

## PipeEndoscope: Non-destructive Roughness Inspector for Small Pipes

### 1. The PipeEndoscope

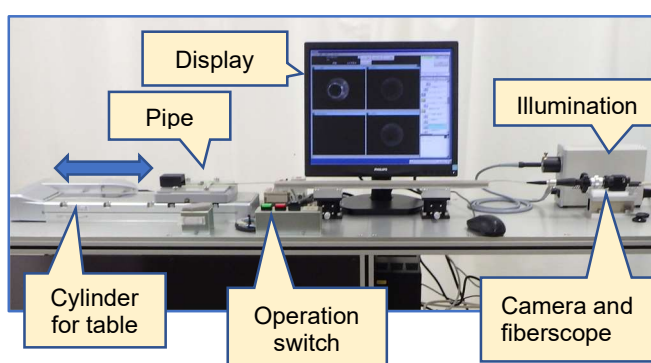
(Patent pending)

We have newly developed **the PipeEndoscope**, a *non-destructive roughness inspector*, for the measurement of an inner surface roughness and the detection of scratches or residues inside a nozzle **without cutting it open**. This enables **total number inspection in nozzle production** to ensure all the nozzles produced to have a determined roughness, no-scratches, and no residues. The conventional surface roughness tester requires to cut a sample in half so that the measuring should be a sampling inspection.

### 2. Specifications

Measurable ID: 0.45 – 2.00 mm  
 Maximum pipe length: 250 mm  
 Fiber scope diameter: 0.35 – 1.2 mm  
 (changeable for a pipe diameter)  
 Tester size: 1200L × 950H × 400D  
 Camera: CCD with 300 thousand  
 pixels in monochrome  
 Variable parameters: feed pitch and  
 number of measuring time  
 Measuring time: approx. 2 seconds  
 per one pitch including feeding time

【Overview of the PipeEndoscope】



### 3. Measuring example

The images of the insides of pipes captured by the inspector (right) demonstrate that **the reflected light varies** according to the inner surface roughness. Existing of scratches or residues also makes the reflection brighter, meaning that the image brightness implies the surface quality.

For the use in volume production, the data and images are stored into a server to be traced afterward.



### 4. Operation

- 1) Insert a fiber scope into a pipe, and place the pipe in the test bed.
- 2) Push the start button to feed the fiber scope in 5 mm followed by the predetermined number of times of image capturing (17 times at max.)
- 3) The roughness converted from the image brightness by collated with the database is displayed on the monitor.
- 4) If scratches or residues are found, the buzzer goes off and the monitor shows the image.
- 5) The pipe is removed by hand from the bed, followed by pressing of the reset button to return the robot cylinder back to the home position.

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