a tool mark which is typically observed on the surface of a manually flared copper pipe.

The riser side of whip #128 was not straight. The position of the copper pipe at this location was likely exposed to bending or torsional stresses. In addition to flaring marks, a fresh surface scratch was also noted (Figure 5 to Figure 7).

Figure 8 to Figure 10 show the condition of whip #228 in the as-received condition. The valve side and the riser side of the copper pipe were straight. The length of the copper pipe was considerably more than the other whips.

Figure 11 to Figure 14 show the condition of whip #328 in the as-received condition. The valve side of the copper pipe was straight with some flaring marks near the valve.

Figure 15 and Figure 16 show the condition of the riser side of whip #328. The copper pipe at this location was fractured adjacent to the flared area. The pipe was straight near the fracture location. The fracture profile indicated that flared end had been bent off the copper pipe.

Figure 18 to Figure 20 show the condition of whip #428 in the as-received condition. The valve side of the copper pipe was straight. The valve remained at the explosion site.

The images of the riser side of whip #428 are presented in Figure 19 and Figure 20. The copper pipe at this location was fractured adjacent to the flared end. The fractured portion, however, was attached to the pipe. The fracture profile of the whip was similar to that of whip #328 and verified that the intense bending loads exerted to the riser side of the whip caused the fracture.

2.2 Fractography

Micrograph of whip#328 fracture surface is presented in Figure 21. The fracture surface configuration indicated that the final fracture zone was at about the 6 o'clock position, and the fracture origin was between the 12 and 2 o'clock position.

The final fracture surface in Figure 22 and Figure 23 indicated that the copper pipe had been fractured under bending stresses. The fracture origin is presented in Figure 24. The wall of the copper pipe near the fracture origin exhibited necking typical of ductile fracture.

SEM images of the fracture surface of whip #328 at the locations indicated in Figure 21 are shown in Figure 27 to Figure 32. The fracture features along the tube were elongated dimples typical of ductile failure.

3.0 DISCUSSION

The examination of the whips indicated that bending stresses were exerted to installed whips. As a result, whip #128 was slightly bent; whip #328 and whip #428 ruptured.

The fracture surface around the pipe wall of whip #328 consisted of slightly elongated dimples indicating the whole failure occurred in ductile mode. It is concluded that the copper pipe of whip #328 was overloaded by bending stress and ruptured accordingly.

4.0 CONCLUSIONS

Whip #328 fractured by ductile tearing.

The riser side of whip #328 had been overloaded in response to a bending load in excess of the copper pipe mechanical strength and ruptured accordingly.

The condition of the riser side of whip # 128 and #428 indicates that both whips had been exposed to a severe bending load. However, the bending load was more than the mechanical strength of the copper pipe of whip #428 and a ductile rupture occurred.

Materials Engineer

Note: Unless otherwise instructed, we shall dispose of all parts and test samples sixty days from the date of this report.

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APPENDIX I

FIGURES 1 - 32

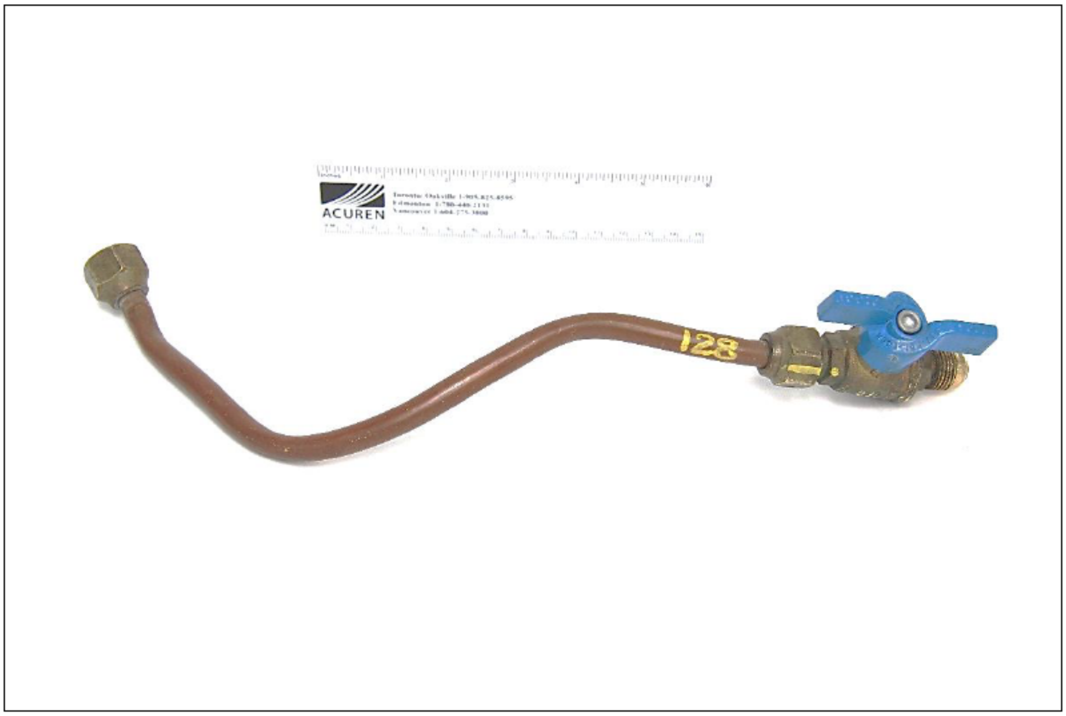

Figure 1 General condition of whip #128 as received.

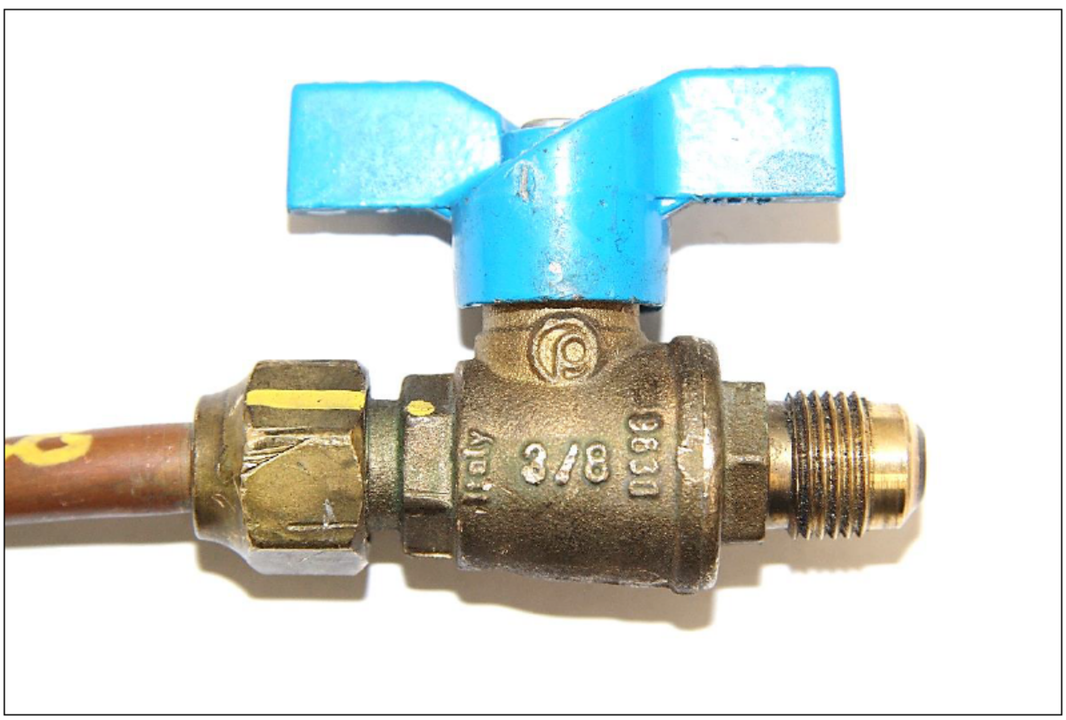

Figure 2 The valve side of whip #128.

