# CHARACTERIZATION OF THE ANISOTROPY OF DC01 STEEL SHEET THROUGH ACOUSTIC EMISSION TESTING

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## ABSTRACT

During acoustic emission measurements, various sound phenomena are detected and analyzed, enabling the prediction of faults. This method is applied to investigate anisotropy, which indicates changes in the propagation direction of sound waves. Anisotropy assists in identifying stress directions and determining the orientation of structural defects. To determine the appropriate anisotropy, a mechanism has been developed to position the sensors correctly, thereby optimizing the manual measurement technique. Cold-rolled steel sheets of DC01 material quality were used for the tests.

## 1. ACOUSTIC EMISSION, ANISOTROPY

Acoustic emission testing, a non-destructive examination method, involves the detection and analysis of various sound phenomena. This process utilizes ultrasonic sensors to introduce pulses with frequencies above 20 kHz into the materials under inspection. The key advantage of this examination lies in its ability to predict defects in advance, making it a widely applied technique, particularly in the assessment of tanks and rolled sheets.

The concept of anisotropy plays a crucial role in this testing methodology, addressing changes in the propagation direction of sound waves. It is important to note that the propagation of sound waves is not uniform in all directions, necessitating the use of multiple sensors for a comprehensive evaluation. Anisotropy becomes instrumental in identifying stress directions and determining the orientation of structural defects within the material. As a result, incorporating anisotropy considerations enhances the precision and accuracy of acoustic emission inspections.

## 2. MEASUREMENT

During the examination, I utilized cold-rolled steel sheet of DC01 material quality, obtained from Dunaferr after being decommissioned. I placed two sensors on the sheet, spaced 200 mm apart. One sensor emits the impulse, while the other sensor receives the sound waves. This setup allows us to determine the speed of sound propagation and the time delay. I rotated these sensors every 15 degrees, as the propagation of sound waves is not uniform in all directions. To introduce the impulse into the material, a coupling medium is required; therefore, I used oil.

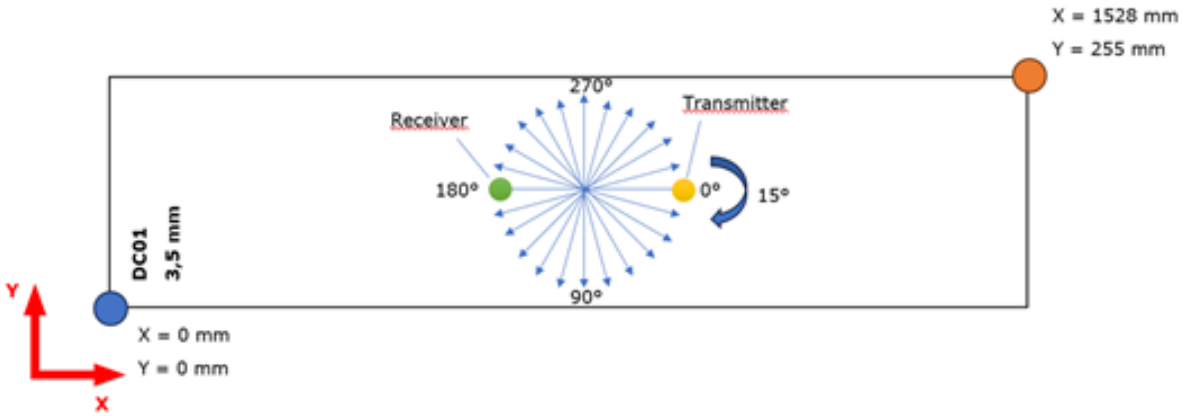



Fig. 1.
Measurement plan

The second figure shows that the measurement was unsuccessful, as the diagram does not allow for the precise determination of propagation speeds associated with different angles. The issue was that the sensor was not symmetric during the measurement, there was inadequate coupling between the sensor and the surface, and the sheet did not lay flat.

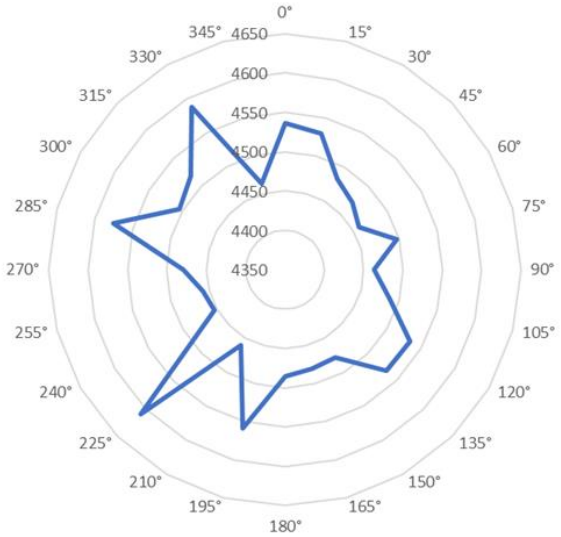



Fig. 2.
Measurment problem

To tackle these challenges, a customized template was devised using a 3D printer. This innovative approach aimed to address the complexities associated with anisotropy and uneven sound wave propagation in the material. The template served as a strategic tool to optimize sensor placement during acoustic emission testing.

The application of this 3D-printed template facilitated a systematic measurement process, resulting in the generation of a butterfly diagram from the acquired data. The butterfly diagram offers a visual representation that enables a nuanced observation of areas on the sheet where sound propagation occurs at varying speeds. This valuable information aids in identifying regions of potential concern, allowing for a more detailed and insightful analysis of the material's integrity.

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The use of 3D printing technology in creating the template underscores the importance of leveraging advanced manufacturing techniques to enhance the precision and efficiency of testing methodologies. By customizing tools for specific testing needs, we can overcome inherent challenges and extract more meaningful insights from the acoustic emission measurements. This integrative approach contributes to the continuous refinement of testing procedures and underscores the commitment to advancing non-destructive examination techniques for improved material assessment and defect prediction.

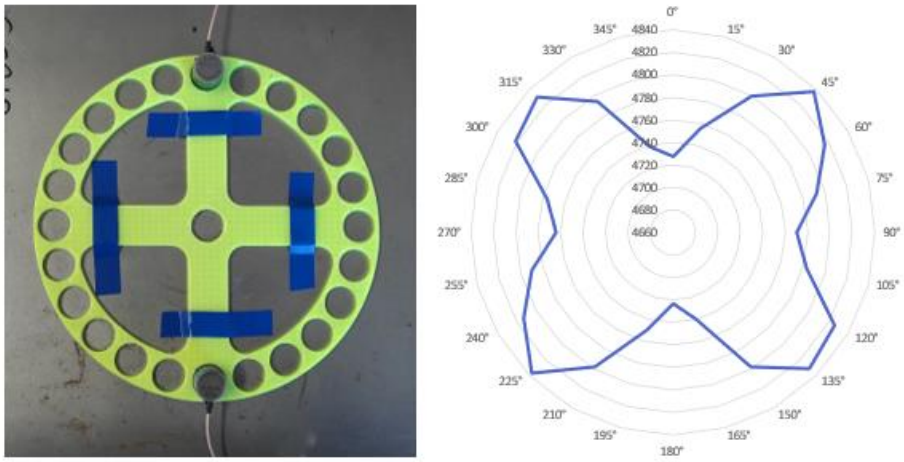



Fig. 3.
New measurement

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