SOG #1600.1(R9/03)

THERMAL IMAGING CAMERA

Purpose:

A. To establish a guideline to facilitate the most effective method for deploying a Bullard Thermal Imaging Camera in a way that provides the most protection for our personnel.

B. To provide a reference document to be used for training personnel in the uses, deployment, limitations, operation, and care/maintenance of the Bullard Thermal Imaging Camera.

Guidelines:

A. The district has 2 thermal imaging cameras, one each in Engine 703 and 704. Personnel should become familiar with the location of the TIC on the apparatus. Ultimately, the Company Officer shall determine who will operate the TIC.

B. The Company Officer shall be responsible for the TIC and should place it in service at all structure fires or any other incident where smoke will or could hamper visibility regardless of the initial size-up.

C. When operating in the "Rescue Mode", personnel shall use the available TIC to aid in the search for victims. If operating ahead of or separate from the first hand line, a lifeline should be used.

D. If conditions warrant the use of the camera, the nozzle person shall be the operator of the TIC. The Incident Commander should be notified that the TIC is in use. Though field exercises it has been determined that the safest and most efficient operation of the camera occurs when the operator view is not obstructed by other firefighters. Camera operators must be aware that they have a tendency to move faster than the rest of the team who are operating in zero visibility. Other personnel operating with the initial hand line crew shall coordinate their efforts in order to maintain compliance with the "Two In/Two Out" SOG. Search and suppression activities should occur in compliance with their respective SOG's. Two person teams are the policy and should only be deviated in extremely dire situations.

E. In moderate to heavy smoke conditions the TIC allows a crew to quickly check a smoke filled area to determine whether or not there is fire present. The camera operator must remember not to move too quickly, so that the rest of the team is not lost in the zero visibility environment.

F. The TIC has the potential to inspire overconfidence because it allows firefighters to "see" in an environment that in reality has zero visibility. Firefighters should remember that they must stay low even if the camera allows them to see that the majority of the heat is at the ceiling. The possibility of a flashover in the dynamic atmosphere of a structure fire is higher than ever before because of new materials, construction methods

and rapid responses. Personnel must understand that the camera could fail and an escape route must be easily located, either by following a hand line or lifeline to safety.

G. The TIC can also serve as a tool for detecting heat during the overhaul phase of an incident. It must be remembered, however, that the camera cannot penetrate most construction materials, nor can it penetrate water. Because the camera has a black and white display it is sometimes difficult to differentiate between what is heat or fire trapped in a wall and what is radiant heat. A Hot Spotter is still the primary tool for locating areas or objects that have a higher temperature than their surroundings because it allows the differential between that area or object and its surrounding to be determined in degrees.

H. The TIC may be requested by various agencies within Boone County. If a request is received by PSCC, Engine 703 shall be dispatched and the camera taken to the incident scene by the most expedient means possible.

Thermal Imaging Camera Uses:

A. Provides safer navigation in a space where there is zero visibility due to smoke.

B. Allows personnel to "see" in a zero visibility environment, which is a very useful addition to traditional search and rescue techniques. The time necessary for completing a primary search can be cut by almost half by utilizing a TIC.

C. Enables suppression crews to execute a faster, more effective interior attack. The shortest route to the fire, holes in the floor and obstacles in the structure can be determined and located efficiently.

D. Reduces fatigue of interior crews because efficiency in performing searches and suppression is increased.

E. Allows Rapid Intervention Teams to quickly and efficiently locate downed firefighters.

F. May be used to determine fluid level within a container, which may be useful during an incident involving hazardous materials.

G. May be used as a search tool to locate persons in open wilderness areas.

Background Information:

A. Products of combustion, primarily smoke, cause lack of visibility on the fireground. Smoke is composed of two elements; fire gases produced by the fuel's chemical breakdown and soot. Heavy smoke causes all the light to be scattered or blocked since the light waves cannot penetrate the particles. This zero visibility condition is what limits the effectiveness of lighting for interior firefighting operations. This lack of visibility heightens the potential for firefighters to become disoriented and lost within the fire building and in turn could hamper their ability to exit the structure in an emergency situation.

B. Thermal energy is not visible to the human eye, but the firefighters can feel the heat present. The TIC allows a thermal heat view of one's surroundings.

