Střední škola České Velenice

| | |
|---|---|
| **Název projektu** | **Rozvoj technického vzdělávání v Jihočeském kraji** |
| **Číslo projektu** | CZ.1.07/1.1.00/44.0007 |
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# TECHNICKÝ SLOVNÍK

## pro strojírenské obory

# Anglický jazyk

Aleš Brothánek

esf evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

# Obsah:



Poznámka: autor anglického technického slovníku níže uvedené texty vybral, didakticky upravil (parafrázoval) v souladu s dikcí autorského zákona a dále již jen dle potřeby pokrátil tak, aby korespondovaly s podobou technického slovníku pro Německý jazyk.

Citace dle: ČSN ISO 690:2011-Bibliografické citace.

# Brazing, welding, soldering

Brazing - The American Welding Society (AWS), defines brazing as a group of joining processes that produce coalescence of materials by heating them to the brazing temperature and by using a filler metal (solder) having a liquidus above 840°F (450°C), and below the solidus of the base metals.[1]

Soldering - Soldering has the same definition as brazing except for the fact that the filler metal used has a liquidus below 840°F (450°C) and below the solidus of the base metals.[2]

Welding joins metals by melting and fusing them together, usually with the addition of a welding filler metal. The joints produced are strong, usually as strong as the metals joined or even stronger. In order to fuse the metals, a concentrated heat is applied directly to the joint area. This heat is high temperature. It must be - in order to melt the "base" metals (the metals being joined) and the filler metals as well.[3]

[1] Dostupné z: http://www.lucasmilhaupt.com/en-US/brazingfundamentals/brazingvssoldering/ [citováno 20.4.2015]

[2] Dostupné z: http://www.lucasmilhaupt.com/en-US/brazingfundamentals/brazingvssoldering/ [citováno 20.4.2015]

[3] http://www.lucasmilhaupt.com/en-US/brazingfundamentals/brazingvswelding/ [citováno 20.4.2015]

addition /əˈdɪʃ.ən/ – přidávání

apply /əˈplaɪ/ - použít

base metal /beɪs ˈmet.əl/ – základní (hlavní) kov

brazing /ˈbreɪ.zɪŋ/ – pájení

coalescence /kəʊ.əˈles.əns/ – srůstání, spojování

joining /dʒɔɪnɪŋ/ – spojování

filler metal /ˈfɪl.ər met.əl/ – přídavný materiál

fusing /fjuːzɪŋ/ – slučování, tavení

heating /ˈhiː.tɪŋ/ – zahřání

liquid /ˈlɪk.wɪd/ – kapalný

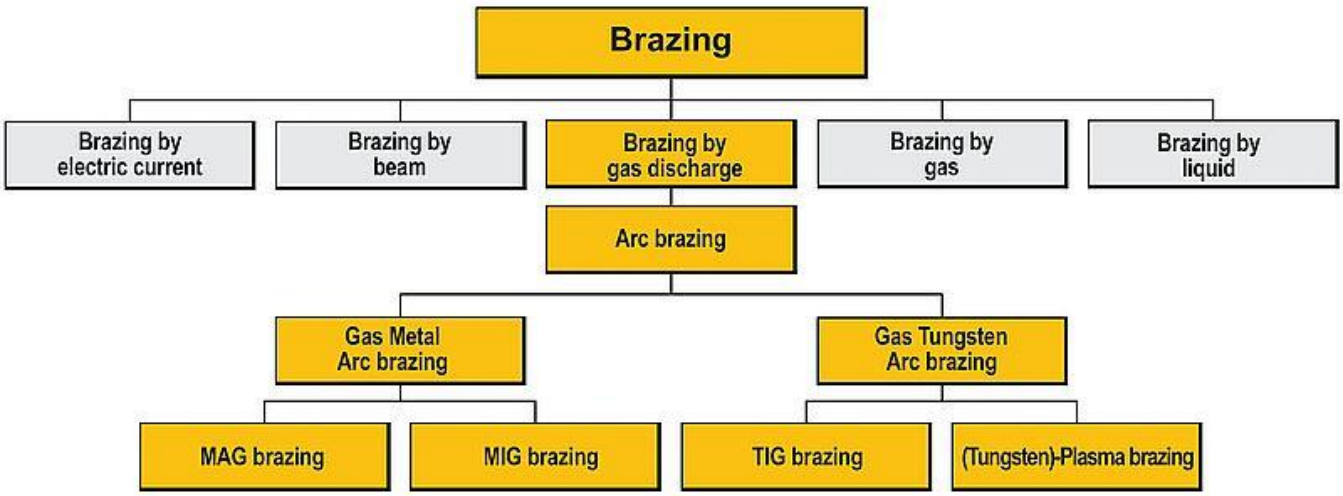
melting /ˈmel.tɪŋ/ – tavení

solder /ˈsəʊl.dər/ – pájka (přídavný materiál)

soldering /ˈsəʊl.dərɪŋ/ – pájení (letování)

solid /ˈsɒl.ɪd/ - pevný

welding /ˈwel.dɪŋ/ – svařování




Obrázek č. 1[4]

arc /ɑːk/ - oblouk

beam /biːm/ – paprsek

discharge /dɪsˈtʃɑːdʒ/ – výboj (elektrický)

electric current /ɪˈlek.trɪk ˈkʌr.ənt/ – elektrický proud

gas /gæs/ – plyn

inert /ɪˈnɜːt/ - netečný

tungsten /ˈtʌŋ.stən/ – wolfram

MAG – metal active gas

MIG – metal inert gas

TIG – tungsten inert gas

[4] Obrázek dostupný: http://www.migweld.de/service/bilder-zum-download.html [citováno 20.4.2015]

## Schematics of GMA brazing

brazed seam /ˈbreɪ.zd siːm/ – pájený šev (spoj)

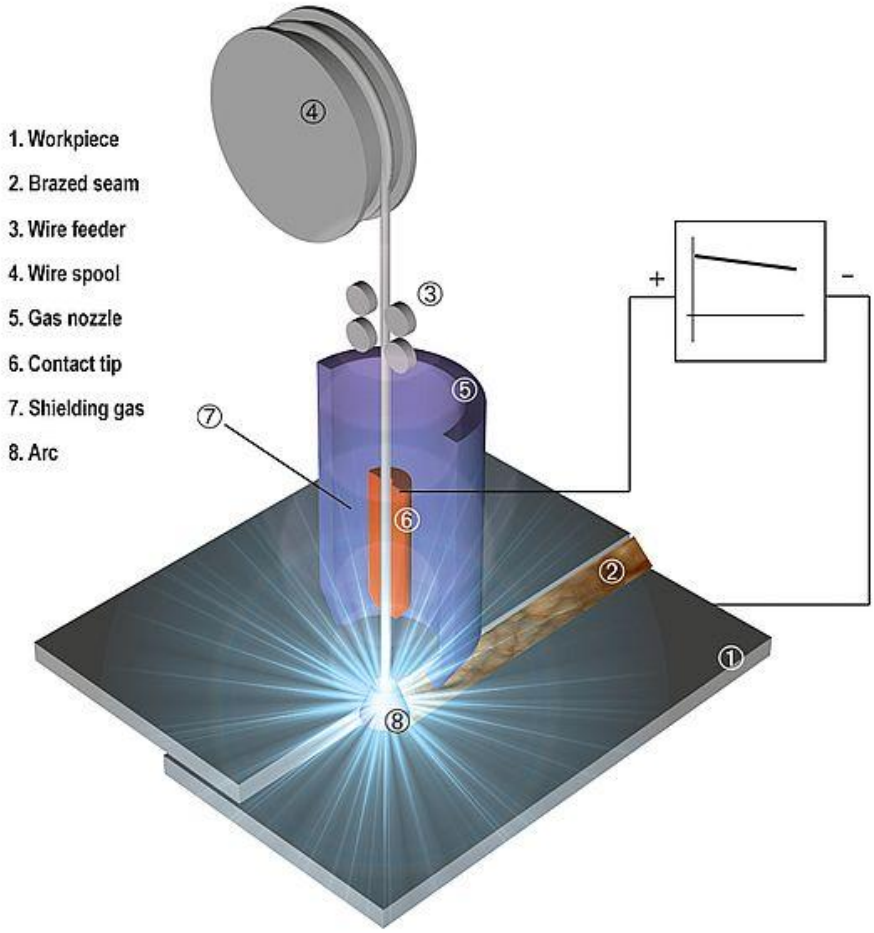
gas nozzle /gæs ˈnɒz.ļ/ – plynová tryska

shielding gas /ʃiːldɪŋ gæs / – ochranný plyn

workpiece /wɜːk piːs/ – obrobek

wire feeder /waɪər ˈfiː.dər/ – podavač drátu

wire spool /waɪər spuːl/ – cívka drátu

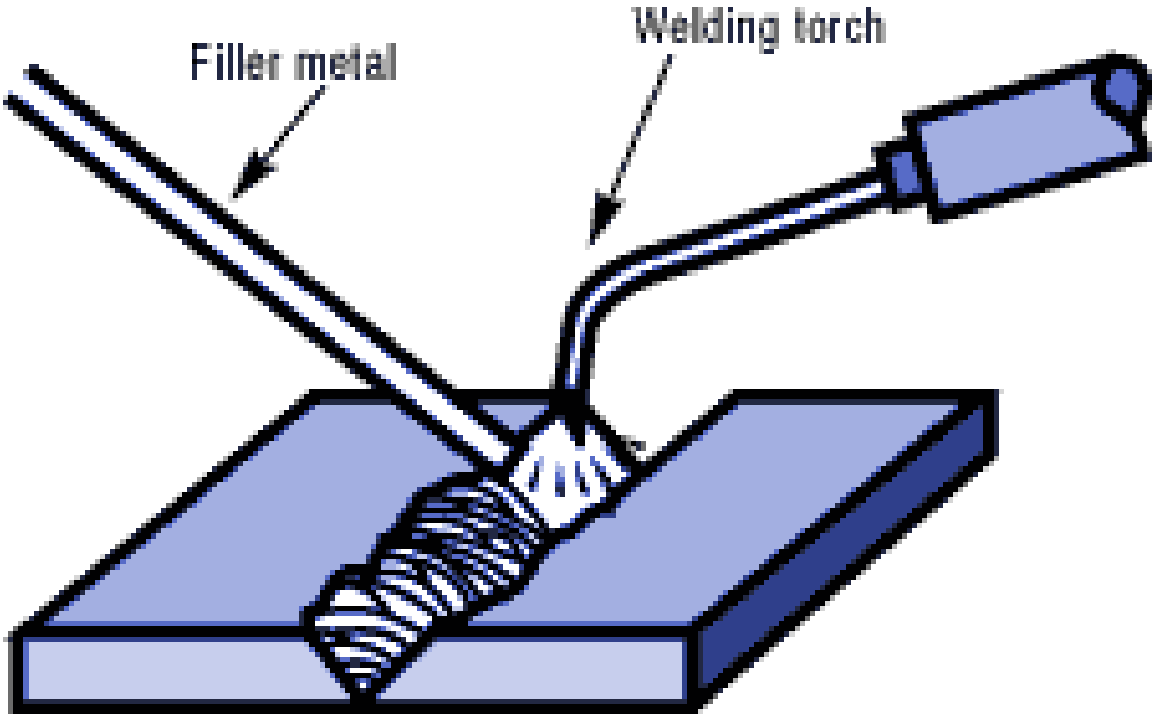



Obrázek č. 2[5]

[5] Obrázek dostupný: http://www.migweld.de/service/bilder-zum-download.html [citováno 20.4.2015]

filler metal /ˈfɪl.ər  met.əl/ – přídavný materiál, plnivo

welding torch /ˈwel.dɪŋ tɔːtʃ/ – svařovací plamen



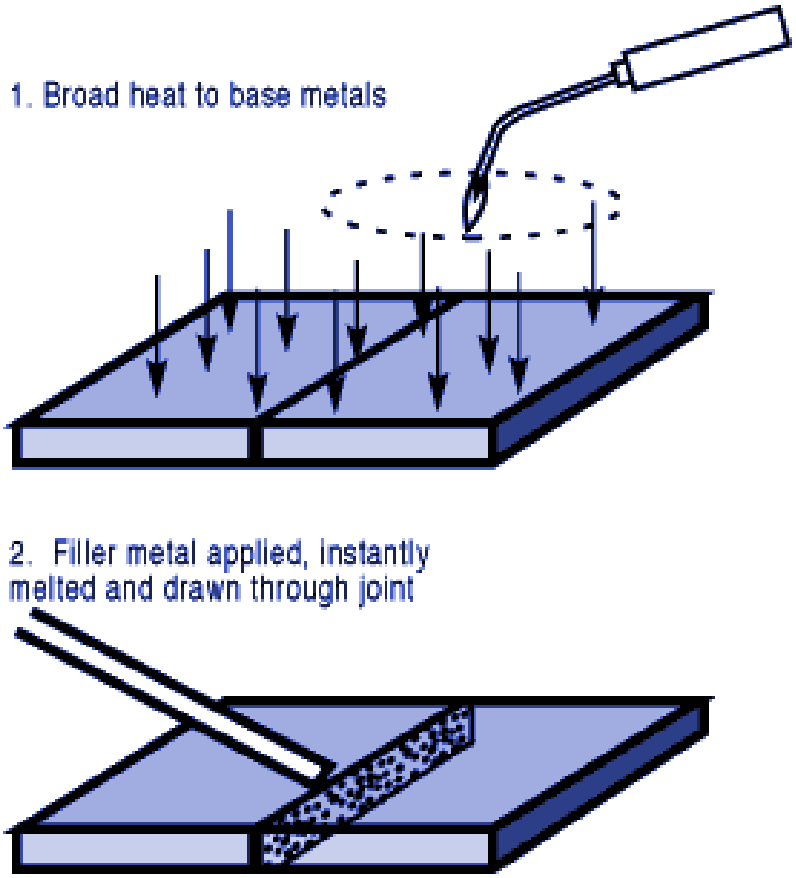

Obrázek č. 6[6]

[6] Obrázek dostupný: http://www.lucasmilhaupt.com/en-US/brazingfundamentals/brazingvswelding/ [citováno 20.4.2015]

broad heat /brɔːd hiːt / – zeširoka ohřát

instantly /ˈɪn.stənt.li/ – okamžitě

draw /drɔː/ - natáhnout




Obrázek č. 7[7]

[7] Obrázek dostupný: http://www.lucasmilhaupt.com/en-US/brazingfundamentals/howbrazingworks [citováno 20.4.2015]

Welding joint

square /skweər/ - čtverec

closed /kləʊzd/ - uzavřený

bevel /ˈbev.əl/ - šikmý, kosý

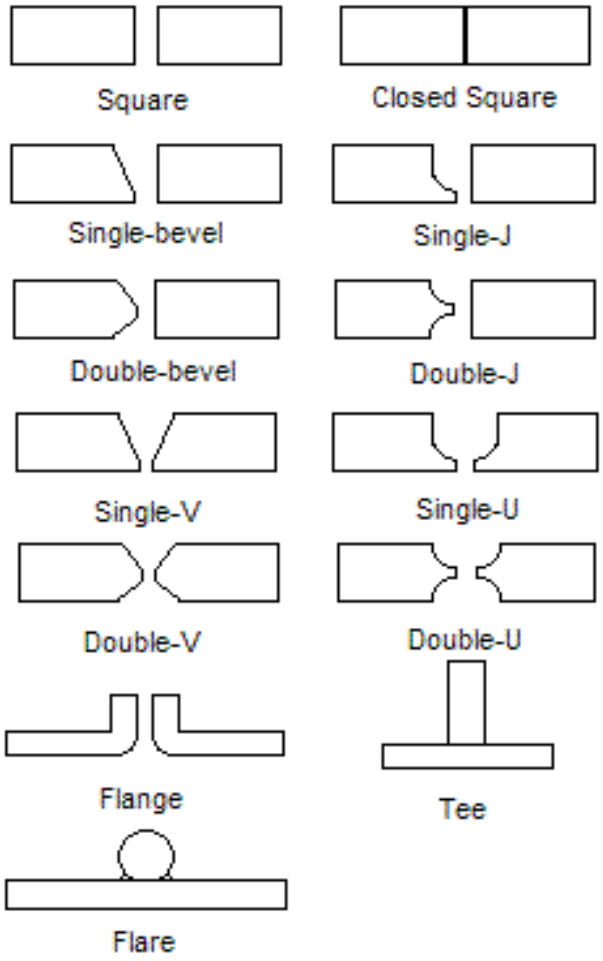
single /ˈsɪŋ.gļ/ - jediný

double /ˈdʌb.ļ/ - dvojitý

flange /flændʒ/ - příruba

tee /tiː/ - T (písmeno)

flare /fleər/ - zvon




Obrázek č. 8[8]

[8] Obrázek dostupný: http://en.wikipedia.org/wiki/File:Butt_Weld_Geometry.GIF [citováno 20.4.2015]

# Metal forming

## Sheet-Metal Forming Processes

Roll forming - Long parts with constant complex cross-sections; good surface finish; high production rates; high tooling costs.

Stretch forming - Large parts with shallow contours; suitable for low-quantity production; high labor costs; tooling and equipment costs depend on part size.

Drawing - Shallow or deep parts with relatively simple shapes; high production rates; high tooling and equipment costs.

Stamping - Includes a variety of operations, such as punching, blanking, embossing, bending, flanging, and coining; simple or complex shapes formed at high production rates; tooling and equipment costs can be high, but labor costs are low.

Rubber-pad forming - Drawing and embossing of simple or complex shapes; sheet surface protected by rubber membranes; flexibility of operation; low tooling costs.

Spinning - Small or large axisymmetric parts; good surface finish; low tooling costs, but labor costs can be high unless operations are automated.

Superplastic forming - Complex shapes, fine detail, and close tolerances; forming times are long, and hence production rates are low; parts not suitable for high-temperature use.

Peen forming - Shallow contours on large sheets; flexibility of operation; equipment costs can be high; process is also used for straightening parts.

Explosive forming - Very large sheets with relatively complex shapes, although usually axisymmetric; low tooling costs, but high labor costs; suitable for low-quantity production; long cycle times.

Magnetic-pulse forming - Shallow forming, bulging, and embossing operations on relatively lowstrength sheets; most suitable for tubular shapes; high production rates; requires special tooling.[9]

bending /bend/ - ohýbání

blanking /blæŋkɪŋ/ - stříhání

coining /kɔɪnɪŋ/ - ražení (mince)

cost /kɒst/ - cena, náklady

contour /ˈkɒn.tɔːr/ - obrys, tvar

embossing /ɪmˈbɒsɪŋ/ - ražení (reliéfové, plastické)

equipment /ɪˈkwɪp.mənt/ - vybavení

[9] Dostupné z: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

flanging /ˈflændʒɪŋ/ - vytváření příruby, lemování

forming /fɔːm ɪŋ / - tvarování, formování

hence /hens/ - tudíž, (a proto)

labor /ˈleɪ.bər/ - práce

membrane /ˈmem.breɪn/ - membrána, blána

punching /pʌntʃɪŋ/ - děrovat, razit

roll /rəʊl/ - válcovat, kutálet

rubber-pad /ˈrʌb.ər - pæd/ - gumová položka

shallow /ˈʃæl.əʊ/ - mělký

shape /ʃeɪp/ - tvar

spinning /ˈspɪn.ɪŋ/ - tlačení plechu na rotující model, předení, stáčení

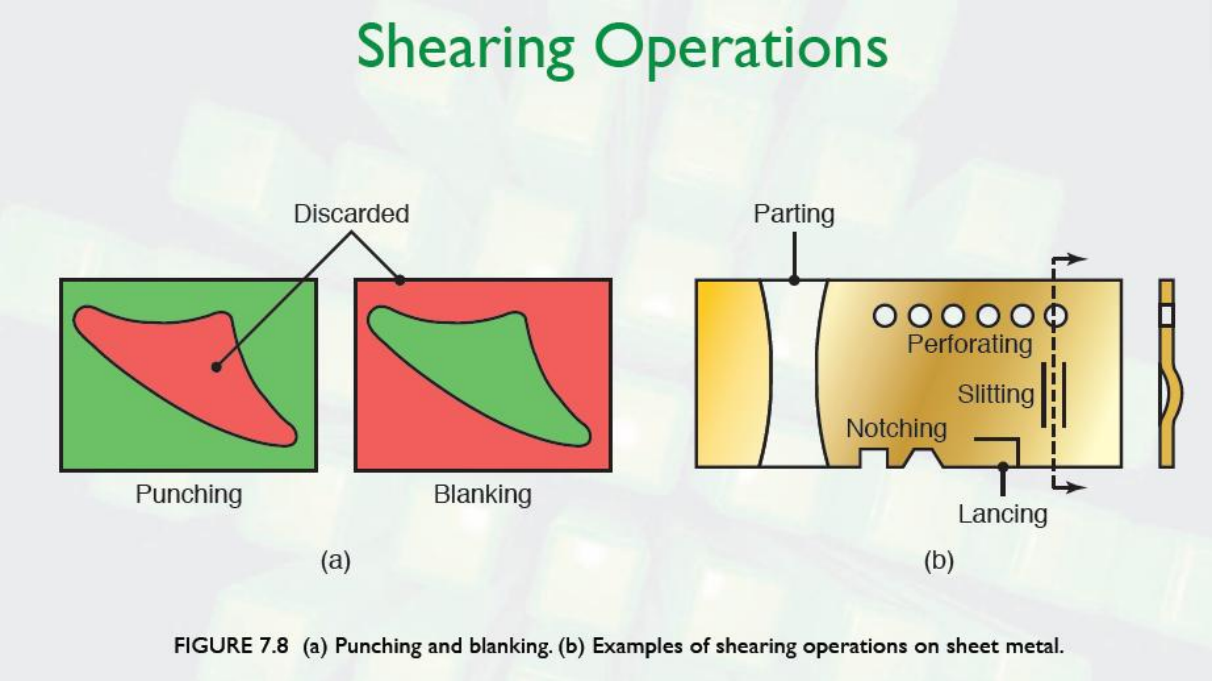
stamping  /stæmpɪŋ / - ražení, razítkování

