
SPECTREX INC.
FLAME DETECTION

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Contents

1. Fire Detection – motivation
2. SharpEye Detector Range
3. Detector Accessories
4. How to Specify & Locate Detectors
5. Application of Flame Detectors

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Motivators to install Fire / Flame Detectors

- Fear of actual loss / catastrophe
- Legal / Fire department requirements
- Insurance premium benefit
- Recognition of risk / preventative measure

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The Customer Expectation

Detect Fire

Only Fire

Anytime there is fire

Anywhere there is fire

or annunciate a ‘Fault’ condition

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Optical Flame Detection - Advantages

- Rapid detection capability
- Detects from a distance – can be up to 215 ft (65m)
- Highly resistant to environmental conditions (wind, cold, rain)
- Self-check capability

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Optical Flame Detection – Limitations

- Not for smouldering fires
- Requires a “line of sight”
- Technically sophisticated
- Higher Cost

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Conventional Detection Limitations

- Only suitable indoors
- Only ceiling mounted
- Unsuitable for high-ceiling structures
- Diffusion-based – heat or smoke has to get to the detector!

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SharpEye
Flame Detectors

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New 40/40 Series – Common Specification

- Heated window
- Enlarged cone of vision
- 100º H , 95º V*
- HART protocol
- Multiple Outputs
  mA, relay contacts, RS485 Modbus
- Sealed Electronics / segregated terminals

* Most models

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New 40/40 Series – common specification

5 Year Warranty

150,000 hours MTBF

SIL2 compliance

EN54-10 & FM performance approvals

Smaller & Lighter : only 2.5kg - stainless steel
: only 1.2kg - aluminium

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New 40/40 Series – common specification

Ex Approvals

- ✓ ATEX
- ✓ IECEx
- ✓ FM
- ✓ CSA

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New 40/40 Series – common specification

Performance Approvals

(pending)

- EN54-10 (CPD)
- FM 3260
- DNV marine

Safety Integrity

- SIL2 (pending)

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Spectrex IR3 Technology

Advantages

- Long Distance Detection (65m)
- Outdoor / Indoor location
- High speed response
- Highest sensitivity
- Lowest false alarm rate
- Automatic self test

Disadvantages

- Moderate cost

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SharpEye 40/40I Triple IR (IR3)

- Maximum detection distance
  - Gasoline - 65m
  - Methane - 30m

- 4 Sensitivity settings
- Increased immunity to false alarms

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SharpEye 40/40 UV/IR Dual-Sensor

Now **two** versions :

40/40L (LB with BIT)

Solar blind UV sensor and IR sensor at 2.5 – 3 µm for hydrocarbons, hydrogen and metal fire detection

40/40L4 (L4B with BIT)

Solar blind UV sensor and IR sensor at 4.5 µm for detection of hydrocarbon fires only

- High-Speed Response 20 msec to Saturated Signal
- Immune to False Alarms

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NEW 40/40M Multisensor - IR4 technology

- 40/40M Quad IR Flame Detector offers combined capability to detect hydrocarbon and 'invisible' hydrogen fires simultaneously with all the benefits of IR3 technology!

- Maximum detection distance

  Gasoline - 65m
  Methane - 30m
  Hydrogen - 30m

- High immunity to false alarms

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SharpEye 40/40U UV

- 40/40U (UB with BIT) is used for all types of fires, including Ammonia & Hydrogen fires
- Typical response time is 3 secs.
- This detector is prone to false alarms mainly from electrical sparks or corona and is **not** recommended for outdoor location or where other radiation sources may be present.

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SharpEye 40/40R Single IR

- Detects a 1ft^2 gasoline pan fire at 15m.
- Single IR detectors are used mostly for indoor applications in areas where false alarm stimuli are not expected.
- Response time – 10 sec typical

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‘Mini’ Detectors

The 20/20 Mini Detector models :

- MI-I IR3
- MI-3 IR3
- ML UV/IR

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20/20MI - Low Power IR3

All the benefits of Triple IR technology but

- Compact and lightweight (1.2kg)
- Lower Cost & Power
- Non-Ex design and EExia approved option.
- Up to 40m detection range

Detection at 10m or less not covered by European standard EN54-10.
Thus, MI-3 (or MI-1 set at 10m sensitivity) cannot be approved.

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20/20ML Mini UV/IR

A compact, lightweight housing specially designed as a general purpose detector to Withstand harsh environments

Non-Ex design only

Up to 15m detection range

SharpEye
Flame Detector
Accessories

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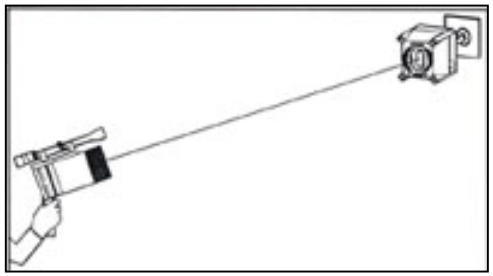
Flame Simulators



- Flame Simulators test the detector in-situ without the need for actual flame
- Versions for IR3, Multi-IR, UV/IR, IR and H_2 type flame detectors
- Allow detector testing remotely from 3 up to 9 metres, with optional beam collimator
- Certified EExd for hazardous areas

No need for expensive scaffolding and other access problems !

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Sharpeye Accessories

- All SharpEye detectors use a stainless steel Mounting / Alignment bracket to allow easy installation and direction of the detector to the required flame detection area.

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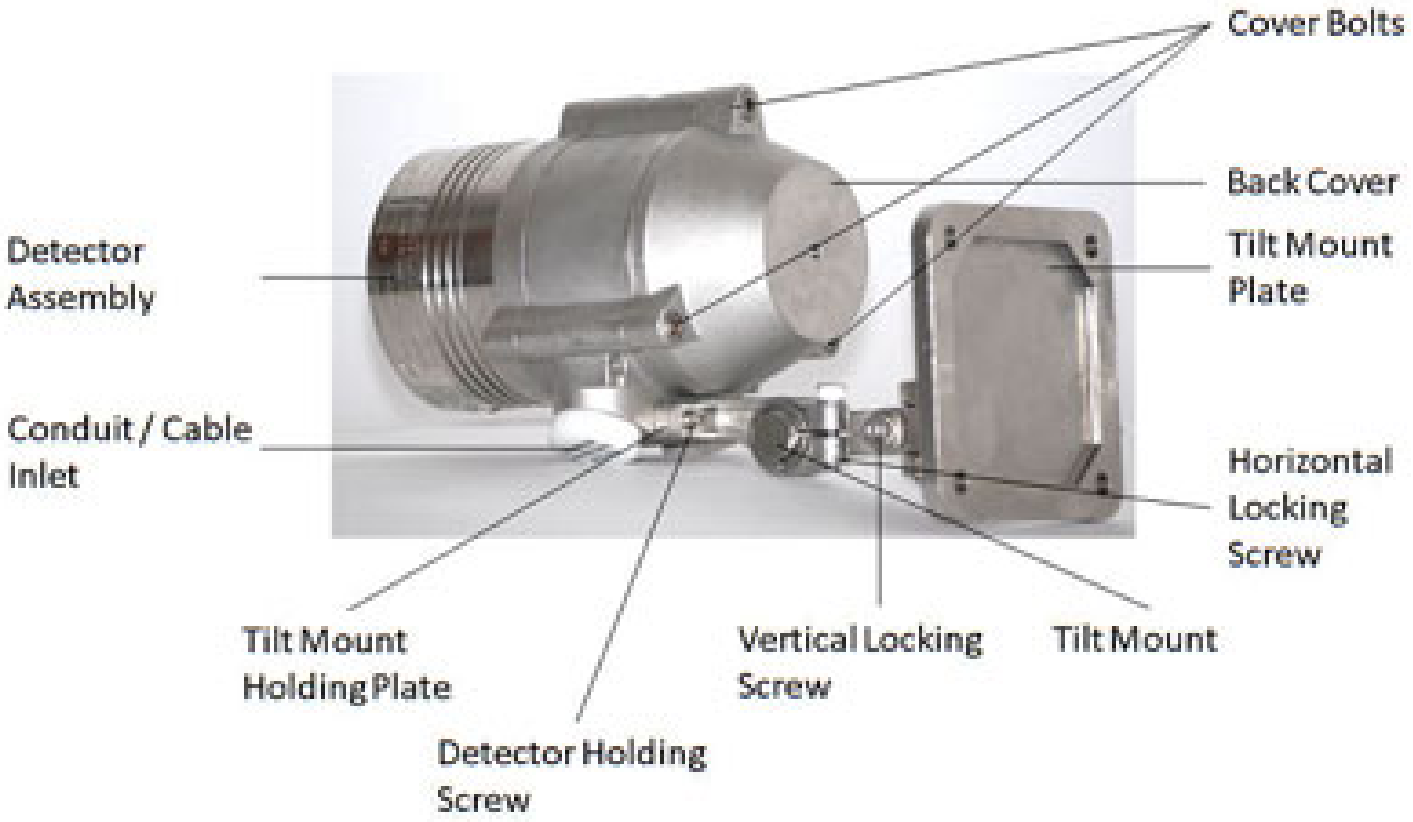
40/40 with Tilt Mount



