

Laser Bore Inspection System "ANALYZER3"

Sample Tests and Case Studies

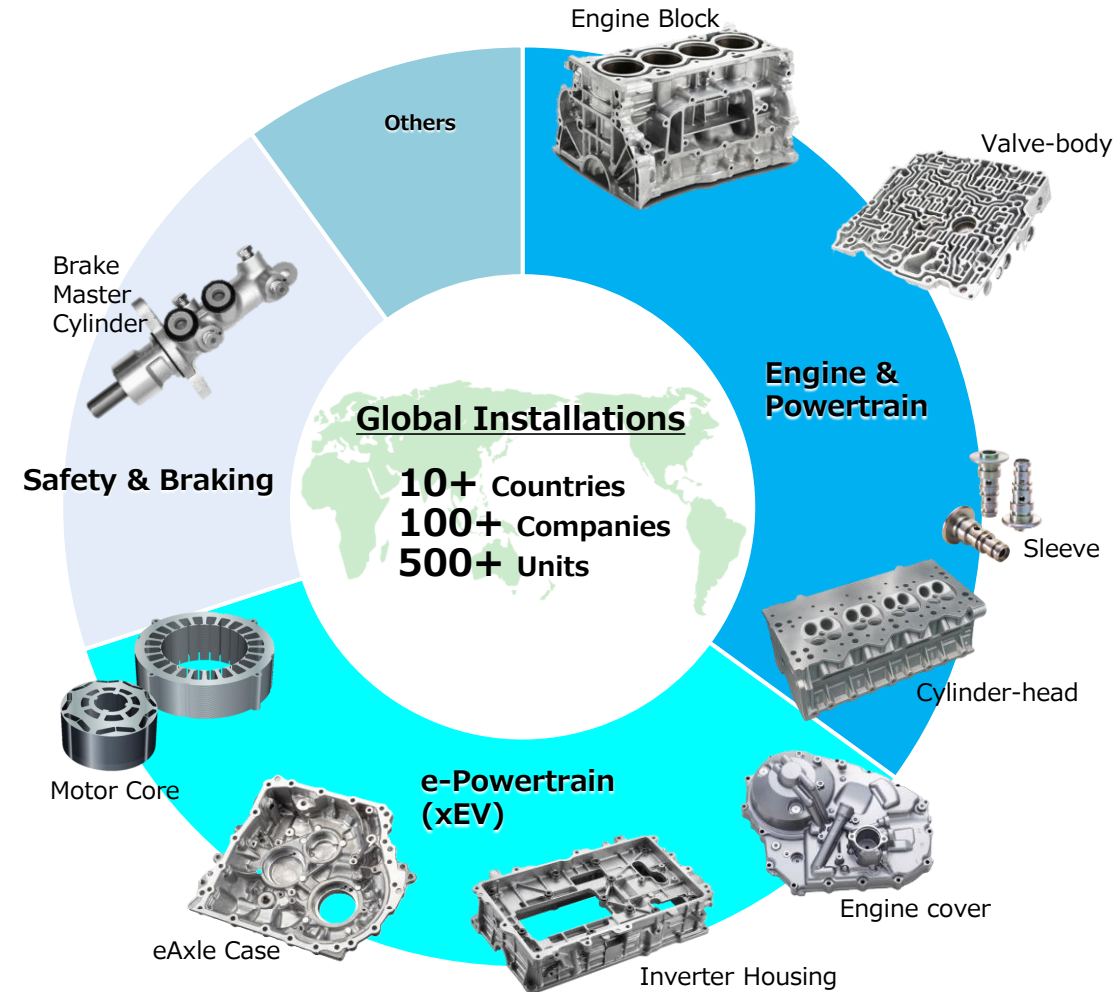
Key Applications:

Deep Bores, Tapped Holes, Motor Cores, etc.



Real inspection data and evaluation results using actual workpieces.

