FireLaser DTS Linear Heat Detection
Application and Design Considerations

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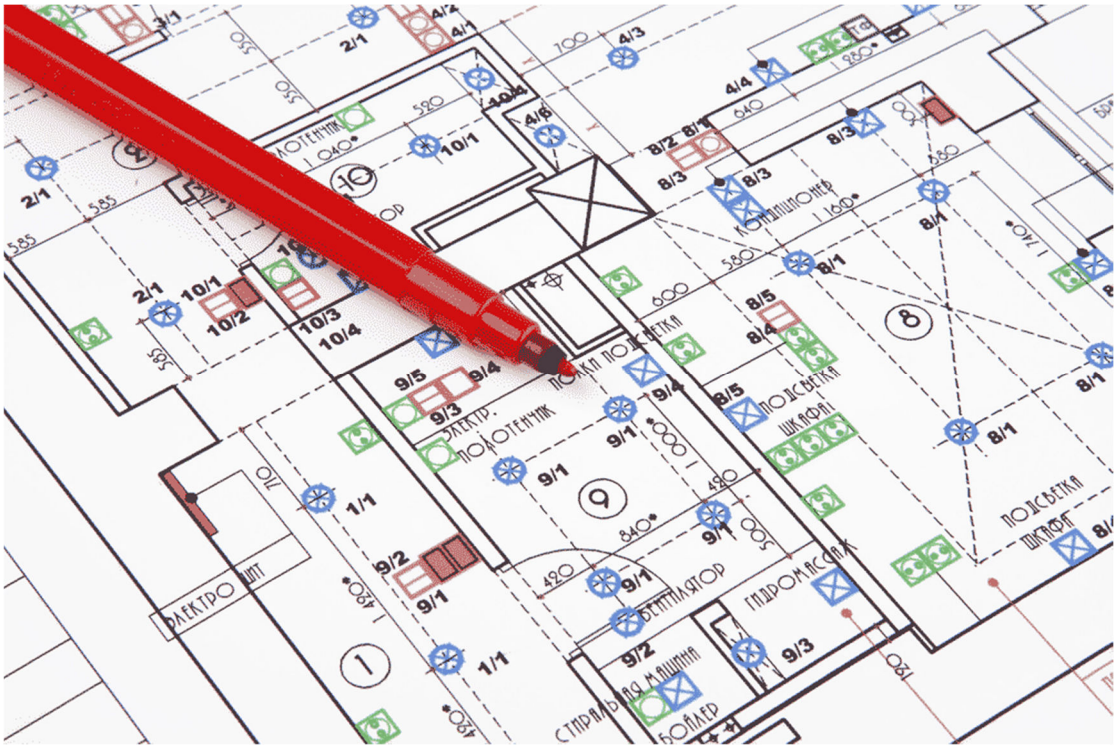

IMPORTANT — PLEASE READ BEFORE USE

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All LHD system designs must be undertaken by a suitably qualified competent fire detection and alarm system designer in compliance with the regulations and standards of the relevant jurisdiction. Local and national regulations always take precedence over the guidance contained in this document.

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Document Revision History

Rev.	Date	Reason for Issue	Author	Approved
1	23-Jun-23	First Issue	RK	RK
2	20 Aug 2026	Revised: document retitled as *Application and Design Considerations* and reclassified for general distribution; disclaimer and scope section strengthened; BS 5839-1 removed; EN 54-22 and EN 54-14 adopted as primary standards; RapidScan alarm type framework added; application sections updated with two-tier alarm tables and NEN 2535 reference; diagrams added.	RK	RK

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Contents

1 Important Disclaimer and Scope of This Document
2 Introduction to FireLaser DTS and FireFiber AT
3 EN 54-22 Certification
4 RapidScan Alarm Types
  4.1 RapidScan Fixed Temperature
  4.2 RapidScan Rate of Rise
  4.3 RapidScan Hotspot
  4.4 Combined Alarm Strategy
5 System Design Principles
  5.1 Cable Position Relative to Ceiling
  5.2 Setpoint Temperature
  5.3 Cable Spacing
  5.4 Maximum Ceiling Height
  5.5 Cable Location Near Walls, Shelving and Obstructions
6 Application: Car Park Monitoring
7 Application: Warehouse Protection
8 Application: Road Tunnels
9 Application: Rail Tunnels

1 Important Disclaimer and Scope of This Document

1.1 Purpose

This document provides general guidance to engineers and system designers planning the installation of FireLaser DTS fiber optic linear heat detection (LHD) systems. It provides illustrative examples of system design, installation principles and typical alarm configurations across a range of common applications.

This document covers design considerations only and is not a substitute for site-specific engineering design. It does not replace, supersede or override any applicable national standard, local regulation, authority having jurisdiction (AHJ) requirement, or site-specific risk assessment. For specific installations, we recommend working with a qualified competent fire detection and alarm system designer with knowledge of the application and the regulatory environment of the relevant jurisdiction.

IMPORTANT — REGULATORY COMPLIANCE

This document cannot be used as a basis for overriding local or national regulations or standards. Local and national regulations always take precedence. The design of any fire detection system must comply with all applicable regulations in the jurisdiction of installation. Bandweaver Technology Ltd. does not guarantee the accuracy of this document with respect to current legislation in any jurisdiction and accepts no liability for designs based on this guidance.

1.2 Geographic Scope

This document is intended for international use. Design principles are referenced primarily to EN 54-14 (Guidelines for planning, design, installation, commissioning, use and maintenance of fire detection and fire alarm systems) as the relevant European guidance standard, and EN 54-22 as the product certification standard for the FireFiber AT sensing cable. Where national standards are referenced in specific application sections, this is for illustrative purposes only.

Examples of jurisdiction-specific references in this document include:

- NEN 2535 (Netherlands) — referenced in the Car Park Monitoring application section
- EN 54-14 (Europe) — referenced as the primary design guidance framework

Other national standards may apply in other jurisdictions. Engineers are responsible for identifying and applying the applicable standard for their specific jurisdiction.