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Software for configuration

Spectrex dedicated software communicates with and configures SharpEye detectors: 40/40 Series; 20/20SI; 20/20MI; 20/20ML

Special (free) software enables users to communicate with the detector to:

- change detector configuration,
- perform manual BIT,
- view detector signals and status & save data to a log file.

Use Spectrex USB cable c/w RS232/485 converter to connect to the detectors.

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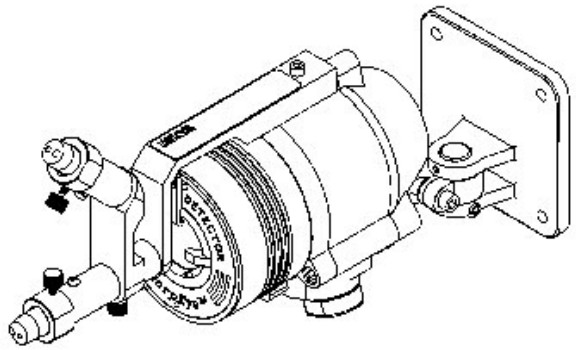
Laser Detection Area Coverage Pointer

- *Does the detector cover the entire hazardous area that needs protected?*
- *Has Designer/Installer located the detector correctly and does the cone-of-vision cover the most dangerous area*

This simple tool answers these questions!

The Laser Detection Area Coverage Pointer designates the detector's 90º cone of vision on-site to optimise the detector's location and the actual detection area covered!



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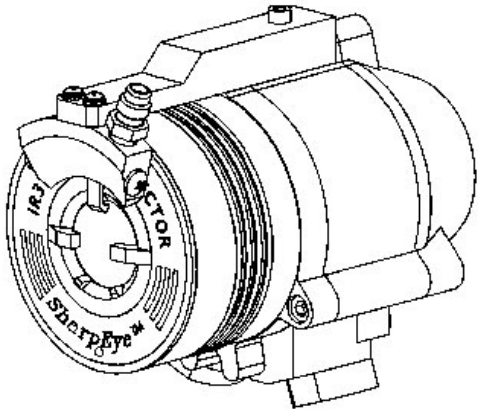
Air Shield

- Flame Detectors are often used in highly polluted or dirty areas - forces maintenance personnel to access the detector frequently just to clean its optical window.

- The Air Shield allows connection of a continuous compressed air source (by user) directed onto the detector's external window

- prevents accumulation of dirt or dust thus reducing the need for and frequency of maintenance.

Air Source	- clean, dry, oil-free
Pressure	- 2 Bar (30 psi)
Flow	- 3 SCFM
Connection	- ¼" Quick fit



*Also available for M series

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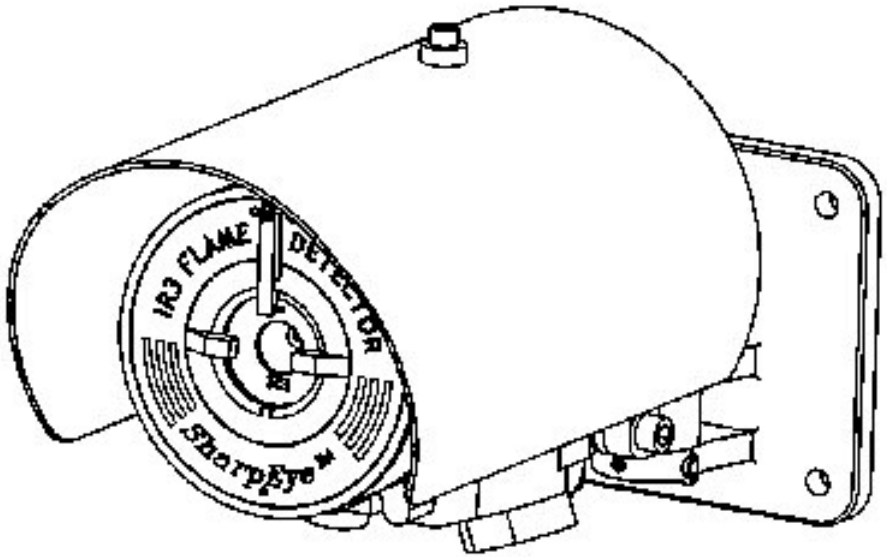
Weathershield

- protects the detector from different weather conditions, such as snow and rain.



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How to choose Flame detector type and location

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Define the Problem!

The various aspects that need to be carefully considered include:

- All fuels/materials that are potential sources of fire/risk
- Fire size to be detected
- Detection distance (range) required
- Speed of response required
- All nuisance radiation sources present
- Environmental conditions

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Fuel Types

- Assess which fuels/materials present a potential fire hazard
- Consider whether they are hydrocarbon based or non-organic.
- Liquid, Gaseous or solid fuels.

Also consider

- potential sources for false alarm
- the environmental factors e.g. oil mist, grease, weather extremes.

This will determine the types of flame detector(s) that can be used

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Fire Size and Maximum Detection distances

In standard tests, fire size is defined differently for the type of fuel:-

- **Liquids** – by steel pan fire size
  e.g. 0.09m^2 (1ft^2) gasoline pan fire

- **Gaseous** – by flame height, orifice size, pressure
  e.g. 0.5m (20”) CH_4 plume fire (3/8”OD orifice @ 3psi)

- **Solid fuels** – by weight, size and pre-ignition configuration
  e.g. wood crib fire arranged in 20x20cm sq. stack

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Detector sensitivity and max. detection distance is related to fire size.

- Detector performance is normally specified in relation to a standard fire e.g. 0.09m² (1ft²) gasoline pan fire.
- The detector can be further defined by distance at which it will detect that fire size and in the response time specified.

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Maximum detection distance (meters) for various fuels and detector types

Fuel	Fire size	40/40I IR3	20/20SI 20/20 CTI IR3	20/20 MI-1 IR3	40/40L-B 20/20L-B UV/IR	40/40L4-B UV/IR	40/40U-B 20/20U-B UV	40/40R 20/20R IR	40/40M Multi IR	20/20SH IR3 (H2)
Gasoline	$0.1m^2$ pan fire	65	60	40	15	15	15	15	65	-
n-Heptane		65	60	40	15	15	15	15	65	-
Diesel Fuel		45	45	27	11	11	11	11	45	-
JP5		45	45	30	11	11	11	11	45	-
Kerosene		45	45	30	11	11	11	11	45	-
Ethanol		40	27	30	7.5	7.5	11	7.5	40	19
Isopropyl alcohol		40	27	30	7.5	7.5	11	7.5	40	-
Methanol		35	23	24	7.5	7.5	7.5	7.5	35	8
Methane	0.5m plume fire	30	20	12	5	5	12	5	30	-
LPG (Propane)		30	20	12	5	5	12	5	30	-
Hydrogen		-	-	-	5	-	10	-	30	30
Polypropylene Pellets	0.2m dia pan fire	5	5	5	5	5	6	4	5	-
Office Paper	$0.1m^2$ pan fire	10	20	15	5	5	6	6	10	-

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Cone of Vision

- 40/40 detectors have a 100º horizontal / 95º vertical cone of vision (except models M & R)

- Place the detector at an angle of ~45° downwards. This way the detector sees straight down and straight forward (and catches the least amount of dirt).

