AGH University of Science and Technology
Krakow
Department of Strength and Fatigue of Materials and Structures
KWZMiK
Laboratory
Non-destructive methods of flaw detection and investigation of material's mechanical properties

Group ……

Academic year……

Date …… *Mark*……

Full name ……

Full name ……

REPORT

1. FLAW DETECTION IN STEEL PLATE

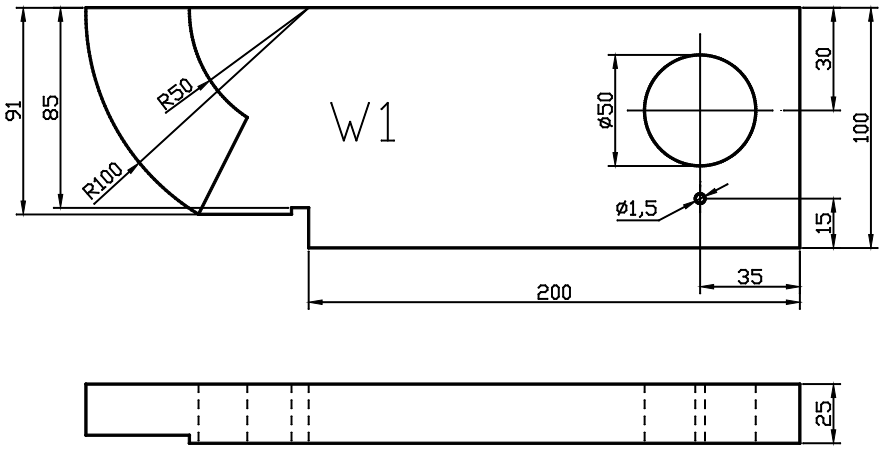
1.1. Calibration of the Ultrasonic Flaw Detector

a) Specify the type and designation (ID) of ultrasonic probe……...…….……

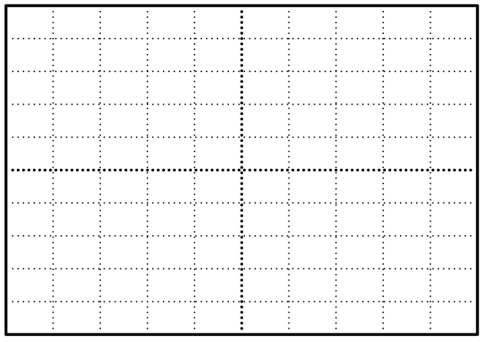
Measuring range	Calibration echo 1	Calibration echo 2	Velocity of the ultrasonic wave
…… mm	…… mm	…… mm	…… m/s

b) Make a sketch of how the ultrasonic probe is placed on the calibration block W1 and the way of wave propagation.

- ultrasonic probe



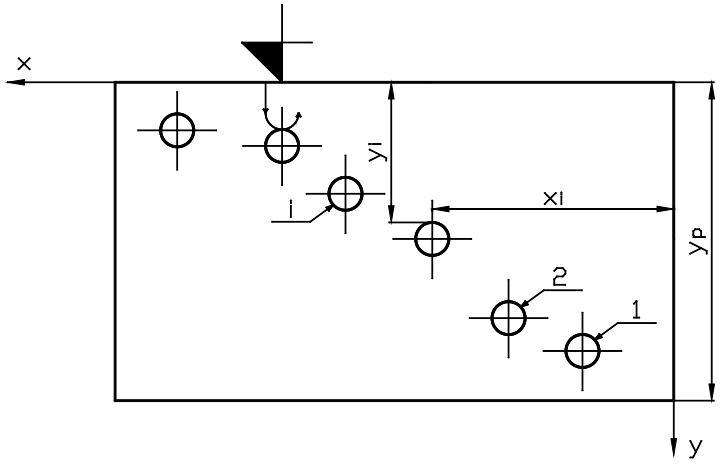
c) Draw an oscillogram referring to scaling on the calibration block W1 for calibration echo 2.



0 ..... mm

1.2. Steel plate examination

a) Sketch of steel plate and a way of flaw detection.

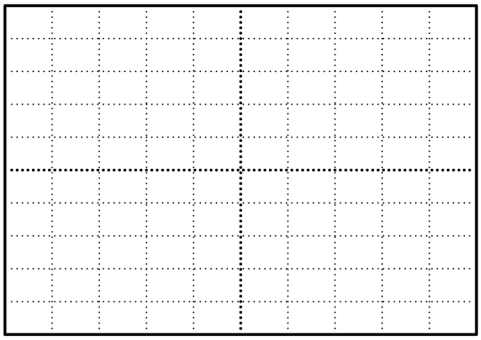


b) Test results.

	Plate height (y_p)	Flaw No.								
		1	2	3	4	5	6	7	8	9
Measurement using flaw detector y_i [mm]										
True position of the flaw y_i [mm]										

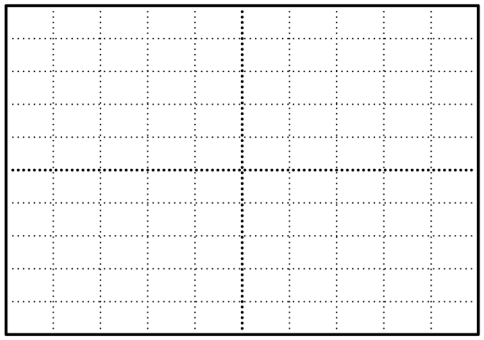
c) Examples of oscillograms

Backwall echo



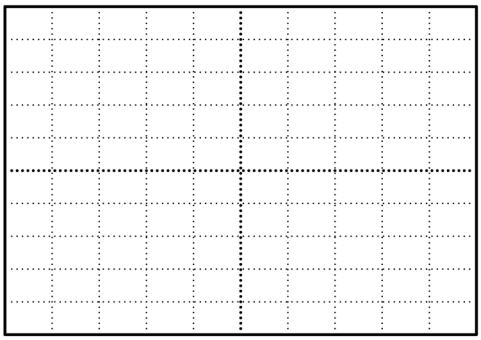
0 ..... mm

Flaw echo (No. 1)



