



System EM14809
Camera EM13686
Insertion Encoder EM13943

MZ-5™ HD-UV Inspection System

User Operation and Service Manual



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Federal Communications Commission (FCC) Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 (and Parts 25 and 90) of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy; and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications.

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IMPORTANT: If you are in possession of a printed or electronic version of this document, be aware that it may not be the current version. To ensure that you are using the most up-to-date version of this document, please contact the InterTest Customer Service and Support Group.

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Chapter 1 — Preface and General Information

About This Manual

Disclaimer



IMPORTANT: This manual contains information about the MZ-5™ HD-UV Inspection System (MZ-5™ HD-UV Inspection System), manufactured by InterTest, Inc. and contains information, which is reasonable and customary for this type of equipment.

No representations or warranties are made as to the accuracy or completeness of the information contained herein. In addition, no representations or warranties are made as to the completeness and compliance of any test procedures, which are performed using this Equipment. Because this manual was designed for quick reference, it is restricted in scope to the operation of the system. Should you have questions beyond the scope of this manual, please call the InterTest Customer Support Group.

Purpose

The intended audiences for this manual include InterTest, Inc., End Users, Field Support Personnel, Product Evaluators, and qualified third-party personnel. It is primarily intended for personnel who are using the equipment and those responsible for test procedures.

OSHA Compliance and Safety Guidelines

OSHA (the Occupational Safety & Health Administration of the United States Department of Labor) has established specific standards for Personal Protective Equipment (PPE). The standards are detailed in the document entitled *General Requirements 1910.132, (Standards - 29 CFR)* and should be reviewed by all personnel prior to working on InterTest, Inc. equipment and systems. Refer to <http://www.osha.gov/> for information about steps that must be taken to protect the eyes, face, ears, hands, and other body parts from potential harm. It is the responsibility of the technician or other service personnel to adhere to all OSHA guidelines as they concern PPE devices and their proper use.

Revision Information

As it becomes necessary to revise this manual, InterTest will give the reasons for the revision in this section.

Revision	Description	Revised By	Approved By
Original	Initial Release	KB	
B	Updated with Revised Software	KB	

Manual Versions

Refer to the cover page & the document footer for the manual version.

When troubleshooting a problem that may occur, InterTest Customer Service and Support Personnel may ask for this information in order to ensure that the user is referencing a suitable version of the manual.

Cautionary Symbols and Symbol Terminology

Table A describes the various symbols that may be included in this manual and mounted on the equipment. The severity level of a potential hazard varies. Refer to Table B for hazard level descriptions.

Table A — Manual and Equipment Safety Symbols






Symbols	Definitions
	DANGER/WARNING/CAUTION: Risk of electric shock.
	DANGER/WARNING/CAUTION: Refer to instruction manual.
	DANGER/WARNING/CAUTION: Explosion Hazard.
	DANGER/WARNING/CAUTION: Avoid exposure to water and liquids.
	DANGER/WARNING/CAUTION: Avoid eye and skin exposure to UVA Light.

Table B — Description of Cautionary Terms

Cautionary Term	Description
DANGER	Indicates the presence of an extreme hazard that will probably cause death or severe personal injury. Hazards of this kind MUST be avoided at all cost.
WARNING	Indicates the presence of a hazard that could cause death or severe personal injury. Hazards of this kind MUST be avoided at all cost.
CAUTION	Indicates the presence of a hazardous condition that can or will cause minor personal injury or property damage if the hazard is not avoided. The Caution Indication is also used for property-damage-only accidents. The Caution Indicator may be used to warn against potential equipment damage and possible service interruption.

Safety Considerations

Preface

This manual describes this equipment, its functions, and its use. It also describes the precautions to be taken to ensure safe operation. Please read this manual thoroughly before attempting to operate the equipment. By doing so, you will familiarize yourself with the equipment's capabilities and understand its functions. After you finish reading this manual, store it in an accessible location for future reference.

Carefully follow all warnings and instructions included in this manual and marked on the equipment.

Operational, General Safety Considerations and Precautions

Always observe the guidelines and precautions that follow.



DANGER, Risk of Electric Shock: Unplug the power cord from the wall receptacle when advised to do so in a procedure. Be advised that the equipment must be turned off when service work is required.

Never remove the top cover of the controller. Electrical shock hazards exist due to high internal voltage. There are no user-serviceable parts inside the controller, except for fuses, which are accessible via the rear panel. Refer all service to the InterTest Customer Service and Support Group.



IMPORTANT: To ensure operator safety, read and understand this manual before using the system. Using any piece of this equipment in a manner not specified by the manufacturer does not protect the user from harm.

In addition, accessories listed in this manual are the only accessories considered suitable for use with this system. Accuracy of the rotary encoder is compromised when the probe is operated at steep angles.

To avoid injury, read and understand the associated documentation for MZ-5™ HD-UV Inspection System component prior to attempting operation. Direct any questions about equipment operation to the InterTest Customer Service and Support Group at 908-496-8008 or via email to service@intertest.com.



DANGER, Explosion Hazard: Do not use this system in explosive environments. The controller requires adequate ventilation to prevent overheating. Do not cover or drape the controller. To ensure adequate airflow, provide a three-inch (7.6 cm) clearance between the controller chassis vents and any solid objects.



IMPORTANT If LED's need servicing. Contact InterTest

IMPORTANT: Proper use of this product requires a protective earth ground path at the AC power source. Using a two-conductor extension cord or any other device that compromises this ground path is in violation of safe operating guidelines.

The unit should never come in direct contact with any voltage or current source. Damage to the equipment and/or electrical shock to the operator may result.

The unit is equipped with a power supply mounted in the back of the equipment. It accepts a 3-wire grounding type plug only. It is necessary that the equipment be grounded. The plug will only fit into a grounding-type power outlet. This is a feature for the user's safety. Never use an adaptor to bypass this very important safety feature. If you cannot insert the plug into the wall outlet, contact an electrician to replace what may be an obsolete wall

outlet. Under no circumstances should the user attempt to defeat the purpose of the grounding-type plug.



Never attempt to modify the power cord. Do not insert or unplug the power plug with wet hands. This could result in an electrical shock. When unplugging the power plug, always grasp its plug portion. Never pull on the power cord directly. Pulling on the power cord may expose or snap the internal wires, which would weaken or damage the power cord and result in an electrical shock.

Do not place anything on top of the power cord. Never locate the equipment where people will walk on the power cord or where heavy items may move over it. Never stretch or excessively bend the power cord. Always insert the power cord's plug completely into the socket. Failure to do so could result in a fire or an electrical shock.

Never use power cords other than the power cords that were provided. Using improper power cords could result in a fire or an electrical shock.

For safety reasons, the use of an extension cord is not recommended. If an extension cord must be used with the equipment, ensure that the total amperage rating of the extension cord is equal to or greater than 15 amperes. If an extension cord must be used, never allow other devices to share the extension cord.



IMPORTANT: Never use the equipment in a wet or overly damp location. Exposing the equipment to water or other liquids could result in a fire or an electrical shock.



IMPORTANT: The MZ-5™ HD-UV Inspection System is to be used for inspecting gun tubes, Tank gun tube, mortar tube, ship gun tube, turbine rotor bores, generator rotor bores, shaft and pipe inspections **ONLY**. Improper use of this product for objects for which it is not intended or for environments for which it is not intended will void the warranty. Warranty information can be found starting on Page **15**.



CAUTION: The UVA output is an eye and skin hazard. Do not allow close or prolonged exposure to the UVA output of the MZ-5™ HD-UV Inspection System. UV Eye protection is required for close or prolonged exposure.



