PROJECT: #2209-074

LOCATION: [redacted]

RE: EZ Fire was contacted to provide consultation at the above-referenced location to determine the cause of heat detector false alarms that are causing *multiple* fire department dispatches to the premises.

DATE OF SITE VISIT: 9/28/2022

DATE OF REPORT: 10/6/2022

PREPARED FOR:

[redacted]

PREPARED BY:

EZ Fire[2]
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[1] [redacted]

[2] https://ezfire.us/

REPORT OF FINDINGS

EZ Fire is pleased to provide the consultation services to determine the cause of the heat detector false alarms that have been reported. The investigative process began with requesting the list of apartments, times, and dates of the alarms. The investigation was followed up with a site visit to review the condition of each apartment's heat detector.

Before the site visit, the preliminary investigation indicated that the heat detector false alarms mostly originated from the 15th floor, the highest occupied floor at the premises.

1. May 11th Compactor Sprinkler Head was knocked out by a resident throwing a large item down the compactor chute.
2. May 25th @ 8:45 AM Smoke Detector at the top of the Elevator Shaft
3. June 3rd @ 6:36 PM Heat Detector in Apt. 1516
4. June 24th @ 5:35 PM Heat Detector in Apt. 1518
5. June 26th Smoke on 14th Floor - Actual Real Alarm from smoke conditions
6. July 2nd Smoke on 14th Floor – Actual Real Alarm from smokey conditions
7. July 6th @ 1:25 AM – 1501 – Kitchen Heat Detector
8. July 14th @ 4:30 AM – 1501 – Kitchen Heat Detector
9. August 3rd @ 12:00 PM – 1508 - Kitchen Heat Detector
10. August 11th @ 6:00 AM – 1418 Kitchen Heat Detector
11. August 11th @ 9:25 PM – 1508 Kitchen Heat Detector
12. August 18th @ 9:00 PM – 1503 Kitchen Heat Detector
13. August 20th @ 9:10 PM – 15th Floor Hallway Smoke Detector Outside Unit 1510
14. September 6th @ 4:25 PM – 15th Floor Hallway Smoke Detector Outside Unit 1507

Figure 1 - List of Alarm Transmissions

The alarms with red text are of interest as anomalous. The alarms correlate to the peak period of high temperatures in White Plains, NY, in the Summer of 2022. The false alarms fall within the two red dashed bands of Fig. 2 and Fig. 3. **No further anomalous heat detector alarms have been reported since the last alarm on August 18, 2022, to the date of this report.**

System Type and Operation

The fire alarm system is an addressable fire alarm system by Gamewel/FCI. The fire alarm system is designed for a high-rise Occupancy Type R-2 and to comply with the Building Code of NYS. The initiating devices, which include heat detectors are individually addressable. The heat detectors sense heat using a thermistor. A thermistor is an electronic component that changes its resistance based on temperature in a non-linear manner. There are two types of thermistors, Positive Temperature Coefficient (PTC) and Negative Temperature Coefficient (NTC). The type used in addressable fire alarm heat detectors is NTC; as the temperature increases, the resistance decreases. The heat detector’s internal design converts the thermistor's resistance to an analog voltage. An Analog-to-Digital Converter (ADC) converts the voltage to a digital stream of bits, typically an embedded feature of the microcontroller in the heat detector printed circuit board. To a microcontroller and its program code, the bit stream represents the thermistor's amount of sensed heat. From that point forward, the additional components, the logic and the proprietary program of each manufacturer, guided and bounded by regulatory standards, is applied to the heat detector's operation.

The heat detectors installed at the premises are addressable, **135° F fixed-temperature type**, model **#ATD-L2F**[3]. The Original Equipment Manufacturer (OEM) is System Sensor (a Honeywell company), and the detector is branded under Gamewel/FCI (a Honeywell company).

