OLYMPUS

Olympus Remote Visual Inspection Webinar Series

Episode 1: Fundamentals

Scientific Solutions Division | Bayard Morales

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What You'll Learn:

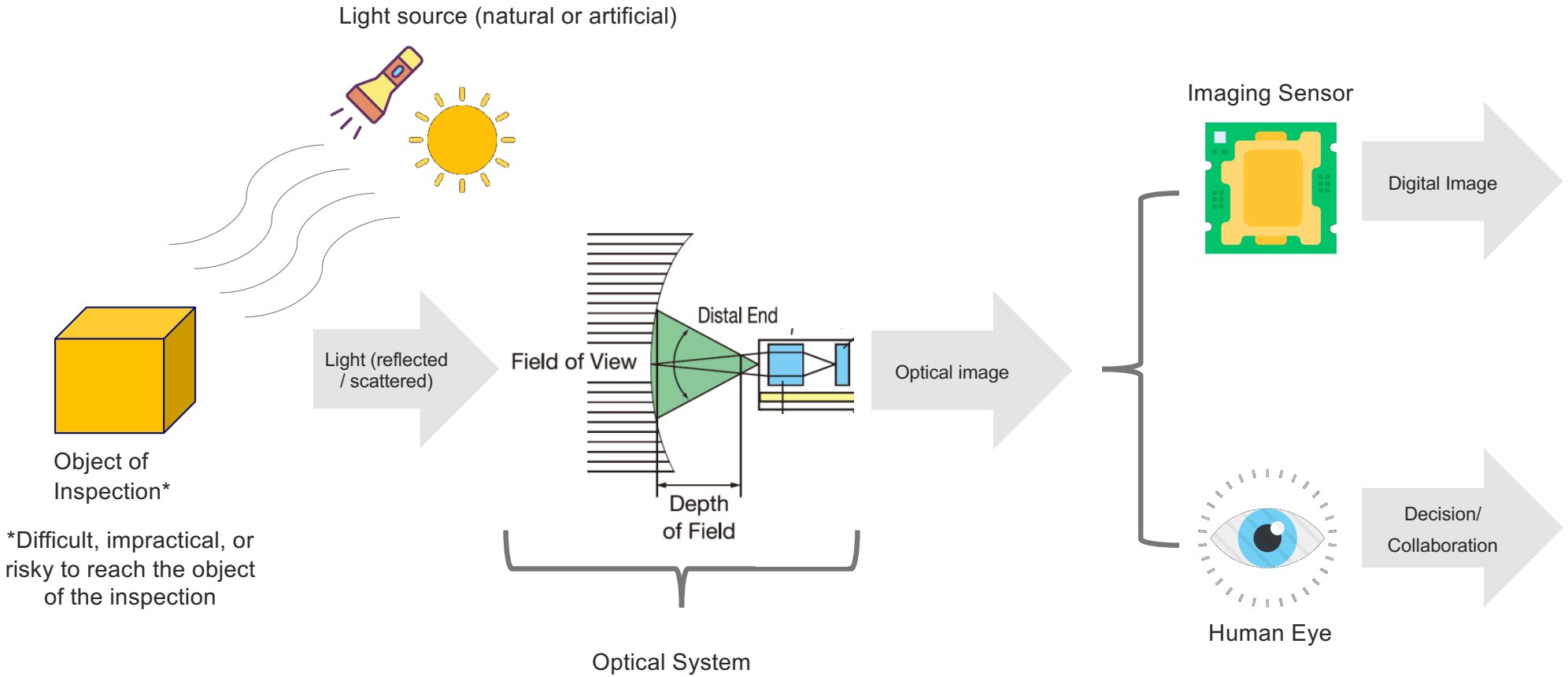
01 How Remote Visual Inspection (RVI) Methods Work

02 The Main Parts of a Videoscope and their Functions

03 What Modern Videoscopes Can Do

04 How to Select the Best Videoscope

What Is Remote Visual Inspection?



Types of Remote Visual Inspection Equipment

RVI = Remote Visual Inspection

Remote visual inspection (RVI) methods extend the reach of the human eye to places that are otherwise too difficult, impractical, or impossible to be observed directly. These include:

Borescopes
Fiberscopes

Videoscopes/
Endoscopes

Olympus Specializes in Industrial Endoscopes

- **Stick Cameras**
- **Push Cameras**
- **Unmanned Aerial Vehicles (UAVs)**
- **Remotely Operated Vehicles (ROVs)**

What Are Industrial Endoscopes?