C. A TIC is a device that translates a thermal picture into an electrical picture and then a visual image for the human eye. This is accomplished because it relies on the thermal energy emitted by all objects and not on reflected visible light. Thermal Imagers provide vision capability with zero light present. Thermal energy is characterized by its long wavelength, and fortunately for firefighters, the nature of this long wave thermal energy allows it to travel through smoke and mist. In essence the TIC "sees" through smoke and mist.

D. Everything viewed through the camera's lens retains its shape, people look like people and rooms look like rooms. The TIC provides the firefighter with a black and white television view through the smoke and darkness.

E. When viewing a room using the TIC, hot things appear white, hotter objects appear brighter white, and colder items appear black to gray. The whiter the representation displayed, the more heat present in the object.

Limitations:

A. The TIC allows a two dimensional view of a smoke filled environment. Depth perception is limited. Firefighters operating the camera should remain low to the ground, scanning the entire area before them. When scanning an area with the TIC begin at the ceiling and conclude at the floor area immediately in front of you. Walking with the TIC is discouraged, as trip hazards may be overlooked.

B. Thermal energy does not travel directly through walls. A TIC does not allow an area to be viewed, which is behind a wall. If fire is present inside a wall, the camera will only be able to "see" it if the fire has increased the temperature of the wall itself. Fire inside wooden clad walls will be picked up much faster than fire on the other side of a more significant barrier such as concrete. Normal overhaul guidelines must be utilized in order to locate fire extension.

C. A human being will not provide sufficient thermal energy to penetrate most standard construction materials or solid items such as furniture. Therefore, it is reinforced that while conducting a search, rescuers must look under/around beds, sofas and other objects where victims may have hidden to escape fire.

D. Water, plastic and glass are all effective barriers for the TIC and may cause a reflective image. The team operating the camera must remember that the image present on the TIC's screen could be a "mirror image" of themselves or fire behind them being reflected off of glass, plastic or water. To test suspicious images, the crew should wave their arms and determine whether they are seeing their own image.

E. Also, firefighters and occupants who are wet from hand line operations could be masked from the camera's view during a search because there is a momentary balance of thermal signatures.

F. The TIC must be used with the understanding that it is only a mechanical device and it can fail. Firefighters must plan for this possibility by carrying flashlights, maintaining contact with the wall, a hand line, employing a lifeline or other routine methods for remaining oriented to location and the position of exits in a zero visibility environment. Crews should continue to employ standard firefighting practices.

G. Count on no more than 20 minutes of operation per battery, less in cold temperatures. Change the battery each time the operator leaves the structure to exchange SCBA bottles unless the TIC is being handed off to another crew that is completing the primary search.

H. Be aware that if the controls on the TIC are bumped the unit could become deactivated.

I. The image displayed by the TIC may decrease in quality as soot builds up on the lens and screen while operating on the fireground. A soft cotton cloth should be used to clean the lens and screen periodically while operating the camera.

J. If the picture displayed on the screen suddenly becomes distorted, check to insure the carrying strap is not in front of the lens.

K. "White Out" is a condition caused by aiming the unit at a very hot object or flame, which causes the TIC's sensor to become overloaded and the display to show all white, rendering the TIC useless. To correct the problem, aim the camera away from the extreme heat source and the display should return to normal in less than one minute, often within just a few minutes.

L. The TIC has not been determined to be intrinsically safe as an ignition source. This device is not to be used in a potentially explosive atmosphere.

Operation of the TIx Camera:

A. The TIx camera is stored in Engine 703 behind the driver's seat in a hold made by Bullard. The camera must be completely clean, dried and plugged in after each use.

B. In order to deploy the camera, remove the strap holding it in place, unplug the charging cable, grasp the pistol handle and lift straight up from the holder. The shoulder strap should be utilized in order to lessen the chance of the unit being dropped.

C. To turn on the camera, simply depress the large green "On/Off" button on the left side of the unit. Upon depressing the "On/Off' button the "Sleep" indicator light will appear on the viewing screen. However, the thermal image will not appear immediately as the unit requires a few moments to

warm-up and complete the self-calibration process. After approximately 20 seconds, the thermal image will appear.

D. On the left side of the display screen, a bar graph allows the operator to see the amount of power that remains in the units battery pack.

E. To conserve battery life, the imager includes a unique "Sleep" feature. To put the unit into "Sleep" mode, simply press the yellow "Sleep" button on the left side of the unit. When in the "Sleep" mode, the "Sleep" indicator light will appear on the viewing screen. To bring the unit out of the "Sleep" mode, simply push the yellow button again. The thermal image will immediately reappear on the screen.