stretch /stretʃ/ - natahovat

surface /ˈsɜː.fɪs/ - povrch, plocha

tool /tuːl/ - nástroj, opracovat

tubular /ˈtjuː.bjʊ.lər/ - trubkový




Obrázek č. 9[10]

discard /dɪˈskɑːd/ - odstaňovat

lancing /lɑːnsɪŋ/ - naříznutí, propíchnutí

notching /nɒtʃɪŋ/ - vrubování, vytváření zářezů

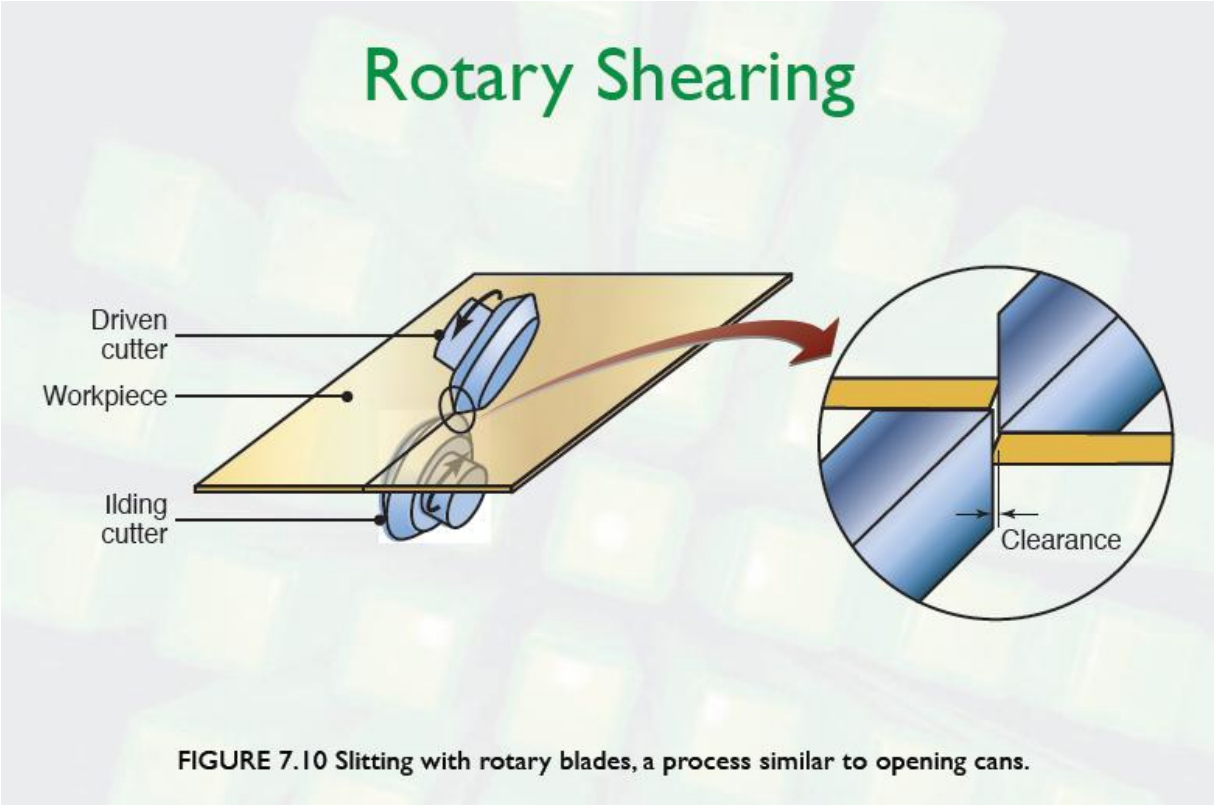
parting /ˈpɑː.tɪŋ/ - dělení

perforating /ˈpɜː.fər.eɪtɪŋ/ - děrovat

shearing /ʃɪərɪŋ/ - stříhání

slitting /slɪtɪŋ/ - prořínutí

[10] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]




Obrázek č. 10[11]

blade /bleɪd/ - ostří, čepel

can /kæn/ - plechovka

clearance /ˈklɪə.rəns/ - odstranění, odklizení

cutter /kʌt.ər/ - řezný nástroj

driven /ˈdrɪv.ən/ - hnaný

rotary /ˈrəʊ.tər.i/ - otáčivý

[11] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

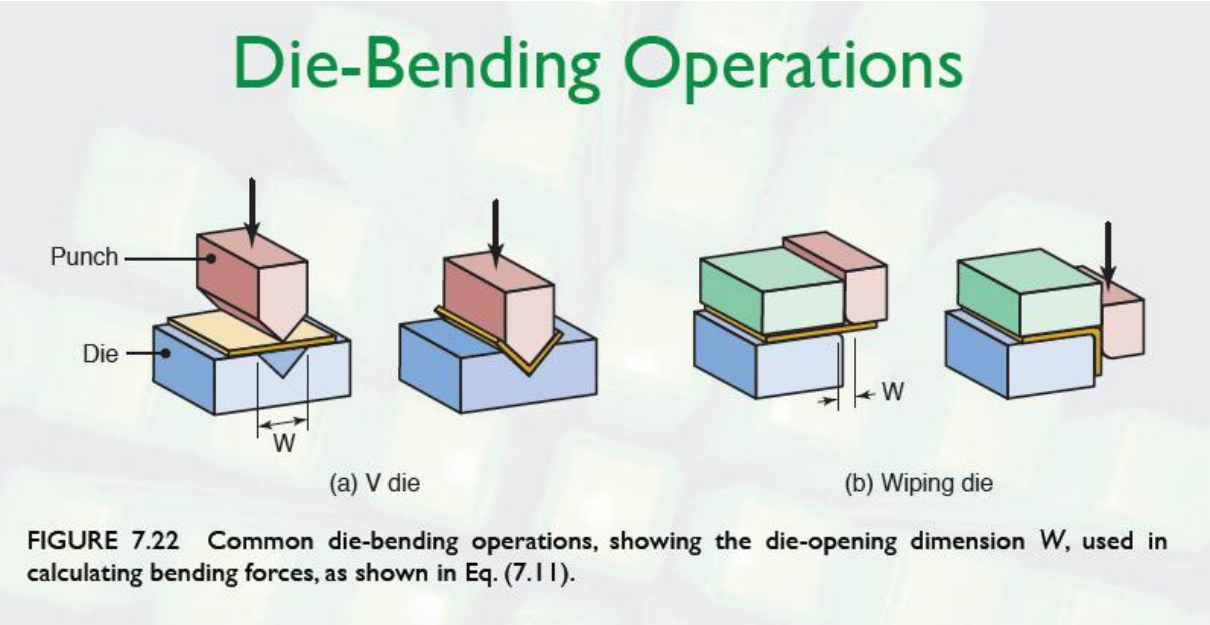



FIGURE 7.22 Common die-bending operations, showing the die-opening dimension W, used in calculating bending forces, as shown in Eq. (7.11).

Obrázek č. 11[12]

die /daɪ/ - zápustka, raznice, ohybnice

punch /pʌntʃ/ - ohybník, (průbojník, děrovačka)

[12] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

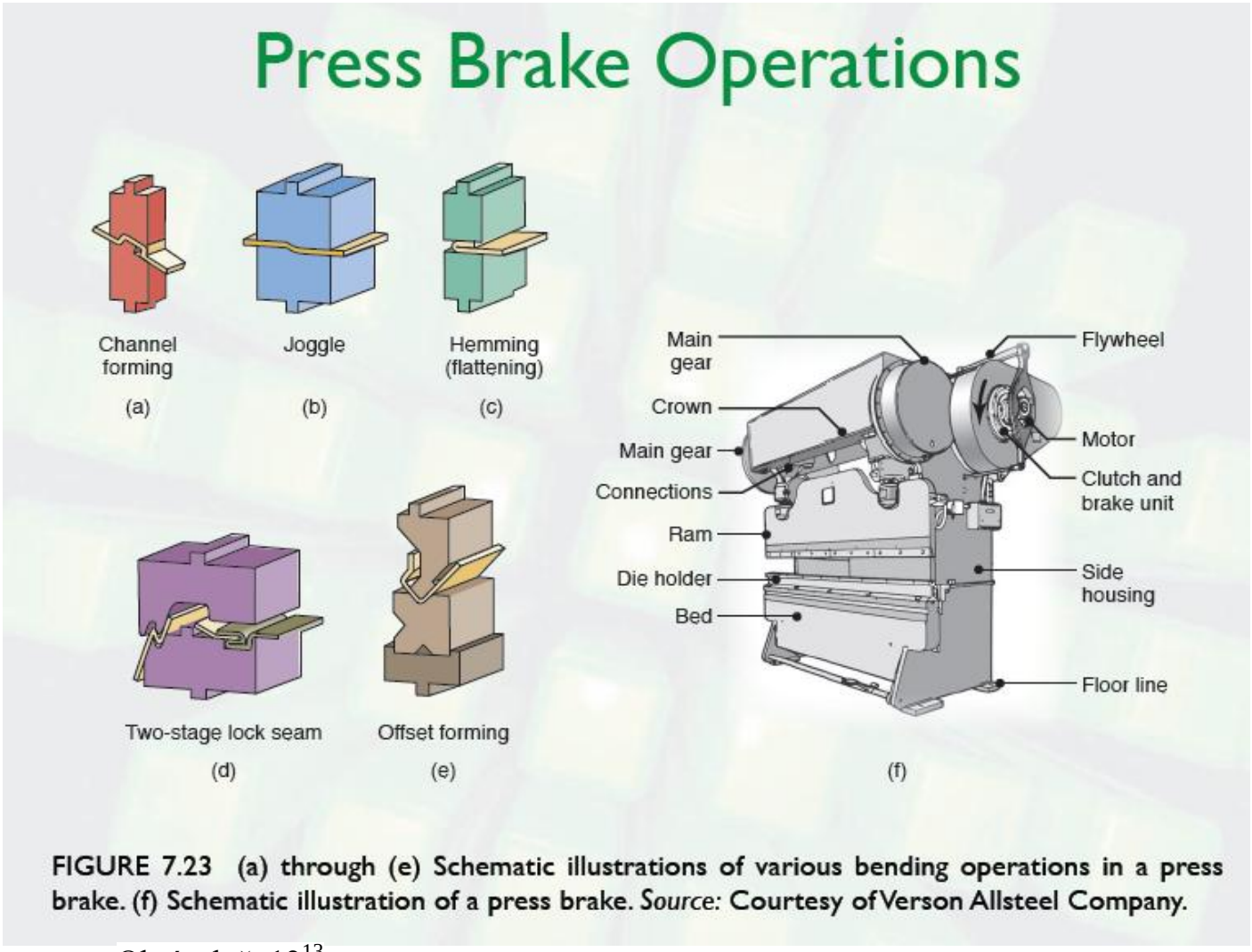



**FIGURE 7.23** (a) through (e) Schematic illustrations of various bending operations in a press brake. (f) Schematic illustration of a press brake. *Source:* Courtesy of Verson Allsteel Company.

Obrázek č. 12[13]

channel /ˈtʃæn.əl/ - kanál

hemming /hemɪŋ/ - lemování, obroubení

joggle /ˈdʒɒg.l̩/ - otřásat, lomcovat

lock /lɒk/ - zámek, zarážka, uzavřít (sl.)

offset /ˌɒfˈset/ - ohyb, ohraňování, kompenzovat (sl.)

ram /ræm/ - beranidlo, buchar

seam /siːm/ - čev, spoj

stage /steɪdʒ/ - stupeň, etapa

[13] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

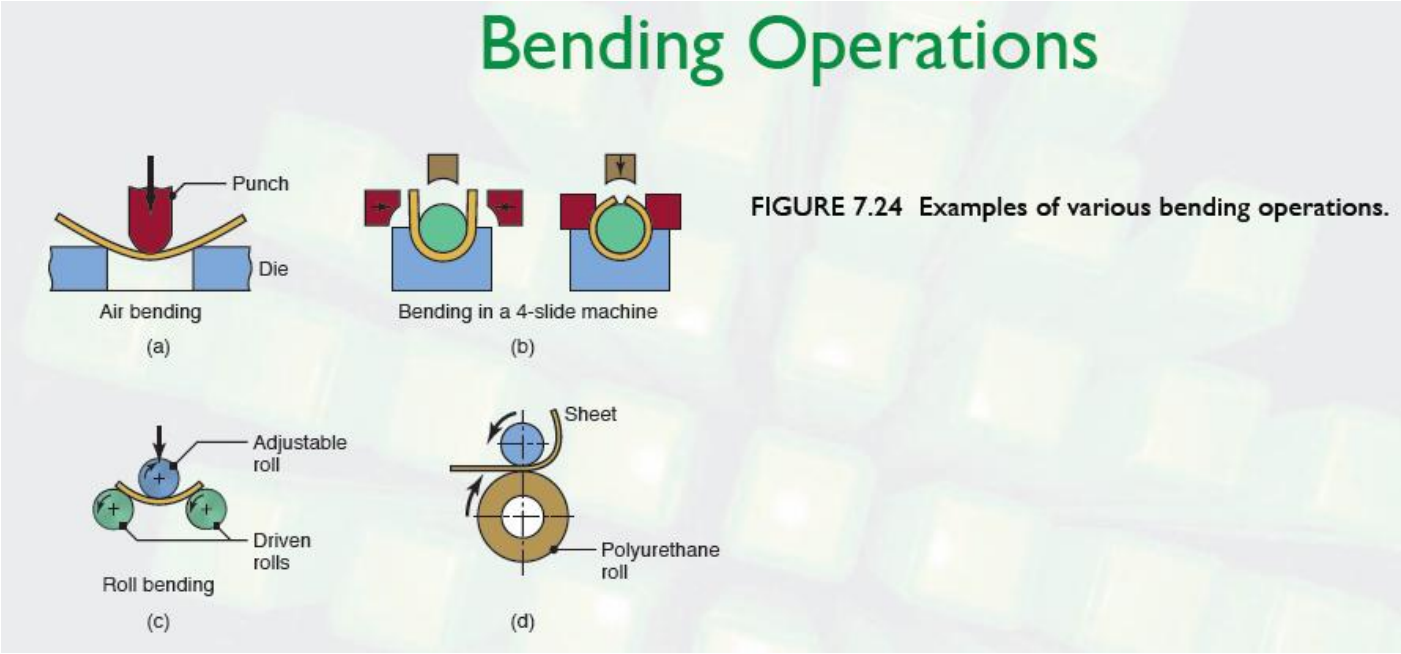



FIGURE 7.24 Examples of various bending operations.

Obrázky č. 13 a č. 14[14]

adjustable /əˈdʒʌs.tə.bl̩/ - nastavitelný

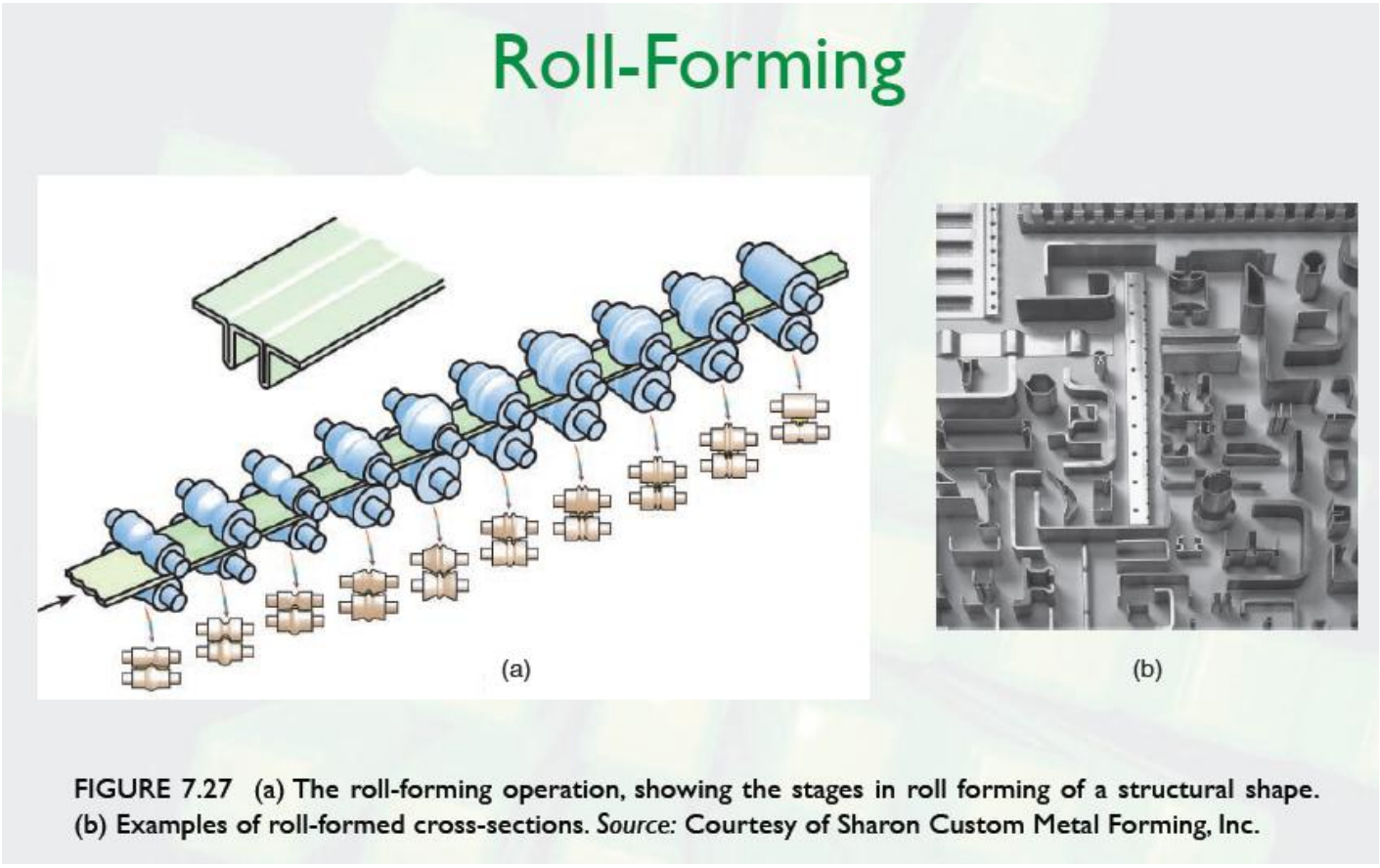



FIGURE 7.27 (a) The roll-forming operation, showing the stages in roll forming of a structural shape. (b) Examples of roll-formed cross-sections. *Source:* Courtesy of Sharon Custom Metal Forming, Inc.

[14] Obrázky dostupné: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

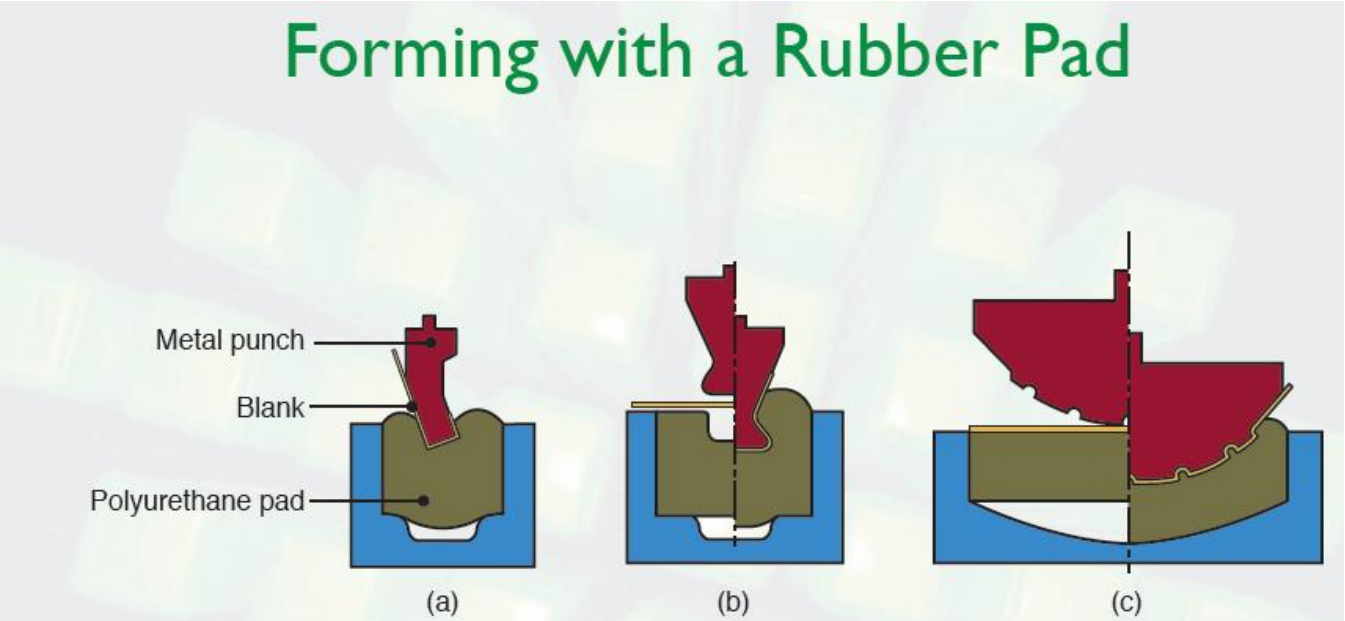



**FIGURE 7.33** Examples of bending and embossing sheet metal with a metal punch and a flexible pad serving as the female die. *Source:* Polyurethane Products Corporation.

