

A photograph of an enclosed parking structure. The ceiling is made of large, grey concrete panels with visible horizontal joints. A long, metal mesh cable tray runs diagonally across the ceiling, containing various cables. Fluorescent light fixtures are mounted on the ceiling, providing illumination. In the lower portion of the image, several cars are parked in rows, and yellow support pillars are visible. A semi-transparent green box is overlaid on the bottom left of the image, containing white text.

## Enclosed Parking Structures

SecuriHeat ADW, SecuriHeat d-LIST

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# 1 Introduction

Car parks are a growth area in many economies where urbanisation and vehicle ownership are advancing. At the same time, modern car parks are also evolving with ever increasing fire risks and fire safety challenges. The use of highly combustible materials such as lithium-ion batteries has increased fire intensity and the speed of fire spread between vehicles, as well as to adjacent floors and buildings. This in turn is affecting relevant building and fire code changes, in particular those relating to the underground and enclosed overground car parks where the risks from a fire can be significantly elevated.

In particular, the rapid growth of Electric Vehicle (EV) adoption has led to efforts to increase the number of battery charging stations within car parks, leading to areas where these vehicles are concentrated. While fires involving EVs are statistically no more likely than internal combustion engine vehicles (ICEVs), battery fires are known to be more intense and difficult to extinguish.

One unique fire risk with EVs is the “thermal runaway” from the battery failure that quickly leads to smoke and fire with intense temperature. A further increased risk and resulting hazard is the fact that very high levels of hydrogen fluoride can be given off by battery fires, hampering effective firefighting efforts and indeed rendering them dangerous. The increased intensity also presents a challenge to the structures of car parks and connected buildings – most of these structures were designed with ICEV fires in mind and modern combined vehicle fires have been known to completely destroy these structures.

In any given jurisdiction, a number of general building and fire codes, as well as car park specific regulations and industry codes of practice such as NFPA 88A Standard for Parking Structures, are adopted to address the fire hazard, means of egress and fire protection requirements of enclosed car parks. However, the advent of dangerous EV fires mean that it may be sensible to go further, adding risk-informed, Performance-based Design elements to fire detection in order to better protect the public, the buildings and firefighters attending a blaze.

When assessing fire safety, the main feature of an underground car park is its confined space condition. In the event of a fire, the confined space characteristics lead to a large amount of smoke accumulation, which makes evacuation difficult. Firefighting in these circumstances is difficult and risky, and responders at the scene will be much better equipped to make good decisions if the fire alarm system is able to give them information as to the main location of the fire, which may not be obvious in a smoke-filled enclosure.

Common fire causes in car parks involving ICEVs include as electrical malfunctions, engine sparks or overheated mechanical hardware. Faulty or damaged batteries and battery charging are the main sources of fire risks around EVs. Careless smokers and other human activities are also a risk.

Appropriate measures to limit fire damage in enclosed parking structures include portable fire extinguishers, suitable fire compartmentations, mechanical ventilation systems, fire detection with an automated fire extinguishing systems, and CO warning systems. Early detection of a fire incident underpins the overall effectiveness of all subsequent measures. A well-designed and reliable fire detection system provides risk mitigation to potentially prevent a battery or battery charging station fire from developing and spread out of control before an orderly evacuation can be put in motion. An early alarm can also facilitate the fire services response well before any fire spread beyond the fire object of origin and ensure the situation not develop into a life-threatening situation. A suitable fire detection system can also be used to operate the smoke management system and actuate pre-action and co-incident (or interlock, double interlock) suppression systems.

Securiton’s SecuriHeat ADW and d-LIST linear heat detection products are robust, reliable and quick-acting fire detection systems well suited for all types of enclosed parking structures. While SecuriHeat d-LIST is designed as a fully addressable heat detection solution equivalent to spot-type heat detectors, SecuriHeat ADW offers a low-cost reliable fire detection solution covering up to a dual-zone (2 x 800 m<sup>2</sup> (8,611 ft<sup>2</sup>)) area from one main detector unit.

The purpose of this Case Study is to provide fire safety and protection consultants, qualified fire system specifiers, design engineers or technicians, with recommendations for the application and use of SecuriHeat to protect enclosed parking structures in various built environments include residential, commercial, industrial, public assembly and infrastructure.

The Case Study also provides key requirements on Inspection, Testing and Maintenance (ITM) of SecuriHeat LTHD; and world-class technical and application support offered by Securiton through its headquarters teams in Europe and its vast global network of regional offices and distribution partners.

## 2 Aspects of fire safety and prevention

Underground and enclosed carpark can be found in large public structures such as shopping malls, railway and rapid transit hubs, airports, exhibition centres and tall commercial and residential buildings. They are also common fixtures for high density residential apartment blocks although the size of these parking structures is smaller.

To cater for rapid growth of Electric Vehicles (EVs) [1], significant emphasis has been placed on fire safety and prevention in enclosed parking structures. For example, the largest electric vehicle charging station in Beijing, China came into service in the underground parking lot of the Wukesong sports centre, the venue for the 2022 Winter Olympics ice hockey event, with a total of 200 charging points to provide maximum charging capacity for around 1,300 vehicles a day [2].

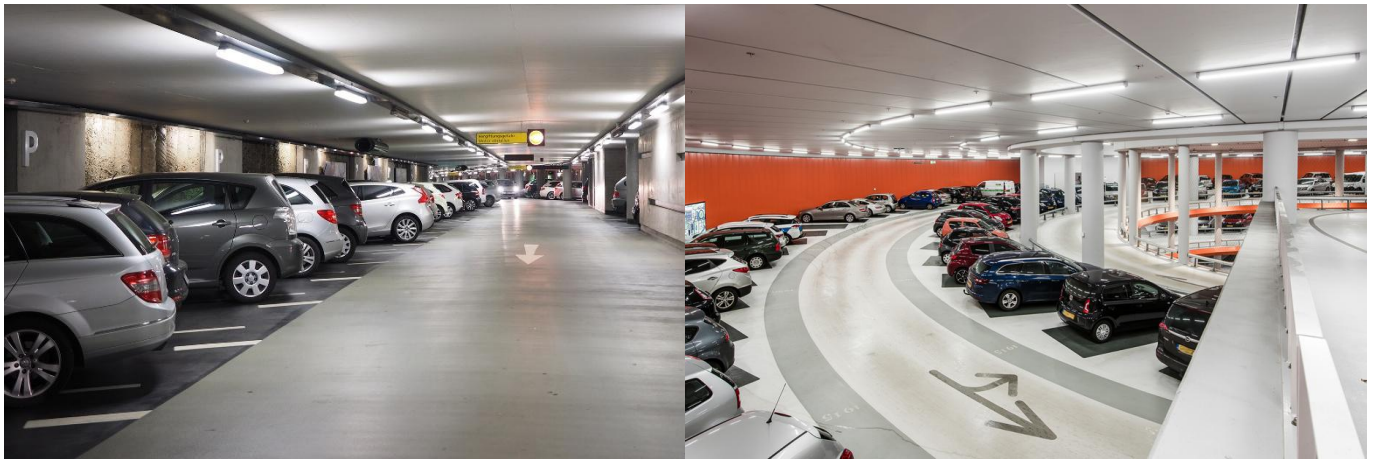
Where underground and enclosed carpark are also used as part of the egress route, a fire incident starting from these areas can present both technological and behavioural challenges when not detected early. Fires in any enclosed parking structure, regardless size or structural layout, can have a significant impact on building and life safety when the fire and toxic hot smoke can spread throughout the building above. For large buildings with high occupancy loads, one added challenge for fire safety is to address the critical importance of evacuating large numbers of occupants. This will include the continued monitoring of tenable conditions within egress routes to safety and ensuring the time required to evacuate before untenable conditions arise.