Chapter 2 — Introduction to the MZ-5™ HD-UV Inspection System

Overview

Figure 1 shows the MZ-5™ HD-UV Inspection System

Camera Assembly

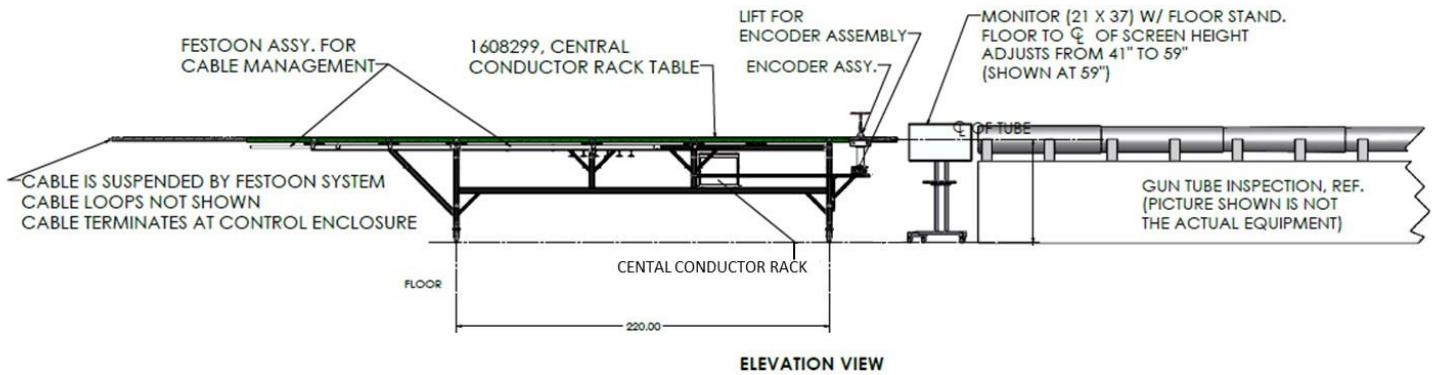


Figure 1 MZ-5™ HD-UV Inspection System as Installed on Central Rack

MZ-5™ HD-UV Components Description

The MZ-5™ HD-UV Inspection System Components are detailed below in

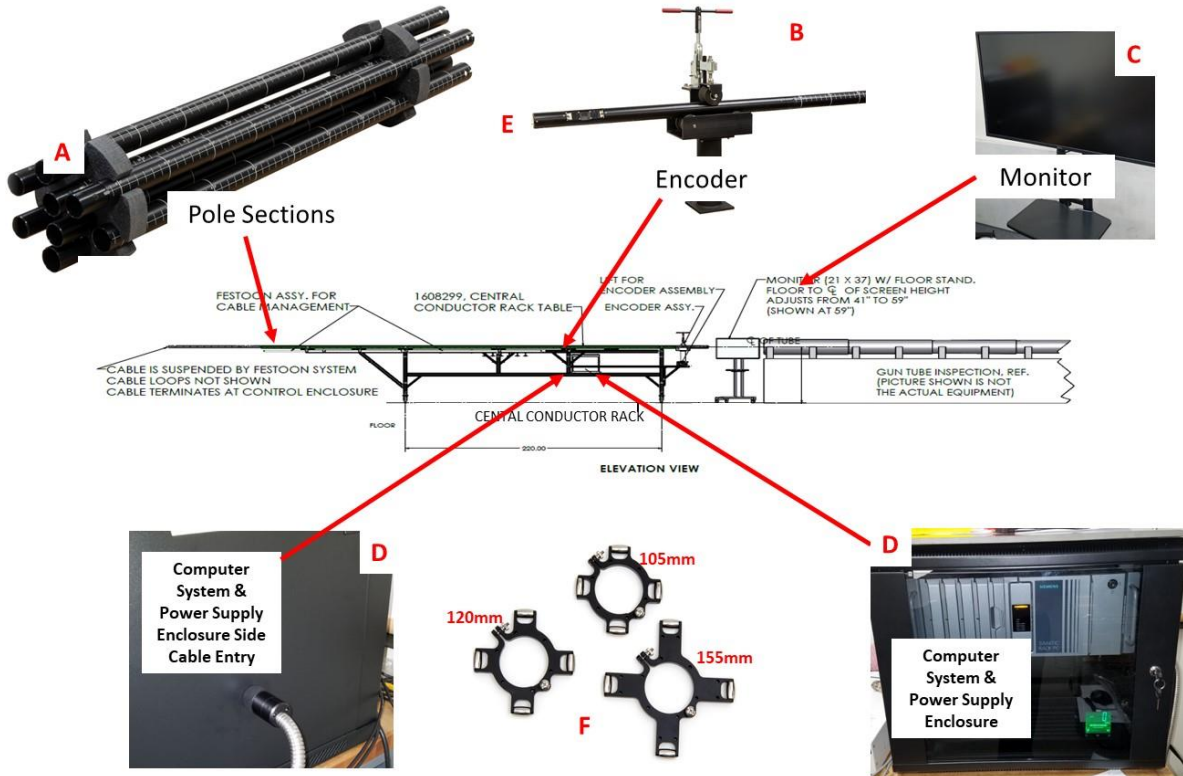


Figure 2 MZ-5™ HD-UV Inspection System Components Description (Not Assembled)

Table C — MZ-5™ HD-UV Inspection System Components Description

Item	Description
A	Pole Sections
B	Horizontal Encoder
C	Monitor with Stand
D	Computer System, UPS & Power Supply Encoder
E	Camera Head Assembly
F	Centering Fixtures

System Features

The system is designed for the internal visual inspection of gun tubes, mortars, howitzers, and cannons utilizing white and/or UV illumination. The 40-inch length x 57 mm outer diameter head contains two cameras that visually reveal the general state of a gun tube's interior. The head is equipped with one high-definition camera for viewing axially down tube, and one high definition camera directly viewing the tube inside surfaces.

The camera head provides direct down-bore and sidewall images, allowing the operator to pinpoint the location of surface features. The front view camera has a fixed focus lens with a 104° vertical & 124° wide field of view. The side view camera is remotely focused permitting highly detail images of the gun tube wall.

The rack mount unit contains a computer, uninterruptable power supply, storage compartment & the system electronics. System operation and image capture functions are done using the computer. The camera head is connected to the rack through a side mounted Optical Fiber and Power connector.

A 43" high definition, 4K IPS monitor is mounted on a rolling cart at the operator's station. It displays the selected camera's image from either the down tube or side view cameras.

System Functionality

The intended use of the MZ-5™ HD-UV system is to inspect the interiors of large bore gun tubes. It is able to find erosion, cracks, missing rifling, forcing cone wear, carbon buildup, and copper buildup. Under UV illumination, the system will see the fluorescent results of a magnetic particle test (MT) or fluorescent penetrant inspection (FPI). The included centering devices ensure the camera head is centralized within the gun tube achieving maximum inspection performance. The unit fits 105 mm, 120 mm, and 155 mm barrels (additional sizes available upon request). It can be adapted to other size guns with additional centering rings.

An operator may toggle between camera views; one viewing forward and one viewing to the side at the tube sidewall. Arrays of high-intensity LED's surrounding each camera view ensure ample white light illumination and arrays of UV LEDs provide illumination for inspections use black light techniques. The insertion tube is marked for down tube location measurement. A roller clamp sensor tracks down tube position and an internal sensor tracks the cameras rotation. Both of which are displayed on-screen.

A 43-foot sectional pole assembly allows easy insertion and has measurement graduations marked in inches aiding in the identification of the flaw or corrosion location in the bore. Applications include: Tank gun tube, mortar tube, ship gun tube, turbine rotor bores, generator rotor bores, shaft, and pipe inspections.

Specifications

Refer to Table D for general specifications and Table E for forward and side camera specifications.

Table D — General Specifications

Item	Description
Camera Rack Mount Controller Console	Records, Adjusts Focus (Side View) & Light Intensity
Pole Assembly	43 feet overall length with head installed
Centering Fixture Mounting Collar Set	Allows for easy switching of centering rings??
Centering Rings	105 mm, 120 mm, and 155 mm
Heavy Duty Camera Cable	25 meters
4K Monitor	Dell 16:9 4K IPS Monitor

Table E — Front Camera Specifications/Side Camera Specifications

Item	Description
Signal System	USB3 Camera
Image Device	1/2.45-type Exmor CMOS (13.19 megapixels)
CMOS Effective Pixels	13.9MP
Digital Zoom	16X
End Camera Focus	Fixed w/ 104° Vertical & 124 Horizontal FOV
Side Camera Focus	Remote
Minimum Object Distance	50 mm (wide end)
Minimum Illumination	6 lux (F1.2)
Operating Temperature	-5 degrees to 50°C (23°F to 122°F)
Storage Temperature	-20 degrees to 60°C (-4°F to 104°F)

Customer Support

Service and support for all InterTest products is available by calling the InterTest Customer Support Group at (908) 496-8008. We also welcome comments, suggestions and technical inquiries by fax at (908) 496-8004 or email to service@intertest.com. Information about our warranty policy and its limitations follows in the next section.

Warranty Statement



IMPORTANT: The MZ-5™ HD-UV Inspection System is to be used for inspecting tank gun tube, mortar tube, ship gun tube, turbine rotor bores, generator rotor bores, shaft, and pipe inspections ONLY. Improper use of this product for objects for which it is not intended or for environments for which it is not intended will void the warranty.

InterTest, Inc. guarantees the custom products manufactured by InterTest, Inc. to be free from defects in materials and workmanship for a period of one (1) year, from the date of original purchase. Any and all other products not manufactured by InterTest, Inc. will carry the OEM's limited warranty, which will be passed to the purchaser through and supported by InterTest, Inc. InterTest, Inc.'s obligation under this limited warranty shall be confined to the repair or exchange of any part, or parts thereof, that prove defective under normal use and service for which the product was intended and/or designed for.

This limited warranty covers conditions that upon our examination at our facility shall disclose to our satisfaction to be defective.

This limited warranty is in lieu of all other warranties, express or implied, including the warranties of merchantability and fitness for use and of all other obligations or liabilities on our part, and we neither assume, nor authorize any other person to assume for us, any other liabilities in connection with the sale of InterTest, Inc. equipment. This warranty shall not apply to any equipment that has been subject to accident, negligence, alteration, abuse, unauthorized repair, improper storage, or other misuse.

This limited warranty applies only to the original purchaser and cannot be assigned or transferred to any third party without express written consent from InterTest, Inc.

This limited warranty does not apply to consumable items, expendable items, or normal wear and tear, nor does it apply to failure due to radiation, overheating and / or below freezing temperatures.

Additionally, InterTest, Inc. assumes no responsibility, either expressed or implied, regarding the improper usage of this equipment or interpretation of test data derived from this product. InterTest, Inc.'s responsibility and obligations, in all cases, are limited strictly to the repair and/or replacement costs outlined above. All sales will be considered final and all orders are non-cancelable, non-returnable and non-refundable.

