

## I. Warranty

The manufacturer shall make standard a warranty for the thermal imager, all features and accessories installed in the thermal imager to be free of defects in material and workmanship, under normal use and service, for a period of **five** years. As part of this warranty, the manufacturer must provide free inbound and outbound shipping for transport within the continental United States for all repair service. The manufacturer must provide an optional warranty that covers all required battery replacements for a period of five years. In addition, the imager's housing shall carry a limited lifetime warranty.

## II. Service

The manufacturer must be located in the U.S.A. and provide a full-service repair center in the U.S.A. to ensure timely and efficient processing of any service related issues concerning the imager. Warranty repairs must carry a guaranteed 48-hour turnaround (2 full business days from the time of receipt at the service center to the time that the manufacturer ships the imager).

Non-warranty repairs must carry a guaranteed 48-hour (2 full business days) turnaround from the time the manufacturer receives purchase order authorization to complete the repairs to the time the manufacturer ships the imager. Upon request, the manufacturer must provide the names and contact information for three (3) fire departments that can serve as references, verifying that the manufacturer complies with this requirement.

## III. Quality

The manufacturer must ensure quality, design and manufacturing methods through third-party certification to ISO 9001, or its equivalent. To ensure that the product is of the highest quality, documentation must be presented upon request illustrating a battery of tests that have been conducted to verify water resistance, heat resistance and shock/impact resistance.

## IV. Physical Configuration

The imager shall be a hand-held design with a total weight not exceeding 2 lbs. (0.907 kg) with the battery and all features installed. The imager shall ship in a re-usable delivery case. The imager shall include two rechargeable batteries and a battery charger with AC adapters. The imager's physical dimensions shall be no more than 4.5" (114 mm) tall, 5.5" (140 mm) wide and 8" (203 mm) long.

## V. Durability

The imager shall remain operational after being submerged under 3 feet of water for 30 minutes. The imager shall withstand a 6-foot drop in any orientation and sustain no operational damage. The manufacturer must perform these tests in front of designated department representatives at a mutually determined time and location. Failure to perform these tests in front of designated department representatives shall constitute non-compliance with this portion of the specification.

## VI. Technology

The imaging technology shall utilize a 320x240 pixel uncooled vanadium oxide (VOx) focal plane array. The Noise Equivalent Temperature Difference (NETD) shall be less than 50 mK. The imager shall exhibit an ability to evade whiteout when pointed directly at flames. The detector shall operate with core temperature ranges of -40°F to 175°F (-40°C to 79°C). The dynamic range of the detector and associated electronics shall be nominally 1100°F (592°C). The detector spectral response shall be 7 to 14 microns. Mid-wave or short-wave infrared products that operate below this portion of the infrared spectrum (below 7.5 microns) are not acceptable due to unreliable performance in smoky conditions. The frame rate of the infrared engine shall be no less than 60 Hertz. The infrared engine shall utilize a proprietary Image Contrast Enhancement (ICE<sup>™</sup>) technology that provides superior infrared imagery utilizing three state-of-the-art image processing techniques: (1) Edge Enhancement algorithms that sharpen distinctions between objects and regions; (2) Dynamic Contrast Thresholding which isolates the most significant image content and then applies further image processing; and (3) Adaptive Rescaling, which decomposes the image into three spatial frequencies and then optimizes the imagery.

## VII. Image Colorization

In order to provide a greater degree of safety, the imager shall utilize a tri-color automatic colorization mode. This colorization mode shall utilize a yellow/orange/red color scheme. The display will show yellow colorization at temperatures of 500°F (260°C) to 799°F (426°C), orange colorization at temperatures of 800°F (427°C) to 999°F (537°C), and red colorization at temperatures of 1000 °F (538°C) or hotter. Such colorization shall be gradient in nature so as to be able to discern scene details though the color (this requirement does not apply to manually engaged colorization).

Manual Colorization Mode – see XIII. Switches

## VIII. Outer Housing

The imager shall be ergonomically designed, and the outer shell or housing must be manufactured from heat-resistant Ultem<sup>®</sup> thermoplastic. Due to the likelihood of rigorous use, the Ultem must be molded with color pigment throughout to mask small surface scratches. Outer shells or housings that are painted or otherwise lack consistent color through their entire thickness are not acceptable.

## IX. Colors

The imager should be available in no less than eight scratch-resistant colors to allow for color-coding as needed by the department. Colors shall include, at a minimum: Metallic Blue, Red, Yellow, Black, White, Orange, Blue, and Lime-Yellow.