1.3 Intended Audience

This document is intended for use by Bandweaver partners, consultants, installers, and system designers as general product application guidance. It is intended to support understanding of typical FireLaser DTS applications and cable installation principles. It does not qualify the reader to design, approve, install, commission, or certify a fire detection system unless they are otherwise competent and authorised to do so under the applicable regulations.

1.4 Relationship to FireLaser Operations and Installation Manual

This document covers system design and cable installation guidance only. For hardware specifications, commissioning procedures, software configuration, power requirements and

communications interfaces, refer to the relevant FireLaser DTS Operations and Installation Manual.

Project Specific Design Inputs

Project-specific design inputs should include:

- applicable national/local standard;
- AHJ, insurer, consultant, or client requirements;
- ceiling height and roof geometry;
- ventilation and air movement;
- obstructions, beams, ducts, shelving, and partitions;
- ambient temperature range and seasonal variation;
- fire load and expected fire scenarios;
- required detection response time;
- alarm zoning and cause-and-effect;
- commissioning and acceptance test method.

2 Introduction to FireLaser DTS and FireFiber AT

The FireLaser DTS (Distributed Temperature Sensing) system is a fiber optic linear heat detection system manufactured by Bandweaver Technology Ltd. It uses the FireFiber AT sensing cable as a continuous distributed temperature sensor, providing a temperature measurement at points every 0.5 to 1 metre along the entire length of the cable. This density of sensing points gives the system a level of spatial coverage that is fundamentally different from point-type heat detectors.

The system operates by transmitting a laser pulse along the optical fiber and analysing the backscattered light to calculate temperature at every point. The FireLaser DTS processor applies alarm algorithms to this continuous temperature data to generate fire alarms, as described in Section 4.

The FireFiber AT cable is a purely passive sensor with no electronic components along its length, making it suitable for use in harsh and electrically noisy environments. It can be deployed in two principal ways:

- Space detection — the sensing cable is installed at ceiling level to provide distributed temperature monitoring across a protected area.
- Spot or proximity detection — the sensing cable is routed in close proximity to the specific hazard to provide rapid response, for example on conveyor belts, cable trays or shelving racks.

3 EN 54-22 Certification

EN 54-22 is the European standard for resettable line-type heat detectors. It defines the performance requirements, test methods and classification system for linear heat detection systems including fiber optic distributed temperature sensing systems. It is the primary product certification standard applicable to the FireLaser DTS system for European and international markets, and many national standards outside Europe are derived from or aligned with it.

3.1 Classification of FireFiber AT under EN 54-22

Under EN 54-22, linear heat detectors are classified by response temperature class and response type. The FireFiber AT sensing cable holds the following certifications:

Classification	Response Temperature	Description
A1N	54°C	Fixed temperature response at 54°C static threshold
A2N	70°C	Fixed temperature response at 70°C static threshold
BN	85°C	Fixed temperature response at 85°C static threshold

The N suffix denotes that the certified detection method is static fixed temperature response. The EN 54-22 standard also defines an R (rate-of-rise) classification for cables with an inherent rate-of-rise detection mechanism. The FireFiber AT cable is certified for static response only under EN 54-22. Rate-of-rise and Hotspot alarming are provided as analytical capabilities of the FireLaser DTS processor, described in Section 4.

3.2 Relationship to National Standards

EN 54-22 certification provides the product performance baseline. The design and installation of a complete fire detection system must additionally comply with the relevant national installation standard for the jurisdiction. In European markets this will typically be a national implementation of EN 54-14. The designing engineer is responsible for determining which national standards apply.

4 RapidScan Alarm Types

The FireLaser DTS processor applies three alarm algorithms to the continuous distributed temperature data provided by the FireFiber AT sensing cable. These are collectively referred to as RapidScan alarms. They can be configured independently for each detection zone, allowing the alarm strategy to be optimised for the specific risk and environmental conditions of each area.

Where the applicable standard or authority requires the certified fixed-temperature response to be the primary fire alarm criterion, Rate of Rise and HotSpot alarms should be configured as supplementary or pre-alarm functions unless otherwise approved.

CERTIFICATION NOTE

RapidScan Fixed Temperature is the EN 54-22 certified detection method for the FireFiber AT cable. RapidScan Rate of Rise and RapidScan Hotspot are system-level analytical capabilities of the FireLaser DTS processor and are not part of the EN 54-22 cable certification. Their use as primary or secondary alarm signals is subject to the requirements of the applicable national standard and the approval of the competent fire detection and alarm system designer and authority having jurisdiction.

4.1 RapidScan Fixed Temperature

RapidScan Fixed Temperature triggers an alarm when the measured temperature at any point along the sensing cable within a defined zone exceeds a configured absolute temperature threshold. This is the EN 54-22 certified detection method for the FireFiber AT cable. The threshold is set by the system designer based on the ambient temperature conditions of the protected area, in accordance with the applicable national standard. Guidance on setpoint temperature selection is provided in Section 5.2.

4.2 RapidScan Rate of Rise

RapidScan Rate of Rise triggers an alarm when the rate of temperature increase at any point within a defined zone exceeds a configured threshold, expressed in degrees Celsius per minute.

The algorithm compares the current temperature measurement against an adaptive baseline, incorporating a degree of measurement averaging. This means the algorithm responds to genuine sustained temperature rises while remaining stable against minor transient fluctuations in ambient temperature — such as those caused by door openings, ventilation changes or passing vehicles — reducing the likelihood of nuisance alarms from small environmental changes.

Because the adaptive baseline adjusts to gradual changes in ambient conditions, the algorithm maintains its sensitivity to rapid temperature rises characteristic of a developing fire regardless of the prevailing ambient temperature level. In practice, RapidScan Rate of Rise frequently results in faster system response than the fixed temperature threshold alone, particularly in the early stages of a fire.

Note: *RapidScan Rate of Rise is a system-level capability of the FireLaser DTS processor. It is not an EN 54-22 certified cable characteristic. Its use is subject to acceptance by the competent fire detection and alarm system designer and applicable regulatory authority.*

4.3 RapidScan Hotspot

RapidScan Hotspot, also referred to as Deviation, triggers an alarm when the maximum temperature measured at any point within a defined zone exceeds the average temperature of that same zone by a configured threshold, expressed in degrees Celsius.