ANALYZER3 – Target Workpieces



■ Engine & Powertrain

Workpiece	Diameter(mm)	Depth(mm)
Valve-body	6 ~ 30	20 ~ 150
Engine Block	50 ~ 100	80 ~ 150
Cylinder-head	6 ~ 20	20 ~ 50
Sleeve	6 ~ 15	55 ~ 70

■ e-Powertrain(xEV)

Workpiece	Diameter(mm)	Depth(mm)
Engine cover	M8 ~ 30	15 ~ 30
Inverter Housing	M6 ~ 25	15 ~ 30
eAxle Case	M6 ~ 25	20 ~ 50
Motor Core	4 ~ 8	70 ~ 150

■ Safety & Braking

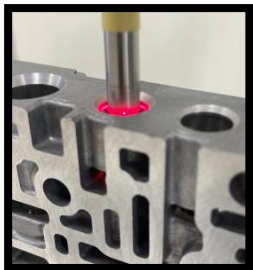
Workpiece	Diameter(mm)	Depth(mm)
Brake Master Cylinder	15 ~ 40	100 ~ 200

Minimum Detectable Size: **0.2mm**

Defect Type	Valve-body	Engine Block	Cylinder-head	Sleeve	Engine cover	Inverter Housing	eAxle Case	Motor Core	Brake M/Cyl.
Porosity	⊙	⊙	⊙	⊙	⊙	⊙	⊙	—	⊙
Scratches	○	○	○	○	—	—	—	—	⊙
Chipping	⊙	○	○	⊙	⊙	⊙	⊙	—	⊙
Foreign matter / Residual chips	⊙	⊙	○	⊙	⊙	⊙	⊙	—	⊙
Burrs	▲	—	—	▲	—	—	—	—	▲
Unmachined surface	—	—	—	⊙	○	○	○	—	⊙
Lamination defect	—	—	—	—	—	—	—	⊙	—

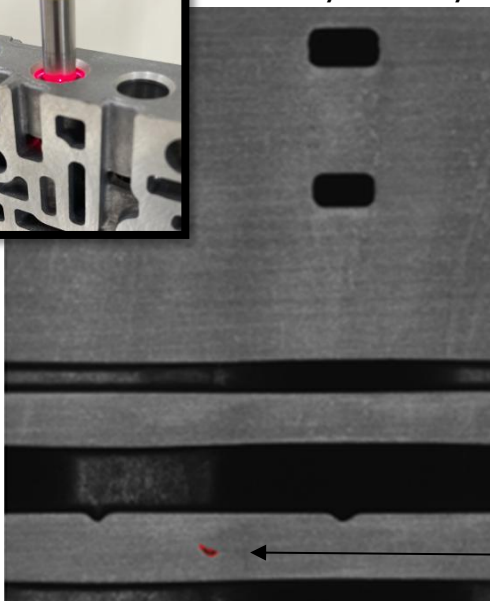
⊙ : Multiple cases confirmed ○ : Cases confirmed ▲ : Condition-dependent — : Not applicable

Valve-body — Porosity Inspection Image



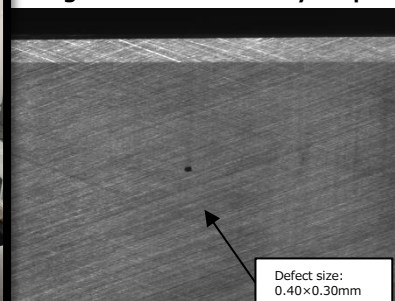
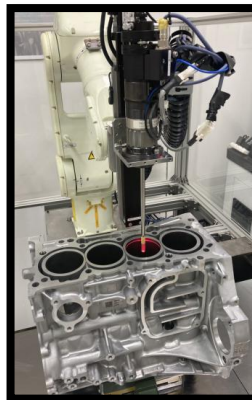
Limitations of Visual Inspection

- Bore too deep to inspect visually.
- Defect size cannot be measured by eye.



