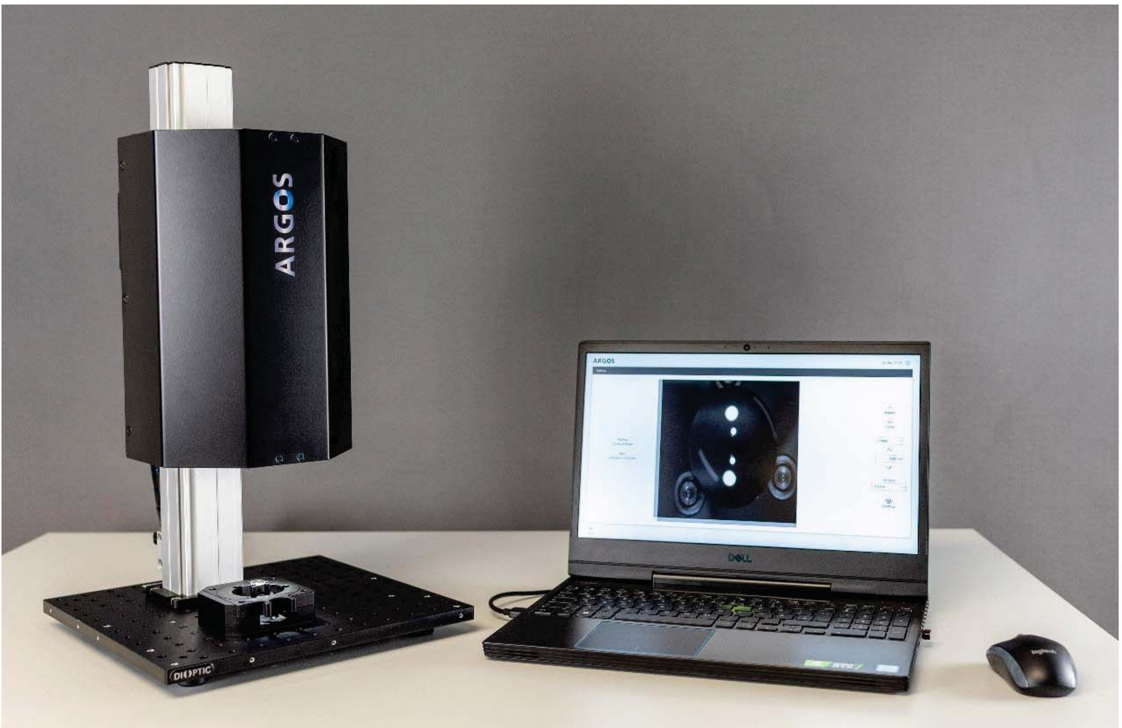
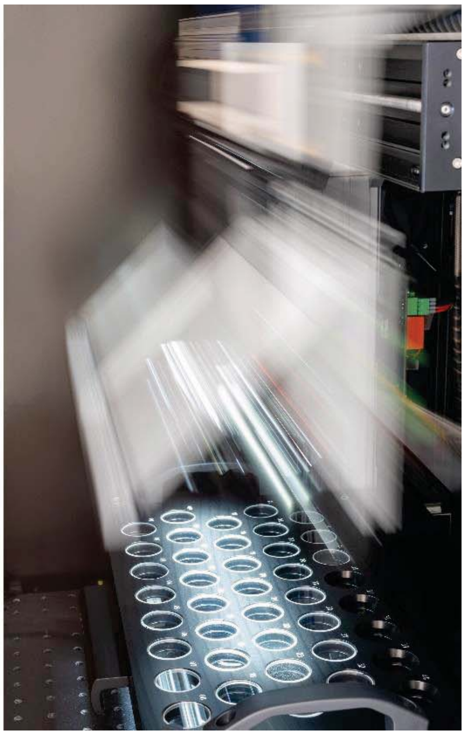
AUTOMATED SCRATCH-DIG INSPECTION

Advantages of replacing manual-visual inspection





Worldwide a tendency can be observed to increase accuracy and quality of inspection of optical parts. More often than ever before, manufacturers explore computer-based inspection systems to gradually replace human inspectors. We describe how machine vision inspection systems can help to improve quality while reducing costs.

Inspection of optical surfaces: Man vs. Machine

Optical inspection of lenses and mirrors is traditionally done by human inspectors. This causes high cost and subjective inspection results and is incompatible with a highly efficient high-quality digital workflow. Also, ISO 10110-7 formulates complex criteria for a pass or fail, which are difficult or even impossible to keep in mind when observing defects on optical samples.

On the other hand, machine vision-based inspection systems, such as ARGOS by DIOPTIC, can solve the task of highly reliable objective testing of optical surfaces according to ISO or MIL rules. These systems are typically equipped with a dark field illumination unit and a high-resolution optical camera generating high quality images of relevant defects. Ideally, the images taken within seconds are then used as a basis for a computerized analysis by machine learning algorithms. The data is strictly analyzed according to ISO 10110-7 or any other criteria given by the system owner.

The need for automated inspection systems

In a highly efficient cost sensitive environment not only computerized testing is needed. Testing systems must also be semi or fully automated to reduce the cost of human interaction within the QC workflow even for comparatively small numbers of units. In addition, automated systems also reduce sources of defect classification errors.