Because the alarm threshold is referenced against the zone's own measured average temperature rather than a fixed absolute value, the Hotspot algorithm automatically compensates for variations in background temperature across different zones or at different times of day. This self-calibrating characteristic makes it particularly effective in environments where ambient temperatures vary, such as car parks, tunnels and warehouses.

RapidScan Hotspot is well suited to detecting localised heat sources — such as a vehicle fire or a hotspot on a conveyor belt — that produce a temperature anomaly relative to the surrounding area, even where the absolute temperature has not yet reached the fixed threshold.

Note: *RapidScan Hotspot is a system-level capability of the FireLaser DTS processor. It is not an EN 54-22 certified cable characteristic. Its use is subject to acceptance by the competent fire detection and alarm system designer and applicable regulatory authority.*

4.4 Combined Alarm Strategy

In most applications all three RapidScan alarm types are configured simultaneously for each detection zone. The system generates an alarm on the first of the three thresholds to be exceeded. This combined approach provides both the regulatory assurance of the certified fixed temperature response and the practical detection speed advantage of the rate-of-rise and hotspot algorithms. Typical alarm level ranges for each application are given in the relevant application sections.

5 System Design Principles

The following design principles are derived from EN 54-14, which provides guidance on the planning, design and installation of fire detection and fire alarm systems. They represent general good practice for ceiling-mounted linear heat detection applications. These principles should be applied by a qualified competent fire detection and alarm system designer and are subject to the requirements of the applicable national standard.

5.1 Cable Position Relative to Ceiling

The sensing cable must be positioned within the zone of hot gas accumulation near the ceiling to ensure adequate thermal coupling with fire gases. The following positioning requirements apply:

- The sensing cable should be positioned not less than 25 mm below the ceiling surface.
- The sensing cable should be positioned not greater than 150 mm below the ceiling surface.

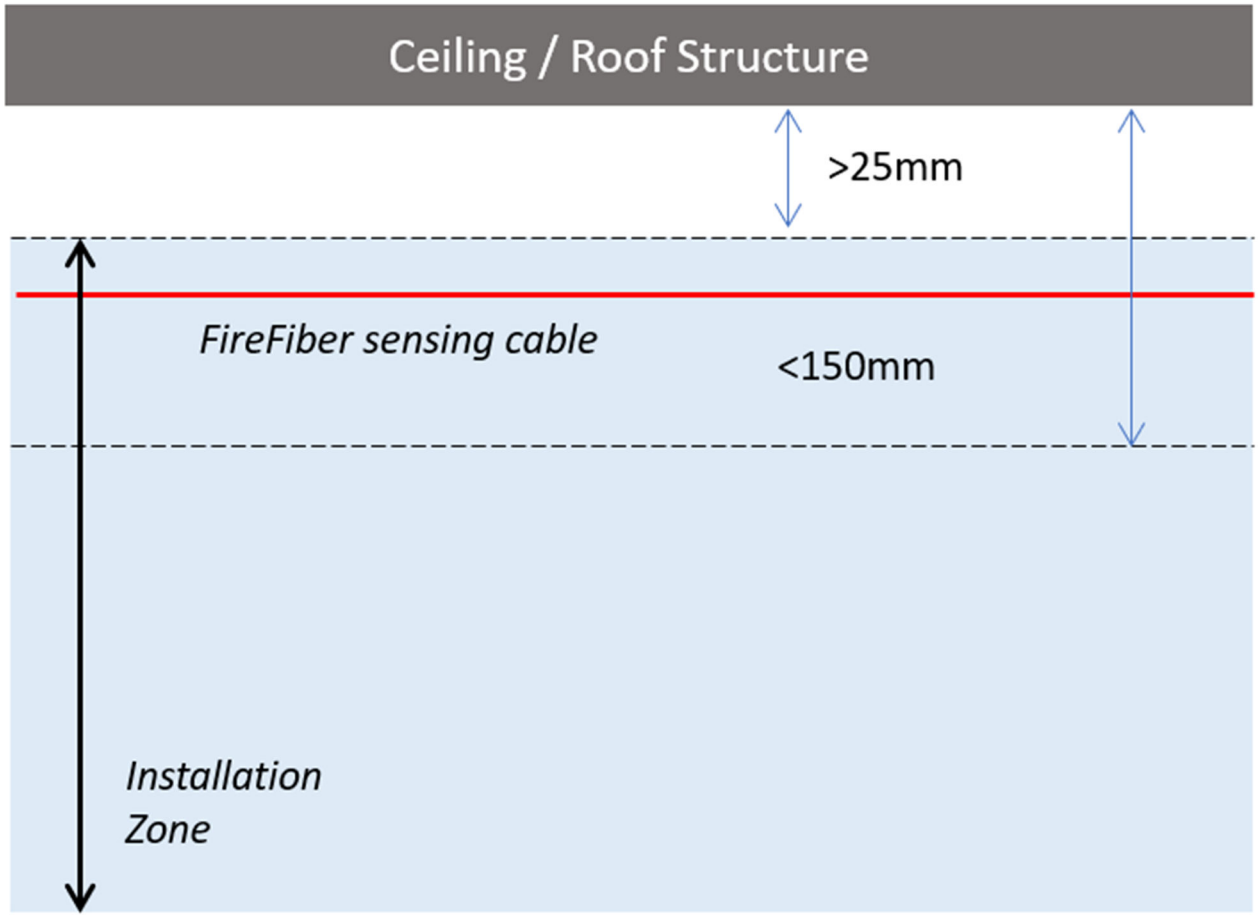

Figure 1 — FireFiber AT cable position relative to ceiling (per EN 54-14)

5.2 Setpoint Temperature

The RapidScan Fixed Temperature alarm threshold must be set at a level that provides reliable detection of fire conditions while avoiding nuisance alarms from normal ambient temperature variations. The following principles apply in accordance with EN 54-14:

- The fixed temperature threshold should be set at not less than 29°C above the average ambient temperature of the protected area.
- The fixed temperature threshold should be set at not less than 4°C above the highest temperature the sensing cable can expect to experience under normal non-fire conditions.