Many people in industry will use different words for industrial endoscopes, like videoscope, borescope, video-probe, and endo-camera

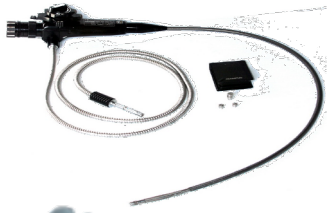
Industrial Endoscope*

Videoscopes

Fiberscopes

Rigid Borescopes

Mini Borescopes



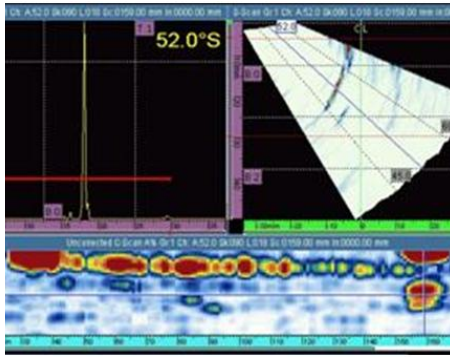
Flexible insertion tubes with articulation and interchangeable scope/optics

Non-flexible; straight line access required

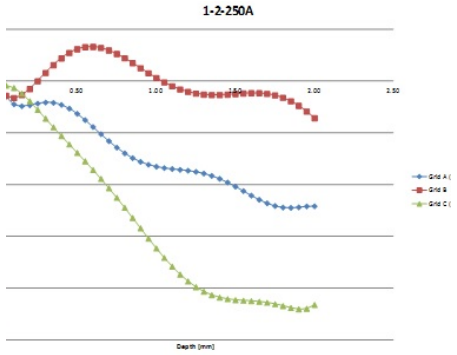
***Note:**
- *Endo (Greek, endon):* within
- *Scope (Greek, skopein):* to look, examine

What Are Industrial Endoscopes Used For?

- Remote visual inspection is a type of nondestructive testing (NDT) technology that enables the **inspection of surfaces**
  - Industrial **endoscopes are used mainly in confined areas** where the access via other means is not possible
  - They can be used in combination with other techniques such as eddy current, phased array, and ultrasonic testing to examine internal structures/defects or X-ray diffraction/fluorescence for material analysis
- **Advantages of RVI:**
  - Easy to understand — a picture is worth 1000 words
  - No certification requirement — either no or less strict regulations
  - On-site or remote inspections are both possible — internet-enabled mobile devices
- The **interpretation of RVI results is simpler since the images are easier to understand** than most other inspection technologies:



Trained Technician

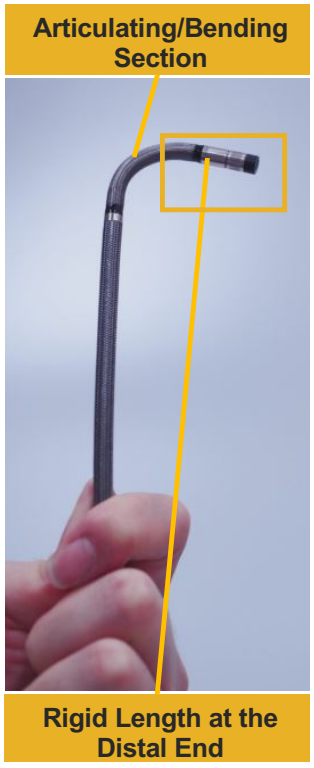


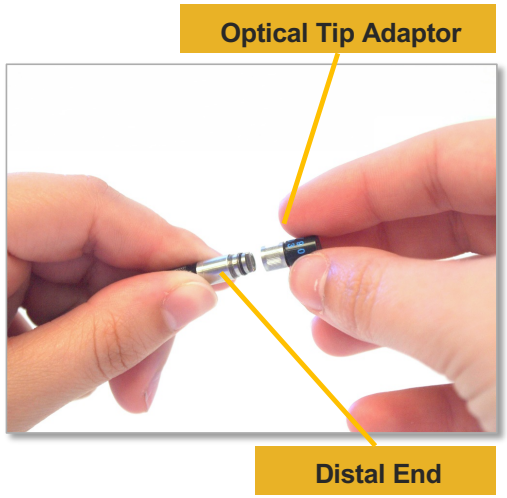
Scientist

Everyone

The Main Parts of a Videoscope

- Videoscopes come in different shapes and forms, but they all share certain elements:





The Main Parts of a Videoscope

If we follow the typical steps of videoscope inspection, we can understand the function of each part:

1. **Access:** After setting up the videoscope, the inspector will attach an **optical tip adaptor** to the **distal end**, then introduce the **insertion tube** via the access route, guiding it toward the area of interest, *pushing or pulling* it, *rotating* it, and *articulating* the **bending section** with the **remote control.**

2. **Illumination**: Light is continuously generated by the **light source** and distributed by the light fiber through the **insertion tube** to the **distal end** with the **optical tip adaptor**, illuminating the inspection surface.

3. **Imaging:** The light that is reflected and dispersed by the inspection surface is captured by the lens in the **optical tip adaptor** and focused into the imaging sensor housed in the **distal end**, which generates a digital image.

