

QSA GLOBAL.



OPERATING MANUAL. MAN-067, REVISION A

OPENVISION HD.

OVHD-NDT-70 HARDWARE MANUAL

Revision Record

Revision	Date	Description
A	03/2023	Production Release



DANGER – RADIATION WARNING

OpenVision™ HD device must be operated only by trained and qualified radiographers who have read and understand this operating manual or by trained assistants working under their direct supervision.

WARNING

The use of these radiographic devices by unqualified personnel or when safety procedures are not fully met, could result in life-threatening dangers.

The x-rays produced by these devices emit high levels of highly penetrating radiation during use.

Since radiation cannot be detected by the human senses, strict operating and emergency procedures must be followed. The proper use of calibrated and operable survey meters must be employed to avoid potentially dangerous levels of radiation exposure.

Take advantage of the three basic radiation protection methods to minimize radiation exposure:

Time: Spend less time near the radiation source.

Distance: Increase your distance in a direction away from the radiation source.

Shielding: Use effective shielding between you and the radiation source.

Do not perform any unauthorized modifications to the device or components of the system.

It is important that trained and qualified radiographers perform or supervise a daily safety inspection of the radiography system for obvious defects prior to operation of the system.

Do not use any components that are not approved for use with the radiography system, or after-market components that may compromise the safety designed into the system.

Consult with local governmental regulations and industry standards for additional requirements pertaining to the operation of any x-ray equipment.

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Equipment Specifications.

Table 1 OpenVision™ HD Specifications

Part Number	OVHD-NDT-70
<u>Imaging Specifications</u>	
Detector Type	CMOS
Pixel Pitch	74.8 µm
Pixel Matrix	1944 X 1536
Sensitive Area	5.72" x 4.52" (145.4 mm x 114.9 mm)
Grayscale	16 Bit
System Resolution	1280 X 720
<u>C-Arm Dimensions</u>	
X-Ray Tube to Detector	9.5 in. (24 cm) to 20.9 in. (53 cm)
Throat Depth	21 in. (58 cm)
Detector Thickness	2.5 in. (6.4 cm)
X-Ray Tube Thickness	3.4 in. (8.7 cm)
<u>System Weight</u>	
C-arm	16 lbs. (7.2 kg)
HDMI Monitor	2 lbs. (0.9 kg)
Shipping Weight	50 lbs. (23 kg)
Beam Collimation	18° Horizontal / 10° Vertical
Startup Time	~30 seconds
Shutdown Time	~5 seconds
Battery Life (Continuous / Standby)	2 hours / 3 hours (5 Ah battery)
Operating Temperature	-20° F to 120° F (-29° C to 49° C)
Storage Temperature	-20° F to 140° F (-29° C to 60° C)
Display Options	Wired HDMI Monitor: 7 in. LCD Wi-Fi Tablet: 10 in Touchscreen PirateEye Any device with HDMI input
Data Storage	Internal: 128 GB (Transfer via USB drive) Wi-Fi Tablet: 128 GB (Transfer via USB-C)
Shipping Dimensions	32 in. x 20.5 in. x 12.5 in (82 cm x 52 cm x 32 cm)
X-Ray Tube Classification	Shielded
Leakage Radiation Exposure Rate	Less than 2.58 E ⁻⁰⁴ C/kg in one hour (1 R/hr) at one meter from the x-ray tube target
FDA Accession #	Pending FDA submission

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The OpenVision HD is built in compliance with ISO 9001:2015 and meets the following standards when used as directed:

- ANSI/HPS N43.5-2005 (R.2013)
- Ionizing Radiation Regulations (2017)
- ISTA 3A Over the Road vibration standard
- MIL-STD-810, Method 514, Annex C, Cat 4
- REACH/ROHS

Heads Up Display (HUD)

- ANSI Z87.1+, US Federal OSHA
- US Mil Spec MIL-PRF-31013
- CE END 166 FTKN

Battery/Charger



California Energy Commission



Underwriters Laboratory for Canada and U.S.

Safety Precautions.

Personnel operating this equipment must be completely familiar with this manual and they must read and understand these important safety alerts before proceeding.



WARNING

The OpenVision™ HD is classified as a shielded x-ray tube assembly.

Do not perform any unauthorized modifications to the OpenVision HD system or components of the system.

It is important that trained and qualified personnel perform or supervise a daily safety inspection of the OpenVision HD system for obvious defects before using the system. Do not compromise on safety. Always perform the daily inspection of the system prior to use.

Any foreign material (dirt, mud, ice, etc.) must be removed before using the system. Inspect, clean, and test the equipment as described in this manual to ensure long-term safety and reliability.

Do not use any component that is not approved for use with the OpenVision HD system or any after-market component as they may compromise the safety features designed into the system.

Defective equipment that is discovered during the daily inspection must be removed from service until repaired or replaced.

The user of this equipment must follow the operating instructions, in the order shown, to ensure safe operations and compliance with government regulations.

IMPORTANT SAFETY ALERTS

NOTICE: Can cause minor problems and reminders.

CAUTION: Can cause equipment damage or potential problems.

WARNING: Can cause serious or fatal injury.



WARNING: JOB SITE SAFETY PRECAUTIONS

Surveillance

Only trained and qualified individuals, or assistants working under their direct supervision, may operate the OpenVision HD system. The qualified individuals must be physically present at the site and able to control and limit access to the vicinity of the work.

Locking

Keep the OpenVision HD controller locked while assembling the system and when not being used to perform scanning. Locked is defined as the controller key switch in the Off position with the key removed. Store the key in a secure location.



WARNING: ACCIDENTAL RADIATION OCCURANCES

An Accidental Radiation Occurrence is defined by Part 21 CFR 1000.3 as a single accidental event or series of accidental events that has/have resulted in injurious or potentially injurious exposure of any person to electronic product radiation as a result of the manufacturing, testing, or use of an electronic product.

Report any accidental radiation occurrences (ARO's) to QSA Global, Inc. so that QSA Global, Inc. may notify the Food and Drug Administration.



NOTICE: DOSIMETRY

It is the responsibility of users of this equipment to comply with all local, national and international regulatory and licensing rules and regulations. Proper dosimetry including film badges, thermoluminescent dosimeters or optically stimulated luminescence badges (OSL); direct reading pocket dosimeters and audible alarm ratemeters may be required to be worn during all radiographic operations.

Operating Conditions

OpenVision HD is designed for applications where the equipment will not be exposed to harsh handling or environmental extremes. See Equipment Specifications for more information.

X-Ray Training

It is required that OpenVision HD operators are properly trained and qualified to perform radiographic inspections. This manual does not address radiographic inspection techniques or procedures.

Precautions

The OpenVision HD system is designed for portability and is ruggedized for industrial environments. However, it does contain fragile components. Use care to avoid strong vibrations and shock conditions (e.g. equipment drops or transportation outside the approved case) to the main housing, detector housing, and display(s).

CAUTION

Do not attempt to open or modify the detector housing, main housing, or X-ray tube. Opening any of these components will void the system warranty and may expose the operator to a high voltage shock hazard.

CAUTION

Do not allow liquids to come into contact with any part of the OpenVision HD system. The main housing and detector housings have been made water resistant, but they are not "waterproof". Appropriate care should be taken to protect all cabling and connectors to ensure reliable and safe operation of the OpenVision HD system.



