AEI CORPORATION
Advanced Engineering Investigations

PRELIMINARY INVESTIGATION REPORT

Sprinkler System Freeze Loss

Rep/Ins:	Lake Forest Condo Association
Location:	1630 Lake View Terrace, Building B, Unit 304B, Frisco, Colorado
Claim No.:	115884-1
Date of Loss:	02/23/22
AEI Project No.:	15092

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Prepared for:
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Submitted by:

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Date

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INTRODUCTION

At the request of John Iverson with McMillan Claim Service (McMillan), AEI Corporation (AEI) investigated a water loss involving a sprinkler system at 1630 Lake View Terrace, Building B, Unit 304B, in Frisco, Colorado. AEI was asked to evaluate the installation, inspection, testing, and maintenance of the sprinkler system. Additionally, AEI was asked to evaluate the applicable codes and industry standards of care regarding the installation of the sprinkler system. The following is a summary of our findings to date.

BACKGROUND

The subject property is a multi-story wood framed condominium/townhome building constructed in the early 1990s. The building was constructed in four sections with three units in each section, for a total of twelve units per building. When the building was constructed, the applicable codes required the installation of a sprinkler system. Western States Fire Protection (Western) has been inspecting and servicing the sprinkler system proximate to the loss.

On February 23, 2022, the sprinkler system in Building B, Unit 304B, was observed leaking in the kitchen from the west ceiling in proximity to the mechanical room. The maintenance staff opened the ceiling to determine where the leak was located and concluded a sprinkler line in the attic was the source of the water.

INVESTIGATION TASKS

The following tasks were performed by AEI during the course of the investigation:

1. Attended a site inspection on March 14, 2022.
2. Reviewed the items listed below.

REVIEWED ITEMS

The following items were provided or gathered for review:

1. 1991 Edition of the Uniform Fire Code (UFC).
2. 1987 Edition of National Fire Protection Association (NFPA) 13, *Standard for the Installation of Sprinkler Systems*.

3. The 2020 Edition of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

SITE INSPECTION

This writer attended a site inspection on March 14, 2022. John Iverson of McMillan and Keith McBreathy from Summit Resort Group (Summit) were also in attendance. The kitchen area of Unit 304B was accessed (Figure 1), and it was observed that the ceiling had been opened to locate the leak (Figure 2). There were two levels of gypsum board, a main ceiling, and an additional fire barrier approximately 15-inches above the main ceiling, also shown in Figure 2. The water damage observed was limited to the kitchen of the subject unit. It was determined by Summit that a sprinkler line had separated, resulting in the discharge of water into the unit. The subject sprinkler line was determined to be comprised of ¾-inch Poz-Lok tubing and a ¾-inch Poz-Lok 90° elbow, as shown in Figure 3.

Figure 1. Kitchen in Unit 304B (15092 CBS 1-007).

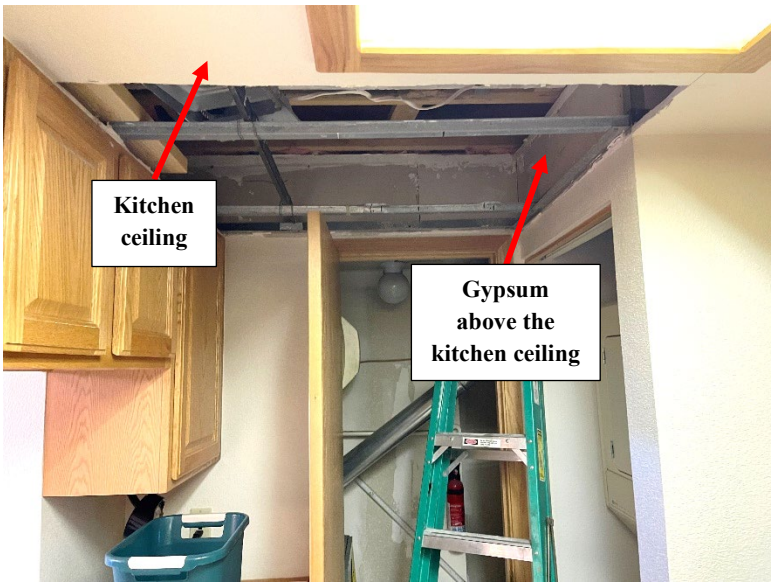

Figure 2. Removed ceiling in kitchen of Unit 304B (15092 CBS 2-006).