4. **Observing and Recording:** The digital image is relayed to the **base unit**, where it is shown on a screen. The inspector can then decide to **take still images**, **record videos,** or **perform measurements.**

The Main Parts of a Videoscope

- Among the parts discussed, there are **three** critical elements on a videoscope:

Light Source

Insertion Tube

Optical Tip Adaptor

Critical Element 1: Light Source

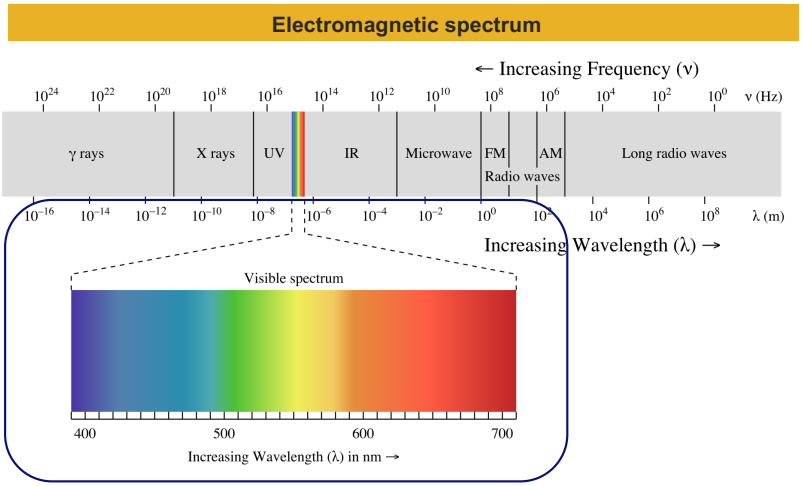
You can only see something that reflects light!

- When we say “light,” we are often referring to **visible light**, which is the portion of the electromagnetic spectrum that can be perceived by the human eye. This is the most common type of light used in RVI.

- The **amount of light captured by the videoscope is one of the most important factors for a good image**:

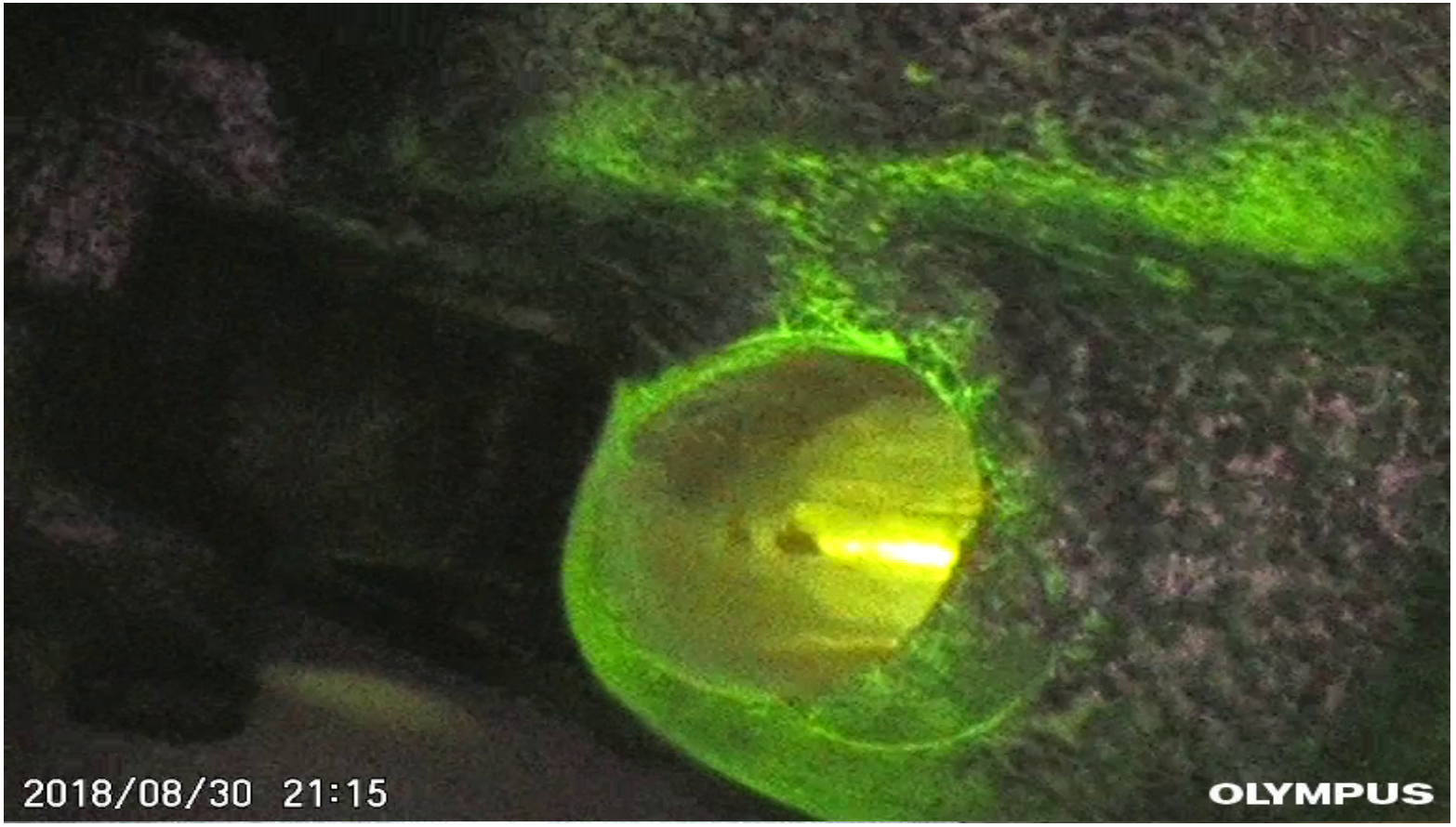
  – **Too little light:** the image is too dark, making it impossible to visualize objects.