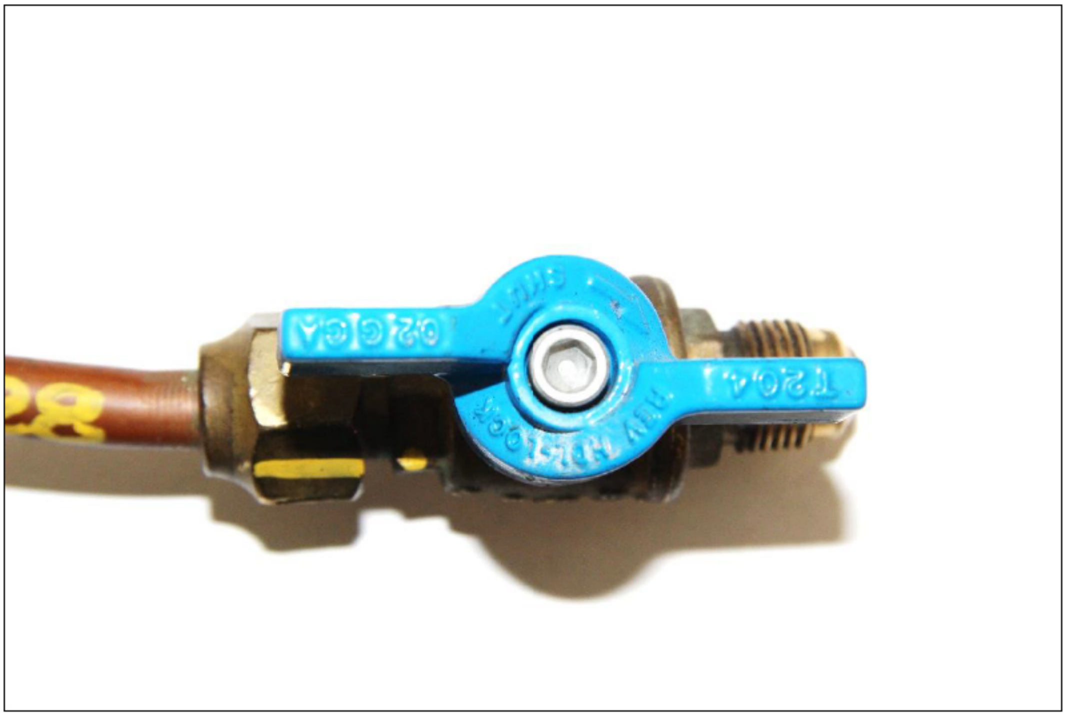

Figure 3 The valve side of whip #128.

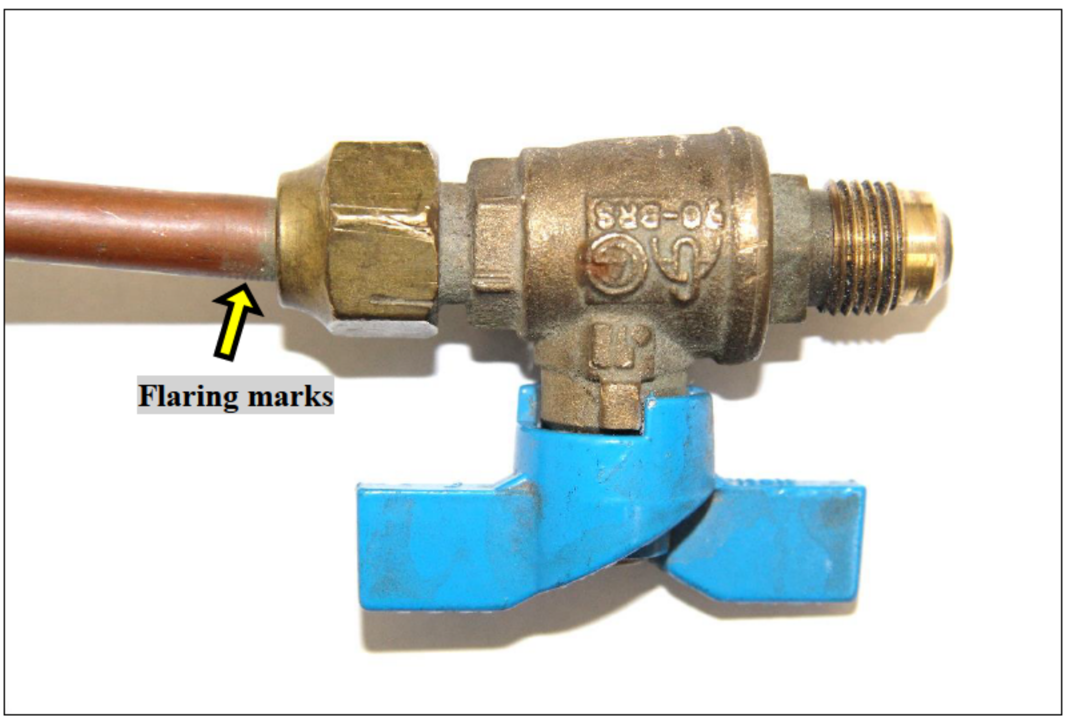

Figure 4 The valve side of whip #128.

Figure 5 The riser side of whip #128 was bent.

Figure 6 Whip #128 was bent at the riser side.

Figure 7 Whip #128 was bent at the riser side.

Figure 8 General condition of whip #228 as received.

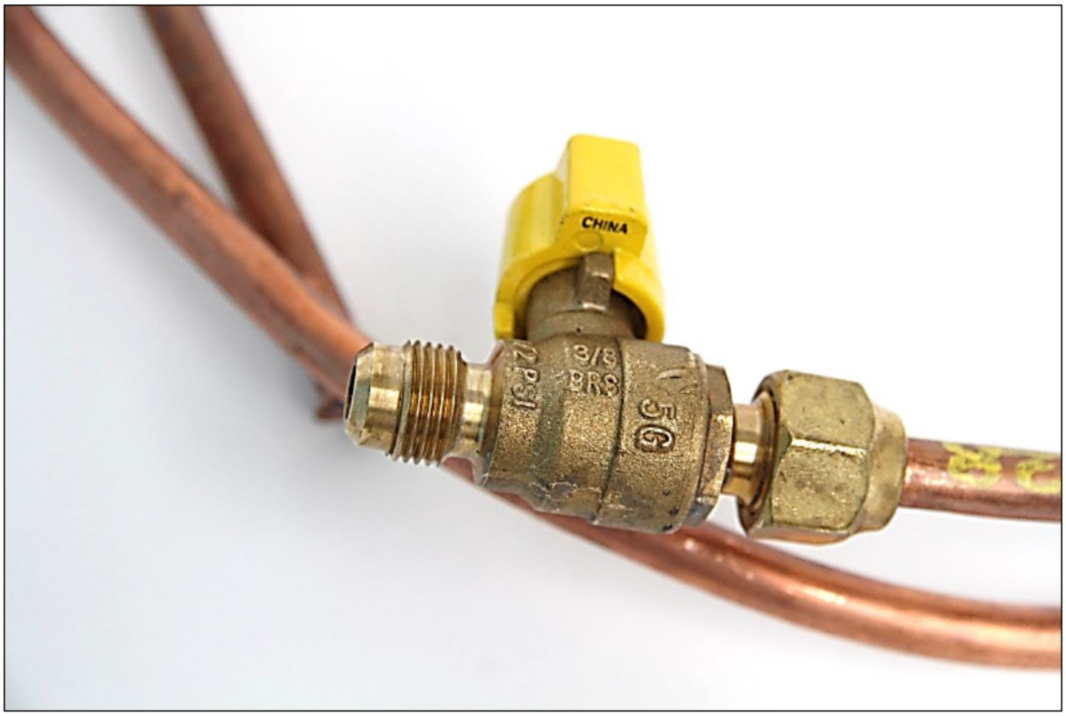

Figure 9 The valve side of whip #228.