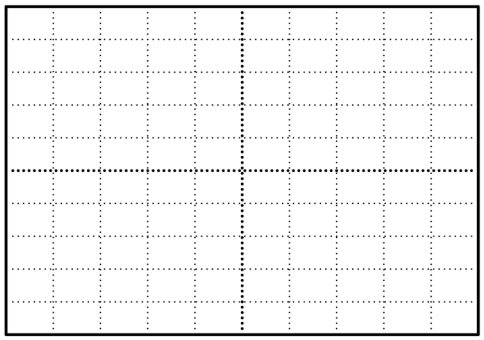
0 ..... mm

Flaw echo (No. 5)



0 ..... mm

Flaw echo (No. 8)



0 ..... mm

2. THICKNESS MEASUREMENT

2.1. Calibration of the Ultrasonic Thickness Gauge

Specify the type and designation (ID) of ultrasonic probe……

2.2. Test results

Measurement	Steel specimen No.			
	1	2	3	4
Caliper [mm]				
Ultrasonic Thickness Gauge [mm]				

3. ESTIMATION OF THE ULTIMATE TENSILE STRENGTH OF GRAY CAST IRON

3.1. Calibration of the Ultrasonic Material Tester on microsecond test block.

3.2. Longitudinal wave velocity measurement in gray cast iron specimen.

Specimen height	$l_{Ż}$ = …… mm
Wave propagation time	$t_{Ż}$ = …… μs

The calculation of the wave velocity in gray cast iron

$$C_{\text{L Żel}} = \frac{l_{Ż}}{t_{Ż}} = \_\_\_\_\_ \frac{\text{m}}{\text{s}} = \ldots\ldots\ldots\ldots\ldots\ldots \frac{\text{m}}{\text{s}}$$

3.3. Estimation of ultimate tensile strength

$$R_{\text{m}} = \ldots\ldots\ldots\ldots \text{ MPa}$$

4. DETERMINATION OF THE ELASTIC CONSTANTS FOR ALUMINUM

4.1. Longitudinal wave velocity measurement C_{L}

Specimen height	l_{Al} = …… mm
Wave propagation time	t_{Al} = …… μs

The calculation of the wave velocity in aluminum

$$C_{\text{L Al}} = \frac{l_{\text{Al}}}{t_{\text{Al}}} = \_\_\_\_\_ \frac{\text{m}}{\text{s}} = \ldots\ldots\ldots\ldots\ldots\ldots \frac{\text{m}}{\text{s}}$$

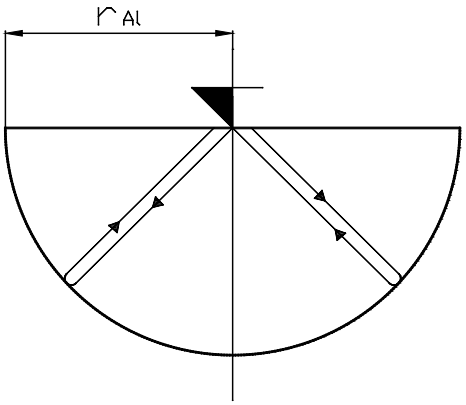
4.2. Transverse wave speed measurement C_T

Sample radius	r_{Al} = …… mm

Specify the type and designation (ID) of ultrasonic probe.……

Calibration of the Ultrasonic Flaw Detector

Measuring range	Calibration echo 1	Calibration echo 2
…… mm	…… mm	…… mm



The measured transverse wave velocity in aluminum:

$$C_{T\,Al} = \text{…….. m/s}$$

4.3. Determination of the constants *v*, *E*, *G*

(assume the density ρ=2700 kg/m^3)

$$\nu = \frac{\frac{1}{2}\left(\frac{C_{L\,Al}}{C_{T\,Al}}\right)^2 - 1}{\left(\frac{C_{L\,Al}}{C_{T\,Al}}\right)^2 - 1} = \frac{\qquad}{\qquad} = \text{……}$$

$$E = \frac{(1+\nu)(1-2\nu)}{1-\nu}\rho \cdot C_{L\,Al}^2 = \frac{\qquad}{\qquad} \text{……} = \text{……}$$

$$G = \rho \cdot C_{T\,Al}^2 = \text{……} = \text{……}$$

Validation of the results:

$$G = \frac{E}{2(1+\nu)} = \frac{\qquad}{\qquad} = \text{……}$$

Notes to the report:

1. *Filled report must be provided to lecturer within 2 weeks of carrying out the experiments (during the consultation hours).*
2. *Separate conclusions must be provided for each experiment.*
3. *In experiment no. 4, the unit [MPa] should be used. Provide results with an accuracy of 1 MPa.. Poisson's ratio value should be given to two decimal points.*
4. *Conclusions for experiment no. 4 must contain a comparison (table) with the values given in the literature. Give the source (book) from which the values of the constants v, E, G were read.*