Obrázky č. 15 a č. 16[15]

serve /sɜːv/ - sloužit

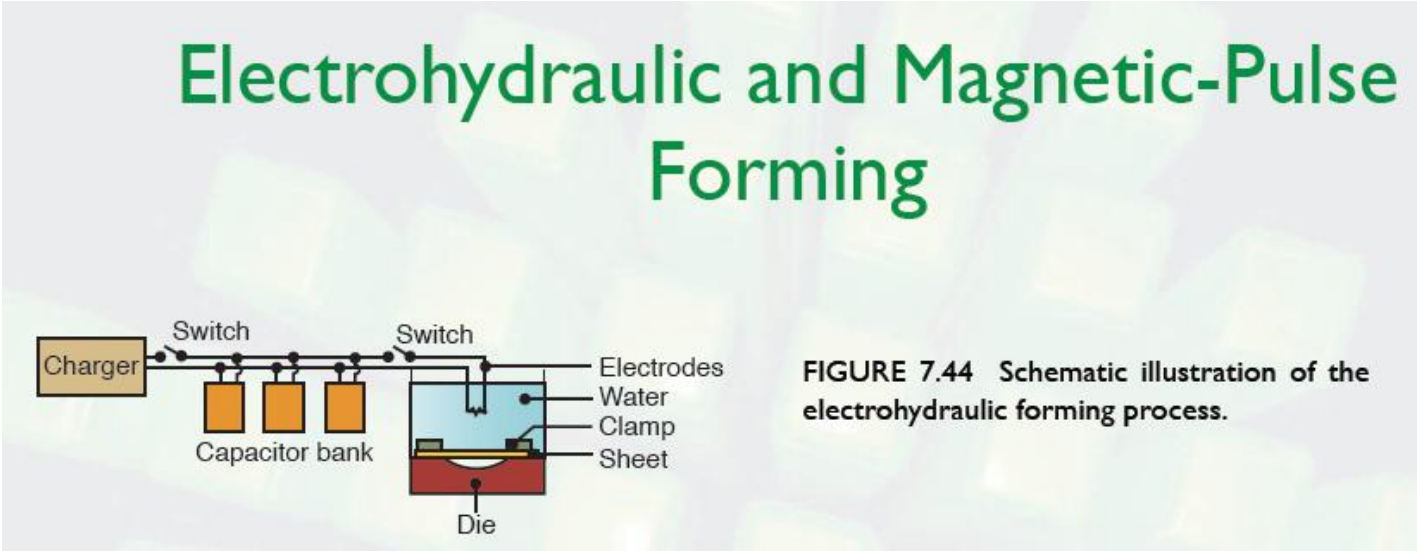



**FIGURE 7.44** Schematic illustration of the electrohydraulic forming process.

charger /ˈtʃɑːˌdʒər/ - nabíječka, zdroj

clamp /klæmp/ - svorka

switch /swɪtʃ/ - spínač

[15] Obrázky dostupné: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

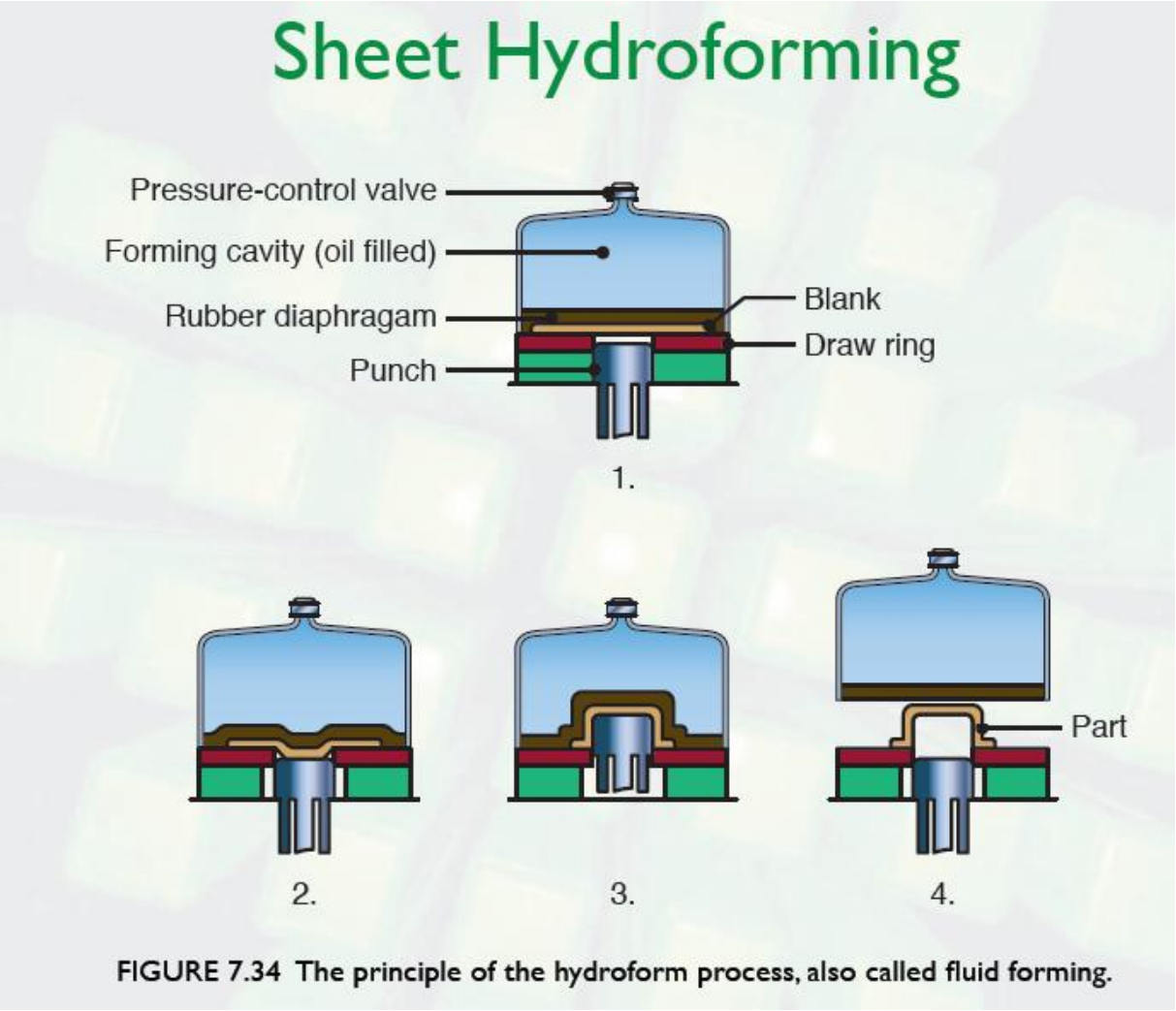


FIGURE 7.34 The principle of the hydroform process, also called fluid forming.

Obrázek č. 17[16]

cavity /ˈkæv.ɪ.ti/ - dutina, prostor

diaphragm /ˈdaɪ.ə.fræm/ - membrána, bránice

valve /vælv/ - ventil, klapka

[16] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

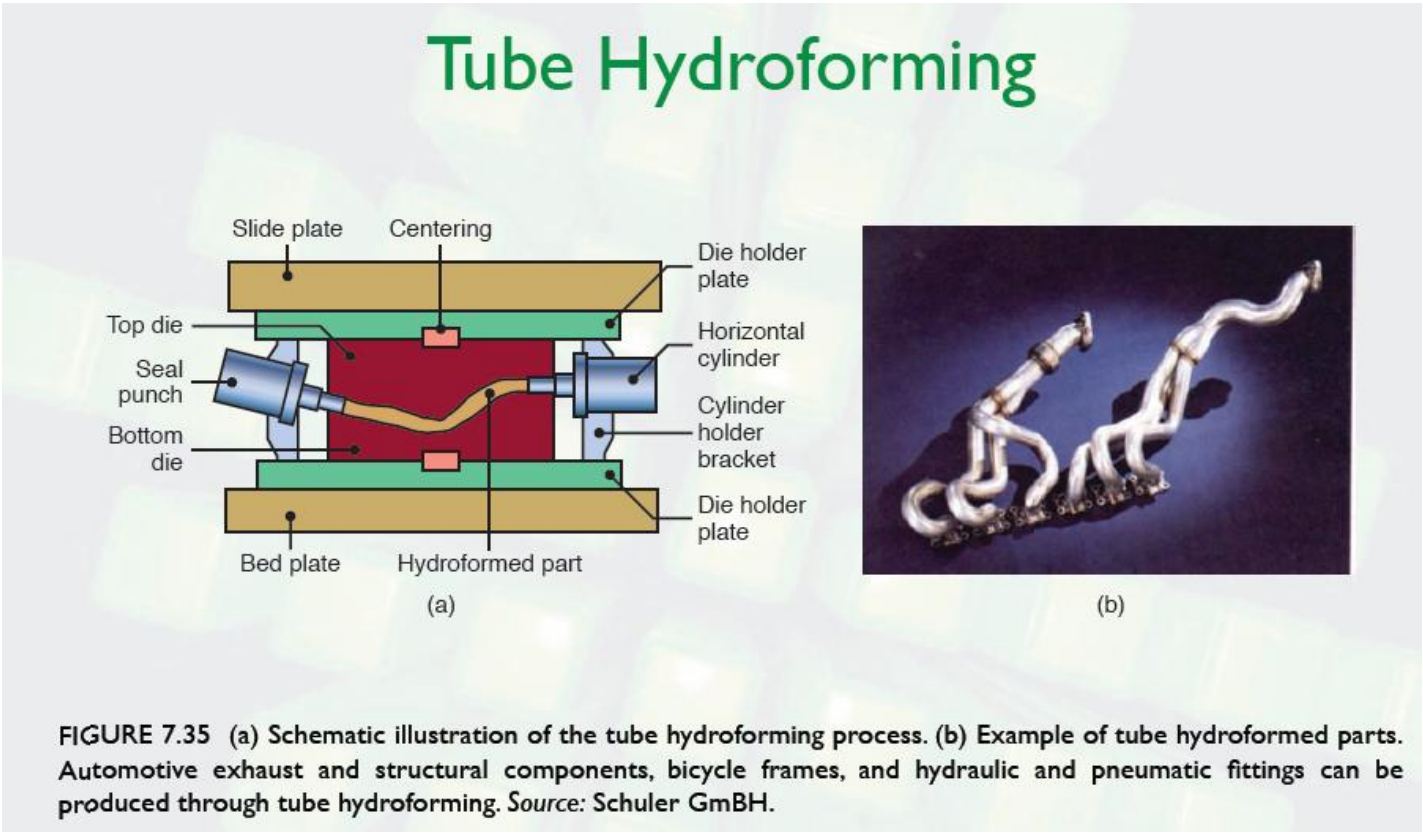



**FIGURE 7.35** (a) Schematic illustration of the tube hydroforming process. (b) Example of tube hydroformed parts. Automotive exhaust and structural components, bicycle frames, and hydraulic and pneumatic fittings can be produced through tube hydroforming. *Source:* Schuler GmBH.

Obrázek č. 18[17]

bracket /ˈbræk.ɪt/ - konzola, držák

exhaust /ɪgˈzɔːst/ - výfuk

frame /freɪm/ - rám

holder /ˈhəʊl.dər/ - držák

[17] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

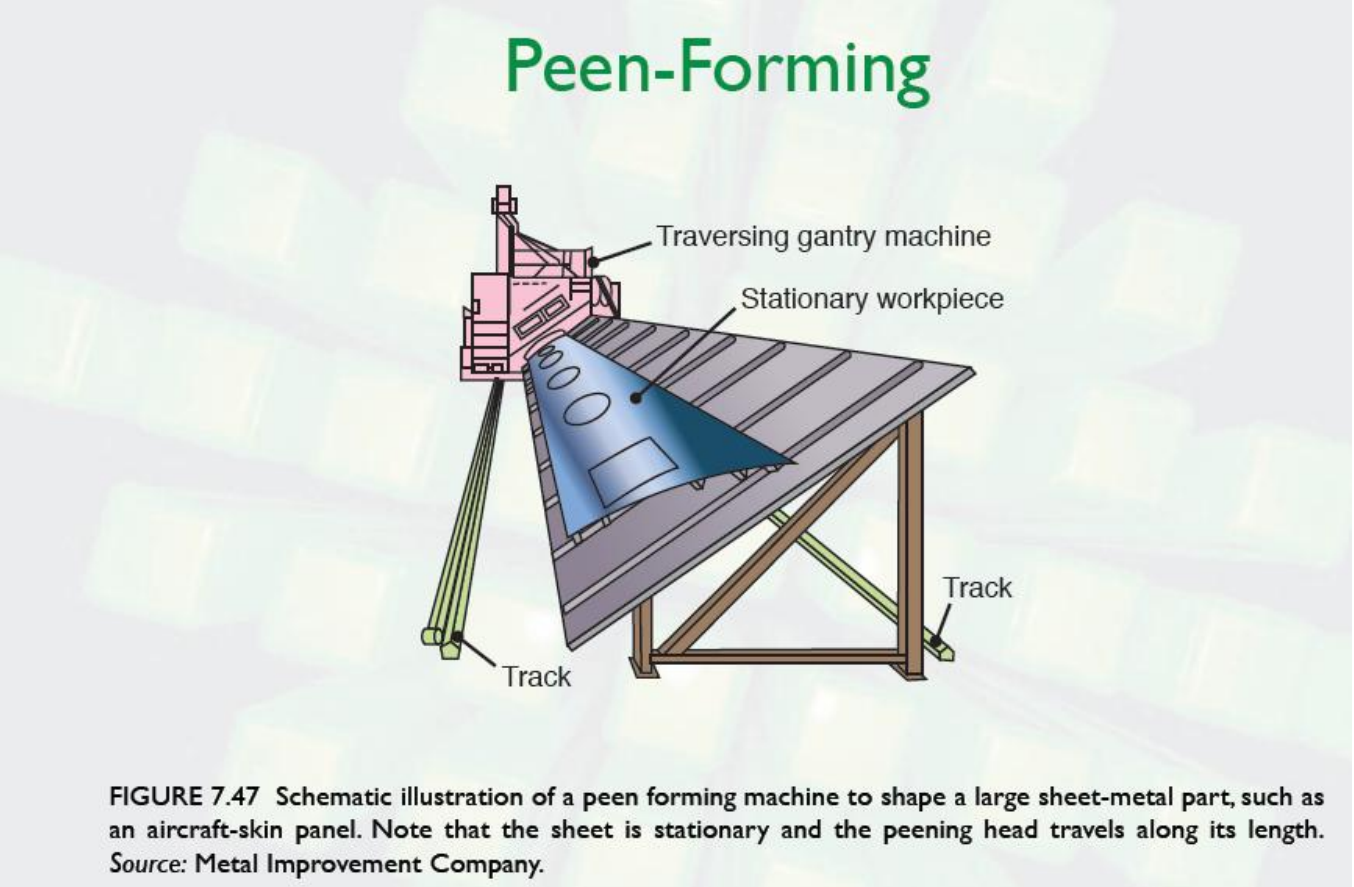


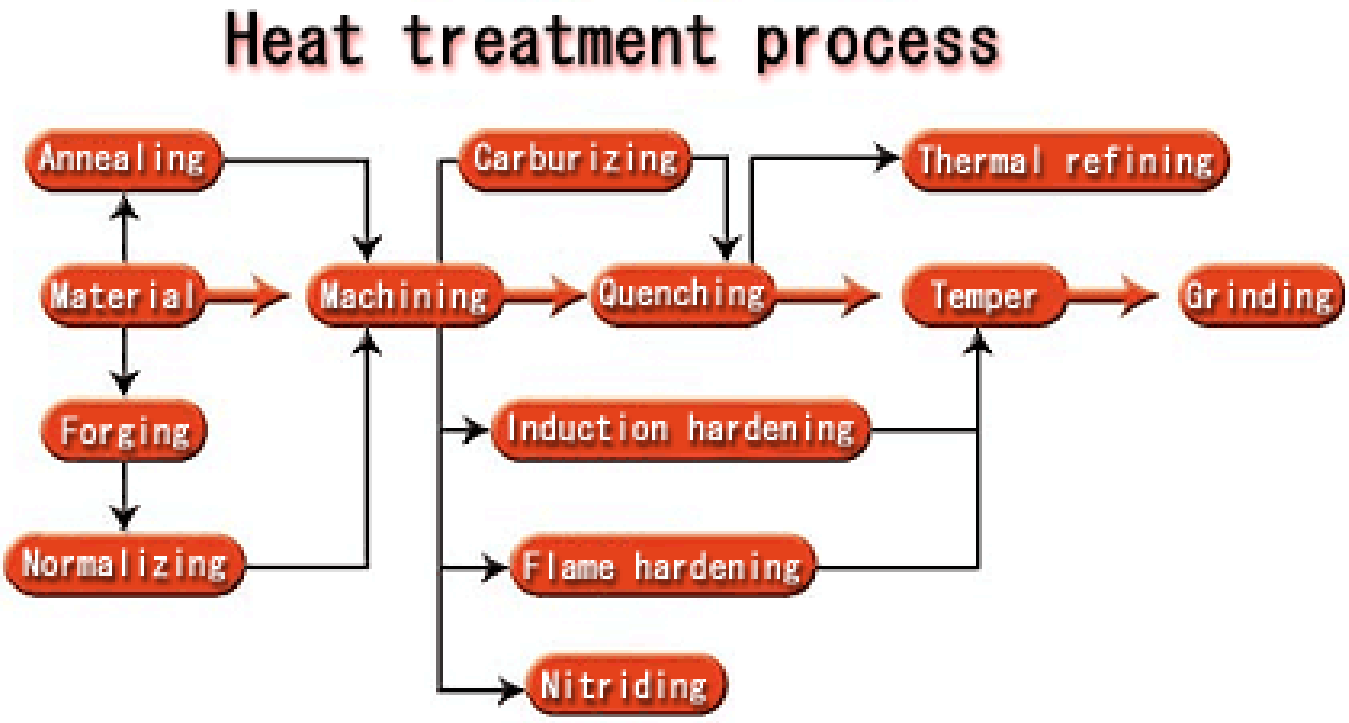

FIGURE 7.47 Schematic illustration of a peen forming machine to shape a large sheet-metal part, such as an aircraft-skin panel. Note that the sheet is stationary and the peening head travels along its length. *Source:* Metal Improvement Company.

Obrázek č. 19[18]

[18] Obrázek dostupný: http://www3.nd.edu/~manufact/MPEM_pdf_files/Ch07.pdf [citováno 20.4.2015]

# Heat and chemical treatment

Heat treating is a group of industrial and metalworking processes used to alter the physical, and sometimes chemical, properties of a material.




Obrázek č. 20[19]

[19] Obrázek dostupný: http://tbl.com.my/products-and-services/ [citováno 20.4.2015]

**Martensite**, named after the German metallurgist Adolf Martens (1850–1914), most commonly refers to a very hard form of steel crystalline structure. [20]

**Austenite**, also known as gamma phase iron (γ-Fe), is a metallic, non-magnetic allotrope of iron or a solid solution of iron, with an alloying element.[21]

**Cementite**, also known as iron carbide, is a chemical compound of iron and carbon.[22]

**Bainite** is an acicular microstructure (not a phase) that forms in steels at temperatures of 250–550 °C (depending on alloy content).[23]

**Stages of Heat Treatment**

- **Stage l**—Heating the metal slowly to ensure a uniform temperature.
- **Stage 2**—Soaking (holding) the metal at a given temperature for a given time and cooling the metal to room temperature.
- **Stage 3**—Cooling the metal to room temperature.