In practice, Bandweaver's partners commonly set the fixed temperature threshold in the range of 55°C to 60°C for general indoor applications where the normal ambient temperature does not exceed approximately 30°C. For environments with higher or variable ambient temperatures the threshold should be reviewed and set accordingly by the designing engineer.

5.3 Cable Spacing

When the FireFiber AT sensing cable is mounted on a flat, unobstructed ceiling, the effective detection radius at each measurement point may be taken as 5.3 m, consistent with EN 54-14 guidance for linear heat detectors. Because the FireLaser DTS system provides a temperature measurement point every 0.5 m to 1 m along the sensing cable, the detection coverage is continuous along the cable route rather than limited to discrete point detector locations.

As an initial design reference only, a maximum spacing of up to 10.6 m between parallel cable runs may be derived from twice the 5.3 m detection radius. This spacing assumes a flat ceiling, unobstructed heat flow, appropriate cable positioning, and environmental conditions suitable for ceiling-level heat detection.

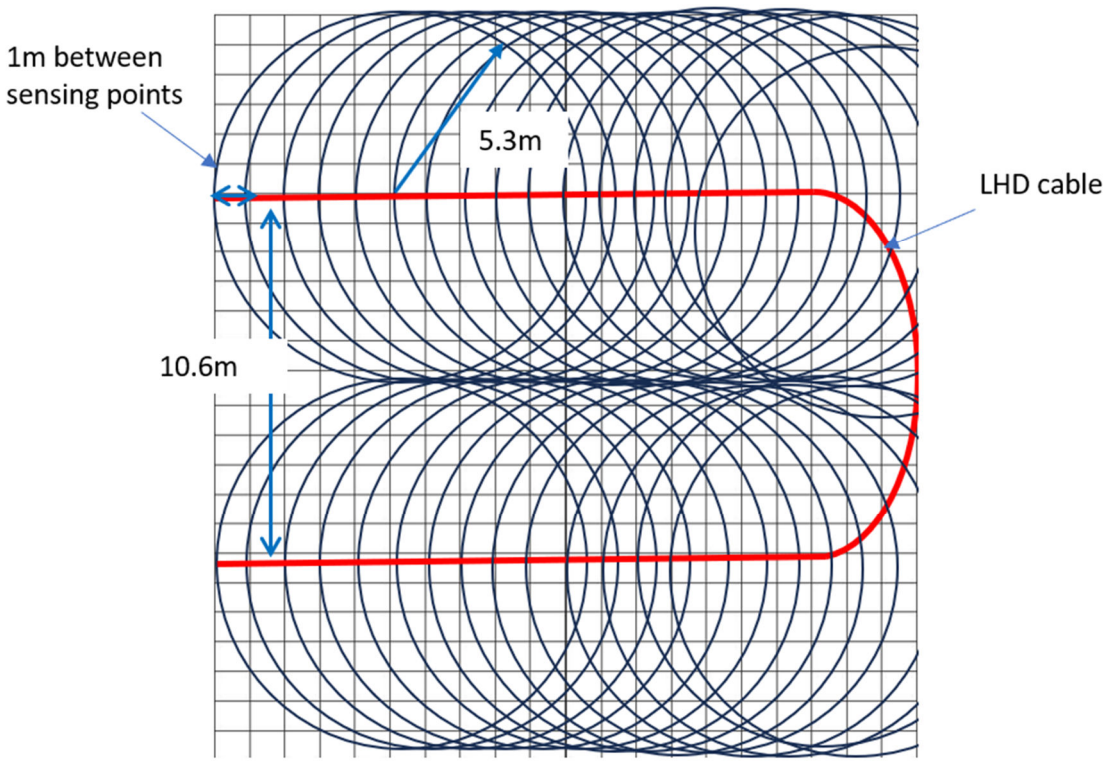

Figure 2 — Illustrative 10.6 m cable spacing derived from 5.3 m individual detection radius

Final cable spacing shall be determined by the responsible competent fire detection and alarm system designer and verified against the applicable national standard, local regulations, ceiling height, ventilation conditions, obstruction layout, fire risk, required response time, alarm strategy, and any requirements of the authority having jurisdiction.

Where local or national standards specify a smaller maximum spacing, or where project conditions reduce the effectiveness of ceiling-level heat detection, the smaller or more conservative spacing shall be applied. The 10.6 m figure shall not be used as a basis for overriding local regulations, project specifications, insurer requirements, or approval authority requirements.

Note: *The 10.6 m maximum spacing is Bandweaver's derivation from the EN 54-14 coverage radius principles. Some national standards and local authorities having jurisdiction may specify different maximum cable spacing requirements. Always verify with the applicable national standard.*

5.4 Maximum Ceiling Height

The maximum ceiling height for heat detection is governed by the applicable national standard. The following general guidance from EN 54-14 applies for fixed temperature detection:

Detection Method	General Area — Max Height	Larger Areas (≥10% floor area) — Max Height
Fixed Temperature	7.5 m	10.5 m
Rate of Rise	9.0 m	10.0 m

Project-specific use outside the ceiling-height limits of the applicable standard should be treated as a performance-based design decision. Such use may require supporting fire engineering analysis, project-specific testing, or written acceptance by the competent fire detection and alarm system designer and authority having jurisdiction. Bandweaver's product guidance shall not be used as the sole justification for exceeding standard ceiling-height limits.

5.5 Cable Location Near Walls, Shelving and Obstructions

The following rules apply to the positioning of sensing cable near walls and obstructions:

- Not more than 3 m of sensing cable should be mounted within 500 mm of any wall, partition or obstruction that extends to within 300 mm of the ceiling.
- Structural beams, ductwork and any other obstructions with a depth greater than 10% of the ceiling height are treated as walls for this purpose.
- Where an obstruction has a depth of less than 250 mm, sensing cable should not be mounted closer to the obstruction than twice the depth of the obstruction.
- Where an obstruction has a depth of 250 mm or greater, the sensing cable should be routed to maintain the 500 mm clearance.
- If the top of a solid partition or shelving unit is less than 300 mm from the ceiling, it should be treated as a wall.