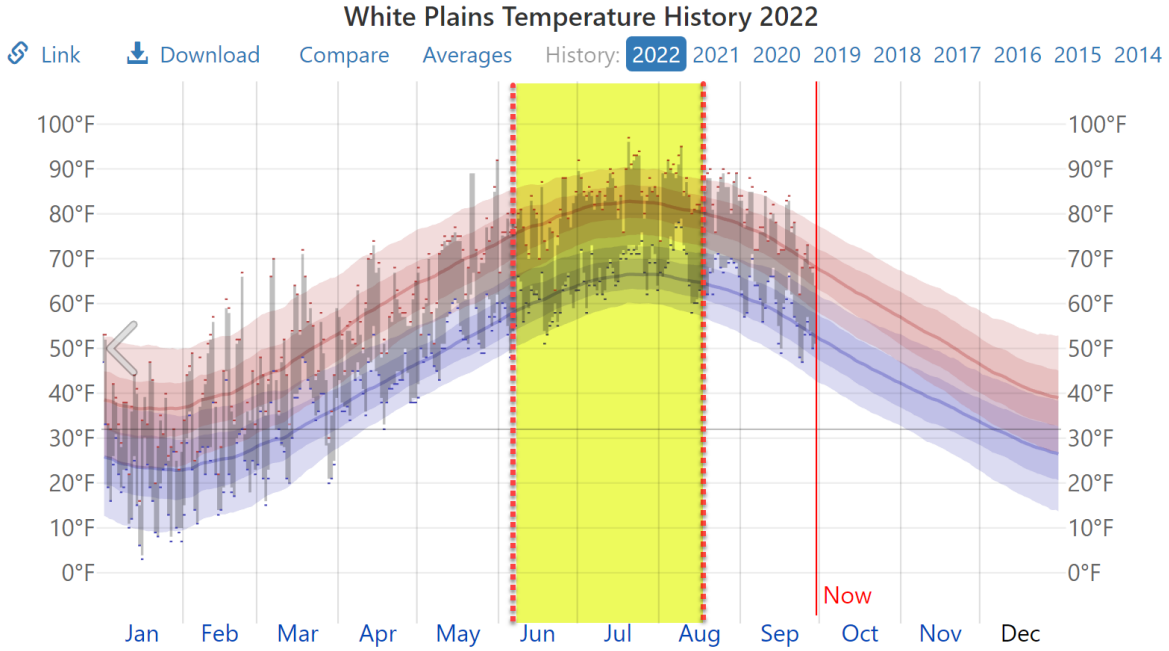


Figure 2 - Average Temperature[4]

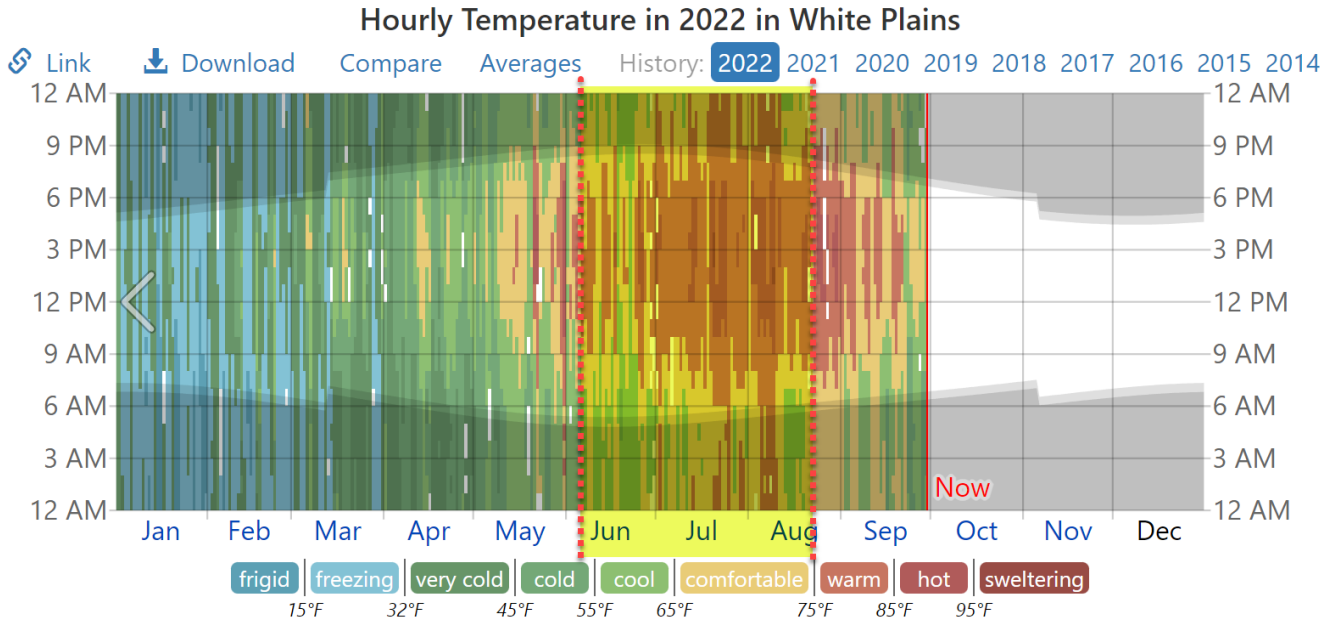


Figure 3 - Hourly Temperature[5]

