BEST PRACTICES:

Thermal Imaging Deployment Strategies and Maintenance

BY **MANFRED KIHN**

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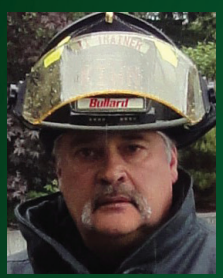

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Tough Enough: Key Considerations for Durability

Durability in the fire service refers to the ability of firefighting equipment, gear, and clothing to withstand the harsh conditions and physical demands of firefighting operations. This includes exposure to extreme heat, flames, smoke, water, and other hazardous materials.

Durability is crucial in ensuring firefighters' safety and effectiveness in the line of duty. It is important for all equipment to withstand these conditions and continue to function properly to protect firefighters and help them perform their duties effectively.

Thermal imager (TI) durability in the fire service is crucial, as TIs play a key role in aiding firefighters in search and rescue operations, locating hot spots, assessing fire conditions, and making critical decisions during firefighting operations. TIs are designed to withstand the extreme conditions firefighters encounter, including high heat, smoke, water, impacts, and rugged handling.

National Fire Protection Association (NFPA) 1801, *Standard on Thermal Imagers for the Fire Service* (2021 ed.), section 8.13 Durability Test, outlines all the requirements NFPA-compliant TIs have to pass.

To break it down in simplified terms, here are some of the key aspects that contribute to TI durability in the fire service.

Robust Construction: TIs are typically built with durable materials that can withstand impact, exposure to heat, and other harsh conditions. They are often designed to meet specific ruggedness standards to ensure they can withstand the rigors of firefighting operations. These materials can include PPSU Thermoplastic, Ultem Thermoplastic, Hi Temp

RIGHT: A scratched display screen that can be replaced in house. *(Photo courtesy of Bullard.)*

Resistant Plastic, Radel R-5100, PPSU, and Polyphenylsufone.

IP Rating: Ingress Protection (IP) ratings indicate the level of protection a device has against dust and water. TIs for firefighting applications often have a high IP rating to ensure they remain operational in wet and dirty environments. The IP67 rating for TIs gives them the ability to be "immersed in 3 feet (1 meter) of freshwater for up to 30 minutes."

Shock Resistance: TIs are subject to potential drops, impacts, and rough handling during firefighting operations. The devices are designed to be shock-resistant to ensure they can continue functioning even after being subjected to rough treatment. A standard drop test for TIs would be a "6-foot (2 meter) drop test with no functional damage."

Temperature Resistance: TIs are designed to withstand high temperatures, as they are used in environments where extreme heat is present. TI components are engineered to operate effectively in these conditions without being damaged. A standard heat test for a TI would be inserting it into heat conditions of "500°F (260°C) for five minutes with no damage to electronics."

Sealed Design: TIs are sealed to prevent dust, water, or other debris from entering the devices and causing damage to internal components. This helps ensure their reliability and longevity. For TIs that have battery compartments that open up, exercise caution to ensure that the batteries stay dry from condensation and that water and debris do not enter when opened if batteries are changed in fire conditions.

EVALUATIONS

Every TI manufacturer has detailed specifications about its products. Create your own evaluation criteria based on their information and conduct your own testing.

Live fire testing is certainly required, as all TIs perform differently than in the boardroom setting.

What is the refresh rate like? What do the image quality and colorization look like? How hot can you get the TI before anything happens to it?

Dunk it, drop it, and bake it. Do not take the word of the sales representative alone. You get what you pay for.

WARRANTIES

Add the warranties from the manufacturers to your evaluation criteria. What do they offer? What is their timeline if repairs are required, and where does the TI have to be sent? Do they offer backup TIs in case of repair delay? Does the distributor carry replacement components such as batteries, display screens, straps, etc.? What repairs can be made in the firehouse before the TI has to go back to the manufacturer? Does the manufacturer offer any sort of preventive maintenance program where the TIs can be sent back after several years of abuse and reconditioned into new condition?