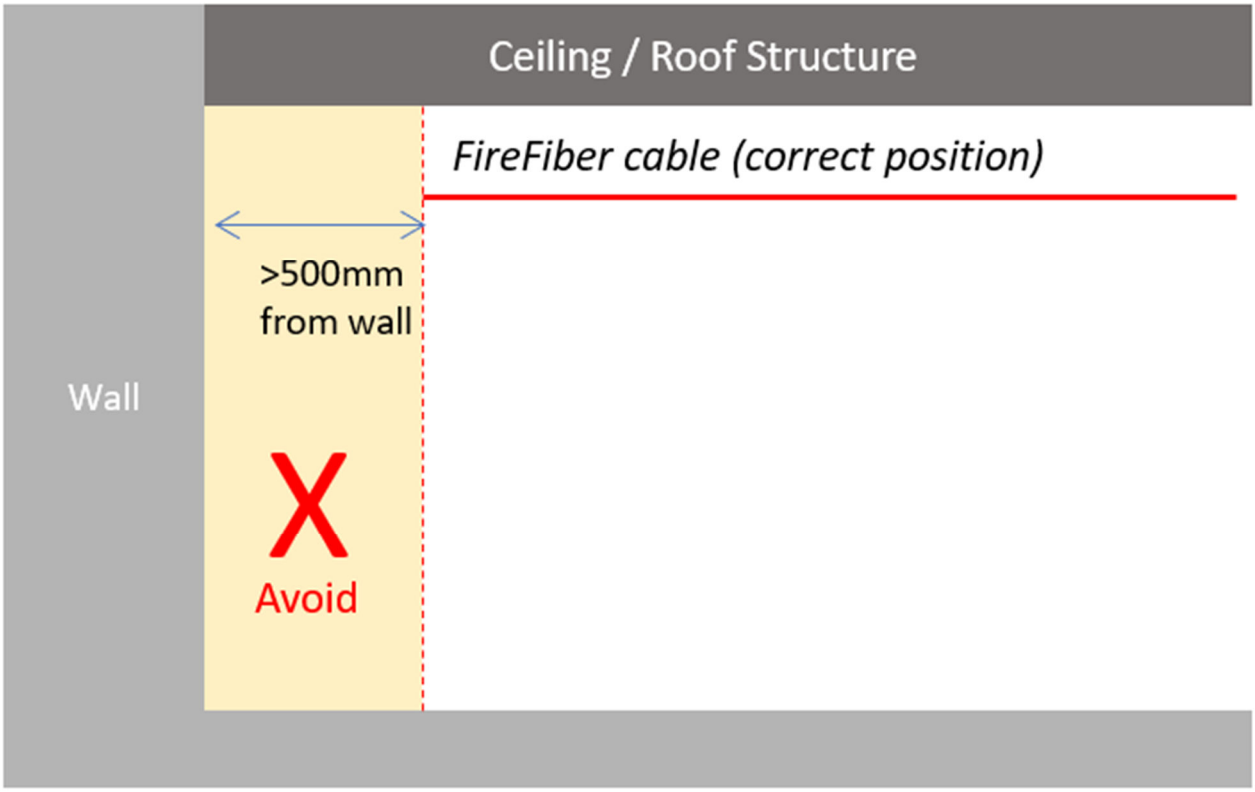

Figure 3 — Minimum 500 mm cable clearance from walls and partitions

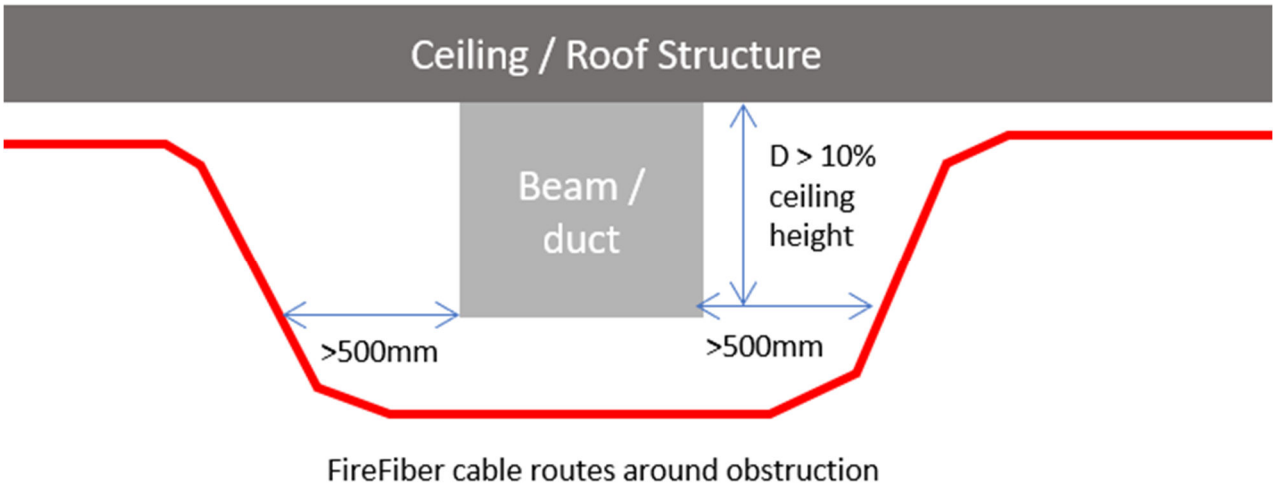

Figure 4 — Cable routing around ceiling obstructions (depth > 10% of ceiling height)

6 Application: Car Park Monitoring

This section provides general guidance on the design and installation of FireLaser DTS systems in car park applications. The information is based on installations carried out by Bandweaver's partners and is illustrative only.

REGULATORY NOTE — CAR PARK APPLICATIONS

In the Netherlands, the design and installation of fire detection systems in car parks is governed by NEN 2535. This standard is referenced in this section as an example of national regulatory requirements. Engineers working in other jurisdictions must identify and apply the applicable national standard. The guidance in this section does not override NEN 2535 or any other applicable standard.

