EMERGENCY RESPONDER
THERMAL IMAGING

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• FIRE SERVICE • LAW ENFORCEMENT • HAZMAT
• EMS • HOMELAND SECURITY

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- Temperature Sensing
- Video vs. Image Capture
- Sensor Performance
- 2-Year Sensor Warranty

Also...What about TIC Standards?

In this issue of *Emergency Responder Thermal Imaging:*

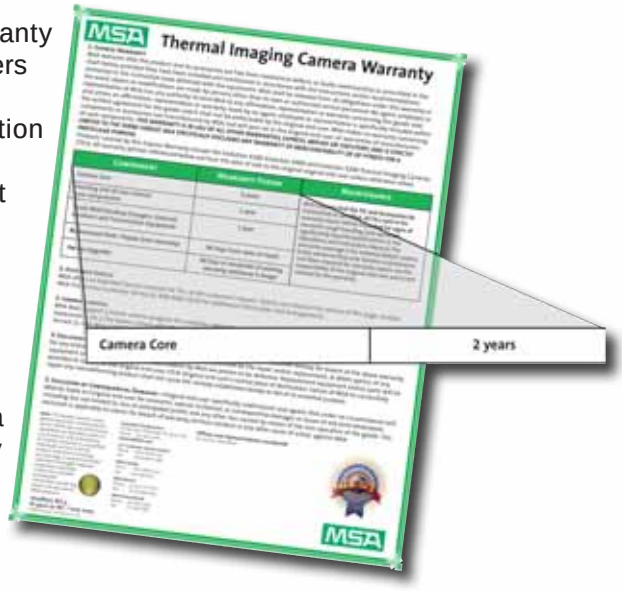
MSA Announces a New 2-Year Camera Core Warranty

Effective July 1, 2005, MSA has announced a new 2-Year Camera Core Warranty on all new and existing MSA Evolution Series TICs.

The camera core in all TICs generally consists of the camera sensor, the sensor electronics that convert the infrared energy hitting the sensor into an image, and the special germanium sensor lens.

The camera core is the most expensive component of any TIC, often accounting for up to 75% of the cost. MSA's new 2-Year Camera Core Warranty gives TIC users coverage where it's needed most.

This new warranty provision covers both new and existing Evolution TICs produced within the past 24 months. Contact your local MSA Distributor to see how this new MSA 2-Year Camera Core Warranty can work for you.



TIC Export License WARNING!

Thinking of lending your TIC to a friend outside the U.S.? Planning to take your TIC across an international border? ***Better think again.***

The United States Department of Commerce has strict export license requirements concerning both the export and transport of all types of thermal imaging/infrared cameras outside the United States.

The reason: TICs are considered "dual use" items. In other words, they have both commercial and military applications and therefore need to be controlled. All TIC manufacturers are closely monitored when exporting TICs outside of the U.S., even to our NATO allies. If your TIC is lost or stolen, report it to local authorities and your TIC manufacturer immediately.

Temperature Sensing – Emergency Responders Need to Understand Aspect Ratios and the Effects of Emissivity

The most often used feature on an Emergency Response/Fire Service TIC is *Temperature Sensing* – which is the ability to read the temperature of an object at a distance.

Temperature Readouts

Most TICs have this feature, giving the user a temperature readout either on a temperature bar scale or shown as a digital number on the TIC display. The MSA Evolution 5000 TIC and the new Evolution 5200 TIC display the temperature readout both ways – on a temperature bar and with a digital readout right below the temperature bar.

Digital Temp Measurement (DTM)

Having the temperature displayed both ways, an MSA exclusive, is helpful in two ways. First, the temperature bar is an active icon that constantly changes with the dynamics of the fire. Movement up and down the scale is a real attention getter - the greater the bar height, the greater the temperature.

For a more accurate understanding of either the temperature of an object or the temperature differences between two objects, MSA's Digital Temperature Measurement (DTM) readout on the TIC display is more accurate than having to estimate the temperature on the temperature bar.

