Industrial Borescope

Operating Manual

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Introduction

Thank you for purchasing a GE Inspection Technologies' industrial borescope. We value your business and appreciate your choosing us as your remote visual inspection provider.

Our family of rigid borescopes includes over 400 different models, all with unique combinations of diameter, length, direction-of-view and field-of-view, to allow you to select the optimum scope for your application. All use the highest performance optics for a superior image, and incorporate unique design features to enhance durability.

By following the use and care instructions in this guide, you will be rewarded with years of dependable, trouble-free service. Please read these instructions completely before use.

Warnings and Precautions

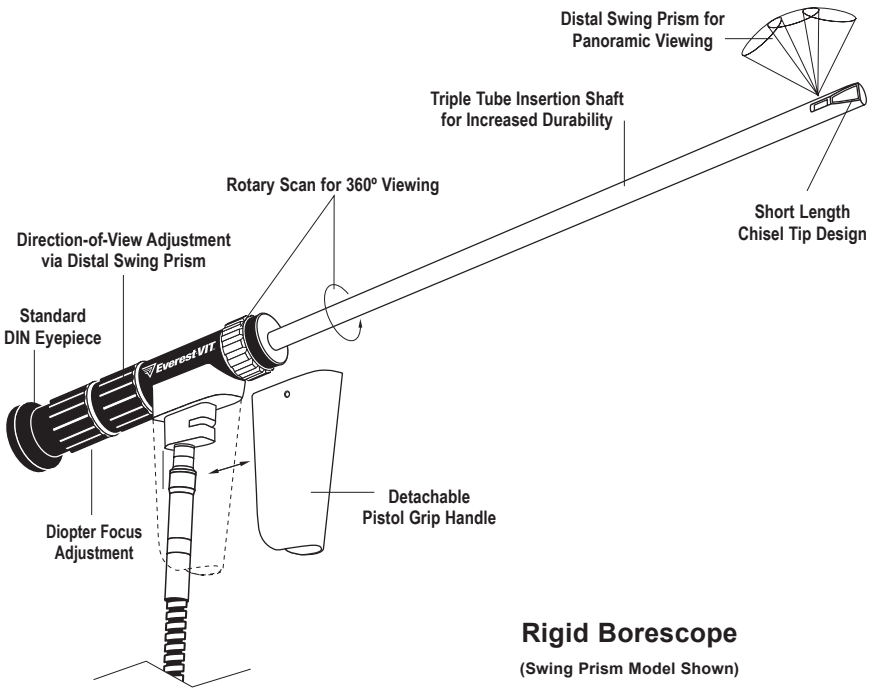
The following precautions will help you to use your borescope safely and prolong its life.

- Do not apply lateral force to the rigid shaft while inserted into equipment. Only rotate the shaft, or move it in and out to change the view.
- Keep protective caps on the eyepiece and viewing tip when the scope is not in use.
- Take care not to drop the borescope on hard surfaces. The optical lenses and glass covers will break from hard impacts.
- Protect borescope from unnecessary moisture, heat, dust and shock.
- Never leave the scope unattended when it is connected to an operating light source.
- Do not leave the borescope connected to an operating light source for extended periods of non-inspection time.
- Never use the instrument to observe within a human or animal body.
- Never insert the borescope into live electrical areas.
- Use only recommended accessories because other products may lead to unpredictable performance.

System Description

Your rigid borescope is designed to provide the highest performance optical imaging in a very durable package. A computer-optimized optical train of precision- fabricated lenses capture a high resolution image at the viewing tip and carry it back to the eyepiece, while a fiber-optic bundle carries light in the other direction to illuminate the imaged area. All models except Mini-Rigids incorporate a triple tube shaft design and all-metal construction, which makes the scopes more durable to withstand rough handling in today's industrial workplace. A removable pistol grip helps to get in those tight spaces when necessary and the rotatable shaft conveniently provides a complete perimeter view without having to rotate the entire scope body.

NOTE: Mini-Rigid models do not have rotable shaft, integral zoom or focus features.