F. The TIx imager features a fully adjustable aperture (Thermal Throttle) which means you always get the clearest picture. Simply put, the Thermal Throttle controls the amount of energy that reaches the thermal detector. The process is similar to that of the pupil in the eye. When there is bright light the pupil shrinks to protect itself. When there is low light the pupil expands. The Thermal Throttle works the same way. In high heat situations, the Thermal Throttle may be reduced down to obtain the best contrast and the clearest image. In low heat situations, the Thermal Throttle is manually adjusted, the operator can always get the clearest image.

1. The Thermal Throttle is manually adjusted by turning the Thermal Throttle dial on the front left of the unit. Turning the dial clockwise (towards the lens) closes the Thermal Throttle, turning it counterclockwise opens the Thermal Throttle. For increased durability, the Thermal Throttle is equipped with a safety slip mechanism, which engages when the Thermal Throttle reaches the fully open or fully closed position. This mechanism prevents over-adjusting or over-tightening the dial.
2. Bullard recommends the following Thermal Throttle adjusting procedure: Once the unit is turned on and the internal calibration is completed, turn the Thermal Throttle clockwise until the image on the screen disappears. This is the fully closed reference position. Then turn the Thermal Throttle knob in the opposite direction until the picture contrast is to your liking. It will take less then one full revolution of the Thermal Throttle to completely open the aperture. Once the aperture is fully open the safety slip mechanism engages to ensure the Thermal Throttle is not over-tightened. Continuing to turn the dial beyond that first full revolution will not improve the contrast. Must of the needed adjustment will be accomplished within about ¼ of a revolution of the Thermal Throttle.

G. To charge a battery using the exterior battery charger found on the holder, simply insert the battery into the charger so that the metal connectors on the battery are aligned with the metal connectors in the charger. A red light will illuminate on the charger to indicate that the battery is charging. When the light on the charger turns to green the battery will be fully

charged. You may leave the battery in the charger indefinitely. You cannot overcharge the battery.

H. The direct charge system allows the battery in the imager to be charged inside the camera. Connect the charger to the camera by using the gray connector cord. Insert one end of the cord into the charger using the outlet provided on the front of the charger and the other end into the direct charge plug located on the handle of the imager. As with the exterior charger, a red will indicate that the battery is charging and a green light will indicate that the battery is fully charged.

I. To open the battery compartment on the imager simply turn the two thumb knobs outward, pull the door open and remove the battery. To insert a new battery make sure the Bullard decal is facing away from the camera and the type is right side up. The battery can easily be replaced in the dark. To do so, simply locate the notched bottom of the battery. Make sure the notch is pointing away from you and is on the left-hand side.

J. Do not attempt to disassemble the sealed case of the Bullard Thermal Imager. If the unit is not functioning properly return it to Bullard for evaluation. Disassembling the unit voids all warranties.

K. The TIx camera is not certified as intrinsically safe.

Operation of the T3MAX Camera:

A. The T3MAX camera is stored in Engine 704 behind the driver's seat in a holder made by Bullard. The camera must be completely clean, dried and plugged in after each use.

B. In order to deploy the camera, depress the retaining latch with your left thumb while grasping the imager with your right hand. Pull the imager upward and away from the holder.

C. To turn on the camera, simply depress and release the large, dark gray power button under the LCD display. Upon pressing the power button the camera will display the Bullard logo and initiate a calibration sequence. The thermal image will appear in approximately 8 seconds. To turn off power, depress and release the power button again.

D. The Bullard T3 is equipped with an automatic gain control (AGC) that manages the sensitivity of the unit ensuring optimal image resolution in intense energy situations. When the AGC engages to accommodate high heat scenes, the letters EI appear on the screen indicating that the unit has shifted into Electronic Integration or EI mode. This is an indication that the T3 has scanned an object it has calculated to be at least 200°F.

E. You will periodically observe a momentary freeze in the image. This is normal and is a function of the self-calibration shutter. The shutter will activate every 30 seconds to three minutes, depending on the environment. The shutter will also activate each time the T3 goes into, and out of, EI mode.