Overall, TI durability in the fire service is critical to effectiveness in aiding firefighters in their operations. Fire departments must ensure that they invest in high-quality, durable TIs that can withstand the demanding conditions of firefighting environments to support the safety and efficiency of firefighters on the scene. ■

Every TI manufacturer has detailed specifications about its products. Create your own evaluation criteria based on their information and conduct your own testing.

Knowing Your Thermal Imager

I recently had an opportunity to participate in a large live fire training weekend and engaged with many firefighters about thermal imaging. To my surprise they had a lack of knowledge about their own Fire Departments thermal imaging (TI) equipment, why is that, probably because they are not being used.

I am sure that this topic has been covered before, but I feel strongly to revisit this information.

Here are some of my questions that I asked:

Question, "What brand of TI do you have", answer, were not sure!

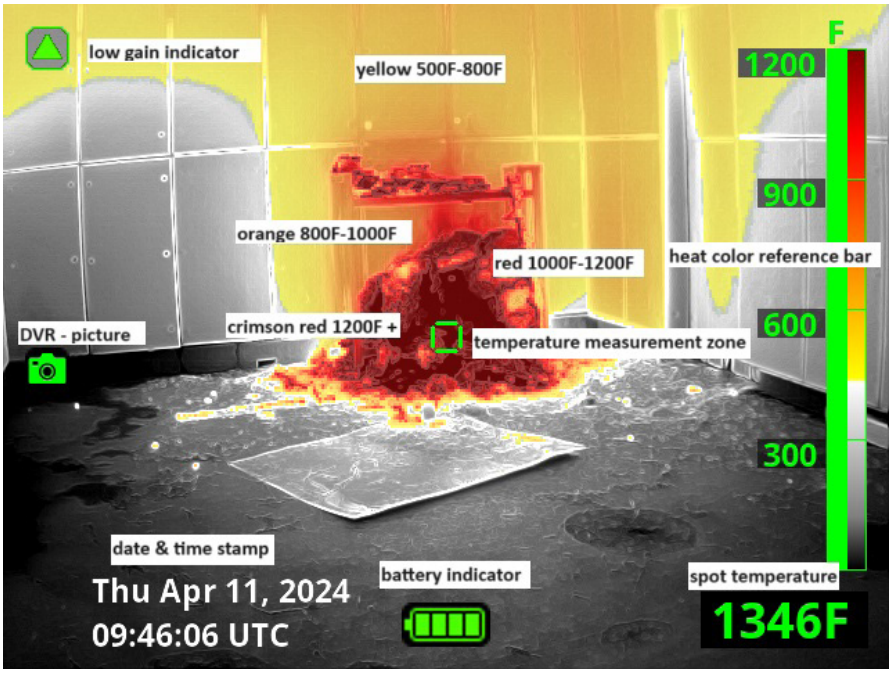
Question, "What are the three basic colors in thermal imaging", answer, yellow, orange, gray? *The correct answer is white, black, grayscale, meaning white is hot, black is cold, and everything in between are shades of gray. All Imagers today will produce a High Heat Colorization based on their temperature ranges producing Yellow, Orange & Red which are advanced colorization.*

Question, "How many gain states does your TI have", answer, we don't know! *Correct answer is 2 modes – High Gain and Low Gain…indicated by a green box with green triangle in it in the upper left corner of your display screen when in the Low Gain Mode.* *Note that with the newer technology now available, the seamless shifting between gain states is now effortless meaning no delay in shuttering or any loss of viewing of detail or critical information.