Rigid Borescope

(Swing Prism Model Shown)

Below is a description of the functional components of the borescope.

Imaging System

The imaging system includes the eyepiece optics, the optical lens train, and the distal lens set.

The eyepiece magnifies the image carried back by the lens train for viewing by the human eye. On most models the eyepiece includes a diopter focus adjustment so different users can adjust the lens set to their particular vision prescription and use the borescope without glasses. All GE Inspection Technologies' eyepieces are of standard "DIN" design and therefore compatible with standard eyepiece attachments such as right-angle adapters and camera couplers.

The optical lens train is a set of precision-cut lenses placed in the shaft at specific distances apart to carry the image in sharp focus back to the eyepiece. This lens train accounts for the rigid borescope's excellent resolution, because the image is never broken into a finite number of optical fibers or video camera pixels. The image remains unpixelated all the way to the operator's eye.

The distal lens set is a combination of lenses that capture images and focus them into the optical lens train. This lens set determines the field of view and depth of field.

Illumination System

The illumination system includes a bundle of fiber-optic cables that extends from the light guide post to the viewing tip and any distal lenses at the tip that may focus or spread the light as it is projected. This bundle serves as a conduit for light entering the post from a light guide, and carries the light down the shaft to illuminate the target area for viewing.

Models with a "U" in the model number prefix contain a special illumination bundle made of quartz fibers. These fibers provide optimum performance for transmitting ultraviolet light to the inspection area and are purchased for use in applications where fluorescent dyes need to be stimulated with ultraviolet light.

Illumination System (Continued)

Borescope Body
The body is the hand-piece of the borescope. Focus, Zoom, Rotary Scan and Swing Prism control knobs are conveniently located on the body.

Shaft (or Barrel)
The shaft, or barrel, is the working length of the borescope and carries the optical train into equipment to be inspected. The shaft's unique triple tube design provides special protection of the optical train and enhances the durability of the scope.

Distal Section
The distal section houses the termination point of the illumination fiber-optic bundle and the lens set that focuses images into the optical train. These components are assembled in a precise orientation to provide the highest possible imaging performance, along with the desired direction and field-of-view.

System Setup

Setup consists only of focusing the eyepiece to your eye, plugging a light guide into the post and available light source, and making a few checks to ensure the borescope is operating properly.

Focus the Eyepiece: Remove protective lens caps and, if desired and available, attach the rubber eyecup. Focus the eyepiece for your eye by rotating the focus knob while looking into the eyepiece. The viewing tip should be pointed at an object with sharply defined edges. Typed text on white paper is a recommended target for this adjustment.

Plug into a Light Source: Connect the exit end of an ACMI light guide to the rigid scope post and insert the other end into the light guide socket of an Everest VIT or other compatible light source. Turn the light source on, wait about 30 seconds for the lamp to reach peak intensity, and check to ensure that a bright light is projected from the tip of the borescope. The scope is now ready to use.

Check Operation: Look through the eyepiece to ensure the scope is providing a sharp, clear image. Clean the eyepiece and distal cover glass if dirty. Check the operation of all equipped features, such as focus, rotary scan, zoom and swing prism. If performance of any of these features is degraded, return the scope to the Service Center for evaluation and repair. Continued use of a damaged scope could cause further damage.

Operation

To effectively perform an inspection, you must be familiar with the internal design of the application you are inspecting and also be familiar with the operation of the borescope. Inside the application your vision will be limited to the scope's field-of-view, so you must be able to visualize the location of the scope tip and its orientation to the area to be inspected.

Holding the Borescope

Hold the scope body in one hand in a way that is comfortable and allows you to comfortably look into the eyepiece. The pistol grip can be removed if desired by firmly pushing it forward.

Inserting the Borescope

Before inserting the scope into an application, be sure to check to see that the scope's path is not blocked. Slowly insert the scope shaft into the equipment to be inspected and observe the view through the eyepiece. Rotate the shaft if necessary to get the best viewing angle.