The laws of the State of New Jersey shall govern this warranty.

NOTE: In the event that the equipment can not be returned to InterTest, Inc. for any reason, the customer agrees to pay for all travel and living expenses incurred to have an InterTest, Inc. Representative evaluate, assess or affect a warranty repair in the field.

Returns for Repair or Service

In the event a product is damaged and needs repair, it must be sent to the Service Department at the main office in Columbia, NJ. An RMA (Return Merchandise Authorization Number) must be issued prior to the unit being returned. **Call InterTest, Inc. at (908) 294-8008 to obtain an RMA Number.** When shipping the product to InterTest, Inc. be certain to include the proper value for shipping insurance. Shipments returned without an RMA will be refused or an administrative fee may be applied to the transaction.

Be prepared to provide the product number, serial number and a brief description of the problem or damage in order to obtain an RMA number.

Return Procedure

Once a product is received by InterTest, Inc. it will be evaluated by one of our qualified technicians. The fee for any repair evaluation not sent in under warranty is \$55 (USD). This cost is in addition to any other charges required. Prior to any repairs being completed, a repair evaluation will be issued and payment must be arranged. Payment via credit card is preferred and will expedite the repair process.

Once payment is arranged, the authorization to repair the product is given. Completed repairs will ship back to the customer using the pre-arranged shipping methods.

Unpacking and Examination

Before setting up the system, refer to the safety sections of this manual. The following items come standard with your MZ-5™ HD-UV Inspection System:

To unpack the system, first remove all tape and packing material from the components. Next, carefully inspect each piece for damage and/or missing parts. Inspect all control panel knobs and switches for proper operation. If any portion of the system has suffered damage during shipment, notify InterTest Customer Support Group at once.

NOTE: Retain all packing material for possible future use (in the event that the system or system components need to be shipped in the future).

- Computer & Power Supply Enclosure
- Dual View Camera Head
- Bumper Guard
- 8ea. 4 foot long poles
- 25 Meter Camera Cable
- Set of 3 of Rotating Centering Rings (105, 120, and 155 mm)



Chapter 3 — General Operation and Components

Introduction

This chapter describes how to assemble and prepare the system for use. Sections include the following:

- Assembly Guidelines
- System Assembly Procedure
- Control Box Console Functions
- Pendant Controller Functions

Assembly Guidelines

After examining the individual components, you are ready to assemble the system. Be sure to follow these safety precautions as you work:

- Keep the system on a flat, level surface at all times.
- To unplug a power cord, pull using the plug body and not the cord.
- Connect cables and cords for the system first before plugging the power into main power.
- When disassembling the system, make disconnecting the main power your first step after shutting down all individual components' power.
- Never plug the system into an ungrounded outlet.

System Assembly Procedure



IMPORTANT: DO NOT submerge the Camera Head, Control Box, and any other component in water or any other liquid. When cleaning the Camera lenses, do not use cleaning liquids, rather use clean non-abrasive lens tissue only. Never use cotton swabs to clean a lens.

To assemble the system, perform the following steps:

- (1) **Refer to Figure 3:** Take 6' insertion pole with the section that starts at 3 feet mark and slide over and up the 25 Meter Power & Fiber Cable off the back of the Camera Head. Once the pole meets the base of the Camera Head, snap together. Repeat steps for other 7 poles so the measurement markings are in ascending, numerical order. The measurement markings on the poles should line up if snapped together correctly.

Note: Pole sections are designed to be assembled in a specific order



Figure 3-Camera Head & Pole Sections

- (2) Refer to Figure 4. Make sure the Rack Mount Control Unit is powered **down**. The **ON/OFF** Switch for the system can be found on the front of the UPS. The display will not be lit if the unit is **“OFF”**

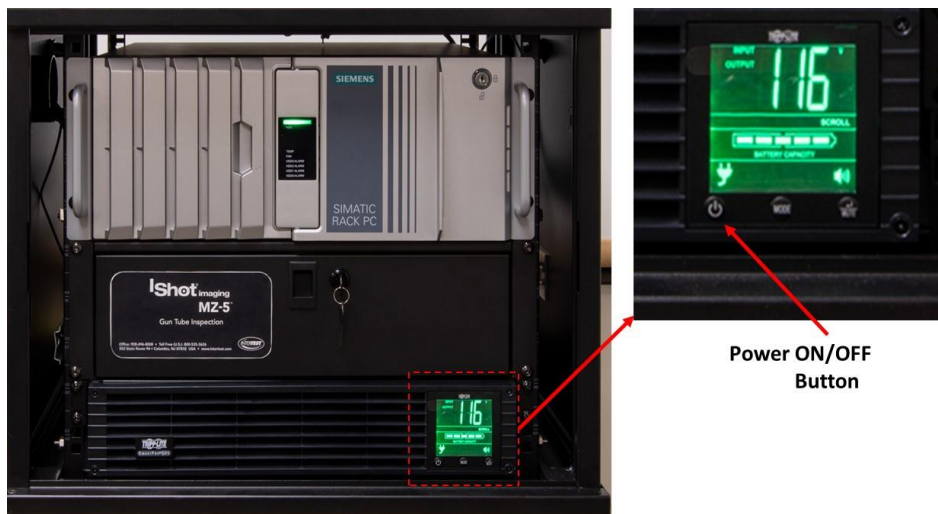


Figure 4 System ON/OFF

- (3) Once the cable is fed through the Insertion Poles, **Refer to Figure 5** to make sure the unit is powered **OFF**. **Refer to Figure 6** Attach the large connector for the Power & Fiber Cable connector on the right-side Rack Mount Computer Control Unit. “

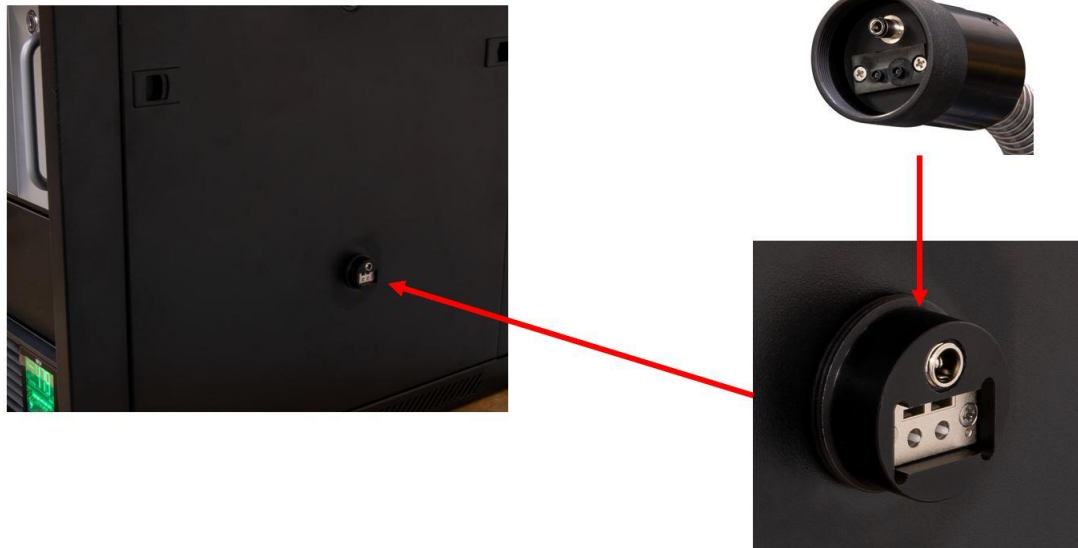


Figure 5-Attach Fiber and Power Cable to Rackmount Box

- (4) **Refer to Figure 6**: thread the Bumper Guard into the Camera Head.



Figure 6-Thread in Bumper Guard into Camera Head



IMPORTANT: Always power down the system prior to changing centering rings.

- (5) Refer to Figure 7. Unlock the encoder handle. Feed the camera / poles into the Encoder assembly. Lock the handle.

Note: Centering rings can only be attached after it has passed through the Encoder.