6.1 Cable Spacing and Layout

In car park applications the sensing cable is typically installed at ceiling level, running longitudinally along the car park bays. Based on installations carried out by Bandweaver's partners, cable spacing at ceiling level typically ranges from 8 m to 13.5 m, depending on the applicable national standard and ceiling height. Under NEN 2535, the designing engineer should verify the applicable maximum spacing. A cable offset of at least 500 mm from the perimeter walls should be maintained.

Spacings above the indicative 10.6 m reference in Section 5.3 should only be used where permitted by the applicable national standard or accepted by the competent fire detection and alarm system designer and authority having jurisdiction.

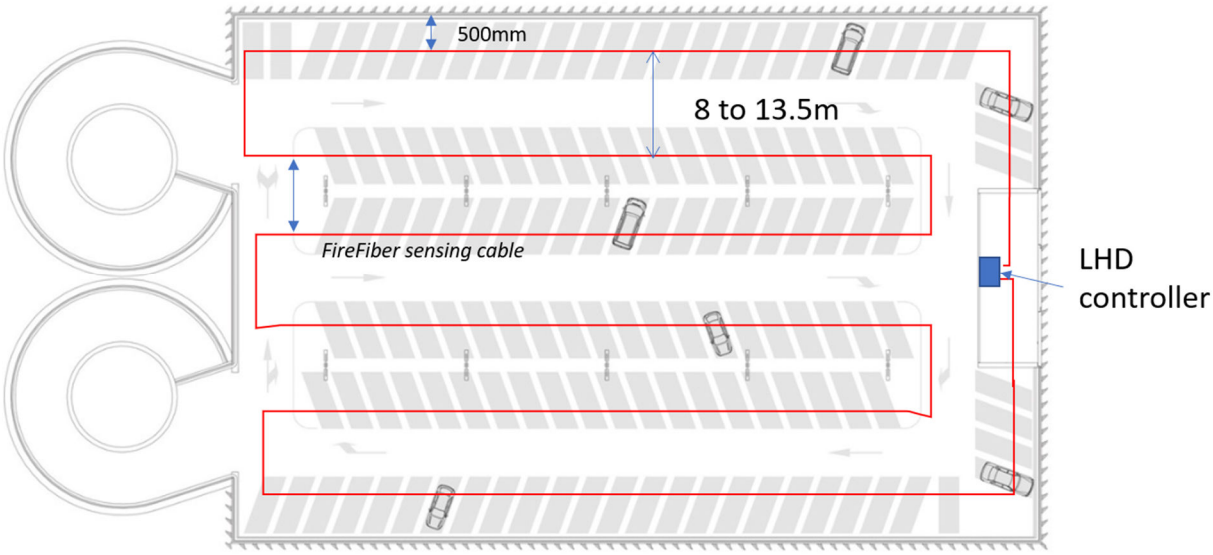

Figure 5 — Illustrative car park ceiling-level cable layout (plan view)

6.2 Alarm Levels

The following alarm levels are representative of configurations deployed by Bandweaver's partners in car park applications. They are illustrative only and must be reviewed and approved by the designing engineer in accordance with the applicable national standard.

Alarm Type	Typical Range	Basis
RapidScan Fixed Temperature	50°C – 60°C	EN 54-22 certified — primary detection method
RapidScan Rate of Rise	7°C/min – 12°C/min	System-level capability — subject to regulatory acceptance
RapidScan Hotspot	7°C – 12°C above zone average	System-level capability — subject to regulatory acceptance

Note 1: *Fixed Temperature values are illustrative. The designing engineer must set the threshold in accordance with Section 5.2 and the applicable national standard.*

Note 2: *Rate of Rise and Hotspot alarm levels are not EN 54-22 certified cable characteristics. Their use as primary or secondary alarm signals must be confirmed with the applicable regulatory authority.*

6.3 Commissioning and Testing

Car park installations are commonly commissioned using a fire pan test. A typical test uses a 0.25 m² fire pan; the system must generate an alarm before the pan finishes burning. Based on partner experience, with a ceiling height of 2.5 m and a cable spacing of 8 m, the system will typically alarm on a RapidScan Rate of Rise or Hotspot threshold of 10°C under these conditions. The commissioning test method should be agreed with the competent fire detection and alarm system designer and the applicable regulatory authority, including compliance with NEN 2535 where applicable.

Any live fire test or fire pan test must be subject to site safety approval, risk assessment, method statement, fire watch arrangements, ventilation controls, and approval by the client, competent fire detection and alarm system designer, site operator, and authority having jurisdiction. Alternative simulated heat tests may be required where live fire testing is not permitted.

7 Application: Warehouse Protection

This section provides general guidance on the design and installation of FireLaser DTS systems in warehouse applications. The information is based on installations carried out by Bandweaver's partners and is illustrative only. Engineers must apply the applicable national standard for their jurisdiction.

7.1 Cable Spacing and Routing

In warehouse applications the sensing cable is typically installed at ceiling level, with cable spacing ranging from 8 m to 13.5 m depending on the applicable national standard and ceiling height. In addition to ceiling-level installation, the sensing cable may also be routed on or adjacent to shelving or racking frames to provide proximity detection at the hazard level. In high-bay warehouses, mounting cable on the racking provides a complementary layer of detection closer to the stored goods.