- **Annealing** is a heat treatment in which the metal is heated to a temperature above its recrystallisation temperature, kept at that temperature some time for homogenization of temperature followed by very slow cooling to develop equilibrium structure in the metal or alloy.
- The steel is heated 30 to 50$^{o}$C above $Ae_3$ temperature in case of hypo-eutectoid steels and 30 to 50$^{o}$C above $A_1$ temperature in case of hyper-eutectoid temperature
- The cooling is done in the furnace itself.
- The aim of annealing is to increase the ductility. [24]

[20] Dostupné z: https://en.wikipedia.org/wiki/Martensite [citováno 20.4.2015]
[21] Dostupné z: https://en.wikipedia.org/wiki/Austenite [citováno 20.4.2015]
[22] Dostupné z: https://en.wikipedia.org/wiki/Cementite [citováno 20.4.2015]
[23] Dostupné z: https://en.wikipedia.org/wiki/Bainite [citováno 20.4.2015]
[24] Dostupné z: http://www.slideshare.net/RakeshSingh125/f-annealing [citováno 20.4.2015]

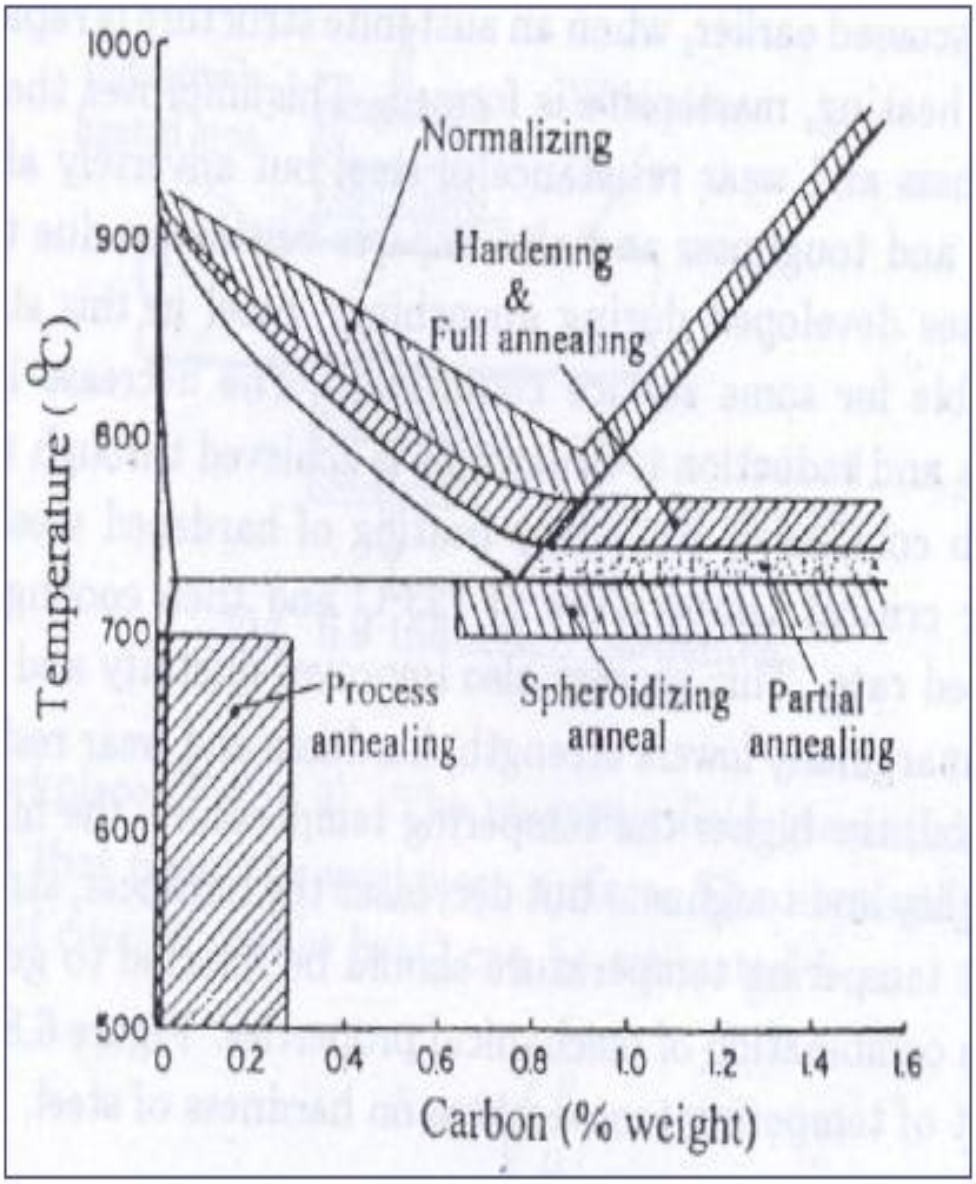
- **Normalizing** consists of heating a suitable steel to a temperature 50-100$^0$ C above $Ae_3$ temperature in case of hypoeutectoid steels and above $A_{cm}$ temperature in case of hyper-eutectoid steel, soaking for sufficient time and then cooling in still air.
- The aim of normalizing is to increase the toughness. [25]

- In **hardening** heat treatment, the steel is heated 30 to 50$^o$C above $Ae_3$ temperature in case of steels and 30 to 50$^o$C above $A_1$ temperathypo-eutectoid ure in case of hyper-eutectoid temperature, held at that temperature for some time followed by cooling at a rate faster than the critical cooling rate to produce martensite which is a hard phase.
- The aim of hardening is to increase the hardness and strength of the steel.[26]

- **Tempering** consists of heating a hardened steel to a temperature below eutectoid temperature and keeping it at that temperature for a specified time to reduce brittleness followed by air cooling.
- The aim of tempering is to decrease brittleness of hardened steel.[27]

[25] Dostupné z: http://www.slideshare.net/RakeshSingh125/normalising [citováno 20.4.2015]
[26] Dostupné z: http://www.slideshare.net/RakeshSingh125/f46a-hardening [citováno 20.4.2015]
[27] Dostupné z: http://www.slideshare.net/RakeshSingh125/f-tempering [citováno 20.4.2015]

Obrázek č. 21[28]




- CARBURIZING

Carbon is added to the surface of low-carbon steel. Two methods carburizing steel.

i ) Heating the steel in a furnace containing a carbon monoxide atmosphere.

ii) Steel placed in a container packed with charcoal or some other carbon-rich material and then heated in a furnace.[29]

[28] Obrázek dostupný: http://www.slideshare.net/RakeshSingh125/f46a-hardening [citováno 20.4.2015]
[29] Dostupné na: https://en.wikipedia.org/wiki/Carburizing [citováno 20.4.2015]

- NITRIDING

Methods in that the individual parts have been heat-treated and tempered before nitriding.

The parts are then heated in a furnace that has an ammonia gas atmosphere.

No quenching is required so there is no worry about warping or other types of distortion.

- FLAME HARDENING

Harden the surface of metal parts. When you use an oxyacetylene flame, a thin layer at the surface of the part is rapidly heated to its critical temperature and then immediately quenched by a combination of a water spray and the cold base metal.

- QUENCHING

Rapid cooling of a workpiece to obtain certain material properties. It prevents low-temperature processes, such as phase transformations, from occurring by only providing a narrow window of time in which the reaction is both thermodynamically favorable and kinetically accessible. For instance, it can reduce crystallinity and thereby increase toughness of both alloys and plastics

others:

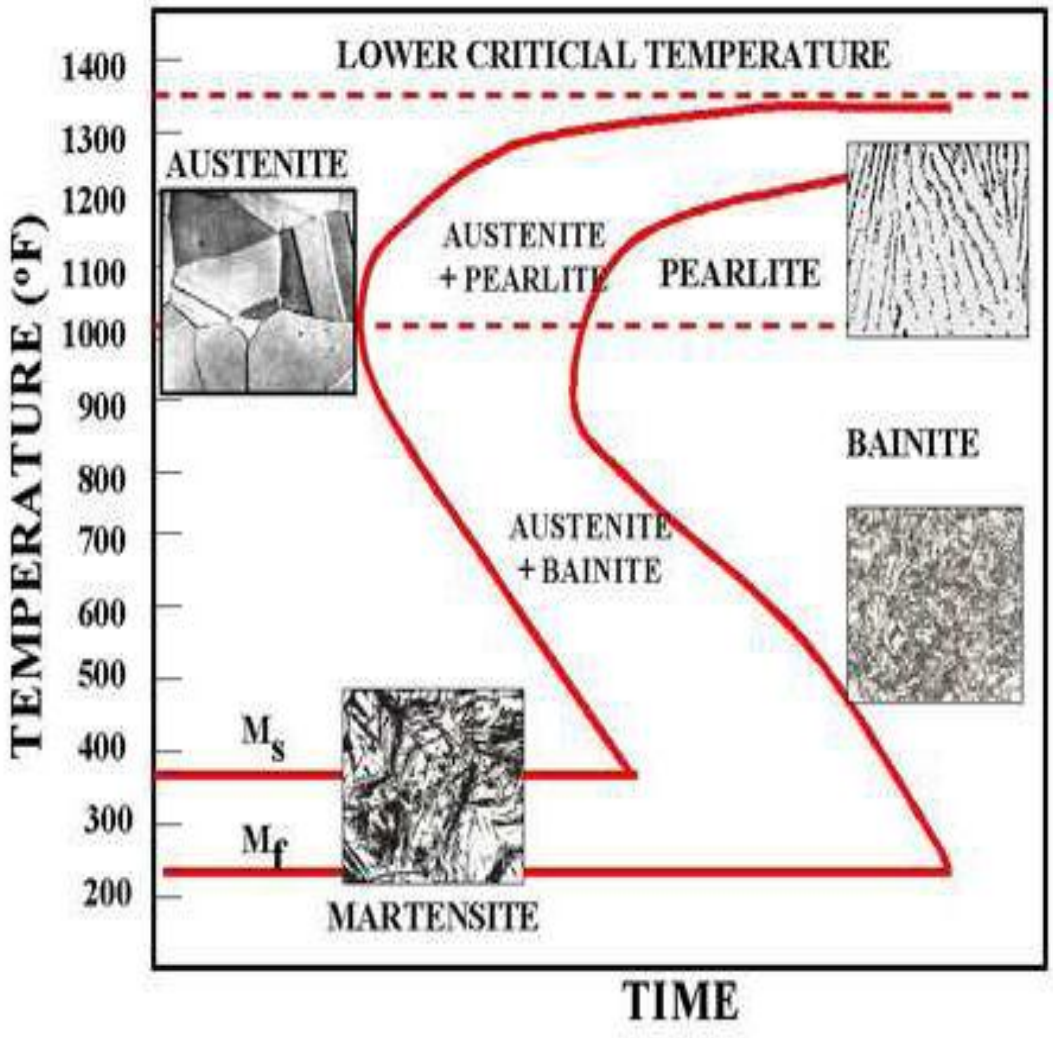
Batch Furnace – a heat-treatment furnace that soaks a stationary workpiece.

Phase - a portion of material with a uniform crystal structure, consistent properties, and recognizable boundaries. At room temperature, steel consists of two or more phases.

Quenching Medium - the liquid or air substance used to cool a metal during quenching. Water, saltwater, air, and oil are common quenching mediums.

Recovery Annealing - an annealing process that attempts to partially restore the original grain structure of the metal and still preserve the strain hardening that has developed.[30]

Obrázek č. 22[31]




[30] Dostupné na: http://www.slideshare.net/kartikm1991/14250-ch2 [citováno 20.4.2015]
[31] Obrázek dostupný: https://en.wikipedia.org/wiki/Carburizing [citováno 20.4.2015]

accessible [əkˈsesəbəl] – dostupný, přístupný

anneal /əˈniːl/ - žíhat

austenite /aus·ten·ite/ - austenit (tuhý roztok uhlíku v železe)

batch [bætʃ] – dávka (zpracovávat po dávkách – sloveso)

boundary /ˈbɑʊn·dri, -də·ri/ - hranice, mez

brittle /ˈbrɪt.l̩/ - křehký

carbon [ˈkɑːbən] - uhlík

cementite \si-ˈment-ˌīt\ – karbid železa

charcoal [ˈtʃɑːˌkəʊl] – dřevěné uhlí

common [ˈkɒmən] - běžný

consist [kənˈsɪst] – skládat se

decrease /dɪˈkriːs/ - snižovat

distortion [dɪˈstɔːʃən] – pokřivení, pokroucení

ductility /dʌkˈtɪl·ɪ·ţi/ - houževnatost

cooling [kuːlɪŋ] – ochlazování

ensure /ɪnˈʃʊər/ - zajistit

favorable /ˈfeɪ·vər·ə·bəl/ - příznivý

forging [ˈfɔːdʒɪŋ] – kování

furnace /ˈfɜr·nəs/ - pec

heat treatment [hiːt ˈtriːtmənt] – tepelné zpracování

harden /ˈhɑː.dənɪŋ/ - tvrdnout

increase  /ɪnˈkris/ - zvyšovat

kinetic /kəˈneţ·ɪk/ - pohybový

layer [ˈleɪə] - vrstva

martensite /ˈmɑːtɪnˌzaɪt/ - martenzit (nestálý tuhý roztok uhlíku v železe)

occur [əˈkɜː] – nastet, přihodit se

pearlite /ˈpɜːlaɪt/ - perlit

rapidly [ˈræpɪdlɪ] – rychle

recognizable [ˈrekəgnaɪzəbəl] - rozeznatelný

reduce [rɪˈdjuːs] – snížit omezit

refining /rɪˈfɑɪn/ - rafinace, čistění

restore [rɪˈstɔː] - obnovit

soaking [ˈsəʊkɪŋ] – ponořování, napouštění, namáčení

stationary [ˈsteɪʃənərɪ] – nehybný, pevný

strain [streɪn] – nápor, tlak

surface [ˈsɜːfɪs] - povrch

quench /kwentʃ/ - kalit

temper [ˈtempə] – popouštět

thermal [ˈθɜːməl] - tepelné

toughness [ˈtʌfnɪs] – tvrdost, tuhost

uniform [ˈjuːnɪˌfɔːm] – jednotný, stejný

warp /wɔrp/ - ohýbat, deformovat

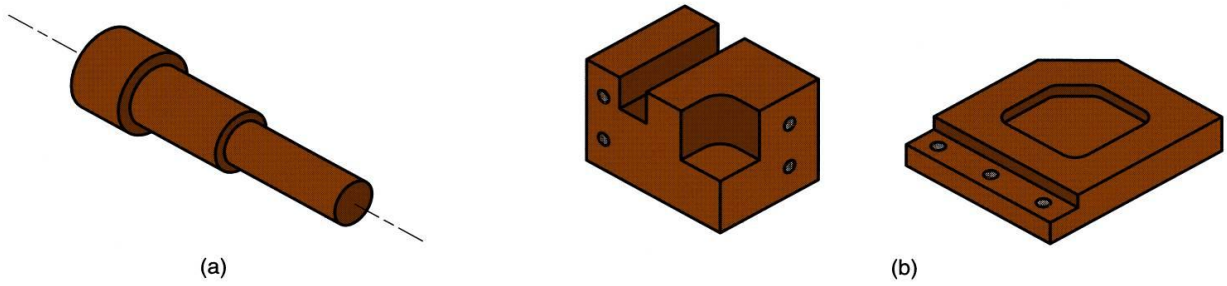
# Machining

A material removal process in which a sharp cutting tool is used to mechanically cut away material so that the desired part geometry remains

- Most common application: to shape metal parts
- Most versatile of all manufacturing processes in its capability to produce a diversity of part geometries and geometric features with high precision and accuracy

Classification of Machined Parts

- **Rotational** - cylindrical or disk-like shape (a)
- **Nonrotational** (also called prismatic) - block-like or plate-like (b)




Obrázek č. 23[32]

capability [ˌkeɪpəˈbɪlɪtɪ] – schopnost

cone [kəʊn] – kužel

cutting [ˈkʌtɪŋ] – řezný

cylindrical [sɪˈlɪndrɪkəl] – válcovitý

determine [dɪˈtɜːmɪn] – určit, stanovit

diversity [daɪˈvɜːsɪtɪ] – různost

feed [fiːd] – posouvat

[32] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

feature [ˈfiːtʃə] – znak, rys, prvek

machining [məˈʃiːnɪŋ] – obrábění, strojní zpracování

prism [ˈprɪzəm] – hranol

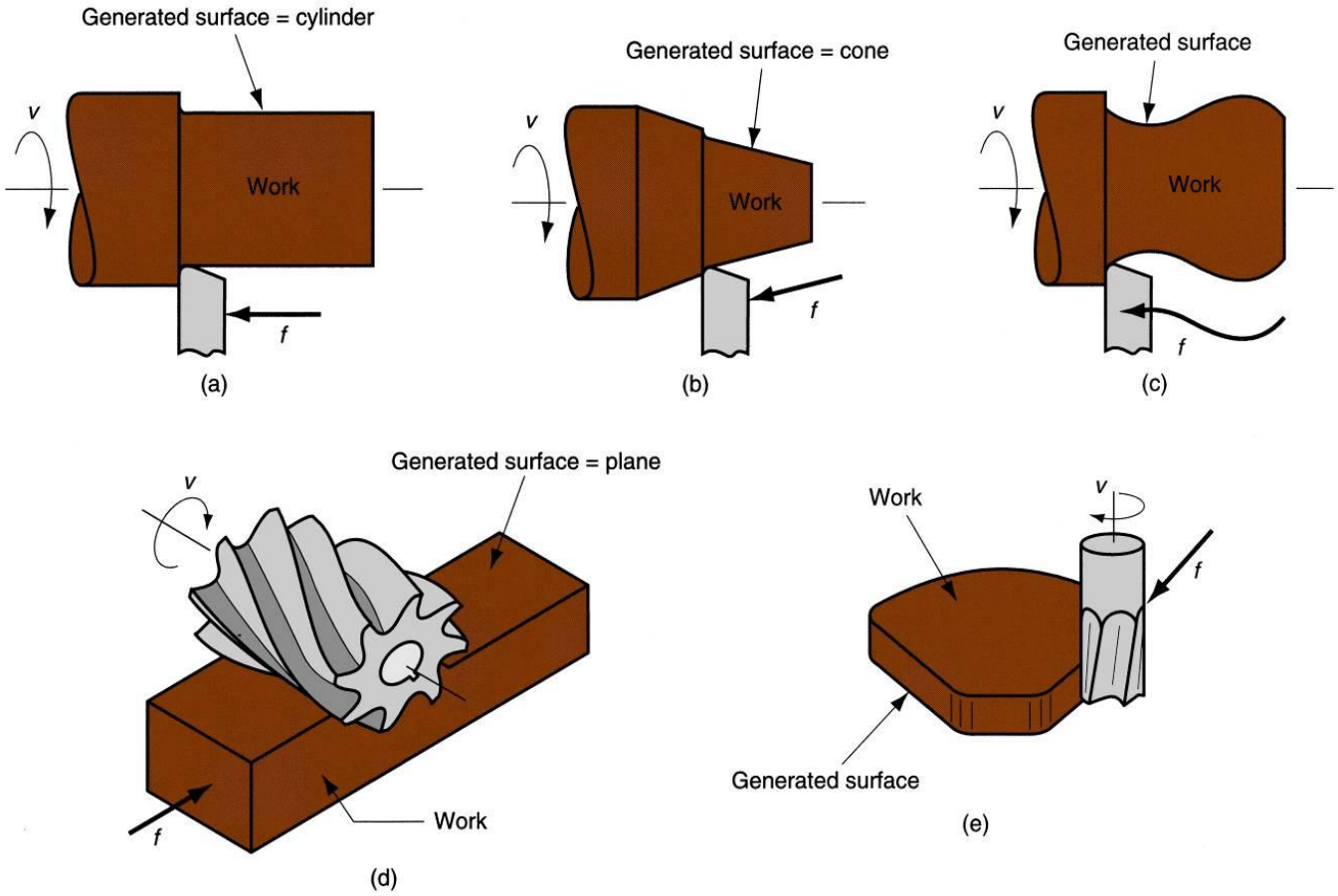
removal [rɪˈmuːvəl] – odstranění

versatile [ˈvɜːsəˌtaɪl] – víceúčelový, univerzální

## Machining Operations and Part Geometry

Each machining operation produces a characteristic part geometry due to two factors:

1. Relative motions between tool and workpart
    - ***Generating*** – part geometry determined by feed trajectory of cutting tool
2. Shape of the cutting tool
    - ***Forming*** – part geometry is created by the shape of the cutting tool

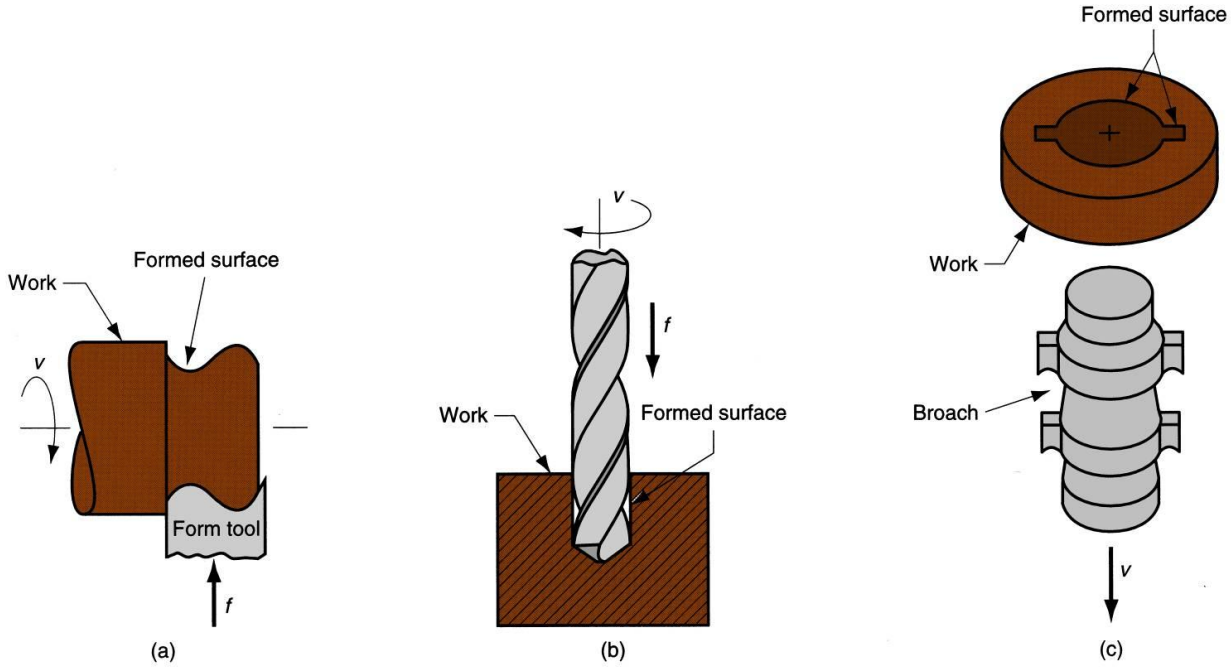



Obrázek č. 24[33]

Generating shape: (a) straight turning, (b) taper turning, (c) contour turning, (d) plain milling, (e) profile milling.

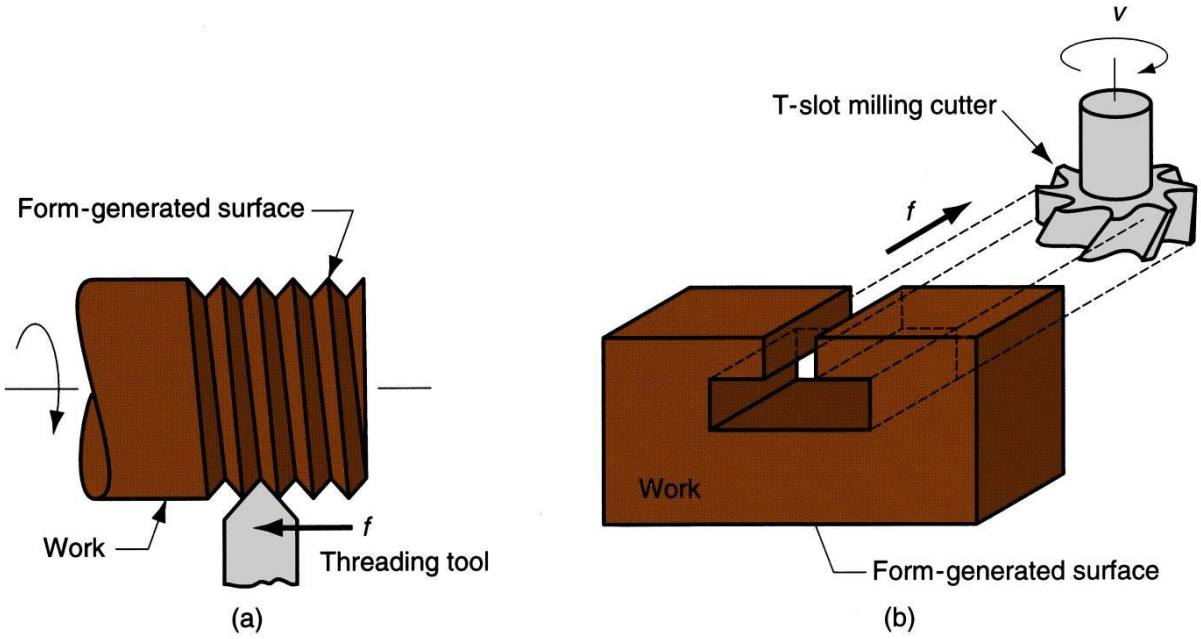
[33] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

Forming to Create Shape




Forming to create shape: (a) form turning, (b) drilling, and (c) broaching.