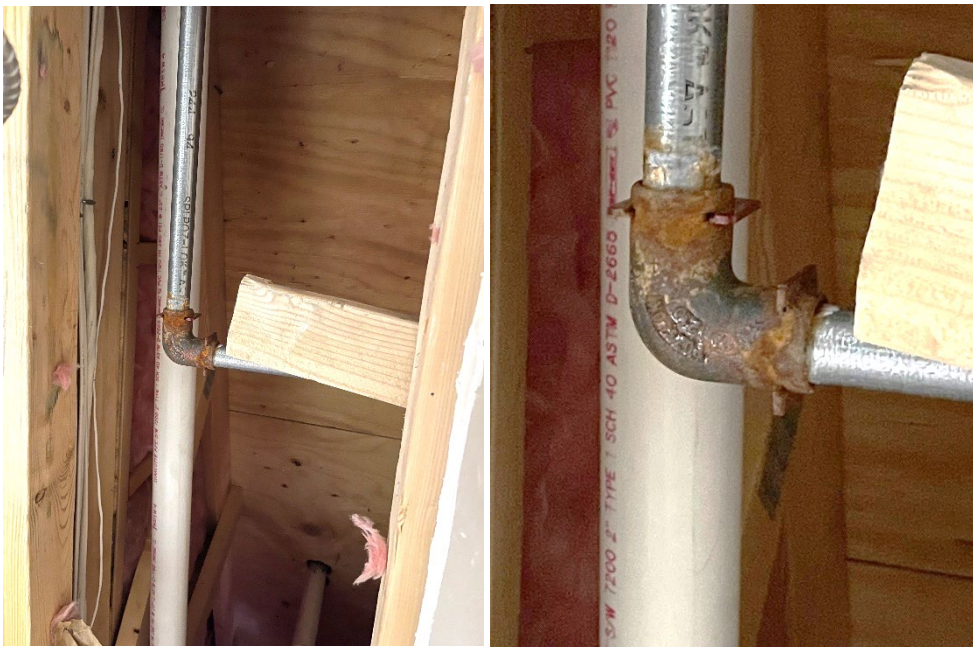

Figure 3. Subject sprinkler pipe and fitting (15092 CBS 2-001, CBS 2-002).

The area of the leak was documented and the tubing was marked for removal, as depicted in Figure 4. The tubing was cut and removed, as illustrated in Figure 5. Corrosion products were observed and the tubing was separating from the north side of the fitting, as shown in Figure 6. The tubing had moved approximaely ½-inch from its assembled location. The key, used to lock the tubing to fitting, was still in place and the tubing could not be moved by hand, as depicted in Figures 6, 7, and 8. When installed, Poz-Lok tubing is inserted into a Poz-Lok fitting through an O-ring until it bottoms out. The fitting has two slots that a key slides into and is then knocked into place with a hammer to lock the fitting onto the tubing.