[3] https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/9020-0620_F.pdf

[4] https://weatherspark.com/h/y/24859/2022/Historical-Weather-during-2022-in-White-Plains-New-York-United-States#Figures-Temperature

[5] https://weatherspark.com/h/y/24859/2022/Historical-Weather-during-2022-in-White-Plains-New-York-United-States#Figures-ColorTemperature

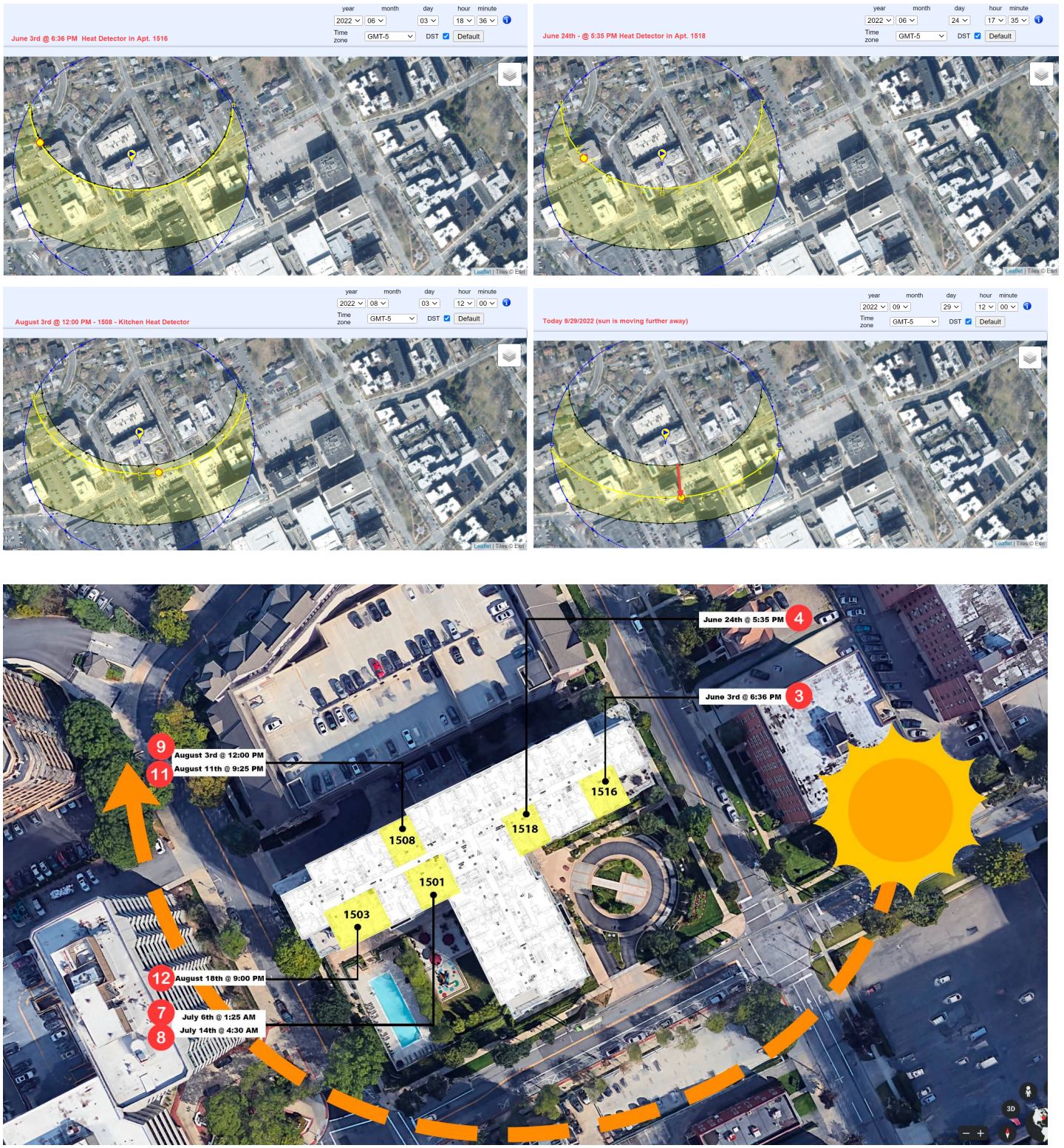


Figure 4 - Sun Movement (note sun moving further away from the premises starting in mid-August to September). Alarms are numbered and dated as per the List of Alarm Transmissions in Fig. 1.[6]