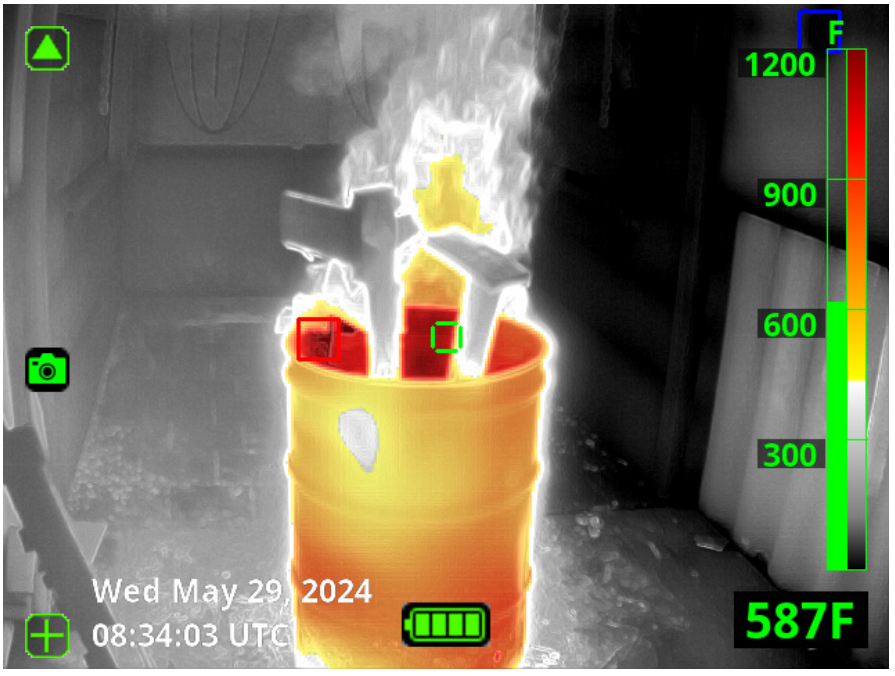
Question, "Can you use a TI on every call that you respond to", answer, 90% were none believers. *The correct answer is to think outside the box and take your horse blinders off. A TI can be used not only at nighttime but in daytime conditions as well. If you use it just for 5 minutes the TI gives you information that you cannot see with the naked eye.*

Question," When was the last time you trained using your TI", answer, not for a long time! *The correct answer is to consider using the TI on all training exercises no matter what it is that you are doing. You as a firefighter have an obligation to do the best job that you can do using all the tools given to you which includes a TI.*

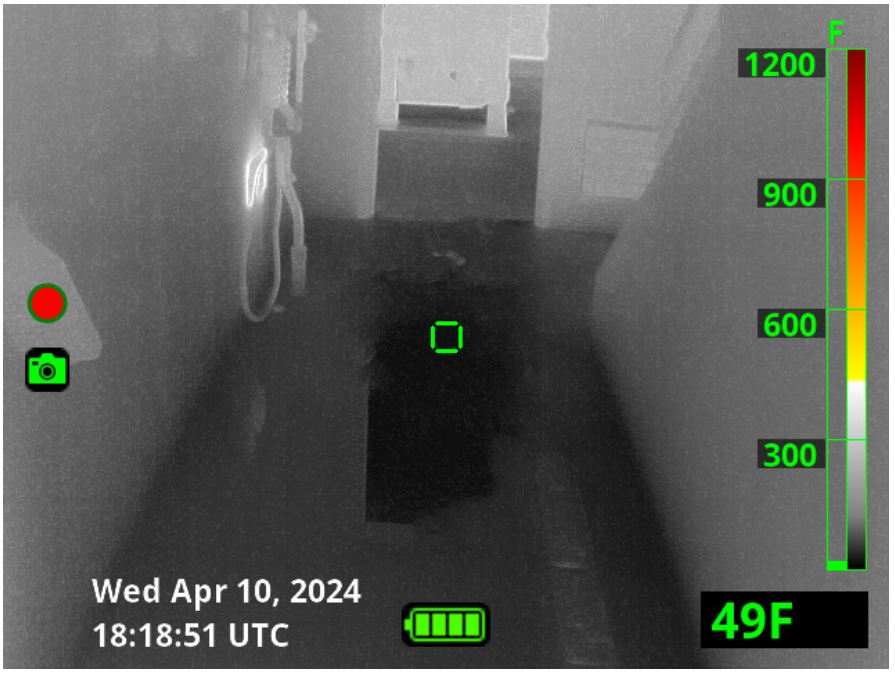
Question, "What is a black hole", answer, do not know. *The correct answer is it could be just a puddle of water on the floor, or it could be a hole in the floor that the cooler air is coming up through. Regardless, you the firefighter need to be diligent with your tools and sound the floor to ensure structural integrity. The TI is telling you something, but you cannot rely 100% on that information, you still need to investigate the manual way.*