  – **Too much light:** excess light causes glare, and no features can be distinguished in the image.



- **Objects interact differently with different types of light**, so by changing the light source, we may be able to see things that are otherwise invisible.
- Other types of light commonly used in RVI inspection:
  – Ultraviolet (UV)
  – Infrared (IR)

Critical Element 1: Light Source



Critical Element 2: Insertion Tube

- Another critical factor in remote visual inspection is **how to get the probe to the right place.** If we are using a videoscope, we are often dealing with narrow spaces, places out of reach/far away, and positions that are difficult to maneuver to.

  - **Diameter:**
    - The diameter of the access point and the clearances the insertion tube has to go through limit the **diameter** of the videoscope that can be used
    - Typical diameters are between 2 mm (0.08 in.) and 8.5 mm (0.3 in.)

  - **Length:**
    - How far the inspection object is, or the insertion depth, determines the **length of the insertion tube** to be used
    - Typical lengths between 1 m (3.3 ft) and 30 m (98 ft)

  - **Articulation and stiffness:**
    - The route to get to the inspection object, and all its twists and bends, requires suitable **articulation** of the bending section and adequate **insertion tube flexibility**
    - Typical articulation angles between 90º and 180º

Critical Element 3: Optical Tip Adaptors

- The **optical tip adaptor** is the final critical element:
  - These fixed lens systems create a focused image that is projected onto the imaging sensor
  - **IMPORTANT**: You will not have good image if you use the wrong tip adaptor
  - Different inspections require different tip adaptors; there is no single tip adaptor that will provide high-quality images in all conditions

- Optical tip adaptor properties:

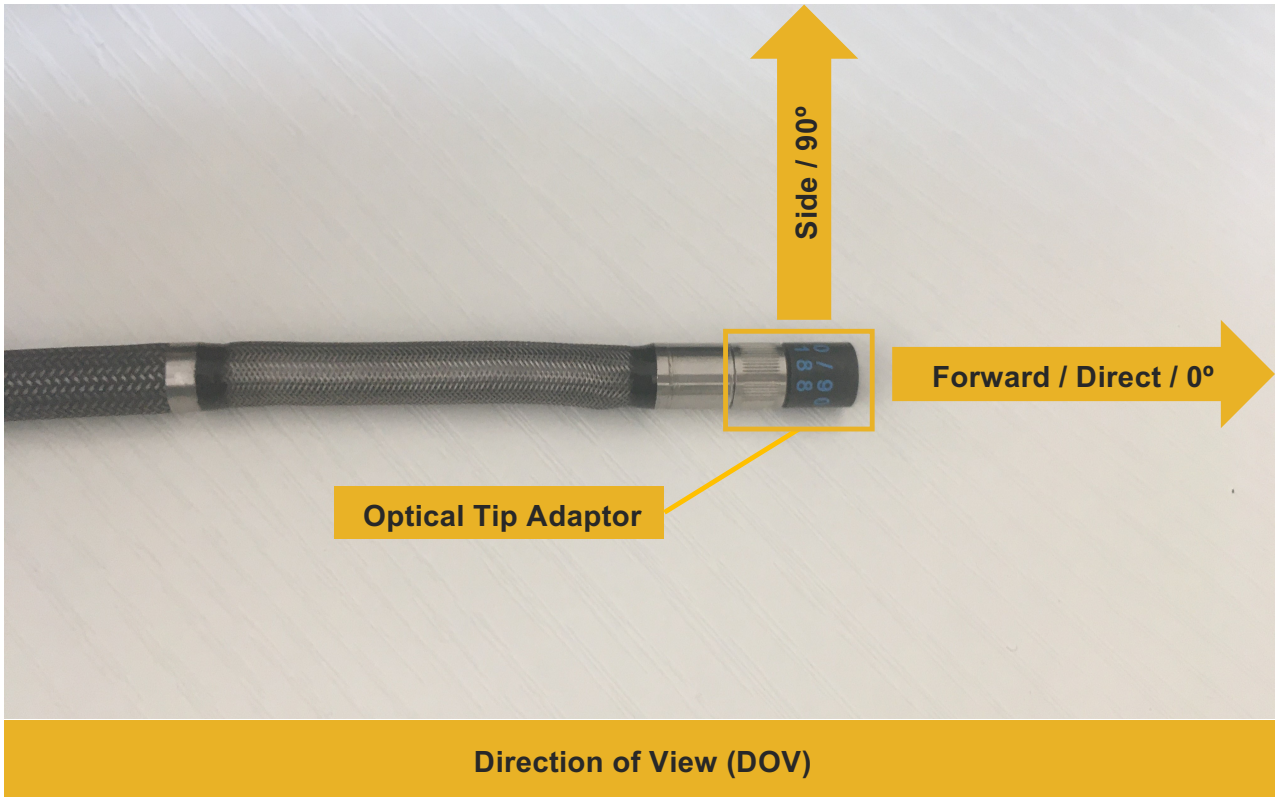
1. **Direction of View**
2. **Field of View**
3. **Depth of Field**
4. **Magnification**

