

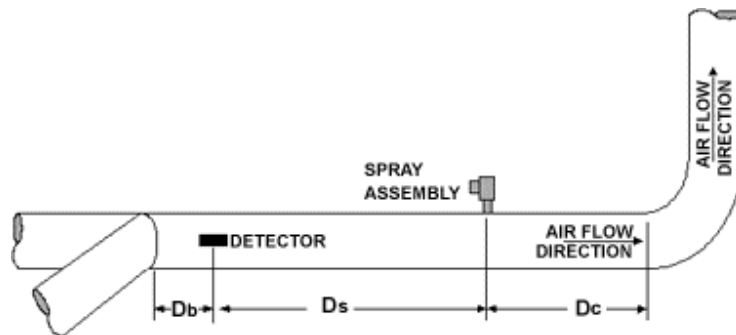


## Special Hazard Fire Detection & Suppression

### SPARK DETECTION AND EXTINGUISHMENT SYSTEM DESIGN

An effective Spark detection system must monitor all potential paths of a spark or ember through all branches of ducts and once a spark or ember is detected, it must establish a curtain of water through which the spark must pass. Each main duct system is considered a protection zone. If your dust collector has a single main duct, then only one zone is required.

The air in the ducts is travelling at a very great rate of speed and therefore carries a spark or ember very rapidly. Air transport speeds of 1.829 m/min (6000 ft/min). are not uncommon which means a spark can be carried 30 meter (100 feet) in one second. Detecting the spark, turning on the water and establishing a spray curtain across the entire duct can take as much .288 seconds or .0048 minutes. If the spark is travelling a 30 m/sec (100 feet) per second, we will therefore require the detector to be placed at least 8,8 m (28.8 feet) ahead of the water spray nozzle since that is how far the spark will travel in .288 seconds. If there is insufficient length available on the main duct, detectors can be placed on the branch lines or the main duct must be extended.



### AIR VELOCITY

The air velocity must be greater than 152 m (500 feet) per minute and less than 3.048 m (10,000 feet) per minute to ensure proper operation and detection. The air velocity is generally known prior to installation but we highly recommends that the air velocity be measured and confirmed prior to installation. If the air velocity is not known, you can simply calculate the velocity based on the dust collector capacity and the size of the duct (area of a cross section of the duct).

$$\text{Velocity}(V) = \frac{\text{CUBIC METER PER MINUTE (M3)}}{\text{AREA OF DUCT IN SQ.METER (A)}}$$

The diameter of a circular duct can be calculated by dividing the circumference by  $\pi$  which is the equivalent of 3.1416. The following table provides the area in meter/feet of a cross section of various size ducts. If you are not sure of the duct size, you can measure the circumference and use that column of the table:



## Special Hazard Fire Detection & Suppression

DUCT SIZE	DUCT CIRCUMFERENCE	AREA (SQ.MTR or FT)
20,32 cm (8 inches)	63,83 cm (25.13 inches)	0,0324 Square Meter (.3491 Square Feet)
25,4 cm (10 inches)	79,8 cm (31.42 inches)	0,0507 Square Meter (.5454 Square Feet)
30,48 cm (12 inches)	95,76 cm (37.70 inches)	0,0730 Square Meter (.7854 Square Feet)
35,56 cm (14 inches)	111,71 cm (43.98 inches)	0,099 Square Meter (1.069 Square Feet)
40,64 cm (16 inches)	127,66 cm (50.26 inches)	0,1298 Square Meter (1.396 Square Feet)
45,72 cm (18 inches)	143,64 cm (56.55 inches)	0,1643 Square Meter (1.767 Square Feet)
50,8 cm (20 inches)	159,59 cm (62.83 inches)	0,2029 Square Meter (2.182 Square Feet)
55,88 cm (22 inches)	175,54 cm (69.11 inches)	0,2455 Square Meter (2.640 Square Feet)
60,96 cm (24 inches)	191,52 cm (75.40 inches)	0,2922 Square Meter (3.142 Square Feet)
66,04 cm (26 inches)	207,47 cm (81.68 inches)	0,3429 Square Meter (3.687 Square Feet)
71,12 cm (28 inches)	223,42 cm (87.96 inches)	0,3977 Square Meter (4.276 Square Feet)
76,2 cm (30 inches)	293,40 cm (94.25 inches)	0,4565 Square Meter (4.909 Square Feet)
81,28 cm (32 inches)	255,27 cm (100.5 inches)	0,5194 Square Meter (5.585 Square Feet)
86,36 cm (34 inches)	271,27 cm (106.8 inches)	0,5864 Square Meter (6.305 Square Feet)
91,44 cm (36 inches)	287,27 cm (113.1 inches)	0,6574 Square Meter (7.069 Square Feet)