LEFT: Understanding your imagers colorization and on-screen symbology. *(Photo courtesy of Bullard.)*



LEFT: Showing Low Gain state indicated by the green box with triangle in upper left corner. *(Photo courtesy of Bullard.)*



Above: Showing a hole in the floor or is it a reflection that looks like a hole. *(Photo courtesy of Bullard.)*

Question, "When was the last time your batteries were replaced", answer, did not have a clue! *Do me a favor and this is not just for volunteers but pertains to full time FD's as well. Next time on shift, take out your TI and turn it on, put it down and complete your truck check. This should take about 30-45 minutes and then go back to your TI. Is it still on, or does it have a sleep mode or is it off? If it is still on that is a good thing, if it is off that is not a good thing. Pull out your battery and check the date on it, anything greater than 2 years I would suggest getting replacement batteries. What I have found out through my travels is that the imager gets turned on and off at the beginning of the shift and checked off as working on the check sheet. Then the big call comes in and all hands-on deck, the imager is pulled off the truck and turned on and when you need it most is when the battery goes dead, in about 5-15 minutes. *Note all batteries suck! No batteries last forever and again from experience, maintenance happens on SCBA, rescue tools and batteries get changed in flashlights, but the TI is a neglected valued tool. When the TI goes dead it gets tossed aside and the FF's blame the manufacture, not the manufactures' fault when you have a 5–7-year-old battery, blame yourself! If the manufacturer tells you that you should get a 4-hour run time and you are only getting 20 minutes, do the math!*

Until next time practice, practice, practice and stay safe. ■

What's Your Deployment Plan?

By now, we are all aware that thermal imagers (TIs) save lives. The TI tool improves efficiency on the fireground and enhances firefighter safety.

Helping firefighters see through thick smoke reduces search times for trapped victims and increases the odds of lives being saved. Simply put, a TI lets firefighters search faster, assess an interior fire flow path quickly and accurately, and safely maneuver through a smoke-filled environment.

Some fire departments have one TI per station or apparatus, but I am now seeing a trend beginning to take shape in the fire service. With more knowledge and education in the uses of thermal imaging additional imagers are being obtained in terms of Situational and Advanced TI. I have seen several fire departments providing a TI for the company officer and a second one for the crew members. So, there is one TI in the front of the apparatus and another in the back of the cab for the crew. This practice is becoming more and more common with truck companies

TOP: Firefighter by a heat source.

RIGHT: Firefighter recovering a victim. (Photos courtesy of Bullard.)

that use a split crew deployment of their staffing. Each part of the crew—whether conducting vent-enter-search, roof, outside vent, or other duties—has the additional capability the TI brings in the hands of a trained firefighter.

Let's take this thought process a step further. The best situation for a firefighting crew is to deploy four TIs on each apparatus. This is the first step toward a deployment plan of one TI for each firefighter operating in the interior of the structure. Deploying four TIs speeds up the entire crew and increases the efficiency and effectiveness of the team. Increased team efficiency and accountability are key benefits, as is the advantage of having more eyes on the fire. The TI's ability to portray fire progression, display the cooling effects of water or foam, and signal extreme heat buildup enables firefighters to react in the moment to limit property loss, conserve water or foam supplies, and potentially evacuate before conditions become unsafe. These are all reasons to increase your TI fleet.

Having a TI on the apparatus is one thing, but having a firefighter grab the TI before entering a burning structure is another. In past columns, I have written about how critical it is for firefighters to grab the TI off the truck. When you pull up to a structure fire, the adrenaline is flowing, and it's easy to forget to grab the TI, as you are in a hurry to exit the apparatus. Then, when the situation is critical, someone realizes that the TI is still on the truck. This is a critical point that I don't mind writing about often because having the TI with you saves lives. The TI is a critical component of a crew's tool kit. Bringing TIs in on a call should be as second nature as putting on a self-contained breathing apparatus when entering a burning structure. Deploying a TI should be part of your fire department's standard operating procedures (SOPs).