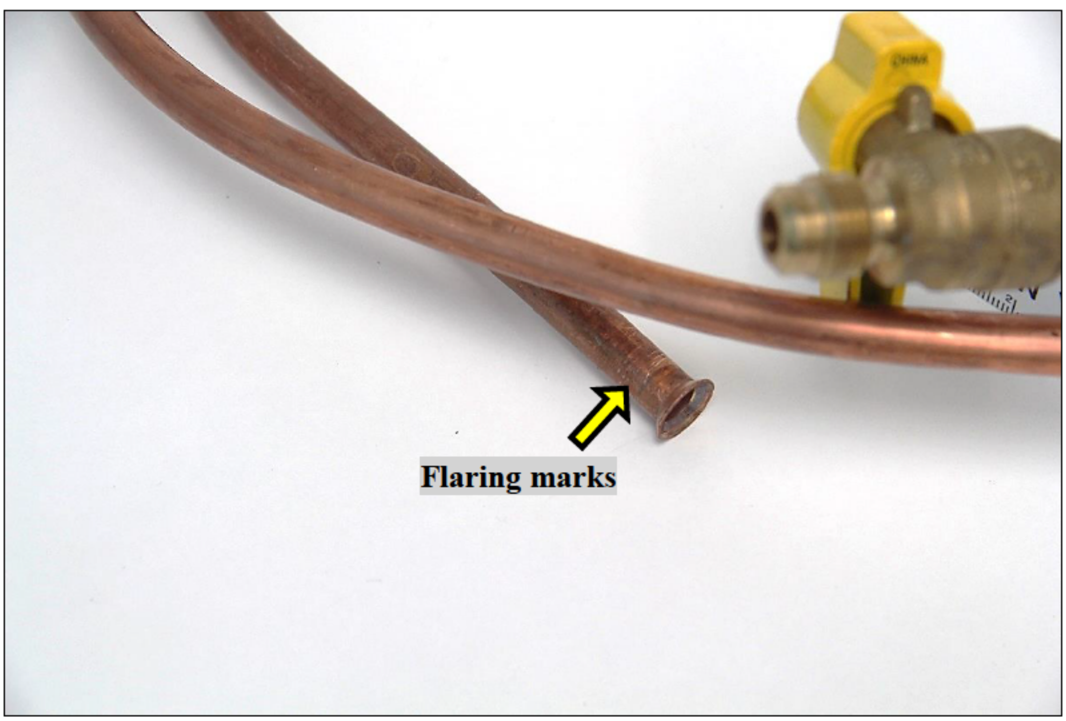

Figure 10 The riser side of whip #228. The riser side is straight.

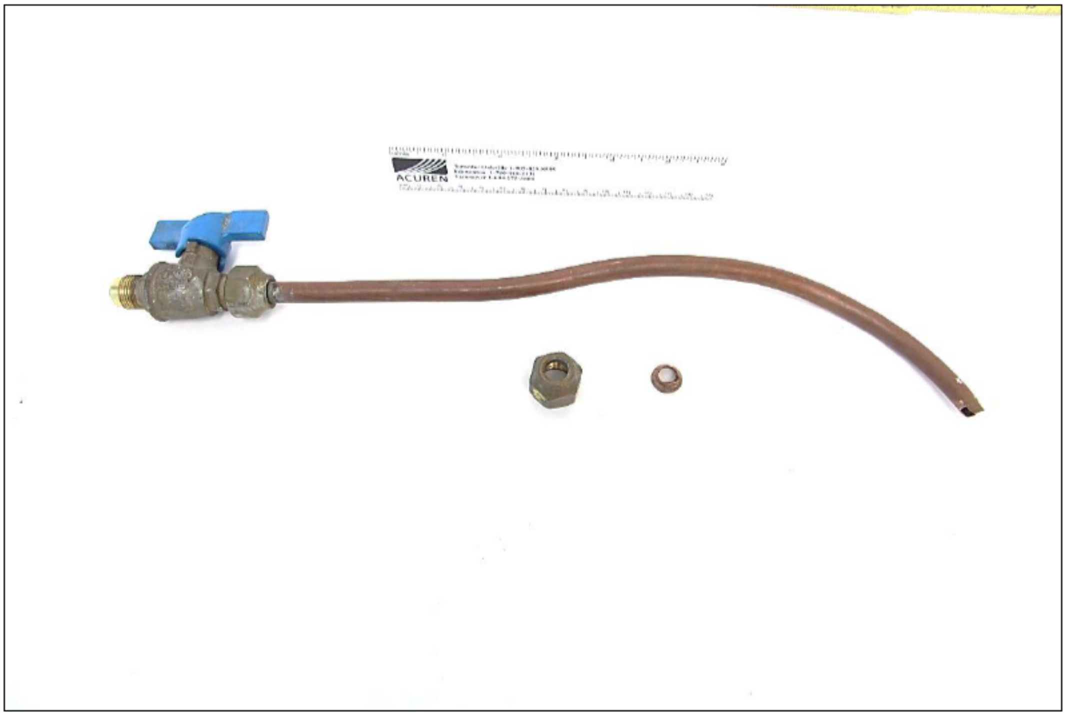

Figure 11 General condition of whip #328 as received. The riser side was fractured. The fracture fragments are shown.

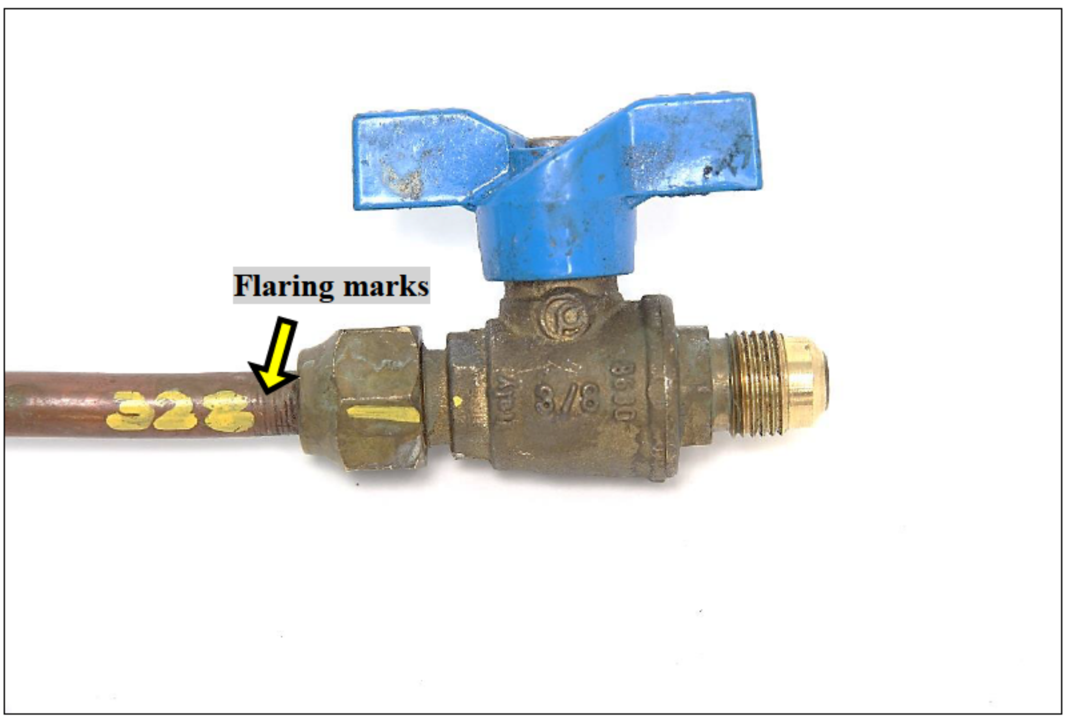

Figure 12 The valve side of whip #328.

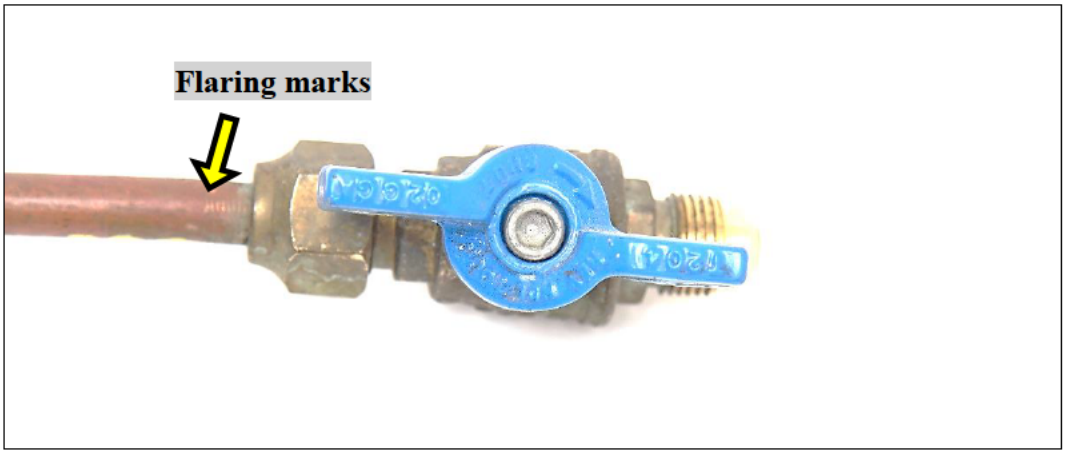

Figure 13 The valve side of whip #328.