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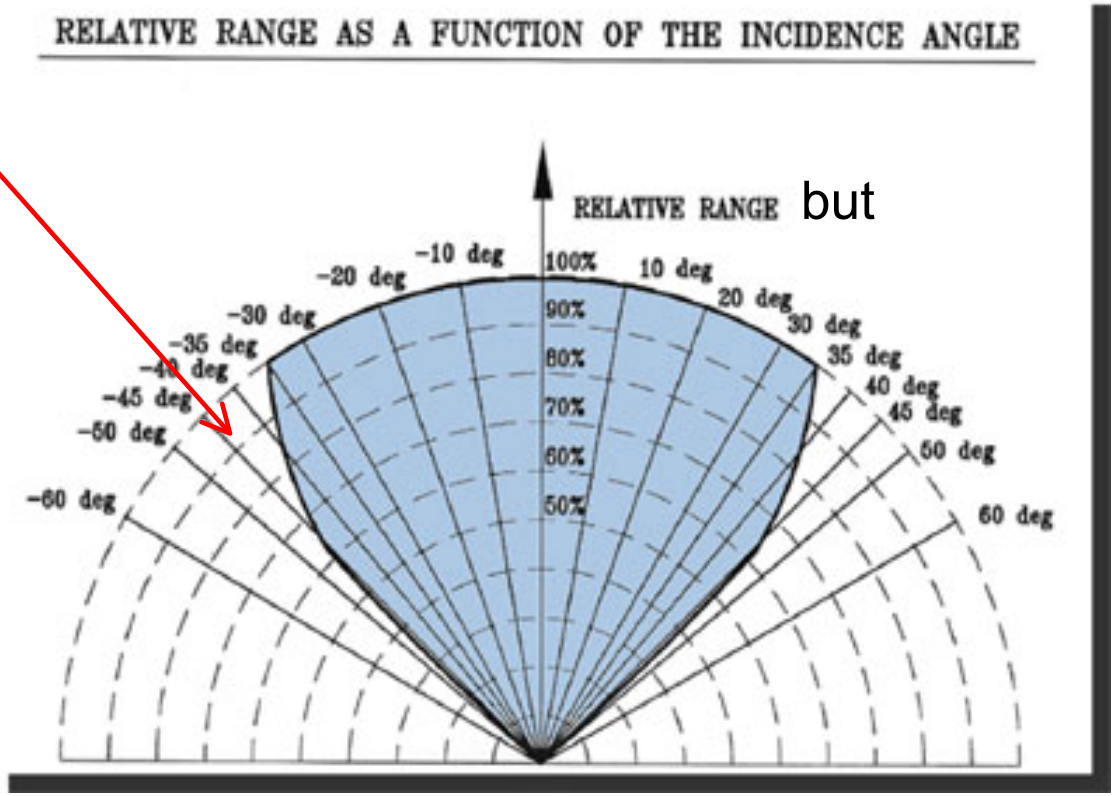
Cone of Vision

Typical cone of vision for standard Triple IR (IR3) detector

Reduced sensitivity at the edges of the cone of vision can result in ‘blind spots’ in the design.

The detector would respond to a fire but it would need to be larger.

In practice, up to 4 times larger than on the central axis



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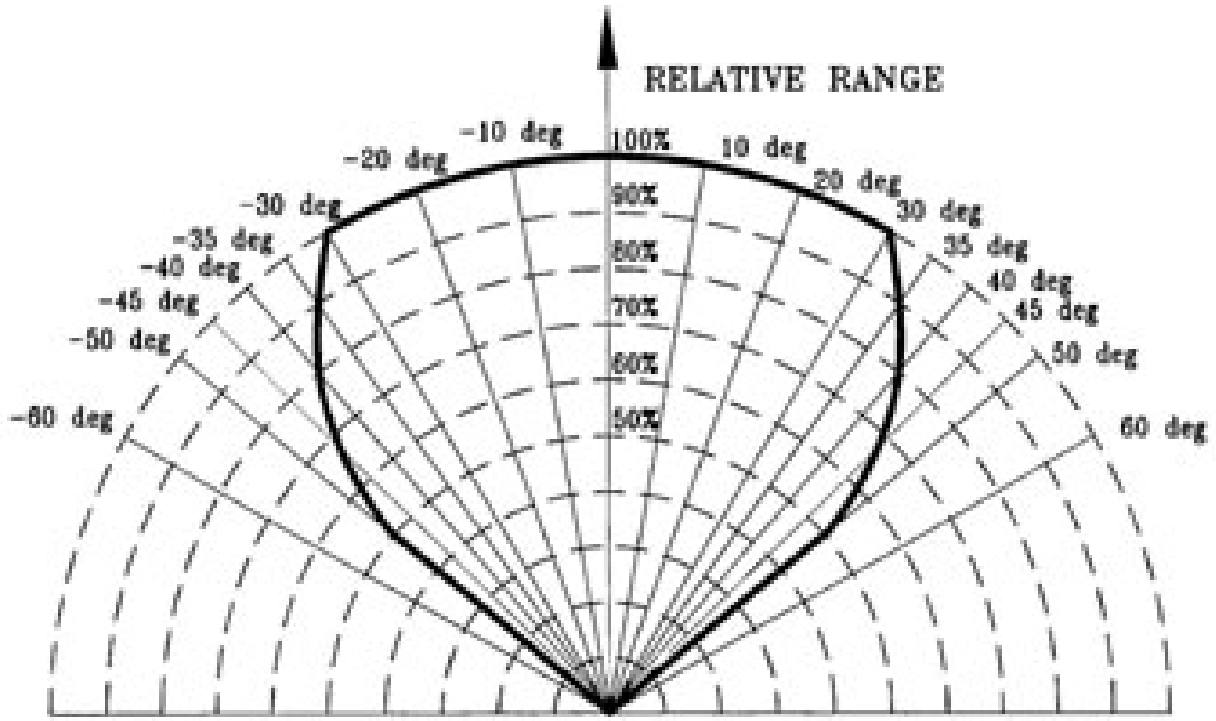
40/40 Horizontal – 100º (except M & R)



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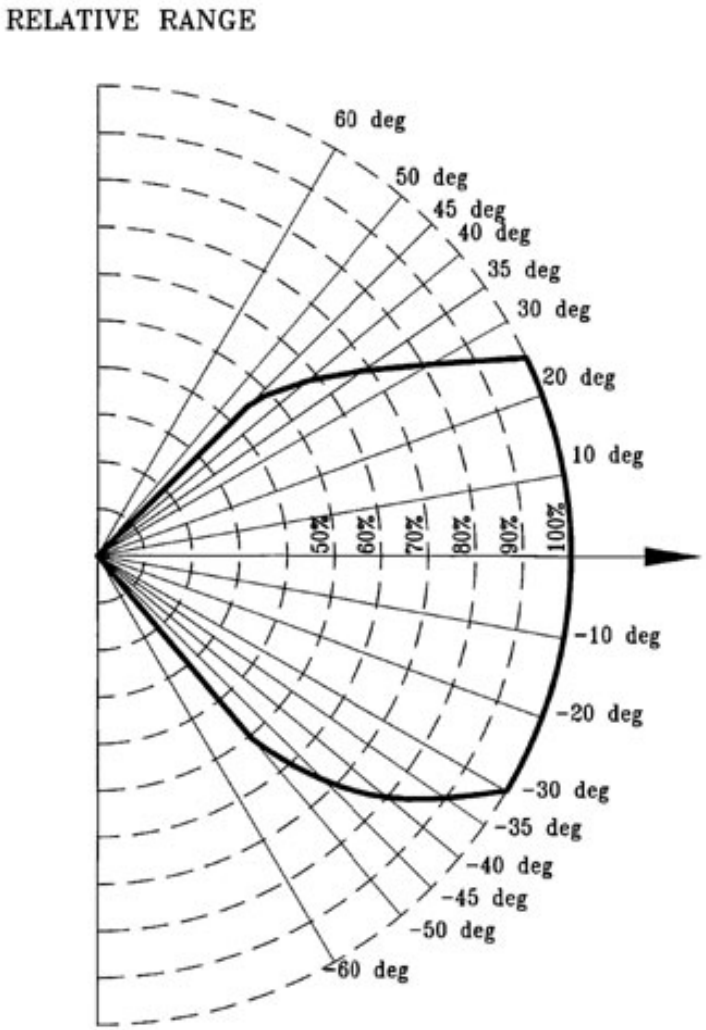
40/40 Vertical - 95º