### 2.1 Enclosed parking structures

Per NFPA definition, an Enclosed Parking Structure *“is any parking structure that is not an open parking structure”*. Underground carpark are defined as ‘Basement and Underground Parking Structures’ [3] that *“are located below grade. A basement parking structure has other occupancies above it and an underground parking structure has no occupancy other than parking above it”*.

Basement and Underground Carparking are considered as specific cases of enclosed parking structures. For the purpose of this Case Study, enclosed parking structures are categorised below with their characteristics, illustrated in Figure 1:

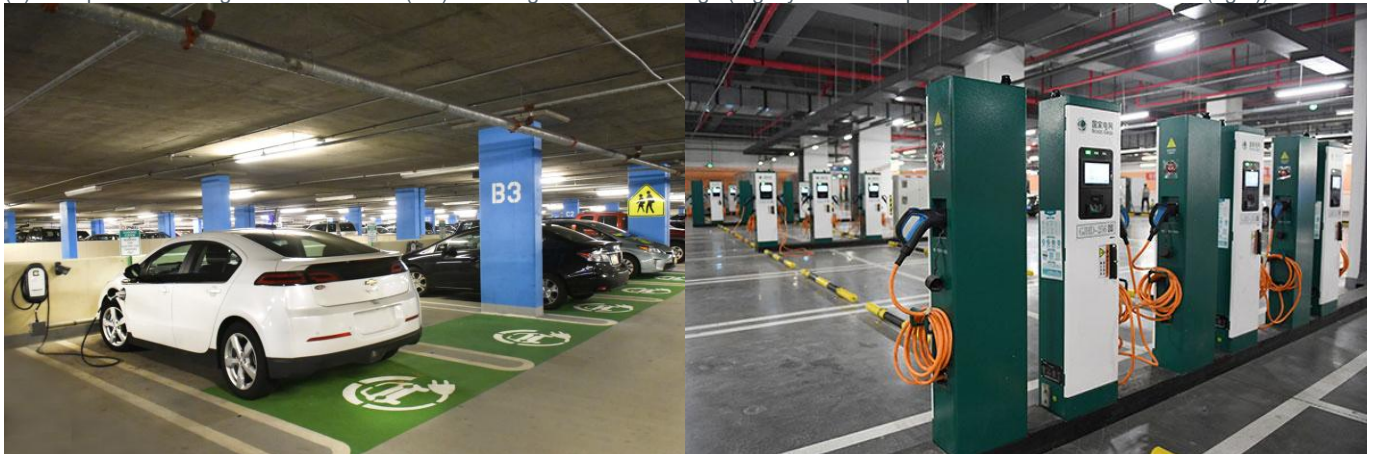
- (a) Enclosed parking structures with standard ceiling height or a high ceiling with vertical openings: Standard underground carpark ceiling height may vary according to different local building codes. For example, the minimum standard ceiling height for enclosed parking structures is typically 2.1 m (6.9 ft) per National Construction Code (NCC) (3.8.2.2) in Australia. However, a higher clearance of 2.5 m (8.2 ft) is often recommended and even mandatory required for accessible parking spaces which accommodate ceiling hoists, as well as for overall comfort and to account for fittings like lights, HVAC ducts and sprinklers.
- (b) Carpark with irregular roof structure or unusual and innovative design: Some carpark are based in underground spaces under heritage buildings. As such, the ceiling may not be as flat or in as regular shape as modern purpose-built structures. This category effectively includes innovative carparking technology, for example cylindrical carpark or automated car stackers, driverless fully automatic parking systems that can stack cars into small spaces, or mechanical parking systems that can use car lifts or double parkers to move cars to different levels.
- (c) Carpark with designated EV charging bays or entire parking level with charging stations. The emerging trend in EV charging solutions, such as Volkswagen’s complete autonomous mobile charging robots [4], can also have an impact on fire protection and fire safety in enclosed parking structures. The 2 most common EV charging facilities incorporated in carpark are single or small enclosed charging station area; and large charging station level or carpark designated for EVs.



(a) Enclosed parking structures with standard ceiling height (left) or high ceiling with vertical openings (right)



(b) Carparks with irregular roof structure (left) or through innovative design (e.g. cylindrical carpark or automated car stackers (right))



(c) Enclosed parking structures with designated EV charging bays (left) or entire parking level with charging stations (right)

Figure 1 Enclosed parking structures

## 2.2 Fire risk, consequence and safety

When assessing fire safety, the main feature of an enclosed parking structure is its confined space condition. In the event of a fire, the confined space characteristics lead to a large amount of smoke accumulation thus making evacuation difficult. Common fire causes in carparks involving ICEVs, include electrical malfunctions, engine sparks or overheated mechanical hardware. Careless smokers remain a risk, while faulty batteries and battery charging are the main sources of fire risks involving EVs.

Potential fire risks involving vehicles were first documented with the publication of NFPA 88 Standard for Garages in 1932. In 1973, the first edition of NFPA 88A Standard for Parking Garages [5] was released. Evolving in the past 40+ years and 10 revisions, such standards aim to address all aspects of design and safety considerations for carparks, from means of egress, construction, opening requirements to fire sprinkler systems.

Extensive research has been conducted to establish quantitative benefits of various fire detection and protection methods to ensure a high level of fire safety. Examples of such research includes a study from 1987 in Australia to evaluate sprinkler systems [6]; a 3-year program commissioned with Building Research Establishment (BRE) in the UK in 2006 to examine fire spread in car parks [7]; and a large number of smaller scale research programs from advanced detection, safe egress to optimised protection of underground and enclosed carparks [8]. This research

facilitated the development of local and national fire safety codes of practices. For example, the Fire Safety Requirements for AVPS<sup>1</sup> Guideline in the state of Victoria, Australia [9], was developed and adopted to address, among other design requirements, fire hazard, means of egress and fire protection requirements (e.g. fire sprinkler systems).

Although practical electric vehicles (EVs) appeared during the 1890s, modern day interest in electric and alternative fuel vehicles, as opposed to conventional ICEVs, in private motor vehicles really started at the beginning of the 21st century due to environmental concern over emissions. Significant improvements of EV technology such as much higher battery capacity and longer lifespan result the sales of EVs accelerating to a record of 6.6 million in 2021, in comparison with only 120 000 electric cars sold worldwide in 2012 [10].

Further research projects (e.g. [11]) have provided comprehensive assessment of battery fires in EVs. The fire risk of EVs increases with more batteries and with batteries containing more energy. In addition to trauma from impact, batteries can be stressed by temperature extremes and fluctuations, heavy rain, overcharging, or charging too quickly. A number of significant fires in car parks were also reported in recent times, such as Stavanger airport multi-level carpark fire in January 2020 in Sola, Norway; an EV fire in a residential building underground carpark in Brussels [12], and a New Year's Eve 2017 fire in multilevel King's Dock carpark in Liverpool, England, that destroyed over 1,200 vehicles and took nearly 40 hours to fire burnt itself out after firefighters arrived on the scene.