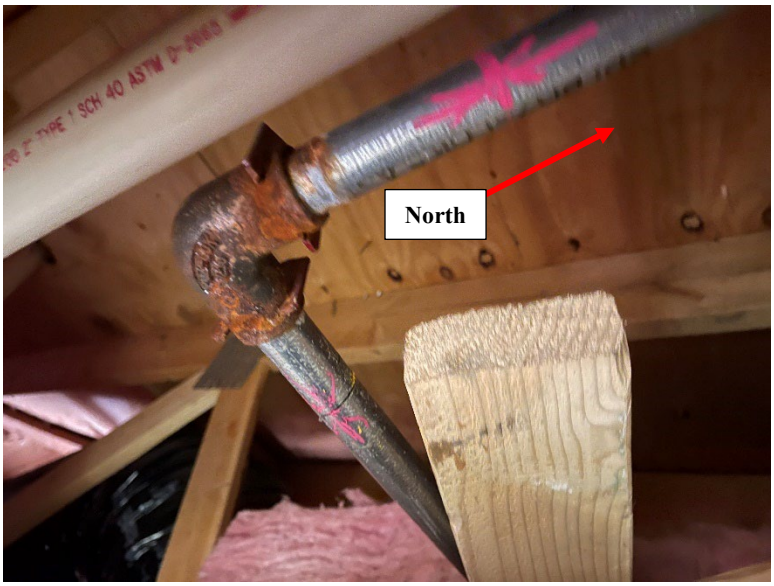

Figure 4. Tubing marked for removal (15092 CBS 2-015).

Figure 5. Poz-Lok tubing and fitting after removal. Tubing can be observed starting to separate from the fitting (15092 CVBS 2-019).

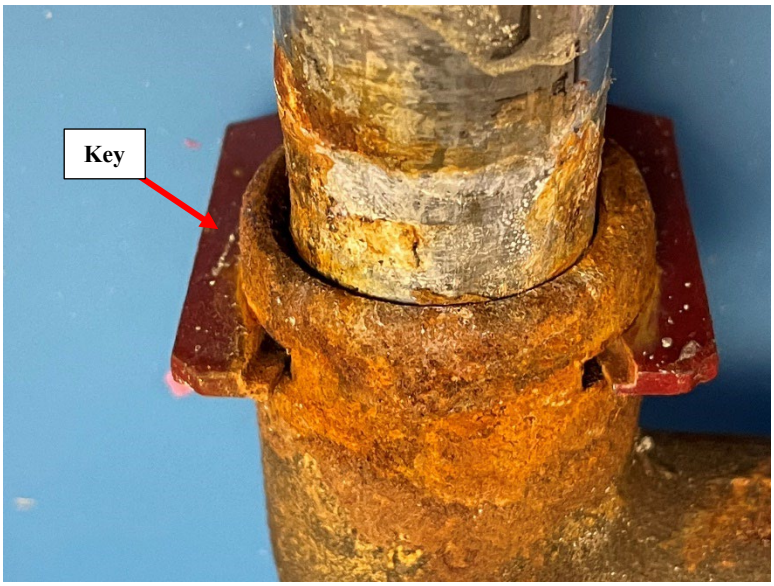

Figure 6. Key used to hold tubing in place in the elbow fitting. Tubing separation from fitting is visible (15092 CBS 2-025).

Figure 7. Tubing separating from the elbow fitting (15092 CBS 2-027).

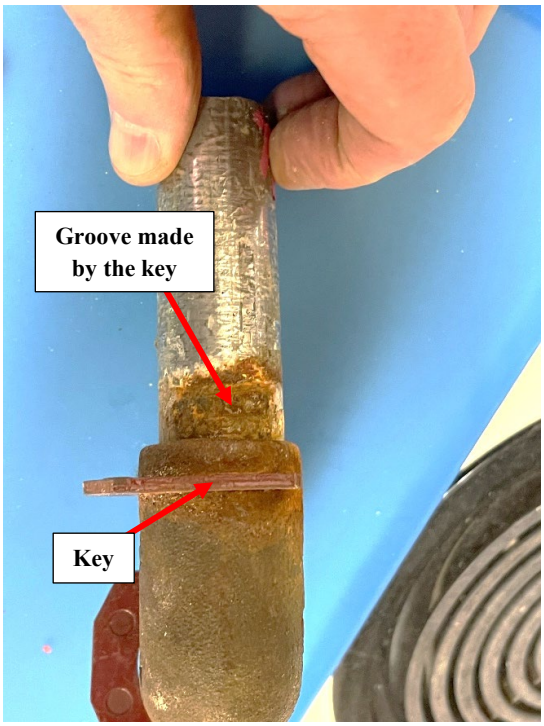

Figure 8. Groove from the key in the tubing wall (15092 CBS 2-023).