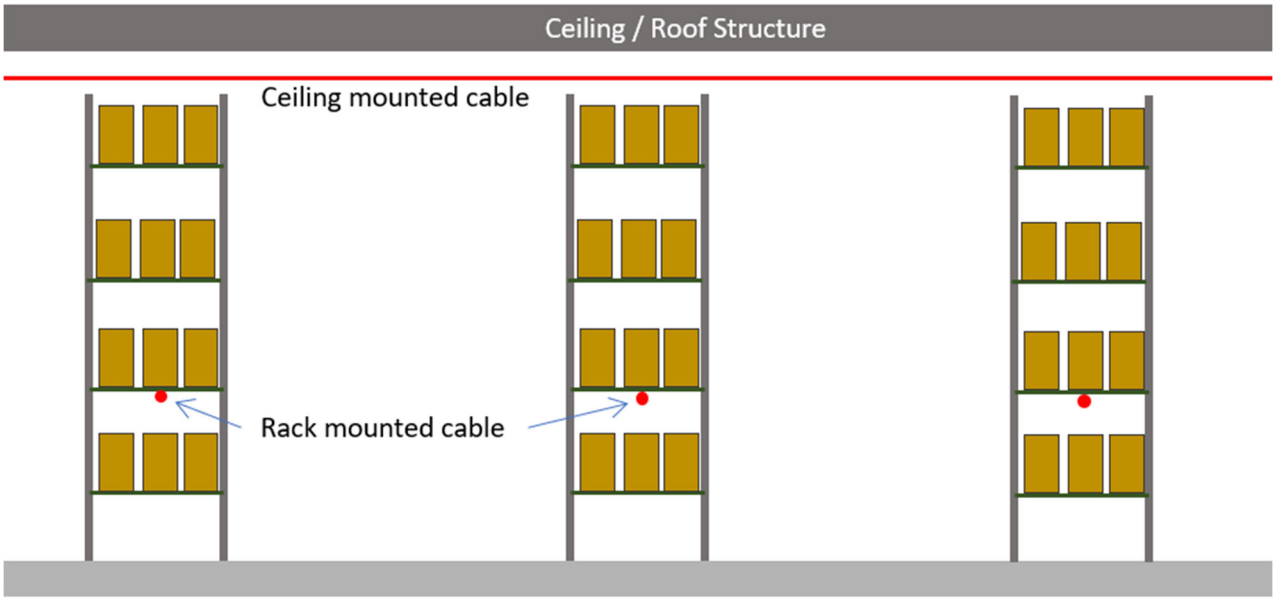

Figure 6 — Warehouse ceiling-level and rack-mounted cable installation (cross-section)

7.2 Alarm Levels

The following alarm levels are representative of configurations deployed by Bandweaver's partners in warehouse applications. They are illustrative only and must be reviewed and approved by the designing engineer in accordance with the applicable national standard.

Alarm Type	Typical Range	Basis
RapidScan Fixed Temperature	50°C – 60°C	EN 54-22 certified — primary detection method
RapidScan Rate of Rise	7°C/min – 12°C/min	System-level capability — subject to regulatory acceptance
RapidScan Hotspot	7°C – 12°C above zone average	System-level capability — subject to regulatory acceptance

Note 1: *Fixed Temperature values are illustrative. The designing engineer must set the threshold in accordance with Section 5.2, the applicable national standard, and the specific goods stored.*

Note 2: *Rate of Rise and Hotspot alarm levels are not EN 54-22 certified cable characteristics. Their use as primary or secondary alarm signals must be confirmed with the applicable regulatory authority.*

7.3 Maximum Ceiling Height

Maximum ceiling height is governed by the applicable national standard as described in Section 5.4. In some cases engineers and authorities having jurisdiction have accepted greater ceiling heights for fiber optic LHD systems in warehouse applications, due to the increased density of sensing points. Any such deviation requires explicit agreement from the competent fire detection and alarm system designer and regulatory authority.

7.4 Commissioning and Testing

Warehouse installations are typically commissioned using programmable heater devices that simulate heat over a defined 1 m section of sensing cable to a programmable temperature, allowing zone-by-zone verification of system response. Bandweaver can provide suitable heater devices for commissioning purposes; alternatively the installation company may use their own equivalent device.

8 Application: Road Tunnels

This section provides general guidance on the design and installation of FireLaser DTS systems in road tunnel applications. The information is based on installations carried out by Bandweaver's partners and is illustrative only. Engineers must apply the applicable national standard and authority having jurisdiction requirements for their specific tunnel.

8.1 Cable Spacing and Configuration

In road tunnel applications the sensing cable is installed along the tunnel ceiling or roof arch. The number of cable runs and their spacing depends primarily on the carriageway width:

- For tunnels with a carriageway width of less than 10 m: a single sensing cable run along the centreline of the tunnel roof is typically sufficient.
- For tunnels with a carriageway width of 10 m or greater: dual sensing cable runs are typically deployed, positioned symmetrically across the tunnel roof.

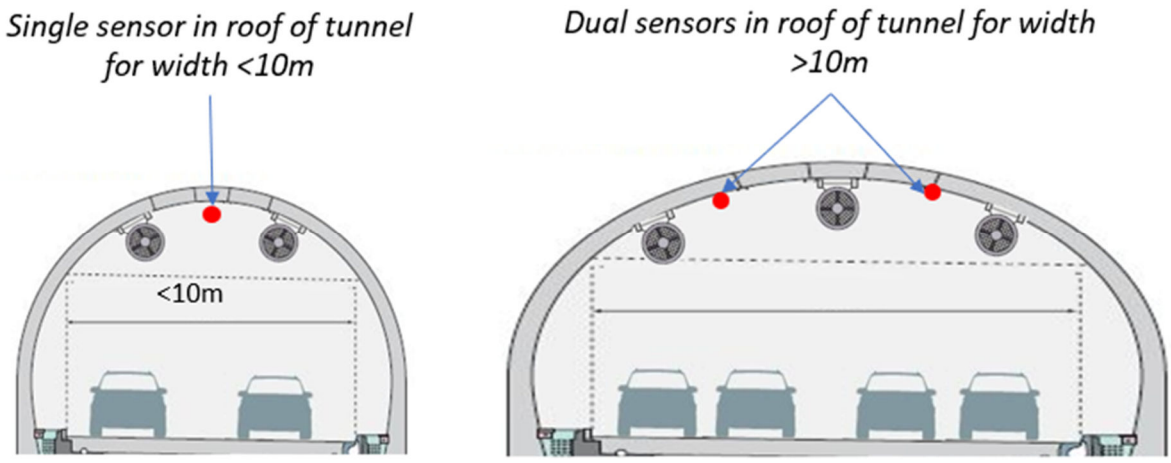

Figure 7 — Road tunnel cable configuration by carriageway width

8.2 Alarm Levels

The following alarm levels are representative of configurations deployed by Bandweaver's partners in road tunnel applications. They are illustrative only and must be reviewed and approved by the designing engineer.

