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NEW

10 Things to Consider Before Buying a Handheld or Belt-Worn Radiation Detector

A Guide for Investing in Portable Radiation Detection and Spectroscopy Systems

CONTENT

INTRODUCTION

Through years of working with our customers, FLIR has learned that no single product can meet all the various applications for handheld systems. Different applications require different detector sizes and sensitivities. Some applications require smaller, more rugged devices while at other times, increased sensitivity outweighs the importance of deploying a compact, lightweight instrument.

It can be a complicated decision, but it doesn't have to be! This guidebook provides helpful tips for evaluating and investing in the right tool for a deployment program. The key word is deployment, as the instrument itself is only one part of a much larger strategy. Use the primer below to get familiarized with different types of handheld instruments.

TYPES OF HANDHELD INSTRUMENTS

PRD: Personal Radiation Detector
By far the most widely deployed type of radiation detector, PRDs are belt-worn devices that form the frontline for threat interdiction. However, they require the support of more capable instruments once the initial detection has been made. PRDs typically monitor for gamma radiation activity. When the presence of radiation is detected, the instrument automatically produces a visual, audible, and/or tactile alert. This first, on-scene warning alerts frontline operators of a potential radiological hazard, so they can retreat to a safe place or continue monitoring activity levels. PRDs do not provide information about the nature of the radiation source. Additional tools are needed to perform identification once the initial detection has been made. There are a number of ANSI standards that define a PRD.

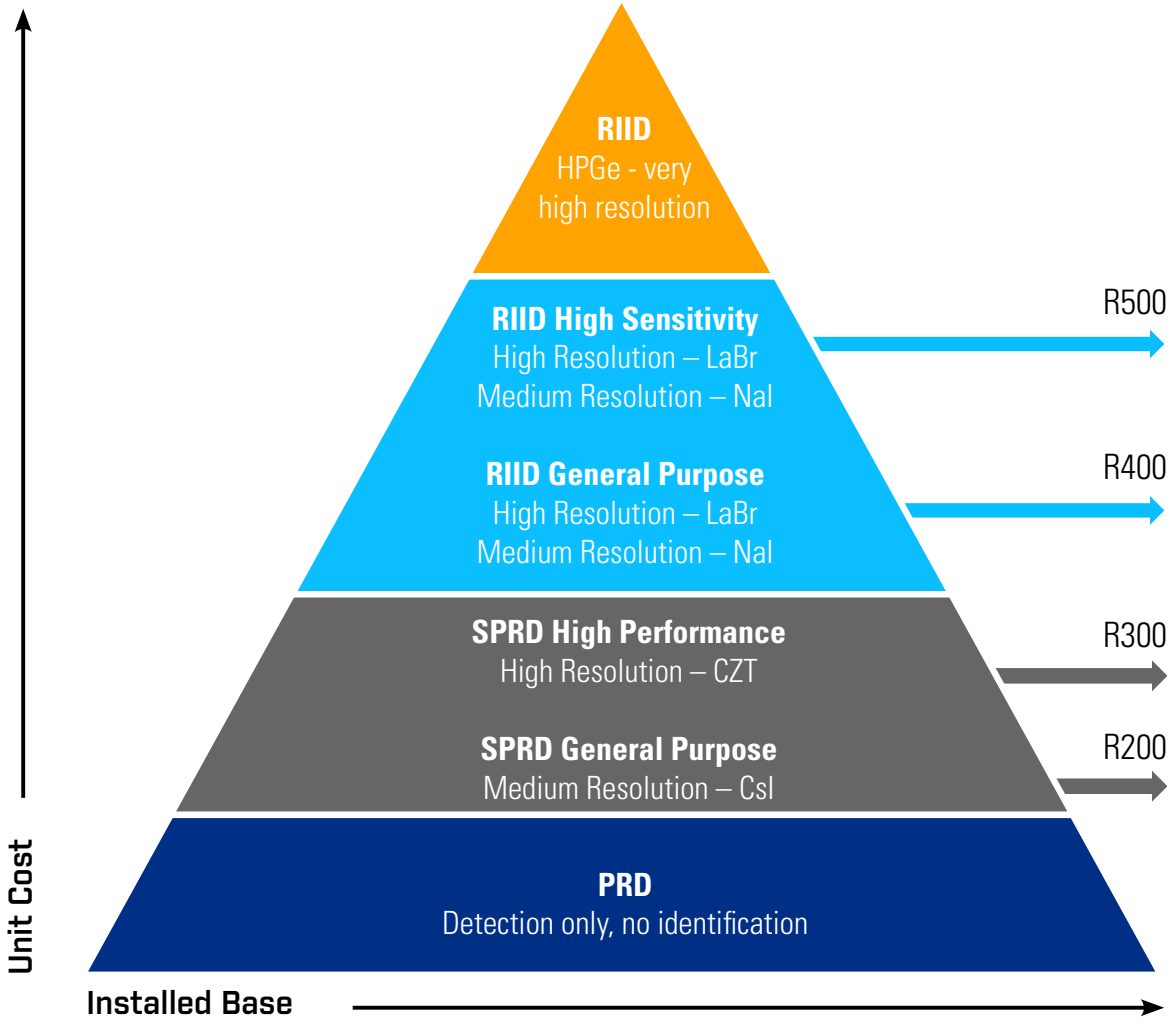
SPRD: Spectroscopic Personal Radiation Detector
Like a PRD, these instruments are belt-wearable or vehicle-mounted and are part of the responder's daily toolkit. SPRDs also monitor for gamma and/or neutron radiation activity. They operate as a PRD when worn during patrol activities, providing an alarm when radiological hazards are initially detected. In addition, SPRDs provide real-time spectroscopic capability to enhance the quality of information generated on-scene during a radiological event. Responders use the SPRD to perform isotope identification, which translates to a more informed and safer forward decision-making process. ANSI N42.48 defines the standard for SPRDs.