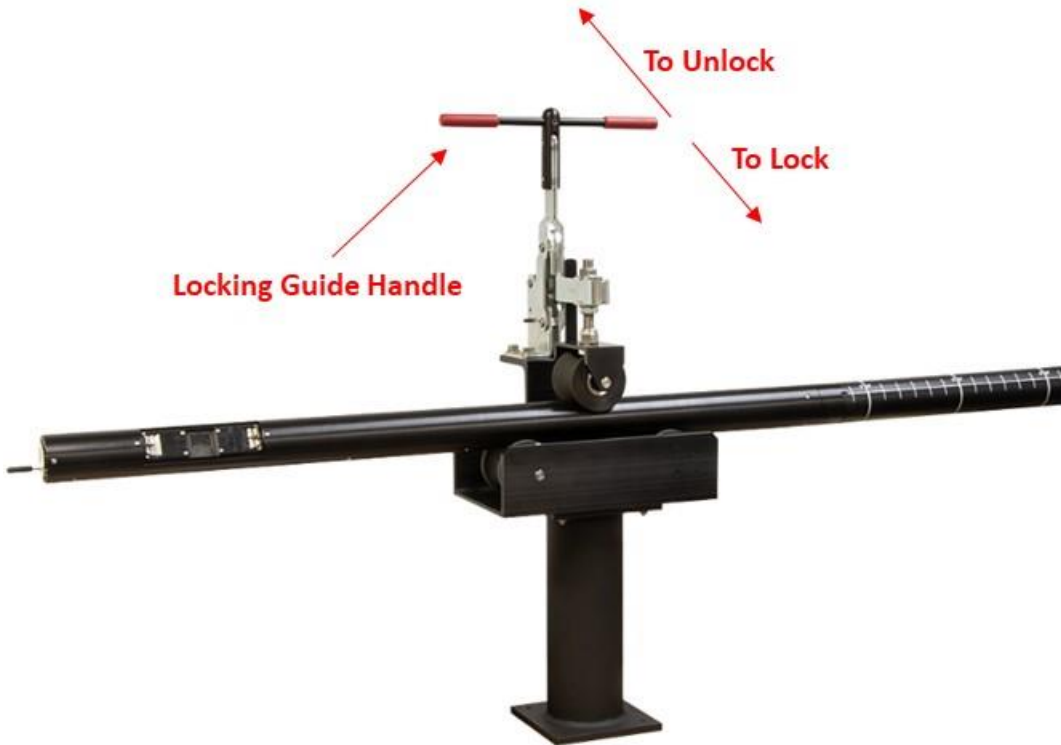


Figure 7 Linear Encoder

- (6) **Refer to Figure 8:** Mount the Centering Rings to the Camera Head first, loosen the integrated thumb screw. Place the appropriately sized ring, 105, 120, or 155mm around the camera. and tighten the thumb screws. Next place centering rings on the pole(s) as needed. Refer to figure 9 on next page. The Camera Head & single pole are pictured with the Centering Rings attached.

Note: Centering rings can only be attached after it has passed through the Encoder.

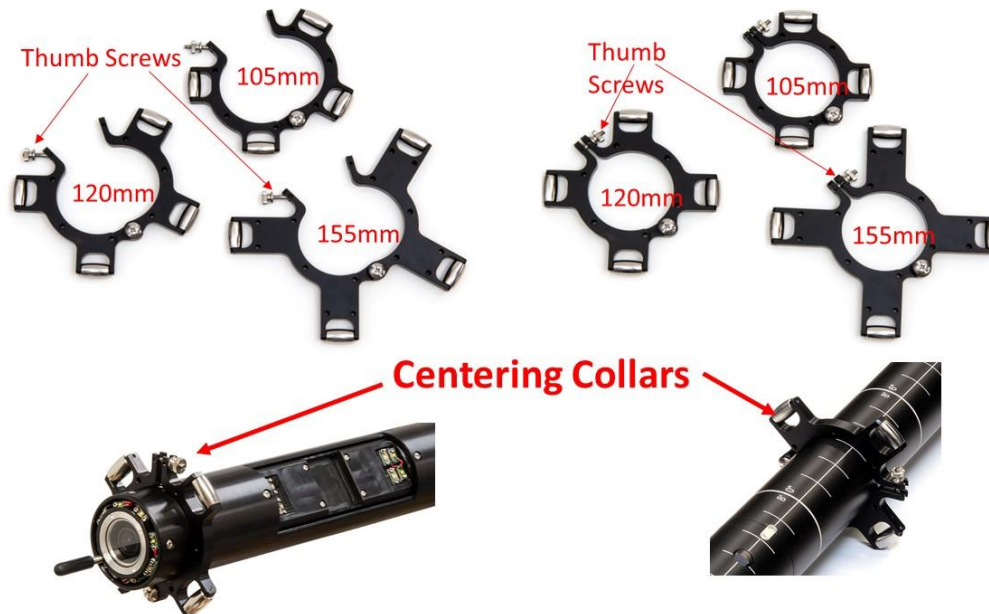


Figure 8-Loosen Thumb Screws and Attach Centering Rings



Insertion Pole General Guidelines

The following are general guidelines concerning the use of the Insertion Poles. Referring to Figure 9, when attaching the 1st Pole to the camera, ensure that graduations begin at 3 ft and ends at 7 ft. 6 inches

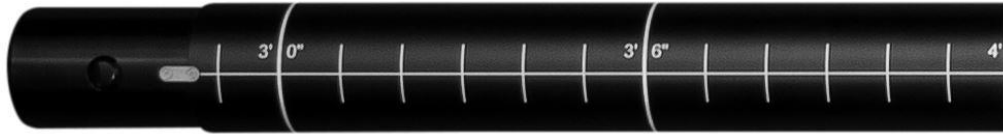


Figure 9 1st Pole Section

Referring to **Figure 10**, when adding pole sections. Be sure to grab the correct pole. There are 8 sequential sections. The Poles will snap together.



Figure 10 Ensure Proper Pole Sequence is Used

(7) Refer to Figure 11. On the last Pole Section Insert the Cable Clamp & Tighten Screws.



Figure 11 Last Pole End Cap / Cable Clamp

(8) Refer to Figure 12: Power Up the System

- a. Turn “ON” the UPS
- b. Turn “ON” the Computer. Open the “Door” & press “Power” button
 - i. May need to turn “ON” the Computer with the rear power switch

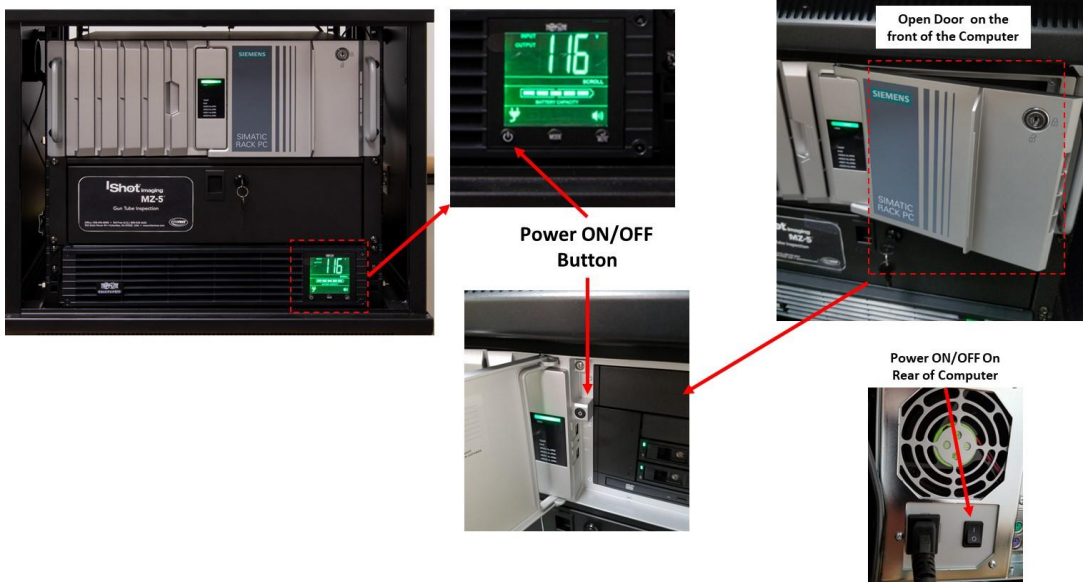


Figure 12 System Power "ON/OFF"

Note: There are two levels of operation.

- 1) User
- 2) Admin

Rack Mount Computer Control (User Level)