Alarm Type	Typical Range	Basis
RapidScan Fixed Temperature	50°C – 60°C	EN 54-22 certified — primary detection method
RapidScan Rate of Rise	7°C/min – 12°C/min	System-level capability — subject to regulatory acceptance
RapidScan Hotspot	7°C – 12°C above zone average	System-level capability — subject to regulatory acceptance

Note 1: *Tunnel ambient temperatures can vary significantly. The Fixed Temperature threshold must be reviewed in light of the expected tunnel ambient temperature range.*

Note 2: *Rate of Rise and Hotspot alarm levels are not EN 54-22 certified cable characteristics. Their use must be confirmed with the applicable regulatory authority.*

8.3 Commissioning and Testing

Road tunnel installations are commonly commissioned using a fire pan test. A typical test uses a 1 m² fire pan; the system must generate an alarm before the pan finishes burning. Based on partner experience, with a ceiling height of 5 m to 8 m, the system will typically alarm on a RapidScan Rate of Rise or Hotspot threshold of 10°C. The commissioning test method and acceptance criteria should be agreed with the tunnel operator, the competent fire detection and alarm system designer and the applicable regulatory authority prior to testing.

Any live fire test or fire pan test must be subject to site safety approval, risk assessment, method statement, fire watch arrangements, ventilation controls, and approval by the client, competent fire detection and alarm system designer, site operator, and authority having jurisdiction. Alternative simulated heat tests may be required where live fire testing is not permitted.

9 Application: Rail Tunnels

This section provides general guidance on the design and installation of FireLaser DTS systems in rail tunnel applications. Rail tunnel environments present specific challenges including overhead line equipment (OLE), structural obstructions in the tunnel crown, and the need to detect fires originating close to the wheel-base of rolling stock. Engineers must apply the applicable national standard and authority having jurisdiction requirements for their specific tunnel.

9.1 Cable Positioning Considerations

Rail tunnels often have obstructions in the tunnel crown — the optimal detection location. The following principles apply:

- Where the tunnel crown is unobstructed, the sensing cable should be positioned at the crown in accordance with the ceiling height limits described in Section 5.1.
- Where obstructions prevent installation at the crown, alternative positions on the tunnel wall or arch should be selected to maximise proximity to rising hot gases.
- Because fires in rail tunnels frequently originate at the wheel-base of rolling stock, the cable position should be assessed for its ability to detect a ground-level fire source as well as overhead conditions.

9.2 Cable Configuration by Tunnel Type

The number of cable runs depends on the tunnel configuration and rolling stock type:

- Single-track or dual-track tunnels: a single sensing cable run positioned in the tunnel crown or upper arch is typically appropriate.
- Three-track or wider tunnels: a dual cable strategy is typically deployed, with cables positioned to provide lateral coverage across the full tunnel width.

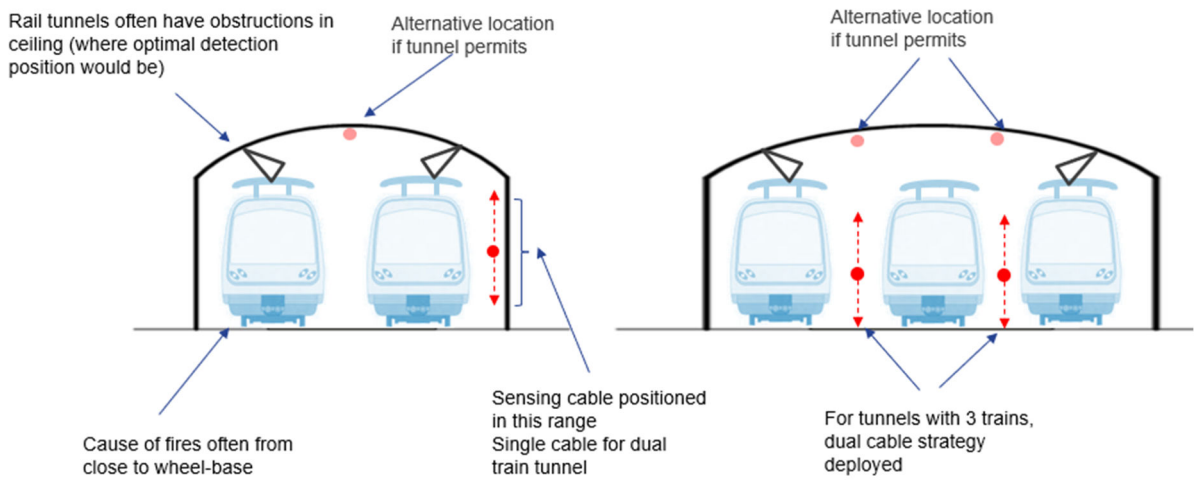

Figure 8 — Rail tunnel cable configuration — single and dual cable strategies

9.3 Alarm Levels

The following alarm levels are representative of configurations deployed by Bandweaver's partners in rail tunnel applications. They are illustrative only and must be reviewed and approved by the designing engineer.

Alarm Type	Typical Range	Basis
RapidScan Fixed Temperature	50°C – 60°C	EN 54-22 certified — primary detection method
RapidScan Rate of Rise	7°C/min – 12°C/min	System-level capability — subject to regulatory acceptance
RapidScan Hotspot	7°C – 12°C above zone average	System-level capability — subject to regulatory acceptance

Note 1: *Rail tunnel ambient temperatures are generally more stable than road tunnels but the presence of train-generated heat should be considered when setting thresholds.*

Note 2: *Rate of Rise and Hotspot alarm levels are not EN 54-22 certified cable characteristics. Their use must be confirmed with the applicable regulatory authority.*

9.4 Commissioning and Testing

Rail tunnel installations are typically commissioned using programmable heater devices that simulate heat over a defined 1 m section of sensing cable to a programmable temperature, allowing zone-by-zone verification of system response. Bandweaver can provide suitable heater devices; alternatively the installation company may use their own equivalent device. The commissioning test method and acceptance criteria should be agreed with the infrastructure owner, the competent fire detection and alarm system designer and the applicable regulatory authority prior to testing.

This document provides general application and design considerations only. It does not constitute project-specific design approval, installation approval, regulatory approval, or acceptance of any deviation from applicable standards. Final responsibility for system design, installation, commissioning, and approval remains with the appointed competent fire detection and alarm system designer, installer, commissioning body, and relevant approving authority.

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