F. The imager is equipped with a temperature measurement capability. The right side of the display will show a bar graph or Relative Heat Indicator

(RHI). The RHI will indicate the approximate temperature of the object viewed within the "crosshairs" shown in the middle of the screen. The accuracy of the indicators is dependent on numerous factors including the distance from the object being viewed and its emissivity, which is the object's ability to radiate heat. Units are calibrated with a preset emissivity corresponding with normal construction materials. Objects with emissivities that vary greatly from this, such as metals and shiny objects, will reduce the accuracy of the temperature indication. Additionally, temperature measurement accuracy decreases as the distance from the object in the "crosshairs" increases. *The RHI provides a quick reference to compare objects of similar emissivities to serve as a guide to pinpoint intense heat sources. Due to the inherent problems with accuracy, use this feature with caution and verify indicated heat levels through traditional means whenever possible.*

G. The imager features a Red Hot high heat colorization. When viewing a scene of intense heat, extremely hot objects will appear as red on the screen. Those objects that the T3MAX calculates to be approximately 1100°F or hotter will be colored red. The Red Hot feature provides an enhanced visual awareness of the hottest objects in a scene. *The Red Hot feature will only activate when the unit is in EI mode.*

H. To insert the imager into the charger depress the black imager retaining latch at the upper left corner of the Powerhouse with your left thumb and set the imager firmly into place in the upped recess of the Powerhouse, with the lens facing downward and the top of the imager facing to the right. Release the latch when the imager is fully seated into the unit. The battery charger is automatically activated when the imager is inserted. Battery charge condition is indicated by a two-color LED on top of the unit adjacent to the imager recess. A red LED indicates that the battery is being charged; a green LED indicates that the battery is fully charged and its charge is being maintained by the Powerhouse unit.

I. Insert the spare rechargeable battery into the Powerhouse by holding the battery by its broad flange, with the label on top. Insert the battery by pressing it into the opening at the lower left of the Powerhouse unit. Once fully inserted, the battery will snap firmly into place and the battery charging circuit will automatically activate. If the battery is inserted incorrectly, it will not be possible to fully insert it. In this case, the battery will not snap into place, and the charging circuit will not activate. Battery charge condition is indicated by a two-color LED just to the left of the charger opening. A red LED indicated that the battery is being charged; a green LED indicates that the battery is fully charged and its charge is being maintained by the Powerhouse unit.

J. To remove the spare rechargeable battery from the Powerhouse grasp the protruding flange of the battery, lift up and pull the battery out of the opening.

K. Fully charged NiMH batteries will provide a run time of 2 ½ hours. This run time will be less in extreme heat or extreme cold conditions.

L. The Bullard T3 Thermal Imager is not certified as intrinsically safe. Thermal Imaging is not a technology designed to replace current fire fighting tactics. Rather, it is a tool that allows the firefighter to be more effective and to make better decisions.

To Maintain Optimal Performance of the Bullard Thermal Imager:

A. Daily or After Each Use:
   1. Ensure the unit is working properly.
   2. Insert a fully charged battery, as necessary.
   3. If necessary, recharge the previous battery.
   4. Verify all battery chargers and associated cables are functioning properly.
   5. Using a damp cloth, clean off large pieces of debris.

B. Weekly:
   1. Clean lens with soft cloth and mild cleaner.
   2. Clean LCD display cover with soft cloth and mild cleaner.
   3. Verify all hand straps are in usable condition and properly secured.
   4. Check for cracks, holes or other damage to the unit's outer shell.
   5. Verify the batteries do not show physical signs of damage.

C. Monthly:
   1. Check tightness of all external screws, including those holding on straps, those connecting the LCD display cover and those connecting any bumpers. Do not over-tighten.
   2. Cycle each battery fully. This is accomplished 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.
   3. Using a damp cloth and mild cleaner, clean the outer shell of the unit. Do not immerse the unit under water for cleaning.
   4. Verify that the battery contacts on the unit are corrosion-free.
   5. Verify the battery chargers are corrosion-free on all primary contacts.

D. Variable:

   The frequency of these maintenance steps will be determined by the amount of use the unit receives in the field. While this is a guideline, users should replace any part when they notice a decrease in product performance or usability, rather then waiting for a specific period of elapsed time.
   1. Every 8 to 24 months: replace the LCD display cover.
   2. Every 12 to 36 months: return the unit to Bullard for a Preventive Maintenance service.
   3. Every 18 to 36 months: replace the rechargeable batteries.

   If at any time the thermal imager shows signs of damage or is not functioning properly, call 1-877-BULLARD.