The sprinkler riser room on the lower level was inspected. The incoming water line was a combination line for the domestic and sprinkler systems. The incoming water line branched off to a 1 ½-inch supply for the sprinkler systems. The sprinkler manifold consisted of steel pipe and tees that supplied four sprinkler risers. The risers transitioned to 1 ½-inch Poz-Lok components and tubing, as illustrated in Figure 9. There were Western inspection tags on the system, as shown in Figure 10. The fire alarm system, an FCI fire alarm control panel, was in the riser room and the panel was in alarm, as depicted in Figure 11.

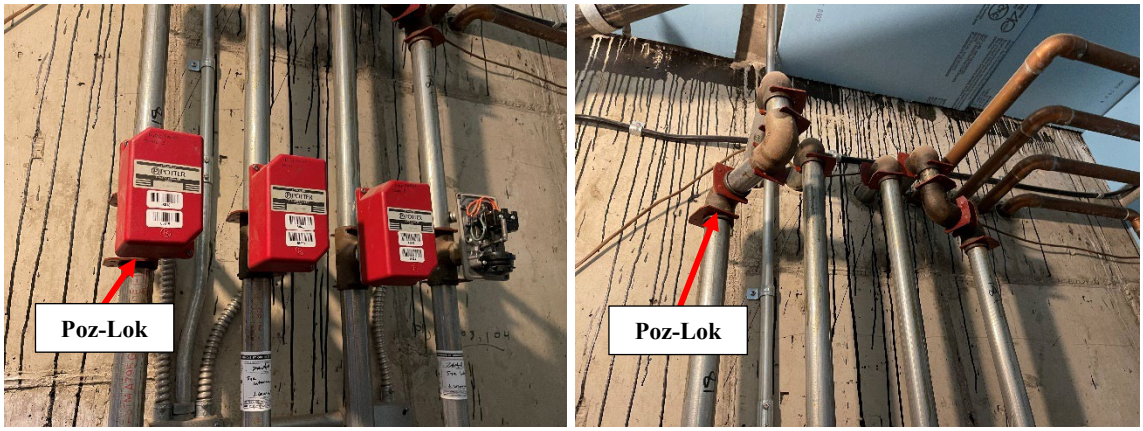

Figure 9. Typical of the Poz-Lok components used for the sprinkler risers (15092 CBS 2-073, CBS 2-074).

