



PRECIPITATION HARDENING



Student:

Year:

Date:

Teacher:

Program:

- Principle of precipitation hardening.
- Relation of mechanical properties on the aging condition.
- Determination of mechanical properties of aluminium alloy after aging under given conditions.

Tasks:

Task 1: Determine mechanical properties and deformation characteristics on testing specimens.

Task 2: Draw the dependence of mechanical properties on logarithm of aging time.

Task 3: Estimate time for maximum hardening at $t_v = 160\text{ }^\circ\text{C}$ for given aluminium alloy.

TABLE 1: Used aluminium alloy

EN AW-7075 AlZn5,5MgCu	Chemical composition of testing specimen [wt %]									
	Si	Fe	Zn	Mg	Cu	Mn	Cr	Ti	Rest	Al
Element	0,14	0,25	5,54	2,36	1,62	0,22	0,19	0,014	-	rest

Testing specimen:

Rod: 60 mm diameter, hot extruded, rolled to 21 mm thickness at 200°C , mechanical properties of semi-product: $R_m = 292\text{ MPa}$, $R_{p0,2} = 248\text{ MPa}$, $A_{5,65} = 11,1\%$

Heat treatment parameters (precipitation hardening):

Solution annealing: $470^\circ\text{C}/1\text{h}$ (furnace with air atmosphere) / cooling: water $25\text{ }^\circ\text{C}$

Artificial aging: temperature 160°C (0,1 ÷ 24) hours (furnace with air atmosphere) / cooled on restful air

TABLE 2: Artificial aging time at the temperature

Time of	[min]	6	30	120	600	960	1440	5760
AA	[hours]	0,1	0,5	2	10	16	24	96
Sample specification		0.1	0.5	2	10	16	24	-

NOTE: Every time is represented by two testing specimens labelled by numbers 1 and 2 (identification of aging time)

Values

TABLE 3: Measured and calculated values

Quantity	Rod	Artificial aging time [min]							NA*
		6	30	120	600	960	1440	5760	5760
d ₀ [mm]	1	8,03	8,04	8,04	8,07	8,06	8,07	8,06	8,01
	2	8,01	8,02	8,03	8,06	8,06	8,07	8,07	8,01
S ₀ [mm ²]	1								
	2								
F _{max} [kN]	1	26,08	27,22	27,65	28,37	28,40	28,21	27,67	27,02
	2	26,91	27,08	27,49	28,55	28,23	28,19	27,52	26,60
R _m [MPa]	1								
	2								
\bar{R}_m [MPa]									
F _{p0,2} [kN]	1	17,08	21,20	23,26	24,56	24,66	24,59	23,30	16,85
	2	17,14	20,66	23,03	24,84	24,84	24,50	23,08	16,74
R _{p0,2} [MPa]	1								
	2								
$\bar{R}_{p0,2}$ [MPa]									
L ₀ [mm]	1	40							40
	2	40							40
L _u [mm]	1								
	2								
A _{5,65} [%]	1								
	2								
$\bar{A}_{5,65}$ [%]									
d _u [mm]	1							-	
	2							-	
S _u [mm ²]	1							-	
	2							-	
Z [%]	1							-	
	2							-	
\bar{Z} [%]									
HV30		142	155	169	174	176	170	167	141

* 4 days of natural aging (NA)

Conclusion: