AGH University of Science and Technology
Chair of Strength, Fatigue
of Material and Construction

Faculty..
Year...............................*Group*.........................
Date..............................*Mark*..........................
Name...
....

Laboratory

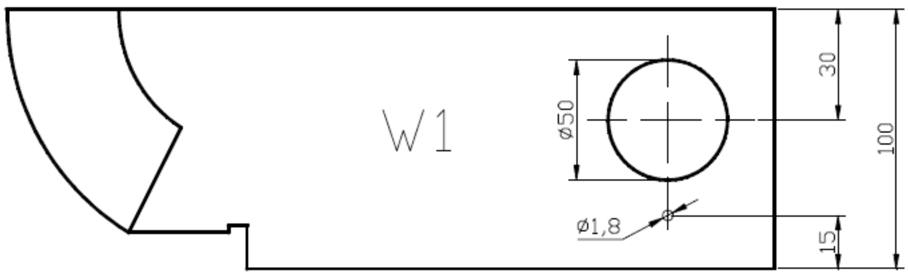
Non-destructive methods of flaw detection
and investigation of material's mechanical properties

Report

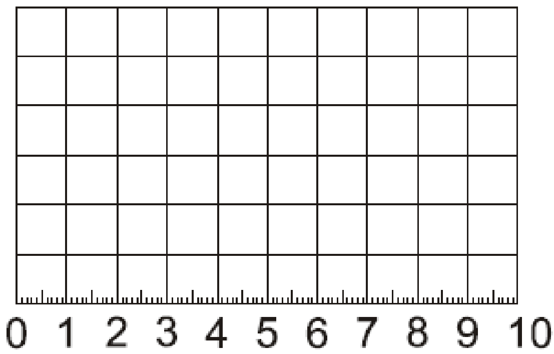
<u>1. Flaw detection in a metal plate</u>

1.1 Time domain scaling

a) Make a sketch of how a head is placed on a sample and the way of wave propagation



b) Draw an oscillogram referring to scaling on the W1 sample

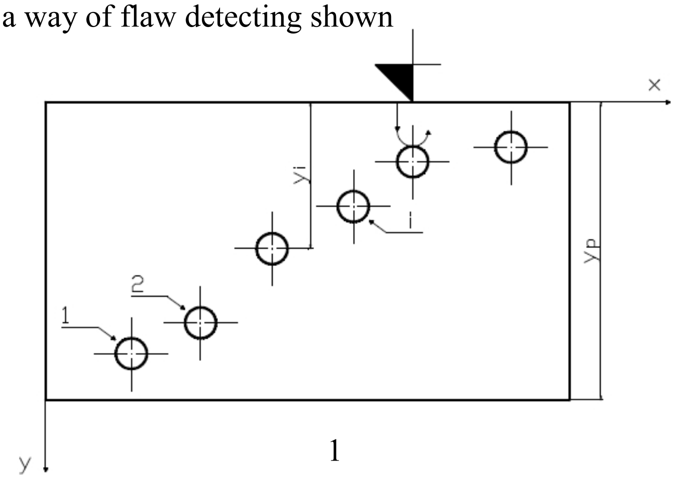


distance between two grid lines:

1 gd = …..................mm of a way to the reflector

1.2 Plate examination

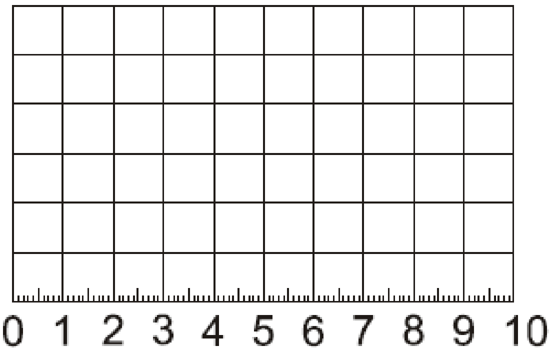
a) A sketch with a way of flaw detecting shown