Research (e.g. [13]) on carpark fire statistic data also suggests that modern day carpark fires appear to be much harder to extinguish. In 1997, 95 percent of carpark fires analysed were extinguished in under 60 minutes. However, in French carpark fires occurring between 2010 and 2014, only 40 percent were extinguished in under an hour; 30 percent of the fires took more than two hours to extinguish, and 10 percent took more than four hours. By contrast, fewer than 1 percent the 1997 fires took longer than two hours to put out.

Furthermore, battery fires give of high level of hydrogen fluoride, which can hamper effective firefighting efforts. The increased intensity also presents a challenge to the structures of car parks and connected buildings due to lesser fire intensity design criteria adopted from current and existing industry code of practices. As a result, in some countries and cities EVs in underground and enclosed car parks are prohibited [14], while insurance companies [15] assess and demand a high premium for loss coverage of both environmental and economic catastrophe from fires involving EVs.

A common fire safety and protection principle is to ensure a suitable fire detection system is provided for not only the alarm signalling for emergency evacuation, but also to use the alarm for firefighting system actuation. With a reliable fire detection system designed for enclosed parking structures, fire incidents can be detected and managed to avoid or minimise operation interruption, building damages, and to ensure building occupants life safety. Early detection means that, even as the fire situation progresses, fire suppression and extinguishing system can be actuated and fire services notified automatically. They can arrive at the scene much earlier, before the fire spreads, and ideally receive information as to the location of the blaze before firefighters enter the smoke-filled floor affected.

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<sup>1</sup> AVPS: Automated Vehicle Parking Systems

### 3 Challenges to reliable fire detection

The collective risks to business interruption, property damage and life loss due to fire incidents involving vehicles inside enclosed parking structures, i.e. underground and enclosed car parks, remain a real threat across many built environments. These range from small and large residential and commercial buildings to large public assembly places such as transit hubs, airports, sports stadia, office buildings, hospitals and shopping malls. Early detection is critically important, as is the reliability of the alarm system. However, early and reliable detection faces the following challenges in the environmental conditions within the protected space:

- Exhaust fume resulting in ambient pollutants that are problematic for smoke detectors.
- Dust, lint, brake grease build-up over time, creating a harsh environment for electronics and smoke detectors in particular.
- Irregular airflow pattern or turbulent airflow due to frequent vehicle movement.
- The potential rapid spread of fire and smoke from the time of ignition: fire can grow rapidly due to significant fuel loads, and EVs make the situation much worse due to very high level of hydrogen fluoride produced by fires involving batteries.
- Can be exposed to a wide range of temperature and seasonal change of ambient conditions.
- Pinpoint location of the actual source of fire can be difficult due to closely packed vehicles, and because smoke rapidly obscures the area in a confined space.

In addition, because car parks are important building elements to ensure continuous efficient and orderly movement of people and goods, unnecessary operation interruptions are highly undesirable and must be avoided. The frequency of the maintenance regime and the need to access a fire detection system are also important considerations. Non-intrusive access and low maintenance requirements of a fire detection system can keep TCO<sup>2</sup> low.

SecuriHeat d-LIST line-type heat detector is an ideal solution to address the key challenges of ensuring a reliable fire detection for all types of enclosed parking structures, while SecuriHeat ADW is a cost-effective option for smaller size parking structures that require only single or dual fire zone coverage.

Challenge	Securiton advantages
Large open space or multi-levels with vertical openings	Both SecuriHeat d-LIST and ADW meet design requirements of flexible placements of sensing cables/tubes for ceiling level detection and localised heat detection where hazards or hot smoke propagation are identified in the event of a fire.
Diluted hot smoke and heat dispersion due to forced, changing or natural ventilation	Use of SecuriHeat LTHD detection systems have the sensitivity and flexibility to react to relatively small fires even in an open area.
Exhaust fumes, dust, lint and airborne grease	Both the d-LIST sensor cable and the ADW sensing tube are sealed systems which are immune to ambient pollutants.
Wide ambient temperature range	SecuriHeat LTHD products can operate in wide range of ambient conditions. For example, SecuriHeat d-LIST operating temperature range: main detector unit -25°C to +70°C (-13°F to +158°F), sensing cable -40°C to +85°C (-40°F to +185°F)
False alarms	SecuriHeat ADW uses highly sensitive rate-of-rise detection combined with fixed threshold alarm for maximum reliability. The Dynamic Heat Watch feature allows the system to discern between ambient heat rises and a real fire system through verifying rate-of-rise anomaly after initial detection.  SecuriHeat d-LIST uses highly sensitive rate-of-rise detection combined with fixed threshold alarm for maximum reliability.
Need to pinpoint fire source to aid firefighting especially regarding EVs	With up to 100 individual sensors per cable (200 per detection unit), SecuriHeat d-LIST offers localisable detection as well as optional flexible zoning as required.
Low TCO and easy access for maintenance	Routine service and testing are done from the main detector unit.  Easy to clean with pressure washers and common chemicals. The whole detection system and sensing cables require no or minimal routine maintenance.

Table 1 Challenges to and solutions for enclosed parking structures protection

<sup>2</sup> Total Cost of Ownership

## 4 Optimised design & Use case

SecuriHeat LTHD products can be used as the main detection method for all types of enclosed parking structures. The cost-effective SecuriHeat ADW is an integrated line type heat detector with a response behaviour based on heat differential and/or maximum heat. It is suitable for car parks that require single or dual fire zone coverage. The product self-check feature and the periodic, automatic test are other advantages for use in applications where the legally prescribed functional and maintenance checks are performed outside the protected zone due to traffic hazardous operations in busy parking lots. On the other hand, SecuriHeat d-LIST cable sensor system can be used in all enclosed parking structures, large and small, to cater for designs where addressable heat detection, precise incident localisation and alarm control are required.

This chapter outlines design recommendations and methods using SecuriHeat LTHD products as follows:

- 1 Codes of Practice
- 2 Design criteria with a focus on SecuriHeat d-LIST
- 3 Application Scenarios including open spaces, risk-based detection around EVs
- 4 Use of SecuriHeat ADW for smaller car parks

### 4.1 Codes of practices

Fire engineering professionals work within the prescriptive constraints of applicable building codes and standards such as NFPA 1 [16]), NFPA 101 [17], and NFPA 5000 [18] and the International Building Code [19], while applying the best engineering practices to address industry and building occupancies specific needs<sup>3</sup>. In particular, the risks and uninterrupted business operation requirements together with critical safe egress of high numbers of occupants in and around large public spaces, include large underground car parks that are often classified as confined spaces, shall be adequately addressed. In this regard, Performance-based Design (PBD) together with a risk-based approach to the optimisation of fire detection, fire protection and human interaction to supplement prescriptive baseline design, is the key to meeting the requirements for building and life safety as well as risk management for instance described in NFPA 551 [20], ISO 16732-1 [21] and BS 9992 [22], and applicable local AHJ's<sup>4</sup> directives.