Refer to Figure 13

- 1) Double Click on the Docuview Program Icon

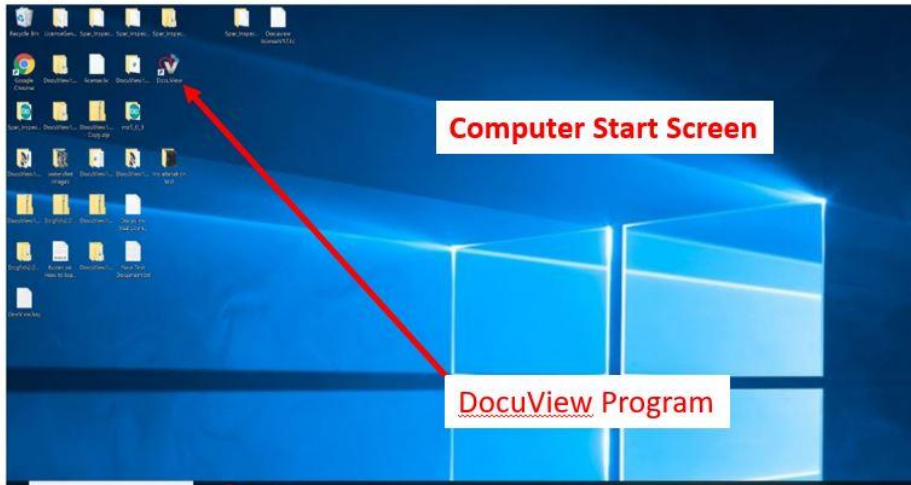


Figure 13- Computer Start Screen & DocuView Program

Refer to Figure 14 & 15

- 2) Click on the Settings Tab Figure 14A & then General Settings Figure 14B

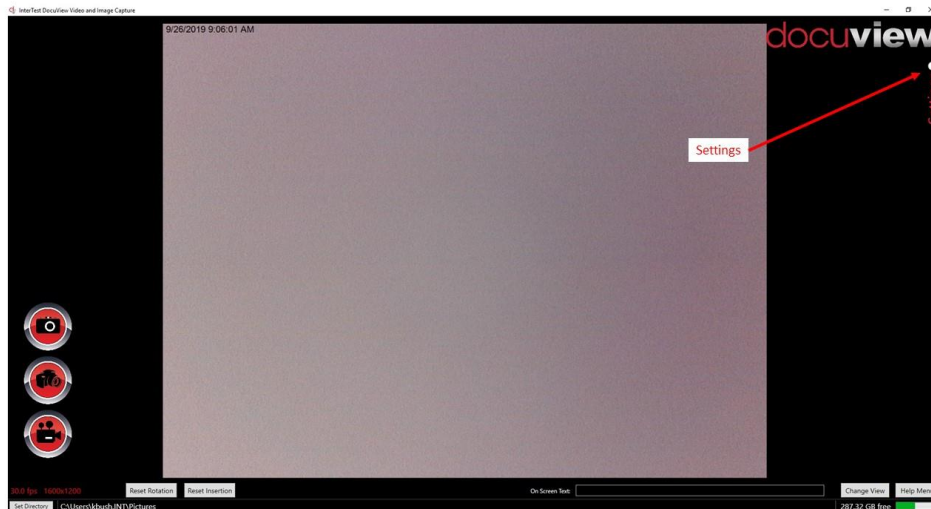


Figure 14 Opening General Settings Tabs

Refer to Figure 15

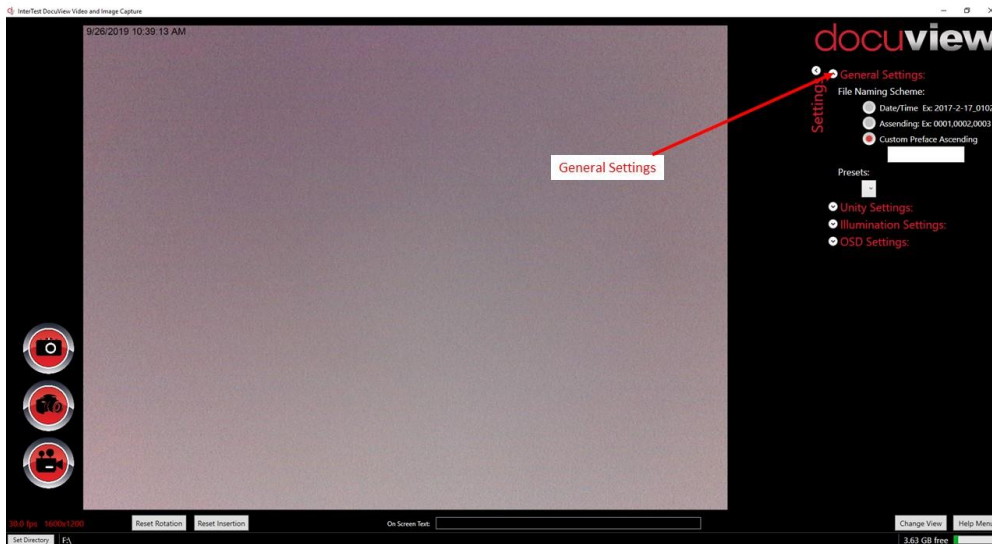


Figure 15 General Settings

Refer to Figure 16

- 3) Menus available in “General Settings”
 - a. File Naming
 - i. Date/Time
 - ii. Ascending
 - iii. Custom Preface
 - iv. Combination of text & numbers.
Will add four digits to the end of
The filename

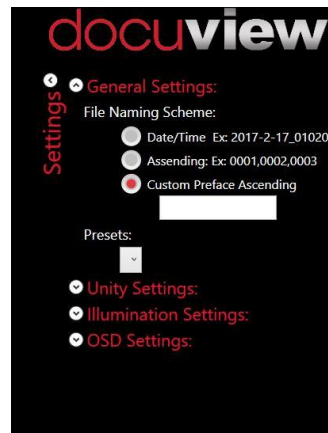


Figure 16 General Settings

Refer to Figure 17

- 4) Click on the “Set Directory” Button to set the save location for images & videos
 - a. Current “Save” location is displayed to the right of the “Set Directory” Button

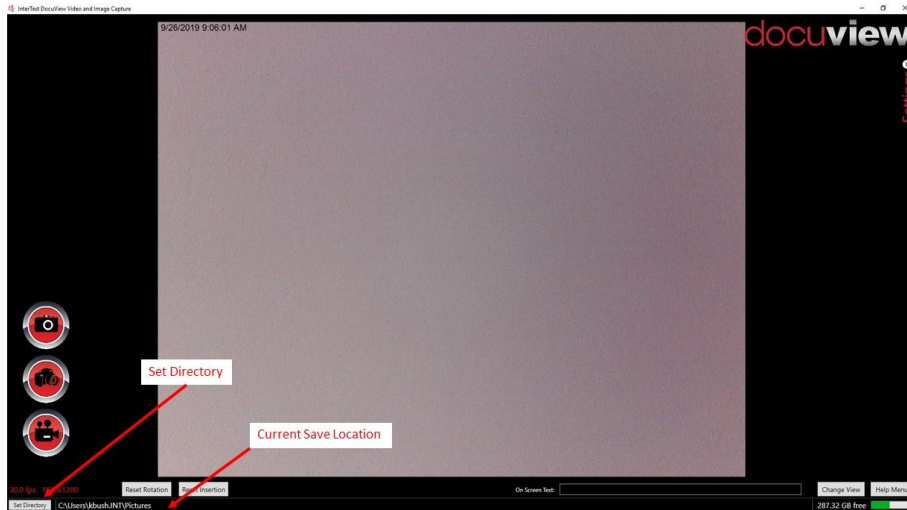


Figure 17 File Save Location

Note:

- 1) JPEG Files are approx.. 19:1 Compression compared to Bitmap files

Refer to Figure 18

- 5) Open General, Unity, Illumination and OSD (On-Screen Display) Settings

Note: Settings are stored by the system & DO NOT need to be set each time.

- a. Camera Presets (Configured in Admin mode)
 - i. Includes camera & lighting settings
- Note: Change view button used to switch cameras

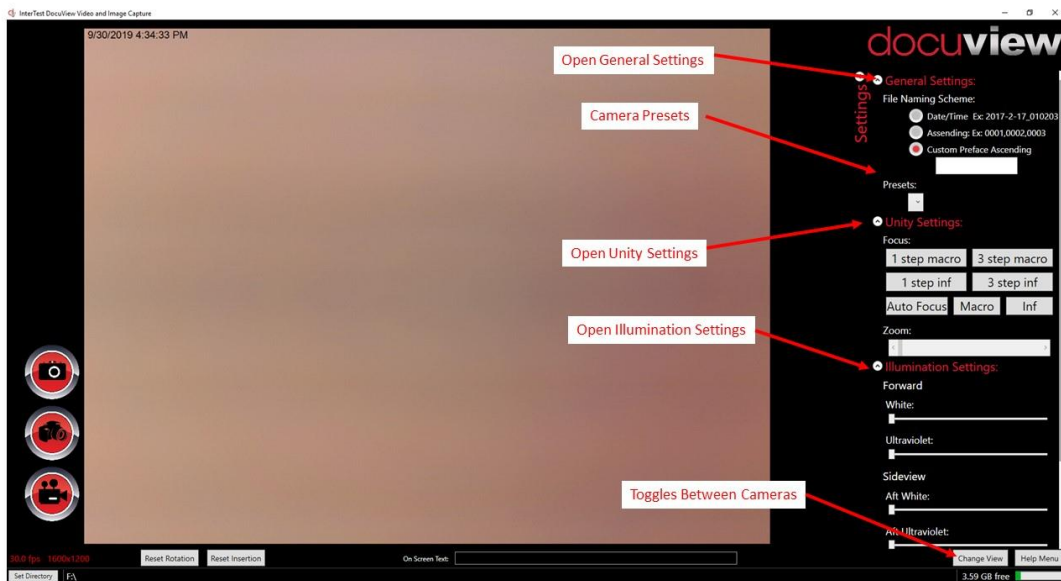


Figure 18 Camera Control & Toggle Between Cameras

- 6) Refer to Figure 19 Camera & Lighting Control
- This feature works on both the Forward & Aft cameras
 - See Figure 21 for Definition of Forward & Aft Lighting