SCENARIO

Let's look at a training example where the use of multiple TIs would have aided the crew in extricating an entangled firefighter more quickly. Here was the assignment: A rapid intervention team (RIT) was conducting a training exercise with a fire department. The team's assignment was to locate and disentangle a firefighter from a large pile of debris, provide immediate life support functions, and get the firefighter to the building exterior. This training was conducted under live-fire conditions with near-zero visibility. The department used the digital video recorder (DVR) on the TI to videotape the session to aid in feedback following the training.

The team struggled with the disentanglement of the firefighter in zero-visibility conditions. During the debrief, it became clear that if one member of the RIT equipped with a TI had been assigned to monitor the situation and provide instruction to the team about specific actions required to extricate the firefighter and execute the removal process, the task could have been done in a shorter time. The RIT can only advance as fast as its slowest team member, which is an argument for why deploying multiple TIs is effective and efficient.

All fire departments—whether career, volunteer, combination, or industrial—can benefit from deploying multiple TIs. Having additional TIs on your apparatus as well as SOPs for deploying them is critical to firefighter safety. The efficiency that the TI brings to a department can be magnified in situations where staffing is not optimal. The price of TIs has been dropping over the past few years, and TIs are more affordable than ever. Fire departments can more easily afford these valuable life-saving tools and embrace the use of multiple TIs. ■

SCAN ME

Read real life case studies on three different TI Deployment Models here.

Where Do You Carry Your Thermal Imager?

In my job, I get to communicate with firefighters from all around the world. This leads to some interesting conversations about how they operate, types of responses, and obviously thermal imaging.

In one conversation, it was explained to me that one department's thermal imagers (TIs) are used by the lieutenants. The TIs are kept in the office in the firehouse and not carried on the apparatus. The TIs are taken only on house fires. Who am I to judge how a fire department operates and how it carries equipment?

TIs have come a long way in technology and pricing. Many years ago, some departments were lucky to have one. Some departments have TIs mounted in every riding position, while others have them mounted in the back for the crew or just in the front officer's seat area.

I have challenged firefighters by saying, "Do you think that you can use a TI on every call that you go on"? That answer has prompted some debate. However, the fact that the TI comes from the apparatus regardless of if it gets used or not is a step in the right direction. The mentality that you do not need to have your TI needs to change. A TI is invaluable, and there are so many different applications for it.

RIGHT: A thermal imager and a spare battery mounted on an engine doghouse for rear crew accessibility. *[Photos courtesy of the Shelby (NC) Fire Department.]*

ABOVE: A thermal imager mounted in front at the officer's riding position.

APPLICATIONS

Here are some applications outlined in National Fire Protection Association (NFPA) 1408, *Standard for Training Fire Service Personnel in the Operation, Care, Use and Maintenance of Thermal Imagers*: search and rescue, safety officer, explosions, aerial operations, USAR, airborne operations, overhaul, fire attack, size-up, wildland firefighting, hazmat, confined space, overheated machinery, accountability, incident command, ventilation, law enforcement, wildlife enforcement, RIC, exposure protection, electrical emergencies, aircraft emergencies, motor vehicle incidents, scene assessment, rehabilitation, EMS, fire/arson investigations, building construction, training, line placement, and the list can go on if you think outside the box.

PROPER INSTALLATION

Ensure that your vehicle-mounted powerhouse chargers or in-vehicle chargers are compliant to NFPA 1901, *Standard for Automotive Fire Apparatus*. They can be wired to either a 12-volt DC or 120-volt AC. Make sure to follow the manufacturer's instructions and use only qualified personnel for this installation. This method ensures that the TI is always fully charged for when you need it.