## Special Hazard Fire Detection & Suppression

96,52 cm (38 inches)	303,28 cm (119.4 inches)	0,7325 Square Meter (7.876 Square Feet)
101,6 cm (40 inches)	319,28 cm (125.7 inches)	0,8116 Square Meter (8.727 Square Feet)
106,68 cm (42 inches)	335,03 cm (131.9 inches)	0,8948 Square Meter (9.621 Square Feet)
111.76 cm (44 inches)	351,03 cm (138.2 inches)	0,9821 Square Meter (10.56 Square Feet)
116,84 cm (46 inches)	367,03 cm (144.5 inches)	1,073 Square Meter (11.54 Square Feet)
121,92 cm (48 inches)	383,03 cm (150.8 inches)	1,1690 Square Meter (12.57 Square Feet )

### DETECTOR LOCATION

The Hansentek detectors react very quickly to sparks and embers and therefore, the water spray pattern is established very quickly. The most significant delay in entire system is the reaction time of the water solenoid valve and the time it takes for the water spray to provide a curtain across the entire duct. The time it takes for the solenoid valve to open introduces the largest delay. There are a number of factors which effect the solenoid such as water pressure and mechanical variations in the valve itself. Since these factors are variable, we must allow the maximum time in our calculations to ensure the curtain of water is fully developed before the spark arrives.

The various maximum delay factors involved are:

- detector response time: 60 usec
- micro-processor sampling cycle: 20 msec
- assembly opening time: 200 msec
- water spray traverse time of the duct: 68 msec

The Total System Reaction time is thus .288 seconds or .0048 minutes.

With a known velocity we simply calculate the distance ahead of the spray for placement of the detectors using the formula:

Distance (Ds) = Total System Reaction Time (Tr) X Velocity (V)

For example, with a velocity of 1.524 m (5000ft) per minute, we require the detectors to be placed .0048 X 1.524 (5000) = 7,32 m (24 Feet) ahead of the water spray.



## Special Hazard Fire Detection & Suppression

The following table provides various calculated values:

Velocity	Distance (Ds)
914,4 m/min (3000 ft/min)	4,39 m (14.4 feet)
1067 m/min (3500 ft/min)	5,12 m (16.8 feet)
1219 m/min (4000 ft/min)	5,85 m (19.2 feet)
1372 m/min (4500 ft/min)	6,58 m (21.6 feet)
1524 m/min (5000 ft/min)	7,32 m (24 feet)
1676 m/min (5500 ft/min)	8,05 m (26.4 feet)
1829 m/min (6000 ft/min)	8,78 m (28.8 feet)
1981 m/min (6500 ft/min)	9,51 m (31.2 feet)
2134 m/min (7000 ft/min)	10,24 m (33.6 feet)
2286 m/min (7500 ft/min)	10,97 m (36 feet)

Detectors should not be located close to branch lines or they will become obscured by dust due to turbulent air flow. Detectors must be placed 2.5 X last branch diameter down stream from that branch (Db).