Forming and Generating




Obrázky č. 25 a 26[34]

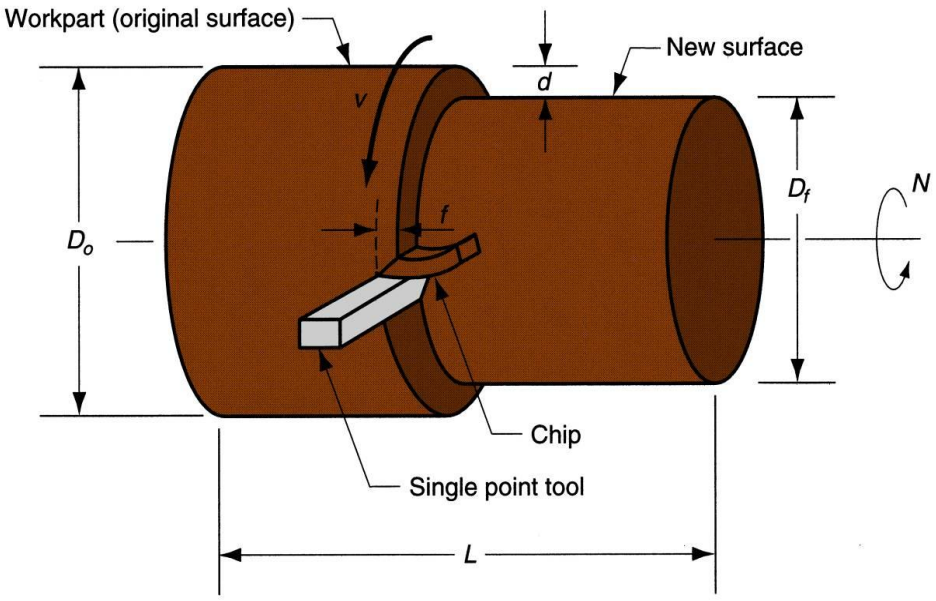
Combination of forming and generating to create shape: (a) thread cutting on a lathe, and (b) slot milling.

[34] Obrázky dostupné na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

## Turning

Single point cutting tool removes material from a rotating workpiece to generate a cylinder

- Performed on a machine tool called a *lathe*
- Variations of turning performed on a lathe:
  - Facing, Contour turning, Chamfering, Threading




Obrázek č. 27[35]

broaching [brəʊtʃɪŋ] – protahování

chamfer [ˈtʃæmfə] – srazit, zkosit

contour [ˈkɒntʊə] – obrys, tvar

drilling [drɪlɪŋ] – vrtání

milling [ˈmɪlɪŋ] – frézování

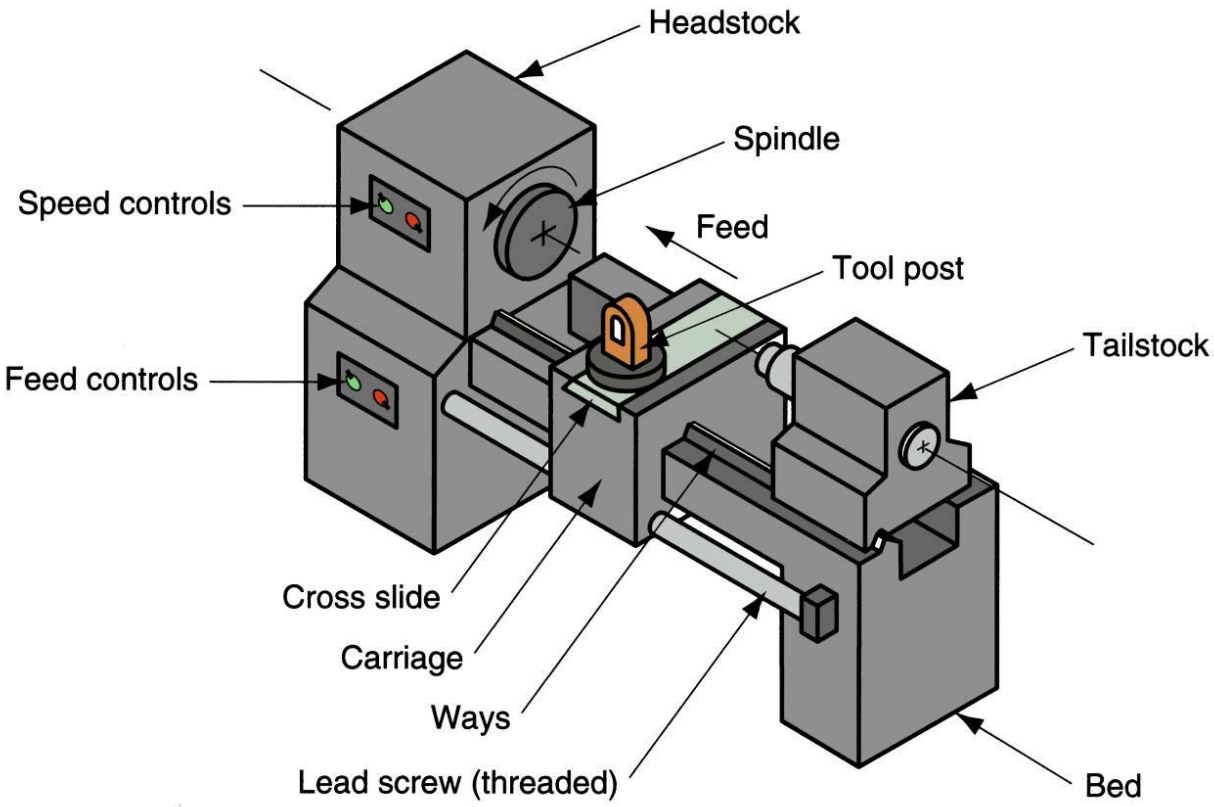
planing [pleɪnɪŋ] – hoblování

slot [slɒt] – drážka

threading [θredɪŋ] – řezání závitůturning [ˈtɜːnɪŋ] – soustružení

[35] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

Engine Lathe




Obrázek č. 28[36]

bed [bed] – lože

chuck [tʃʌk] – sklíčidlo

lathe [leɪð] – soustruh

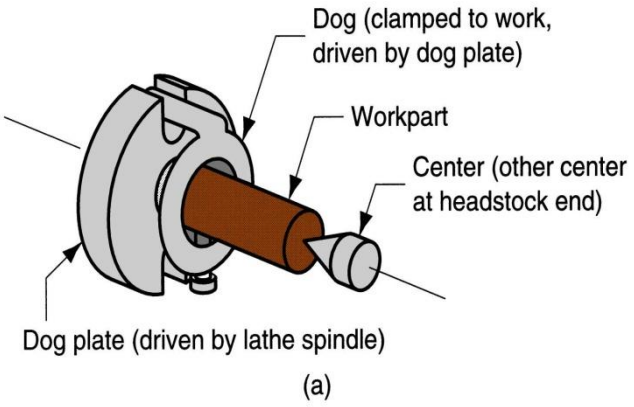
spindle [ˈspɪndəl] – vřeteno, hřídel

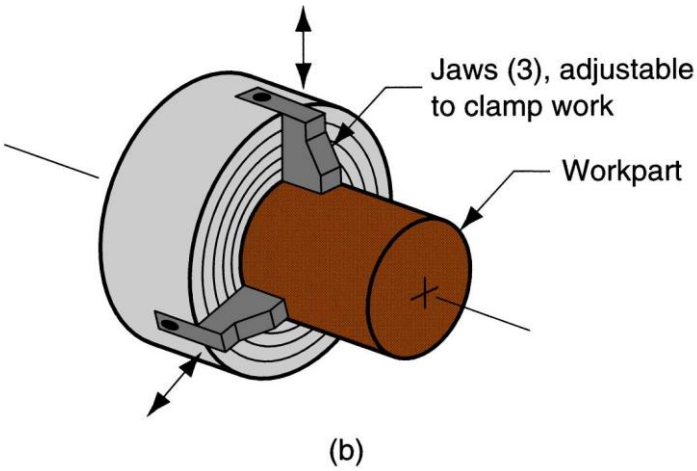
tool post [tuːl pəʊst] – nožová hlava

[36] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

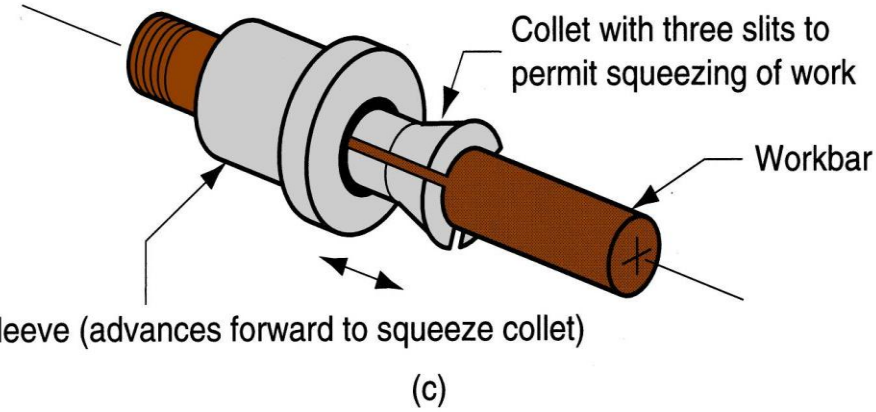
## Methods of Holding the Work in a Lathe

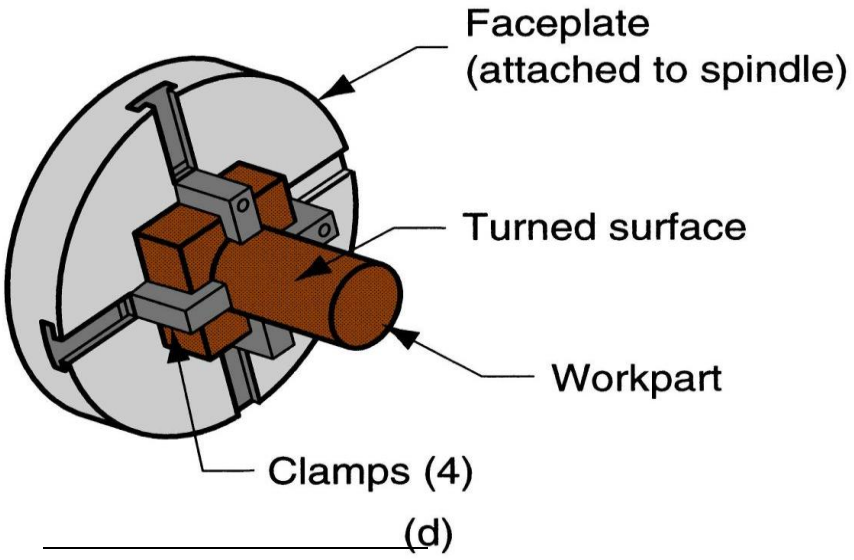
- Holding the work between centers
- Chuck
- Collet
- Face plate




Obrázky č. 29, 29, 30, 31[37]




[37] Obrázky dostupné na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

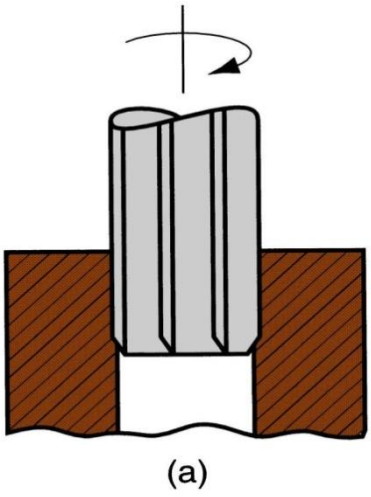
## Boring

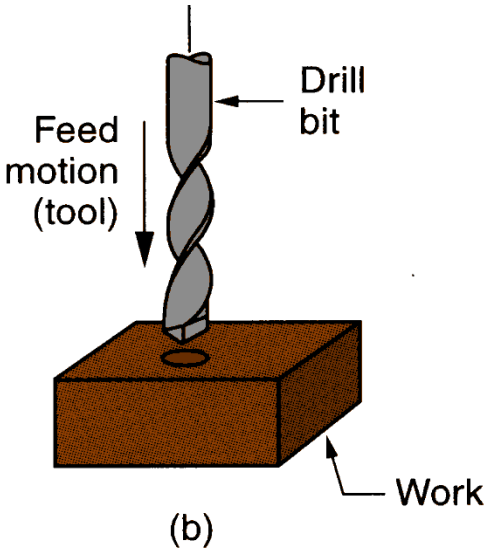
- Difference between boring and turning:
  - **Boring** is performed on the inside diameter of an existing hole
  - **Turning** is performed on the outside diameter of an existing cylinder
- In effect, boring is internal turning operation
- Boring machines
  - Horizontal or vertical - refers to the orientation of the axis of rotation of machine spindle

## Drilling (b)

- Creates a round hole in a workpart
- Compare to boring which can only enlarge an existing hole
- Cutting tool called a *drill* or *drill bit*
- Machine tool: *drill press*

Obrázky č. 32, 33[38]




[38] Obrázky dostupné na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

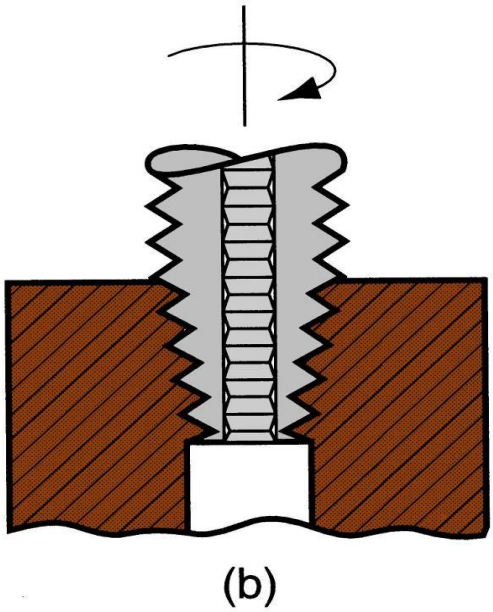
**Reaming (a)**

- Used to slightly enlarge a hole, provide better tolerance on diameter, and improve surface finish

**Tapping (b)**

- Used to provide internal screw threads on an existing hole
- Tool called a *tap*

Obrázek č. 34[39]




[39] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

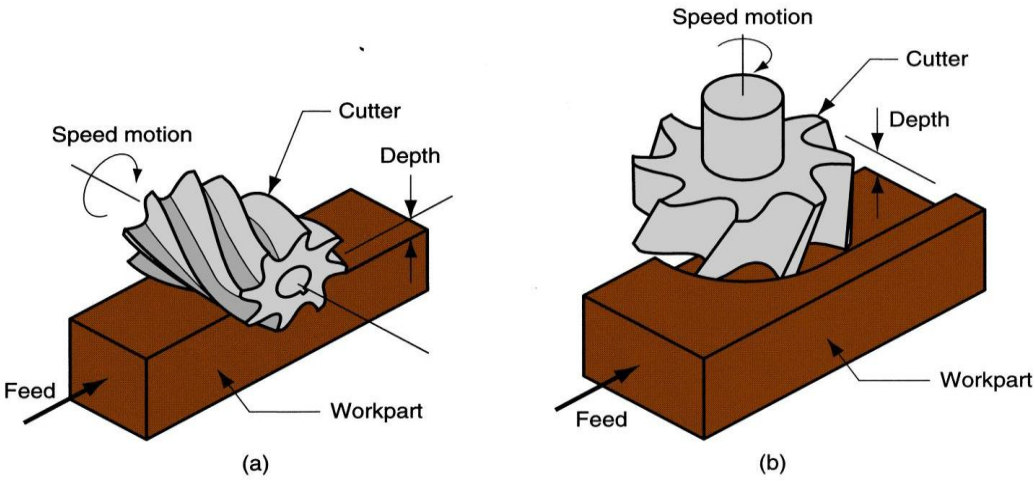
## Milling

Machining operation in which work is fed past a rotating tool with multiple cutting edges

- Axis of tool rotation is perpendicular to feed
- Creates a planar surface
  - Other geometries possible either by cutter path or shape
- Other factors and terms:
  - Interrupted cutting operation
  - Cutting tool called a milling cutter, cutting edges called "teeth"
  - Machine tool called a milling machine

Two Forms of Milling

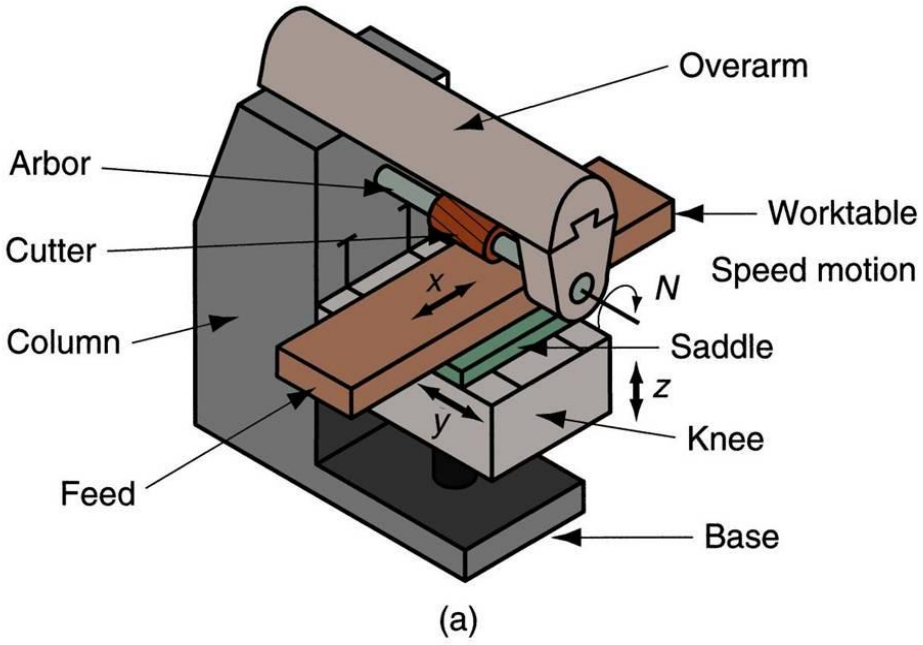
Obrázek č. 35[40]




Two forms of milling: (a) peripheral milling, and (b) face milling.