Defect size:
1.50×0.80mm

Engine Block — Porosity Inspection Image

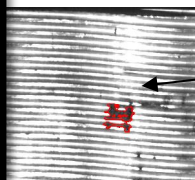


Limitations of Visual Inspection

- Heavy workpiece requires transfer to a dedicated fixture for inspection.
- Bore too deep to fully inspect the inner wall visually.

Defect size:
0.40×0.30mm

Inverter Housing (M6 Threaded Hole) — Porosity Inspection Image



Defect size(upper):
2.29×1.41mm
Defect size(lower):
2.14×0.75mm

Limitations of Visual Inspection

- High hole count makes 100% visual inspection impractical.

Tapped Holes



Cases for EV powertrains (such as inverter cases, battery cases, and axle cases) often have dozens of threaded holes, making reliable inspection of all holes a major challenge on the production line.

- The large number of threaded holes increases the risk of oversight.
- It is necessary to accurately evaluate inspection standards (e.g., $\varnothing 3$ mm or larger within [X] mm from the end face).
- Workpieces are large and heavy, imposing a heavy workload during inspection.



[Customer Feedback (Excerpt)]

- We automated the inspection of approximately 60 threaded holes, reducing the inspection time from about 3 minutes to about 2 minutes.
- Eliminating reliance on manual visual inspection has helped prevent missed defects and judgment errors, providing greater confidence in product quality.
- It has significantly reduced the physical burden and mental stress on operators, with positive feedback from the production line that inspection work has become much easier.

ANALYZER3 Inspection Scene



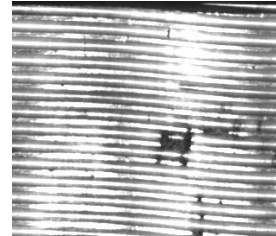
With a $\varnothing 2.3$ mm probe shaft, ANALYZER3 can capture images inside M6 tapped holes.

※Available for tapped holes starting from M4 (minimum).

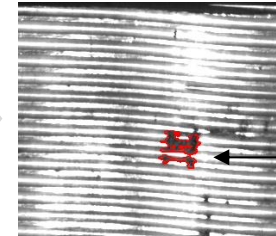


ANALYZER3 Inspection Image Data

M6-Porosity inspection data



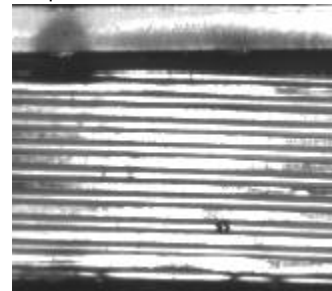
Inspection Results



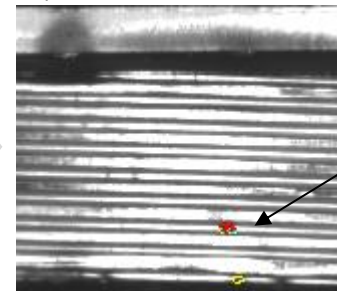
Detected size(top) :
2.29×1.41mm

Detected size(bottom) :
2.14×0.75mm

M12-Spatter contamination inspection data



Inspection Results



Detected size :
0.70×0.30mm

- Detects porosity and welding spatter.
- Defects of approx. 0.5 mm or larger are judged as Fail.

Valve Body



The valve body is a critical component that controls hydraulic fluid flow inside the transmission to manage gear shifting. It contains numerous oil passages, deep holes exceeding 100 mm, and intersecting holes, making internal visual inspection difficult. It is one of the most common workpieces inspected using ANALYZER3.