RIID: Radio Isotope Identification Device
A RIID is also called a RID (Radionuclide Identification Device). Both terms refer to the same type of instrument. RIIDs are handheld devices most often used as a secondary verification tool at the site of a radiological event, but can also be deployed on the frontline as needed. These instruments typically use scintillation and semi-conductor detector materials, some cooled for performance, and are more sensitive than PRD and SPRD instruments. RIIDs are the best all-purpose survey tool for gamma and/or neutron radiation and always generate the spectroscopic information needed to identify the specific nuclide. ANSI N42.34 defines the standard for RIIDs.

1 The deployment pyramid provides basic guidance regarding cost vs. performance trade-offs.

The deployment pyramid represents many attributes of a typical deployment program. It takes into consideration the instrument type, detection technology, performance capability, quantity deployed, and the associated financial investment. Moving up the pyramid provides gains in additional system performance like sensitivity, measurement fidelity, and other operational features that enhance use of the instrument, such as reachback.

Each tier also represents an increase in instrument cost. Lower cost options allow more units to be fielded on the front-line. In a well-balanced deployment program, this base-detection capability is supported by secondary responders equipped with more robust instruments from the higher tiers.



Ask FLIR how the identiFINDER® R-Series can fulfill many of the requirements in the medium resolution RIID and SPRD tiers, while maintaining the most favorable cost to performance balance.

2

Consider detector materials and resolution. Both are key to operational success.

The simplest type of detector used in handheld instruments is a gas tube, like the Geiger Müller (GM) used to detect gamma radiation in many PRDs and the Helium 3 tube used to detect neutrons in SPRDs and RIIDs. Instruments used to identify gamma radiation use a variety of energy sensitive detectors that broadly fall into two types; scintillation or semi-conductor. Both detect the presence of radiation and provide a signal output proportional to the energy of the detected radiation. The output can be sorted and stored to provide a unique 'energy fingerprint' of a radionuclide. This spectroscopic information is used to determine the identification of the radioactive material present. FLIR combines various detector types and sizes to provide optimum performance across the broadest range of requirements:

CsI

The identiFINDER R200 utilizes Silicon Photomultiplier (SiPM) technology paired with Cesium Iodide, or CsI(TI), detectors to provide ≤7.5% resolution in a pager-sized device. This pager is belt-worn and brings gamma radiation identification to front line operators.