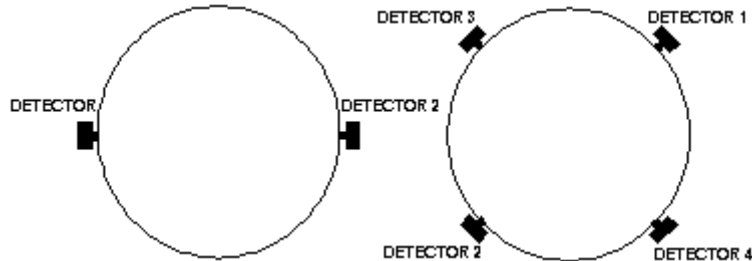
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### NUMBER OF DETECTORS

The number of detectors on any given main duct or branch line is determined by of the duct. Normally round ducts only require two detectors, one on each side of the duct. If the duct diameter is greater than 111,76 cm (44"), then four detectors are required and situated as shown below. The detectors must be mounted opposite each other in the same vertical plane in order to perform their required sensitivity testing function. NEVER MOUNT A DETECTOR ON THE BOTTOM OF A DUCT.



## Special Hazard Fire Detection & Suppression



The number of detectors in a square duct can be determined by using the simple ratio of Height to Width formulas detailed below. Note: MAX DIMENSIONS FOR WIDTH OR HEIGHT ARE 127 cm (50")

Detector ratio formulas:

**Where  $H/W < 1.7$ :** two detectors are required

**Where  $1.7 < H/W$ :** four detectors required.

Note: For Installations using detectors that are not opposite each other, ***Sensitivity Checking cannot be done.***

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### WATER SUPPLY

The recommended water pressure for the Hansentek 900-1 Spray Assembly is a minimum of 3,4 bar (50 PSI) and the maximum is 6,9 bar (100 PSI), in order for proper operation to take place. A booster pump should be installed if pressure could fall below 3,4 bar (50 PSI) and a pressure reducer should be installed if water pressure exceeds 6,9 bar (100 PSI).

The absolute minimum water pressure required at entry to the Assembly is 310.0 kPa or 3,1 bar (44.96 PSI). Water flow through the Assembly at 3,1 bar (310.0 kPa) is 72.0 l/Min (19 Gal/Min).

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### NUMBER OF SPRAY ASSEMBLIES

The number of nozzles required is a function of both the duct size and air speed. Normally, only one spray nozzle is required but for ducts larger than 99,1 cm (39 inches), multiple nozzles are needed.



## Special Hazard Fire Detection & Suppression

### NUMBER OF SPRAY ASSEMBLIES NEEDED:

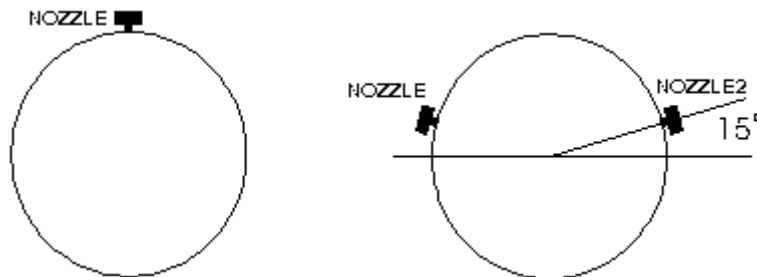
- Up to a 99,1 cm (39") diameter duct with maximum air velocity of 1372 m/min (4500 ft/min): 1 spray assembly
- Up to a 99,1 cm (39") diameter duct with 1372 m/min (4500 ft/min) < air velocity < 1676 m/min (5500 ft/min): 2 spray assemblies
- From a 101,6 cm (40") to 106,7 cm (42") diameter duct with a maximum air velocity of 1372 m/min (4500 ft/min): 2 spray assemblies
- From a 109,2 cm (43") to 116,8 cm (46") diameter duct with a maximum air velocity of 1372 m/min (4500 ft/min): 3 spray assemblies

(for other diameters and air velocities not listed please consult us)

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### PLACEMENT OF SPRAY ASSEMBLIES

The Spray Assembly must be mounted on the top of the Duct and a proper distance away from any elbows (Dc). If two spray assemblies are required, they should be mounted as shown in order to allow the nozzle to properly drain. All nozzles must be mounted in the same plane of vertical circumference.



The nozzles must have straight ducts (constant diameter) past their placement in order to guarantee a proper cone of spray. The distance that the spray assembly must be maintained from any elbow is a function of the air velocity. Minimum distance to the closest bend is calculated as  $(Dc) = 0.00113 \times \text{velocity of air flow in meter per minute (feet per minute)}$ . The factor is .00113 times the velocity. Therefore if velocity is 1524 m/min (5000 ft/min), the minimum distance of separation is  $.00113 \times 1524 (5000) = 172 \text{ cm (5.65) feet}$ .