WARNING: Class 2 Target Laser

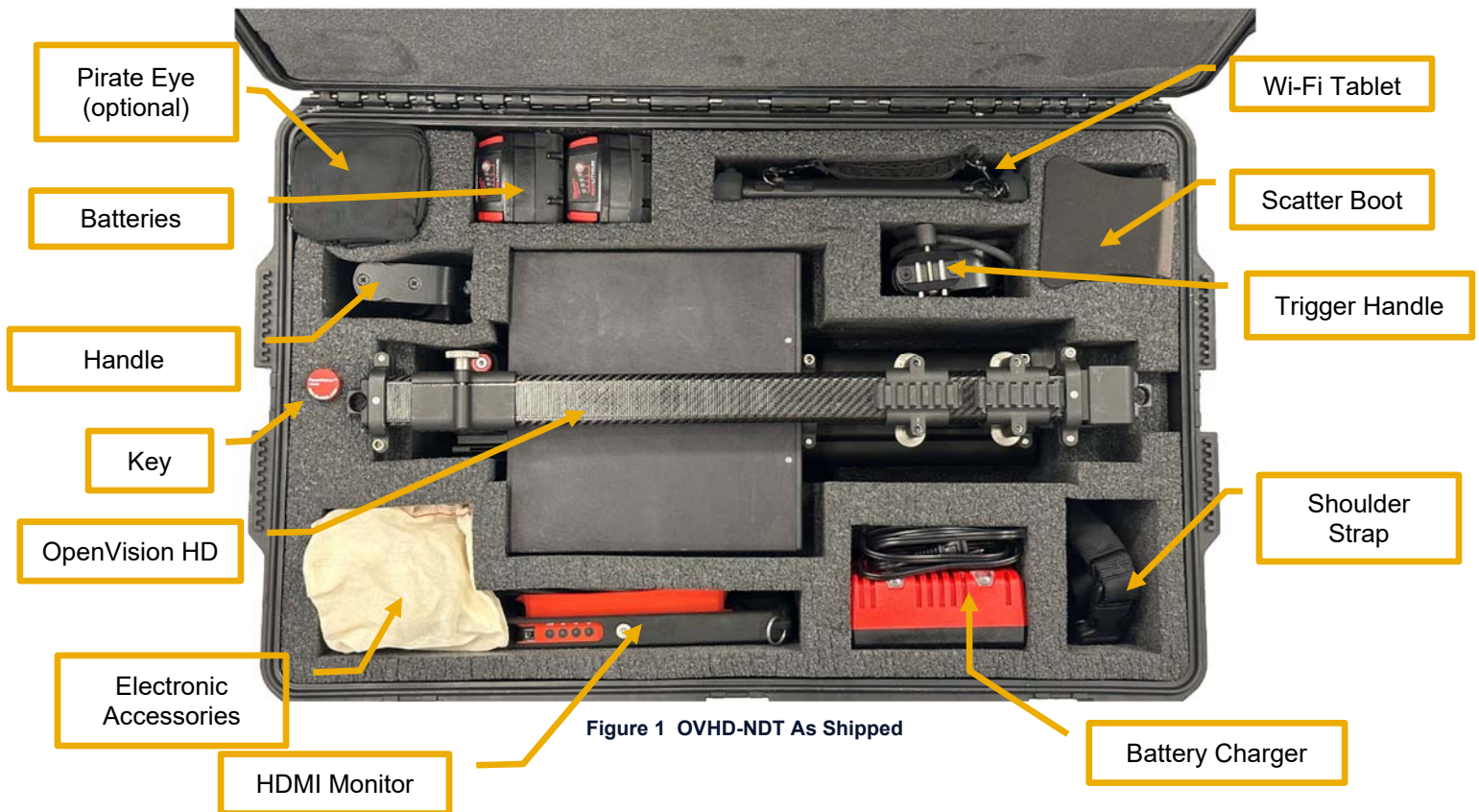
Because the blink reflex (glare aversion response to bright lights) will limit the exposure to no more than 0.25 seconds, Class 2 laser pointers are considered to be safe. Furthermore, Class 2 lasers do not harm eyes unless a person deliberately stares into the beam, making laser protective eyewear not necessary. A Class 2 laser is not a skin or materials burn hazard. NEVER aim any laser towards an aircraft or vehicle in motion.



Getting To Know Your Openvision HD.

What's Included

OpenVision™ HD is shipped complete in a custom hardsided case. Some components are packaged and placed in bags or located loose in the case.





ITEM	PART #	DESCRIPTION
1	-	Monitor Sunscreen
2	-	Tablet Charger (with optional tablet only)
3	ELE114	USB-A to USB-C Adapter – Allows connection USB-A flash drive (with optional tablet only)
4	ELE115	Ethernet Adapter – Allows connection from Ethernet to OpenVision HD or Tablet
5	ELE116	USB 3.0 Adapter – Connection from OpenVision HD USB-A to Ethernet Adapter
6	-	Monitor batteries and charger
7	-	USB charger cable – Allows for changing monitor batteries via USB outlet
8	ELE111	USB Wall Charger – Allows charging of monitor batteries via standard 120 outlet
9	TOL028	7 Piece Allen wrench set
10	313425	Bungee Sling
11	313056	Controller Key – Used to turn on / power up OpenVision HD – Removed for shipment

Figure 2 - OpenVision HD as shipped misc. components

System Overview

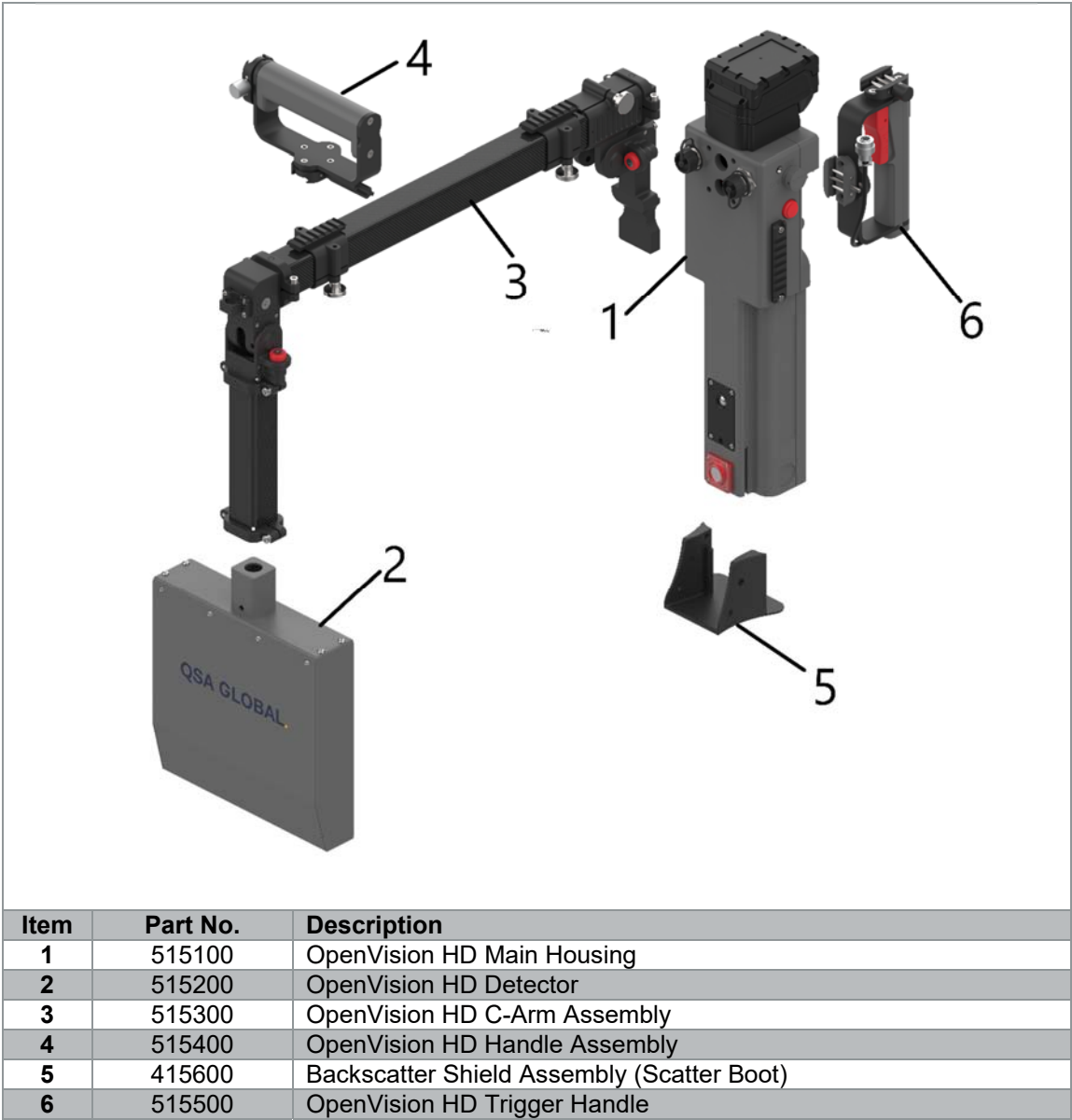


Figure 3 OpenVision HD Assembly Description

Main Housing

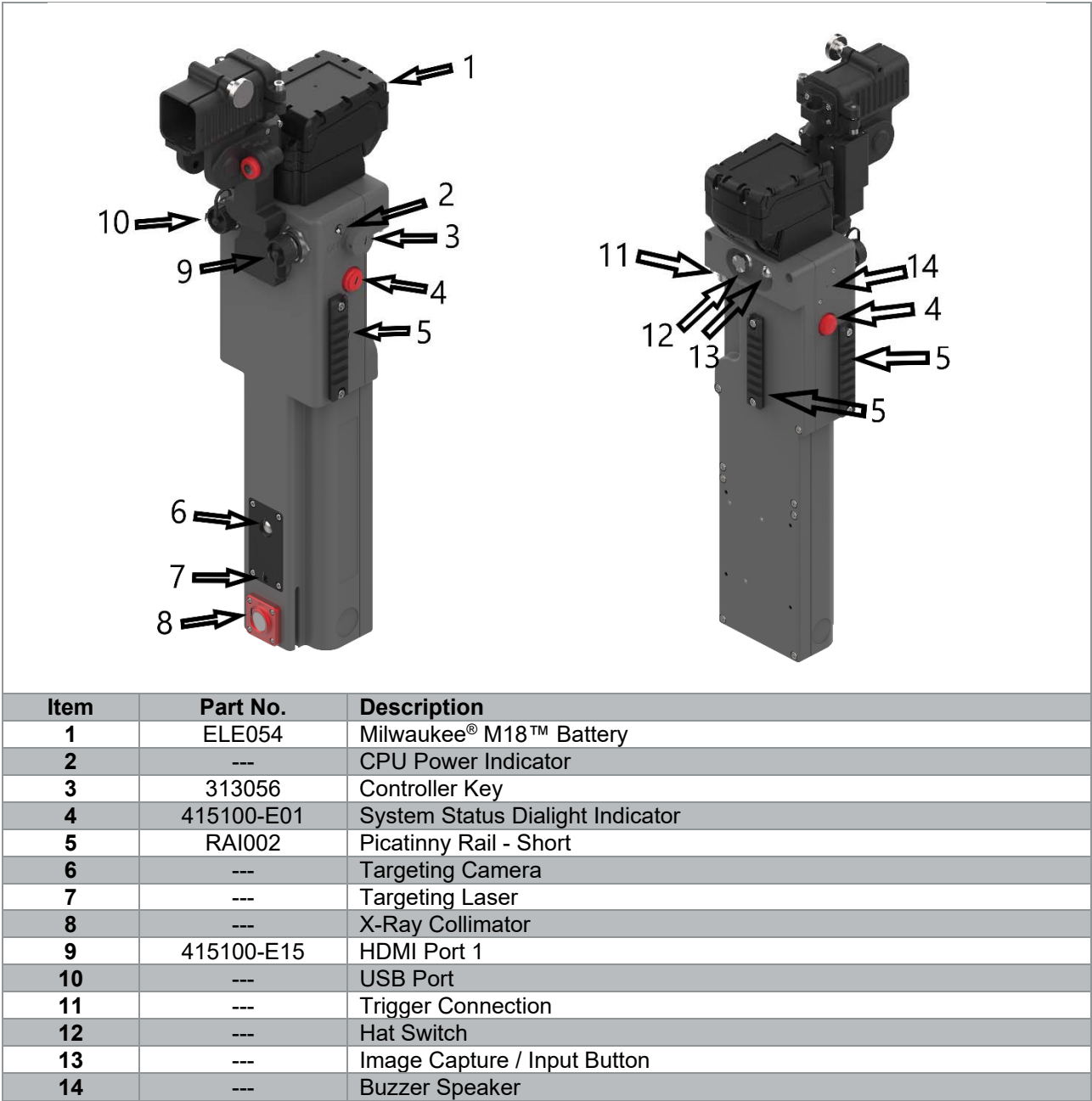


Figure 4 OpenVision HD Main Housing Assembly (Item # 415100-NDT)

HDMI Monitor

The OpenVision HD monitor (Figure 5 and Figure 6) is a lightweight 7-inch HDMI display. It can be connected to either of the two HDMI ports provided on the OpenVision HD via the HDMI cable provided. The monitor comes configured to work with your OpenVision HD system. Spare batteries and a battery charger (Figure 7) are included.



Figure 5 Monitor Assembly



Figure 6 Back of Monitor



Figure 7 Battery Charger

Trigger Assemblies

OpenVision HD comes standard with an adjustable trigger handle (Item # 515500). The trigger handle can be used for X-ray firing and image / video capture. Refer to Figure 9 for the connection location.



Figure 8 Adjustable Trigger Handle (Item # 515500)

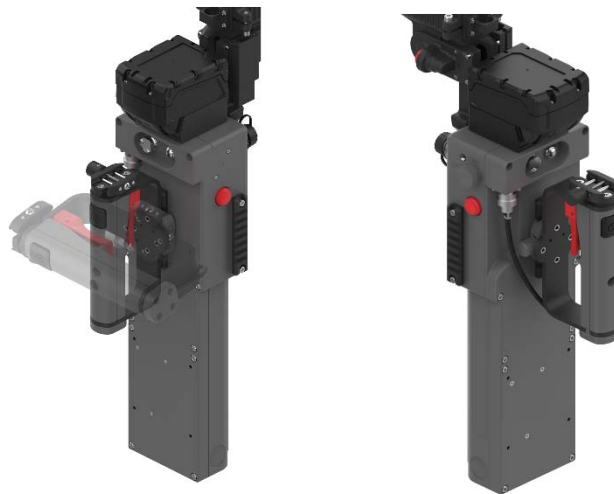


Figure 9 Trigger Handle Assembly Orientation Options

Principles Of Operation.