(except M & R)



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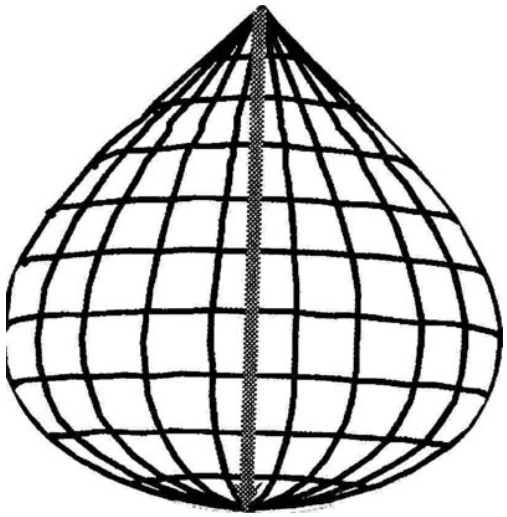
Cone of vision

Remember - the cone is 3-dimensional



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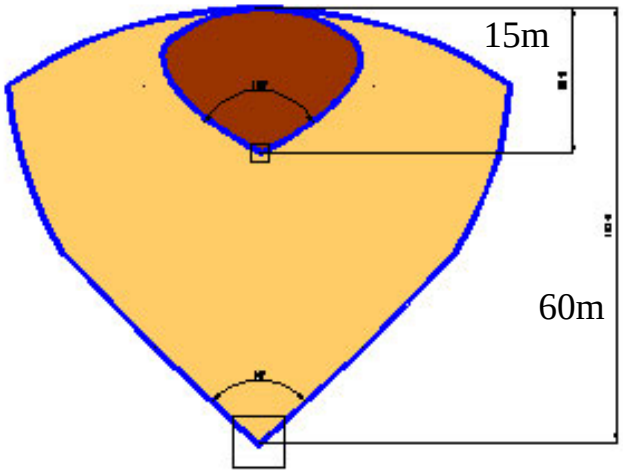
SharpEye IR3 - Field of View



Flame detectors cone of vision are from 70 to 120º. Some claim that a wider cone of vision provides a bigger area coverage.

However this can be misleading and, in many cases, totally incorrect!

The 40/40I IR^3 detector has a 100º cone of *vision* and detects a 1sq.ft. fire at 65m.

The area the detector can cover is far greater - up to 7 times that of a '15m' detector with a 120º cone of vision!!

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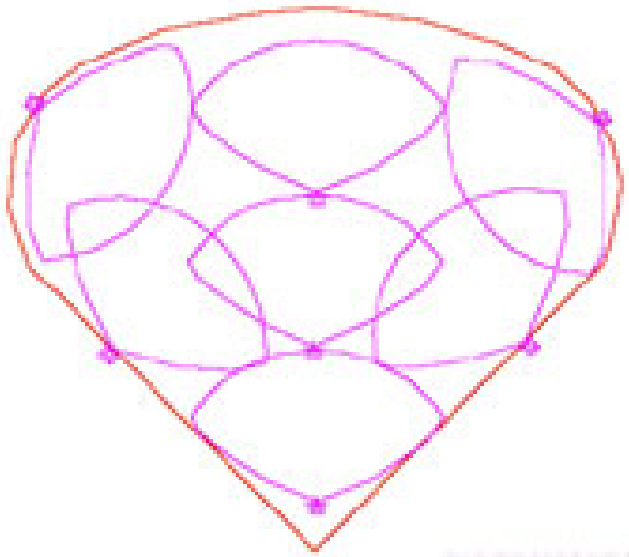
Cone of vision
– the difference between 15m and 60m

One ‘60 metre’ IR3 detector

versus

Seven ‘15 metre’ UV/IR detectors



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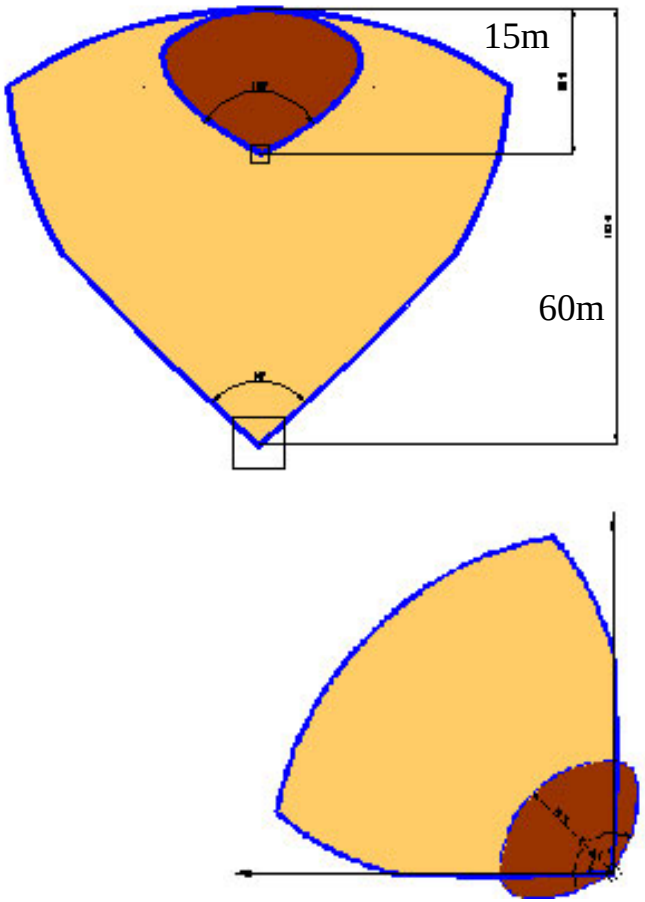
SharpEye IR3 - Cone of Vision



Most flame detectors are placed in the corner of a structure to achieve maximum coverage along both walls and into the area.

Here, the “additional” 20-30º from a 120º detector is meaningless as it is

outside the walls of the building!

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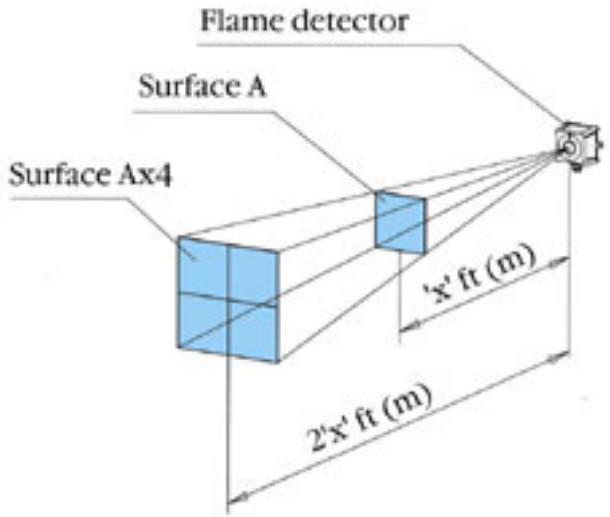
Inverse Square Law

Sensitivity and detection range are related to size of the fire.

If the detector is located further from (or closer to) the source of fire, the detectable fire size will vary according to the Inverse Square Law.



Doubling the detection distance results in only 25% of the radiant energy reaching the detector!

Conversely, for the same response time, the fire size needs to be 4 times larger at this longer distance!