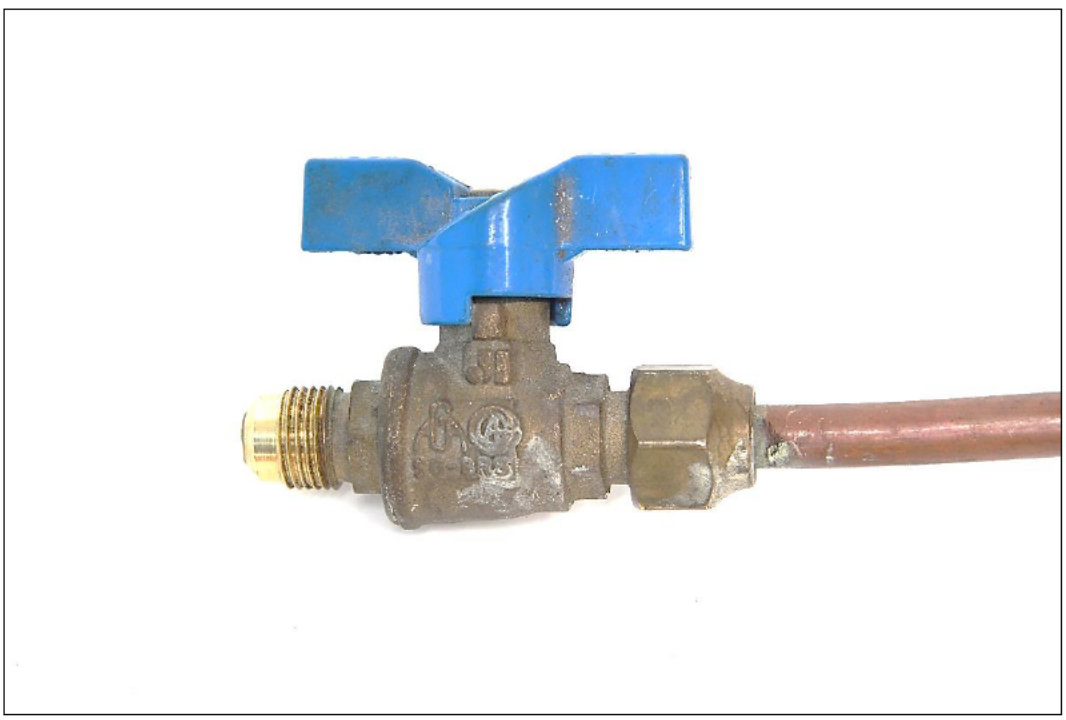

Figure 14 The valve side of whip #328.

Figure 15 The fracture surface of the rise side of whip #328.

Figure 16 The fracture surface of the rise side of whip #328.

Figure 17 General view of whip #428 as received. The valve side is intact, and the riser side is fractured.

Figure 18 Intact condition of the valve side of whip #428.

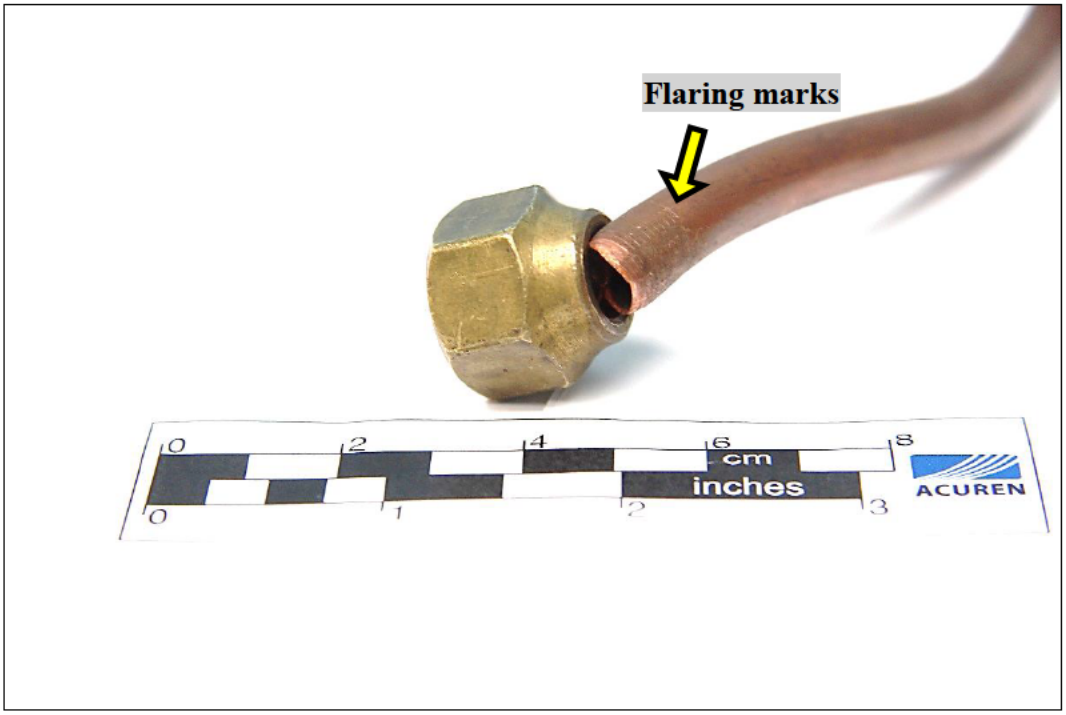

Figure 19 The position of the fitting indicated that bending forces were applied to the riser side of whip #428.

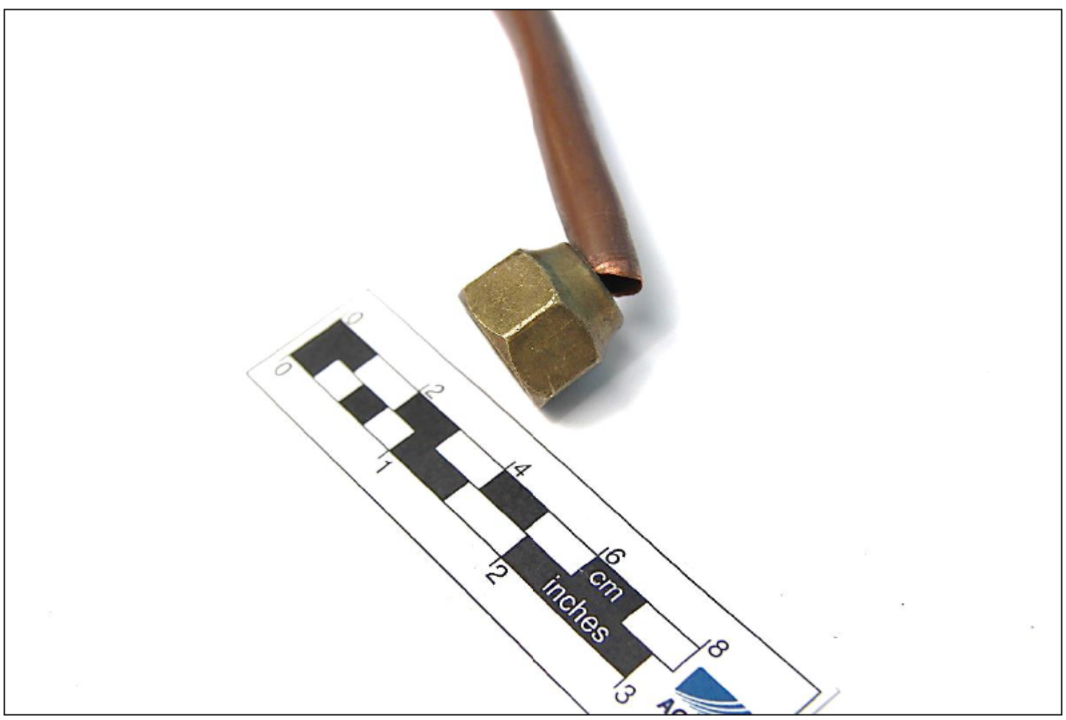

Figure 20 The position of the fitting indicated that bending loads were applied to the riser side of whip #428.