Radiography uses X-rays or gamma rays passing through a specimen onto an imaging medium (film, digital detector, imaging plate, etc.) on the opposite side. The quality and quantity of radiation reaching the imaging medium is largely determined by the object's thickness and density. Radiation *energy* (X-ray = kV; Gamma Ray = isotope) governs its penetrating power. Radiation *intensity* is governed by current (milliampere or mA) for X-rays, and by content activity (Curie/Becquerel) for radioisotopes.

Radiographic Quality

Radiographic quality depends on an image's photographic (density, contrast) and geometric (definition, distortion) properties. Proper *energy* and *intensity* selection are both essential for producing high-quality radiographs.

Sources (X-Ray & Gamma Ray)

Table 2 Radiation Comparisons

Radiation Source	Energy (Quality)	Intensity (Quantity)
X-Ray	Determined by voltage (kV) Higher kV = shorter wavelength = higher penetration	Determined by tube current (mA) Higher mA = more electrons = more X-rays
Gamma Ray	Determined by type of radioisotope (keV or MeV) Higher isotope energy = increasing penetrating capability: Co-60 > Cs-137 > Ir-192 > Se-75	Determined by radioactivity (Ci/Bq): Gamma Rays produced by unstable nuclei disintegrations Higher Ci = more disintegrations of nuclei = more gamma rays

Radiation Zones.

Output Radiation Levels

OpenVision™ HD radiation levels vary depending on kV/mA settings. QSA Global, Inc. performs testing at maximum power at the highest kV setting (70 kV, 0.17 mA) to verify collimation and image quality. Operators must be aware of safe boundary distances while using the OpenVision HD. When the main housing is fully expanded ("D" = 53 cm [20.8 in]), the most susceptible area of high dose rate (when specimens do not block entire X-ray output beam) is immediately adjacent to detector housing. The "C" callout in Figure 10 is positioned in this approximate area.

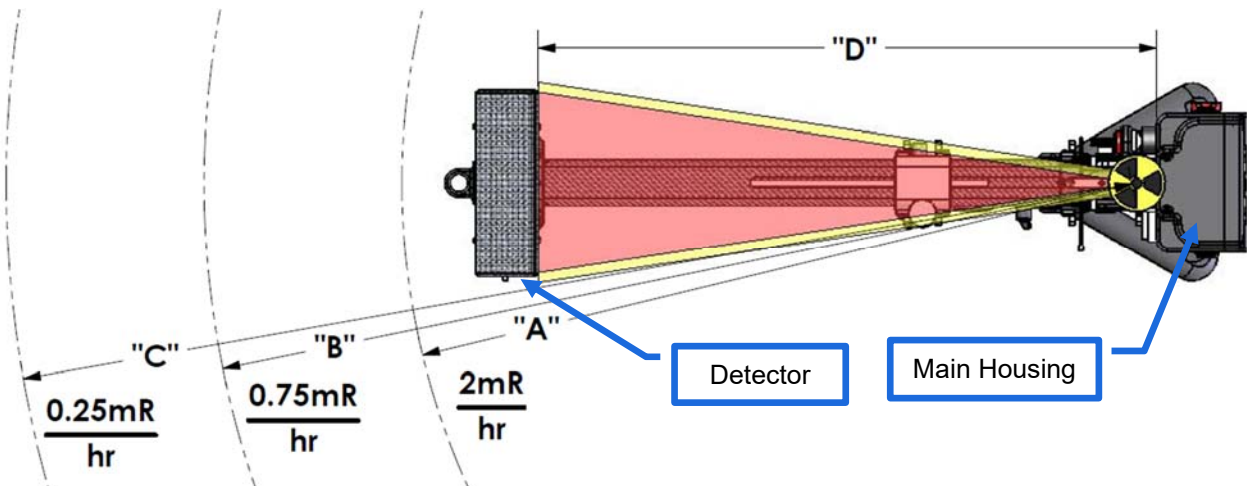


Figure 10 OpenVision HD Output Boundary Distances

Figure 10 shows boundary distances for 2, 0.75 and 0.25 mR/hr. Table 3 details typical distances for these boundary levels with different operating conditions.

Table 3 Boundary Distance Comparison

Main Housing Distance to Detector (in [cm]) "D"	kV / mA	Boundary Distance (ft [m])		
		2 mR/hr (20 μ Sv/hr) "A"	0.75 mR/hr (7.5 μ Sv/hr) "B"	0.25 mR/hr (2.5 μ Sv/hr) "C"
20.8 [53] (Fully Expanded)	70 / .17	37.84 [11.53]	61.78 [18.83]	107.01 [32.61]
13.8 [35]	70 / .17	9.48 [2.89]	15.48 [4.72]	26.82 [8.17]

Actual measurements can vary based on the material being scanned and its geometry. To minimize operator exposure, QSA Global, Inc. recommends using a backscatter shield assembly (Item # 415600) with your OpenVision HD.

