

DENSO Corporation / Air Gap Sensor

Prevent machining defects with CNC machine tools using precise workpiece seating confirmation.



Not noticing seating failures of ABS actuator parts produces defectively machined goods.

Our biggest headache was having to stop the line for a full inspection...

In Denso's Driving Safety Production Division, ABS actuator parts must be manufactured with a high machining accuracy.

In the past, when cutting using a CNC machining center, a pneumatic "gap sensor" was employed to verify the seating of the workpiece and the chuck.

However, the repeatability of 20 - 30 μm obtained with the conventional pneumatic "gap sensor" was unstable and unable to detect trapped cutting chips or workpiece float, leading to defective products due to seating failure.

Since the machined workpieces are all subject to a full inspection, sending defective machined parts to the next process means that the line has to be stopped during the inspection process and productivity goes down.

Murata:

"Using a conventional pneumatic gap sensor, 20 μm was the limit of confirmable seating detection.

We called it a 'sensor to detect workpiece presence' , not a seating sensor.

Our goal was to find a detection method for defective workpiece seating using an entirely new technique to detect failures before cutting, keeping the next processes free of defective parts. "

Required accuracy of 5 μm !

Everyone said "you can't get that accuracy in mass production...", but they set out in collaboration with chuck manufacturers to develop new workpiece seating confirmation.



DENSO Corporation

Driving Safety Manufacturing Division
Shoichi Murata



Firstly, high-accuracy chucking was achieved using a precision diaphragm chuck. The challenge was the Z-axis seating accuracy.



With 24-hour operation, continued machining without noticing that the seating of the workpiece is incorrect will reduce the yield and cause a drop in productivity.

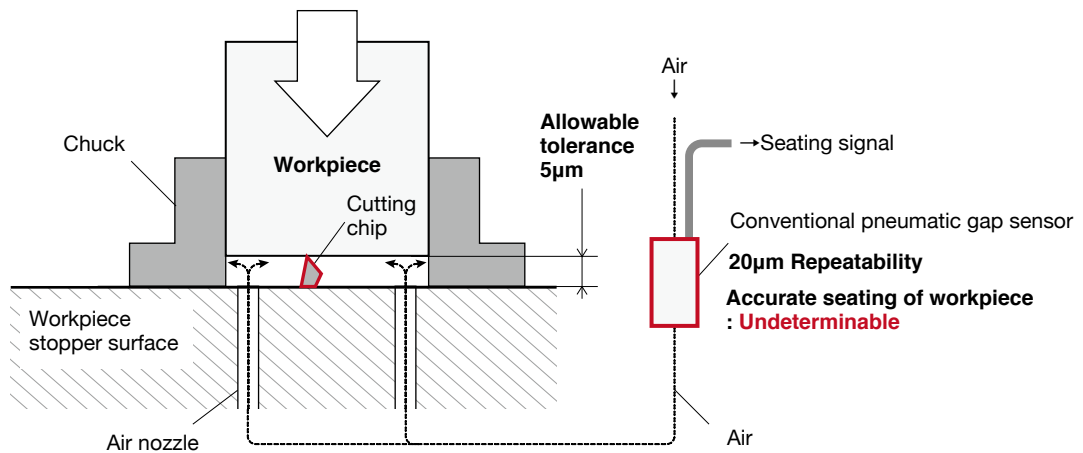


1. Workpiece before machining
A 5 μm seating accuracy was required in order to prevent machining defects.



2. Workpiece during precision machining
Lathe→drilling processes are followed by machining actuator parts.

✗ Seating confirmation using a conventional pneumatic "gap sensor"



Problems

- ✗ The repeatability of a conventional pneumatic "gap sensor" is a low 20 µm, meaning that the **accurate seating of the workpiece cannot be detected** when held in the chuck.
- ✗ Defective machining results in stopping the line for a full inspection, **decreasing productivity**.

The opportunity to adopt a Metrol sensor came in the form of the M-TECH Mechanical Components & Materials Technology Expo held in 2013 at Tokyo Big Sight.

We received an inquiry after a chance visit to the Metrol booth, featuring a demo performance of our "Air Gap Sensor" precision seating sensor.



Air Gap Sensor (DPA-A2)

Murata:

"I saw the Air Gap Sensor seating demo at the exhibition and thought 'That's it!' Exactly the precision seating sensor I had been looking for. I immediately asked for a trial sample, and started evaluation tests with the chuck manufacturers."

Conventionally, the pneumatic "gap sensor" adopted for machine tools had been used for detecting machined workpieces, but with a low repeatability of 20 µm, it was limited, at best, to simply confirming the presence or absence of the workpiece. Accurate seating confirmation of the jig and workpiece was impossible

Technology which picks up on defects before cutting.