Temperature Accuracy - Understanding Emissivity

When using the temperature sensing feature on a TIC, the temperature readings may vary due to the *emissivity* of the object. Emissivity is a measure of the thermal emittance of the object's surface. Depending on the object, (comparing a bright aluminum wheel on a fire truck to a painted aluminum wheel) the emissivity value can be either very high or very low, affecting the temperature reading. A mirrored surface like bright aluminum may reflect 98% of the energy, while absorbing only 2% of the energy. A painted aluminum surface will prove to be just the opposite, absorbing 98% of the energy and reflecting only 2%. This could affect the temperature reading on your TIC.

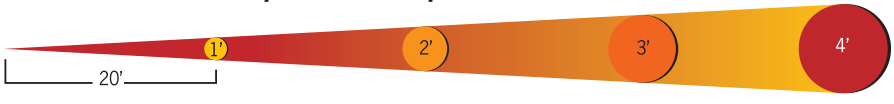
Emissivity Values	
Polished Aluminum	.02
Stainless Steel	.14
Cast Iron	.65
White Painted Wall	.91
Brick, Red, Rough	.93
Note: The larger the number, the greater the amount of thermal energy absorbed and seen with a TIC.	

Scientific and Industrial TICs allow the user to set emissivity values for known materials. That would obviously be impractical for Fire Service TICs. Therefore, most Emergency Responder/Fire Service TICs have a pre-set average emissivity to minimize temperature reading variances. Even so, temperature readings could be off by +/-10%, or about 27°F, whichever is greater when using your TIC.

Temperature Accuracy - Aspect Ratio:

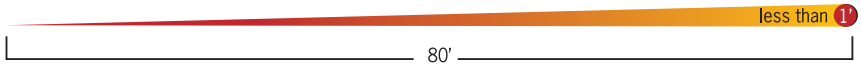
When using temperature sensing on a TIC, the temperature reading can be affected by the aspect ratio of the sensor. Imagine a symmetrical cone moving out from the center of the sensor to the object that you are observing (let's say a faulty appliance, or a bad ballast in the ceiling). Most fire service TICs have aspect ratios of 20:1, 30:1 or 40:1. For example, if the object is 20 feet from the TIC, then the temperature being measured is the average temperature of everything within the 1-foot diameter circle at the end of the cone. If you are 40 feet from the object, the temperature measured is the average of everything within the 2-foot diameter. At 80 feet, it would be a 4-foot diameter.

Standard TIC 20:1 Aspect Ratio temperature measurement is less accurate.



Obviously, with a 20:1 aspect ratio, the further the TIC is from the hot object, the less accurate the temperature measurement is since it will be giving the average temperature of everything located within the scene.

MSA's 85:1 Aspect Ratio temperature measurement is 4X more accurate, at both long and short distances. It offers pinpoint accuracy.



The MSA Evolution 5000 TIC and the new Evolution 5200 TIC both have aspect ratios of 85:1 for pinpoint accuracy. Using the above example, standing 85 feet from the bad ballast, the MSA Evolution TIC will give you a more accurate temperature reading with its 1-foot diameter average temperature calculation vs. the 4 foot diameter calculation on a standard TIC with an aspect ratio of only 20:1! Furthermore, at only 20 feet (in the kitchen with the faulty appliance), the MSA Evolution TIC measures temperature with a circle diameter of less than 3 inches vs. the standard 1-foot circle diameter on other TICs.

TIC Battery Management

by Eric Buzard, Product Line Manager
Thermal Imaging Systems, MSA

Every thermal imaging camera depends on a chemical mixture housed in a lightweight package to provide the power that allows the camera's sensor and electronics to operate. Without the battery, the TICs would be impractical in the rigors of most Emergency Response applications. So what is it about batteries that makes them work? Do some of them work longer than others? How about cycle life – when will batteries stop working?

Basic Battery Chemistry

We use several battery chemistries every day. Some are used in more "simple" products while others are used to power systems found in hospitals and in computers. Here's where you will generally find the different battery types in use:

Battery Chemistry	Where Used
Nickel-Cadmium (Ni-Cad)	Two-way radios, biomedical equipment, power tools
Nickel-Metal-Hydride (Ni-MH)	Laptop computers, cell phones, thermal imaging cameras
Lithium-Ion (Li-ion)	Laptop computers, cell phones, thermal imaging cameras
Alkaline and Rechargeable Alkaline	Portable entertainment devices and flashlights (portable CD and DVD players, hand-held gaming devices)

What are the Advantages & Disadvantages of the different battery chemistries?