Backscatter Radiation Levels

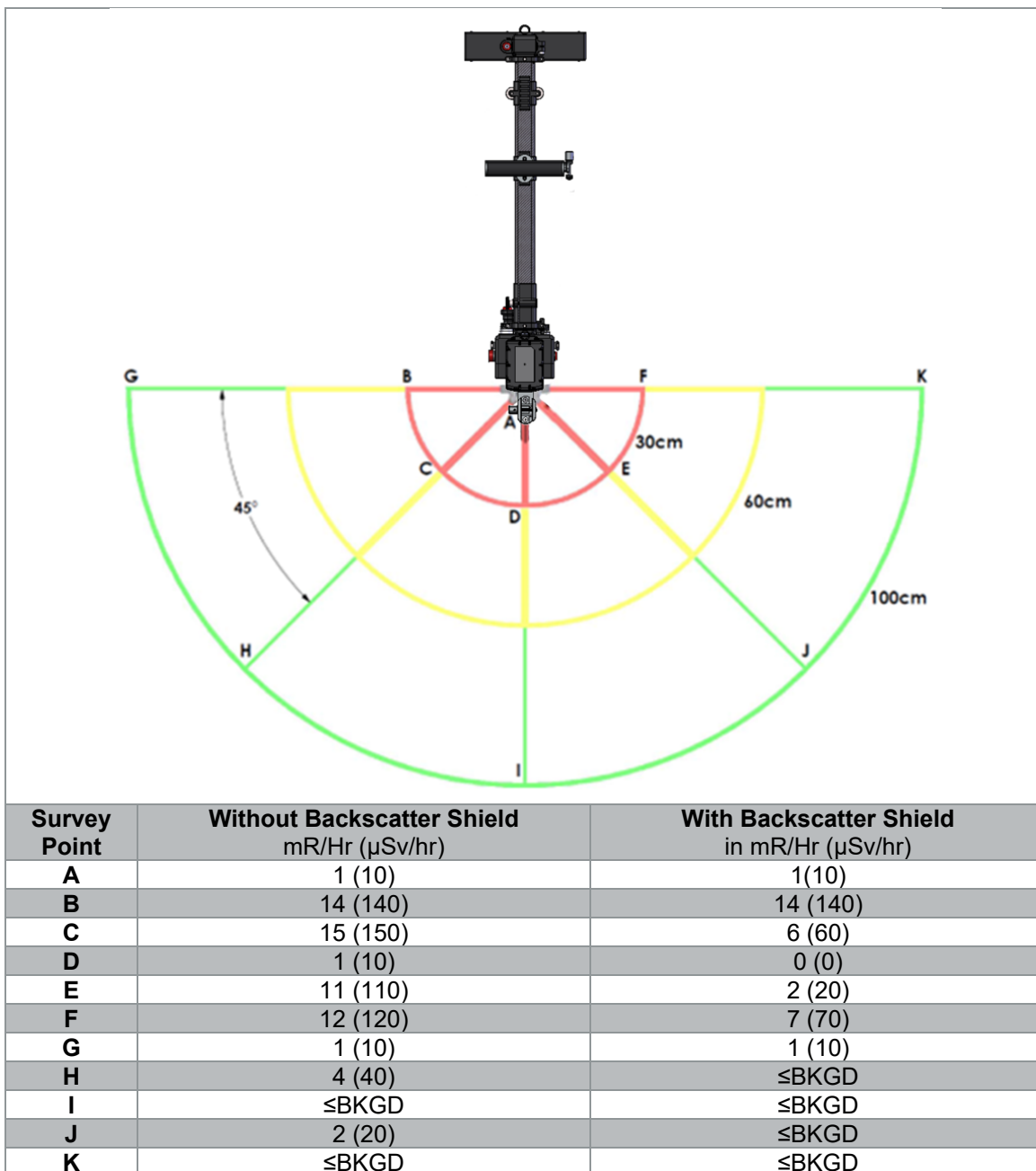


Figure 11 Example Scatter Radiation Survey

Figure 11 shows an example survey of backscatter radiation (user exposure) for a typical sample (**NOTICE:** for reference only; actual readings may vary). The example survey shown in Figure 11 was created with the following conditions:

- 6 in steel pipe
- 2 in calcium silicate insulation
- .040 in [1 mm] thick aluminum cladding
- 70 kV @ 0.17 mA (maximum power at the highest kV level)

See the following section for additional information on backscatter.

Backscatter

Backscatter occurs when X-rays interact with material (piping, insulation, etc.), potentially travelling in undesirable directions (e.g. towards the operator). Backscatter is dependent on many variables including geometry, material, and energy level. It can potentially increase the dose to the operator's extremities.

The best way to minimize backscatter is to use the lowest kV / mA combination to achieve acceptable images. Use of the optional backscatter shield (Figure 12) will help reduce the amount of backscatter when firmly applied to the scanning surface as shown in Figure 14.

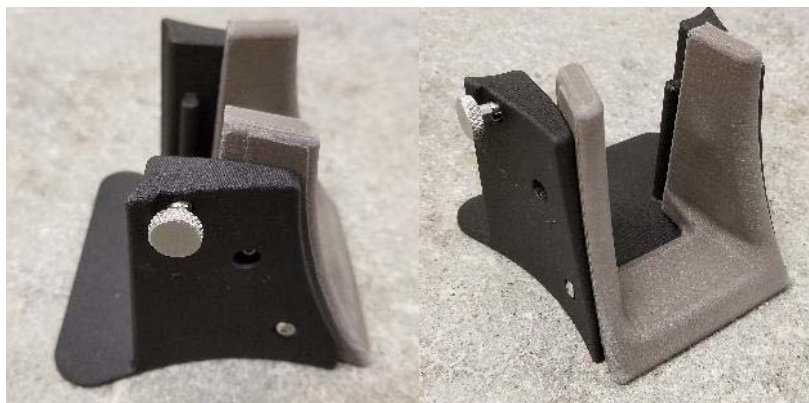


Figure 12 Backscatter Shield (Item # 415600)

CAUTION: Whenever scanning an unknown material and/or geometry, it is recommended that operators monitor for backscatter levels to minimize operator dose.

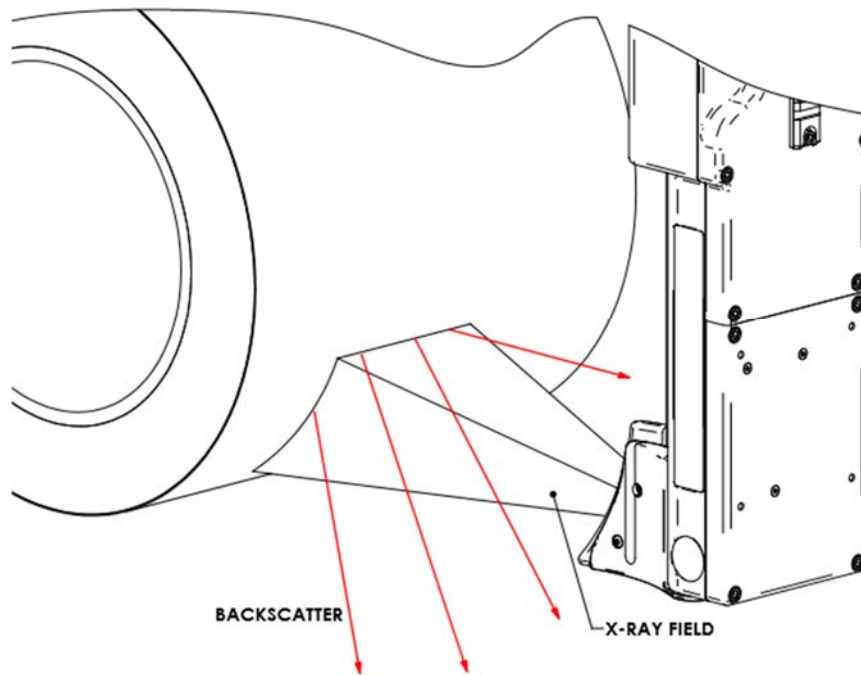


Figure 13 Example of Backscatter

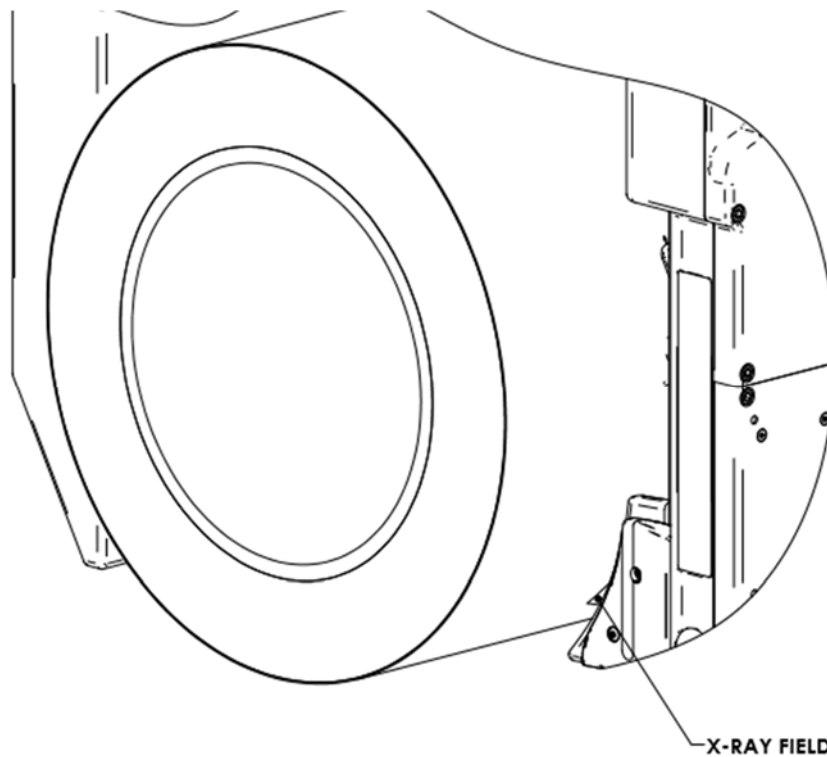


Figure 14 OpenVision HD with backscatter shield properly positioned against insulation sheathing.