In addition to general building and fire codes, other carpark specific codes, safety regulations or industry codes of practice are adopted to address the provisions of fire safety. The above mentioned regulations include NFPA 88A Standard for Parking Structures [5] and Fire Safety Requirements for Automated Vehicle Parking Systems (AVPS) Guideline in state of Victoria, Australia [9]. NFPA 13 [23] provides reference to building occupancy assigned to enclosed parking structures. FM Global and AXA XL Risk Consulting [24]) define, often with cross reference to NFPA 13 where applicable, where and how sprinklers are installed.

With the emerging rapid adoption of EVs, new specific standards and codes of practices such as UL 2580 [25], UL 9040A [26] or FM Global Property Loss Prevention DS 5-33 [27], have introduced layers of safety measures to reduce risks of battery fires. Some of the most noticeable recent code changes to address modern day fire hazards in Enclosed parking structures include [28]:

- The 2022 edition of NFPA 13 changed to “*increase the recommended hazard classification for parking structures from an Ordinary Hazard Group 1 to an Ordinary Hazard Group 2*”. The effect is a 33 percent increase in the design density.
- As of January of 2021, FM Global data sheets [29] also increased the hazard category for parking garages and car parks from a Hazard Category 2 to a Hazard Category 3.
- The current 2023 edition of NFPA 88A stipulates that “*all parking garages are now required to have sprinkler systems installed in accordance with NFPA 13*”.

Although there might be marginal differences from one country to another in Deem-to-Satisfy (DtS) prescriptive building and fire code requirements on fire detection, a combination of DtS prescriptive and risk-based design approach is the best engineering practice to meet prescriptive requirements as well as to satisfy facility operators' need for business continuity and property protection.

To select a suitable fire detection system, relevant design and alarm codes must be applied. Examples of these include NFPA 72 [30], BS 5839-1 [31], VdS 2095 [32], and others like AS 1670.1 in Australia [33], NEN 2535 in Netherland [34], R7 in France [35] and DBI 232 in Denmark [36]. Taking into account requirements from all relevant codes and standards, industry code of practices and government regulations for safety, an approach combining risk and PBD is a fitting fire engineering methodology to devise a suitable Fire Detection solution to safeguard

<sup>3</sup> Each country or state/province might have its own (or adopted) building and fire code or directives. Examples are the Muster-Verwaltungsvorschrift Technische Baubestimmungen (MVB TB) in Germany, The Regulatory Reform (Fire Safety) Order 2005 in the UK and National Building Code of India 2016.

<sup>4</sup> AHJ: Authority having jurisdiction

enclosed parking structures. As an example, for the design and installation of LTHD, NFPA 72 [30] stipulates that LTHD cables or tubing installed must be no more than 50.8 cm (20 in.) from the ceiling. However, this standard requirement is limited because it applies to only flat ceilings and is not affected by the total ceiling height. Other research and performance testing may be referred to for better linear heat cable placements (e.g., [37]).

Different standards have different spacing requirements for compliance. NFPA 72 requires that all points (spot-type heat detectors) on the ceiling have a spacing within a distance of 0.7 times the listed spacing of the heat detector, commonly known as Point 7 (0.7) Rule. Furthermore, reduction in listed spacing (of up to 15 m (50 ft.)) that must be applied when detectors are mounted on ceilings higher than 3 m (10 ft.). For example, for ceiling height of 8.5 to 9.1 m (28 to 30 ft.), 34% of listed spacing applies, means a spacing of 5 m (17 ft.) for heat detectors with a maximum listed spacing of 15 m (50 ft.). Spacing is also reduced when the heat detectors are installed on other than flat, smooth or slightly sloped (generally a slope no greater than 10% of the roof height) ceilings.

Performance-based Design (PBD) is typically implemented when elements of fire safety and protection system design are not covered in the prescriptive codes among others due to unique building structure, environmental conditions, added detection for early warning or extended egress considerations [38].

Table 2 illustrates how SecuriHeat LTHD Fire Detection system performance, as well as other design parameters such as environmental conditions and typical applications, are defined. Note that SecuriHeat LTHD products meet all response classes and all environment groups per EN 54-22 [39]; and supported key temperature classes and range of spacing options per NFPA 72 [30].

<b>Design Parameters</b>	<b>BS/EN 54-22 [39]<sup>5</sup></b>		<b>NFPA 72 [30]</b>	
<b>Class vs. Detection Range</b>	<b>Response Class</b>	<b>Detection Range °C (°F)</b>	<b>Temperature Class</b>	<b>Response Temperature °C (°F)</b>
	A1	54 - 65 (129 - 149)	Ordinary	58 - 79 (136 - 174)
	A2	54 - 70 (129 - 158)	Intermediate	80 - 121 (176 - 250)
	B	69 - 85 (156 - 185)	High	122 - 162 (252 - 324)
	C	84 - 100 (183 - 212)		
	D	99 - 115 (210 - 239)		
	E	114 - 130 (237 - 266)		
	F	129 - 145 (264 - 293)		
	G	144 - 160 (291 - 320)		
<b>Environment Group</b>	<b>Environment Group</b>	<b>Temperature Range °C (°F)</b>	n/a	
	(E)1	-5 to +40 (+23 to +104)		
	(E)2	-10 to +55 (+14 to +131)		
	(E)3	-25 to +70 (-13 to +158)		
<b>Typical Applications and Boundary Conditions</b>	E1: Indoor; Stable and Clean Conditions; Commercial and industrial E2: Indoor; Varying and polluted environment; Commercial and industrial E3: Outdoor; Harsh conditions			

Table 2 Design and performance parameters for LTHD per codes and standards

## 4.2 Design criteria

The SecuriHeat ADW 535 or SecuriHeat d-LIST systems are both highly sensitive and reliable linear heat detectors suitable for parking areas. The advantage of the d-LIST system lies in its localisation – temperature sensors in the sensor cable indicate precisely where the source of the fire is. With this information, responders can act quickly to tackle and/or isolate the blaze – and this is especially useful when it comes to mitigating the dangers of multiple electric vehicles with their heavy fuel loads burning in a confined space.

<sup>5</sup> ISO 7240-20 [5] and AS 7240-20 [5] are derived from BS/EN 54-20.

A summary of SecuriHeat d-LIST key performance parameters is shown in [Table 3](#) below.

<b>Model</b>	<b>Key performance parameters</b>
<b>SecuriHeat SCU 835 (d-LIST) classes and sensors cable</b>	
Classes	Integrating: A1I, A2I, BI, CI Non-integrating: A1N, A2N, BN, CN
Cable length	SEC-15 cable 2 x 350 m (1'148 ft) per controller
Addressable sensors # (Zone)	2 x 100 sensors (in 1-32 zones) Sensors embedded in the cable at intervals of: 1, 2, 3, 4, 5 or 10 m (3.3, 6.6, 9.9, 13.0, 16.5 and 33.0 ft.)
<b>Rating and operational data</b>	
Rating	SCU 835 Sensor Control Unit (evaluation unit): IP65 SEC-15 cable: weather-proof fully sealed system
Operating temperature	SCU 835 Sensor Control Unit: -25°C to +70°C (-13°F to +158°F) SEC-15 cable: -40°C to +85°C (-40°F to +185°F)
Measuring temperature range	SEC-15 cable: -40°C to +120°C (-40°F to +248°F) Temperature resolution of 0.1°C (0.18°F)
Sensing Cable Attributes	Cable Diameter: 15 mm (0.59 in); Min. Bending Radius: 250 mm (9.8 in)
Detection and actuation	Maximum temperature and temperature changes (differential or integration algorithm)
# of Relays	4 Built-in; Expanded to 16 with REL 835 Module
<b>Product type approval standards and compliance level</b>	
EN 54-22:2015+A12020	Integrating and non-integrating line-type heat detector; Response classes: A1N, A2N, BN, CN as well as A1I, A2I, BI, CI
UL 521; NFPA compliant	Response Classes: LOW, ORDINARY, INTERMEDIATE

**Table 3 SecuriHeat d-LIST SCU 835 controller and SEC-15 cable**

A summary of SecuriHeat ADW products key performance parameters is shown in [Table 4](#) below.