[6] https://www.sunearthtools.com/dp/tools/pos_sun.php#txtSun_8

Heat Detector Design Considerations

NFPA 72-2010, 29.7.3.2* Fixed-temperature detectors or alarms shall have a temperature rating **at least 25ºF** (14ºC) above the normal ambient temperature and **shall not be rated 50ºF** (28ºC) **higher** than the maximum anticipated ambient temperature in the room or space where installed.

NFPA72, 17.6.2.1 Classification. Heat-sensing fire detectors of the fixed-temperature or rate-compensated, spot type shall be classified as to the operation temperature by Table 17.6.2.1.

Table 17.6.2.1 Temperature Classification and Color Code for Heat-Sensing Fire Detectors

Temperature Classification	Temperature Rating Range °F	Temperature Rating Range °C	Maximum Ceiling Temperature °F	Maximum Ceiling Temperature °C	Color Code
Low*	100–134	39–57	80	28	Uncolored
Ordinary	135–174	58–79	115	47	Uncolored
Intermediate	175–249	80–121	155	69	White
High	250–324	122–162	230	111	Blue
Extra high	325–399	163–204	305	152	Red
Very extra high	400–499	205–259	380	194	Green
Ultra high	500–575	260–302	480	249	Orange

*Intended only for installation in controlled ambient areas. Units shall be marked to indicate maximum ambient installation temperature.

Figure 5 - Heat Detector Classification

The OEM's technical specifications for the heat detector in use indicate an operating temperature range between –4° F to 100° F and recommends an installation environment room temperature between 60 – 80°F[7] (See below).

Veloticit® Series ATD-L2F, ATD-RL2F Technical Specifications

SYSTEMS

ATD-L2F/ATD-RL2F:
Dimensions: 2.1" (5.3 cm) Height
4.1" (10.4 cm) diameter installed in the B501 base
6.1" (15.5 cm) diameter installed in the B210LP base
Shipping Weight: 4.8 oz. (137 g)
Operating Temperature:
ATD-L2F or ATD-RL2F: –4° F to 100° F (–20° C to 38°C)
ATD-HL2: –4° F to 150°F (–20 C to 66°C)

TEMPERATURE AND HUMIDITY RANGES

This system meets NFPA requirements for operation at 0 – 49°C/32 – 120°F and at a relative humidity 93% ± 2% RH (noncondensing) at 32°C ± 2°C (90°F ± 3°F). However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and its peripherals be installed in an environment with a normal room temperature of 15 – 27°C/60 – 80°F.

STANDARDS

Figure 6 - Specs of Actual Heat Detector Installed at the Premises

7 https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/9020-0620_F.pdf?download=false

The OEM recommends maintaining the maximum operating temperature of the device within100°F. Prolonged exposure outside or at the manufacturer-recommended extremes could “adversely affect” the operation of the ATD-L2F heat detectors.

Heat Detector Internal Board

Two (2) heat detectors that were previously removed from apartments and which were stored on-site were taken off-site and dismantled for further investigation.

The heat-sensing thermistor shows evidence of heavy contamination (see Fig. 7). **The thermistor exhibits no visible markings to identify its manufacturer** and part number. **The research found a “near-match” for the actual NTC thermistor in use**[8].

Additionally, it was noted that the two boards are marked “BOARD #1” and “BOARD 4”, and the two models exhibit radically different designs. BOARD #4 is actually the older version of the two and it was a detector that Gamewell private-labeled from System Sensor (a Honeywell company) before Honeywell bought Gamewell out. BOARD #1 is a new series by Honeywell which is marketed under Velociti® Series 2. Honeywell is currently producing Velociti® Series 3, as well.