[40] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

## Horizontal Milling Machine




Obrázek č. 36[41]

arbor [ˈɑːbə] – hřídel

axis [ˈæksɪs] – osa, souřadnice

base[beɪs] – základna

boring [ˈbɔːrɪŋ] – vrtání

clamp [klæmp] – svorka, upnout

collet [kälət] – kleština

column [ˈkɒləm] – hřídel

enlarge [ɪnˈlɑːdʒ] – zvětšit

interrupt [ˌɪntəˈrʌpt] – přerušit

jaw [dʒɔː] – čelist

[41] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

motion [ˈməʊʃən] - pohyb

path [pɑːθ] – dráha

ream [riːm] – rozšířit otvor

saddle [ˈsædəl] – sedlo

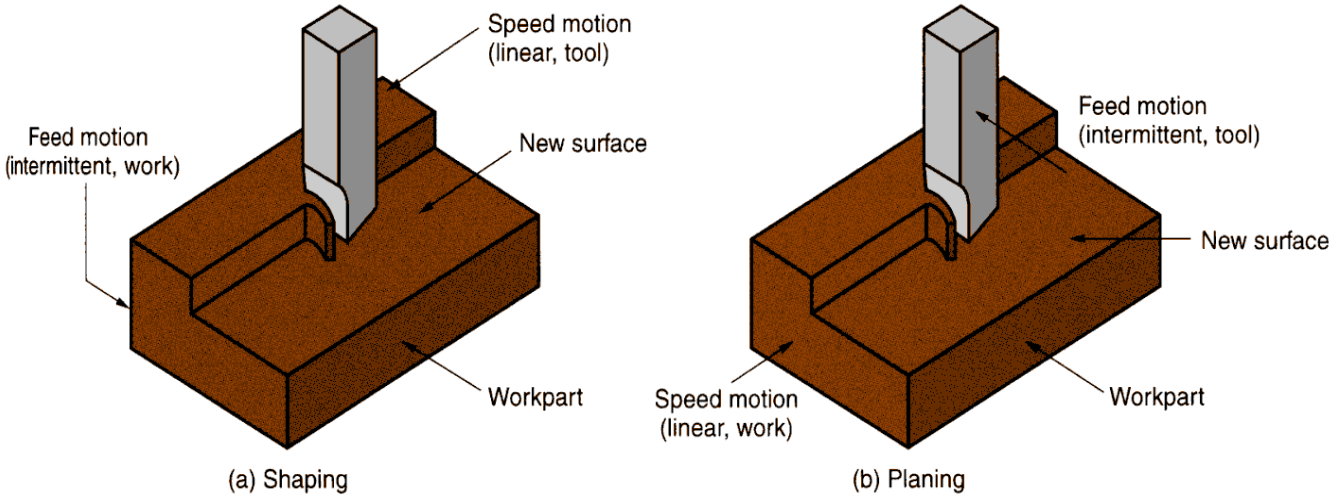
shapeing [ʃeɪpɪŋ] – tvarování

slit [slɪt] – zářez, řez

squeeze [skwiːz] – sevřít, zmáčknout

## Shaping and Planing

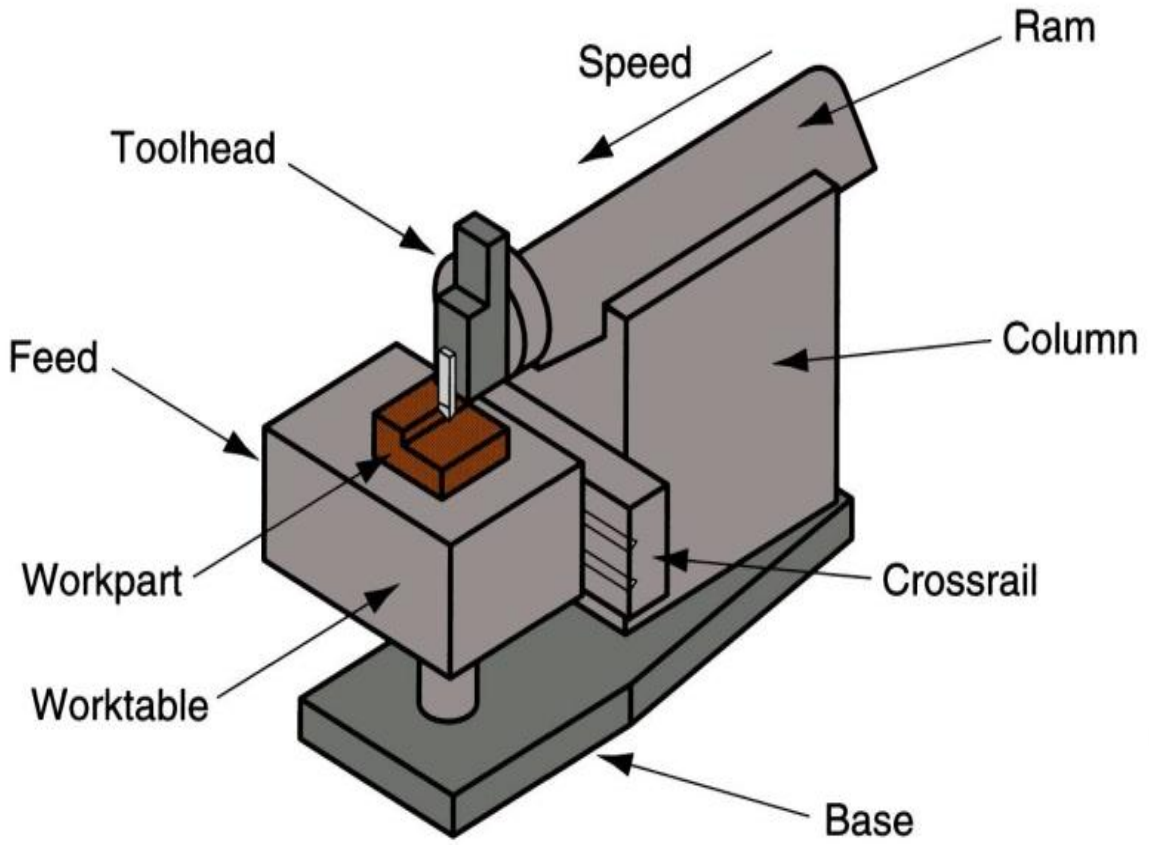
- Similar operations
- Both use a single point cutting tool moved linearly relative to the workpart



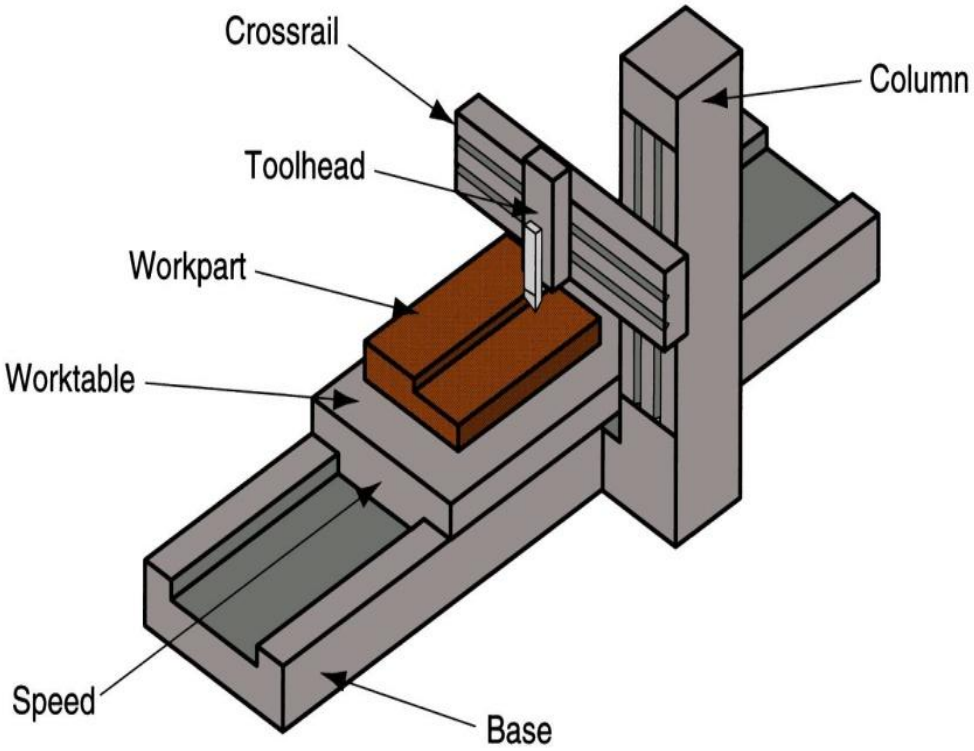

Obrázek č. 37[42]

- A straight, flat surface is created in both operations
- Interrupted cutting
  - Subjects tool to impact loading when entering work
- Low cutting speeds due to start-and-stop motion
- Typical tooling: single point high speed steel tools

[42] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]



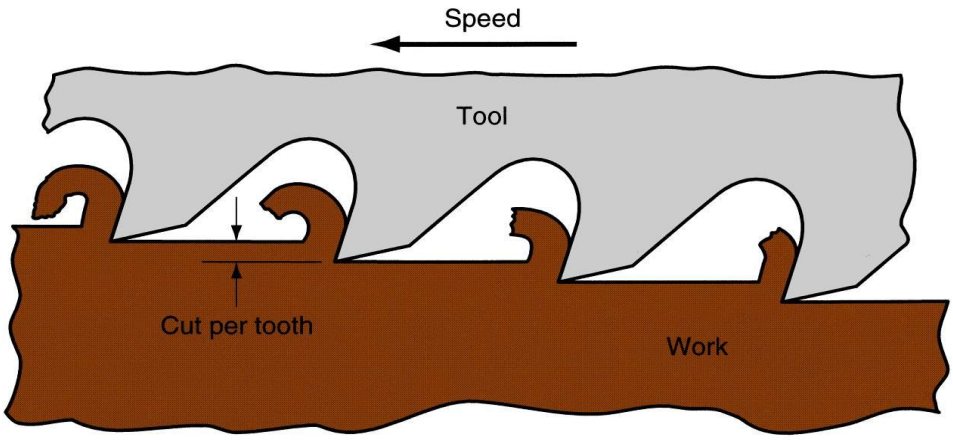

Obrázky č. 38, 40[43]




[43] Obrázky dostupné na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

## Broaching

- Moves a multiple tooth cutting tool linearly relative to work in direction of tool axis




Obrázek č. 41[44]

## Advantages:

- Good surface finish
- Close tolerances
- Variety of work shapes possible

Cutting tool called a ***broach***

- Owing to complicated and often custom-shaped geometry, tooling is expensive

[44] Obrázek dostupný na: http://www.slideshare.net/MuhammadMuddassir1/2-machining-operations-and-machine-tools [citováno 20.4.2015]

Obrázek č. 42[45]

Classification of Modern Machining Processes

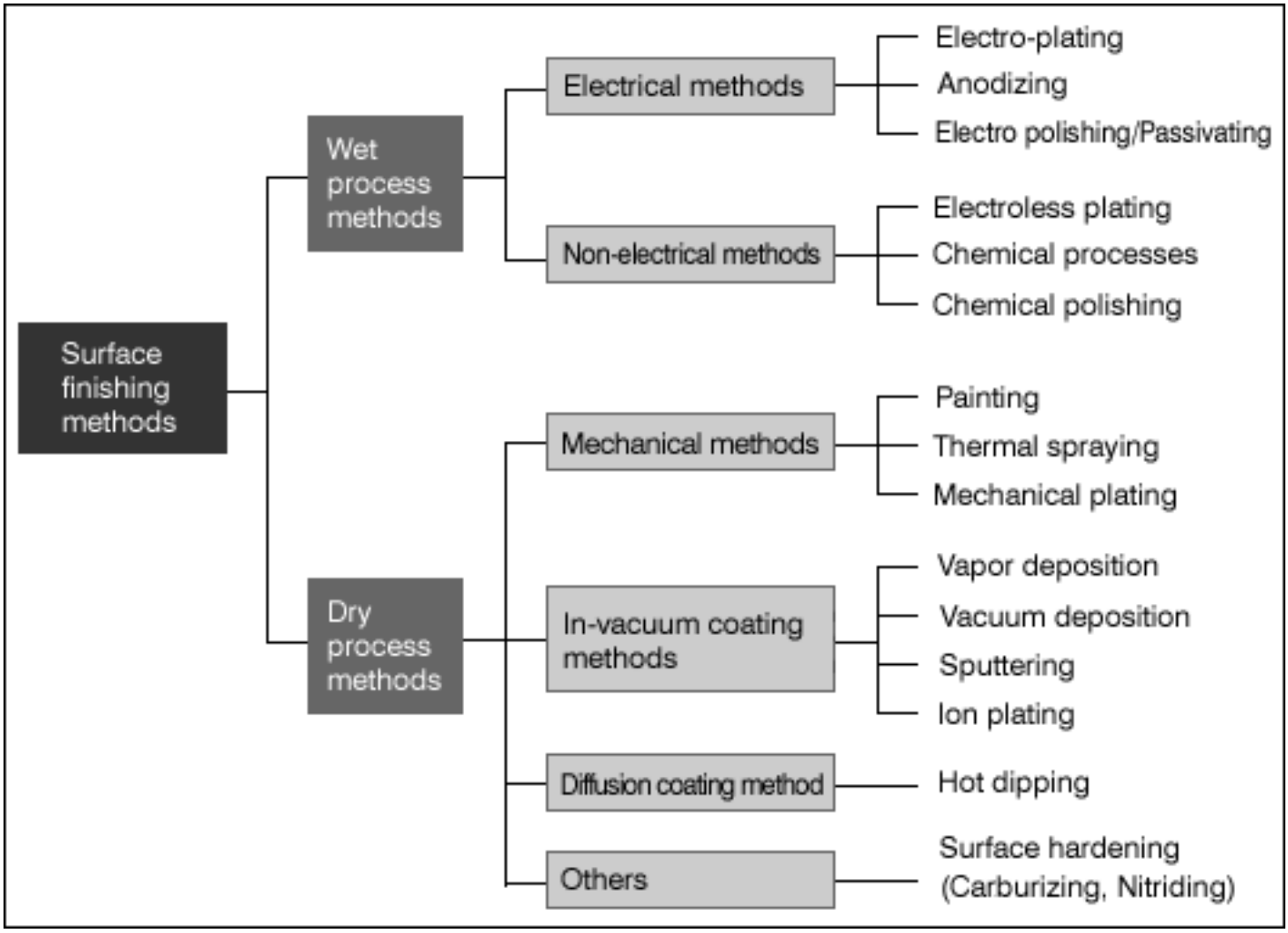
| *Type of energy* | *Mechanism of metal removal* | *Transfer media* | *Energy source* | *Processes* |
|---|---|---|---|---|
| Mechanical | Erosion | High velocity particles | Pneumatic/ hydraulic pressure | AJM, USM, WJM |
| | Shear | Physical contact | Cutting tool | Conventional machining |
| Electrochemical | Ion displacement | Electrolyte | High current | ECM, ECG |
| Chemical | Ablative relation | Reactive environment | Corrosive agent | CHM |
| Thermoelectric | Fusion | Hot gases | Ionized material | IBM, PAM |
| | | Electrons | High voltage | EDM |
| | Vapourization | Radiation | Amplified light | LBM |
| | | Ion stream | Ionized material | PAM |

AJM Abrasive Jet Machining
CHM Chemical Machining
ECG Electrochemical Grinding
ECM Electrochemical Machining
EDM Electric Discharge Machining
IBM Ion Beam Machining
LBM Laser Beam Machining
PAM Plasma Arc Machining
USM Ultrasonic Machining
WJM Water Jet Machining

[45] Obrázek dostupný na: https://books.google.cz/books?id=uC3rHzhogmMC&printsec=frontcover&dq=machining&hl=cs&sa=X&ved=0CDcQ6AEwA2oVChMI7b3Ny_uTxgIVxFgUCh0adAB4#v=onepage&q=machining&f=false [citováno 20.4.2015]

# Surface finishing

Obrázek č. 43[46]




[46] Obrázek dostupný na: http://www.misumi-techcentral.com/tt/en/surface/2009/07/0001-hydrogen-embrittlement.html [citováno 20.4.2015]

*1. Electroplating*

**Electroplating** is a process of coating deposition on a part, immersed into an electrolyte solution and used as a cathode, when the anode is made of the depositing material, which is dissolved into the solution in form of the metal ions, traveling through the solution and depositing on the cathode surface.

acidic [əˈsɪdɪk] – kyselý, kyselinový

anode [ˈænəʊd] – anoda, kladný pól

cathode [ˈkæθəʊd] - katoda

cellular [ˈseljʊlə] – buněčný, pórovitý

coating [ˈkəʊtɪŋ] – natírání, nanášení barvy

conversion [kənˈvɜːʃən] - přeměna

deposition [ˌdep.əˈzɪʃ.ən] – usazování, nanášení

dissolve [dɪˈzɒlv] - rozpustit

dye [daɪ] - obarvit

electrolyte [ɪˈlektrəʊˌlaɪt] - elektrolyt

electroplate [ɪˈlektrəʊˌpleɪt] – pokovovat

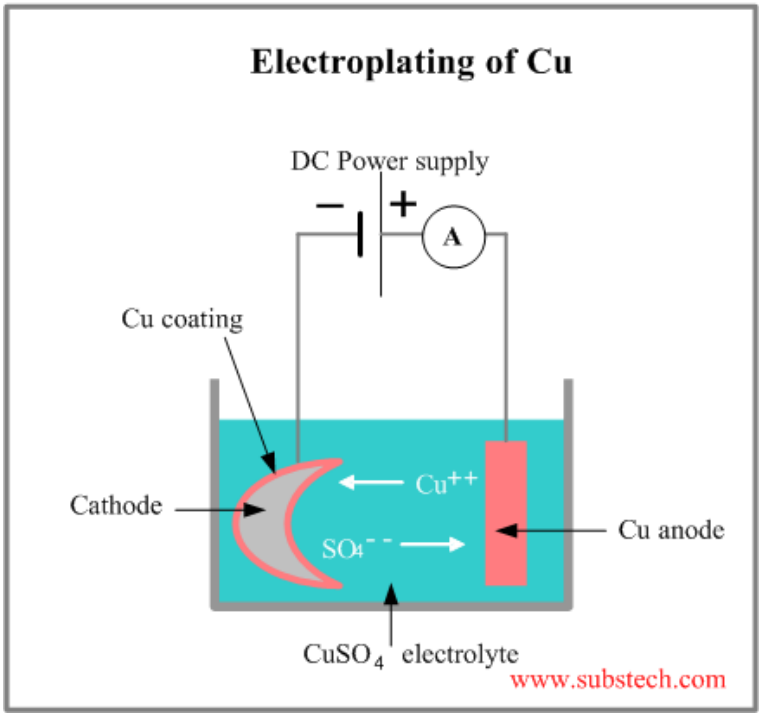
immerse [ɪˈmɜːs] - ponořit

layer [ˈleɪə] - vrstva

solution [səˈluːʃən] – roztok, řešení

power supply [ˈpaʊə səˈplaɪ] – elektr. zdroj

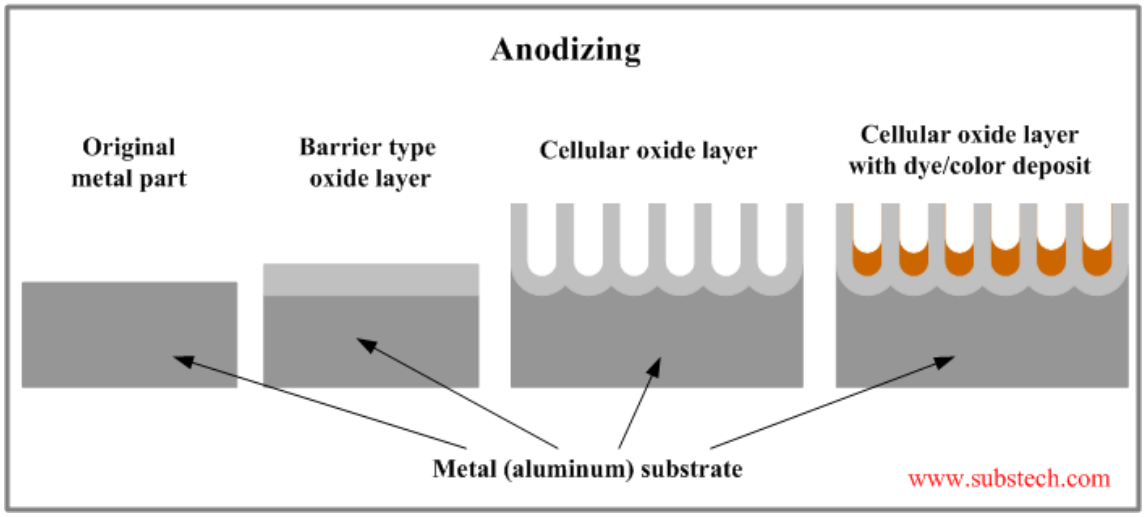
surface [ˈsɜːfɪs] - povrch




Obrázek č. 44[47]

*2. Anodizing*

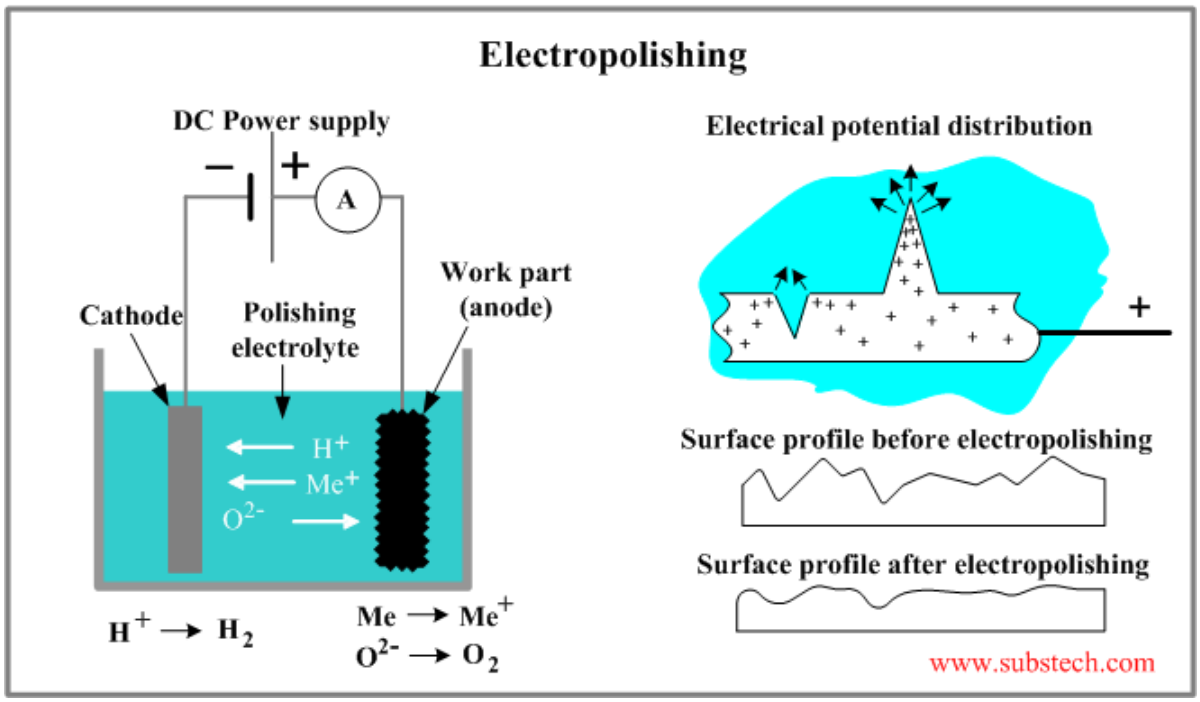
**Anodizing** is an electrochemical process of growing conversion oxide coating as a result of oxidation of an anodically connected metal in an acidic electrolyte solution.




Obrázek č. 45[48]

[47] Obrázek dostupný na: http://www.substech.com/dokuwiki/doku.php?id=electroplating [citováno 20.4.2015]
[48] Obrázek dostupný na: http://www.substech.com/dokuwiki/doku.php?id=anodizing [citováno 20.4.2015]

*3. Electropolishing*




Obrázek č. 46[49]

**Electropolishing** is an electrochemical process in which the atoms of a work piece submerged in an electrolyte convert into ions and are removed from the surface as a result of a passage of an electric current. In electropolishing the metallic work piece dissolves in the electrolyte in contrast to Electroplating where the metallic ions traveling through the electrolyte solution deposit on the work piece surface.