Water pipe, strainers, valves and nozzles installed outside must be heat traced and insulated. Heat tracing and insulation must be adequate to withstand the temperature extremes and environmental conditions of the area where it is installed.



## Special Hazard Fire Detection & Suppression

### CONVEYER SYSTEM FIRE PROTECTION

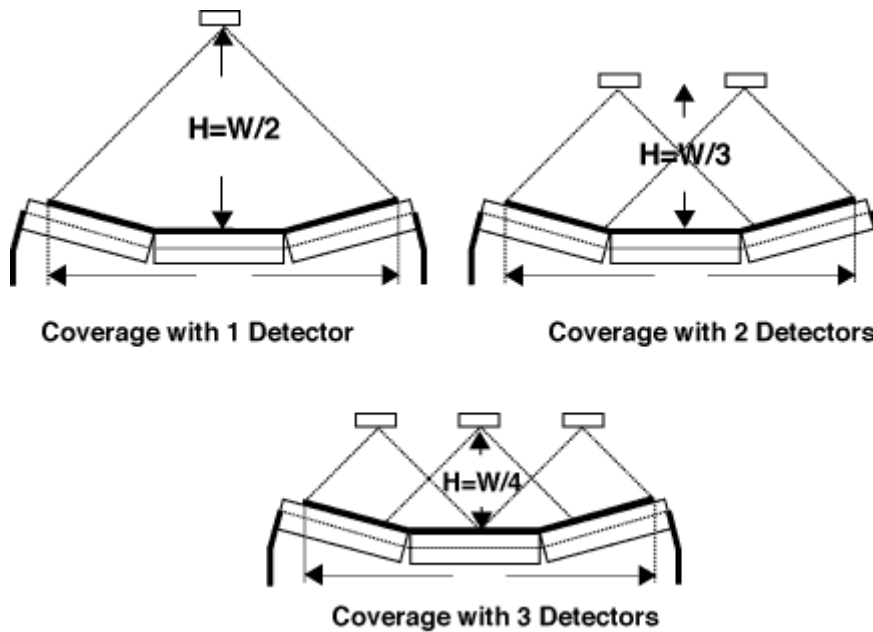
Bituminous and Sub-Bituminous Coals when given the right mixture of oxygen, moisture, heat and time are subject to Spontaneous Combustion or Self Ignition due to which they begin to smolder. If a smoldering chunk of coal or ember is introduced onto a conveyor during a loading/unloading operation, it may be conveyed to a Transfer Station, Crusher or Bunker. At such locations, the coal ember may ignite the coal dust around it and cause a coal dust explosion, which may lead to loss of life and downtime. Embers can reliably be detected only on the conveyor belt itself since at other locations, such as in a Stockpile, the ember may be buried under other coal. The Series 4600 Infra Red Ember Detectors are used to detect embers moving on the conveyor before they reach the subsequent processing machinery or storage hoppers. If the ember is allowed to reach the separation device it could lead to a rapidly expanding fire, fanned by the air movement. The Series 4600 Detectors sense the Infra Red radiation emitted by the hot CO and CO<sub>2</sub> produced by the coal ember and respond when the ember enters their field of view.

- Detector location is governed by:
- Size of the ember to be detected.
- Detector Sensitivity.
- Detector HPCV.
- Detector Speed of Response.