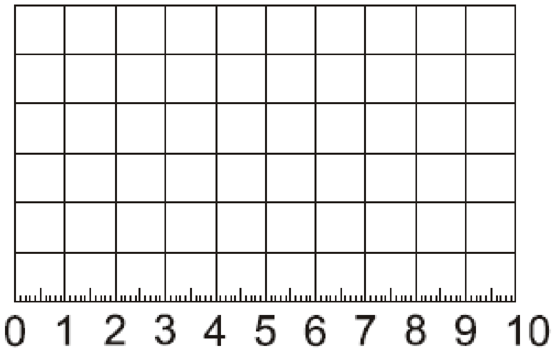
b) Examination results

Flaw No	Plate height y_p [mm]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Grid lines										
y_i (measured) [mm]										
y_i (real) [mm]										

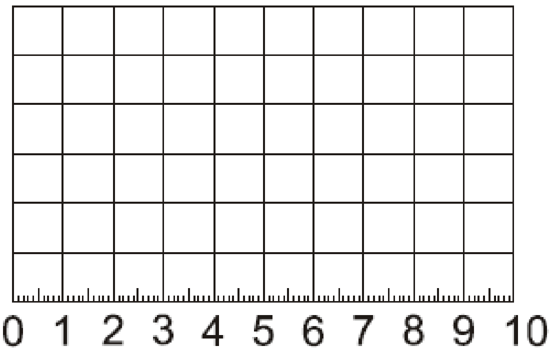
c) Examples of oscillograms



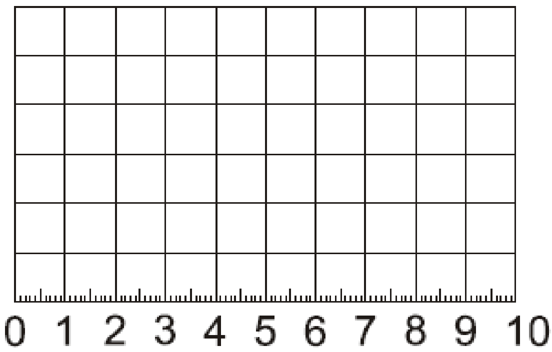
Opposite surface echo



Flaw No 1 echo



Flaw No 5 echo



Flaw No 9 echo

2. Thickness measurement

Steel specimen No	1	2	3	4
Caliper measurement [mm]				
Ultrasonic Thickness gauge [mm]				

3. Weld examination

Weld type..

Plate thickness...mm

Welding method..

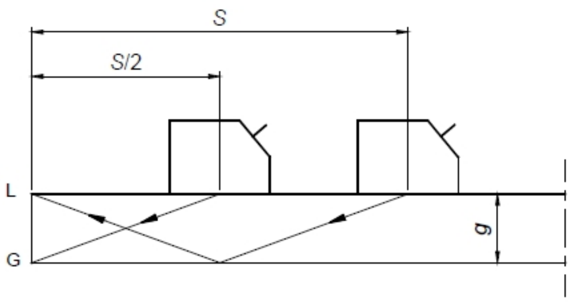
Type and signature of used head...

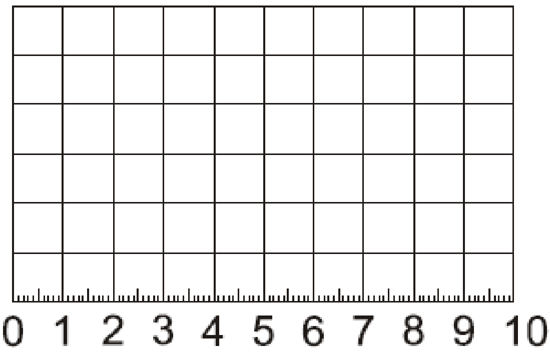
3.1 Preparation of a welded connection

a) Sketch of a way of determining the area where the head is placed

$s = 2 \cdot t \cdot \mathrm{tg}\,\beta =$.............

b) Sketch of a way of determining the observation area





3.2 Parameters of examination

Impulse length...

