

# The definitive guide to remote visual inspection



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## Introduction

The manufacturing environment is a critical one, and to maintain product quality, safety and efficiency, production machinery must be kept in perfect working order, inside and out. This requires keeping a watchful eye on all parts and pieces by means of regular inspections. With the increasing complexity of modern production environments, this presents challenges. Additionally, many of the parts being manufactured such as castings, piping, valves or other heavy industrial products require visual inspection of difficult to access areas.

### **The challenge:** Inspecting difficult-to-access equipment

Inspecting complicated equipment from the outside is not as challenging as viewing it from the inside, which often means dismantling it. This requires manual labor by expert mechanics. This can be time-consuming and often delays production, which directly affects a company's bottom line.

Besides being costly, some areas are simply too difficult to access or the environment too hostile to allow for the kind of regular visual inspection needed to keep machinery operating smoothly and meeting compliance and safety standards.

In some cases this could be because the area needing inspection is hard to visually assess because it's deep within machinery, requires scaffolding to access, or otherwise hidden. In others, the environment may be hostile, as in areas subject to extreme temperatures or bathed in oil or other chemicals. In the case of manufacturing or specialty equipment like that used in food, beverage and pharma production, it's critical that residual product, dust or pathogens are not inadvertently introduced into the environment.

### **The Solution:** Remote Visual Inspection

The best way to tackle these challenges is with tools that allow for remote visual inspection. Remote Visual Inspection (RVI) is the viewing of any surface more than 600mm (23.6") away from the eye or which can not be viewed by direct means. The most widely used of these is the video borescopes, which is made up of a small diameter camera in an articulating, small diameter flexible tube connected to a digital display. Much like a medical endoscope, which is used to probe the depths of the human body without surgical intervention, video borescopes are designed to discreetly yet accurately view formerly hidden areas inside equipment.

Video borescopes are commonly used where distance, angle of view and limited lighting may impair direct visual examination or where access is limited by complexity, security or sanitary constraints or atmospheric hazards.

Because of their ability to offer up-close access to difficult-to-reach places without having to dismantle or deconstruct the object, video borescopes have proven to be invaluable tools for remote visual inspection.

Video borescopes can be rigid or flexible depending on the intended use and the complexity of the path they are expected to travel. Even the simplest video borescope will have a source of illumination to allow a technician to visually inspect nooks, crannies and pathways within a dark environment. Since a video borescope and the spaces it views are often quite small, it will have lenses to magnify what is being viewed to ensure that accurate assessments are made in the process. Video borescopes are used in many industries for trouble-shooting as well as routine equipment inspections of condition and health.

## The advantages of video borescope technology

Modern video borescopes are affordable tools that improve productivity by making it easy to ensure the cleaning validation and verification, as well as condition of components by means of regular, thorough inspection. This allows manufacturers to replace worn or damaged parts before they cause problems or delays. The visual ability of video borescopes make inspections more efficient, and many provide innovative ways of documenting inspection results so that problems are mitigated and legal compliance is met, thus increasing the uptime of equipment.

Video borescopes offer distinct advantages over even the best external examination, especially when used for industrial maintenance that calls for sanitary internal inspection as well as those in challenging environments. Video borescopes can be configured with shorter or longer camera insertion tubes, diameters for small passage access, more lighting or greater "push-ability", and a variety of interchangeable optical tips to adjust the viewing angle and focus range to fit a variety of applications.

Because video borescopes record what they see, they are a tremendous help in inspection reporting, making it much easier to save and share information without requiring the separate step of tallying results and preparing them in a readable format. Video borescopes enabled with Menu Directed Inspection (MDI) software can record images and videos with asset specific data tags showing where and when images were captured. This information can be used to compile a comprehensive report in a Word format, and over time, this information can be used to analyze trends in equipment wear or use.

Using a camera insertion tube steered with a joystick to navigate inside of assets can be challenging. A live on-screen Tip Map aids inspectors in guiding the tip during the inspection. A grid shows the tip direction and helps inspectors maintain orientation for easier navigation. As inspections sometimes need to be performed on equipment that has been recently shut down and may have operating temperatures exceeding limits for even the most rugged video borescope, it's important that the device have a temperature warning system that will alert you to avoid damage to the instrument. When time is critical, external cooling sleeves can allow camera access in temperatures greater than standard operating temperatures.

Many video borescopes will include substantial memory capacity along with USB and microphone ports to allow you to describe observations at the same time they are being captured.

## Why doesn't every manufacturer use video borescopes?

Video borescopes are finely crafted technological instruments with price points that reflect a wide range of features and capabilities. In high-value cases, such as aircraft engine inspection, the return on investment is unquestionable and the most advanced features are widely used. Some companies that only need a video borescope on occasion can get away with borrowing or renting one, but with the range of instruments and features available, it makes sense to invest in one that suits your specific inspection and company needs.

In most cases it's easy to justify the investment in a video borescope. Remote visual inspection provides a quality of condition-based maintenance to the manufacturing process that can increase safety, reduce downtime, improve the quality of output, increase productivity and eliminate many equipment failures.

The fact is that modern video borescopes are the best solution for industrial maintenance jobs that call for remote visual inspection and those in challenging environments. They are affordable tools that increase productivity and improve output by ensuring machinery part quality and improve inspection efficiency. Video borescopes help in compliance by providing consistent and comprehensive documentation of all inspections, and actually can increase the uptime of your manufacturing assets.