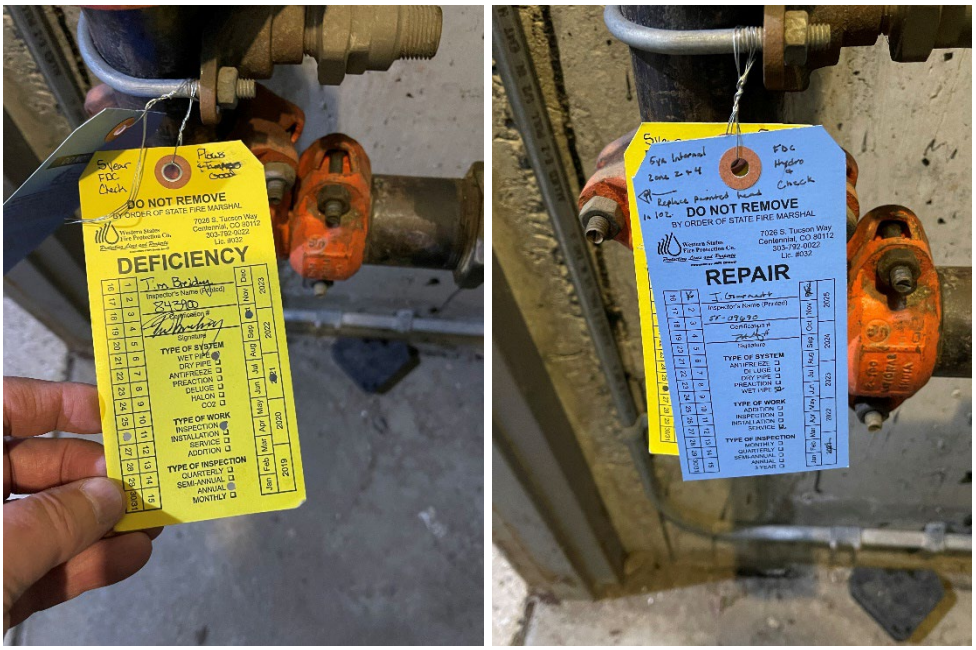

Figure 10. Western inspection tags (15092 CBS 2-040, CBS 2-038).

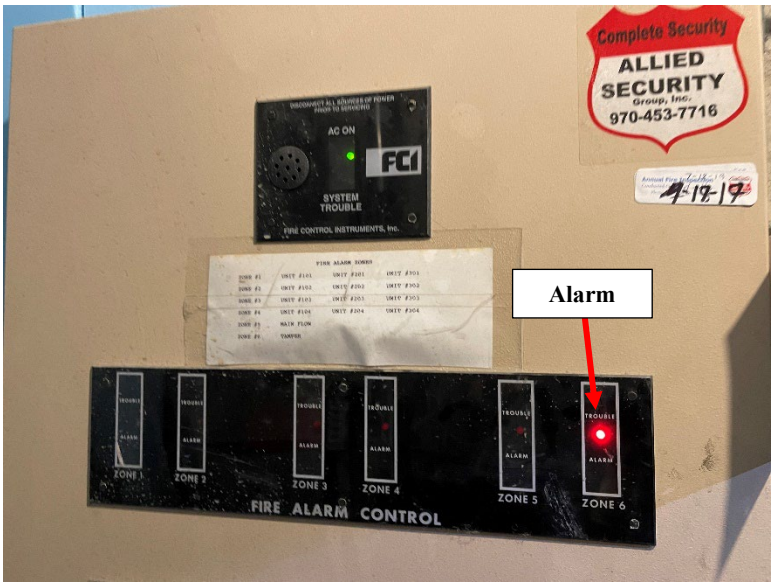

Figure 11. Fire alarm system (15092 CBS 2-091).

WEATHER HISTORY

The weather history for the month of February, from the closest NOAA weather station at Dillon 1 E, CO, was reviewed, as illustrated in Figure 12. In early February 2022, temperatures dropped to a low of minus 22°F on February 4, 2022. Temperatures of 0°F or below were recorded 11 times in February prior to the date of the loss.

Climatological Data for DILLON 1 E, CO - February 2022

Date	Temperature				HDD	CDD	Precipitation	New Snow	Snow Depth
	Maximum	Minimum	Average	Departure					
...									
2022-02-02	26	4	15.0	-2.0	50	0	0.18	3.0	10
2022-02-03	10	-21	-5.5	-22.5	70	0	T	T	10
2022-02-04	10	-22	-6.0	-23.1	71	0	0.00	0.0	10
2022-02-05	21	-17	2.0	-15.2	63	0	0.00	0.0	10
2022-02-06	29	-5	12.0	-5.2	53	0	0.11	2.0	12
2022-02-07	23	-7	8.0	-9.3	57	0	0.00	0.0	12
2022-02-08	29	-6	11.5	-5.9	53	0	0.00	0.0	12
...									
2022-02-12	35	-5	15.0	-2.9	50	0	0.10	1.0	11
2022-02-13	25	-6	9.5	-8.5	55	0	0.00	0.0	10
2022-02-14	35	0	17.5	-0.6	47	0	0.00	0.0	10
2022-02-15	42	7	24.5	6.2	40	0	0.00	0.0	10
2022-02-16	44	9	26.5	8.1	38	0	0.00	0.0	9
2022-02-17	33	1	17.0	-1.6	48	0	0.08	1.0	10
2022-02-18	19	0	9.5	-9.3	55	0	0.00	0.0	9
2022-02-19	27	1	14.0	-5.0	51	0	0.00	0.0	9
2022-02-20	37	11	24.0	4.8	41	0	0.00	0.0	8
2022-02-21	43	11	27.0	7.6	38	0	0.00	0.0	7
2022-02-22	39	17	28.0	8.4	37	0	0.04	0.5	8
2022-02-23	20	11	15.5	-4.3	49	0	0.07	0.5	8

Figure 12. Excerpts from the NOAA weather history for Dillon 1 E, CO.