In some departments, the officer carries the TI; it is attached with a lanyard to his gear at the beginning of the shift and it stays there until the end of the shift. The spare battery is swapped for the next shift, ensuring the TI is always fully charged. Others will leave the TI in the charger until they arrive on scene and then remove it for use.

How long do your batteries last? What are the runtime specifications from the manufacturer? Batteries have improved greatly over the years, giving TIs a longer runtime. However, this is dependent on how old your TI and batteries are.

Here is a service tip: When you come on shift and are conducting your vehicle and equipment check, pull out your TI, turn it on, and leave it on your seat. Unless your TI has a sleep mode feature, it should still be operating when you have completed all the checks around 30 to 40 minutes later. If it is not operating, your battery has gone dead. It's a good thing you have discovered that before your next emergency.

Some TIs have been mounted inside compartments outside of the apparatus, which means more steps for the crews to take, which can delay them during their response. I highly recommend handheld portable equipment—i.e., flashlights, portable radios, gas detectors, and TIs—be mounted inside an apparatus cab to make them readily available.

I have even seen a TI and a spare battery sliding around in fishing tackle-type plastic cases on the floor of the apparatus. The battery was dead, and the spare battery lasted for about 10 minutes—not particularly useful. We replace the batteries in our portable radios and flashlights often enough, but we seem to overlook replacing the batteries in our TI.

A TI is an extremely valuable tool; keep it in sight and readily accessible in the apparatus. This will help as a reminder to take it and use it for its many practical applications. ■

Do You Maintain Your Thermal Imager?

Training firefighters how to effectively use thermal imaging technology is extremely rewarding. During this training, I ask to use the department's thermal imager (TI) to help me teach the class about the benefits of TI technology.

This gives me an opportunity to examine the department's TI. Often, I am handed a TI that needs at least a good wipe down to clean off the soot and grime that has accumulated from everyday use. Sometimes, however, there is a TI that is so filthy that it requires a considerable amount of time to clean to get it back to its original condition. This scenario recently took place at one of my TI training sessions.

A fire chief had asked me to train his crew on why TI technology was so vital to firefighting. Also, he wanted me to inspect his TI, which was not performing the way it did when he first purchased it. When I saw the condition of the TI, it became clear to me that the performance issues cited by the chief were from firefighter neglect. Certainly, this was not intentional neglect by the crew. This crew never thought about cleaning the TI after each call.

Think about the abuse a TI gets when you take it into a structural fire. That same soot, carbon, and grime that you wash off you and your gear after a call is embedded into your TI. After every call, you need to clean and check your TI so it is ready for the next call.

A TI is the most overlooked tool in a firefighter's arsenal when daily and weekly checks are performed at the station. Have you ever cleaned the lens or display cover of your TI? On some TIs, you can easily unscrew the display cover and wipe the soot and dirt from it. Do you check your TI's battery life? Checks should be performed daily or weekly on your fire apparatus to be sure every feature is performing correctly. You always check your self-contained breathing apparatus before and after each use, so why not your TI?

MAINTENANCE PLAN

After my visit with this fire chief, I thought it would be helpful to share with you a TI maintenance plan for keeping this tool on-call and ready to deliver the best service in the most critical situations.

First, always inspect the outside of the TI for damage and cleanliness. Keeping your TI clean means the surface of your TI should look shiny. The reason is not because you want to show off your TI but because the shinier the TI surface, the more radiant heat the TI will reflect rather than absorb. Excessive soot buildup will lead to higher absorption of radiant heat and will affect how long the TI may run in extremely hot environments. All you need to clean your TI is soap and water. Any dish detergent you have at the station will clean your TI. If you have stubborn stains, isopropyl alcohol is a good option for eliminating those stains. Never use straight bleach or hydrocarbon-based solvents on your TI because they can damage the housing or rubber seals.

Next, visually inspect for cracks in the outer shell and any separation of external components. It is also important to inspect all rubber or neoprene, checking for pliability, crumbling, tears, or other visible damage. Cracks, separations, or damaged seals are common causes for water intrusion into the TI. All TIs are IP67 rated (waterproof for 30-minute immersions in three feet of water) or better, but water intrusion is a concern because it can lead to costly repairs. Inspecting your TI after each call is the best way to keep it in working condition.