## X. Monitor/Screen

The imager shall have a 3.5" diagonal LED backlit Liquid Crystal Display (LCD) screen. The display shall consist of no less than 76,800 pixels for high quality resolution. The screen must be visible in thick smoke to the operator while using it at arms-length. In addition, a clear polycarbonate cover must protect the display screen. This cover must be field-replaceable and watertight.

## XI. Lens

The imager shall possess an f/1.3 lens fabricated of germanium and have no less than a 31° (V) x 40° (H) field of view.

## XII. Visual Indicators

The imager shall have a battery status indicator on the viewing display to reduce imager size. Battery indicators that are not located on the display, such as separate LED based indicators, are unacceptable as they increase imager size. The imager shall be capable to provide, on the viewing display, surface temperature measurement of objects. The imager must be able to provide simultaneous presentation of bar graph and numeric temperature indicators as well as separate presentation of either indicator.

## XIII. Switches

The imager shall use only one switch to activate the unit. The switch shall be electronic enabling a press and hold shutdown to prevent accidental shut-off. The imager must utilize a pair of switches that enable the activation of a manual colorization mode and an internally installed Digital Video Recorder (DVR).

The imager shall incorporate a manual colorization mode, as an option or upgrade, which helps the user identify the hottest objects in a scene irrespective of absolute heat levels. This colorization mode must be manually adjustable by the user and colorize the hottest objects in a scene with blue, using gradients of blue so as to discern scene details though the color. Thermal imagers that use yellow, orange, or red to identify hot objects for a manual colorization mode are not acceptable as they can easily be confused with the automatic colorization modes which typically use such colors to designate fire and high heat conditions.

The imager shall incorporate an internal DVR, as an option or upgrade, which enables the recording of thermal imaging video to the internal memory of the thermal imager. The DVR must be manually operable by the user enabling activation and deactivation with a button press.



#### **XIV. Strap Systems**

To reduce bulk, the imager must not have an integral strap system; however, the imager shall accommodate an available self-retracting strap. This retractable strap shall be attachable to a D-ring at the base of the thermal imager, under the display, and must be capable of holding the unit to the firefighter's body with the full weight of the imager, with battery, hanging unsupported from the strap.

#### **XV. Power Supply**

The imager shall be provided with two rechargeable batteries and a battery charger. The batteries shall be 2.4-volt nickel metal hydride (NiMH) packs, providing a minimum of 2 hours of continuous use (1.5 hours if a DVR is recording). The batteries shall have an Ultem outer shell. The batteries must be capable of being loaded into the housing only one way and must be inserted and removed by a person wearing standard firefighting gloves.

#### **XVI. Operation**

Once the imager is registered (see section XVIII), the imager must be fully operational no more than four seconds after activating the power switch. The imager must not have a standby switch or mode.

#### **XVII. Digital Video Recorder (DVR)**

The manufacturer must offer a DVR, internally housed in the thermal imager, capable of recording five hours of video in 720 x 480 resolution. Stored digital video shall download to the user's computer via USB connection. A time and date stamp shall be displayed at the beginning of recorded video for documentation purposes. Attachable DVRs are not acceptable as they increase total size and weight. The DVR must carry a one year warranty.

#### **XVIII. Battery Analysis and Conditioning**

The manufacturer must offer an analyzer / conditioner system for use with the thermal imager's batteries. The hardware unit must utilize a PC software system that enables adding, naming, and removing batteries from a user's inventory. The software must be capable of automatically providing battery analysis and conditioning of up to four separate cycles to ensure optimal battery restoration. The hardware unit must be capable of conditioning up to four separate batteries simultaneously via multiple conditioning units or banks. The software must report analysis conclusions in simple English (i.e. "good" or "bad") for intuitive user understanding. The software must also be capable of notifying the user, via mobile text messaging or email, upon the completion of battery charging and/or analysis / conditioning events. The unit must also be capable of separately charging a battery.

#### **XIX. Truck Mount**

The manufacturer must offer a truck mounted charging system to mount the imager and internal charging system in a vehicle or fire apparatus or on the wall of a fire station. The charging system shall come standard with an additional battery, all necessary mounting hardware, a direct charge system, and a connector that enables the use of an AC/DC power supply. The system must charge the battery in the imager at the same time it charges a spare battery utilizing separate charging systems. The battery in the imager must be charged through contacts on the imager. No cables or wires connecting the imager to the charging system are acceptable, nor are straps or other connecting devices to hold the imager to the truck mounting system. The system must be compliant to NFPA 1901 when properly mounted in a vehicle or fire apparatus. The truck mount must carry a one year warranty.

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