CAUTION: *Do not insert the borescope into moving machinery or a live electrical environment.*

CAUTION: *Never apply lateral force to the shaft when inserted into equipment. Any dents or bends in the shaft may break internal lenses or degrade the focus of the optical train.*

Integral Zoom Function

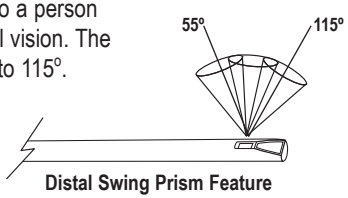
If your scope is equipped with integral zoom, you can magnify the image up to 2X by rotating the zoom control knob counter-clockwise. The zoom control knob provides a continuous increase in magnification of the entire field of view throughout its rotation.

Rotary Scan

You can see a full 360° around the scope tip by using the rotary scan knob to rotate the shaft clockwise and then counter-clockwise. A small nipple on the knob enables you to feel when the tip optics are pointed up without taking your eye away from the eyepiece.

Swing Prism Control

If your scope is equipped with the swing prism feature, you can also adjust the scope's direction-of-view to see more of an object's length than is visible in the scope's optical field-of-view. This knob swings the entire field of view, similar to a person turning their head to see what is beyond their peripheral vision. The direction of view can be varied from a centerline of 55° to 115°.



Distal Swing Prism Feature

Withdrawing the Borescope

Take care when removing the scope from equipment that the shaft is pulled straight out and not inadvertently bent.

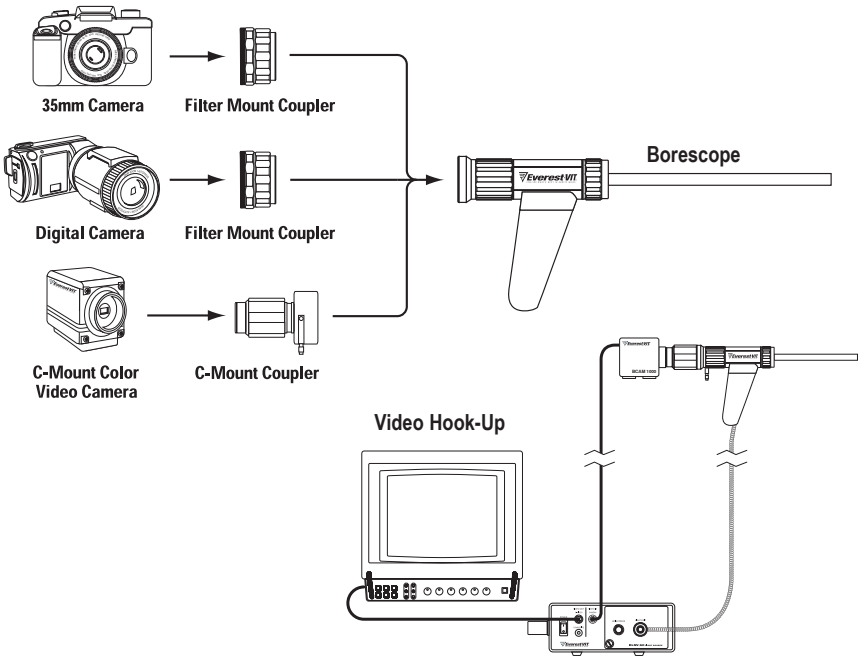
Using Cameras with the Borescope

C-mount video cameras, 35mm SLR cameras and digital cameras can be used with borescopes to document inspection images onto videotape, 35mm film or digital data storage devices. See your local GE Inspection Technologies Sales Representative to determine which is best for you. An optical coupler is required to attach the camera to the eyepiece. The proper coupler depends on the camera being used.

Video Cameras usually have a standard "c-mount" fitting which requires a c-mount coupler. These couplers can have different focal lengths which determine the screen magnification of the image, which in turn can impact image brightness. The proper coupler will depend on the diameter of the scope being used and the available light on the target surface. You may want to have more than one of these couplers to optimize performance on each inspection.

35mm SLR Cameras require a threaded coupler that will screw on to the lens of the specific camera being used. The diameter of the threads must match the lens thread diameter, so have this diameter information available when selecting the threaded coupler.

