

TENSILE TEST

wz1-A

Name:

Academic year:

Example 1

The cylindrical testing specimen manufactured from aluminium alloy has been broken without necking during tensile test. The elongation has been measured after the test, $A = 18\%$.

Calculate the value of contraction Z .

Example 2

The tensile tests of the steel S355J2H were carried out at loading speed 2 mm/min without the sensors.

The cylindrical testing specimens with threaded heads were used for the tests. The initial lengths (gauge lengths) L_0 and initial diameters d_0 of all test specimens are listed in Table 1.

Based on others relevant values listed in Table 1 specify following characteristics: yield strength R_{eL} , ultimate tensile strength R_m , elongation $A_{5,65}$, uniform contraction Z_r and contraction Z .

Specify also following material characteristics

- tensile toughness W_f
- resilience W_{el}
- strain hardening ratio R_m / R_{eL}

Based on obtained values draw temperature dependence of yield strength R_{eL} , ultimate tensile strength R_m , elongation $A_{5,65}$ and contraction Z .

Table 1

Spec. No.			p1	p2	p3	p4	p6	p7	p8
temperature	t	[°C]	20	-20	-60	-175	20	-103	-175
initial diameter	d_0	[mm]	6,004	6,001	5,998	5,996	5,993	6,002	6,004
uniform diameter	d_r	[mm]	5,4	5,344	5,366	5,579	5,364	5,345	5,809
ultimate diameter	d_u	[mm]	2,861	2,964	3,077	3,725	2,943	3,264	3,429
initial length	L_0	[mm]	29,972	29,902	30,164	30,018	30,01	29,929	30,037
ultimate length	L_u	[mm]	42,452	42,547	41,999	39,145	40,811	41,899	44,522
yield force	$F_{eL}, F_{p0,2}$	[kN]	6,9761	8,782	8,631	18,571	8,539	11,023	13,775
yield strength	R_{eL}	[MPa]							
maximal force	F_m	[kN]	12,935	13,746	15,017	21,357	13,229	17,226	17,853
ultimate tens. strength	R_m	[MPa]							
fracture force	F_u	[kN]	7,687	8,302	9,228	15,313	8,099	10,989	12,154
elongation	$A_{5,65}$	[%]							
uniform contraction	Z_r	[%]							
contraction	Z	[%]							

Example 3

The file "wz1-A - tensile test.xls" contains the data exported from the testing machine. Tests were performed on structural steel and aluminium alloy specimens.

The *Test time* is shown in column "A", the values of *Elongation (crossbeam displacement)* are given in column "B", *Standard force (loading force)* data in column "C", *Standard travel (i.e. data from extensometer)* in column "D" and *Specimen diameter (i.e. data from contraction sensor)* are listed in column "E". For both materials

- Specify the loading speed rate valid for the plastic deformation region and compare this value (based on *standard travel* data) with crossbeam speed (i.e. 2 mm/min or 4 mm/min).
- Based on recorded data for *standard force* and *elongation* (column "B") draw appropriate dependence (stress-strain curve) for plastic strain range up to plastic instability point (limit). Draw the same type of stress-strain curve for the case of elongation sensor usage, i.e. based on data for *standard force* and *standard travel*.

Compare the records mentioned above and evaluate the *yield strengths* and *ultimate tensile strengths* from these records (complete Table 2).

Table 2

Spec. No.	Initial length L_0 [mm]	Gauge length L_0 [mm]	Diameter D_0 [mm]	Crossbeam R_e [MPa]	Extensometer R_e [MPa]	Crossbeam R_m [MPa]	Extensometer R_m [MPa]
steel	50	50	9.95				
Al alloy	50	50	10.02				

Example 4

For both materials evaluate following values and/or dependencies based on loading forces and elongations stated in previous example (file "wz1-A - tensile test.xls"):

- Based on data of *Standard force* and *Elongation* or *Engineering (nominal) stress* and *nominal strain* calculate *true stress - true strain* curve for the range of plastic deformation up to plastic instability limit
Carry out the same calculation for data obtained from measurement with sensor(s).
- Evaluate Young modulus E .
- Evaluate Poisson's ratio μ (at interval of deformation from 0.1 % to 0.2 %).
- Specify the strain hardening exponent n in region of uniform plastic deformation.