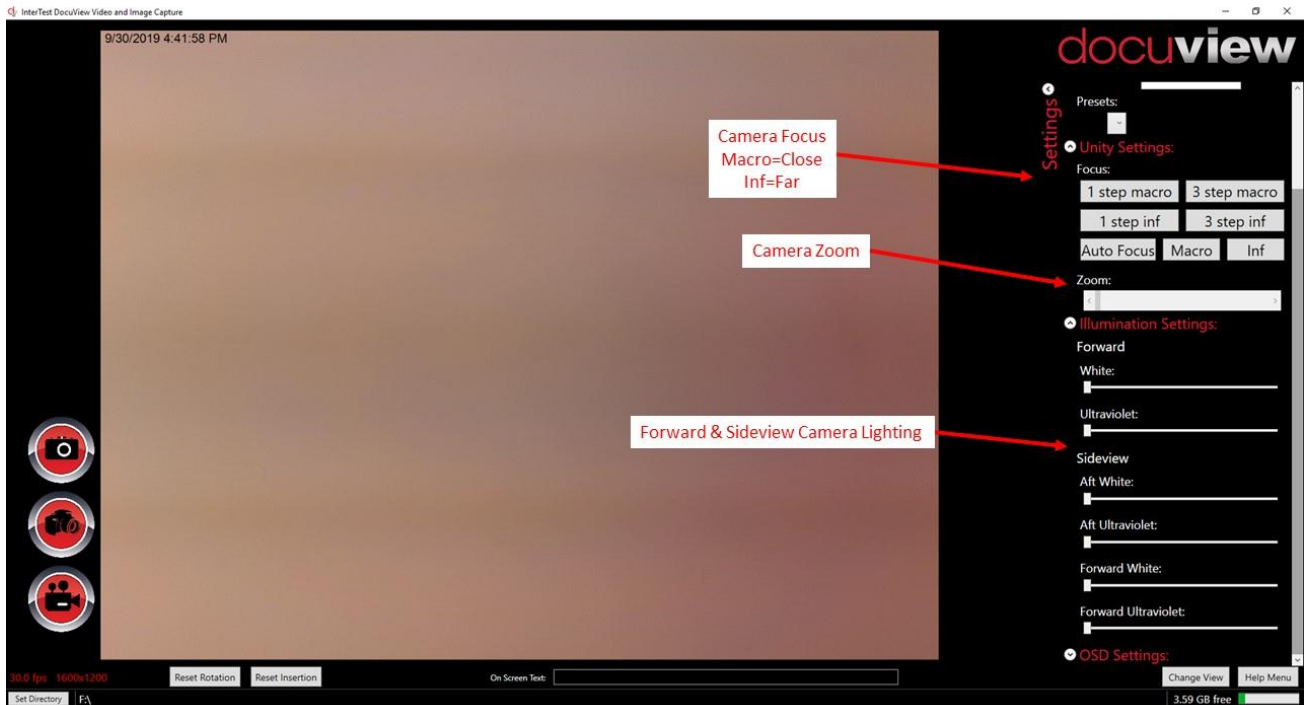


Figure 19 Camera & Lighting Control

- 7) Click on Unity Settings to open Zoom & Focus Controls (Front Camera is manual focus, side view is autofocus)
- Focus:
 - Select 1 or 3 Step Macro (Close) Focus
 - Clicking on Macro will “Step” the camera by either 1 or 3 steps based on which setting was selected.
 - Focus:
 - Select 1 or 3 Step Inf (Far) Focus
 - Clicking on Inf will “Step” the camera by either 1 or 3 steps based on which setting was selected.
 - Zoom:
 - Slide the control to the right. Up to 10X digital zoom available

Note: Forward camera focus is set at the factory. To adjust. See Figure 28

- 8) Refer to Figure 20 OSD & Grid Settings
- a. OSD Settings Refer to where the text appears on the screen
 - i. Font
 - ii. Size
 - iii. Color

Tip: Setting the Grid to half of fvideo frame size will put a reticle on the screen.



Figure 20 OSD & Grid Settings



Figure 21 Forward & Aft Sideview Lighting

- 9) Refer to Figure 23 OSD, On-Screen Display
- a. On-Screen Display
 - b. Font Size, Color & Location
 - c. User Entered On-Screen Text
 - d. Camera Rotation
 - e. Camera Horizontal Position

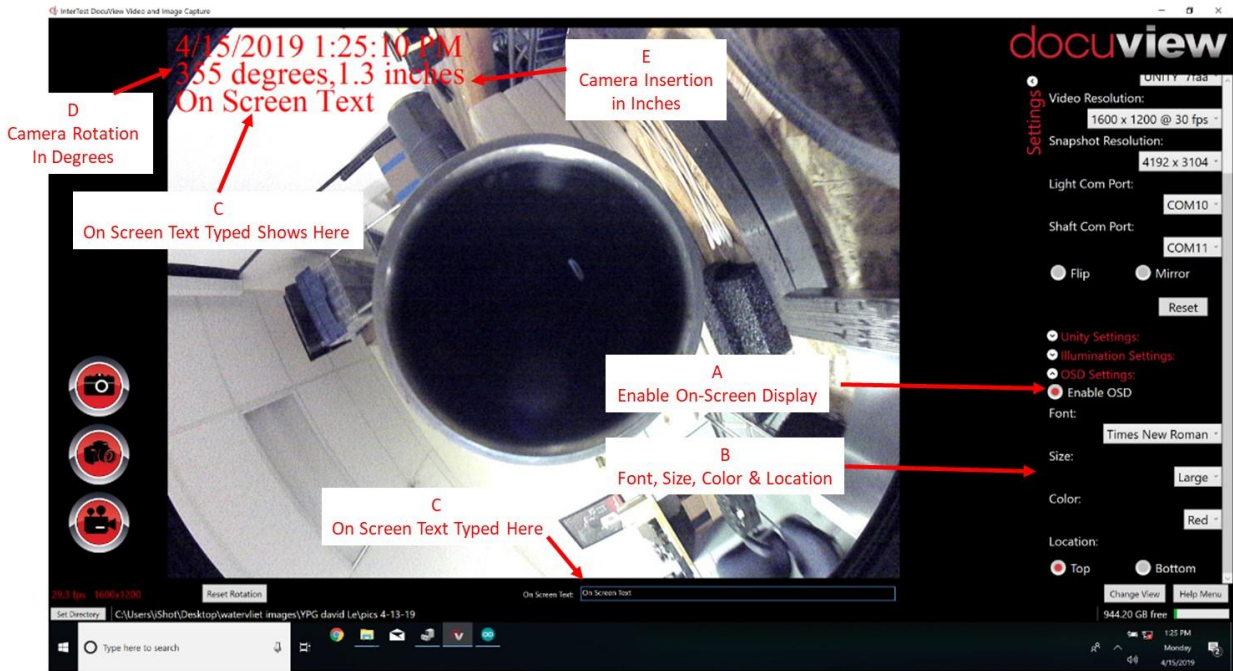


Figure 21 On Screen Display

- 10) Refer to Figure 24 Capture Controls (Admin Mode)
- Image Capture File Type
 - Video Capture Type
 - File Name Type **
 - Capture Control Location

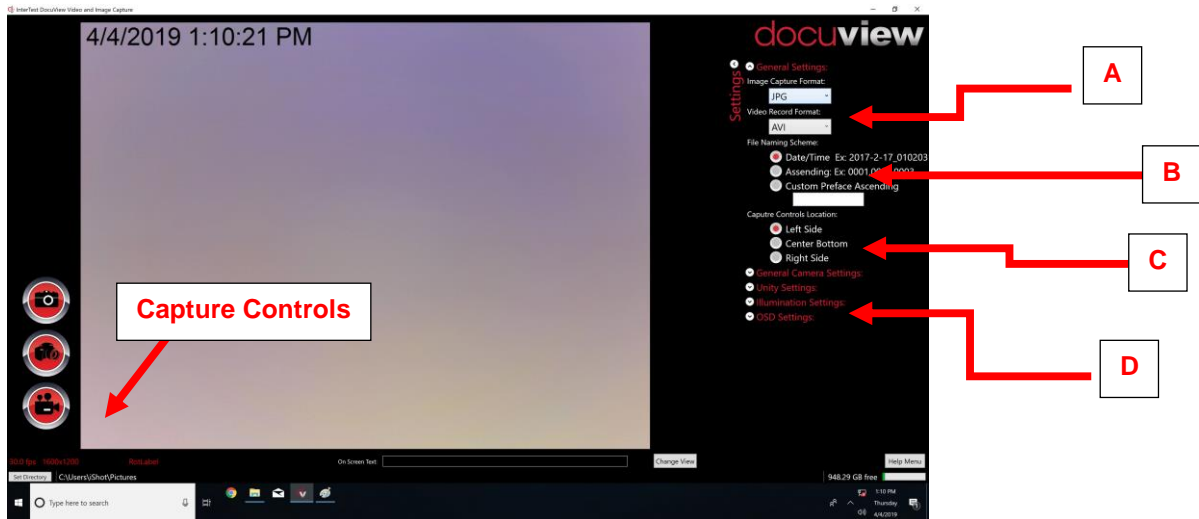


Figure 22 General Settings

**Note:

- Date /Time: Done in sequential order
- Ascending: Done in sequential order, 0001, 0002 etc.
- Custom preface: User defined text. Adds value at end so that sequential images can be told apart

Capture Controls



Still Image Capture



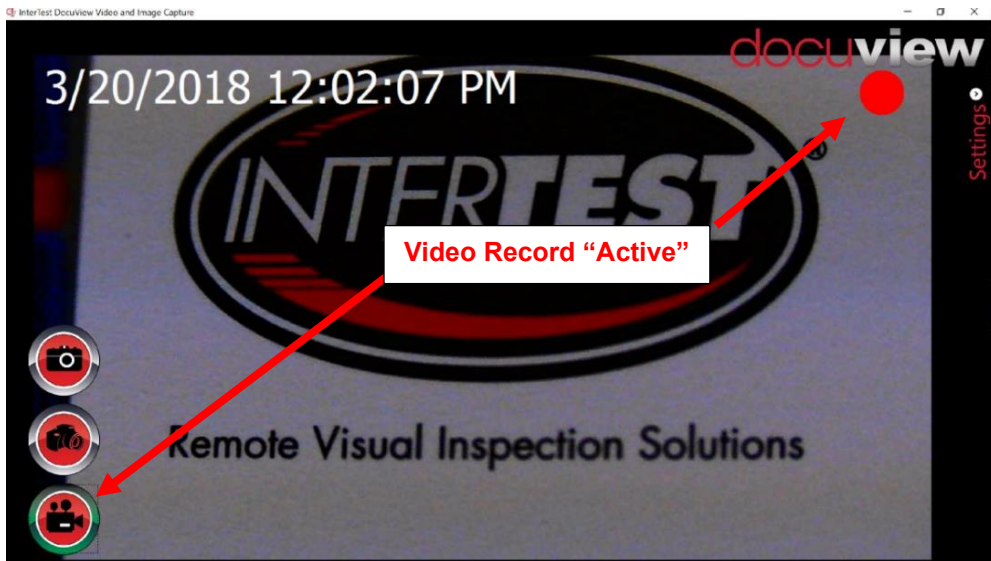
High Resolution Still Image Capture



Video Record**

Note: During Video Record, a Small, Red dot will be visible in upper Right Corner & Icon will be highlighted in **green**. Click the Video Record Icon to stop recording.