✓ **The properties of an optical tip adaptor are fixed**

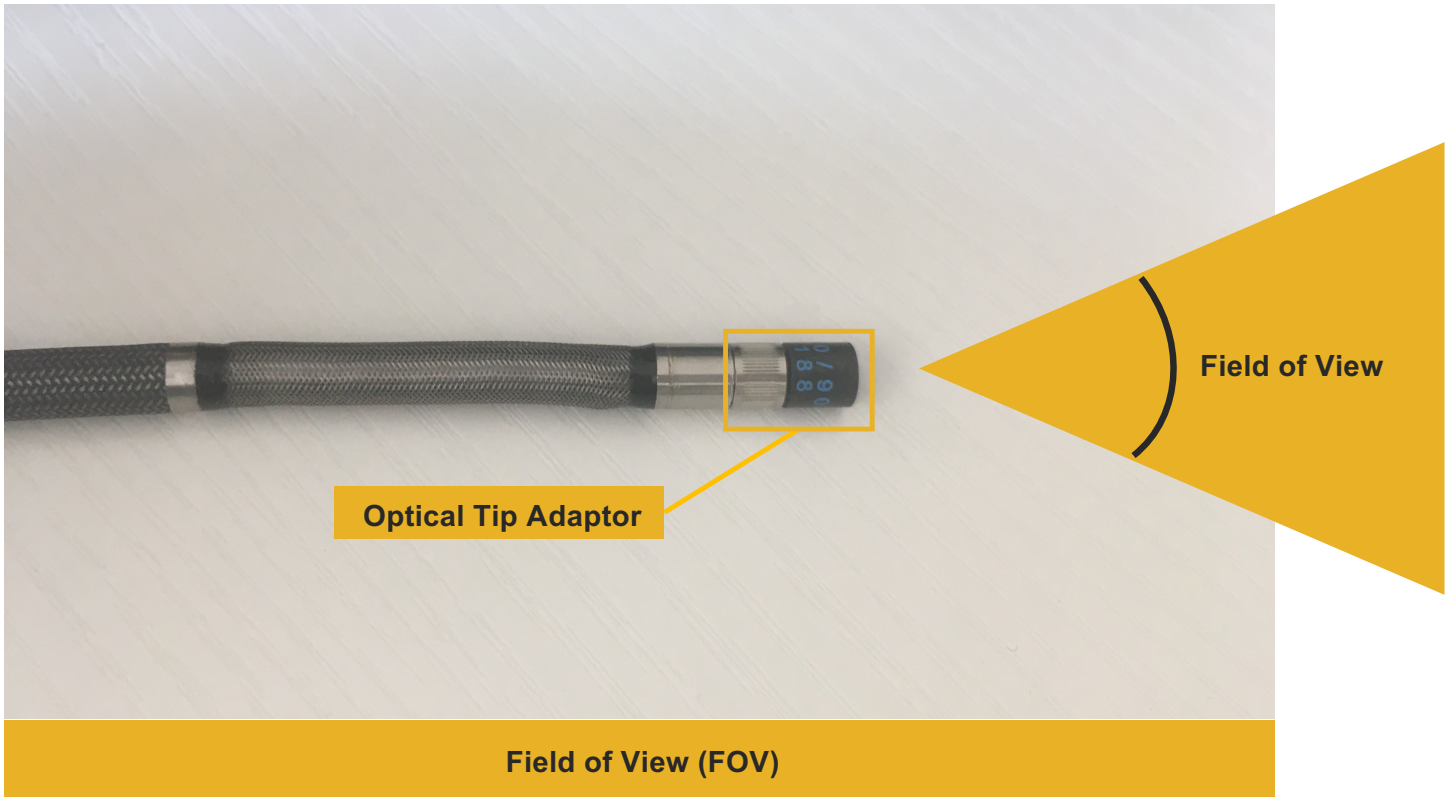
✓ **No room for optical zoom, only digital zoom**