How can an automated inspection system be used in a workflow for production lenses/mirrors, optical assemblies or final products? Three scenarios are often found:

1) Incoming components from suppliers need to be checked for compliance with the ordered quality before further processing is done.
2) Product quality must be increased while manufacturing cost shall decrease.
3) Delivered quality of goods must be documented to justify sales prices and reduce unjustified returns of goods.

Let's address case 1): Manufacturers of optical products in many fields rely on individual optical components sourced from various suppliers. When these deliveries arrive at the factory, they are typically screened 100% for defects with human inspectors to make sure that ordered parts comply with the specified requirements.

An automated inspection system helps saving costs by reducing the workforce needed to screen batches of delivered parts. It also reduces costs by reducing accidentally scrapped parts or even worse, passing faulty parts into production.

In case 2) an automated batch inspection system helps with objective scan and classification results independent of fatigue or experience of a human inspector. The automated system can be loaded and operated by untrained personnel. It can run unattended and in shifts 24/7. Therefore, it can help reduce inspection costs. It also facilitates adding inspections after multiple production steps to monitor and improve processes and product quality.

Case 3) often is observed with manufacturers delivering optical parts for further processing. If the quality level of delivered goods can be documented with measurements by a computerized automated inspection tool for each delivered piece, customers are more willing to pay a premium price for the high quality they require.

Therefore, in order to maintain long lasting customer relationships, it is highly desirable to document product quality detailed.

How does a workflow look like with an automated surface quality inspection tool?

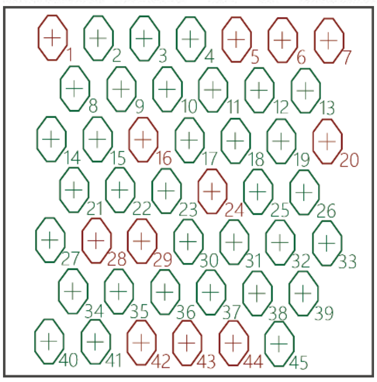
Typically, manual inspection involves a (manual) cleaning step before or during inspection. This is quite the same if an automated tool is operated with trays of samples. Ideally, the system is located in a clean room and an operator cleans each sample before placing it into a tray. For larger volumes a multi-bath ultra-sonic cleaning system will be more efficient.

Once a tray is fully loaded with samples, it is placed onto the 200 × 200 mm stage of the ARGOS inspection system. The software "recipe" for inspection has been pre-defined and is stored in a measurement profile. The profile can be automatically selected using a QR code on the tray.

In some applications, there are even 2D matrix codes on every product that allow the ARGOS software to automatically assign each test report to the tested samples. In other set ups, an operator enters serial numbers by hand or with a bar code reader.

Measurement of a full tray takes between 5 and 60 minutes, depending on the inspection detail and lens curvatures. Plane parts usually take less time than curved parts.

Once the entire tray is measured, the operator checks the graphic report on the screen for failed parts, removes them for a second cleaning step and subsequent sorting into a new tray. If a product fails after this second inspection step it is scrapped.



Typically, no human interaction with inspection reports is required, unless engineers need a data basis to modify processes to yield better quality.

ARGOS matrix – the most flexible system to inspect according to ISO 10110-7

ARGOS matrix 200 features a precision 8″ (205 × 205 mm) stage offering plenty of room for a large number of samples in a tray. Its software is easily configured by creating recipes for different inspection tasks. From automated inspections of many samples in a tray to the ability to serve as a lab-instrument with manual operation for testing of individual pieces, there are almost endless possibilities.

With three standard optics configurations the optimum ARGOS matrix setup can be found for most QC tasks. Standard fields of view are 10 × 7.5 mm, offering an nominal resolution of 2.5 µm (ARGOS matrix S), 20 × 15 mm with a 5 µm resolution (ARGOS matrix M), and 33 × 25 mm with a resolution of 8 µm (ARGOS matrix L).

A stitching option offers virtually unlimited sample size by making the entire 200 × 200 mm (300 × 300 mm optional) sample space accessible for measurements of large samples.

The system automatically tests individual samples placed on a 200 × 200 mm tray piece by piece, generating accurate test results for each sample and for each tray. Reports according to ISO 10110-7 or user-defined surface quality requirements are generated as pdf and json files. They are fully compatible with a digital workflow management, while they can also be used by engineers as a basis for further process optimization steps. Test reports are automatically generated by the system software for each measured sample and for each measured tray, graphically indicating pass/fail for each sample in a tray. This allows for an easy and fast decision about further processing of tested products.

The software also accounts for various areas of each sample under test with different requirements for surface quality, so that e.g. the center of a sample can be tested to higher surface quality standards than the peripheral areas. It can test into the volume of optical parts, to find bubbles or other imperfection. Beam cubes and bonded lenses can be examined for scratches and bubbles at the bond surface.

On top of that, stitching can be combined with automation for fully automated measurements of many samples in a tray with sample sizes being bigger than the field of view of the ARGOS matrix system operated.

ARGOS matrix 200 is optimized for different fields of optical inspection, like wafer level optics, micro optics, mirrors, lenses, sets of lenses, beam splitters and other optics with complex shapes.

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