WARNING

When the System Status Indicators turn AMBER (see Figure 4), ionizing radiation is being produced.

If you wish to perform extended operations with the OpenVision HD system, ensure that ambient temperatures are below 120 °F (49 °C) and above -20 °F (-29 °C).

Quick Setup / Scanning

Your OpenVision™ HD system can be setup and ready for scanning in a matter of seconds by following these steps:

- Unlock main housing by pressing red circular release button and unfold to operating position:

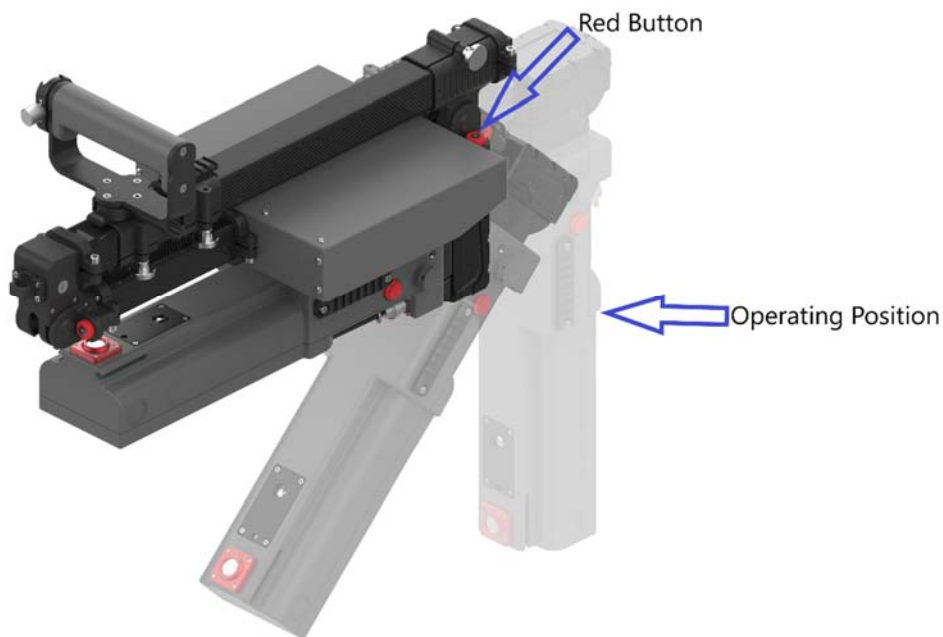


Figure 15 Unlock Main Housing

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- Repeat action for detector side:

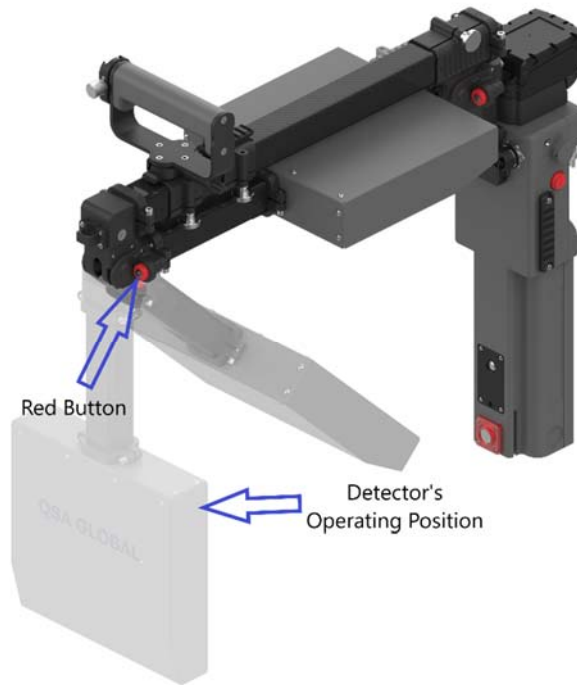


Figure 16 Unlock Detector Side of C-Arm

- Position handles, attach and position pistol grip and monitor mount as desired:

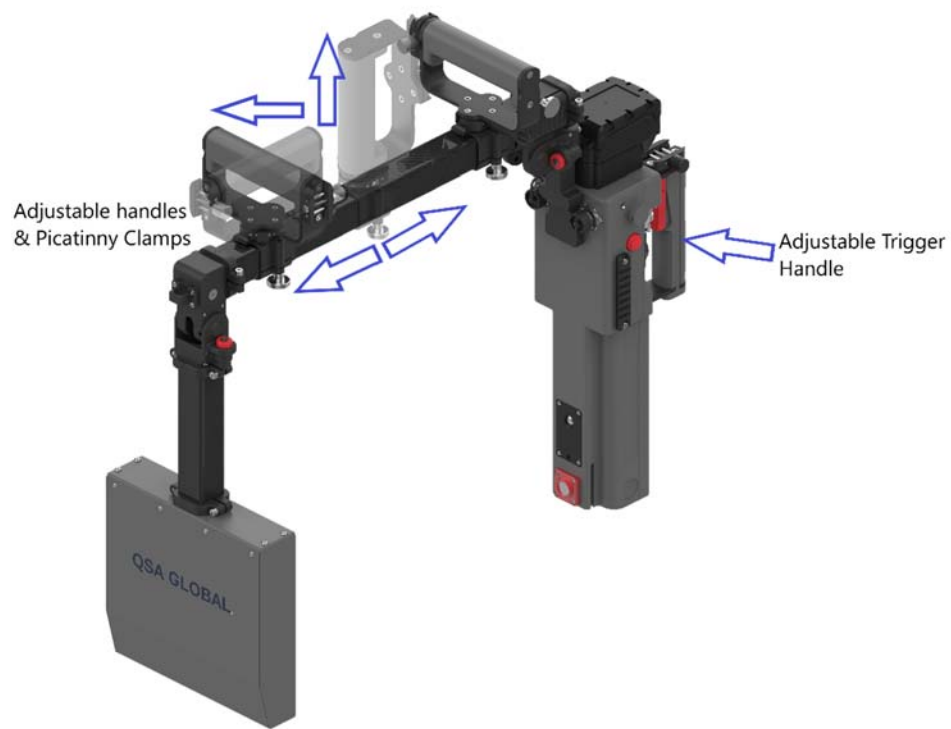


Figure 17 - Handle Adjustments

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- The OpenVision HD utilizes standard picatinny rails and allows the handles and grips to be configured in multiple ways to suit different applications (Figure 18) shows one such configuration. The grip is moved to the top tube and the D-handle is moved to the main housing.