<b>Model</b>	<b>Key performance parameters</b>
<b>SecuriHeat ADW classes and tube</b>	
Classes	see <a href="#">Table 2</a>
Sensing tube length	EN 54-22 : 2 x 10 - 140 m (33 - 459 ft) copper tubes 2 x 10 - 125 m (33 - 410 ft) Teflon tubes NFPA 72: 2 x 10 - 200 m (33 - 656 ft) copper tubes 2 x 10 - 150 m (33 - 591 ft) Teflon tubes
Tube type	Copper (TU 5/4 Cu), Teflon (TU 6/4 PTFE)
<b>Rating and operational data</b>	
IP device approvals	IP65
Operating temperature (main control unit)	-30 to +70°C (-22 to +158°F)
Operating temperature (sensing tubes)	Copper: -40 to +300°C (-40 to +572°F) Teflon: -40 to +85°C (-40 to +185°F)
# of Relays: Built-in (Expanded – Module)	2 (10 – 2 x RIM36)
<b>Product Type Approval Standards and compliance level</b>	
EN 54-22	Classes A1I to GI
UL 521 – ULC-S530-M91	per EN 54-22 Classes A1I to GI
FM 3210 / NFPA 72	Classes Ordinary, Intermediate, High

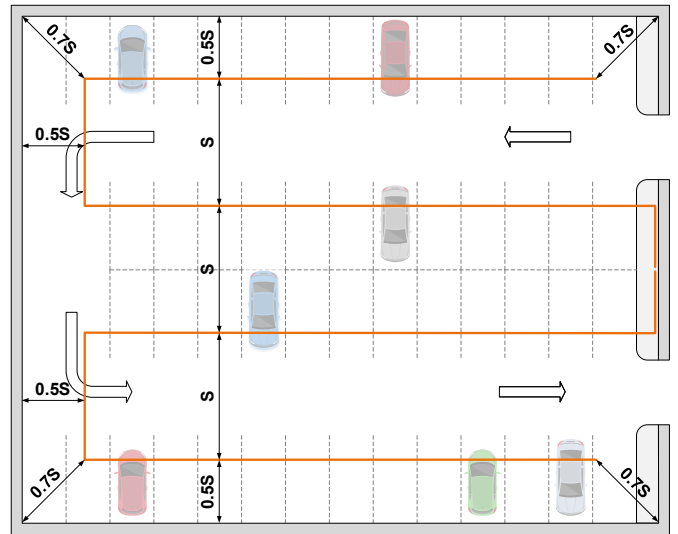
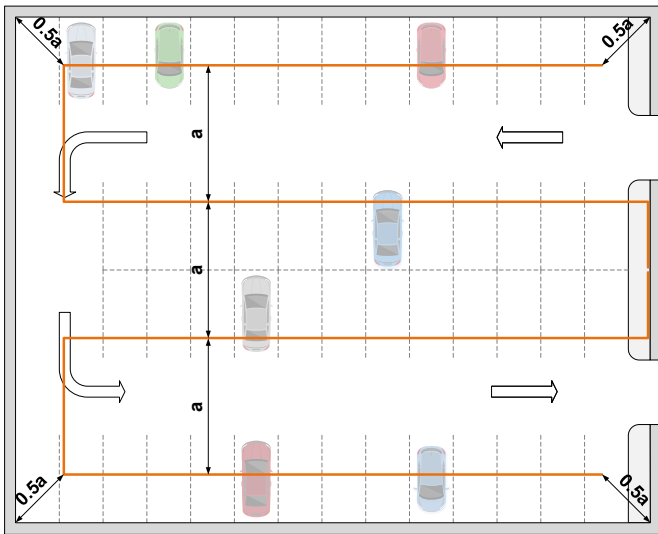
**Table 4 SecuriHeat ADW product key performance parameters**

A carpark is largely considered an open space, where the following design principles apply for heat detection (see Figure 2)

- Conveyance in looping shape (serpentine) is possible
- Maximum permitted distance **a** of sensing tube to sensing tube 7.0 m (23 ft)
- Maximum permitted distance of sensing tube to wall is **b** = 0.5**a** = 3.5 m (11.5 ft)
- Provisions for ceilings with joists or beams according to country-specific directives must be followed

- Conveyance in looping shape (serpentine) is possible
- Maximum permitted distance **S** of sensing tube to sensing tube is dependent on the selected spacing:

Tube to tube <b>S</b>	Tube to wall <b>0.5S</b>	Tube to corner <b>0.7S</b>
15 ft (4.6 m)	7.5 ft (2.3 m)	10.5 ft (3.2 m)
20 ft (6.1 m)	10 ft (3.0 m)	14 ft (4.3 m)
25 ft (7.6 m)	12.5 ft (3.8 m)	17.5 ft (5.3 m)
30 ft (9.1 m)	15 ft (4.6 m)	21 ft (6.4 m)
40 ft (12.2 m)	20 ft (6.1 m)	28 ft (8.5 m)



(a) Spacing according to EN 54-22  
Figure 2 Design considerations for EN 54-22 and NFPA 72

(b) Spacing according to NFPA 72

### 4.3 Application scenarios

The following two sub-chapters provide specific design recommendations for the installation of SecuriHeat d-LIST and SecuriHeat ADW respectively in enclosed parking areas. In many cases, both systems may be suitable, in which case considerations of cost will likely influence the choice. Generally, ADW is the cheaper option both in terms of up-front cost and lifetime costs.

SecuriHeat d-LIST is best suited to larger enclosed parking structures, especially as its cable length of up to 350 m per channel – and up to 100 sensors – means that a single controller can cover a relatively large area. The controller can be positioned in a convenient maintenance room or cabinet. It also offers precise localisation and flexible zoning settings, best suited to an early staged response and/or providing potential firefighters with valuable information on arrival at the scene of a more advanced blaze.

SecuriHeat ADW is generally suited to all other scenarios.