CZT

The identiFINDER R300 utilizes CZT (Cadmium Zinc Telluride) detectors to provide excellent resolution at ≤3.5%. This tool is pager-sized and rugged for high-resolution identification of gamma radiation sources and also offers an option to detect neutrons.

NaI

The identiFINDER R400 and R500 can be deployed with Sodium Iodide, or NaI(TI), detectors. These detectors provide a resolution of ≤8% and are a cost-effective solution for many applications. The R400 fulfills the "workhorse RIID" requirement and is the most widely deployed instrument in its class worldwide.

LaBr

Lanthanum Bromide (LaBr) detectors are available in both the identiFINDER R400 and R500. The large detector volume and high-resolution of LaBr at ≤4.5% provides a superb measurement quality for situations where high-sensitivity and high-quality measurements are needed.

The comparisons above describe the different resolution characteristics of various detector materials offered by FLIR. Resolution is a key consideration for achieving the desired operational performance.

Different radioactive materials produce gamma photons of different but consistent energies. When analyzed, these produce energy peaks which form a unique 'energy fingerprint' that is used to identify the radioactive material. Resolution is expressed as a percentage and is calculated by dividing the width of these peaks at half of their height by the total height of the peak.

A lower percentage indicates it is a higher resolution (performing) detector. Higher resolution makes it easier for the instrument to separate peaks that might otherwise overlap, for example in scenarios where one malicious radioactive material is being shielded or masked by another more benign material. Higher resolution capability generally costs more.

Resolution is the main reason FLIR offers different detector materials in the identiFINDER R-series – to provide differing levels of performance that are right-sized for the mission.

Read on to find why size and not just type of detector is key. Ask FLIR about its multiple detector approach designed to ensure the safety of frontline and secondary responders when instruments are pushed to the limit.

FLIR

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One size does not fit all. Select the right tool for the job.

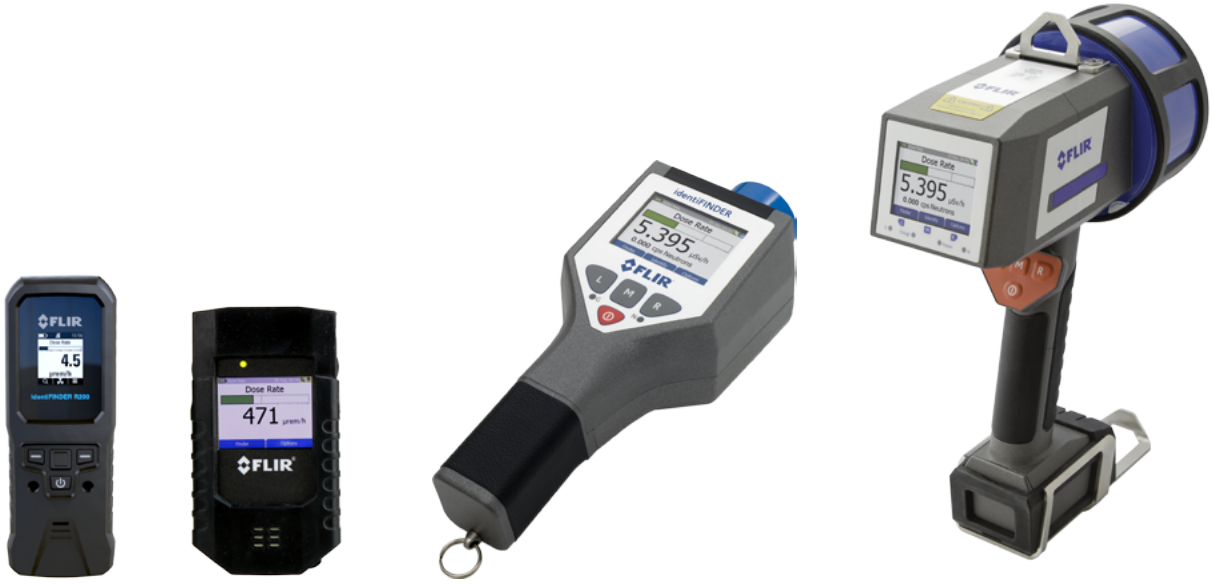
The deployment pyramid is a great place to start when considering what is the right tool for the mission. But there is much more to consider when selecting an instrument, like the size of the detector. Generally speaking, physics determines that the sensitivity of a given instrument is fundamentally decided by the amount and efficiency of detecting material that is present. Bigger is more sensitive, but not always better.