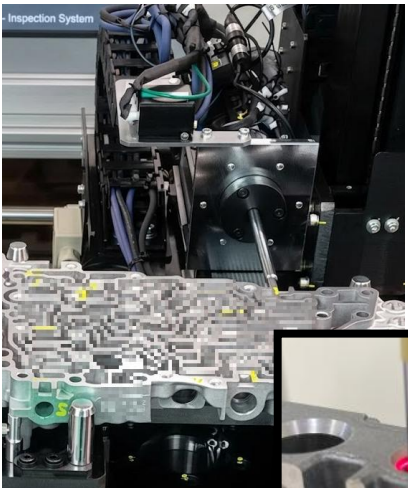
[Customer Feedback (Excerpt)]

- Parameter settings based on manufacturer expertise, such as settings for clustered pores, match real-world inspection standards well.
- We also appreciate the timely responses to our inquiries and thorough post-installation support.

Challenges in Conventional Visual Inspection for Valve Bodies:

- Difficult internal visibility due to many deep and intersecting holes, making accurate defect sizing challenging.
- Varying inspection standards for each hole/area increase the workload on operators.
- Large number of holes leads to long inspection times.

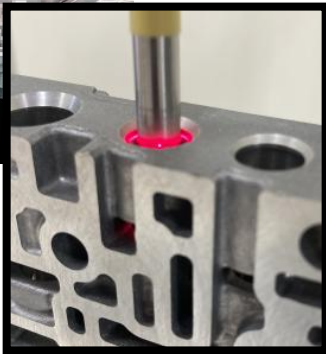
ANALYZER3 Inspection Scene



ANALYZER3 can image valve holes using a $\Phi 6$ mm probe shaft.

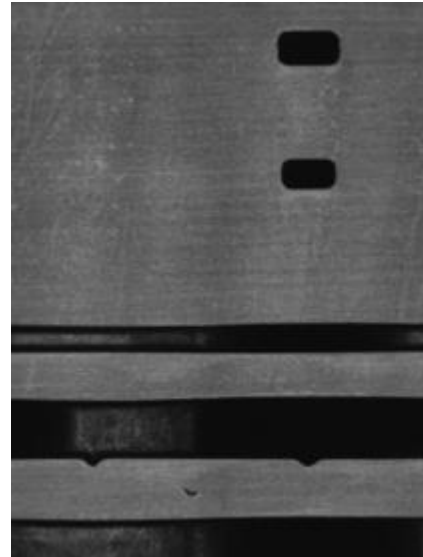
※Even stepped holes (e.g., inner diameter $\Phi 8-20$ mm) can be imaged using a single $\Phi 6$ mm probe shaft.

A hole with a depth of 100 mm can be inspected in approximately 5 seconds.

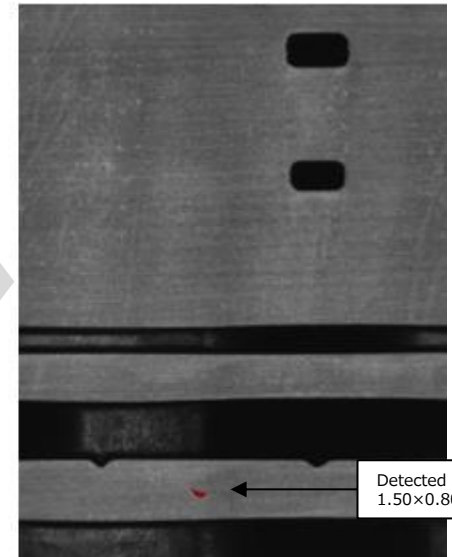


ANALYZER3 Inspection Image Data

Inspection data



Inspection Results



- Images $\Phi 8-20$ mm holes to detect porosity, foreign matter, etc.
- Defects of approx. 0.3 mm or larger are judged as Fail.

Sleeve



Sleeves assembled into valve bodies often have narrow inner diameters and deep-hole structures of around 100 mm. Additionally, high production volumes require efficient and reliable inspection.

Conventional visual inspection presents the following challenges:

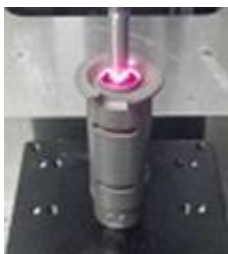
- Narrow and deep inner diameters restrict internal visibility, making accurate defect size judgments difficult.
- A high number of inspection items imposes a heavy burden on operators.
- High production volumes tend to result in long total inspection times.
- Manual visual inspection leads to inconsistency and variation in judgment among operators.