As with most electronic devices, there are tradeoffs associated with using one type of battery over another. For instance, **Nickel-Cadmium (Ni-Cad)** batteries are known to have **superior durability at relatively low cost.** However, these batteries are **susceptible to forming "memory"** – and **they contain toxic chemicals** that make them very environmentally unfriendly.

Conversely, **Nickel-Metal-Hydride (Ni-MH)** batteries have **much higher power capacity and are less prone to forming memory** than Ni-Cad batteries. The tradeoffs with Ni-MH batteries are that they have a **higher self-discharge rate and require higher maintenance efforts** to keep them in working condition.

Lithium-ion (Li-ion) batteries **need no "conditioning," are not subject to forming memory, and have low self-discharge** properties. The tradeoff is the added **expense of special wiring** to ensure that the battery is operating within safe limits.

What about Battery Cycle Life?

Another important aspect of batteries is their cycle life. Simply put, **cycle life refers to how many times the battery can be discharged and recharged over the life of the battery.** Again, when talking about battery chemistry, tradeoffs abound – giving electronics manufacturers tough choices to make when using rechargeable batteries.

Each time a battery is cycled – fully discharged and then fully recharged – it loses a little bit of life. **Most batteries offer anywhere from 300 to 500 cycles** over the life of the battery. Obviously, the less expensive the battery, the fewer cycles you can expect. When choosing battery types, the tradeoffs become increasingly important.

Battery Memory: Something you would Rather Forget!

Some batteries are prone to forming **"memory," which is the build-up of large crystals** within the battery cell. **Ni-Cad batteries have small crystals** that react with the other elements within the battery to generate power. As the battery is discharged and recharged, the cadmium crystals tend to form together, creating larger crystals that prohibit the chemical's ability to generate power.

Ni-MH was once thought to be memory-free, but recent studies have proven that these batteries are **also prone to developing large crystals** (memory). However, the degree to which the memory forms is much less than in Ni-Cad batteries.

While **Lithium-ion batteries are free from forming the crystalline "memory"** phenomenon that nickel-based batteries experience, Li-ion batteries can form "digital memory"– memory associated with the battery's gauge, not the battery's chemical make-up – as found in "smart" batteries. Smart batteries have gauges to show the user how much power is still in the battery. When used, these gauges need to be recalibrated every 30 charges to ensure that the gauge accurately displays the power remaining in the cell. Recalibration simply means to fully discharge and recharge.

Self-Discharge: Which Battery Chemistry is Best?

Virtually all batteries lose percentages of their charge simply by sitting on the shelf. The highest point of self-discharge actually occurs after being fully charged.

Nickel-based batteries tend to have higher levels of self-discharge than other battery chemistry combinations. Within the first 24 hours after charging, a Ni-Cad battery can lose up to 10% of its charge just by sitting in ambient room temperatures. As you can deduce, when temperatures increase, so does the self-discharge of nickel-based batteries.

After one month, self-discharge typically slows. In Ni-Cad batteries, the self-discharge equates to about 10% per month. So if you have Ni-Cad batteries that are 9 months old, these batteries will most likely have lost a majority of their charge. **Lithium-ion batteries, on the other hand, have low self-discharging rates, relative to nickel-based batteries.** In fact, the discharge rate of Lithium-ion batteries is half that of nickel-based batteries, which allows the battery to maintain more of its charge for longer periods of storage.

How can Conditioning help keep Batteries in Top-Shape?

Everyone always wonders what the best way is to keep their batteries performing optimally. **There is no one way to address battery performance.** Different battery chemistries require different maintenance methods, which will directly affect battery performance.

For batteries prone to developing memory, such as Ni-Cad, the best way to condition the batteries is to **periodically (every month) "exercise" the battery.** In other words, you should allow the battery to fully discharge, which helps to prevent memory formation. **However, over-exercising these batteries could also have an adverse affect on battery performance.** Ni-Cad batteries also should not be left on the charger for days, as this will increase the formation of crystals within the battery – the phenomenon referred to as "memory." Batteries can also be "reconditioned," which is a slow process in which the battery is discharged to low levels of voltage, thereby destroying the crystal formulation causing memory issues. Remember, though, that **reconditioning will only work on batteries that have been exercised within a six-month time-frame.** Outside of that period, the battery will not be able to recover from the effect of inactivity and memory formulation.