The detector plays an important role because it collects the gamma photons and converts each interaction into a pulse. These pulses need to be processed to determine how large (energetic) and frequently (count rate) they arrive at the detector. A signal processing channel performs this function, but it has a limit. At some point, pulses begin to overlap and are rejected. The instrument will fall into an overload (saturated) condition. Assuming the same radiation activity level, a larger detector will reach the overload point before a smaller detector, because it collects more photons. In this case, a smaller detector is an advantage!

The opposite applies when the instrument is in search mode. In order to locate a source from a distance or to locate a source when an attempt has been made to hide it with shielding, the highest level of sensitivity is needed. In these scenarios, a bigger detector is better.

There's a reason FLIR offers more than one instrument in a given classification - one size does not fit all scenarios. Different types and sizes of detectors complement one another during a radiological event and provide a greater level of safety.

Take a look at how the identiFINDER R-Series is structured with this consideration in mind, then read on to learn more about application and situational impacts on instrument selection.



4

PRD and SPRD – Finding the balance for deployment.

For many years, PRDs (sometimes called pagers) have been the main front-line tool for initial detection and interception of radioactive material. They perform this function particularly well with an exceptional cost-to-performance index that allows for broad deployment. However, pagers cannot determine whether a detection is a true threat or of a benign nature such as from a medical patient, industrial source, or just normally occurring background radiation.

SPRD devices add the necessary spectroscopic capability to make a determination regarding the nature of the source. SPRDs advance a radiological event from "alarm and wait" to "identify and take action." This could mean instant adjudication for an alarm triggered by a patient who has recently had a medical procedure, saving both time and the cost of an unnecessary escalation. Note the race to provide 'identification capability' may force compromise in performance to reduce cost. When selecting a SPRD, confirm the libraries provided and algorithms employed ensure integrity of the deployment.

By supplementing PRDs with SPRDs, a deployment program can gain these key operational advantages:

- Immediate access to information on the type of radiological event enhances the safety of the frontline responder
- Reachback-enabled devices provide information to secondary responders dispatched to support the event, adding yet another personnel safety measure and allowing better on-scene decision-making
- Spectroscopic information shared with decision makers beyond the frontline enables the mobilization of appropriate resources

While scintillation detector material technology has changed very little, readout and processing capabilities have improved greatly, while also delivering lower power requirements that extend battery life. FLIR is a pioneer in solid state detector technology advancements and has revolutionized the SPRD class of instruments, by bringing spectroscopy capability down the deployment pyramid into pager-sized devices.

identiFINDER R200
General Purpose SPRD

identiFINDER R300
High-Fidelity SPRD

FLIR offers both a general purpose and high-fidelity SPRD solution. Ask us about our approach to this class of instrument.

5

How will an instrument behave when pushed to the limit of operation?

Once the limitation of the detector size and its impact on overload have been evaluated, it is important to understand how an instrument will behave when pushed to its limit of operation. Operator safety is a primary consideration when deploying an instrument. Know how an instrument will perform when pushed to its limit of operation.

FLIR incorporates an additional Geiger Muller (GM) detector into its RIIDs, which automatically takes over when an overload condition is approaching. The operator is notified of this switch. The GM detector can operate at much higher activity levels to ensure the dose rate reading is continuous versus shutting down and leaving the operator in a blind condition. This safety feature is essential when navigating a radiological event. In addition to ensuring operator safety, the switching feature also ensures optimum operation of the instrument at all times. It protects the scintillation detector and doesn't switch back from GM mode until it is safe.