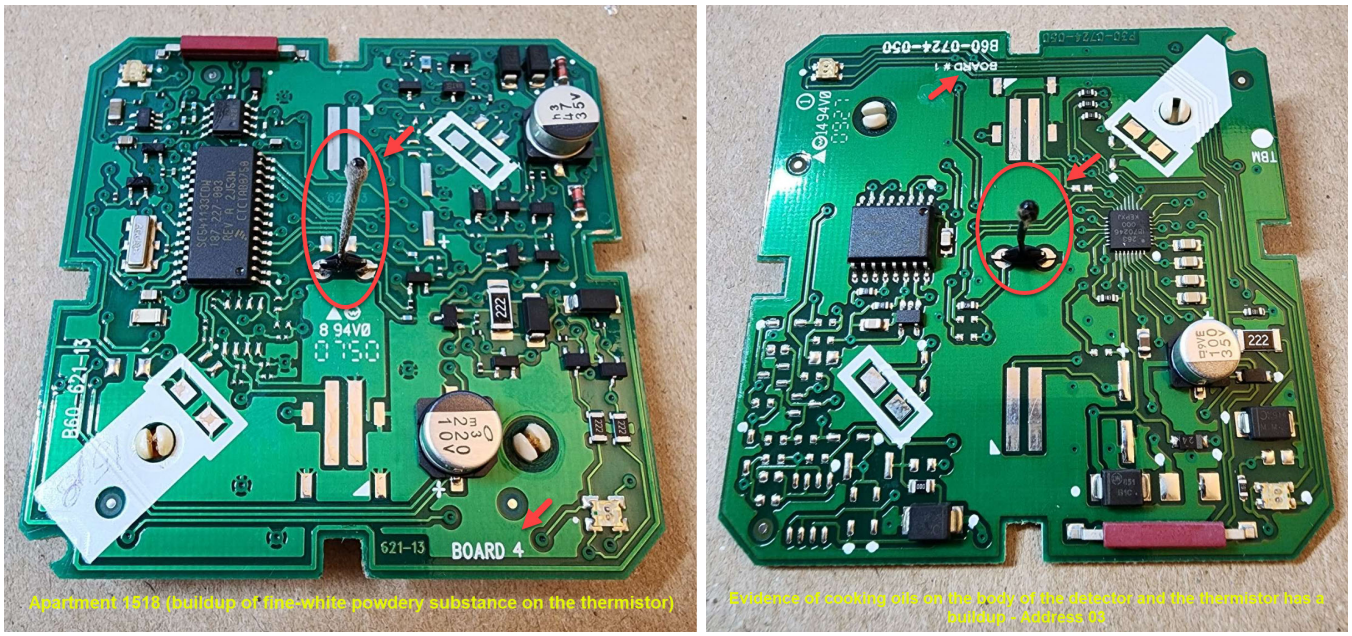


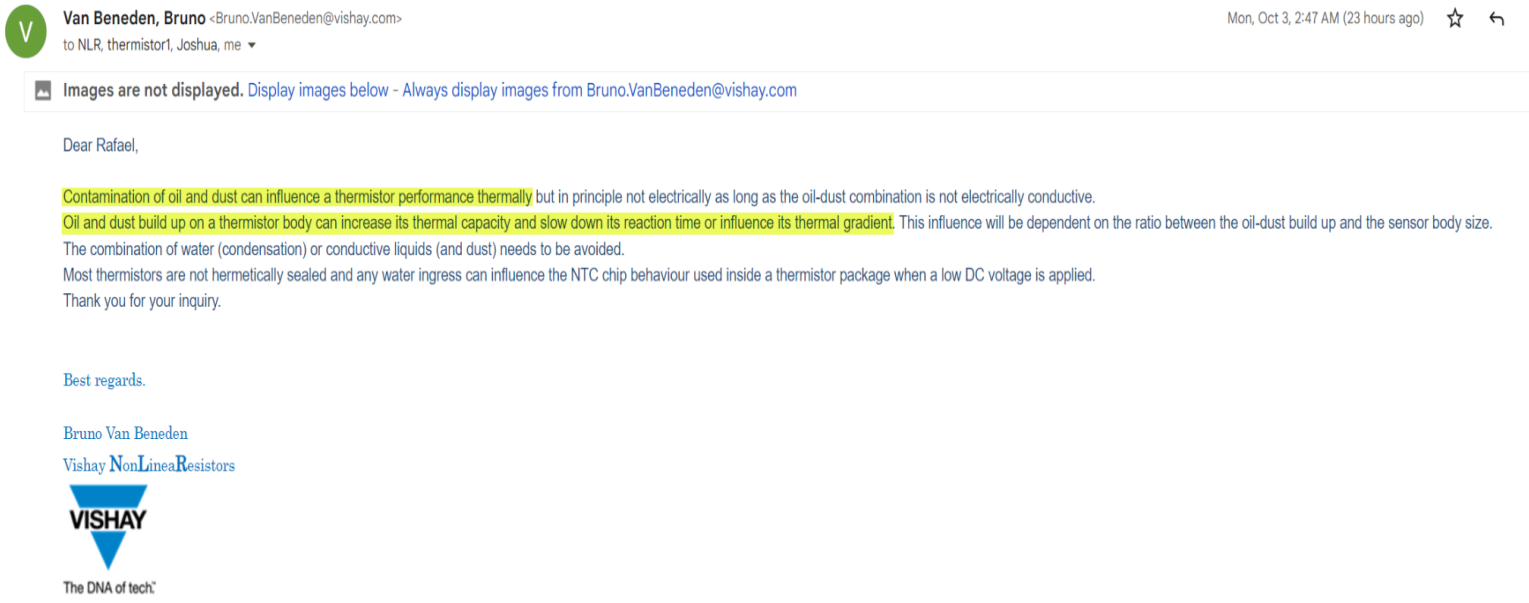
Figure 7 - Contaminated Thermistor

EZ Fire could find no data on **“*how contamination affects a thermistor?”***. According to **Vishay’s published literature, a leading manufacturer of thermistors**, they recommend wearing gloves when handling

[8] Vishay NTC Thermistor “NTCLE413”: https://www.vishay.com/docs/29078/ntcle413.pdf

thermistors to prevent contamination of the thermistor surface[9]. So, it is evident that thermistor contamination should be avoided.

As part of the research, an email was sent to Vishay for assistance with the above question. Vishay was chosen because they are a major manufacturer of thermistors and other components. Bruno Van Beneden from Vishay replied to the email, explaining that a thermistor's performance will be adversely influenced by oil and dust contamination and **how**.



Van Beneden, Bruno <Bruno.VanBeneden@vishay.com> Mon, Oct 3, 2:47 AM (23 hours ago)
to NLR, thermistor1, Joshua, me

Images are not displayed. Display images below - Always display images from Bruno.VanBeneden@vishay.com

Dear Rafael,

Contamination of oil and dust can influence a thermistor performance thermally but in principle not electrically as long as the oil-dust combination is not electrically conductive.
Oil and dust build up on a thermistor body can increase its thermal capacity and slow down its reaction time or influence its thermal gradient. This influence will be dependent on the ratio between the oil-dust build up and the sensor body size.
The combination of water (condensation) or conductive liquids (and dust) needs to be avoided.
Most thermistors are not hermetically sealed and any water ingress can influence the NTC chip behaviour used inside a thermistor package when a low DC voltage is applied.