✓ **Magnification is important!**

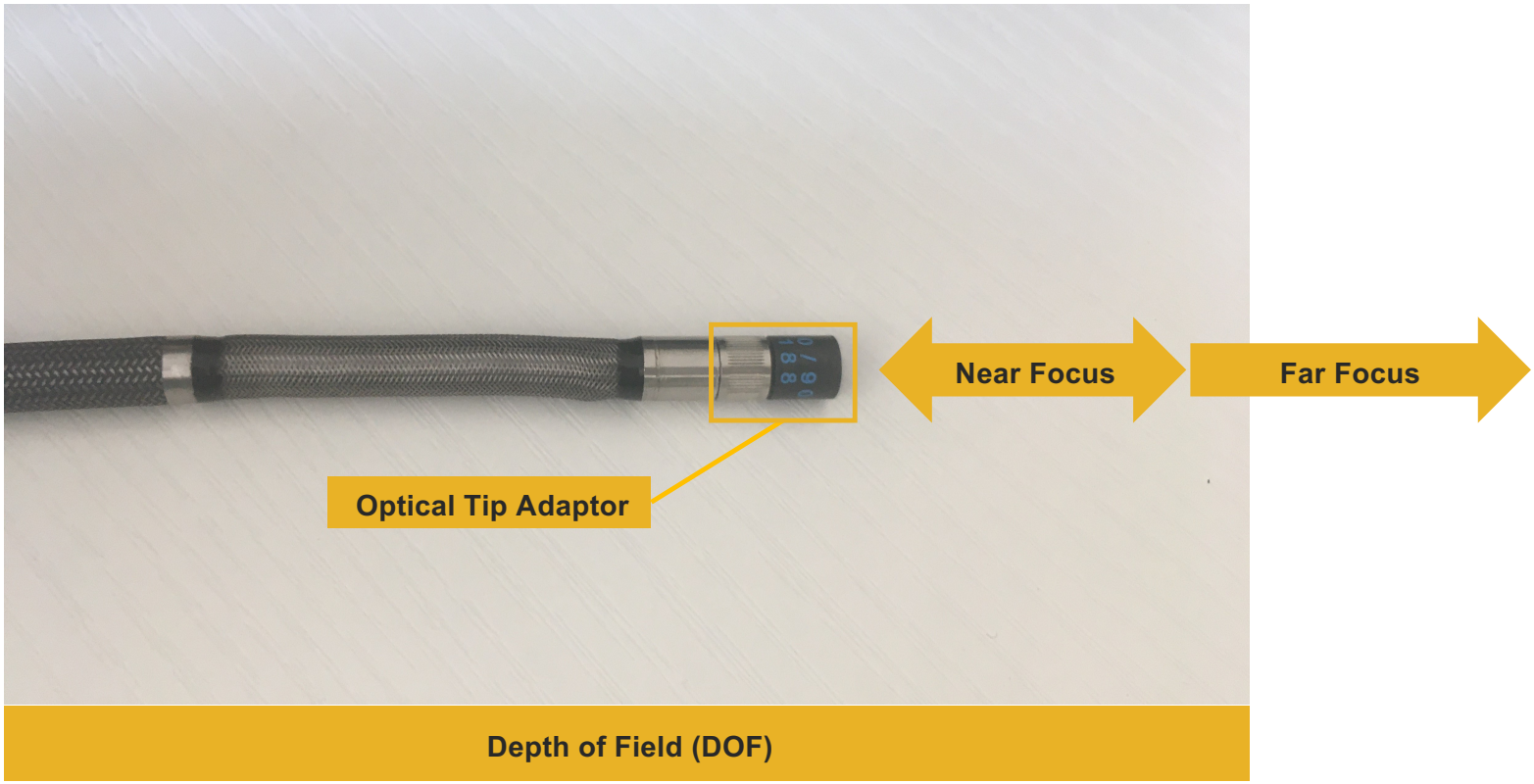
Critical Element 3: Optical Tip Adaptors