[49] Obrázek dostupný na: http://www.substech.com/dokuwiki/doku.php?id=electropolishing [citováno 20.4.2015]

*4. Electroless plating*

**Electroless plating** uses a redox reaction to deposit metal on an object without the passage of an electric current. Because it allows a constant metal ion concentration to bathe all parts of the object, it deposits metal evenly along edges, inside holes, and over irregularly shaped objects which are difficult to plate evenly with electroplating. Electroless plating is also used to deposit a conductive surface on a nonconductive object to allow it to be electroplated.

bathe [beıð] - omýt

conductive [kənˈdʌktıv] - vodivý

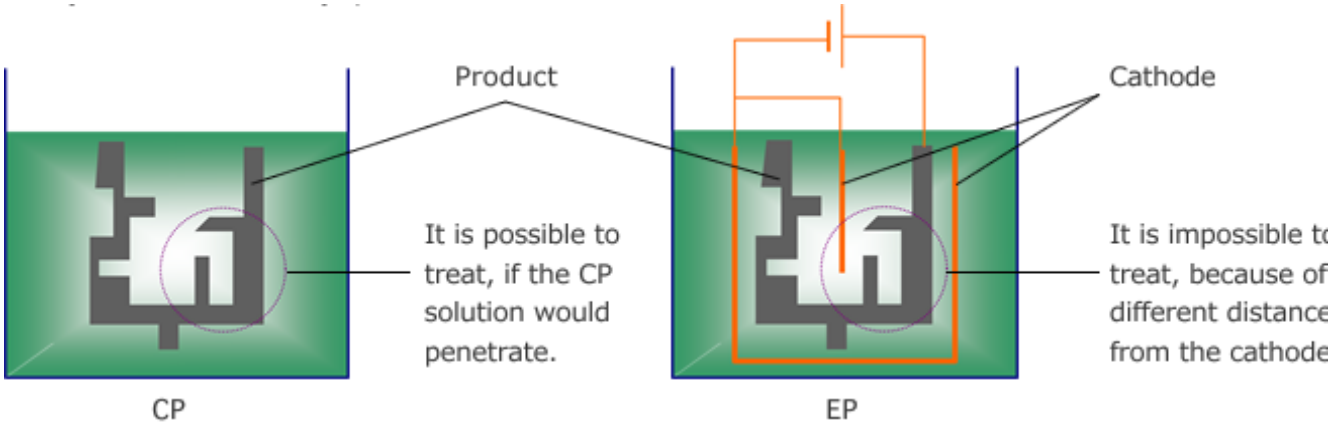
edge [edʒ] – hrana, kraj

evenly [ˈiːvənlı] - rovnoměrně

irregularly [ɪˈregjʊləlı] - nepravidelně

passage [ˈpæsıdʒ] - průchod

*5. Chemical polishing*




Obrázek č. 47[50]

**Chemical Polishing** (CP) treatment is possible to remove the pollutions which cannot remove by only Super Micro Cleaning (SMC), moreover the smooth surface is provided and reduce "real" surface area. Finally CP treatment forms a uniform oxidized layer on the surface which prevent outgassing from inside of materials. Because needless of the cathode unlike Electropolishing (EP), CP is very suitable for treatment of complex shape products.

[50] Obrázek dostupný na: http://www.san-ai-plant.co.jp/en/chemical_polishing/ [citováno 20.4.2015]

smooth [smuːð] - hladký

pollution [pəˈluːʃən] - znečištění

treatment [ˈtriːtmənt] – ošetření, zpracování

prevent [prɪˈvent] – předcházet, zabraňovat

polishing [ˈpɒlɪʃɪŋ] - leštění

outgassing [ɑʊtˈgæs] – vypuštění plynu

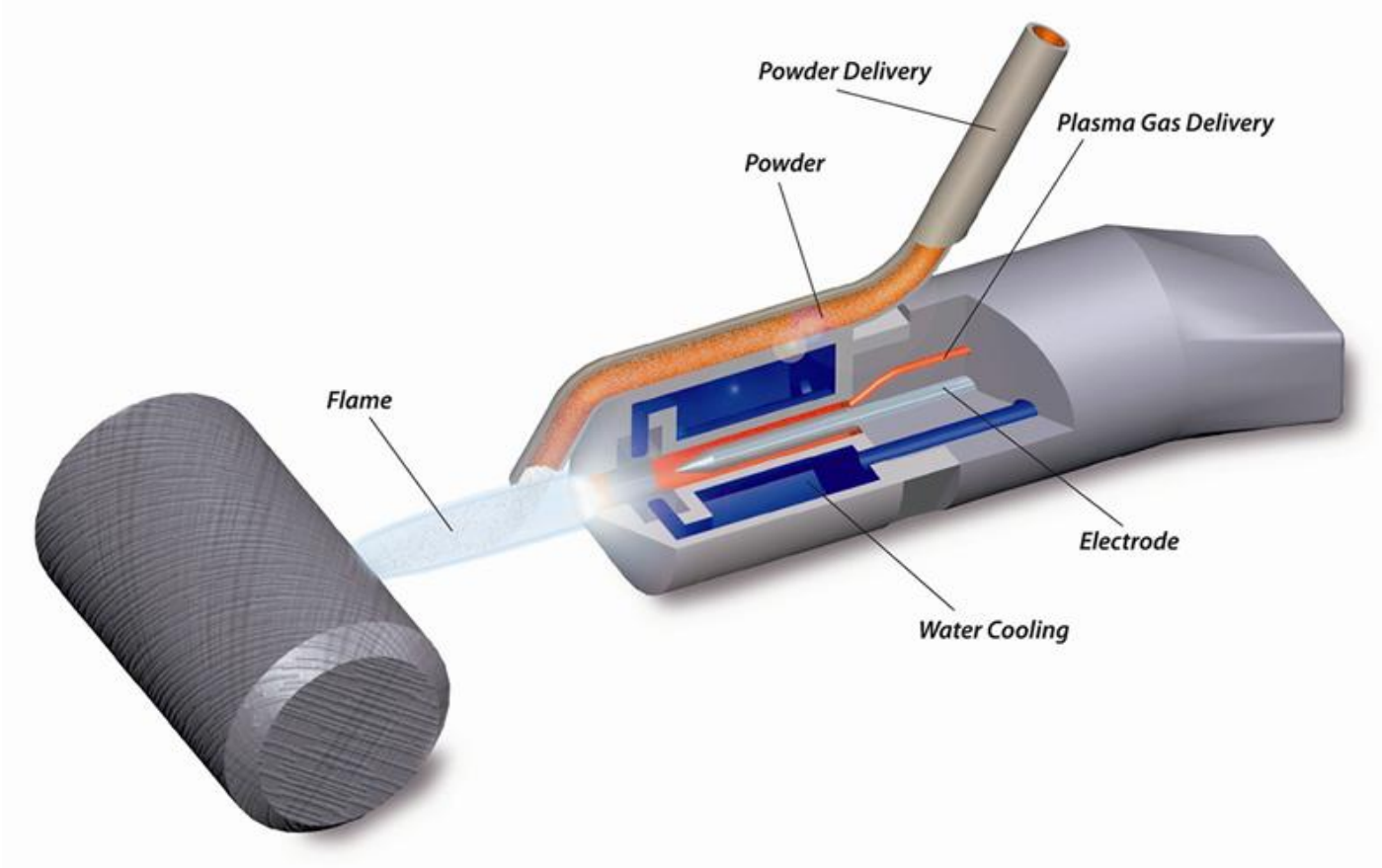
needless [ˈniːdlɪs] - zbytečný

suitable [ˈsuː.tə.bl̩] - vhodný

*6. Thermal spraying*

The gas fuel and oxygen are mixed and ignited to produce a flame. The material, either a wire or powder is fed into the flame. For wire flame spray, the material is melted and the compressed air, passing through a spray nozzle atomises the molten metal and sprays it onto the work piece.

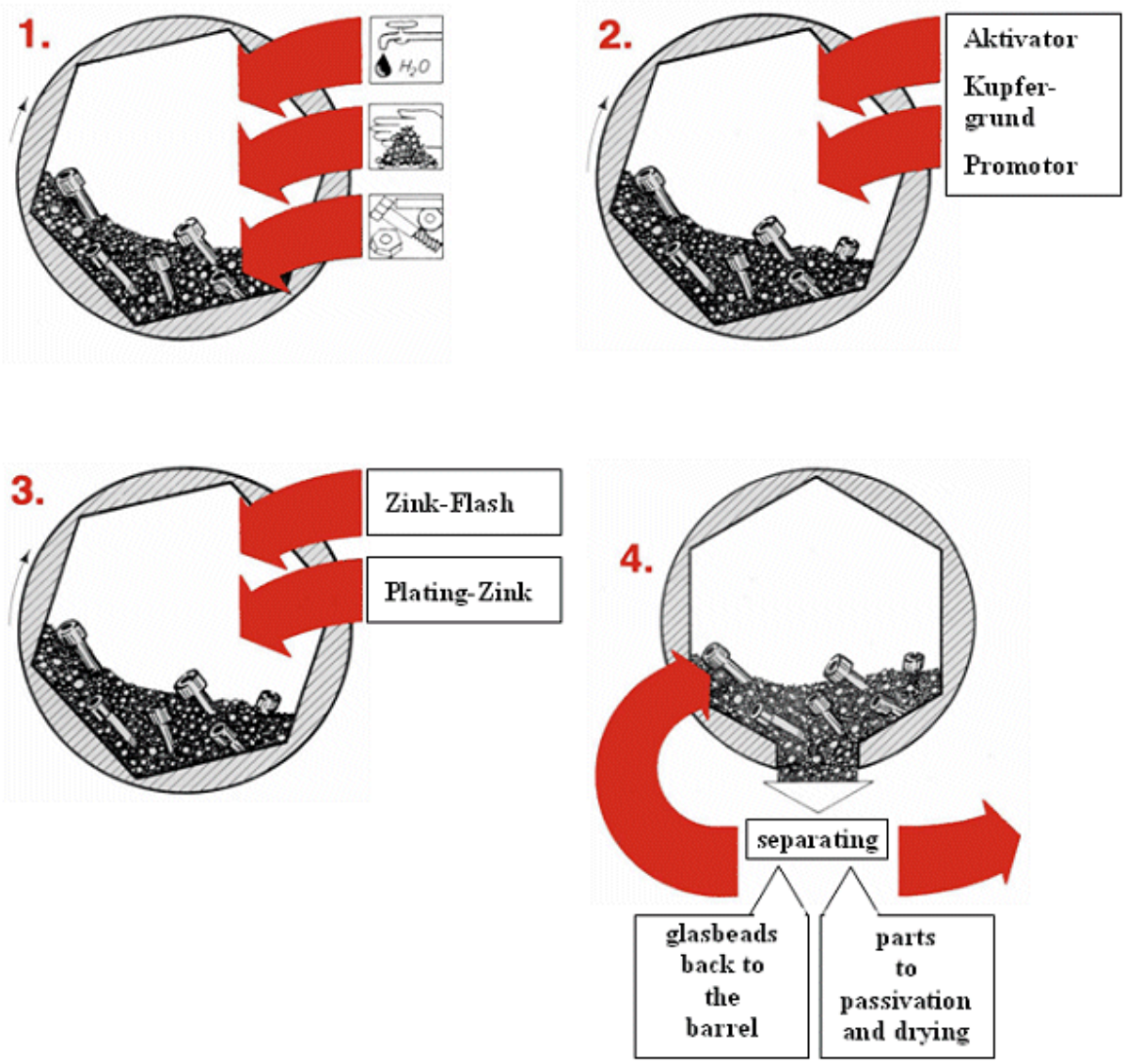
Obrázek č. 48[51]




[51] Obrázek dostupný na: http://www.stellite.com/ [citováno 20.4.2015]

*7. Mechanical plating*

Obrázek č. 49[52]




**Mechanical Plating** is a surface-treatment process for coating parts, iron and steel with a metal layer of zinc, tin as their alloys which protects them against corrosion.

[52] Obrázek dostupný na: http://www.tolkmit-industries.de/e_mechanical_plating.htm [citováno 20.4.2015]

Mechanical Plating extensively prevents the occurrence of hydrogen embrittlement on tempered steel parts.

The metal coating produced by Mechanical Plating is ductile and has a surface with a dull finish. Parts produced in bulk with dimensions of up to app. 150 mm or a weight of 400 gr. can be coated by this process.[53]

barrel [ˈbærəl] – sud, barel

bulk [bʌlk] – objem, náklad

ductile [ˈdʌktaɪl] – tažný, kujný

dull [dʌl] – matný, tmavý

glasbead [glɑːs biːd] – korálek, skl. kulička

occurrence [əˈkʌrəns] – výskyt, příhoda

separating [ˈsep.ər.ət] - oddělit

[53] Dostupné na: http://www.tolkmit-industries.de/e_mechanical_plating.htm [citováno 20.4.2015]

*8. Vapor deposition*

**Physical vapor deposition** (PVD) methods are clean, dry vacuum deposition methods in which the coating is deposited over the entire object simultaneously, rather than in localized areas. All reactive PVD hard coating processes combine:

A method for depositing the metal

Combination with an active gas, such as nitrogen, oxygen, or methane

Plasma bombardment of the substrate to ensure a dense, hard coating.

**Chemical Vapor Deposition** (CVD) is a widely used method for depositing thin films of a large variety of materials. Applications of CVD range from the fabrication of microelectronic devices to the deposition of protective coatings. In a typical CVD process, reactant gases (often diluted in a carrier gas) at room temperature enter the reaction chamber. The gas mixture is heated as it approaches the deposition surface, heated radiatively or placed upon a heated substrate. Depending on the process and operating conditions, the reactant gases may undergo homogeneous chemical reactions in the vapor phase before striking the surface. There is a great variety of chemical vapor deposition processes such as:

atmospheric pressure chemical vapor deposition (APCVD),low pressure chemical vapor deposition (LPCVD), plasma assisted (enhanced) chemical vapor deposition (PACVD, PECVD),

PECVD Process - Institute for Semiconductor Electronics, photochemical vapor deposition (PCVD), laser chemical vapor deposition (LCVD), metal-organic chemical vapor deposition (MOCVD), chemical beam epitaxy (CBE), chemical vapor infiltration (CVI)

bombardment [bɒmˈbɑːdmənt] – bombardování, ostřelování

chamber [ˈtʃeɪmbə] – komora, dutina

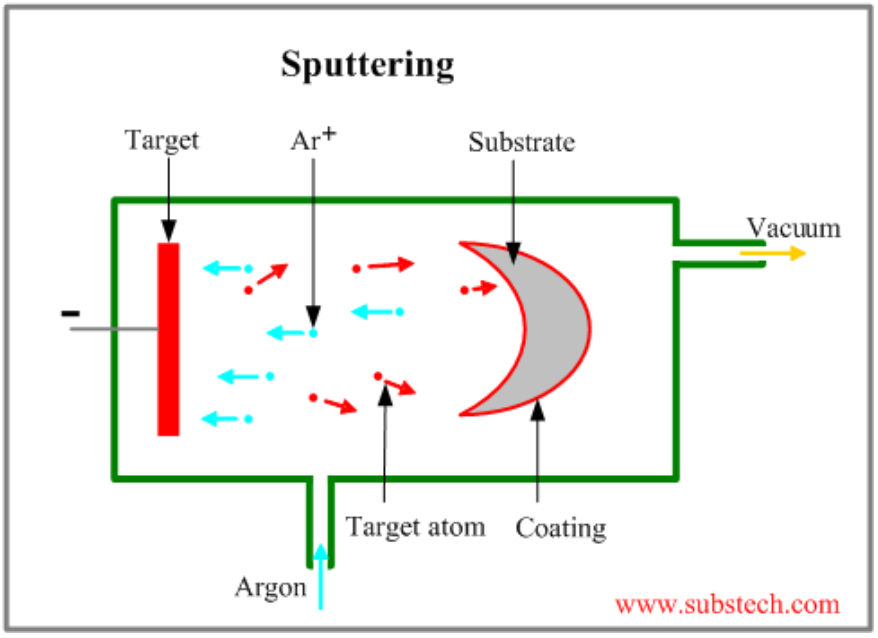
dense [dens] - hustý

strike [straɪk] – udeřit, narazit

vapor [ˈveɪpə] – pára

*9. Sputtering*

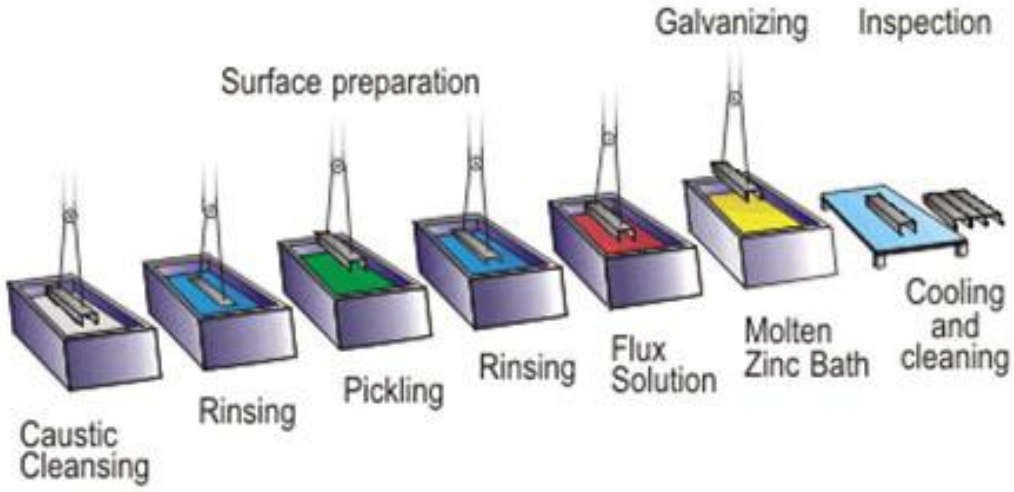
**Sputtering** is a Physical Vapor Deposition method, utilizing argon ions for bombarding a cathodically connected target, made of the coating material. Atoms of the target are knocked out by the high energy ions and deposit on the substrate surface.




Obrázek č. 50[54]

*10. Hot dipping*

**Hot-dip galvanization** is a form of galvanization. It is the process of coating iron, steel or aluminium with a layer of zinc by immersing the metal in a bath of molten zinc at a temperature of around 860 °F (460 °C).




Obrázek č. 51[55]

[54] Obrázek dostupný na: http://www.substech.com/dokuwiki/doku.php?id=sputtering [citováno 20.4.2015]

[55] Obrázek dostupný na: http://www.china-anbermachine.com/Wire-Galvanizing-Line/Hot-Dipped-Wire-Galvanizing-Line.htm [citováno 20.4.2015]

apply [əˈplaɪ] – nanášet, aplikovat

caustic [ˈkɔːstɪk] – žíravý, leptavý

cleansing [klenzɪŋ] - očištění

galvanizie [ˈgælvəˌnaɪz] – galvanizovat, pokovit

molten [ˈməʊltən] – tavený

paint [peɪnt] - nátěr

pickling [ˈpɪk.ḷɪŋ] - naložení

rinse [rɪns] - opláchnout

utilize [ˈjuːtɪˌlaɪz] - použít

# Activity in mechanical engineering

**Job profiles at a company:**

Design engineer

Design engineers research and develop ideas for new products and the systems used to make them. They also work to improve the performance and efficiency of existing products. In this job you will need to be able to use computer-aided design software. You will need to be able to combine engineering and design principles.

Blacksmith

Blacksmiths shape and join metals such as steel, iron, copper and bronze to make decorative and everyday items. These can include wrought iron gates, railings, furniture, tools and horseshoes. To do this job, you will need to have good hand-to-eye coordination and practical skills.

Cad technician

Computer aided design (CAD) technicians use software to create design plans for buildings and machinery. You could work in a wide range of industries, such as engineering, construction and manufacturing. To be a CAD technician, you will need to have good maths and IT skills. You will need to understand how things are made and built. You must also be a creative person.

CNC machinist

Skilled engineering craft workers create precision parts used in manufacturing and engineering. They use computer numerically controlled (CNC) machine tools to cut, drill and finish components. To do this job well you will need basic computer skills, an understanding of engineering instructions and the ability to work to a high level of accuracy.

Electrician

As an electrician you would fit and repair electrical circuits and wiring. This would be in people's homes or businesses. To qualify as an electrician you will need to have industry-recognised training and qualifications. As an electrician you will need to be organised and pay close attention to detail. You will also need a full understanding of safety rules and regulations.

Electrical engineer

Electrical engineers design, build and maintain electrical control systems, machinery and equipment. In this job you will need to be good at solving problems, structuring your workload and enjoy working as part of a team.

Mechanical engineer

Mechanical engineers develop and design components and machinery used in many industries like manufacturing, construction, water, power, health and transport. They also manage teams of technicians and craftspeople who carry out installation and maintenance work.

Production manager (manufacturing)

Production managers oversee the manufacturing process and make sure that production lines are running smoothly and efficiently. They work closely with supervisors and maintenance staff to plan work, set targets and make sure the finished products meet quality standards.

Purchasing manager

As a purchasing or procurement manager, you would be responsible for buying the best quality equipment, goods and services for your company at the most competitive rates. You will need a well organised approach to work, the ability to analyse data and have good business sense. There are different ways into this job, including starting out as an assistant and working your way up, getting a relevant higher education qualification, or going through a management training scheme.

Sheet metal worker

Sheet metal workers make products and components for the engineering, construction and manufacturing industries. They cut metal sheets to precise designs with equipment like laser cutters and join them together using methods like welding and riveting.

Quality control technician

As a quality control technician your job would be to check that your company's products meet national and international quality standards. You might also help to set up and manage quality control systems for businesses.