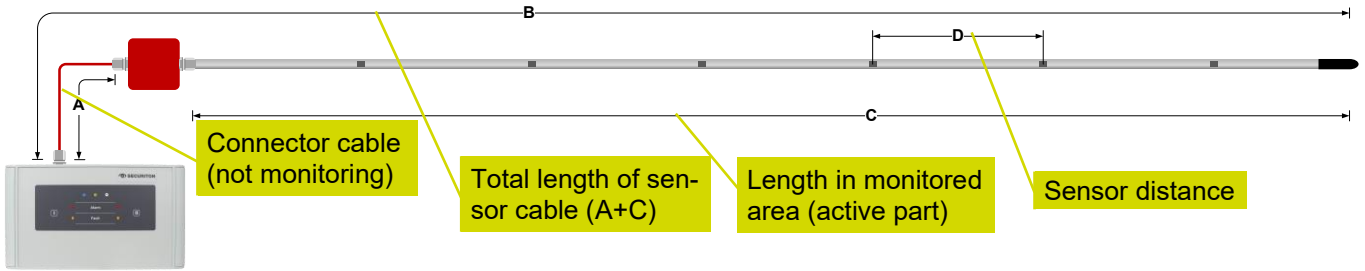
#### 4.3.1 SecuriHeat d-LIST

SecuriHeat d-LIST is available with sensors at various spacings within the cable, between 1 m and 10 m (39.4 ft and 393 ft), but the manufacturer recommendation for underground and multi-storey car parks is to use 3 m or 4 m (42.7 ft or 45.9 ft) spacings (SEC 15/03 or SEC 15/04 cable, respectively). It is also possible to have bespoke spacings manufactured to order. In all cases, the position of the sensors is externally marked, while the sensors themselves remain embedded in protective casing. Consultants and installers planning protection for a parking garage can therefore commission cable with sensor spacing according to local regulations if necessary. Or, if taking a Performance-based Design approach, a spacing option can be chosen to allow one sensor per grouping of car parking spaces in order to balance cost against early warning of a developing fire or fire hazard, and to maximise the

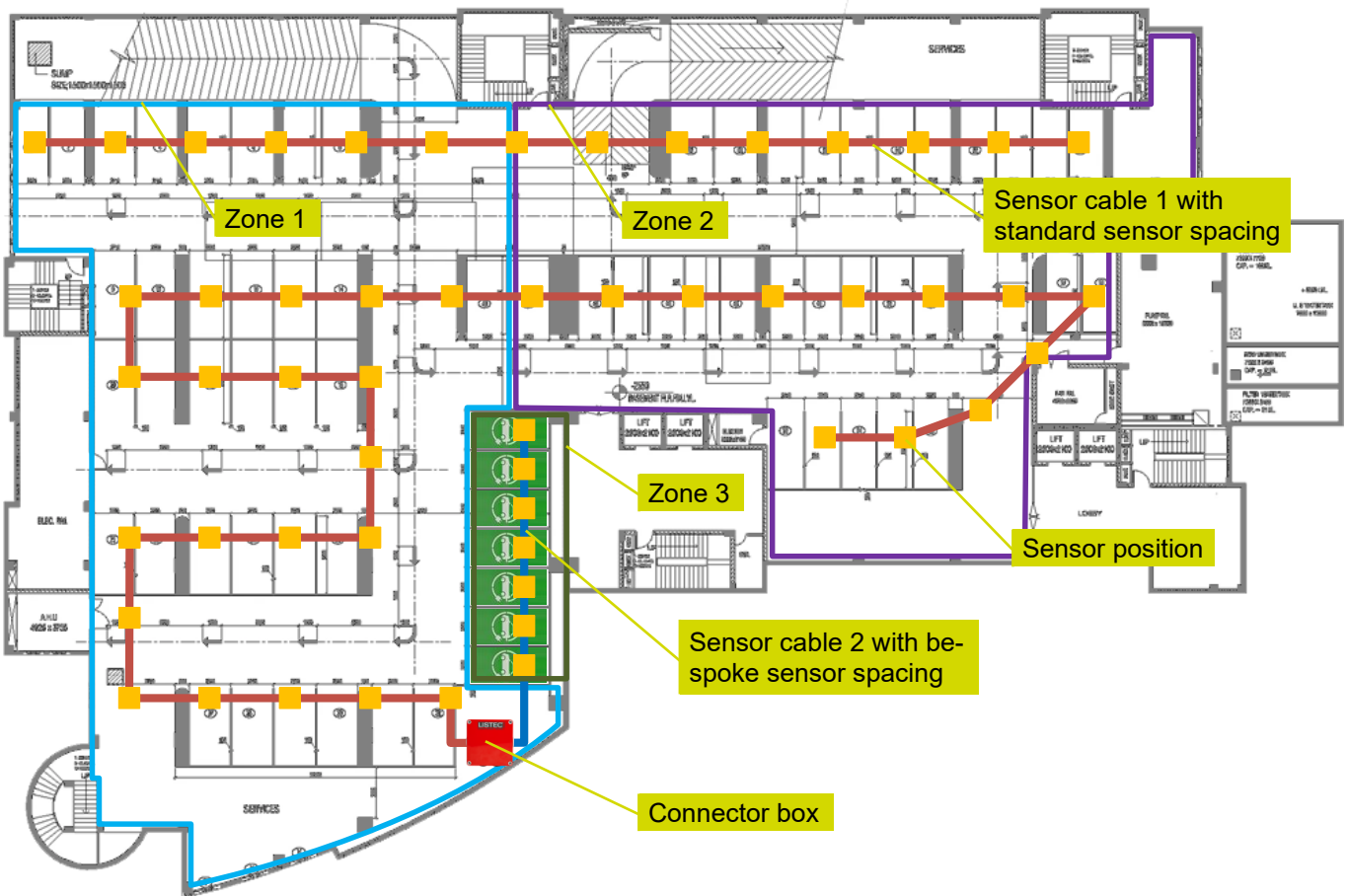
accuracy of localisation. For areas with EV charging points, coverage can be increased to one sensor per parking space or charging point, to maximise early warning in this relatively high risk area.

The objective of SecuriHeat d-LIST design is to effectively provide underside ceiling<sup>6</sup> level detection in general open spaces of each parking level, taking into account roof structure and obstacles, and to match FFFS<sup>7</sup> zoning for the purpose of water release control where applicable. Figure 3 below illustrates:

- Typical enclosed car park layout, with sensor cables for general areas according to manufacturer recommendations or local regulations.
- Sensor cable with bespoke sensor spacing for enhanced coverage of EV charging areas.
- SecuriHeat d-LIST flexible system design with stable, precise zoning function. This does not require extra cable, hence maximising efficiency.