FLIR's SPRD instruments use smaller detectors and different technologies like semiconductor detectors and solid-state-based, signal-collection devices that allow them to continue to operate after an alarm, even in higher activity levels.

Read on to learn about other ways the identiFINDER R-Series instruments work to enhance operator safety.

6 Is neutron detection capability needed?

The desire to monitor for the presence of neutrons is generally driven by two main considerations.

1. Neutrons have the ability to penetrate material and travel distances far greater than any other form of radiation. A neutron detector has a better opportunity of detecting neutrons before any other associated type of radiation like gamma from the same source. The neutron detector is considered by many to be an important early warning system for the detection of malicious material and an additional safety feature.
2. Neutrons are generally associated with the presence of fissile material. They are an absolute secondary confirmation when a gamma-based identification of uranium or plutonium has been made. The presence of neutrons when a non-fissile identification is made can indicate that malicious material is being hidden or masked behind a larger benign source. This is a highly suspicious situation and triggers an immediate response.

Most handheld RIID devices are used as a stand-alone solution and the majority of those deployed have neutron detection capability. Although neutron capability is commonly available, it is possible to buy RIIDs without this option. Belt-worn PRD devices generally do not have neutron capability, due to size and cost considerations. SPRD devices are available with or without neutron detectors, which enables customers to determine a balance point on deployment coverage, capability, and cost.

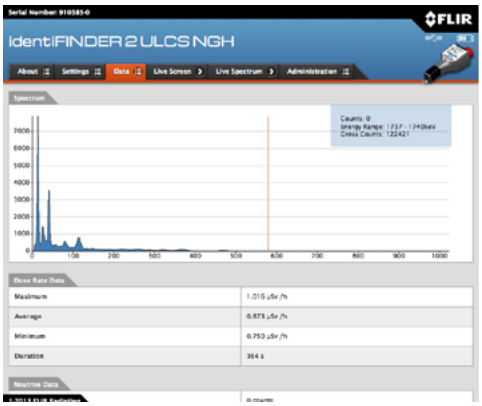
Ask about FLIR's neutron detection options and how they may be best employed for your mission.

7 Reachback – What does this mean and how can this be accomplished?

The term reachback simply means reaching back for support. In the field of homeland security, reachback is the ability to quickly and easily send raw data from the frontline to be independently analyzed for confirmation or validation purposes. This capability helps emergency managers determine the appropriate level of support to be deployed and the next steps.

Reachback can be done in a variety of ways, so consider what is applicable and allowable in the deployment program. The simplest way to perform reachback is to download data from an instrument to a computer and then e-mail it to a designated recipient. As missions have evolved, the demand for real-time reachback has increased. The ability to send data directly from an instrument, without use of a computer, enables secondary responders to arrive on-scene and execute life-saving missions faster.

FLIR supports a variety of One Touch Reachback™ solutions for its identiFINDER R-series instruments. The unique webINTERFACE and simple file storage and transfer options support traditional reachback protocols, while its new mobile app enables the identiFINDER R200 to send data directly from the instrument on the frontline.



Ask about connectivity, phone, satellite phone, and cloud-based solutions. Also consider the availability of mobile apps, which offer leading-edge communication solutions.

8 Put everything into operational context.

The table below compares key operational criteria, using the identiFINDER R-series as an example. It helps to put the operational criteria into practical perspective. When monitoring pedestrian flow at events, entrances, or other checkpoints, the mission is to locate, identify, and separate innocent sources such as a medical patient (recent recipient of a nuclear medical procedure) from potential security threats. The identiFINDER R200, R300, and R400 should be considered. Why?

- There is control of the flow and it can be stopped or started as needed
- Devices with smaller detectors will not overload if a medical patient passes through
- Devices with smaller detectors will not detect sources too distant to physically locate
- The identification-capable devices allow immediate adjudication of the radiological event
- The belt-wearable options leave both hands free to perform daily tasks
- Devices with a neutron detection option add a layer of protection on the frontline

When screening vehicles rather than pedestrians, all devices should be considered to form layers of capability. Smaller detectors provide excellent front-line detection. Larger detectors provide additional support, detect the presence of radiation earlier, deliver increased sensitivity, and can identify more quickly if needed. When monitoring larger volumes such as shipping containers, semi-trucks, and other cargo, sensitivity should be considered. Why?