[Customer Feedback (Excerpt)]

- The pre-purchase sample test allowed us to evaluate the system thoroughly and proceed with installation with complete confidence.
- By narrowing down the inspection items, we achieved our expected detection rates.
- When any issues arise post-installation, the ANALYZER support team responds promptly, enabling smooth fine-tuning and additional parameter setups.

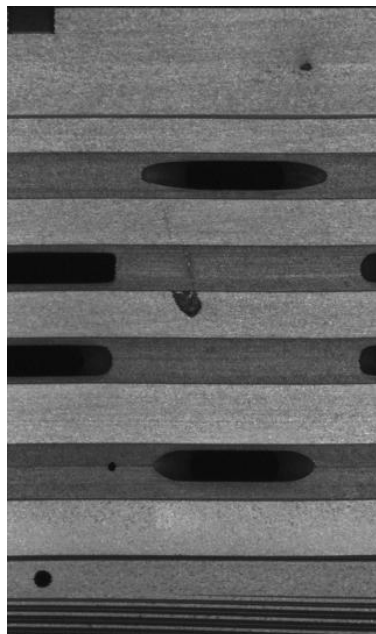
ANALYZER3 Inspection Scene



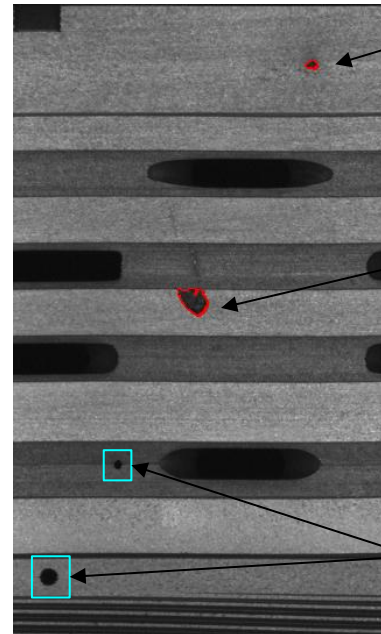
ANALYZER3 images the inner surface of sleeve bores using a $\varnothing 6$ mm probe shaft.

ANALYZER3 Inspection Image Data

Inspection data



Inspection Results



Detected size :
1.00x0.70mm

Detected size :
2.51x2.31mm

Orifice hole
(Should be open)

- Images inner diameters to detect casting pores, foreign matter, etc.
- Defects of approx. 0.2 mm or larger are judged as Fail.
- Capable of detecting unmachined orifice bores.

Brake Master Cylinder

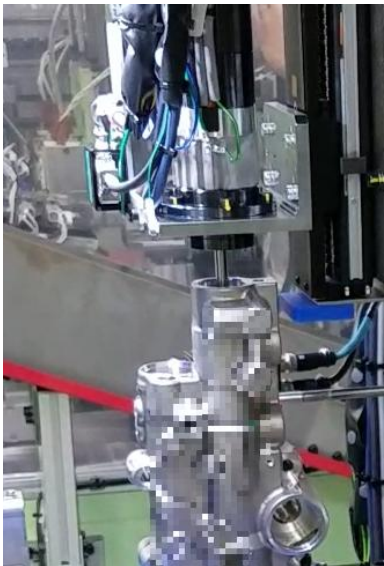


The brake master cylinder is a core component that converts pedal force into hydraulic pressure to control vehicle deceleration and stopping. Because it directly affects safety, it is a functional component with exceptionally high quality requirements among automotive parts.