MSA Dual Battery Truck Charger

To effectively **manage your Ni-Cad batteries, you should exercise them every one to two months. Ni-MH should be exercised every three months.** Be sure to remove the batteries from the charger after a few days, even if it is a trickle-charger. Fully discharging the battery before each recharge will apply undue stress on the battery. Finally, maintaining cooler battery temperatures is a key to prolonging the life of the batteries – even keeping them in a refrigerator when not in use for extended periods.

As mentioned before, **Lithium-ion batteries need not be exercised or reconditioned. Because they are not prone to forming memory, these batteries should perform consistently regardless of use.** However, because these batteries still have low levels of self-discharge, they will lose their effectiveness over time, just as other battery chemical combinations. **Rather than always waiting for Li-ion batteries to be fully discharged before recharging, lithium-based batteries should be charged when partially discharged.**

Conclusion

Most Lithium-ion battery users (whether in their cell phones, laptops or TICs) find that the absence of memory problems, lower maintenance, and smaller size/lighter weight are good reasons to depend on Li-ion batteries to keep them going.

MSA is the first to offer a TIC Lithium Ion Battery

What About TIC Standards?

Users see the need for the protection that TIC standards will offer.

Recent research shows that the Emergency Responders who depend on equipment standards (such as NFPA Standards from the National Fire Protection Association) to help them identify certified safe equipment, see a gap when it comes to Thermal Imaging Cameras.

This is not surprising, once you gauge the rapid growth of TIC applications in the past few years, aided by ever-improving TIC technology and lower costs. Just as there are equipment standards for most all of the life-saving equipment in use in the Fire Service, there is now movement toward a TIC standard that will give firefighters the assurances they are seeking.

No doubt, the TIC standards will address all the issues that are currently being addressed with standards already in existence for similar pieces of Fire Service equipment. Existing standards cover areas such as dropping, dunking, radio frequency interference (RFI), vibration, and exposure to high heat and flame. It is obvious from these existing standards what Firefighters and Emergency Responders expect when it comes to TIC durability and reliability.

Even though standards currently exist that could be applied to TICs, most Fire Service TICs are not designed and tested to meet these standards. A TIC manufacturer's product specifications generally disclose which of the existing Fire Service standards it has designed their TICs to pass and how the testing was conducted. Check and compare TIC product specifications for more information.

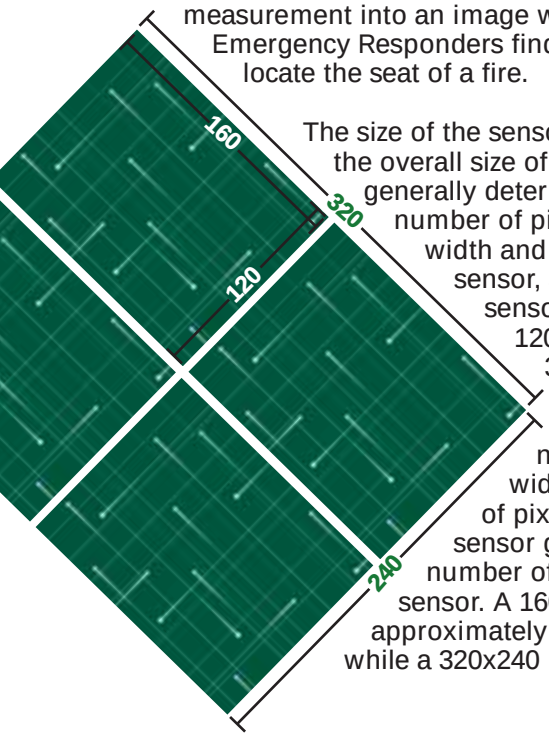
MSA designs and tests Evolution TICs to existing standards that include:

- International Standard CEI, IEC 529, IP 67 Classification for Water and Dust Ingress
- NFPA 1981–2002 Edition, NFPA 1982-1998 Edition simulated for Direct Flame/ Heat Exposure
- MIL-STD-810E Category 1 Loose Cargo Transport for Vibration
- CE/EN 50081-2:1992, EN 50082-2:1992, FCC Part 15 for Radio Frequency Interference (RFI)
- NFPA 1901-12, 1.7 simulated for Rollover on the TIC Truck Charger

Until new TIC Standards become available, designing, and testing today's TICs to existing applicable standards is one way to enhance Emergency Responder safety in TIC use.