- Higher sensitivity improves the speed of initial detection
- Faster identification and adjudication helps maintain flow at a check-point or loading dock
- Devices with a neutron detection option add a layer of protection

Larger volumes provide opportunity for more creative concealment methods (the terms shielding and masking are often used). In these circumstances, a higher resolution device will provide more fidelity and improve the ability to identify both materials present (in the case of masking) or artifacts in the data indicating that a source is being shielded. As a side benefit, higher resolution combined with a larger detector provides even faster identification.

How far away can an instrument detect a source? The question can only be answered generally. It depends on many variables like the size of the source, the instrument, potential shielding between the source and the instrument, and time available to make the measurement. Consider the case of a patient who recently received a nuclear medical procedure. If all environmental factors are equal, the identiFINDER R200 and R300 may detect the patient ~25 feet away, the R400 at ~50+ feet, and the R500 (NaI) at up to 100 feet away. This kind of consideration helps qualify deployment choices.

Do not forget the importance of making an initial detection. In all scenarios, there is great benefit to deploying the maximum number of detectors to increase the tightness of the 'net' in place. The right balance of initial detection and adjudication devices can greatly increase the effectiveness of a security operation.

Visit a tradeshow, attend a local radiation rodeo, or request an on-site demo to try a product and determine if it is the right fit.

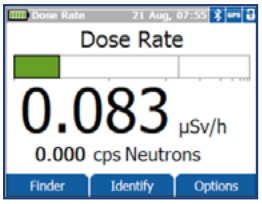
Ask FLIR how its identiFINDER R-series is deployed to maximum effect in global security programs.

identiFINDER Model	**Sensitivity** (Search & Find)	**Resolution** (Spectrum Clarity)	**ANSI Standard**	**Field Ruggedness** (Drop Test + Temperature Shock)	**Portability** (Size and Weight)	**Cost**
R500 (LaBr)	Better	Best	RIID	Good	Good	$$$$
R500 (NaI)	Best	Good	RIID	Good	Good	$$$
R400 (LaBr)	Better	Best	RIID	Better	Good	$$$$
R400 (NaI)	Better	Good	RIID	Better	Good	$$$
R300 (CZT)	Good	Best	SPRD	Best	Best	$$
R200 (CsI)	Good	Good	SPRD PRD	Best	Best	$

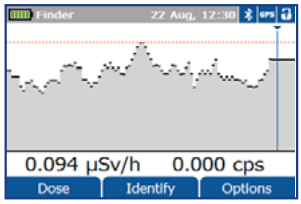
9 Consider the interoperability of instrumentation, resultant cost savings, and user familiarity and safety.

The necessity to utilize a variety of mission-focused, capability-driven instruments in a deployment program can add ancillary costs, including training. Make sure to budget for initial training, refresher exercises to keep teams up to speed, and on-going training to address staff turnover.

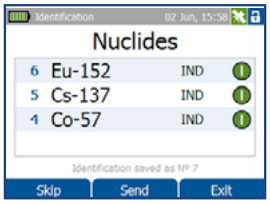
FLIR actively counters this challenge by employing common on-device and web-based user interfaces, terminology, and operational processes such as menu structure and data retrieval functions. The unified approach results in faster and more efficient training programs applicable to the entire identiFINDER instrument family. Instant familiarity across instruments enables the operator to focus on the mission and not the instrument. FLIR's on-device graphics are displayed below as an example of this common approach. The top row shows screen captures from the R400 and R500 models, while the bottom row shows the R200 model. The familiar interface lends itself to quick adoption by the operator, even in the case where menu descriptions are replaced by simple graphical icons.