Thank you for your inquiry.

Best regards.

Bruno Van Beneden
Vishay NonLineaResistors
VISHAY
The DNA of tech.™

Figure 8 - Vishay E-mail Response

[9] Vishay Handling and Mounting - Cautions and Warnings, Section 4 "Handling": https://www.vishay.com/docs/29222/handlmount-ntcletherm.pdf

The heat detectors' are installed in the kitchen near the oven and cooking area, as per local code.

Figure 9 - Heat Detector Mounted Location

Avalon staff member Denilson Da Silva (Maintenance Supervisor), provided access to the apartment kitchen heat detectors [Ref. Fig. 9], and he stated that **"I recall on one of the heat detector alarms I investigated that the apartment was *very hot*."**

Conclusion

My professional opinion points to a combination of factors that contribute to the heat detector false alarms:

1. Prolonged exposure of the heat detectors' internal electronic components to temperature extremes not recommended by the OEM and code [Ref. Fig. 2, 3, 4, 5, and 6], coupled with;
2. Contamination of the heat detector's sensing thermistor affecting its thermal performance [Ref. Fig. 7, and 8]

Proposed Recommendations

1. Perform a **pilot program** and replace the existing 15th-floor apartment heat detectors that are listed in Fig. 1 with conventional heat detectors (Apartments: 1518, 1516, 1508, 1503, and 1501).
2. Monitor the dry contact of the conventional heat detector with the existing fire alarm system-compatible single input monitor module.
3. Install the monitor module outside the apartment, in the hallway, where there is common ventilation under the control of the base buildilng. The recommended location is above the apartment door.
4. Starting around September 2023, replace the remaining apartment addressable heat detectors with conventional heat detectors throughout the remaining apartments.