Figure 23 Image & Video Capture



Camera Settings:

Note: Defaults set at Factory. Click "Reset" to revert to factory defaults

Vision Gauge Software

- (1) Refer to Figure 26 To use the Vision Gauge Software
 - a. Make sure the License USB Stick is installed in the computer
 - b. Launch the program
 - c. While using vision Gauge only the camera **not** currently displayed in Docuview can be seen.

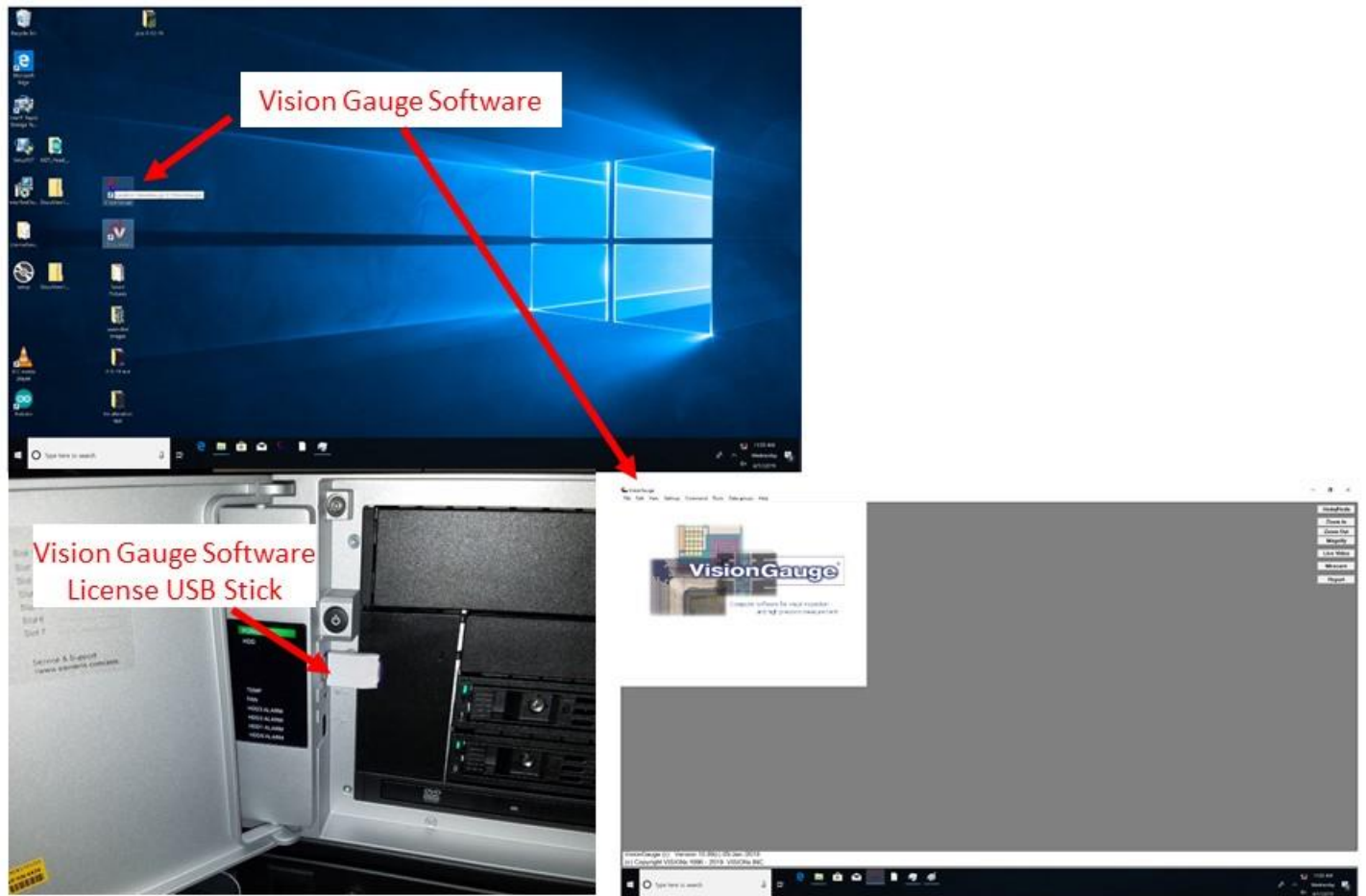


Figure 24 Vision Gauge Software Start Screen

(2) Refer to Figure 27 to View Live Video

- a. To “View” Live Image Click on “Live Video”
- b. To Change Camera(s)

1. Settings→Image Acquisition →Camera Select

Note: Refer to the Vision Gauge Manual for additional Instructions.

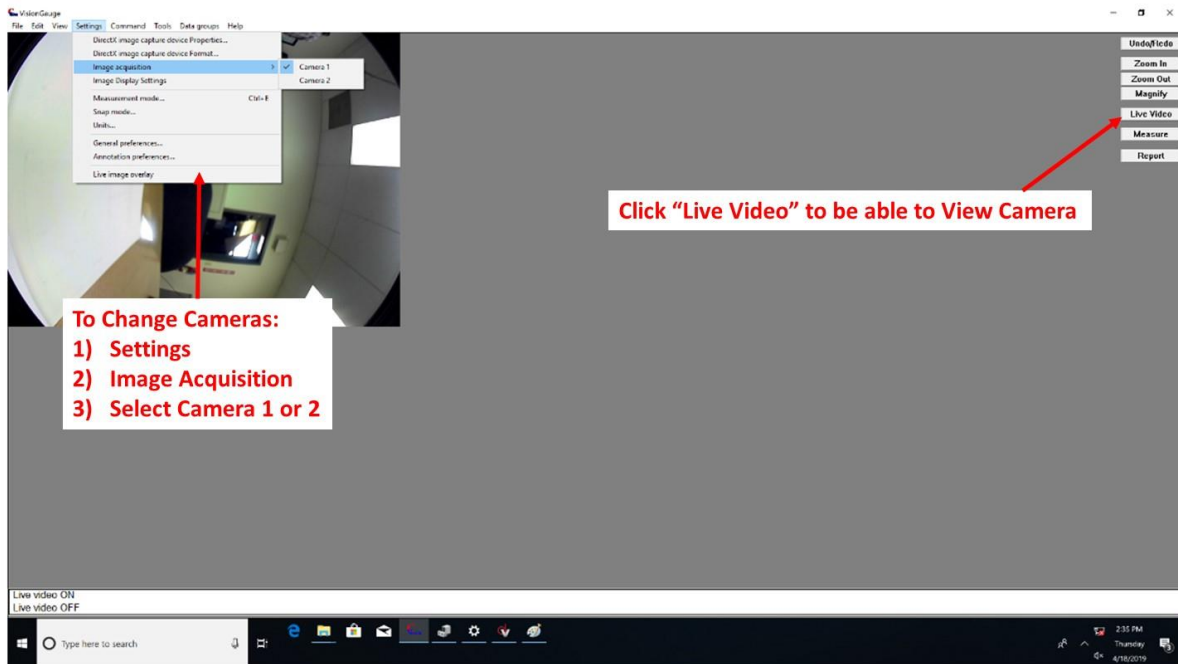


Figure 25 Vision Gauge Live Video

Forward Camera Focus Adjustment:



Figure 26 Forward Camera Focus

Table F --- Camera Settings (Admin Mode)