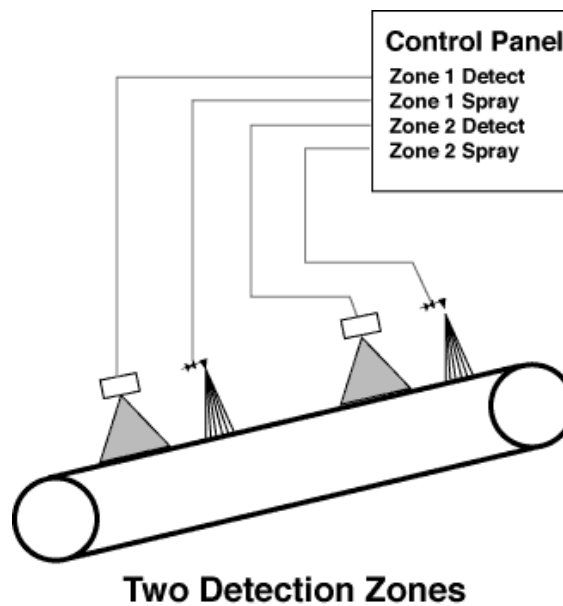
The Series 4600 Detectors should be mounted on the conveyor hood or gantry structure, looking down at the coal being transported. The maximum sensitivity of the Series 4600 Ember Detectors is 10 (w which corresponds to a (nominal) 6,25 sq. cm (1 sq. inch) glowing coal ember traveling at a distance of 1 meter (3.28 ft) from the detector. Since the HPCV of the Detector is 90 degrees across the belt, it should be mounted at a height equal to half the width of the conveyor belt ensuring that the entire belt is covered by one detector as shown below. For increased sensitivity, two or three detectors as shown below should be positioned closer to the belt taking care that the edges of the belt do not fall outside of the Detector HPCV.



## Special Hazard Fire Detection & Suppression



The general rule in fire protection systems for conveyors is to locate Ember Detector(s) upstream from a change in direction (transfer to another conveyor) or a dust producing process or storage point. Hence, once the ember is detected, it can be extinguished before it enters the next process where it can cause a potential explosion. Based on a Fire Protection and Control standpoint, a minimum of two Series 4600 Infra Red Ember Detectors are recommended for each conveyor. Detector D1 should be close to the tail pulley and D2 close to the head pulley, wired as separate zones on the Control Panel.





## Special Hazard Fire Detection & Suppression

On receipt of an alarm signal from any Detector, an Intermittent Localized Water Spray System is activated for a predetermined time duration for a section of the conveyor length immediately down-stream of the responsive Detector. When an ember is detected by Z1, the Control Panel generates Audio-Visual Alarms and activates a Localized Water Spray System for a predetermined duration for a section of the conveyor length immediately downstream of D1. Should the ember be large enough to be detected by Z2, the Control Panel trips the conveyor belt and activates a Localized Water Spray System for a predetermined duration for a section of the conveyor length immediately downstream of D2. Approaches such as these preclude the possibility of the ember entering the next process such as a Crusher, Pulverizer or Bunker.

The exact location of the Series 4600 Detectors and Extinguishing Sets should be decided at site based on the belt speed, belt coasting time and belt coast distance.

The Series 4600 Infra Red Ember Detection System may be supplemented with the Series 5500 Fusible Optical Fiber Linear Heat Detection System for detecting frictional heat fires generated due to jammed and non-rotating idlers rubbing against a moving belt.

### **LINEAR HEAT DETECTION WITH OPTICAL FIBRES**

The Series 5500 FOF Linear Heat Detection Systems consist of:

- Electro-Optic Transducer (EOT).
- Fusible Optic Fiber (FOF) Sensor.
- Fire Alarm Control Panel.

The EOT injects light into one end of the FOF Sensor and memorizes the intensity of light exiting the other end. When the Sensor is subjected to heat, it begins to melt or fuse, thereby reducing its optical transmittance.

The EOT detects this loss of optical transmittance and interprets it as being indicative of the fusion of the FOF Sensor due to an overheat or fire condition (U.S. Patent 4,712,096). The EOT also supervises the FOF Sensor for continuity and renders a trouble signal if the fiber is abraded or broken. The EOT is self-calibrating thereby eliminating the need for manual calibration. Through the process of Integral Automatic Initialization (IAI), the EOT automatically adjusts for:

- Type and Length of FOF Sensor.
- Number and Quality of Splices.

### **Protecting Electrical Switchgear**

Electrical Switchgear present a very unique Fire Detection scenario since conventional Fire Detection Systems are subject to interference by the strong fields generated by the high voltages and current densities present within their enclosures.