Conventional visual inspection presents the following challenges:

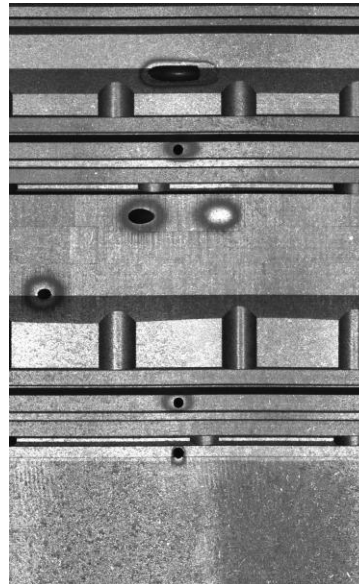
- Deep holes restrict internal visibility, making accurate defect size judgments difficult.
- Small scratches can easily become critical issues as they directly impact hydraulic sealing performance.
- Seal grooves have larger diameters than the main cylinder bore, making them difficult to inspect visually.

ANALYZER3 Inspection Scene



ANALYZER3 images the inner surface of bores using a Ø8 mm probe shaft.

ANALYZER3 Inspection Image Data



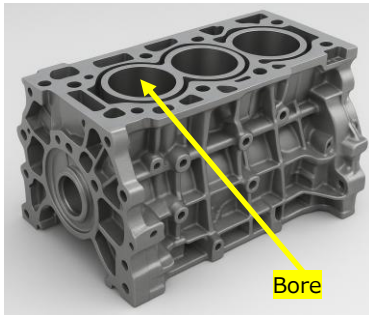
- Images inner diameters to detect casting pores, foreign matter, etc.
- Defects of approx. 0.2 mm or larger are judged as Fail.
- Direct visualization of seal grooves enables accurate evaluation



[Customer Feedback (Excerpt)]

- By automating the inspection process, we were able to reduce the number of inspection operators by half.
- Combined with upstream process improvements and a review of inspection standards, false reject rates have been kept down to 1–2%.
- Refining the inspection criteria on the system also significantly reduced cycle time.

Engine Block

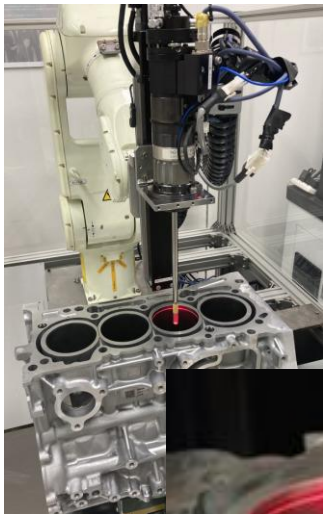


The engine block is the primary structural component of an engine, supporting piston motion and combustion pressure. In particular, engine cylinder bores are large in diameter and deep, making it difficult to visually inspect internal casting pores and scratches. It is one of the most common workpieces inspected using ANALYZER3.

Conventional visual inspection presents the following challenges:

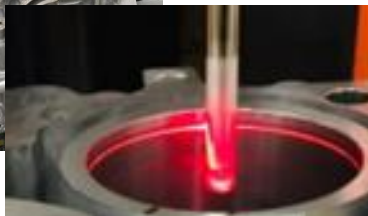
- Workpieces are large and heavy, requiring dedicated fixtures for inspection and imposing a high workload on operators.
- Cylinder bores are large in diameter and deep, making it difficult to visually inspect the entire inner wall.
- Accurate defect sizing for inner wall scratches and foreign matter is challenging.

ANALYZER3 Inspection Scene



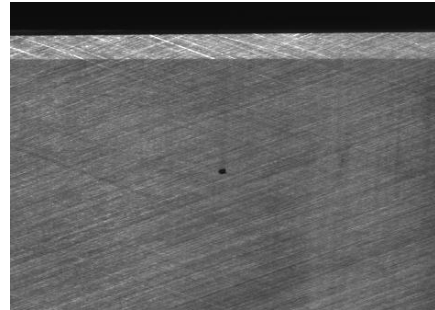
ANALYZER3 can image the inner of bore holes using a $\Phi 6$ mm probe shaft.