Amplification...dB

3.3 Comparison of ultrasonic and radiographic examination results

4. Estimation of tensile strength of gray cast iron

4.1 Scaling of a sampler on normalized samples

4.2 Longitudinal wave speed measurement in cast iron specimen

a) Specimen height $l_{ci}=$...................... mm

b) Wave propagation time $\mathrm{t_{ci}}=$...................... μs

c) Wave speed in cast iron

$$c_{L,ci}=\frac{l_{ci}}{t_{ci}}=\frac{\qquad\qquad}{}\frac{m}{s}=\ldots\ldots\ldots\frac{m}{s}$$

4.3 Estimation of tensile strength

$R_m=$ .... MPa

5. Material constants estimation for aluminum

5.1 Longitudinal wave speed measurement

a) Specimen height $l_{Al}=$...................... mm

b) Wave propagation time $\mathrm{t_{Al}}=$...................... μs

c) Longitudinal wave speed in aluminum

$$c_{L,Al}=\frac{l_{Al}}{t_{Al}}=\frac{\qquad\qquad}{}\frac{m}{s}=\ldots\ldots\ldots\frac{m}{s}$$

5.2 Transverse wave speed measurement

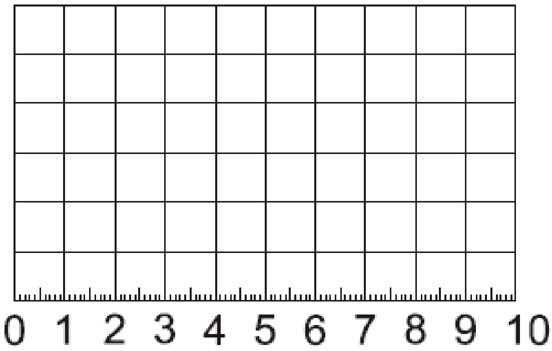
a) Data for scaling in reciprocity method

- steel sample $\underline{r_{st}=50\,\mathrm{mm}}$ $\underline{c_{T,st}=3250\,\mathrm{m/s}}$
- aluminum specimen $r_{Al}=$...................... mm

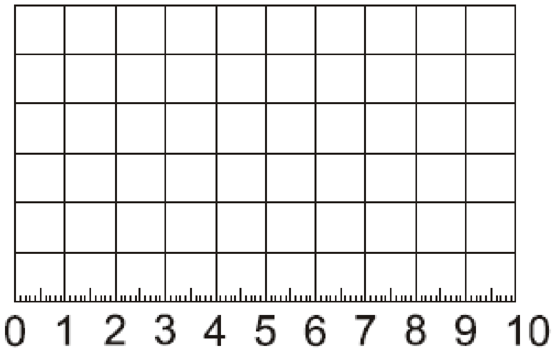
b) Scaling parameter x_{Al} determination

$$x_{Al}=c_{T,st}\frac{r_{Al}}{r_{st}}$$

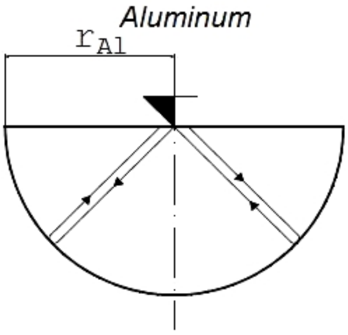
c) Time domain scaling

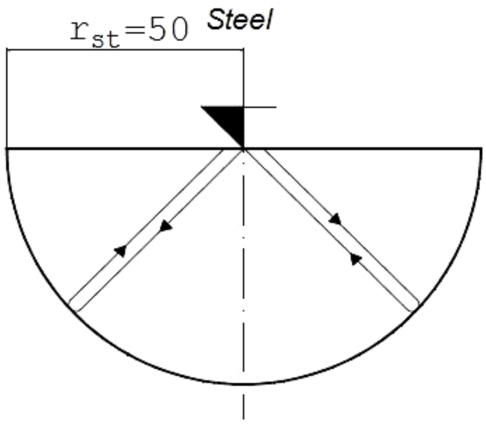


1 gd = …...................... m/s



$x_{st}=$.........................gd





d) Transverse wave speed in aluminum

$c_{T,Al}=$.................... m/s

5.3 Material constants estimation (assumed density ρ=2700 kg/m^3)

$$\nu=\frac{\frac{1}{2}\left(\frac{c_{L,Al}}{c_{T,Al}}\right)^2-1}{\left(\frac{c_{L,Al}}{c_{T,Al}}\right)^2-1}=$$

$$E=\frac{(1+\nu)(1-2\nu)}{(1-\nu)}\rho c_{L,Al}^2=$$

$$G=\rho c_{T,Al}^2=$$

Verification: $$G=\frac{E}{2(1+\nu)}$$