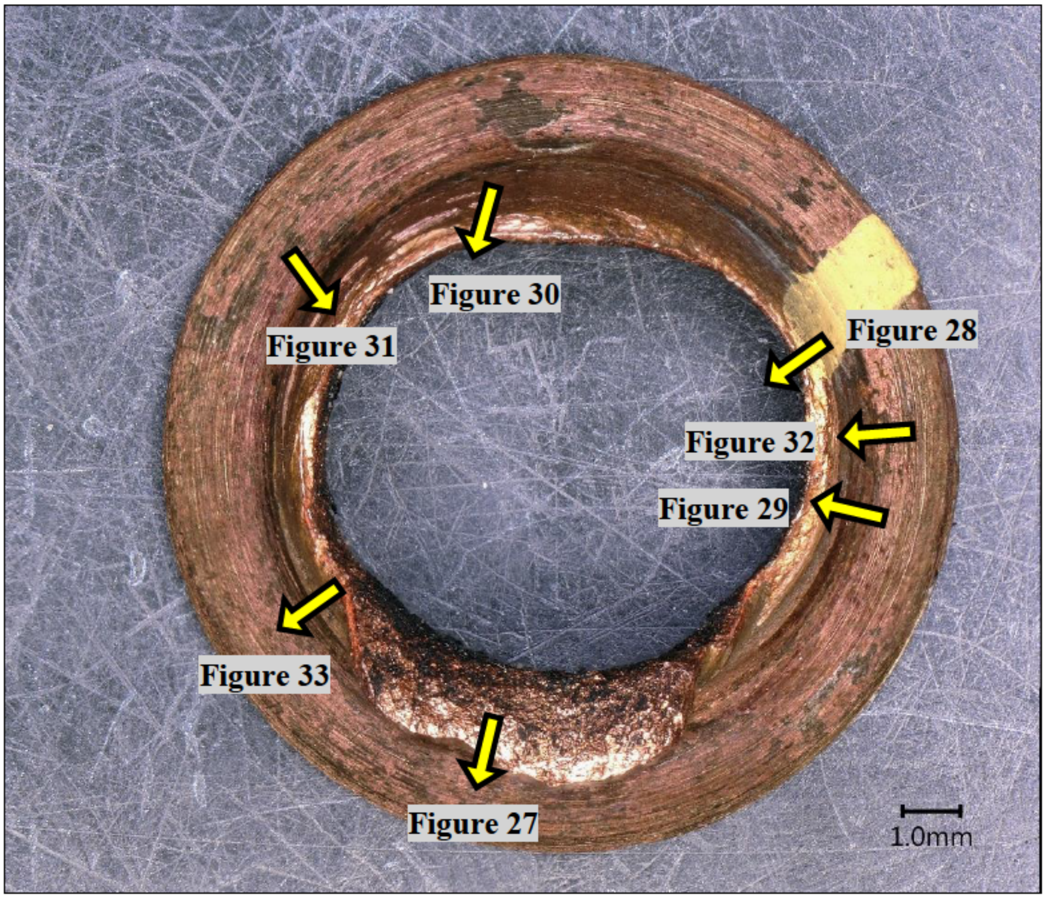

Figure 21 Fracture surface of the riser side of whip #328. Arrows show the fracture propagation direction.

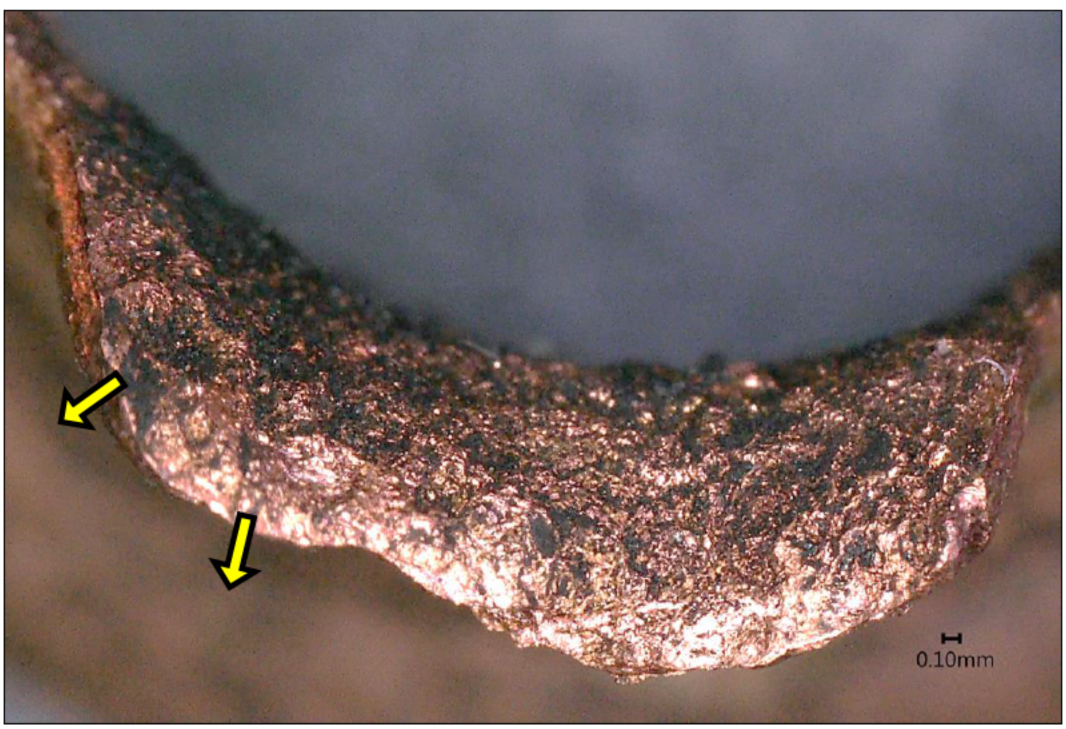

Figure 22 Final fracture zone of whip #328.

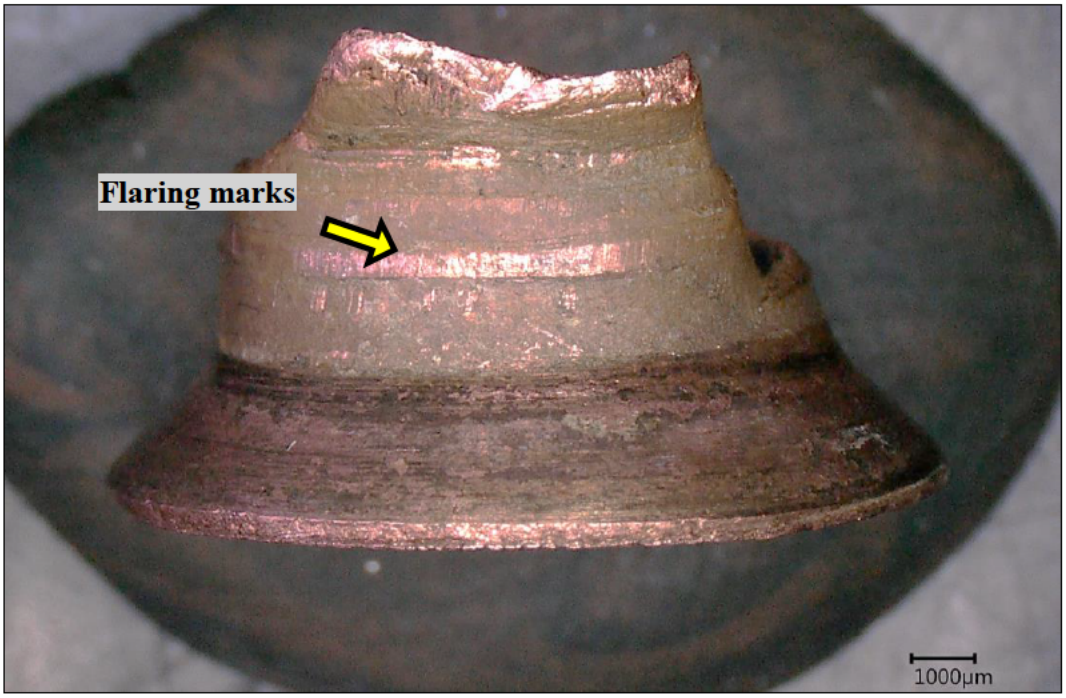

Figure 23 The fracture profile of the copper pipe indicated that the pipe was bent.