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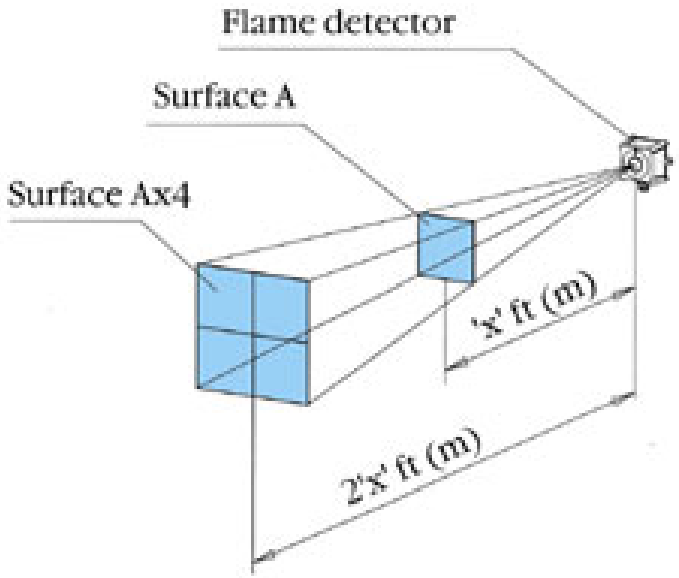
Inverse Square Law



For example, a UV/IR detector can detect 0.1m^2 gasoline fire @ 15m

To provide same response time etc:

- at 30m detection distance :
minimum fire size would need to be 0.4m^2

- at 5m detection distance,
fire size would be only need to be ~0.01m^2

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Environmental conditions

- SharpEye 40/40 Series detectors are designed for severe environment with an extended temperature range from –50ºC to +75ºC *(version for +85ºC as option).*

- All detectors meet IP66/67 (NEMA 250 6P) for weather resistance - and we do lots of Mil-Standard testing for shock, vibration, humidity and temperature.

  However, it is still important that the detector is located in reasonable conditions !

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Can the detector see the fire?

Flame detection range is much influenced by how the detector is installed.

- Try to experience what the detector can '*see*'.
- Mount the detector so that it covers the objects/area that need protection.
- Avoid potential false alarm sources in the cone of vision - such as flares, engine or turbine exhaust

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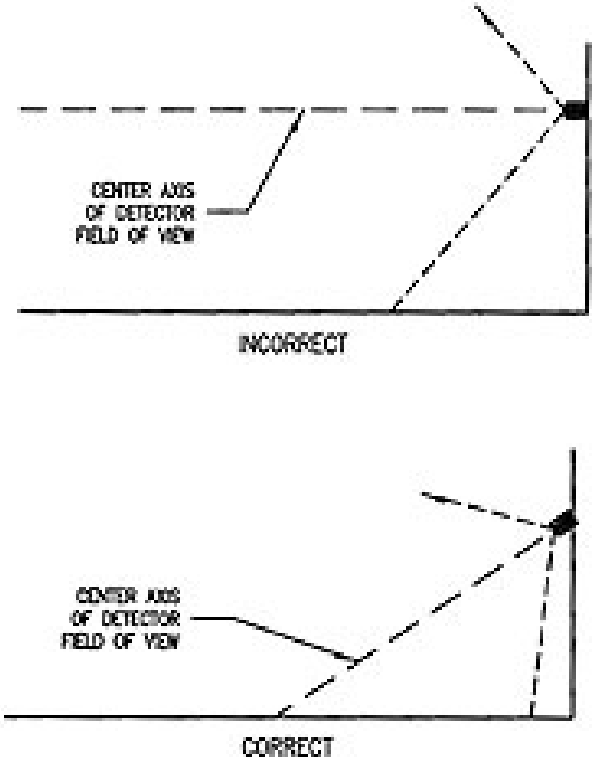
Get the angle correct!



NOTE : DETECTOR MUST ALWAYS BE AIMED DOWNWARD AT LEAST 10 TO 20 DEGREES

Figure 1 – Detector Orientation Relative to Horizon

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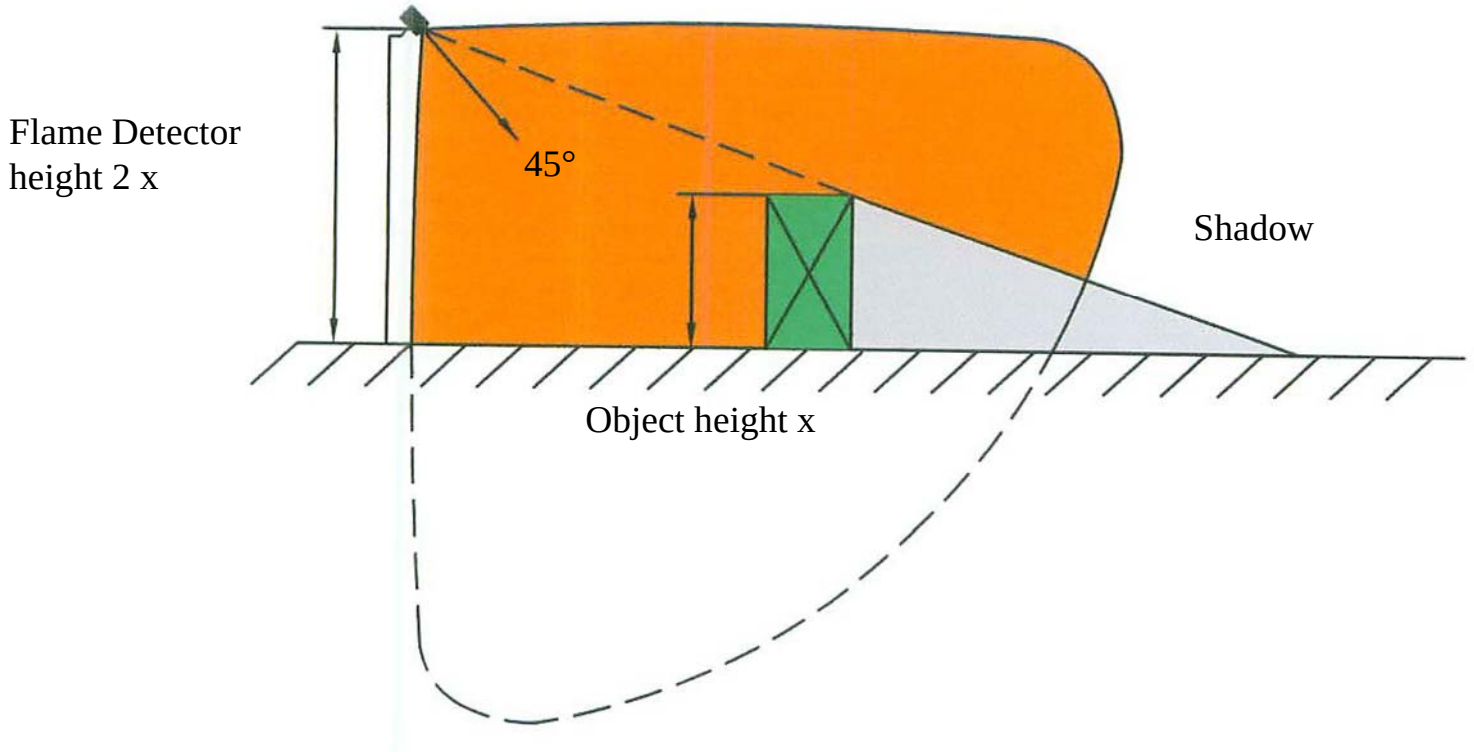
Watch out for ‘Blind Spots’ –

Locate another detector in the opposite corner – this also provides redundant cover should the other detector become blocked.



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Which False Alarm Sources are present?

False alarms are the worst that can happen apart from non-detection. The user loses faith and maybe a real fire alarm is ignored.

- UV detectors false alarms to – the radiation of Arc Welding, Halogen lamps or high pressure mercury lamps (without the protective glass), corona and static arcs.
- IR detectors may false alarm to - chopped black body radiation and, in some cases, direct chopped sunlight.
- Multi IR sensors are less susceptible to blackbody radiation or chopped sunlight but may get insensitive.

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Inhibitors present?

An inhibitor is a substance or vapour that ‘blinds’ the detector.

It is important to know if present in area or emerging from the fire

UV detectors will be blinded by oil or grease on the window, some hydrocarbon vapours like xylene, toluene, chlorine vapours etc.

IR detectors may be blinded by fog, water and ice or a salt layer on the window.

Multi IR detectors may be blinded or masked by blackbody radiation from hot machinery or direct sunlight.