Critical Element 3: Optical Tip Adaptors

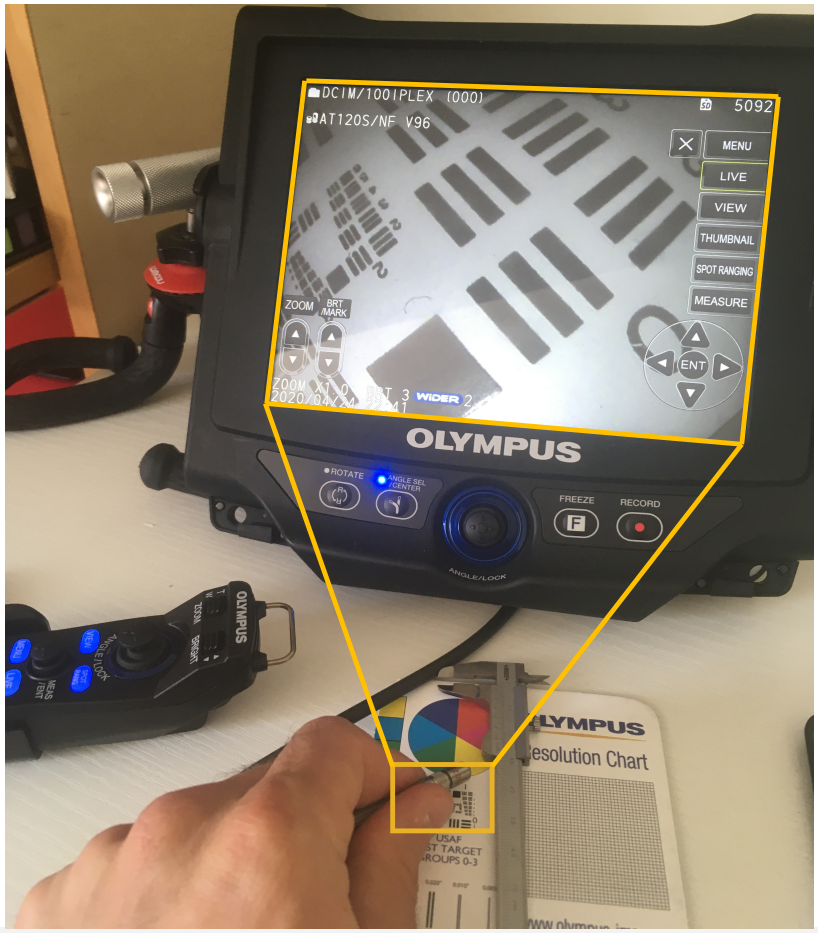


Critical Element 3: Optical Tip Adaptors



Critical Element 3: Optical Tip Adaptors

Magnification



Notice how much larger the image of the object shows on the screen compared to its actual size

Videoscope Functions

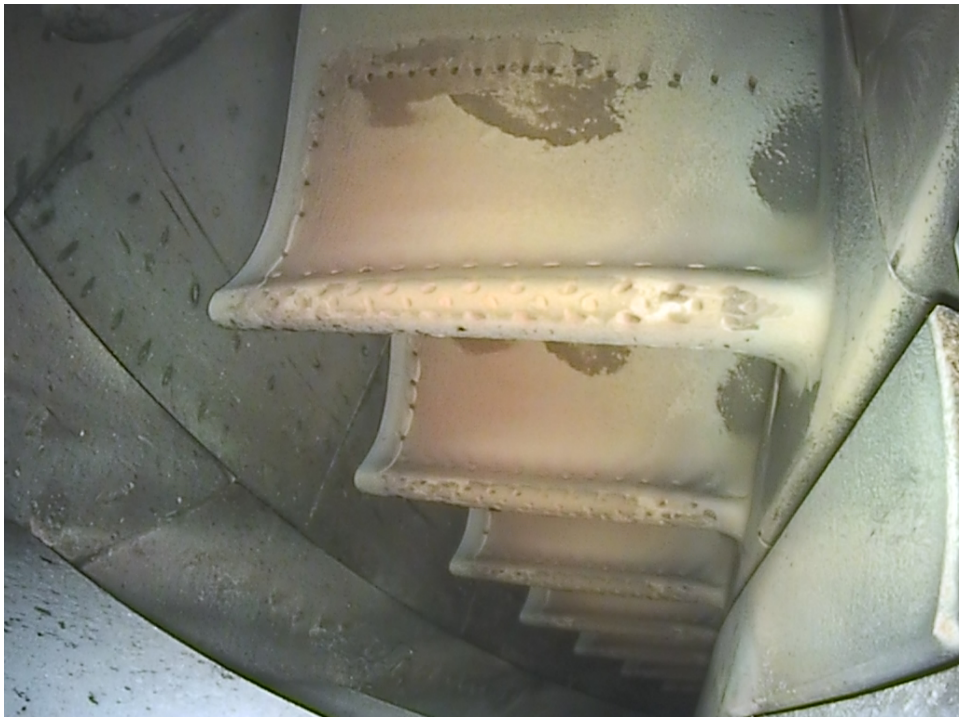
- Now that we have selected a videoscope with the right insertion tube diameter, attached the right optical tip adaptors, and managed to get the probe to the right position, **what can a videoscope do?**