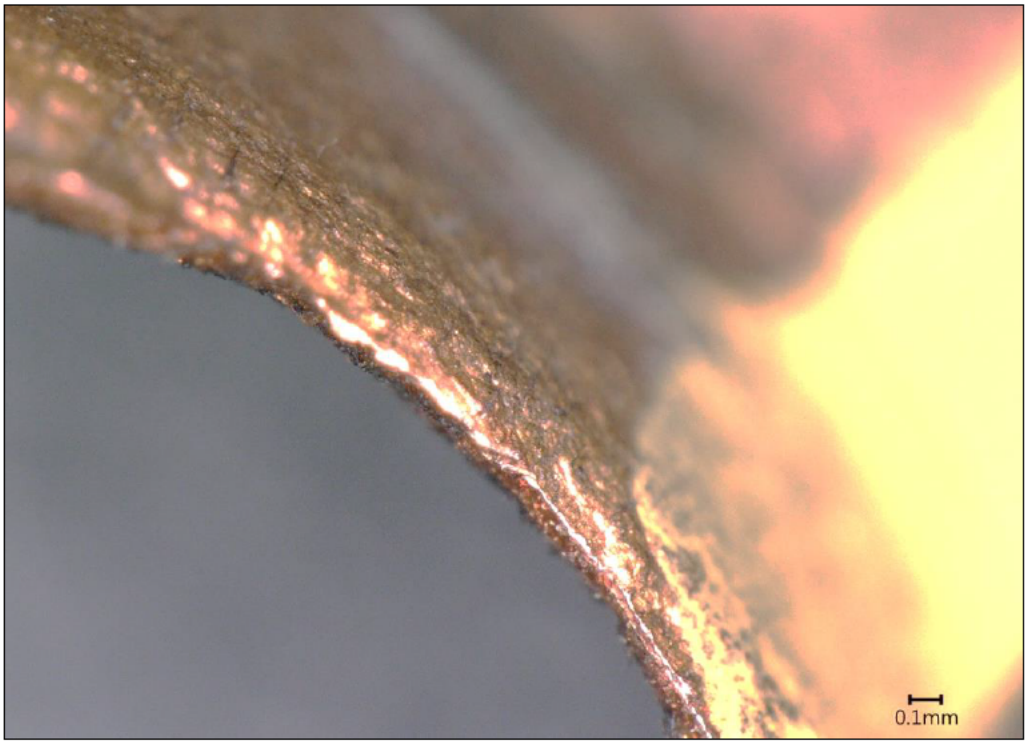

Figure 24 The fracture origin of the whip #328 fracture surface. The wall of the pipe exhibited necking.

Figure 25 Matching fracture surface of whip #328 fracture surface. Black deposits were noted on the pipe ID. The copper pipe was bent toward the final fracture zone.

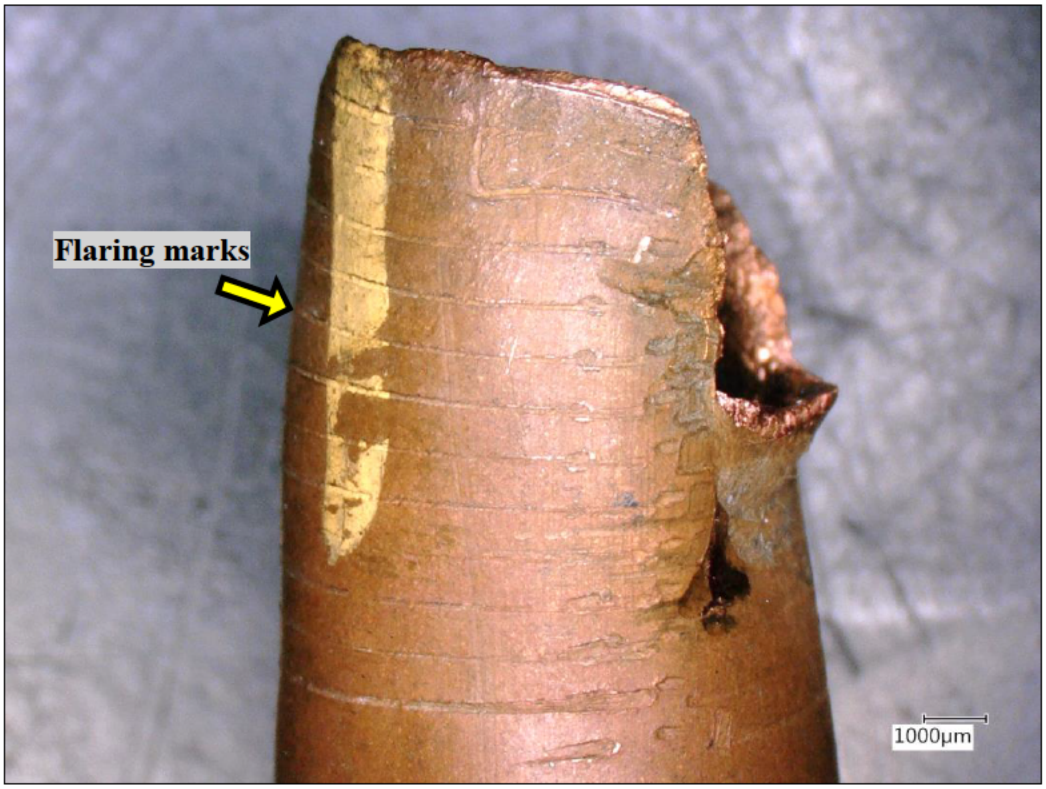

Figure 26 Matching fracture surface of whip #328 fracture surface. The pipe profile shows that it was under bending stress.

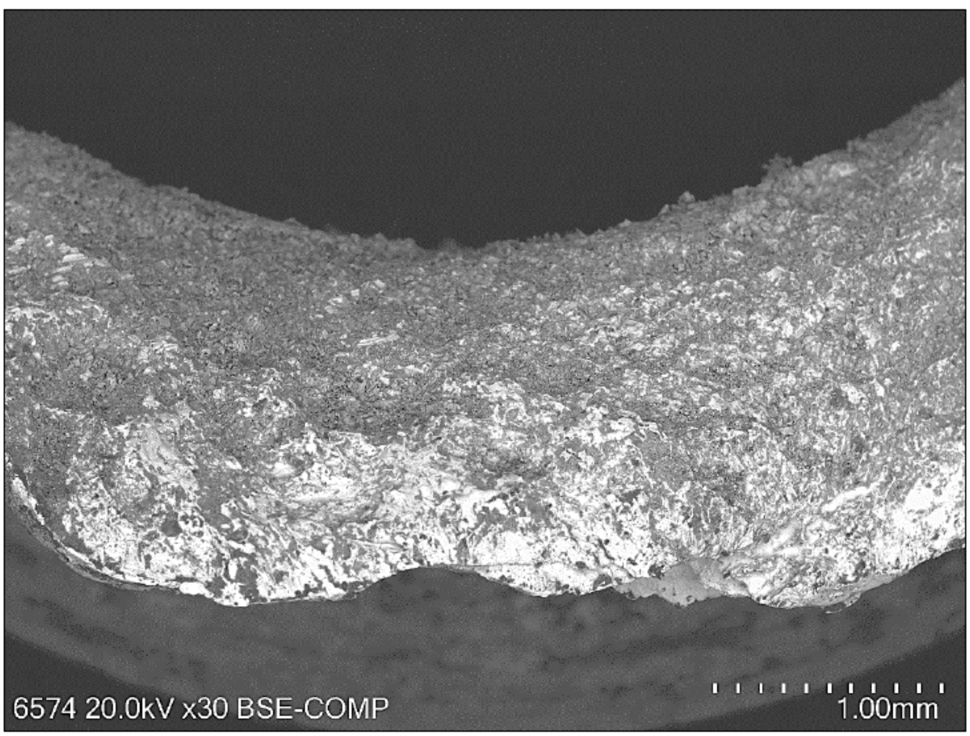

Figure 27 SEM image of the fracture surface, as indicated in Figure 21.