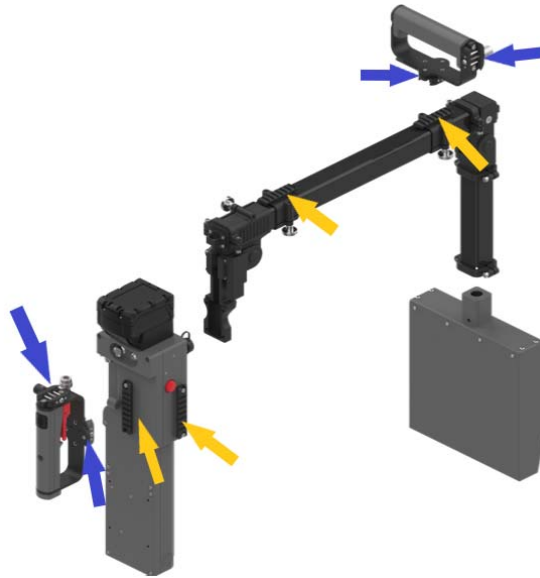


Figure 18 - Optional Handle Configuration Example

- Install the HDMI cable from monitor. Remove cover, install cable into mating connector replace cover.

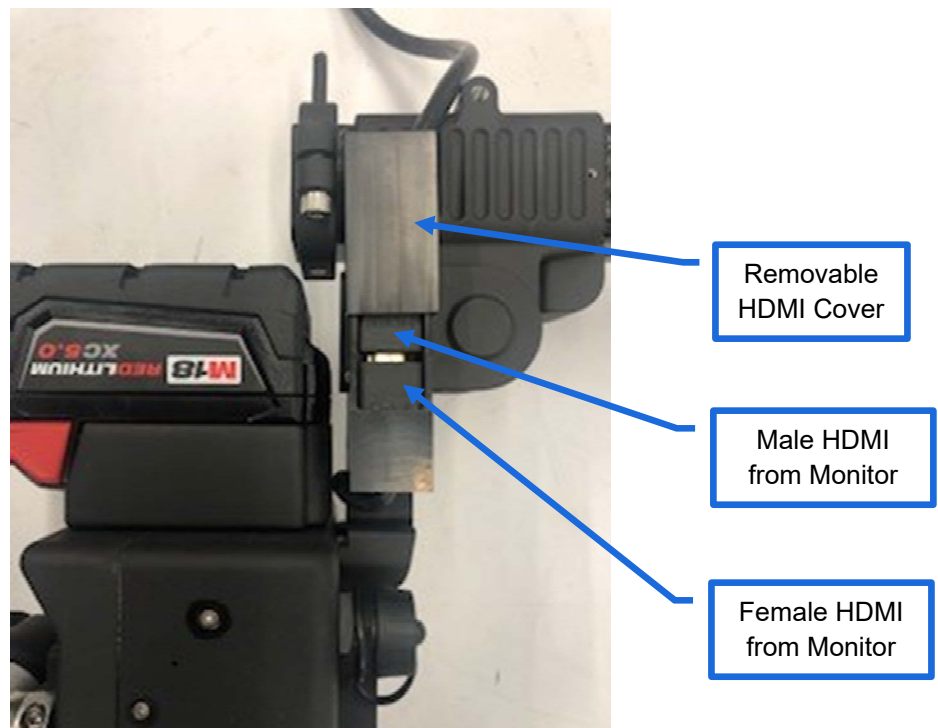


Figure 19 HDMI Cable Installation

- Turn monitor ON (located on upper-right corner of monitor).

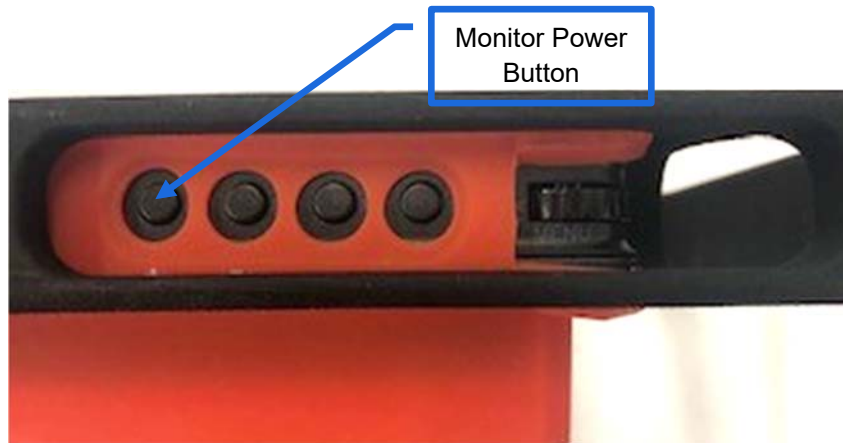


Figure 20 Monitor Power Button

- Install Trigger Switch by pushing up and twisting until it locks into place.

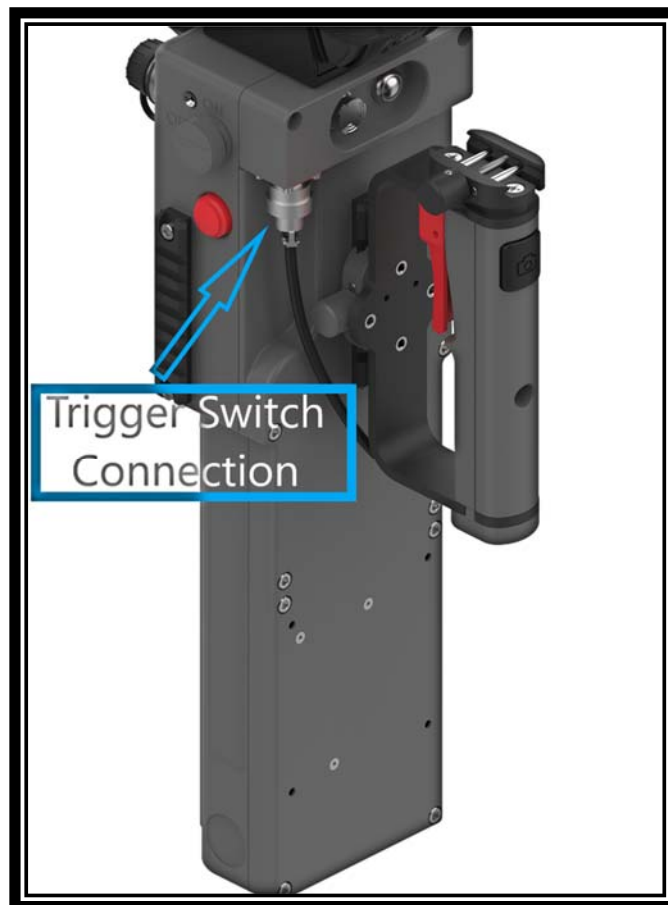


Figure 21 Trigger Switch Connection

- Install controller key and turn to ON and allow time for system to initialize. System status indicators (located on either side of main housing) will turn GREEN when system is ready.