## Special Hazard Fire Detection & Suppression

Conventional Electrical Linear Heat Detection Systems may not be reliable since the electrical interference between the Detector and the Switch-gear can cause false alarms leading to downtime. Also, Switchgear often have forced air cooling systems where the air supply is derived from unfiltered production facility air thus creating a "dirty" environment within the enclosure which makes Ionization and Photoelectric type Smoke Detectors unstable and hence, unreliable. Further, while Spot type Heat Detectors can survive the dusty environment and are usually not affected by electrical interference, they do not have the fast response time that is required.

The key to preventing Switchgear enclosure fires lies in early detection. Timely detection prevents overheat conditions from developing into a fire which may consume not only the effected enclosure but also adjacent enclosures. A fast acting and reliable detection system can only be achieved with the detector mounted within and in physical contact with or in close proximity of each Switchgear component.

The Series 5500 FOF Detectors have certain unique characteristics which make them ideal for detecting overheat and fire conditions within Electrical Switchgear enclosures. Since optical fibers transmit light, the FOF Detection System is completely immune to electrical interference. The high voltages and high current densities present in Electrical Switchgear do not affect the light transmittance through the optical fiber. The low melting point, low thermal mass, and the ability to be placed in physical contact with the equipment to be protected makes the FOF Detector the most responsive of all detection means available. The FOF Sensor can be placed in physical contact with buss bars, thyristors, triacs and other components which generate heat. To achieve timely detection, it is important that the FOF Sensor be placed in physical contact or, at the very least, in the immediate proximity of the Switchgear component.

When using a FOF Detection System for protecting Switchgear Enclosures, several aspects must be taken into consideration:

- Location of the EOT unit.
- Looping the FOF Sensor.
- Detection Zones.
- Electrical Supply to the EOT.

For most applications, one (1) FOF Detector should be used for each Switchgear Enclosure.

The EOT should be mounted outside the enclosure(s) in compliance with NFPA 72 and NFPA 70. The FOF Sensor is then run through the Enclosure to be protected. Using nonmetallic cable ties or other approved fasteners, the FOF is looped around critical equipment and connected back to the EOT. The FOF Sensor should be looped in a manner such that, as far as possible, it is in direct physical contact with components which have a history of thermal failure. However, the exact positioning should be determined at site based on the internal layout of the Switchgear components.



## Special Hazard Fire Detection & Suppression

### Protecting Electrical Floating Roof Tanks

The ODTI Series 5500 Fusible Optic Fiber Linear Heat Detector provides very reliable and cost effective detection of Floating Roof Tank fires. The key to preventing Floating Roof Tank fires lies in early detection of the overheat condition which may develop into a fire and consume not only the effected Tank but also other Tanks in the area. An ideal detector is one that is in physical contact with the Tank Seal. The characteristics of the Series 5500 FOF Detectors make them ideal for detecting overheat conditions within Floating Roof Tanks. Since optical fibers do not transmit electricity, the FOF Detection System is Intrinsically Safe. The low melting point and thermal mass with the ability to be placed in physical contact with the Tank Seal makes the FOF Detector the most responsive of all detectors.

The EOT may be located either outside the Dike Area, on the Floating Roof or at the top of the Tank Shell Ladder. When the EOT is mounted outside the Dike Wall, the FOF Sensor run from the EOT to the Tank must be protected by metal conduit. When the EOT is mounted on the Roof, the wiring must be protected from damage since the Roof level also changes with the level of stored fuel. The Detection wiring must be shielded and the shield must be grounded. When the EOT is mounted on the Tank Shell, it must be protected from lightning strikes.

The FOF Sensor must be positioned relative to the tank seal to be as close to the flame as possible. In Tanks where the top seal does not flip up and down as the roof moves, the FOF Sensor can be mounted directly on the top seal, positioned on the center-line between the roof edge and the tank shell. In cases where the upper seal is mobile, the FOF Sensor must be mounted above the center-line of the seal with a bracket. The FOF Sensor must be protected from abrasion and tangling due to roof level changes. A 1 inch (2.5 cm) diameter self-coiling PVC hose may be used to route the FOF Sensor from the top of the Tank Shell to the Roof. The FOF Sensor must be routed from the EOT to the seal in such a manner that it will not be crushed or broken by people walking on the tank roof. Sufficient FOF Sensor should always be kept as spare so as to be able to restore the System at any time.