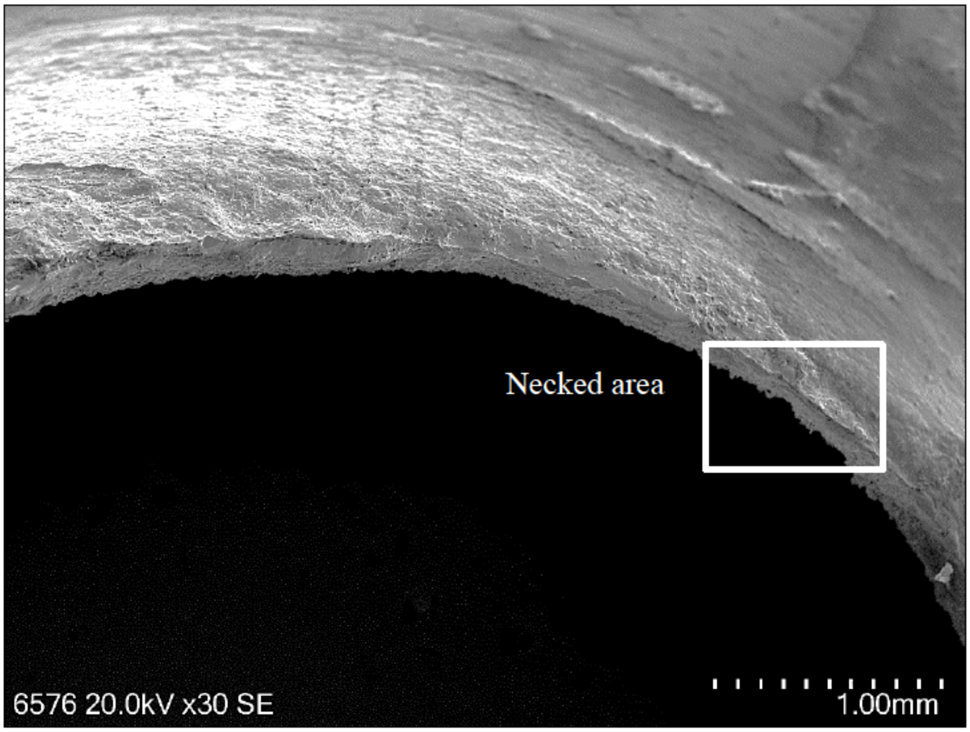

Figure 28 SEM image of the fracture surface, as indicated in Figure 21. Pipe wall experienced necking.

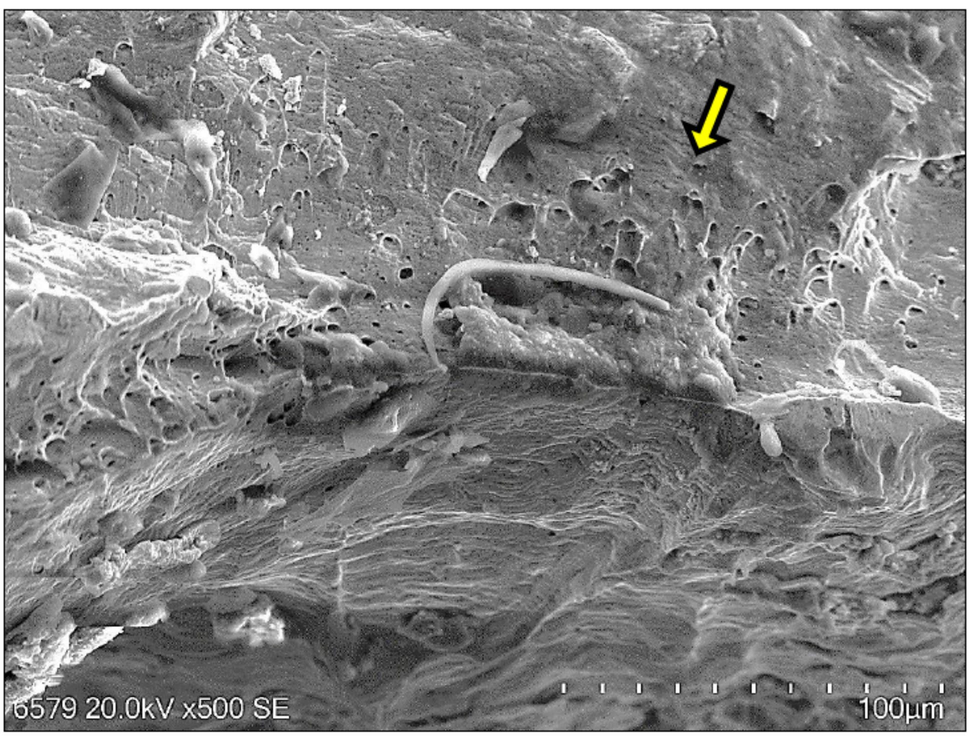

Figure 29 SEM image of the fracture surface, as indicated in Figure 21. Elongated dimples indicating ductile fracture are notable. The arrow shows the fracture propagation direction.

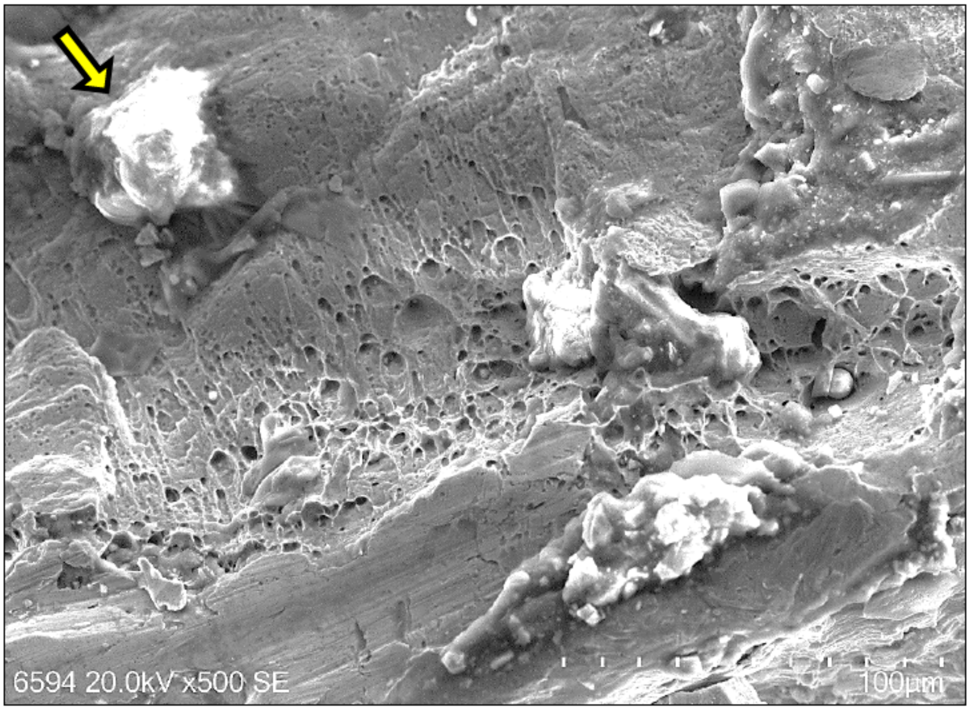

Figure 30 SEM image of the fracture surface, as indicated in Figure 21. Elongated dimples indicating ductile fracture are notable. The arrow shows the fracture propagation direction.

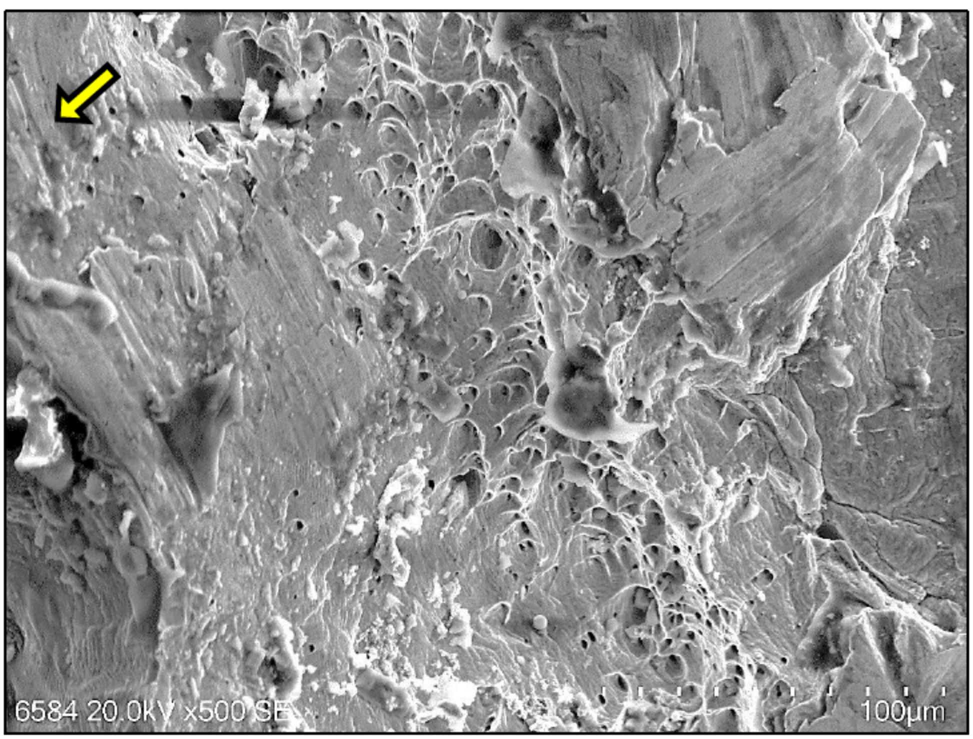

Figure 31 SEM image of the fracture surface, as indicated in Figure 21. Elongated dimples indicating ductile fracture are notable. The arrow shows the fracture propagation direction.