Sensor Performance and Pixel Size

Today's TIC sensors are made up of thousands of pixels (short for *pixel elements*) on a chip about the size of your fingernail. Working together, those pixels measure thermal energy – and then convert that measurement into an image which helps Emergency Responders find victims or quickly locate the seat of a fire.



The size of the sensor (which dictates the overall size of the TIC) is generally determined by the number of pixels along the width and length of the sensor, as in a 160x120 sensor (160 wide by 120 long) or larger 320x240 sensor.

Multiplying the number of pixels wide by the number of pixels long on the sensor gives the total number of pixels of that sensor. A 160x120 sensor has approximately 20,000 pixels, while a 320x240 has four times as many, or about 80,000 pixels. All 320x240 sensors (and the TIC wrapped around them) were previously called "large format" since they were generally four times the size of a 160x120, or "small format" TIC.

Now, new Emergency Responder TIC models are being introduced in the 320x240 sensor format (with four times the pixels of a 160x120) – but at about the same size as a small format 160x120 TIC. How can a 80,000-pixel TIC be about the same size as a 20,000-pixel TIC? It all has to do with the size of the individual pixels.

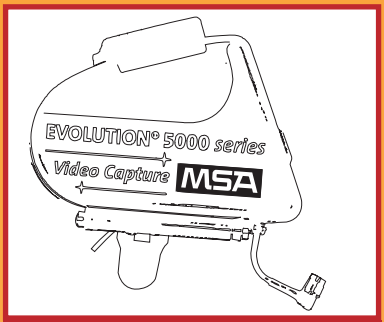
Just how big is a pixel on a thermal sensor? To start with, we have to measure using microns – or millionths of a meter (1/1,000,000 meter). For a reference point, the width of a human hair is about 90 microns. In the past, just about all TIC sensors had pixels measuring about 50 microns (or about 1/2 the width of a human hair). Today's newer sensors now have pixels of around 35 microns, or about 1/3 the width of a human hair.

That small reduction in pixel size is enough to make today's new 320x240-based TICs about the same size as existing small format TICs – keeping the weight and size down for our Emergency Responders/Firefighters while improving image quality, by increasing the number of pixels that go into making up the image.

New Application Coming Soon: MSA TIC Video Capture

The world's first TIC video capture unit goes a step beyond limited single-image capture TICs. It offers full-length recordings that document Emergency Responder/Fire Service incidents and training exercises without additional transmitters or receivers.

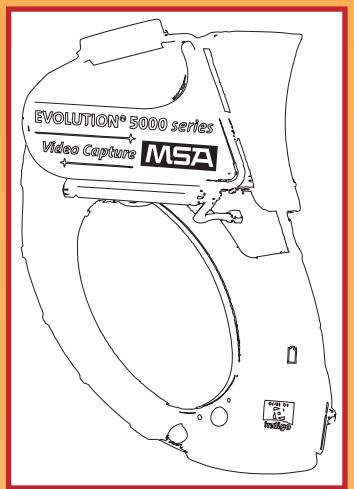
In Emergency Response/Fire Service work, documenting incidents is becoming more and more important. Many Emergency Responders see the benefits of using their existing thermal imaging cameras to record and store images in hazardous environments. There is also a similar application for training environments.



MSA's Video Capture unit is a small, easy-to-use standalone unit, which can be retrofitted to and then removed from any Evolution 5000 or 5200 TIC. Using a standard MSA TIC battery and a standard 512-MB flash memory card, it can handle full length incident or training recording of up to 2 hours.

Until now though, the solutions were limited. The basic approach has been to record and store images through a TIC by transmitting to a recording device attached to the transmitter's receiver station. This approach requires lots of equipment and set-up time, both of which are often in short supply.