Detector Type	Applications	Advantages	Disadvantages
Triple IR (IR3)	- Hydrocarbon fires - Indoors / outdoors	- Moderate speed - Highest sensitivity - High immunity to false alarms - Longer detection range - Unaffected by solar radiation	- Affected by IR sources only at short range in certain rare fire scenarios
Multi IR	- Hydrocarbon and Hydrogen fires - Indoors / outdoors	- As IR3 but with hydrocarbon and hydrogen fire detection	- As IR3
Hydrogen (IR3)	- Hydrogen fires only - Indoors / outdoors	- Detects' invisible' Hydrogen flames - Longer detection range - High immunity to false alarms - Unaffected by solar radiation	- Not to be used for Hydrocarbon fire detection
CCTV (IR3+Video)	- Hydrocarbon fires - Indoors / outdoors	- As IR3 but with color video - More information & record of the protected area before, during and after fire scenario	- As IR3
Dual Band UV/IR *** 40/40L4 & L4B only Hydrocarbon fires**	- Hydrocarbon, Hydrogen, Silane, Ammonia, other hydrogen-based fuel fires and Metal fires - Indoors / outdoors	- Moderate speed - Moderate sensitivity - Low false alarm rate - Unaffected by solar radiation	- Affected by specific UV//IR ratio created by false stimuli - Blinded by thick smoke, grease and oil deposits on the detector window
Single I (IR)	- Hydrocarbon fires - Indoors	- Moderate speed - Moderate sensitivity - Unaffected by solar radiation - Low cost	- Subject to false alarms ((in the presence of flickering IR sources)
Single Ultraviolet (UV)	- Hydrocarbon, Hydrogen, Silane, Ammonia, other hydrogen-based fuel fires and Metal fires - Indoors	- High speed - Moderate sensitivity - Unaffected by solar radiation - Unaffected by hot objects - Low cost	- False alarms from UV sources (arc welding, electrical sparks, halogen lamps) - Blinded by thick smoke,, grease and oil deposits on the detector window

FLAME DETECTION APPLICATIONS

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Applications

- Monitoring large and congested areas for fire break-out.
- Identifying and locating ignition sources.
- Safety surveillance and protection in critical areas.
- Monitoring fire growth and flame front migration

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Industries

- Oil & Gas facilities
- Offshore / onshore
- Petrochemical / Chemical
- Power Generation
- Pharmaceutical
- Hazardous material Storage
- Aircraft hangars
- Automotive / paint spray
- Explosives / munitions
- Waste Disposal facilities
- Printing

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Examples of offshore Installations

Conoco Belanak

178 Units IR3

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Chevron

Tombua, Abgami & Benguela Belize

433 Units IR3

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BP

Thunder Horse & Mad Dog

165 Units IR3

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BP

Atlantis, Holstein & Horn Mountain

230 Units IR3

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Gas Processing Plants

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Refining & Petrochemical

- Productions Areas
- Tank Farms & Product Storage
- Loading Facilities
- Hazard Waste Treatment & Storage

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Refining & Petrochemical

- Processes with high temperatures, pressure & flammable fuels
- Pump rows
- Manifolds
- Hot oil systems

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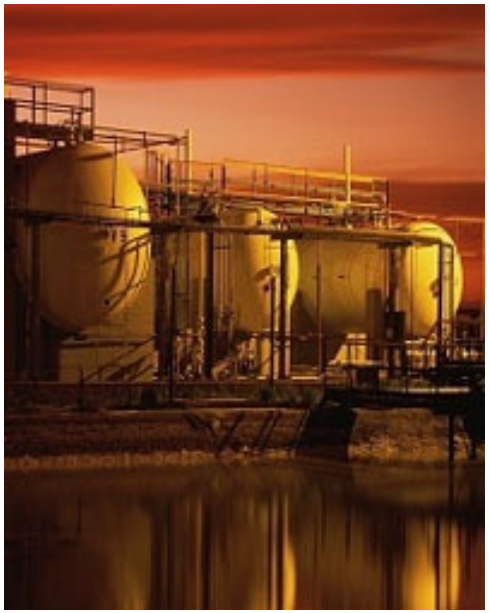
Tank Storage Areas



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Inventory and Facility Protection

70 to 100 Major Facilities

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Rail Car Loading Racks

Flame detectors to watch for fire from leaking hydrocarbons

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MARINE LOADING TERMINALS

Barge & Ship Terminals:
Crude Oil, LPG, Gasoline, Hydrogen, Natural Gas

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Hydrocarbon Filling & Storage Areas

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Floating Roof Storage Tanks

Petrol Tank Farm, Ljubljana, Slovenia

Petrol Tank Farm in Ljubljana, Slovenia is protected by 16 Spectrex SharpEye Triple IR (IR3) Detectors. The detectors are located mainly in the tank area, with 12 units located on the Tanks Floating Roofs, and the rest on the Railroad Terminal. The detectors overlook the entire floating roof area, monitoring for the occurrence of flames caused by fugitive fuel vapors .

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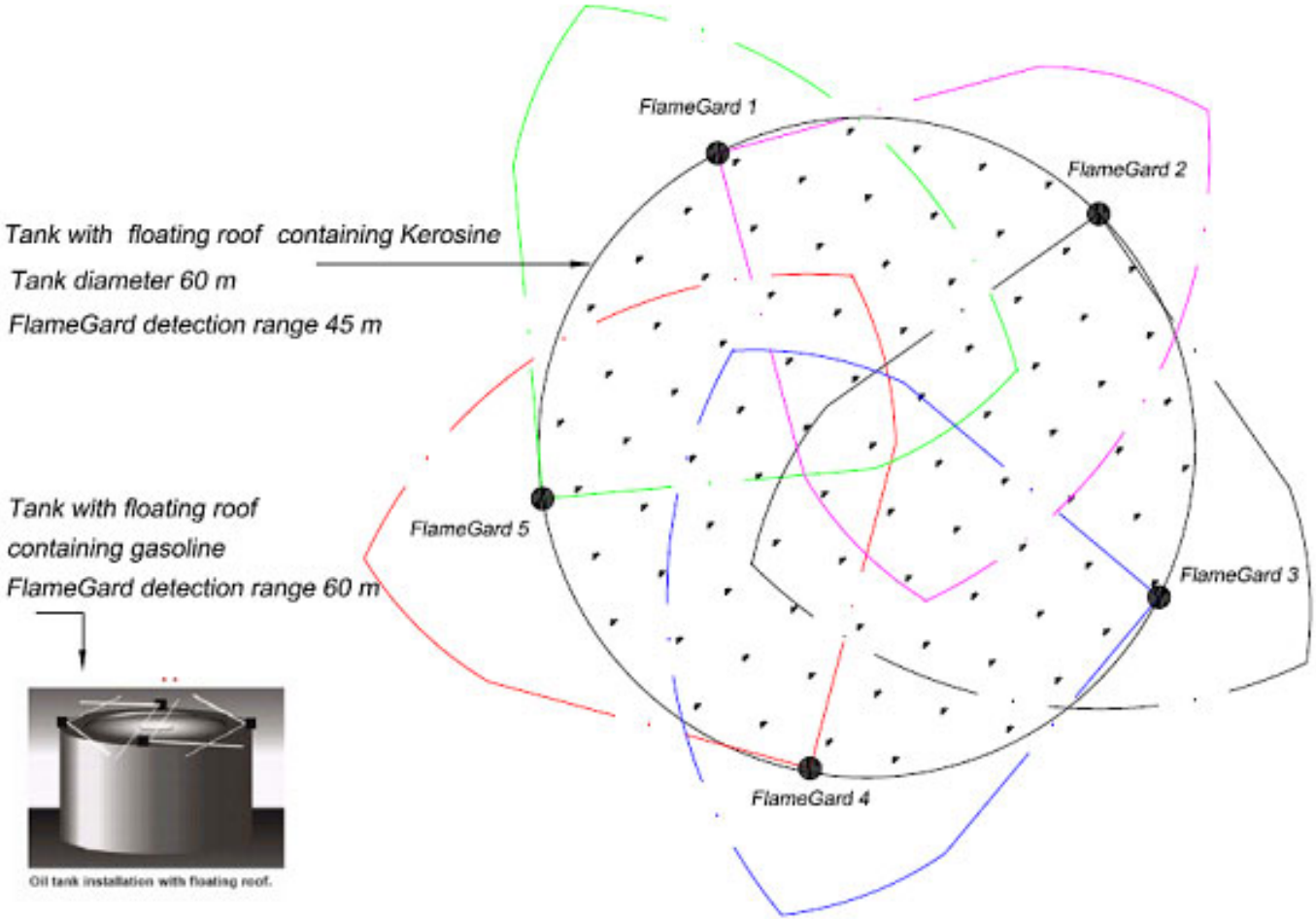
Detector Coverage on top of Tank