Visualize

Capture Images

Record Videos

Qualitative

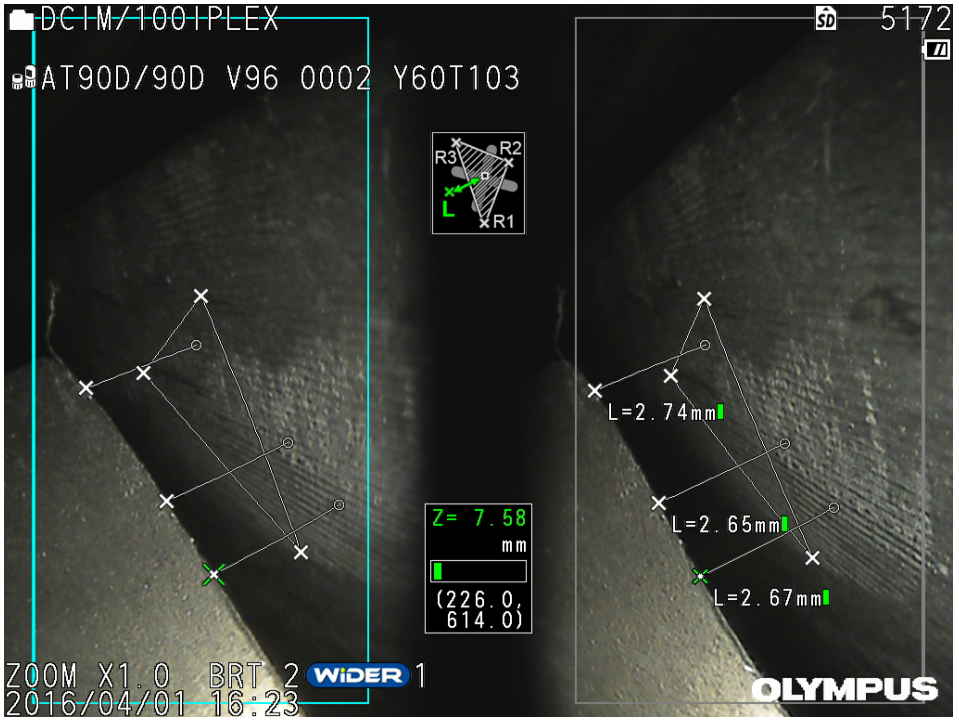


Videoscope Functions

- Now that we have selected a videoscope with the right insertion tube diameter, attached the right optical tip adaptors, and managed to get the probe to the right position, **what can a videoscope do?**

Measurement

Quantitative

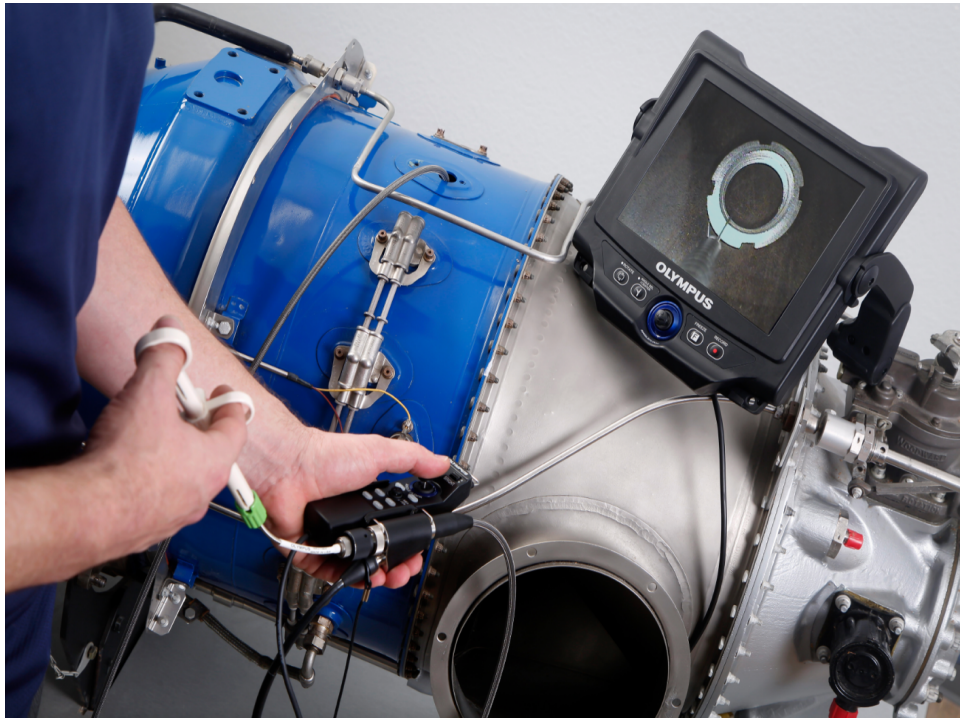


Videoscope Functions

- Now that we have selected a videoscope with the right insertion tube diameter, attached the right optical tip adaptors, and managed to get the probe to the right position, **what can a videoscope do?**

Retrieve/Manipulate Objects

Remote Operations



Visualize, Image, and Record Video

- Submerged videoscope

Measure

- Measuring the depth of a cavity caused by cavitation inside a pipe — complex geometry

Object Manipulation

- Videoscope with working channel and tools

How to Select the Best Videoscope?

- Videoscopes are versatile, and you have many options for traditional applications areas (aviation, automotive, etc.) and novel applications
- **If you need to see, measure, or manipulate objects** in a confined space or inside a machine, the answer is:

  Yes, maybe videoscopes can be a solution for my application

- How to evaluate which videoscope is best for my application?

- Each application will have its particular requirements, but the initial evaluation will always be:

  - What is the objective of the inspection?
  - Where is the inspection happening?
  - How is the access to the inspection area for the inspector and for the insertion tube?
  - What are the environmental and operating conditions?

- **The more the manufacturer understands your application, the better recommendations and support we can provide**

Takeaways

- Remote visual inspection is a method used to visually inspect surfaces that are otherwise difficult to access
- Industrial endoscopes (including videoscopes) are used to inspect confined spaces
- The 3 critical elements of a videoscope are the light source, the insertion tube, and the optical tip adaptor
- There are different types of optical tip adaptors, and the one you choose depends on the application
- Videoscopes can visualize, capture images and videos, perform measurements, and manipulate objects
- To choose the best videoscope, it is important to understand your application

Panel of Specialists:
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Guan-Lu Zhang (EMEA)

Feedback, suggestions, and further questions:
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