New Procedure to Investigate Heat Detector Alarms

EZ Fire recommends that premises staff responding to a heat detector alarm event record the heat detector temperature using an infrared thermometer[10]. This should be performed within a fast response time after the alarm. Please add the measured temperature to your Alarm Log.

Questions

1. **Is there a way to have a heat sensor provide a pre-alarm signal before a full alarm?** Fire alarm heat detectors do not have this feature. Technically, this feature is possible. For example, provide the pre-alarm signal upon the thermal detection of 100°F. A pre-alarm signal would allow staff to focus immediately on an area before a full alarm. Unfortunately, this is not a feature in any code.
2. **Could air conditioning inside the apartments help?** Yes, but this is controlled by each tenant and out of the control of building management. Each tenant has their own separate PTAC units. Therefore, this is why we make the recommendation to install a conventional heat detector and the associated monitor module, ***outside*** the apartment, in the common hallway that is environmentally controlled by the building. Consider that the apartment environment varies if the tenant keeps their sunscreens up or down, or they're not home, and the air conditioning is not running. All these unknowns can cause the ambient room temperature to vary significantly.
3. **Does replacing the existing heat detectors require filing?** We assume yes, and if the building proceeds with our recommendations, this shall firstly be brought up with the local Authority Having Jurisdiction (AHJ). As long as code requirements are met, I see no issue of resistance on the contrary by the AHJ. Conventional heat detectors were the first types of heat detectors, are commonly used, and are not exempt from the code. Please note that the AHJ may make additional requirements.
4. **Could changing the existing 135°F addressable fixed-temperature heat detector to 194°F (the next commercially available temperature model) make the difference?** The only difference should be the "setpoint temperature" at which the alarm activates. The internal electronics of the heat detector are still exposed to high ceiling temperatures inside the apartments, nearing 100°F during peak times, throughout most of the Summer. Additionally, doing so will violate NFPA 72-2010, 29.7.3.2, in Fig. 5, since:
    a. Heat Detector Low Setpoint = [100°F (highest ceiling temp.) + 25°F] = 125°F
    b. Heat Detector High Setpoint = [100°F (highest ceiling temp.) + 50°F] = 150°F
    c. Heat Detector Industry Standard and Commercially Available Setpoint = 135°F
5. **Could replacing the existing 135°F addressable fixed-temperature heat detector to a conventional fixed-temperature heat detector make the difference?** There are no electronics in the proposed conventional heat detector whatsoever. The composition of conventional heat detectors is a heat-sensitive alloy (eutectic alloy[11]) that changes from solid to liquid at a specific temperature. It is simpler in construction and has several orders of magnitude of reliability from failure due to prolonged exposure to a 100°F ceiling. The detector is monitored by a system-compatible single input monitor

[10] https://www.kleintools.com/catalog/infrared-thermometers/infrared-digital-thermometer-targeting-laser-101

[11] https://en.wikipedia.org/wiki/Eutectic_system

module. For best results, the monitor module should be placed in a location that offers a controlled environment. Many sprinkler heads operate on the same principle as a conventional heat detector.

6. **I would like to learn more about heat detectors. Can you recommend a resource?** Yes. We find this an excellent explainer video: https://youtu.be/ma9lxuRvmw0

Thank you

EZ Fire would like to thank the following individuals for their assistance:

- [redacted]
- Bruno Van Beneden from Vishay

This report could not have been possible without your participation!

About EZ Fire

EZ Fire (trademark in progress), is a design, engineering, system integrator, and project management firm that mainly focuses on fire and other life safety systems. The company comprises Fire Alarm Engineers, Architects, and Software Engineers. As a team, we've developed unique and proprietary software technologies that aid us in the following:

- Fire alarm system design
    - Proprietary software assisted design
    - Consistency management
    - Standardization
- Managing fire alarm system installation
    - Real-time cloud-based corroboratory management
- Managing the service and maintenance of fire alarm systems
    - Real-time cloud-based mobile service management

Our Services are:

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Our Customer's benefit:

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- Centralized Central Station Monitoring

EZ Fire provides coast-to-coast services to its customers. *We build upon performance and referrals, not advertising.*