A hole with a depth of 100 mm can be inspected in approximately 5 seconds.



ANALYZER3 Inspection Image Data

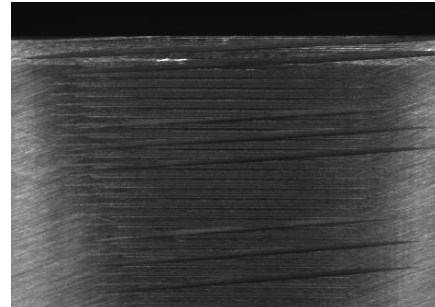
Porosity



Porosity clusters

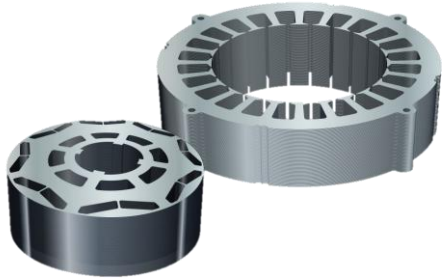


Rough surface residue



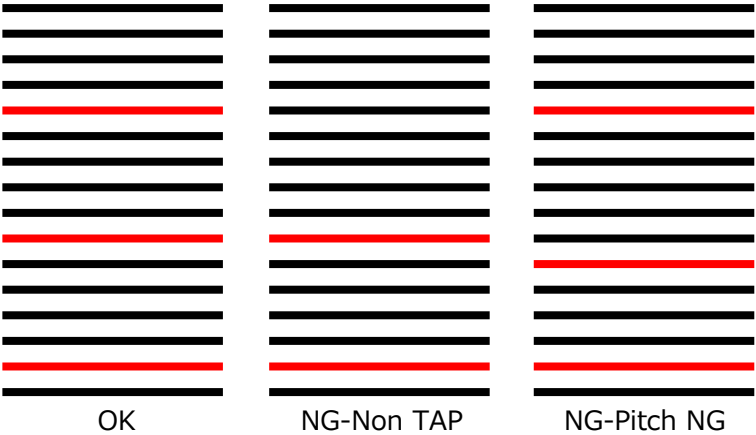
- Images $\Phi 60$ –100 mm holes to detect casting pores, foreign matter, etc.
- Defects of approx. 0.3 mm or larger are judged as Fail.

Motor Core



The motor core is a central component that forms the magnetic circuit of an electric motor and generates rotational torque. Constructed by laminating numerous thin electrical steel sheets, inspection of its stacking condition and internal structure is critical.

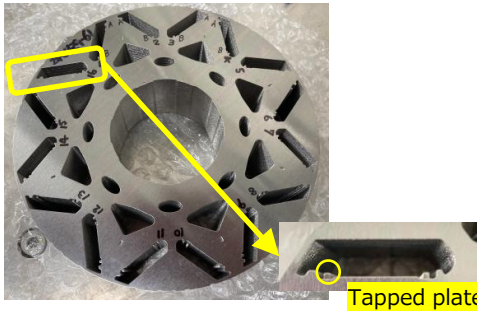
[Illustration] OK vs. NG Examples
Black line: Non-tapped plate, Red line: Tapped plate



One tapped steel sheet is inserted every 5 sheets, for a total of 3 tapped sheets assembled at equal intervals.