SUMMARY OF FINDINGS

The day of the loss, water was observed coming through the ceiling of Unit 304B. The building maintenance staff opened the ceiling to see where the water was leaking from. Approximately 15 inches above the kitchen ceiling was a layer of gypsum, which also had to be removed. Once exposed, the maintenance staff observed a steady stream of water flowing from a partially dislodged section of pipe/tubing at a 90° Poz-Lok elbow.

The weather data for February 2022 was reviewed. Record low temperatures were recorded in the first week of February. The temperatures were at or below 0°F eleven times in February prior to the date of the loss. On the date of the site inspection, there was no insulation in proximity of the tubing and fitting. It is unknown how much insulation may have been over the sprinkler components prior to the loss.

The sprinkler tubing was installed in the enclosed attic space above the kitchen of Unit 304B. The tubing and elbow were examined in place and removed after the examination. A subsequent visual examination of the pipe was completed at AEI. It was noted that the tubing was partially dislodged from the Poz-Lok fitting but could not be moved by hand. Based on the reviewed weather data and the witness marks on the tubing, the failure was the result of water freezing in the tubing. The tubing likely began to dislodge from the elbow in early February and started leaking water when the ice thawed around the date of the loss.

Corrosion was observed at the juncture of the tubing and fitting. However, based on the witness marks, the corrosion did not contribute to the tubing separating from the fitting. The welded seam on the tubing was not damaged and/or leaking, and there were no conditions observed with the tubing and fitting that would indicate any failure mechanism other than freezing.

When installed, Poz-Lok tubing is inserted into a Poz-Lok fitting through an O-ring until it bottoms out. The fitting has two slots that a key slides into and is then knocked into place with a hammer to lock the fitting onto the tubing. The deformity in the tubing created by the key was clearly visible on the subject tubing, and witness marks were observed where the key was dragged over the tubing when it was dislodged from the fitting.

John Iverson from McMillan and Keith McBreathy from Summit informed this writer that the fire department told them the Poz-Lok sprinkler system should not be in the building anymore. Poz-Lok components have not been manufactured and/or used for new sprinkler systems since the mid-to-late 1990s. Back then, a small supply of these parts was available in the Denver area through sprinkler contractors, but Poz-Lok parts can no longer be found. Poz-Lok systems are no longer supported in the sprinkler industry, and parts are unavailable to complete repairs. Additionally, there were several class action law suits involving Poz-Lok sprinkler systems. The majority of the cases involved dry pipe

sprinkler systems installed using Poz-Lok components. The nature of these losses involving dry pipe systems had to do with the welded seam on the tubing. During the manufacture of the tubing, the metal was dipped in zinc. When the metal was rolled to weld the seam, the zinc contaminated the weld and air was prone to leak from the seam, creating problems with the dry pipe systems. The subject sprinkler system in this case was a wet pipe sprinkler system. The statute of limitations to file claims regarding Poz-Lok systems has expired.

CONCLUSIONS

The results of the investigation and analysis performed by AEI Corporation indicate the following:

1. The water loss was the result of Poz-Lok tubing partially dislodging from a Poz-Lok elbow fitting when water in the tubing froze.
2. Parts to repair the Poz-Lok sprinkler system can no longer be obtained, and replacement of the sprinkler system will be required.

The opinions expressed in this report are based upon the education, training, and work experience of this writer. The opinions are also based upon a reasonable degree of certainty and the information available to this writer at the time the report was authored. This writer reserves the right to modify and/or supplement these opinions should new information become available.

ATTACHMENTS

The following are attached to this report:

1. Curriculum Vitae for Charles Sullivan.