The second approach is to purchase an expensive Image Capture TIC. Capable of only still-image capture, these units have limited recording capacity (only about 25 separate images) and cumbersome downloading operations.



MSA's Video Capture unit is built to withstand the harsh environments and high heat that all MSA Evolution TICs are designed and tested to operate in. The unit simply attaches to the side of the TIC.

A New Solution: MSA will soon introduce a better way to use a TIC to record, store and document important incident or training information in a fast, simple, and inexpensive way. MSA's new Video Capture option for all existing Evolution 5000 Series TICs is a small, easy-to-use standalone unit, which can be retrofitted to and then removed from any Evolution 5000 or Evolution 5200 TIC. No need to buy a new TIC to take advantage of the world's first video capture unit for Emergency Responder/Fire Service TICs. In addition, you can pull still shots for reports and slides from the captured video recordings.

Here's How It Works: Simply attach the Video Capture unit to the MSA Evolution 5000 or 5200 TIC. Open the watertight latch and install a standard MSA TIC battery (which will run for up to 8 hours in this new Video Capture unit) and a standard 512-MB flash memory card for up to 2 hours of record time. Close the latch on the Video Capture unit, press the On button, and start recording. When finished, download the video clips to your personal computer using a standard card reader. The video clips can then be stored, viewed or followed up as documentation of the incident or training exercise. The flash memory card can then be erased and used again. Still shots from the videos can also be selected and stored using standard office software.

Actual Size

The RS-MMC flash memory card allows you to download video clips to your personal computer using a standard card reader. There they can be stored, viewed or followed up on a documentation of the incident or training exercise. The flash memory card can then be erased and used again. Still shots from the videos can also be selected and stored using standard office software.

MSA's Video Capture unit is built to withstand the harsh environments and high heat that all MSA Evolution TICs are designed and tested to operate in. The Video Capture unit also works with the same Lithium-ion rechargeable battery and battery charger that the whole Evolution TIC series of products uses.

Video Clips from the MSA Video Capture Unit

Fire. There's a new standard in safety and we are defining it. Every day.

NEW Evolution® 5200 Heat Seeker PLUS

Take the Next Step Up – in TIC Performance and Safety.

The Evolution® 5200 Thermal Imaging Camera delivers *"next generation" performance,* along with ***exclusive features*** available only from MSA.

High Performance Safety:

- 320˚F High Sense mode* range gives **high image definition** over the **widest temperature range** of any Firefighting TIC.
- Twice the Low Sensitivity* in the 320˚ to +1000˚F temperature range, compared to all other Firefighting TICs - for **great Low Sense imaging!**

*Most TICs generate thermal images in either High Sense or Low Sense mode, depending on the temperature of the scene. High Sense mode delivers the best image quality – but has a limited temperature range. Low Sense mode trades image quality for a wider temp range to keep the TIC working in high heat conditions.

MSA Be Sure. Choose MSA.

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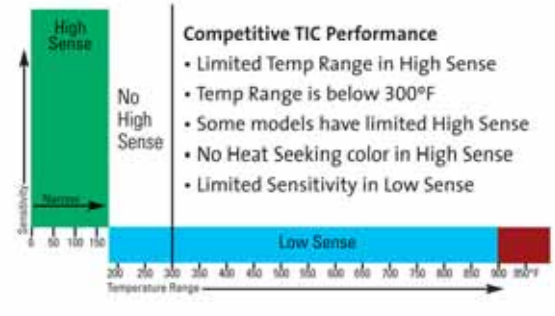

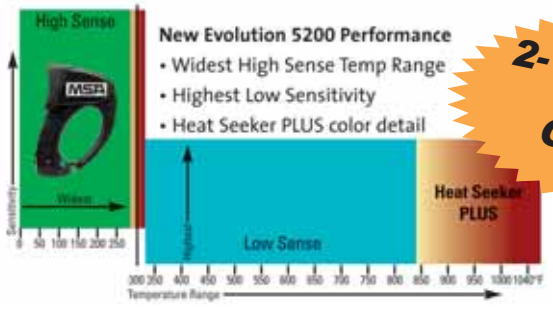

NEW 2-Year Sensor Warranty Only from MSA!

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