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LNG/LPG Storage

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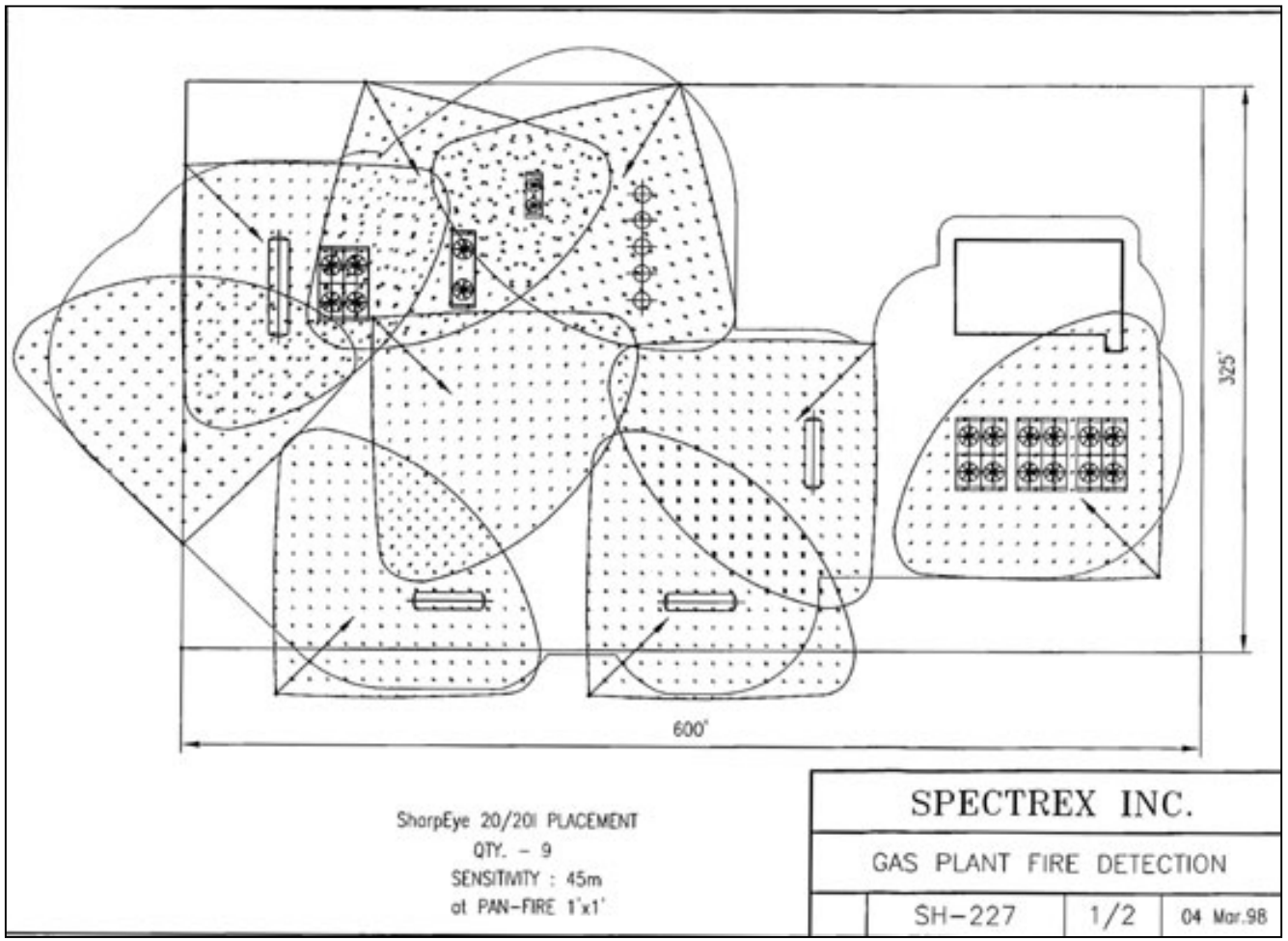
LNG/LPG Storage



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Aircraft Hangar Fire Safety

Aircraft hangars present special fire protection problems due to the high value of their contents and the special procedures and operations carried out inside them.

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Aircraft Hangar Installations

More Than 50 Bases

Over 1500 IR3

- China Lake NAS
- Oceana NAS
- Holloman AFB
- Berstrom AFB
- NASA Langley
- Aero Skunk Works

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Air Force 1 & Marine 1 Hangars

46 Units IR3

16 Units Mini IR3

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Lots of activities …and lots of obstacles for flame detectors!

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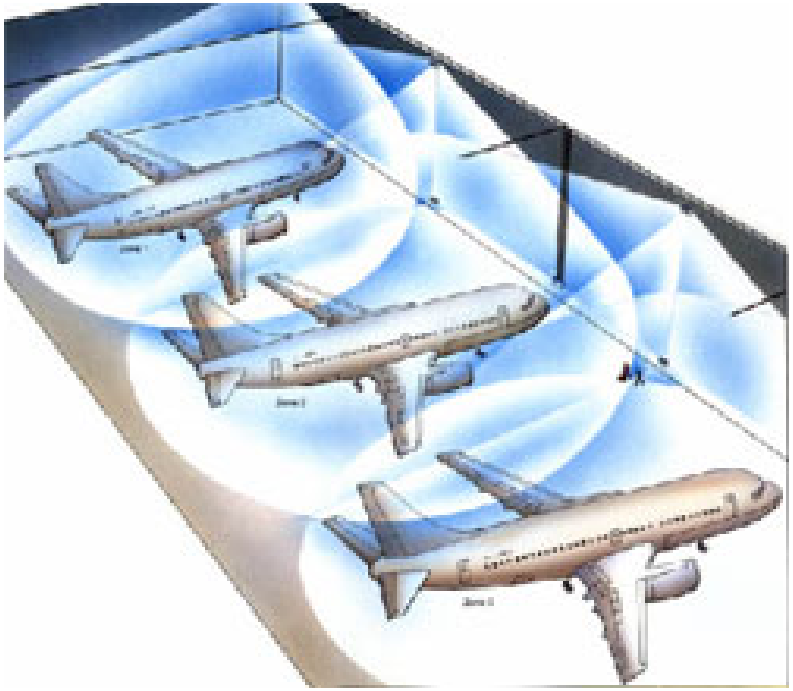
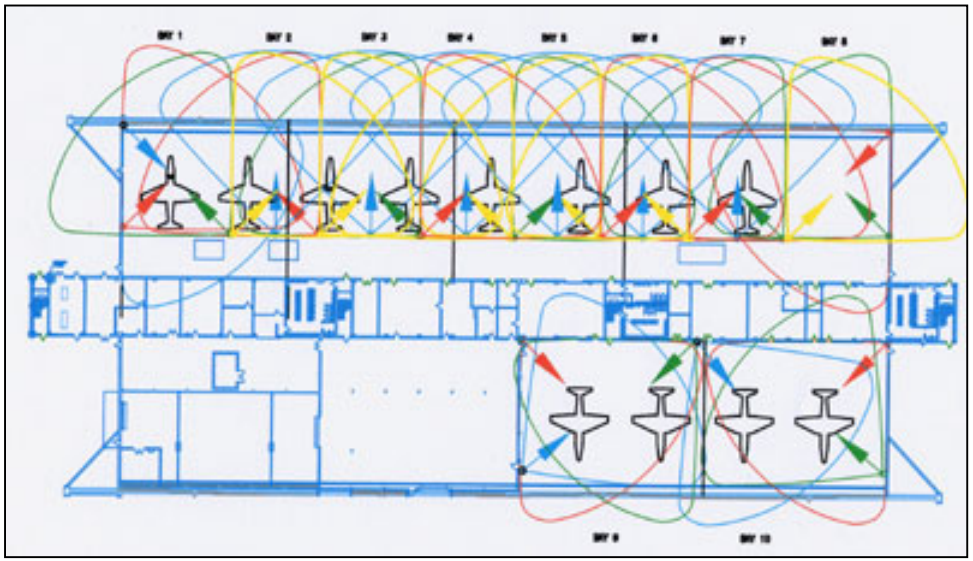