Menu Options		Options		Recommended Setting	Notes
General Settings					
	Image Capture Format				
		JPEG	1080 Resolution	X	
		BITMAP	4K Resolution		
	Video Record				
		AVI			
	File Naming				
		Date / Time		X	
		Ascending			
		Custom Preface Ascending			
	Capture Controls				
		Left		X	
		Center			
		Right			
General Camera Settings					
	Camera Type				
		USB		X	
	Camera Select				
		Unity 7faa	Forward Camera		Use Change View Button
	Video Resolution				
		1600 x 1200 @ 30fps	Forward View		
		1900 x 1080 @ 30fps	Side View		
	Snapshot Resolution				
		4192 x 3104			
	Comport				
		Shaft Encoder	201		
		Lights & Rotational Encoder	200	X	
	Flip				
	Mirror				
	UVC Settings				Do Not Use
	Reset				Used to Reset UVC to Factory Default
Unity Settings					
	Focus				
		1 & 3 Step Macro			Close Focus by 1 or 3 steps each button Press
		1 & 3 Step Inf			Far Focus by 1 or 3 steps each button Press
Front Camera					
	Auto Focus			X	
	Zoom				
	Gain			Leave at Default Position	
	Image Stabilization	ON/OFF		OFF	
	Exposure Mode			Auto	
	Exposure Speed			Normal	
	Exposure Weighting			Average	
	EV Correction			-2/3	
	Shutter Speed			4-Jan	
	White Balance			ATW	
	Enable Color Correction			OFF	
Side/Aft Camera					
	Gain			Leave at Default Position	
	Image Stabilization	ON/OFF		OFF	
	Exposure Mode			Auto	
	Exposure Seed			Normal	
	Exposure Weighting			Center	
	EV Correction			0	
	Shutter Speed				
	White Balance			Auto	
	Enable Color Correction			OFF	
Illumination Settings					
	Ultraviolet			User Defined	
			Aft	See Figure 21	
			Forward		
	OSD				
	Font		User Defined See Figure 22	Arial	
	Size		User Defined See Figure 23	Small	
	Color		User Defined See Figure 24	Red	
	Location				
			Top	X	
			Bottom		



Chapter 4 — Specifications

Detailed System Specifications

Introduction:

The MZ-5 performs visual examinations of bore ID during the MT process. It provides white and UV illumination while viewing the surfaces with live HD video or capture of 13 megapixel photos. The MZ-5 builds on the successful MZ-4 HD by utilizing higher performance sensors matched to display and capture hardware.

Gun Tube Application:

MZ-5 supports the visual examination of 105, 120, and 155 mm up to 8" gun tube bores on the MPI bench during the MT process. Tubes are rotated in place on the MPI bench. Tube lengths up to 40' may be inspected. The head contains two cameras that can be switched between wide field HD down tube view and HD right angle view. Both cameras can operate in HD video or 13 MP still capture modes.

Specifications:

1. Video performance
 - a. HD video for inspection of MPI at 1080p/30 or 1600 x 1200 down tube and side views
 - b. Sensor optimized for white and UV examinations
 - c. 13 MP (4192 x 3104 pixels, 4K type) still image capture down tube and side views
 - d. 90° DOV side view
 - i. Wide field right angle 53° HFOV
 1. 2.1" x 1.2" for 105 mm tube
 2. 2.4" x 1.3" for 120 mm tube
 3. 3.0" x 1.6" for 155 mm tube
 - ii. Remote focus in either auto or manual modes
 - e. 0° DOV down tube view
 - i. 132° x 108° (H X V)
 - ii. 1600 x 1200 pixels
 - f. Optical and camera components protected from process fluids
2. Mechanical head and pole
 - a. 2.25" diameter (permits use of M-3 borescope centering hardware)
 - b. 28' base system length (built up from 5' segments)
 - c. 43' max system length achieved by the addition of 5' extension sections
 - d. 6 each quick on-off centering fixtures for 105, 120, 155 mm tubes
 - e. Extension poles marked for down tube insertion position 1" increments with call outs at 6" intervals
 - f. Tube rotation based on MPI bench motorized hardware
3. Illumination – High performance UV and White LEDs rated 10,000 hour life.

-
- a. UV is 365nm at intensity > 2000 $\mu\text{W}/\text{cm}^2$ on the target surface with < 2 fc white content
 - b. Down bore view – 365 nm UV LEDs 4 units
 - c. Down bore view - White LEDs 4 units
 - d. Side view – 365 nm UV LEDs 4 units
 - e. Side view - White LEDs 4 units
 - f. Side view independent fore and aft intensity control both white and UV
 - g. Down bore view independent intensity control both white and UV
4. System Configuration ref information drawings
 - a. Storage and handling of inspection pole consistent with Magnaflux system diagram for general layout at the MT bench.
 - b. Festoon system utilized for cable management
 - c. Mouse/keyboard control from operator position at insertion to tube station
 - d. Monitor mounted on roll around stand
 5. System Features User Interface
 - a. Industrial PC based operation
 - i. 4 TB RAID 1 storage provides
 1. 5000+ hrs video or
 2. 1,500,000+ stills image at 4K resolution
 - ii. 19" rack mount
 - iii. 4K NVIDIA graphics
 - iv. Windows 10 Pro OS (network compatible)
 - b. DocuView™ display, capture, annotation, and control interface
 - c. 42" 4K resolution display mounted on freestanding roll around stand.
 - d. Selectable down tube and direct side viewing from 2 MA13x type cameras using USB 3.0 Interface
 - e. On screen annotation
 - i. Down tube position based on manual entry or on encoder input
 - ii. Rotation position of side view based on pendulum encoder within head
 - iii. Rotation position based on output from MPI bench or manual entry
 - iv. Manual entry of other data such a part and serial number, comments, etc.
 - f. Video capture and measurement functions.
 - i. HD Video capture 1080/30p or 720/30p
 - ii. High Resolution Still (13 MP) capture
 - iii. VisionGauge® video measurement. +/- .005" accuracy (optional)
 - iv. Captured to storage media
 1. Available Media
 - a. Internal Hard drive (4 TB RAID 1 standard)
 - b. DVD
 - c. USB media
 - g. Inspector hand feeds the pole system into the gun tube. Manual insertion at rates suitable for inspection.
 - h. Controls from PC Mouse & Keyboard

- i. Illumination intensity UV & White for both down tube and side viewing cameras
 - ii. Side viewing camera focus selectable between auto and manual
 - iii. Video Recorder on/off
 - iv. Still image capture
 - 1. 1080 Resolution
 - 2. 13MP (4K) Resolution
 - v. View selection, down tube or side view
 - vi. Video, video image still or 4K image still capture
 - i. Control from PC only
 - i. Annotation
 - ii. Measurement functions with optional Vision Gauge software
 - iii. Setup parameters
 - iv. Video, video image still or 4K image still capture
- 6. System Features mechanical.
 - a. Control unit based on rack mount PC and power conditioning/backup unit installed in fan cooled NEMA type enclosure on center conductor rack
 - b. Pole & cable handling system (central conductor rack optional)
 - i. Pole and center conductor handling system
 - ii. Festoon apparatus to manage cable.
 - c. Rugged cable (anaconda sheath) overall length from head to control unit nominal 80' overall length measured from inspection head through pole to Central Conductor Rack mounted on the Rack Table
- 7. System electrical
 - a. Earth ground required to NEMA enclosure
 - b. 120V/60Hz 30A earth ground power required (alternate power input optional)
 - c. Tripp-Lite 1.5 1.5kVA (1350W) UPS power back up & power conditioning module.



Chapter 5 — Care and Maintenance





- 1) Camera windows should only be cleaned with denatured alcohol & lens wipes



Chapter 6 — Components and Part Catalog

The following is a list of components and parts that may be purchased as replacements or as optional accessories.

EM Number	Description	Reference Image
EM14809	MZ-5™ HD-UV Inspection System	
EM62097	DELL 4K MONITOR 42.5"	
EM13425	SIMATIC IPC547G Rack PC 19", 4HU 32GB** **PC has added 4TB HDD (WD Purple 4TB Surveillance Hard Drive Part # WD40PURZ)	
EM13686	MZ5 CAMERA HEAD ASSEMBLY	

EM Number	Description	Reference Image
EM13498 EM1608231 EM160292 EM160293 EM160294 EM160295 EM160296 EM160297 EM160291	MZ5 OVERALL POLE ASSEMBLY 1 ST POLE ASSY 2 ND POLE ASSY 3 RD POLE ASSY 4 TH POLE ASSY 5 TH POLE ASSY 6 TH POLE ASSY 7 TH POLE ASSY 8 TH POLE ASSY	 <p>The reference image shows three cylindrical pole assemblies. The top two are shorter, with scale markings of 7 5/8" and 8 1/8" respectively. The bottom one is longer, with scale markings of 7 5/8" and 8 1/8".</p>
EM13936	105mm Centering Ring	 <p>A black, C-shaped centering ring with four adjustment points and a central hole.</p>
EM13937	120mm Centering Ring	 <p>A black, C-shaped centering ring, similar to the 105mm version but larger.</p>
EM13938	155mm Centering Ring	 <p>A black, C-shaped centering ring, the largest of the three shown.</p>

EM Number	Description	Reference Image
EM69441	<p>20 Foot Display Port to Mini Display Port**</p> <p>Commercially purchased: StarTech.com DisplayPort Cable Part #: DISPLPORT20L</p>	
EM69442	<p>USB Mouse**</p> <p>Commercially Purchased: Logitech Desktop MK120</p>	
	<p>USB Keyboard** EM69442</p> <p>Commercially Purchased: Logitech Desktop MK120</p>	 <p data-bbox="1300 1562 1425 1581">INT-080-060.CDR</p>

EM Number	Description	Reference Image
	<p>Fiber Jumper**</p> <p>Commercially Purchased. Internal to Control Rack. (OM3 Fiber Optic Cable/LC to LC Fiber Patch Cable) 1m</p>	