Digital Cameras must have a similar lens thread to the 35mm SLR cameras in order to be used with borescopes. As with the 35mm SLR camera, have the thread diameter available when selecting the threaded coupler.



User Care and Maintenance

User maintenance on a borescope can be summed up in two parts: Keeping the scope clean, and storing it properly when not being used.

Cleaning the Borescope
After each use, clean and dry the scope to prevent corrosion and long term exposure to residual chemicals.

1. Clean the scope with a soft, non-abrasive cloth and water. If necessary, use a mild detergent solution, and then wipe clean with a cloth dampened with water.
2. Clean the glass surfaces in the viewing tip, light guide connector and eyepiece with a lens tissue or cotton swab moistened in a lens cleaning solution or alcohol.
3. Dry the entire scope completely and replace the protective lens caps.

CAUTION: *DO NOT immerse the scope body in water. It is not watertight.*

Proper Storage
Store the system in its carrying case away from water, high humidity, high temperature, direct sunlight, dust, salinity, chemicals, X-rays, vibration and shock.

User Care and Maintenance

The following troubleshooting hints may help you to immediately solve some performance problems. If a problem is not solved using these suggestions, call the Service Center and arrange to return your borescope for evaluation and repair. **Never attempt to disassemble the borescope.**

If Image Is Not Clear and Sharp...

- Object may be out of focus. Try adjusting eyepiece diopter focus or moving the viewing tip further or closer to the object.
- Lenses or glass windows may be dirty. Clean glass surfaces on viewing tip and eyepiece with alcohol and cotton swab (or soft cloth).
- If using a c-mount camera, and Moire fringes appear (patterns of curved line distortion), try rotating the camera slightly with respect to the eyepiece.

If Image Is Not Bright Enough...

- Light source intensity may be at a low setting. Turn to maximum intensity.
- Viewing tip may be too far from object. Move tip closer to object.
- Lenses or glass windows may be dirty. Clean glass surfaces on viewing tip, light guide connector and eyepiece with alcohol and cotton swab (or soft cloth).
- Light source lamp may have degraded performance. Install new lamp.
- Light source capacity may be insufficient for application. Try higher intensity light source.

Specifications

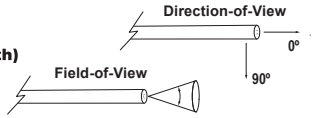
Model Number Explanation

The model number on your borescope indicates its specific characteristics. Here are examples that show the methodology:

Rotary Scan

RZ6 - 48 - 90 - 56

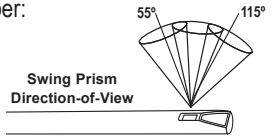
- **Rigid Borescope (RU/RZU indicate quartz fibers for UV inspections)**
- **Has Integral Zoom feature**
- **6.0mm outer diameter**
- **48cm working length (shaft length)**
- **90 degree direction-of-view**
- **56 degree field-of-view**



Swing Prism scopes are indicated by "VAR" in the model number:

R10 - 69 - VAR - 50

- **Rigid Borescope**
- **10.0mm outer diameter**
- **69cm working length (shaft length)**
- **Variable direction-of-view (swing prism scope)**
- **50 degree field-of-view**



Mini-Rigids are indicated with an "RM" prefix:

RM27 - 14 - 70 - 80

- **Mini-Rigid Borescope**
- **2.7mm outer diameter**
- **14cm working length (shaft length)**
- **70 degree direction-of-view**
- **80 degree field-of-view**

Note: Mini-Rigids do not have Rotary Scan, Zoom or Focus features.