Location is important to ensure proper coverage with no blind spots



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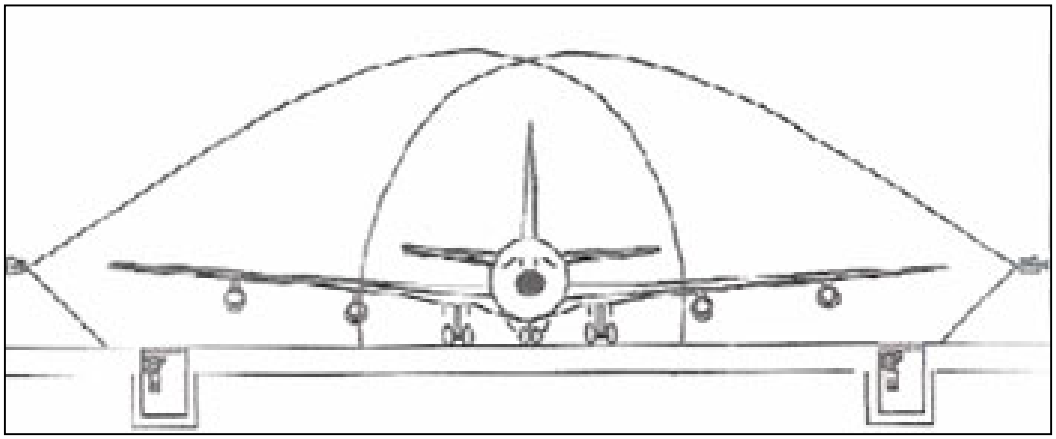
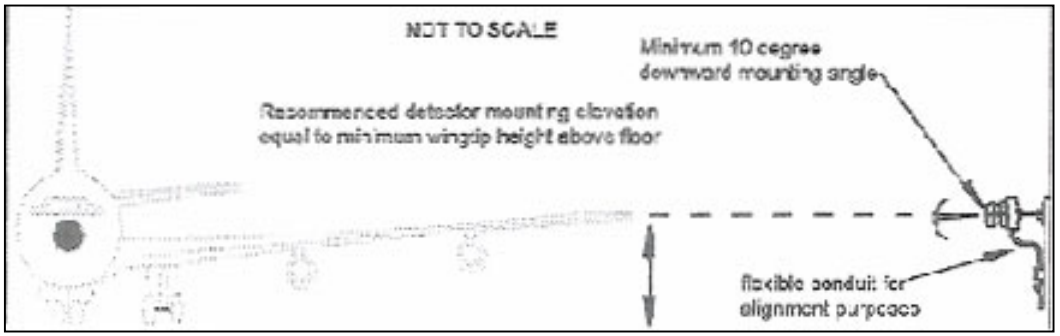
…. especially under-wing areas





SPECTREX INC.

US Coast Guard

250 Units IR3 Installed

312 Mini IR3 Units

SPECTREX INC.

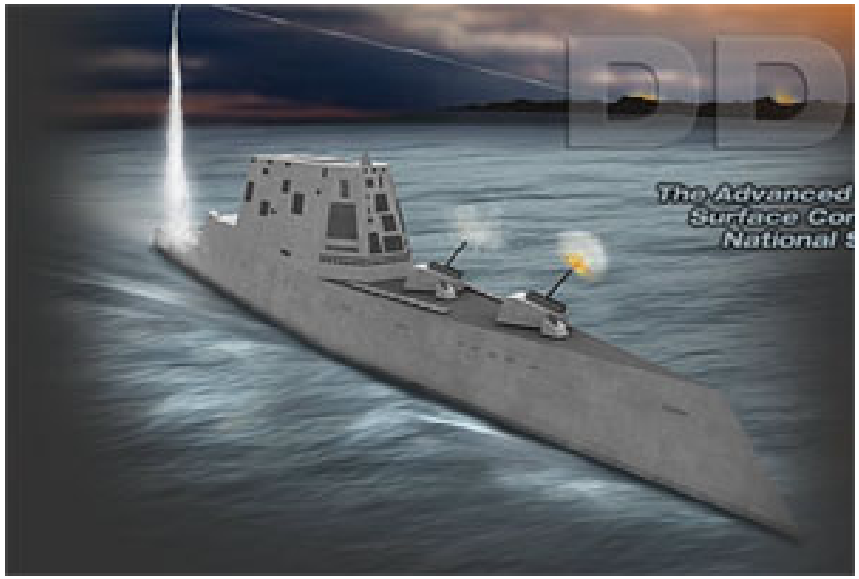
NASA Crawler

12 Units IR3

SPECTREX INC.

New DDX Class Destroyer

General Dynamics & Northrop Grumman



15 units Mini IR3

SPECTREX INC.

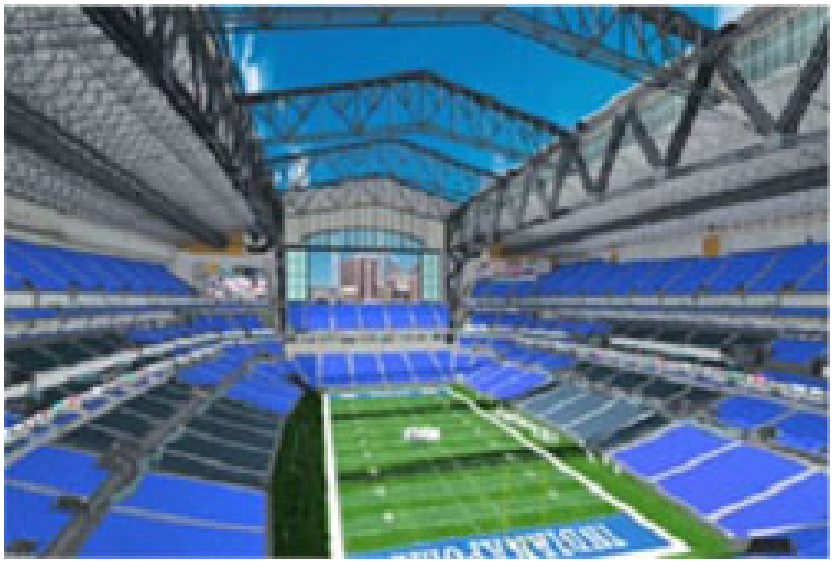
MRAP and MRAPII vehicles

Over 3500 Mine Resistant Ambush Protected Vehicle Systems supplied 07/08

SPECTREX INC.

Lucas Oil Stadium

Indianapolis Colts



10 Units IR3 & 25 Mini IR3

SPECTREX INC.

Airports, Casinos, Malls & Museums

100’s of IR3

SPECTREX INC.

Special Applications

High Temperature Duct monitoring

SPECTREX INC.

Power Plants

Turbine & Transformers

SPECTREX INC.

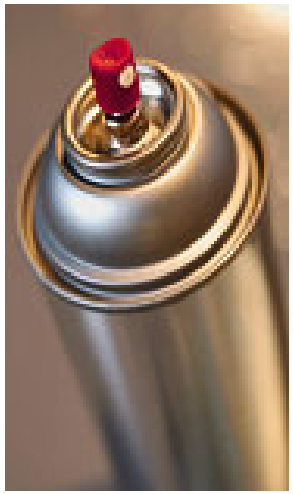
Turbines Enclosures & Back Up Generator Rooms use IR3 flame detectors

SPECTREX INC.

Manufacturing Facilities

SPECTREX INC.

Aerosol Filling Stations



Butane Propellants

SPECTREX INC.

Printing Facilities

Solvents & Hot Surfaces

SPECTREX INC.

The NEW 40/40 series – the most durable, weather resistant, flame detectors ever made!

SPECTREX INC.

40/40 series offer new features such as heated windows, HART capability and comes standard with a

5 YEAR WARRANTY!!

SPECTREX INC.

The 40/40I IR3 Flame Detector sees 1ft2 (0.1m$^{2)}$ heptane fire at 215 ft (65m) in <5 seconds!

It doesn't get much better !

SPECTREX INC.

Spectrex IR3 Flame Detector

We invented it – we perfected it!

Over 40,000 units in Service!