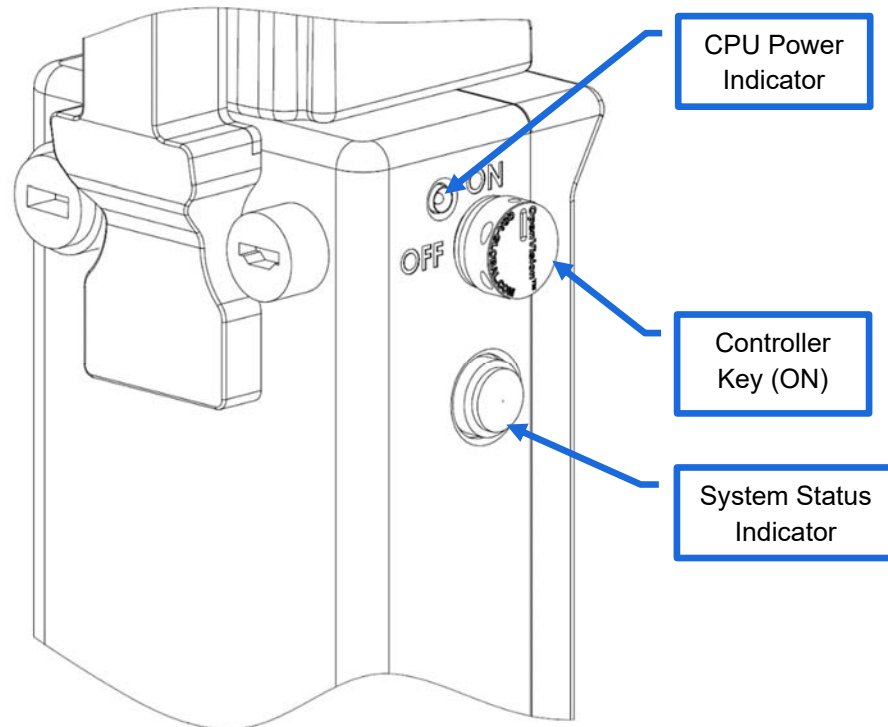


Figure 22 Indicators and Power Switch Details

- Verify kV and mA settings on main status screen.
- Safely perform test shot to verify X-ray functionality.

Accessories.

Heads Up Display (HUD)

This accessory (Item #415140) allows for an alternative to a display mounted directly to the OpenVision™ HD system. HUD specifications:

Ballistic Protection Standards:

- U.S. MIL SPEC MIL-PRF-31013
- ANSI Z87.1+
- U.S. Federal OSHA
- CE EN 166 FTKN

Temperature:

- Storage: -4 °F to 140 °F (-20 C – 60 C)
- Operating: 32 °F to 122 °F (0 C – 50 C)

Weight

- 114 g

The display position can be moved in multiple directions based on user preferences:



Figure 23 Available directional adjustments to display

To make slight adjustments to the focus, adjust the diopter to the left or right using your index finger.



Figure 24 Diopter adjustment

The standard configuration provides the image to your right eye. Clear or tinted lenses can be used based on external lighting conditions.

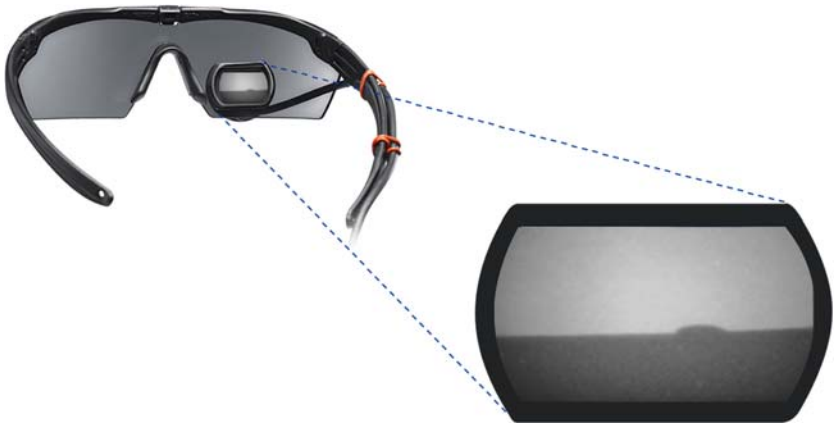


Figure 25 Example image output for HUD

1	Micro-USB charging port *
2	Video input
3	Output to heads-up-display
4	HDMI input
5	Power
6	Reduce brightness
7	Increase brightness
8	Toggle aspect ratio (4:3 / 16:9)**
9	Toggle color / black and white
*	The HUD controller must be charged separately with a USB charger. It is not powered by the OpenVision HD system. Expected battery life is 10 hours.
**	4:3 aspect ratio is recommended

Figure 26 HUD controller and power supply

Handle Options

The OpenVision HD comes standard with Trigger Handle Assembly (Item# 515500) and a non-trigger Handle (Item # 515400). The Trigger Handle and Handle can be swapped to multiple different mounting points depending on the user's preference.



Figure 27 – Item # 515500



Figure 28 – Item # 515400

Wi-Fi Tablet

The Wi-Fi Tablet assembly (Figure 29) allows for wireless viewing and recording. See the software user manual (MAN-066) for operation instructions.



Figure 29 Wi-Fi Tablet (Item # 415430)

Maintenance.

The OpenVision™ HD has been designed to require minimal maintenance by the operator. QSA Global, Inc. recommends daily visual inspection of the system. Specific attention should be paid to the following:

- M18™ battery and its mount (on top of Main Housing) – Ensure both are clean, and in sound shape.
- HDMI cable – Inspect for any cracks or wear.
- Allen/thumb screws – Check for tightness.
- Detector cover – Check for excessive wear.

Use a soft, damp cloth to clean to remove dirt and grime from the OpenVision HD.

CAUTION: Do not use solvents or apply cleaning agents directly on the OpenVision HD as this can damage the components and/or corrode the electronics.

CAUTION

Opening the OpenVision HD housings potentially will damage the system and will void any warranty. If faced with any issues with the OpenVision HD, contact your QSA Global, Inc. representative immediately for guidance.

The OpenVision™ HD has been designed as a rugged, safe, and reliable system. A series of interlocks and self-checks are built in to ensure safe operation. These checks may trigger an error code which will prevent normal. Use Table 4 as a reference guide for system error codes.

NOTICE: Prior to any troubleshooting, please ensure that a fully-charged M18™ battery is installed. A low battery may cause system to report false error codes.

Table 4 Error Code Guide.

Error Code	Description	Corrective Action
001	Memory Failure	Hard drive and/or system memory error or failure. If restart does not clear error, contact your QSA Global, Inc. representative for repair options.
002	LED Failure	Status Indicator LED(s) are not functioning properly. If restart does not clear error, contact your QSA Global, Inc. representative for repair options.
003	X-ray Tube Failure	X-ray tube is not communicating or has malfunctioned. If restart does not clear error, contact your QSA Global, Inc. representative for repair options.
004	X-Ray Over Temperature	X-ray tube has exceeded its operating temperature, forcing system to stop emitting X-rays. Perform following actions to recover from this error: <ul style="list-style-type: none"> • Turn off unit • Place in cooler environment for 30 minutes • Turn unit on
005	Board Over Temperature	Main control board has overheated. Perform following actions to recover from this error: <ul style="list-style-type: none"> • Turn Off unit • Place in cooler environment for 30 minutes • Turn unit on
006	Imaging Camera Failure	Communication error and/or failure with targeting camera. Perform a system restart, if a restart does not clear the error, contact your QSA Global, Inc. representative for repair options.
007	Targeting Camera Failure	Communication error and/or failure with targeting camera. Contact your QSA Global, Inc. representative for repair options.
008	Low Voltage	M18™ battery has insufficient charge; change battery.
009	Camera Communication Error	Communication error with internal camera. Cycle system power to clear error.
010	Camera Communication Error	Communication error with internal camera. Cycle system power to clear error.



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Appendix 1: Parts List.

Part #	Description
OVHD-NDT-70	OpenVision HD System, Complete
515400	OVHD Handle Assembly
415440	OVHD Lightweight Monitor Assembly
415600	OVHD Backscatter Shield Assembly
ELE088	HDMI Cable
ELE054	Milwaukee® M18™ Battery
313056	Controller Key
415140	Pirate Eye Head Mount Display
415430	Tablet Assembly