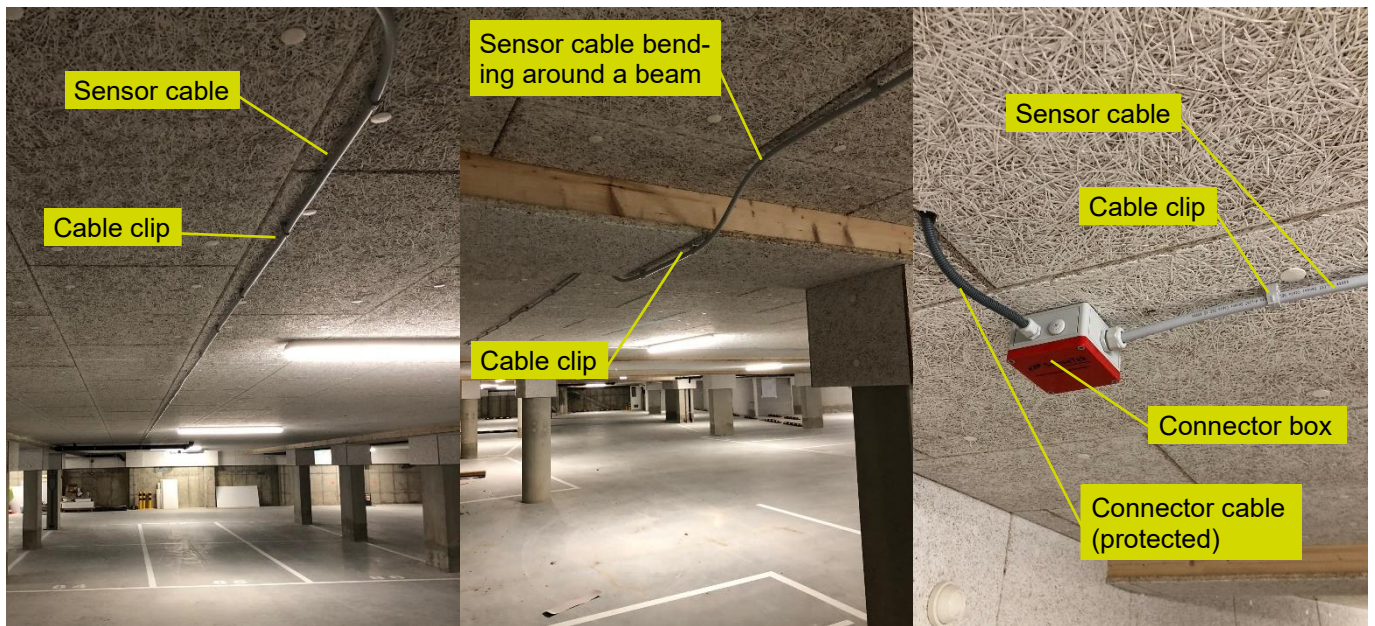
(a) Typical SecuriHeat d-LIST sensor cable arrangement



(b) Fire detection placement SecuriHeat d-LIST (ceiling level open spaces & risk-based detection)

<sup>6</sup> In the context of this document the term 'ceiling' refers to the upper limit of each level in a building structure.

<sup>7</sup> FFFS: Fixed Fire Fighting Systems



(c) SecuriHeat d-LIST placement in car park  
**Figure 3: Illustration of SecuriHeat d-LIST design and applications**

Additionally, it should be noted that:

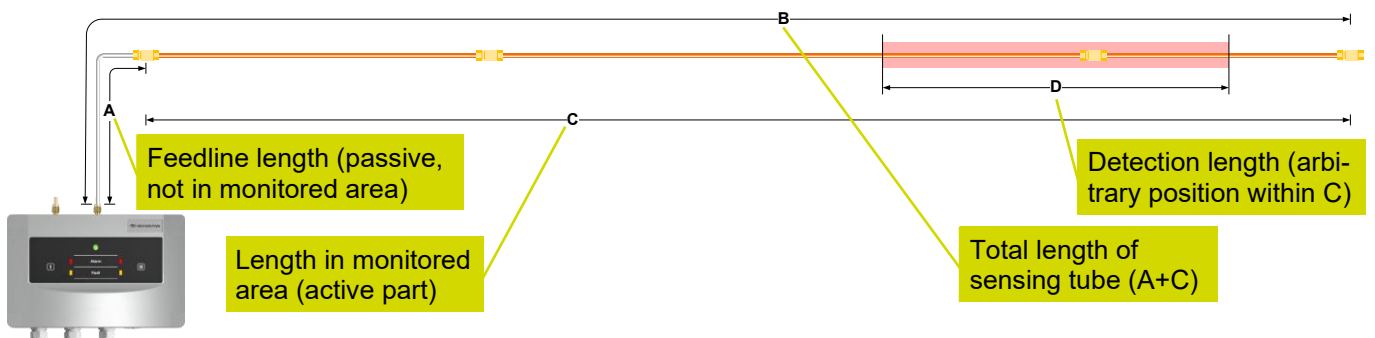
- When use SecuriHeat d-LIST as the only fire detection for code compliance, the area of coverage includes the entire zone is aligned with relevant fire code requirements, such as compartmentation, fire alarm notification or need for FFFS system integration.
- SecuriHeat d-LIST allows installers to add branches and connect controllers easily with connector boxes (CBO 15).
- Choice of Max Alarm, Difference respectively; Integration Alarm to enable Pre-signals in order to investigate and manage fire incidents earlier.

#### 4.3.2 SecuriHeat ADW

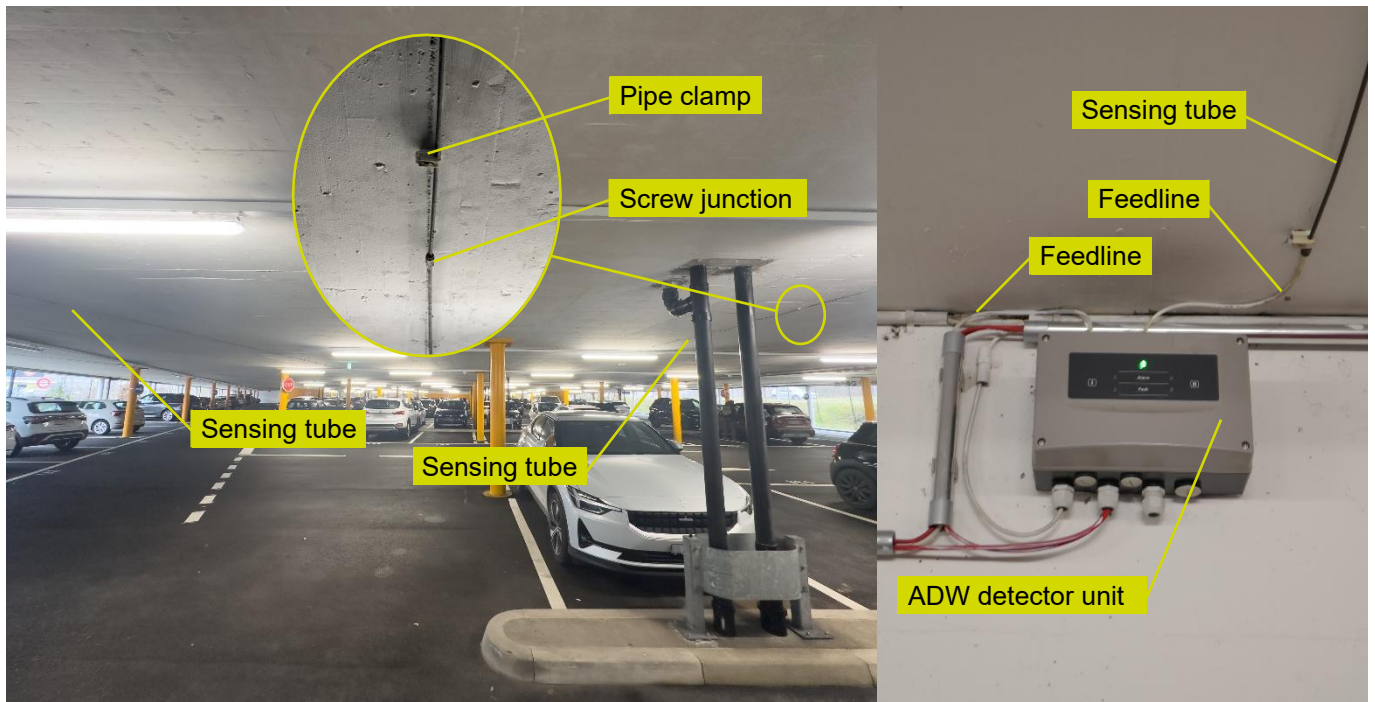
Although SecuriHeat d-LIST is best suited to larger car parks due to its capable of protecting large area per control unit with addressable alarms, SecuriHeat ADW can be a useful alternative for smaller car parks. Although a completely different technology – ADW works by measuring the pressure changes in a sealed metal or Teflon tube - general design principles for linear heat systems remains the same as described for SecuriHeat d-LIST in previous sections. The key performance parameters of SecuriHeat ADW are shown in the table below.

