

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

First School Year

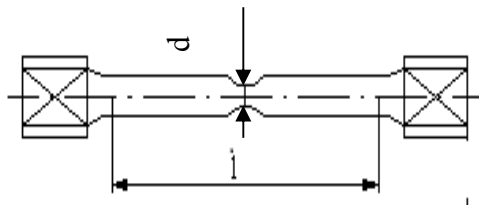
MATERIAL AND TECHNOLOGICAL PROPERTIES

Some of the most important material *properties* are for example:

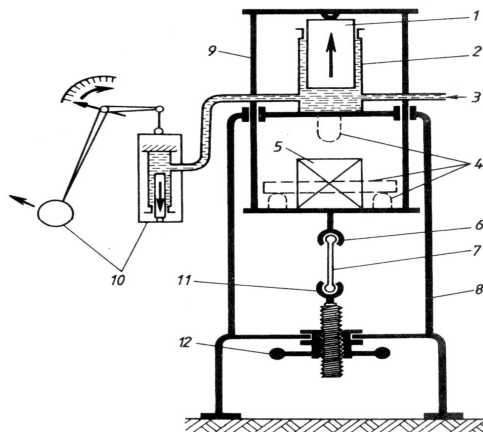
- **Strength** is the *ability* of material to *resist load* without *disturbance*
- **Hardness** is the *ability* of material to *put up resistance* against the entry of foreign *bodies*
- **Elasticity** is the *ability* of material to return to its original shape after *lightening*
- **Brittleness** is the *ability* of material to be hard but not strong

1. We use the **tensile strength test** to *discover* tensile **strength**, relative **elongation**, **ductility** and **necking**. The test is done on a test **bar** (see Picture 1) on a tensile testing machine – see Picture 2.

Picture 1
Shape after necking



Picture 2



- 1 ... piston
- 2 ... press roll
- 3 ... pressure oil
- 4 ... bending test sample
- 5 ... pressure test sample
- 6 ... upper fastening head
- 7 ... tensile test sample
- 8 ... fixed frame
- 9 ... moveable frame
- 10...measuring equipment
- 11...lower fastening head
- 12...regulating equipment

From a tensile test there are coming formulas, for example:

Tension on tensile strength limit R_m

$$R_m = \frac{F_{MAX}}{S_0} \text{ [MPa]}$$

- F_{max} ... maximal **force**
- l_0 original **length**
- l final **length**
- S_0 original **cross section**

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

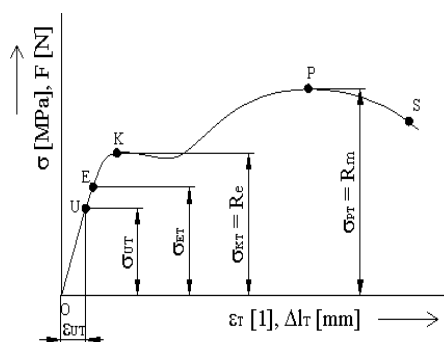
Total **bar elongation** Δl
 $\Delta l = l - l_0 \text{ [mm]}$

Relative **elongation** ε
 $\varepsilon = \frac{\Delta l}{l_0}$

2. We do the **compression strength** test in the same way as the **tensile strength test**. The difference is that **load-bearing forces** work against each other. The working diagram for **tough** materials shows the same **yield point** for **compression** as **tension**.

We can make a working diagram from the tensile test – see Picture 3.

Picture 3

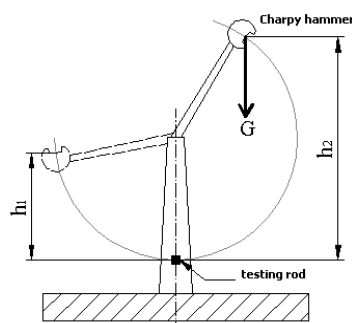


There are the following limit definitions coming from the tensile test diagram:

- σ_{ut} – **proportional limit**
- σ_{Et} – **elastic limit**
- $\sigma_{Kt} (R_e)$ – **yield point**
- $\sigma_{Pt} (R_m)$ – **tensile strength**

3. We do the **notch toughness** test with a heavy **hammer**, rotating around its **axis** – see Picture 4. The **hammer strikes** a test **sample** and breaks the **sample** and rises to a final position. This position is always **lower** than the **initial** position.