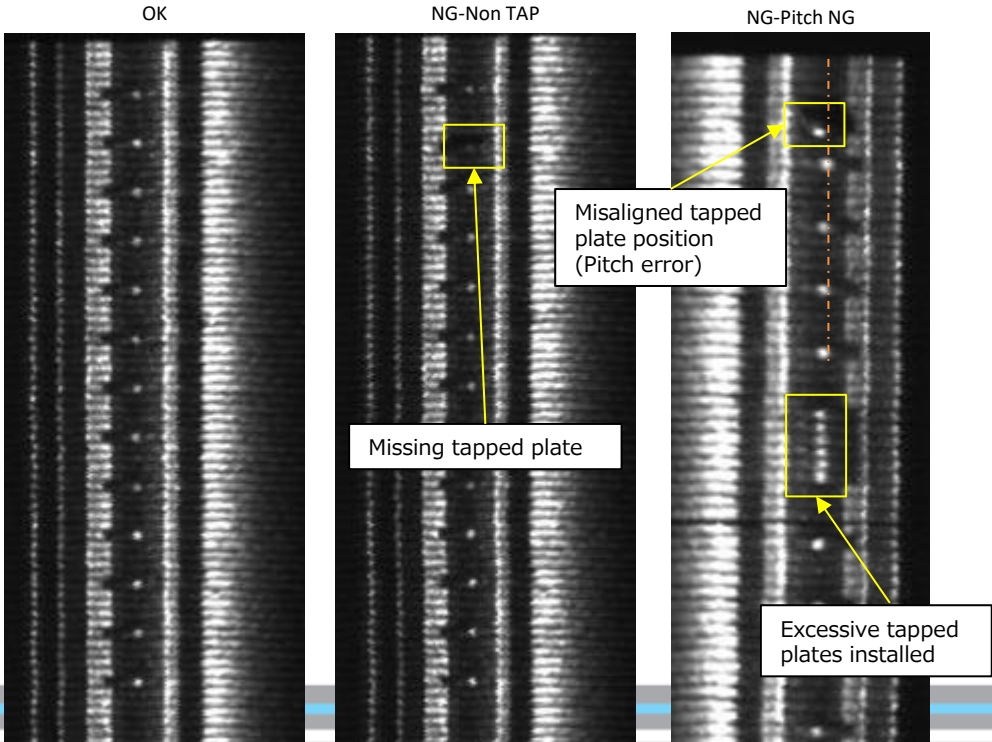
Only 2 tapped steel sheets are present instead of 3.

The second tapped steel sheet is not assembled at the correct interval.



Laminated steel plates are 0.25 mm thick per sheet, with one tapped steel sheet inserted every 5 sheets.
(If the tapped steel sheets are assembled at 1.5 mm intervals, it is judged OK.)

ANALYZER3 Inspection Image Data



Would you like to test with your workpiece?



ANALYZER3 can verify inspection feasibility through sample testing using your actual workpieces. We offer free sample testing for customers considering system adoption.

Why is sample testing important?

Because defect detection inside holes varies significantly depending on workpiece shape, material, and surface condition, evaluation using actual workpieces is essential.

Most of our customers decide on system adoption after conducting sample tests with their actual workpieces.

Sample Test Process

1. Sharing Work Information

If you would like to request a sample test, please share the following information first:

- Workpiece name
- Hole diameter(s) and depth(s)
- Drawings (showing hole locations)
- Defect types (casting porosity, foreign matter, etc.)

*Providing drawings will ensure a smooth evaluation process.

2. Sending samples

Please prepare and send your samples according to the following conditions:

- First test: Up to 20 holes (Free of charge)
- Include actual defective samples whenever possible
- Apply rust-prevention treatment to materials prone to rusting
- Cut heavy items to under 10 kg per piece

3. Test performed

Using the workpieces you provide, we will perform the following evaluations:

- Imaging data acquisition
- Verification of detection capability and false reject rate
- Estimation of inspection cycle time
- Consideration of proposed system configuration

4. Test Result Report

We will provide a report containing the following information:

- Inspection result summary and manufacturer insights
- Inspection images and Pass/Fail results

Reports will be delivered in PDF format. We will schedule a Web meeting to explain the report findings and discuss the next steps.

Key Points for Sample Preparation

To improve evaluation accuracy, we recommend preparing the following types of defective samples: (* Actual defective parts provide higher evaluation accuracy.)

- Large defects that are clearly NG
- Borderline defects at the threshold of NG judgment
- Small defects currently judged as OK



Sample testing starts from just one piece.