### Protecting Electrical Coal Conveyor Belts

Coal Conveyor Belt fires are often caused by the overheating of conveyor idler bearings. Factors such as lack of lubricant, accumulation of grease and dirt or mechanical breakdown, cause the bearings to lock. The resultant friction between the non rotating idler and the moving belt causes the bearings to overheat.

As the bearing overheats, it has the opportunity to ignite the coal dust which has accumulated on the conveyor support structure. Within a short time period, this ignition can spread into coal being conveyed and develop into a sustained fire or explosion, ultimately destroying the conveyor belt and its support structure.

The key to preventing catastrophic fires lies in early detection which can prevent the overheat condition from developing into a fire that consumes the entire conveyor



## **Special Hazard Fire Detection & Suppression**

structure. A fast acting and reliable detection system can only be achieved with the detector mounted in physical contact with or in close proximity of each idler bearing.

The Series 5500 Fusible Optic Fiber (FOF) Linear Heat Detectors have been designed keeping the above in mind.

The low melting point, low thermal mass, and the ability to be placed in physical contact with the equipment to be protected makes the FOF Detector the most responsive of all detection means available. The inherent flexibility of optical fibers makes it possible to attach the FOF Sensor to the bearing support structure. As the bearing overheats, the FOF Sensor fuses and renders an alarm signal.

The FOF detector is capable of responding to overheat conditions on conveyor rollers long before a fire, it is necessary to locate and repair or replace the overheated bearing(s). Consequently, a conveyor should be segmented into a number of detection zones with individual FOF detectors mounted on both sides of the conveyor. The number of detection zones and detector locations should be determined based on the conveyor length and FOF Sensor length required to accommodate crossover and termination lengths.

### **Protecting Electrical Cable Trays**

Fires in Cables and Cable Trays are generally caused by overheating due to electrical faults, welding etc. When the Cable starts to burn, it has the opportunity to ignite adjacent Cables on the tray. Within a very short period of time, the fire can spread to the adjacent trays ultimately destroying the Cable Tray, its support structure and potentially the entire Cable vault.

The key to preventing such catastrophic fires lies in the early detection of the overheat condition. A fast acting and reliable detection system can only be achieved with the detector mounted in physical contact with or in close proximity of the Cable Tray.

To achieve timely detection, it is important that the FOF Sensor be placed in physical contact with or in the immediate proximity of the Cable/ Cable Tray support.

Even though, the FOF detector is capable of responding to overheat conditions on Cable Trays before a fire, it may be necessary to clean the Cable Vault and locate and replace the overheated Cable(s).

The Cable Vault should be segmented into a number of detection zones. The number of detection zones and detector locations should be determined based on the Cable Vault length, the number of Cable Trays, the number of tiers per Cable Tray and FOF Sensor required to accommodate crossover and termination lengths.

In addition to providing audio-visual alarms, the FOF Detection System can be used to actuate localized extinguishing systems and relays to trip the conveyor belt. These factors are generally considered in zoning FOF detectors for protecting Coal Conveyor Systems. The Series 5500 FOF Linear Heat Detector may use either one of the following FOF Sensors:

Desu Systems BV  
A.M.G. Schmidlaan 8  
2652 HJ Berkel en Rodenrijs  
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Tel : +31 10 461 03 33  
Fax : +31 10 461 07 12

E-mail : [info@desusystems.com](mailto:info@desusystems.com)  
Web : [www.desusystems.com](http://www.desusystems.com)



## **Special Hazard Fire Detection & Suppression**

The Silica Core Model 5500-50 FOF Sensor is designed for a Fusion Temperature of 300 C (572 F) with a maximum length of 1500 M (4500 ft) and is provided with a Tefzel buffer and a PVC jacket.

The Acrylic Core Model 5500-51 FOF Sensor is designed for a Fusion Temperature of 140 C (284 F) with a maximum length of 100 M (300 ft) and is provided with a Polyethylene jacket.