## Who uses these video borescopes and how?

Machinery inspectors, quality assurance managers, maintenance personnel and others rely on remote visual inspection to positively impact the manufacturing process in many ways. Here are examples of how video borescopes are used in just a few diverse applications:

### The pharmaceutical and food & beverage industries



The food and drug industry must follow meticulous procedures for validation, verification and routine performance monitoring of processing equipment. Because even the slightest contamination compromises product quality and poses health and safety risks, thorough cleaning of equipment between production batches is crucial. The disassembly of process equipment for cleaning can be extremely difficult, costly and time consuming. Many manufacturers instead use video borescopes as part of clean-in-place (CIP) programs. This helps meet regulatory requirements that include monitoring and data acquisition to help confirm compliance to CIP regulations. Video borescopes are also used for weld integrity inspection of high-purity piping; some provide a negative image for an enhanced view of weld porosity and integrity.

### The automotive industry



Automotive manufacturing uses video borescopes to perform inspections across all stages of the manufacturing process including car body, engine, R&D and component suppliers. Component inspections as diverse as engine blocks, pipe welds, fuel nozzles, hydraulic systems, engine pistons, valve seats and more can routinely be accomplished by remote visual inspection. Video borescopes are ideal for loose part and debris retrieval, and can help automotive factories save time and money—and improve quality—by identifying faulty or out of spec parts without taking apart a large assembly.

### The power and energy sector



Power generator operators often rely on video borescopes to ensure heat recovery steam generator (HRSG)/furnace condition, pipe cleanliness and weld integrity and to perform valve and basic turbine inspections that OEM and service providers don't provide. Wind turbines gear box inspections must be frequent, but are challenging due to difficult access, compact design and harsh environments. Video borescopes are increasingly used for these inspections, as their insertion tube toughness and tip articulation perform well in the hot and oily environment typically found in wind turbine gearboxes, revealing indications to analyze before they impact performance or safety. Manufacturers typically use video borescopes to perform pre-warranty gearbox inspections in the field and blade inspection during manufacturing and in service.

## Turbine engines for power & aerospace

High-value rotating equipment is regularly inspected with video borescopes to help asset owners and operators get the most from scheduled maintenance. Any downtime of a power-generation turbine or airplane directly impacts revenue, so efficiency, continuity and productivity are key. Today's high-end video borescopes rely on advanced technology and provide 3D phase measurement, image enhancement and analysis software.

## What to look for in a video borescope

**Durability** – Read reviews and understand the products full capabilities, environment ratings, potential limitations before you invest in remote inspection equipment. Your video borescope is likely to be used in some tough, even hostile environments, and it's important that it's up to the task.

**Ease of use** – Look for a video borescope that has an ergonomic design and that is usable right out of the box, without a complicated setup. Since many inspections involve pushing and twisting the insertion tube while steering the probe head with a handheld joystick, it's important the tool has a high degree of articulation to let you look at each area from different angles.

**Image quality** – The combination of light output, camera resolution and image processing are the three key components that are required for a great video borescope image. Whether your technicians are watching a streaming video, sending individual photo files for further evaluation or even archiving them as part of compliance, you want the best image quality you can find.

**Portability** – If your device is heavy or awkward, it won't be as easy to access the small spaces you need to inspect. A portable and streamlined video borescope is ideal for hard-to-access inspection areas and often provides better ergonomics for longer inspections.

**Service and support** – Don't find yourself in the awkward position of purchasing a powerful and finely tuned piece of equipment only to find out no one is there to help when you need them. Find out ahead of time what kind of support and training your vendor offers before you sign on the dotted line.

**Features** – Each industry and application has its own unique inspection needs. Take the time to find a video borescope that offers the features and capabilities that are a match for your inspection needs, and that you can rely on now and in the future.

**Measurement options** – Many video borescopes offer the ability to measure the size of indications with incredible precision and accuracy. There are several different measurement technologies available ranging from basic comparison measurements, traditional stereo measurement which provides 3D xyz coordinate calculations- only at the cursors, and even fully-surfaced 3D point cloud visualizations. Not all measurement technologies are created equal so it is important to understand if your inspection requires indication measurement and what level of accuracy and precision is required before making an investment in this advanced technology.

**Reporting capability** – The ability to record tagged images and videos which show where and when images were captured and automatically create an inspection report can save both time and money. The data gathered can be invaluable in improving efficiency, meeting compliance and ensuring quality of output. Trend analysis over time becomes easier.

## Summary

Remote visual inspection via video borescope has become an industry standard. Although video borescopes incorporate the very latest technology, they are not difficult to master and can be useful in both simple and complicated inspections. They save money by reducing the time and resources formerly used to dismantle working equipment, and they are highly useful in meeting compliance and regulations.

Video borescopes range from a simple utility video borescope to those that provide the latest in measurement technology and are designed to work in dark and hostile environments that would otherwise be impossible to access. Some of the most advanced manufacturing industries in the world, like aerospace, food and beverage, automotive and pharmaceuticals rely on video borescopes to keep equipment in working order, production running smoothly and to increase safety and efficiency.

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