Picture 4



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

VOCABULARY

ability	schopnost	lower	dolní
axis	osa	measuring	měřící
bar	tyč	moveable	pohyblivý
bending	ohyb	necking	zúžení
body	těleso	notch	vrub
brittleness	křehkost	piston	píst
compression	tlak	press roll	tlakový válec
cross section	průřez	pressure oil	tlakový olej
discover	zjišťovat	property	vlastnost
disturbance	porušení	proportional limit	mez úměrnosti
ductility	tažnost	put up resistance	klást odpor
elastic limit	mez pružnosti	regulating	stavěcí
elasticity	pružnost	resist	odolávat
elongation	prodloužení	resistance	odpor
equipment	zařízení	sample	vzorek
fastening	upínací	strength	pevnost
force	síla	strike	narazit
frame	rám	tensile strength	zkouška pevnosti v tahu
hammer	kladivo	test	
hardness	tvrdost	tension	napětí
initial	výchozí	testing rod	zkušební tyčinka
length	délka	tough	houževnatý
lightening	odlehčení	toughness	houževnatost
load	zatížení	upper	horní
load-bearing	nosný, zatížený	yield point	mez kluzu

COMPREHENSION QUESTIONS

1. Can you name at least 2 of the most important material properties?
2. What is hardness?
3. What do you know about the tensile strength test?
4. What do you know about the compression strength test?
5. Can you describe the notch toughness test?

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

EXERCISES

1. Translate the expressions into English:

- | | | |
|----|---------------|-------|
| 1 | tvrdost | _____ |
| 2 | houževnatost | _____ |
| 3 | prodloužení | _____ |
| 4 | mez úměrnosti | _____ |
| 5 | měřicí | _____ |
| 6 | napětí | _____ |
| 7 | ohyb | _____ |
| 8 | vzorek | _____ |
| 9 | pružnost | _____ |
| 10 | délka | _____ |

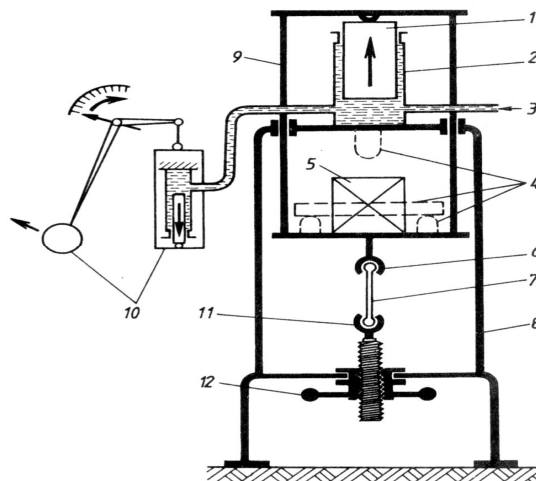
2. Match the material properties with their definitions and translate them:

- | | | | | |
|---|--------------------|---|---|-------|
| 1 | elasticity | a | is the ability of material to return to its original shape after lightening | _____ |
| 2 | strength | b | is the ability of material to be hard but not strong | _____ |
| 3 | brittleness | c | is the ability of material to resist load without disturbance | _____ |
| 4 | hardness | d | is the ability of material to resist the entry of foreign bodies | _____ |

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

3. Add the expressions where you think they should be:

number	expression
	lower fastening head
	fixed frame
	piston
	tensile test sample
	pressure oil
	regulating equipment
	press roll
	measuring equipment
	pressure test sample
	bending test sample
	upper fastening head
	moveable frame



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

KEY – for teachers only

1.

1	tvrdost	hardness
2	houževnatost	toughness
3	prodloužení	elongation
4	mez úměrnosti	proportional limit
5	měřicí	measuring
6	napětí	tension
7	ohyb	bending
8	vzorek	sample
9	pružnost	elasticity
10	délka	length

2. 1c - pružnost, 2a - pevnost, 3b - křehkost, 4d – tvrdost

3. See Picture 1

number	expression
11	lower fastening head
8	fixed frame
1	piston
7	tensile test sample
3	pressure oil
12	regulating equipment
2	press roll
10	measuring equipment
5	pressure test sample
4	bending test sample
6	upper fastening head
9	moveable frame