When installing SecuriHeat ADW in a carpark, consideration must be given to the fact that the minimal effective sensing tube length is 10 m (33 ft) and that at least 10% of the total sensing tube length must be exposed to known potential fire ignition points to reliably detect a fire (see Figure 4 (d) below). In a carpark the sensing tubes generally run in straight lines under the ceiling. If necessary and/or beneficial to layout, the tubing can be woven up and down bays respectively (see Figure 2).

ADW tubing is available in copper or Teflon. All are flexible enough to be bended around obstacles or other structural fittings when needed. However, Teflon tubing is somewhat easier to work with and install, especially when bending or meandering is required, and is therefore ideal for car parks.



(d) Typical SecuriHeat ADW sensing tube arrangement



(e) SecuriHeat ADW tubing placement in car park

(f) Connection of feedline to tube and ADW

Figure 4 Illustration of SecuriHeat ADW design and applications

Additionally, it should be noted that:

- The ADW detector unit can be installed either in the same protected area or outside if a convenient utility area is available.
- In case there is a temperature difference between the protected area (where the sensing tubes are installed) and the mounting location of the SecuriHeat ADW control unit, an external temperature sensor should be installed to compensate for this difference.
- When use SecuriHeat ADW LTHD as the only fire detection for code compliance, the area of coverage includes the entire zone in accordance with relevant fire code requirements, such as compartmentation, fire alarm notification or need for fire extinguishing integration.
- Choice of Max-Alarm, Diff-Alarms threshold respectively; Integration Alarm to enable Pre-signal for early alert for rapid local site response.
- When integrating with other building control systems, only Securiton authorised accessories and modules, such as RIM 36, XLM 35 and SIM 35 can be installed.
- To avoid leaks in the sensing tube due to mechanical stress, use a length of flexible Polyamide tube as a feedline between the ADW unit and the sensing tube (see Figure 4 (f)).

#### 4.4 Features and benefits

Securiton AG as a whole is certified in accordance with ISO standards 9001, 14001 and 45001 and thus meets globally applicable standards with regard to quality management, environmental management, and occupational health and safety management systems.

Securiton LTHD products provide comprehensive line-up for both addressable and non-addressable applications. SecuriHeat d-LIST and ADW offer unobtrusive, easy to install heat detection that is immune to harsh environments and can easily be cleaned and maintained. Key features and benefits of SecuriHeat d-LIST and ADW products are summarised as followings.

Feature	Benefits
<b>SecuriHeat d-LIST</b>	
Individually assessable sensors	Rapid pinpointing of incipient fires
Sealed cable with choice of sensor spacings	Easy installation, no maintenance required
Extremely durable cables	Operate in extreme environments
2-Level of Alarms	Pre-signal: Verify and control (manually initiate the suppression) Alarm: Initiate fire alarm; call fire brigade; initiate suppression

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## SecuriHeat ADW

Copper, steel or Teflon tubing	Resistant to harsh outdoor conditions to achieve best cost/benefit
Dynamic Heat Watch algorithm	Elimination of false alarms
Fully automatic system monitoring	Minimal maintenance
2-Level of Alarms	Pre-signal: Verify and control (manually initiate the suppression) Alarm: Initiate fire alarm; call fire brigade; initiate suppression

For car parks that require a number of SecuriHeat ADW or d-LIST or a combination of the two, detectors may be connected to a laptop for easy service and troubleshooting. SecuriHeat d-LIST and ADW follow identical design approach regarding system integration with building FAS. If a pre-action type sprinkler system or a water mist system is used, SecuriHeat detectors can also be configured to actuate the release of the fire extinguish systems.

### 4.5 Integrated verify, control and respond

SecuriHeat ADW 535 provides one level of alert ('Pre-signal') and one fire alarm signal ('Alarm'). Alerts escalating to alarms from an overheating component or incipient fire provide the early warning needed to prevent the incident from fire ignition or limit the fire spreading out. Table 5 summarises the use of 2 level of alarms from SecuriHeat ADW.

Level	Signal	Typical use
1	Pre-signal	Verify and control (manually initiate the suppression)
2	Alarm	Initiate fire alarm; call fire brigade; initiate suppression

Table 5 Alert and alarm levels for SecuriHeat ADW

SecuriHeat d-LIST features two levels of alert ('Pre-signal') and alarm signal ('Alarm'). Typically, alert from one sensor escalating to alert from adjacent sensor or alarms from the originally alerted sensor provide timely alert to an overheating or incipient fire situation, while alarm signal is used for fire alarm as well as pre-action sprinkler actuation. Table 6 summarises the use of multilevel alarms from SecuriHeat d-LIST.

Level	Signal	Typical use
1	Pre-signal	Verify and control (manually initiate the suppression)
2	2nd sensor pre-signal	Automatic stop of operations and machinery; call emergency team
3	Alarm	Initiate fire alarm; call fire brigade; initiate suppression

Table 6 Alert and alarm levels for SecuriHeat d-LIST

### 4.6 Minimal system access for ITM

Due to the advanced automatic sealing test and automatic self-test functions of SecuriHeat ADW 535, the detection system is largely maintenance free. However, local codes and standards may require a periodic function check. For a safe execution of the functional test without entering the potentially hazardous area or disrupting operations inside the protected areas, make use of the conveniently located test coil.

The SecuriHeat d-LIST sensor cable and the external sensors are maintenance free, because they are completely shielded against external influences. In addition, the individual sensors are tested for their function in each measuring cycle. Individual sections of the cable can be replaced easily in case of mechanical damage.

## 4.7 Support with peace of mind

SecuriHeat d-LIST and ADW products are supported by a range of software tools:

### SecuriHeat ADW

Design	ADW HeatCalc allows the planning of security systems at a very early stage.
Install and service	EasyConfig for simple systems. The practical ADW Config software tool is used for more complex systems and application-specific adaptations.
Monitor and manage	ADW HeatCalc and ADW Config. Extensive analysis functions and setting options ensure safe, cost-effective operation of your system.

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### SecuriHeat d-LIST

Design, install, monitor and manage	SCU 835 can be operated and configured using the d-LISTconfig graphical user interface. Connection is possible via RS485, RS232, USB as well as the Ethernet interface.
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Application support includes:

- Partner accreditation program
- Application and field engineering support
- Worldwide reach through a network of partners, with branch offices or local employees on every continent

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