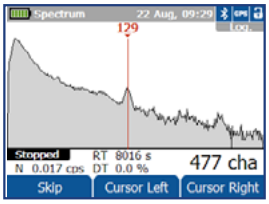
Dose Rate Mode



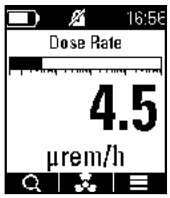
Finder Mode

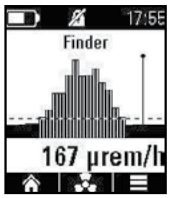


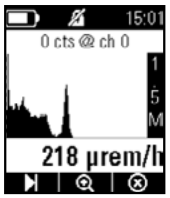
Identification Mode



Spectrum View







Over the lifetime of an instrument, it is common to spend more money training operators to use the equipment than you will on the equipment itself. FLIR actively works to reduce this cost while enhancing operator safety.

For your mission. For your safety.
Over 20,000 deployed worldwide.

10 Consider the total cost of ownership when selecting the tool(s) for a deployment program.

Total cost of ownership is often overlooked when establishing a deployment program. Total cost of ownership extends beyond the instrument itself and the associated training. It also includes how the instrument and deployment program will be supported over its lifetime.

To start, define the expected life of the deployment program and know the life expectancy of the selected instrumentation. This establishes the budgeting window for total cost of ownership.

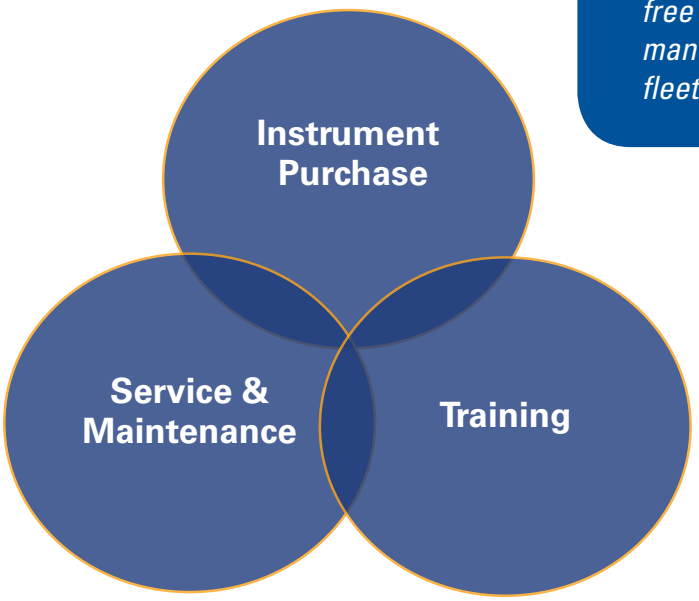
If funding is a one-time event, look for an instrument package that includes long-term support and that is agreed upon up-front with the initial instrument purchase. Alternatively, funding may be allocated on an annual basis. It is important to understand what the typical annual cost of support will be over the lifetime to perform a total cost calculation and estimate for budgeting purposes.

Know what is included in the support program.

- What services are provided?
- What damage coverage is included?
- Does the support program offer fleet management services?
- What is not covered?

Buying an instrument should be a partnership with the manufacturer, the company, and the people. Evaluate the reputation of the instrument and the reputation of the support team. Consider whether they provide the essential elements to make the path forward as safe, successful, cost-effective, and reliable as possible. Ask for references or talk with other users to get independent feedback of the essential elements discussed here.

Ask FLIR about its extended warranty programs, customer support system, lifetime free updates, and how FLIR can help with the management and tracking of larger deployed fleets of instruments.



HEADQUARTERS
FLIR Systems, Inc.
27700 SW Parkway Ave
Wilsonville, OR 97070

DETECTION SALES, AMERICAS
FLIR Detection, Inc.
2800 Crystal Drive, #330
Arlington, VA 22202
Phone: +1-877-692-2120
detection@flir.com

DETECTION SALES, APAC
FLIR Detection, Inc.
3 Pickering Street #03-49
Nankin Row
Singapore - 048660
Phone: +65-6822-1596
detection@flir.com

DETECTION SALES, EMEA
FLIR Detection, Inc.
Luxemburgstraat 2
2321 Meer
Belgium
Phone: +32 (0) 3665 5106
detection@flir.com

www.flir.com/threatdetection
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