Incorporating a mechanism into the production process to prevent machining defects.



Murata:

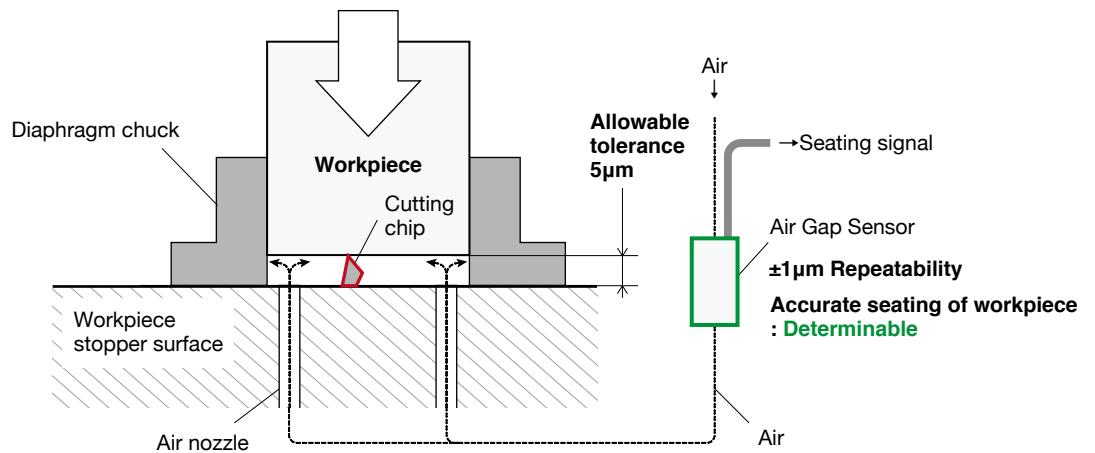
"Seriously, confirming precision seating with a 5 µm allowable tolerance!? I was very dubious at first, but the chuck manufacturer's evaluation results were, in fact, $\pm 1 \mu\text{m}$. The moment I heard this, I thought, 'That will do the trick!' "

"Since it is also necessary to consider the precision of the machine tools themselves, it was very hard to get stable accuracy, but with this, the machining line can get moving! I made the decision immediately. "

After that, through rigorous evaluation tests over 4 months, the decision was made to formally adopt it on the machining line.

Detects workpiece seating defects due to cutting chips before machining can take place, preventing machined defect products. The inspection process no longer stops the line, and there has been an overall improvement in yield.

✓ Seating Confirmation with the "Air Gap Sensor"



Results

- ✓ The "Air Gap Sensor" allows **accurate seating confirmation** with the workpiece chucked.
- ✓ Prevents machined defect products during the production process. **Productivity is improved significantly.**



▲ Interior of the CNC machining center

Precision diaphragm chuck + Precision seating sensor "Air Gap Sensor" = The unbeatable pair eliminates defective products



▲ Exterior of the CNC machining center

Installation is straightforward since the air piping of the conventional pneumatic "gap sensor" can be re-used as is, while the sensor is simply retrofitted.

Continuing the drive for ultra-precise machining and improved productivity.



Murata:

"After adoption, operation has been trouble-free. Reliable awareness of 'poor seating' keeps defects from moving on to the next process."

"The next challenge is to construct a new machining line to suit the digital age. We are driving on with the goal of highly accurate parts machining which unites both people and equipment!"

The "Air Gap Sensor" adopted here has earned a high reputation within DENSO itself, and at the moment is being deployed company-wide as machining lines in one department after the next take it up.

Thank you very much for your cooperation, Mr. Murata.

Cooperated with **DENSO Cooperation Driving Safety Manufacturing Division**

www.denso.co.jp/en

► For further information about the products presented here

Air Gap Sensor Series

Effectively prevents CNC industrial machined defect products.



Precision Mechanical Type
Air Gap Sensor

DPA-A2

Excellence Award
in "Tokyo Venture Technology Award" 2015

NEW!!



1–100 μm detection distance
Short Range Detection Type

DPA-SR1

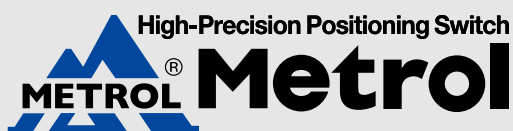
NEW!!



80–350 μm detection distance
Long Range Detection Type

DPA-LR1

The specifications and descriptions are subject to change without notice due to improvements in products.



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APP-DNS-E-K003