GENERAL CHARACTERISTICS:

Swing Prism Range:	Swings field-of-view centerline from 55º to 115º
Rotary Scan:	Allows 360º perimeter viewing
Integral Zoom:	Continuous magnification from 1X to 2X
Depth of Field (Focus):	
Mini-Rigids	3 mm (0.16 in.) to infinity
Models with 35º FOV	10 mm (0.39 in.) to infinity
All other models	5 mm (0.20 in.) to infinity
Tube Construction:	Triple tube construction on all models except Mini-Rigids.
Body Construction:	All-metal construction (except Mini-Rigids); removable pistol grip; standard DIN eyepiece
Operating Temperature:	-40º to 121º C (-40º to 250º F)
Shaft Pressure Resistance:	3 bar (44 psig)
Fluid Resistance (insertion tube only):	Shaft will withstand immersion in aviation fuel, kerosene, gasoline, diesel fuel, mineral and synthetic lubrication oils and hydraulic fluids, most industrial solvents, and water.

Warranty

GE Inspection Technologies warrants the industrial borescopes to be free of defects in material and workmanship and to perform in accordance with the manufacturer's specifications when subject to normal use and service for a period of one year from the date of purchase. GE Inspection Technologies will either repair or replace components found to be defective or at variance from the manufacturer's specifications within this time at no cost to the customer. It shall be the purchaser's responsibility to return the instrument to the authorized service center.

This warranty does not cover breakage or failure due to tampering, misuse, neglect, accidents, improper installation, modification, shipping, or to improper maintenance, service, and cleaning procedures. This warranty is also void if the instrument is not used in accordance with the manufacturer's recommendations or if required service is performed by anyone other than an GE Inspection Technologies authorized agent. No other express or implied warranty is given.

Service

To obtain service for your system, call one of the Service Centers below. If the problem cannot be corrected over the phone, you will be given a return authorization number for shipment to the service center.

ALWAYS contact a GE Inspection Technologies Service Center for a Return Materials Authorization Number (RMA) prior to returning any products for service or repair.

USA
GE Inspection Technologies
Product Service Dept.
721 Visions Drive
Skaneateles, NY 13152

Tel: 315-554-2000
Fax: 1-866-899-4184
Email: geit-info@ge.com

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72379 Hechigen

Tel: +49-7471-9882 20
Fax: +49 7471-9882 30
Email: rvi-infoeuropa@ge.com

Hong Kong
GE Inspection Technologies
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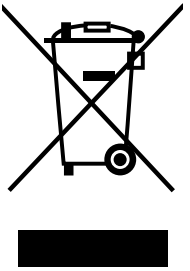
101 King's Road
North Point, Hong Kong

Tel: +852-2877-0801
Fax: +852-2877-0868
Email: rvi-infohongkong@ge.com

Accessories

Part Number	Descriptions
Scope Accessories	
RA103	Rubber eyecup
RAExx-xxx	Various eyepiece extenders and angular adapters
RPA-x	Rigid post adapters to accept Olympus, R Wolf and Storz light guides
LLG-xx-xx	Liquid light guides
MFLG-xx	Fiber-optic light guides
LGA-xx	Light guide adapters to fit various light sources and borescope posts
Light Sources	
ELSV-60	60W Solarc® light source with convenient single power/ video cable connection to C-Mount color video camera.
ELS-24DC	24W Solarc® light source
ELS-24DC KIT	ELS-24DC 24W Solarc® light source with AC adapter, 12V PowerBar™ battery and charging system, and operational carry pouch with shoulder strap.
ELS-120UV	120W UV/White switchable light source
FLS-200UV	200W UV/White switchable light source
Borescope Cameras and Video Accessories	
CAM-V101 SET	C-Mount color video camera set
CAM-DS104	Digital camera set
CAM-SLR	35mm SLR Camera Set
MON-LCD-8	8-inch SVGA LCD monitor
MON-LCD-12	12-inch SVGA LCD monitor
XA216	VGA head-mounted viewer by MicroOptical
XLGABSA	XLG3 video borescope adapter

Environmental Compliance



The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Visit www.ge.com/inspectiontechnologies for take-back instructions and more information about this initiative.

Customer Support Centers

North/South America

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Skaneateles, NY 13152
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315-554-2000
Email: geit-info@ge.com

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72379 Hechingen
Germany
Tel: +49 (0) 7471 9882 0
Email: rvi-infoeuropa@ge.com

Asia/Pacific

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