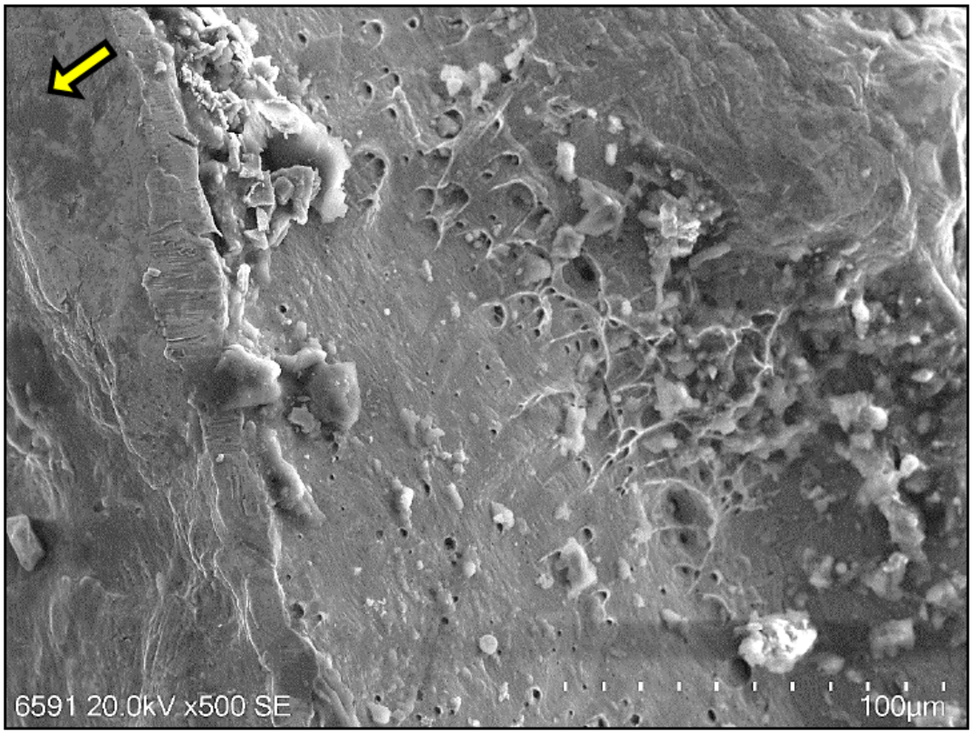

Figure 32 SEM image of the fracture surface, as indicated in Figure 21. Elongated dimples indicating ductile fracture are notable. The arrow shows the fracture propagation direction.

Appendix C: Regulations and Codes

The *Safety Standards Act* adopts applicable regulations and codes that must be followed by individuals working with various technologies in BC. These include the Gas Safety Regulation and CSA B149.1:20 Natural Gas and Propane Installation Code. Some reference clauses applicable to this incident are listed below.

CSA B149.1:20 Natural gas and propane installation code

4.4 Training and quality of labour
4.4.1
All work shall be done in a skillful, thorough manner. Careful attention shall be paid not only to the mechanical execution of the work but also to the arrangement of the installation.

6.22 Testing of piping, tubing, hose, and fittings

6.22.1
The source of test pressure shall be isolated while the piping or tubing system is under test, and the system shall retain the test pressure for the minimum duration required in Table 6.3 without showing any drop in pressure.

6.22.2
Before an ***appliance*** is connected, a piping and tubing system that contains ***fittings*** or joints shall be pressure tested using either air, inert gas, or carbon dioxide in the following manner:
(a) ***Appliance*** shut-off ***valves*** not rated for the test pressure being used and meters and ***regulators*** shall not be connected to the piping or tubing system under test.
(b) The test pressure shall be measured by either a pressure gauge or equivalent device and, if a gauge is used, the minimum diameter shall be 3 in (75 mm) and the maximum range shall exceed the test pressure by at least 15% but not more than 300%. The pressure gauge or equivalent device shall be calibrated to read in increments of not more than either 2 psig (14 kPa) or 2% of the maximum dial reading of the pressure gauge, whichever is less.
(c) A pressure recorder when used for this test shall be calibrated to the requirements of Item (b).
(d) The pressure and duration of the test shall be in accordance with Table 6.3.

6.22.3
After an ***appliance*** is connected, the system shall be tested in the following manner:
(a) Before turning on the gas for the test, a check shall be made to ensure that any opening from which gas can escape is closed.
(b) Immediately after allowing the gas into the piping or tubing system, a test shall be made to determine that no gas is escaping by carefully watching the test dial of the meter or by using a manometer.
(c) Where a meter is not provided, the pressure shall be measured with either a pressure gauge or equivalent device calibrated to read in increments not greater than those specified in Clause 6.22.2 (b), with the following exceptions:
  (i) for a system where the working pressure is 0.5 psig (3.5 kPa) or less, the pressure gauge or equivalent device shall be calibrated to read in increments of not greater than 1 in w.c. (250 Pa); and
  (ii) for a system where the working pressure exceeds 0.5 psig (3.5 kPa) but does not exceed 5 psig (35 kPa), the pressure gauge or equivalent device shall be calibrated to read in increments of not greater than 2 in w.c. of pressure (0.5 kPa).
(d) The test described in Item (b) shall be of a 10 min duration.
(e) Each ***appliance*** connection, ***valve, valve train***, and system ***component*** shall be checked while under normal operating pressure with either a liquid solution or a leak-detection device to locate any source of a leak.

6.22.4
An addition to an existing piping or tubing system shall be tested as an individual system in accordance with Clause 6.22, except that
(a) where the addition is 20 ft. (6 m) or less in length and the normal working pressure is less than 0.5 psig (3.5 kPa), the addition shall be leak tested in accordance with Clause 6.22.3(e); and
(b) where the addition is accomplished using a welded tie-in, and the new system has been tested in compliance with Clause 6.22, the tie-in weld shall be tested in accordance with Clause 6.22.3(e).

Appendix D: Recommendations to Prevent Similar Incidents

Based on the findings of this investigation, TSBC makes the following recommendations intended to prevent a similar occurrence. These recommendations intend to seek improvements to:

- Identifying hazards associated with working on energized gas systems (unsafe work practices)
- Understanding actions required to identify and eliminate hazards

Investigation findings: The gas riser isolation valve was not closed to prevent gas flow in the gas riser pipe serving the fireplaces in four suites, before disconnecting the gas supply line in one suite. Further, the gasfitter manipulated a gas riser pipe common to three other suites, breaking a gas lines in two suites. This created the following hazardous conditions:

1. A pilot flame remained burning in suite #4 (ignition source)
2. Gas escaped under pressure from leaks in the piping system (fuel source)

This resulted in gas leaks reaching an ignition source which caused a major explosion.

Recommendations to prevent work on energized gas system, to identify and eliminate hazards caused by work

Recommendation #1 to gas fitters, fire place companies, contractors

Before removing any appliances or connected piping, isolate the gas supply upstream of the appliance (e.g. fireplace) or connected piping (e.g. whip). On completion of the work, leak test any piping that has been manipulated/modified as a result of the retrofit. Ensure these steps are included as standard safe work procedures.

Recommendation #2 to homeowners, strata corporations and property managers:

When hiring gas contractors, request that their standard safe work procedures include steps to isolate the necessary portions of a gas system when performing retrofit work and that they will test the system to verify it is safe for use. As this may interrupt gas supply to multiple units, coordinate with the gas contractor to facilitate access to restore gas service.