Third, look at the lens or window at the front of your TI. It is very important that the lens or window remains clean and free from dirt so the image quality is not affected. The fire chief who said his TI was not performing well had stains on his TI's lens, which directly affected his image quality. This buildup can reduce the amount of thermal energy getting into the TI, reducing overall picture quality as well as creating a blurry image. Cleaning this area of the TI is not easy, so if you are having image quality issues, call your manufacturer to ask which cleaners to use. In severe cases, replacing the lens may be your only option.

Once you have cleaned and inspected your TI, it is important to perform battery checks on your unit to ensure that, when needed, your battery life is full. TIs all come with different battery technologies ranging from nickel metal hydride to lithium ion and lithium iron phosphate. Batteries in certain TIs can run seven to eight hours. When researching this, determine initial operating run times and the number of cycles for which TI batteries are rated. Batteries with higher cycle life ratings will, under typical conditions, last longer.

The potential lifespan of your TI batteries will depend on your preventive maintenance plan and how often the TI is used in the field. If you use your TI

ABOVE: Using a cleaning wipe on a TI. *(Photo courtesy of Bullard.)*

multiple times a day, the life of your batteries may average about one year. If you use it only a few times a month, you may not need to replace the batteries for two or three years. How often a TI is used, in what kind of temperature extremes, and how batteries are charged and maintained will all impact battery performance. At least once a month, be sure to verify that the battery contacts on the batteries and the TI are free from corrosion. Also, be sure to check that the battery chargers are corrosion free on all contacts and are operating correctly.

Finally, be sure to turn on and check your TI weekly. This sounds easy, but some departments will go a couple of weeks without using their TI. You want to be sure your TI is in focus. Focal distance for most is approximately three feet to infinity. If an object 10 to 15 feet away appears blurry, then it is possible that the focus needs to be adjusted. This is rare, but it can happen. Next, check the TI for clarity. Here you are looking for any noise in the image. Noise looks like background static. It is typically fixed and does not change location as the TI moves. Temperature measurement should also be checked. Does the color activate as expected? Does the TI shift from high gain to low gain appropriately? You can evaluate temperature measurement by pointing your TI at a gas stove or grill. If you have other features on your TI or attached accessories, check them as well.

Your TI is exposed to the harshest environments from water to frequent drops, which can result in gaskets or screws coming loose. Soot, carbon, and dirt commonly build up on the TI, its display cover, lens, or lens window, which can impact performance.

DAILY OR AFTER EACH USE:

- Ensure the unit is working properly.
- Insert a fully charged battery.
- If necessary, recharge the previous battery.
- Verify that all battery chargers are functioning properly.
- Verify that there are no signs of cracking or tearing on any of the rubber pieces and buttons on the unit.
- Using a damp cloth, clean off large pieces of debris.

WEEKLY:

- Clean the lens with a soft cloth and a mild cleaner.
- Clean the LCD display cover with a soft cloth and a mild cleaner.
- Verify all straps are in usable condition and properly secured.
- Check for cracks, holes, or other damage to the unit's outer shell.
- Verify that the batteries do not show physical signs of damage.

MONTHLY:

- Check the tightness of all external screws, especially those connecting the LCD display cover. Do not overtighten.
- Cycle each battery fully by using a conditioner or by fully charging and draining the battery. Ensure that one battery is always fully charged for use at an incident.
- Using a damp cloth and a mild cleaner, clean the outer shell of the unit.
- Verify that the battery contacts on the unit are corrosion-free.
- Verify that the battery chargers are corrosion-free on all primary contacts.

Spending a little time each week maintaining your TI will ensure that it stays operational and productive. Check with your TI's manufacturer for specific recommendations for maintaining it, and if at any time your TI shows signs of damage or is not functioning properly, arrange for proper servicing. Your TI is a life-saving tool that needs to function properly when called on. ■

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