Welder

Welders cut, shape and join sections of metal plate and pipes in a wide range of industries. These include construction and engineering, transport, aerospace, and offshore oil and gas. They also carry out repairs on manufacturing equipment and machinery.[56]

[56] Dostupné na: https://nationalcareersservice.direct.gov.uk/Pages/Home.aspx [citováno 20.4.2015]

attention [əˈtenʃən] – pozornost, péče

blacksmith [ˈblækˌsmɪθ] – kovář

carry out [ˈkærɪ aʊt] – provést, vykonat

computer-aided [kəmˈpjuːtə eɪdɪd] - prováděný za pomoci počítače

develop [dɪˈveləp] – vyvíjet, objevovat

developer [dɪˈveləpə] – vývojář

director [daɪˈrek.tər] – ředitel, člen správní rady

furniture [ˈfɜːnɪtʃə] – nábytek, vybavení

gate [geɪt] – brána

horseshoe [ˈhɔːsˌʃuː] – koňská podkova

item [ˈaɪ.təm] – položka, věc

machinist [məˈʃiːnɪst] – mechanik, strojník

maintain [meɪnˈteɪn] – udržovat

oversee [ˌəʊvəˈsiː] – dohlížet, kontrolovat

pipe [paɪp] – trubka

railings [ˈreɪlɪŋ] – zábradlí, tyč

regulation [ˌregjʊˈleɪʃən] – předpisy, regulace

riveting [ˈrɪvətɪŋ] - nýtování

rule [ruːl] – pravidlo, směrnice

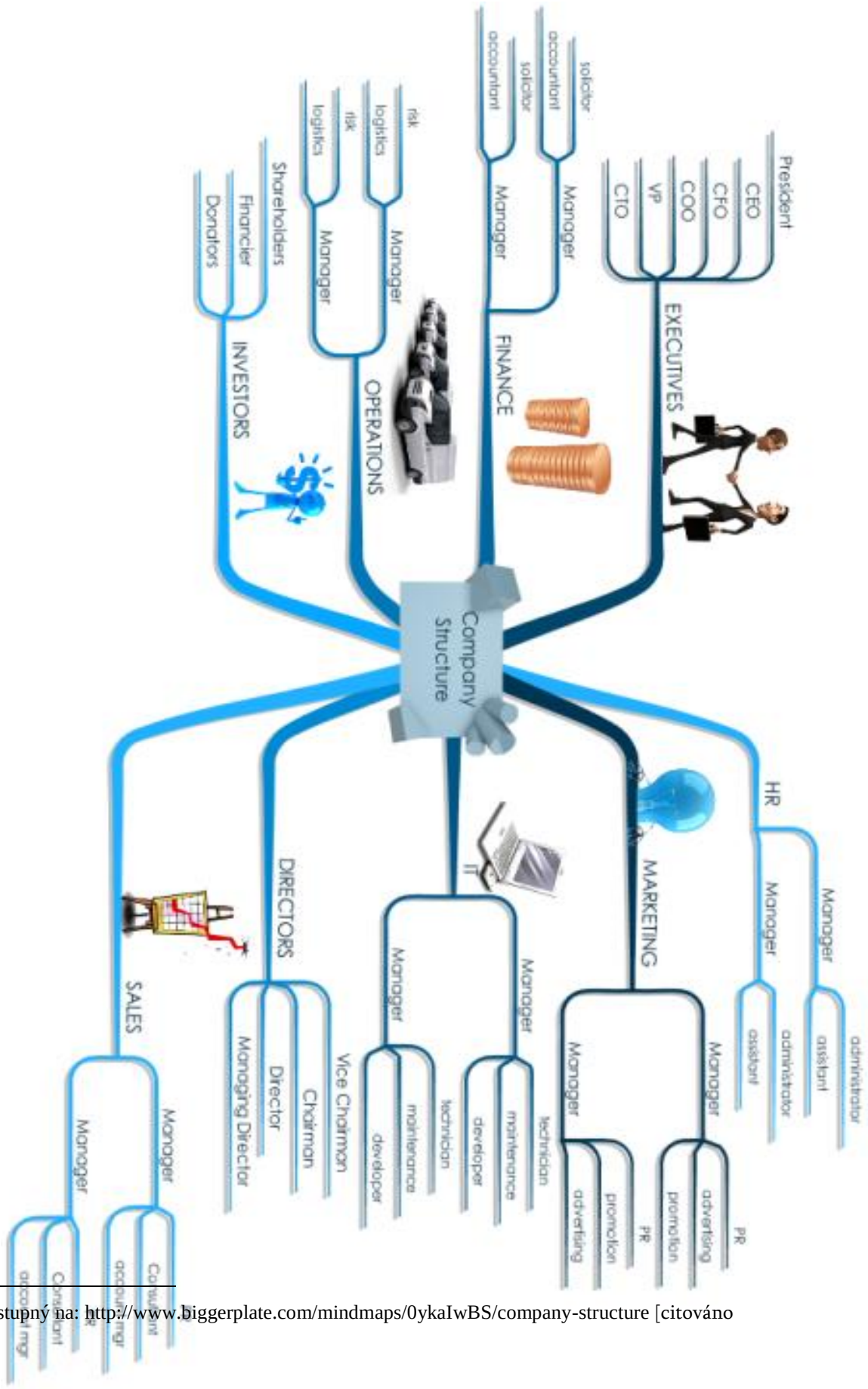
sale [seɪl] – prodej , wrought [rɔːt] – kovaný

skill [skɪl] – dovednost

technician [tekˈnɪʃən] – technik

workload [ˈwɜːkˌləʊd] – pracovní zatížení

**Company structure –** obrázek č. 52[57]




[57] Obrázek dostupný na: http://www.biggerplate.com/mindmaps/0ykaIwBS/company-structure [citováno 20.4.2015]

accountant [əˈkaʊntənt] - účetní

account [əˈkaʊnt] – účet, konto

administrator [ədˈmɪnɪˌstreɪtə] – administrativní pracovník, správce

advertising [ˈædvəˌtaɪzɪŋ] - reklama

assistant [əˈsɪstənt] – asistent, pomocník

donator [dəʊˈneɪtə] - dárce

executive [ɪgˈzekjʊtɪv] – vedoucí pracovník, výkonná rada

financier [fɪˈnæn.si.ər] - finančník

HR – human resources [ˈhjuːmən rɪˈzɔːs] – lidské zdroje

logistics [lɒˈdʒɪstɪks] - logistika

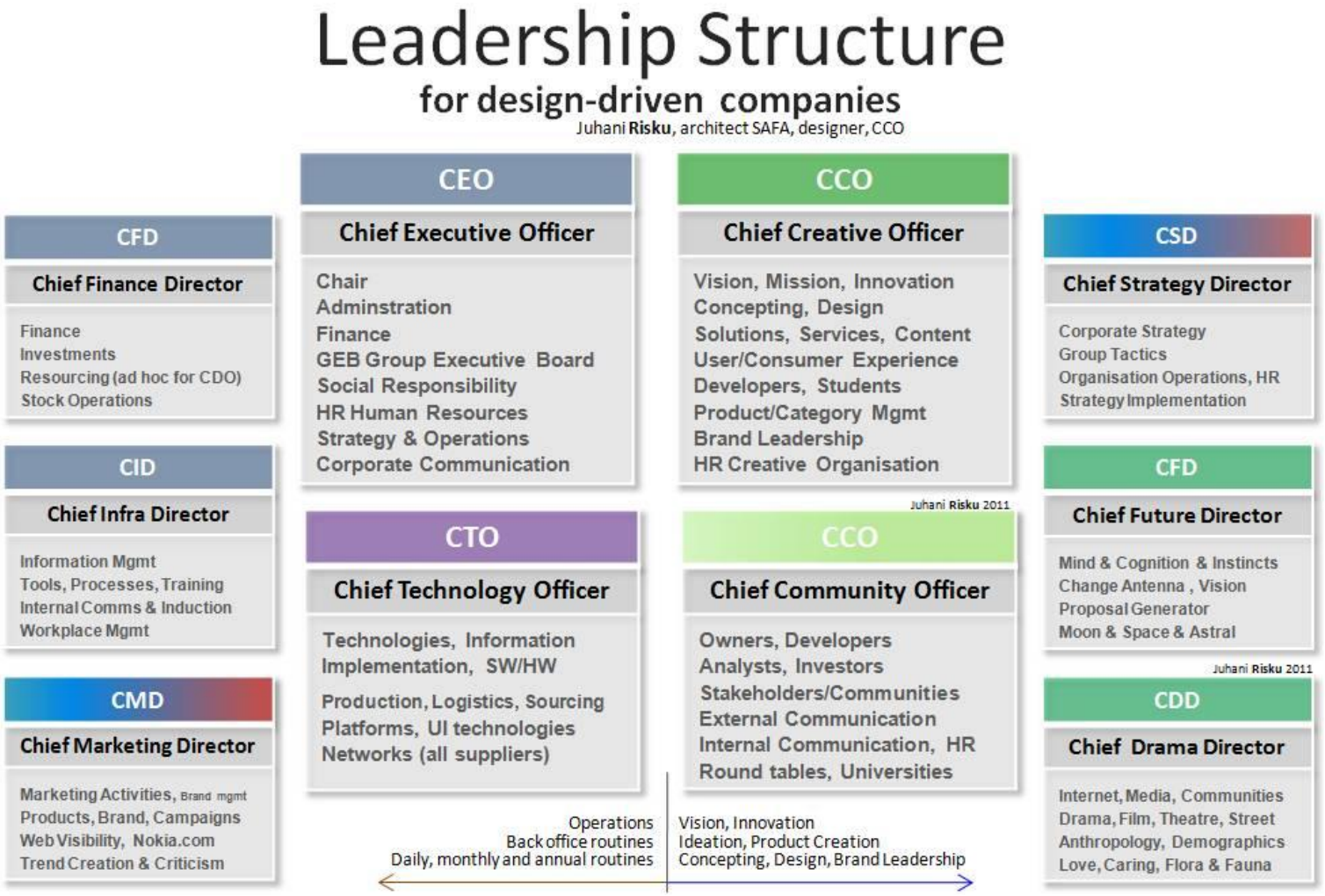
manager [ˈmænɪdʒə] – ředitel, manažer, vedoucí pracovník

PR – public relations [ˈpʌblɪk rɪˈleɪʃən ] – práce s veřejností

promotion [prəˈməʊʃən] - propagace

shareholder [ˈʃeəˌhəʊldə] - akcionář

solicitor [səˈlɪsɪtə] – právní zástupce




Obrázek č. 53[58]

annual [ˈænjʊəl] - roční

brand [brænd] – značka (obchodní)

cognition [kɒgˈnɪʃən] - poznání

content [ˈkɒntent] - obsah

corporate [ˈkɔː.pər.ət] - podnikový

creative [kriːˈeɪtɪv] - tvořivý

innovation [ˌɪnəˈveɪʃən] – novinka, inovace

network [ˈnetˌwɜːk] – síť (silnice, spoje)

[58] Obrázek dostupný na: https://interestmachine.wordpress.com/interest-machine/concepts-and-patents/ [citováno 20.4.2015]

owner [ˈəʊnə] - vlastník

platform [ˈplætfɔːm] – program, stupínek, nástupiště

proposal [prəˈpəʊzəl] - návrh

responsibility [rɪˌspɒnsəˈbɪlɪtɪ] - zodpovědnost

sourcing [sɔːsɪŋ] – zajišťování zdrojů

stock [stɒk] – akcie, cenné papíry

stakeholder [ˈsteɪkˌhəʊldə] – zainteresovaná osoba (subjekt)

supplier [səˈplaɪə] - dodavatel

UI technology - user interface [ˈjuːzə ˈɪn.tə.feɪs] – uživatelské rozhraní

workplace [ˈwɜːkˌpleɪs] - pracoviště

# Assembly

## The evolution of assembly lines: A brief history

The assembly line has long been considered one of the greatest innovations of the 20th century. It has shaped the industrial world so strongly that businesses that did not adopt the practice soon became extinct, and it was one of the key factors that helped integrate the automobile into American society.

### The Early Assembly Line Concept

Prior to the Industrial Revolution, manufactured goods were usually made by hand with individual workers taking expertise in one portion of a product. Each expert would create his own part of the item with simple tools. After each component was crafted they would be brought together to complete the final product.

As early as the 12th century, workers in the Venetian Arsenal produced ships by moving them down a canal where they were fitted with new parts at each stop. During its most successful time, the Venetian Arsenal could complete one ship each day.

### Eli Whitney and Interchangeable Parts

With the start of the Industrial Revolution, machines began to perform work that once required human hands. With the use of machines, factories sprang up to replace small craft shops. This change was made possible by the concept of interchangeable parts, an innovation designed by Eli Whitney.

The concept of interchangeable parts first took ground in the firearms industry when French gunsmith Honoré LeBlanc promoted the idea of using standardized

gun parts. Before this, firearms were made individually by hand, thus each weapon was unique and could not be easily fixed if broken.

It wasn't until Eli Whitney introduced the idea in the United States that the practice took off. He was able to use a large unskilled work force and standardized equipment to produce large numbers of identical gun parts at a low cost, within a short amount of time. It also made repair and parts replacement more suitable.

**Henry Ford**

Henry Ford improved upon the assembly line concept by using the moving platforms of a conveyor system. In this system the chassis of the vehicle was towed by a rope that moved it from station to station in order to allow workers to assemble each part.

Using this method, the Model T could be produced every ninety minutes, or totaling nearly two million units in one of their best years. Often credited as the father of the assembly line, he would be more appropriately referred to as the father of automotive mass production.

**Mass Production and the Robotic Age**

Throughout the 1950s and 1960s, engineers around the world experimented with robotics as a means of industrial development. General Motors installed its own robotic arm to assist in the assembly line in 1961. In 1969, Stanford engineer Victor Scheinman created the Stanford Arm, a 6-axis robot that could move and assemble parts in a continuous repeated pattern. This invention expanded robot use in ways that continue to be applied in modern assembly. At Philips Electronics factory in the Netherlands, production is completed by a number of robot arms assigned to specific tasks.[59]

adopt [əˈdɒpt] – přizpůsobit se

[59] Dostupné na: http://robohub.org/the-evolution-of-assembly-lines-a-brief-history/ [citováno 20.4.2015]

assembly [əˈsemblɪ] - montáž

assigned [əˈsaɪn] – zadat, přidělit

craft [krɑːft] – řemeslo, dovednost

complete [kəmˈpliːt] – dokončit, úplný

disassembly [ˌdɪsəˈsembəlɪ] - demontáž

extinct [ɪkˈstɪŋkt] - vymřelý

firearms [ˈfaɪərˌɑːm] – střelná zbraň

fit [fɪt] – pasovat, umístnit, vhodný

identical [aɪˈdentɪkəl] - shodný

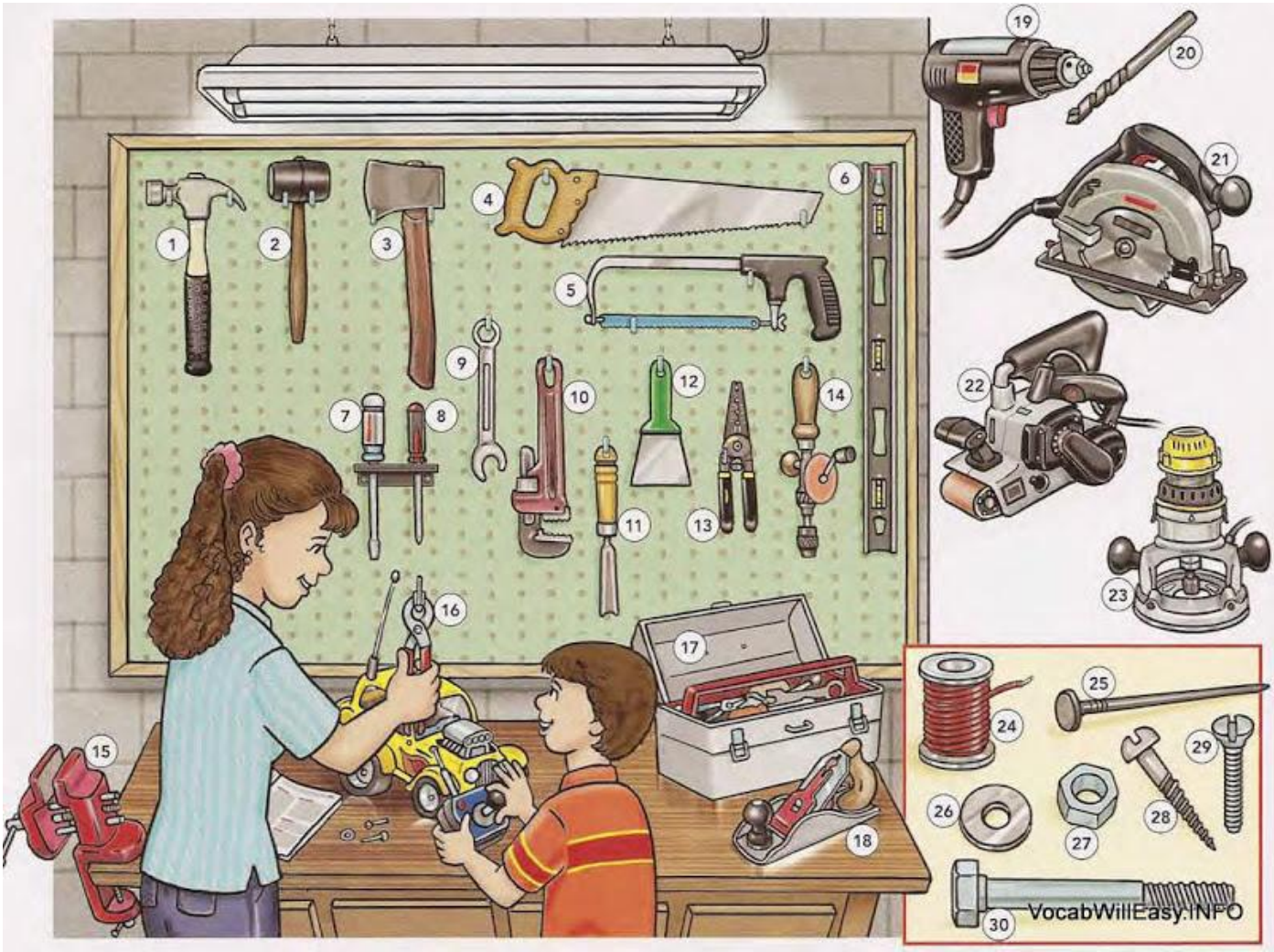
industrial [ɪnˈdʌstrɪəl] - průmyslový

innovation [ˌɪnəˈveɪʃən] - inovace

manufactured [ˌmænjʊˈfæktʃə] – vyrábět, průmyslová výroba

replace [rɪˈpleɪs] - nahradit

unskilled [ʌnˈskɪld] - nekvalifikovaný




TOOLS

Obrázek č. 54[60]

1 hammer [ˈhæmə] - kladivo, 2 mallet [ˈmælɪt] - palice, 3 axe [æks] – sekera, 4 saw [sɔː] - pila , 5 hacksaw [ˈhækˌsɔː] – pilka na železo, 6 level [ˈlevəl] – vodováha, 7 screwdriver [ˈskruːˌdraɪvə] - šroubovák, 8 Phillips screwdriver [ˈskruːˌdraɪvə] – křížový šroubovák , 9 wrench [rentʃ] – klíč, 10 monkey wrench [ˈmʌŋkɪ rentʃ ] – francouzský klíč , 11 chisel [ˈtʃɪzəl] – dláto, 12 scraper [ˈskreɪpə] - škrabka, 13 wire stripper [waɪə strɪpə] – kleště na dráty, 14 hand drill [hænd drɪl] – ruční vrtačka, 15 vise [vaɪs] – svěrák, , 16 pliers [ˈplaɪəz] - kleště, 17 toolbox [tuːl bɒks] – bedna na nářadí, , 18 plane [pleɪn] – hoblík, 19 electric drill [ɪˈlektrɪk drɪl] – el. vrtačka, 20 (drill) bit [bɪt] - vrták, 21 circular/ power saw [ˈsɜːkjʊlə/ ˈpaʊə sɔː] – kotoučová pila, 22 power sander [paʊə sændə] – bruska na brus. papír , 23 router [ˈruːtə] – spec. pila, 24 wire [waɪə] – drát, 25 nail [neɪl] - hřebík, 26 washer [ˈwɒʃə] - podložka, 27 nut [nʌt] – matka, 28 wood screw [wʊd skruː] – vrut do dřeva, 29 machine screw [məˈʃiːn skruː] - šroub, 30 bolt [bəʊlt] - šroub

[60] Obrázek dostupný na: http://kidspicturedictionary.com/english-through-pictures/things-english-through-pictures/workshop/ [citováno 20.4.2015]

## Automobile Assembly Process

### The Parts

Individual parts of the car are constructed in various plants around the country. The parts are shipped to the construction plant via trains or trucks, and it is here that the car is actually assembled.

### Start With the Frame

Cars are constructed from the ground up. The car's frame is secured to the assembly line, and from here, the car will be pieced together.

### Installing the Parts

The frame moves down the line, and installation of parts begins. The suspension, gas tank, axles, drive shafts, wheel drums, steering boxes, gear boxes and breaking systems are all installed at this phase.

### Engine and Transmission Installed

The engine and transmission are paired together and hoisted into place in the car. This is usually done by robots, as the parts can be extremely heavy. The parts are bolted into place by workers.

### Building the Shell

The shell of the car is built next. The floor pan is laid down, and the quarter panels are attached. The front and rear door pillars are attached. Robots are also generally used in this phase.

## Final Body Components

The final body components are installed, including, doors, hood, fenders, trunk lid and bumpers.

## Inspection and Washing

The body of the car is brought into an inspection area, where it is checked for any dents or damages. Once it is approved, the entire body is washed thoroughly to remove residual oils.

## Paint

Calibrated robots apply the paint job, and the car is then put into a baking area where the paint dries into the typical sheen.

## The Inner Workings

Workers take the car's shell and install all of the electrical wiring, lights, seats, door trim, brake pedals, gas pedals, carpeting and all the glass, except for the windshield.

## The Shell and the Frame

Robots suction cup onto the windshield and put it in place on the car. The shell of the car is then mounted on top of the car frame. Once properly connected, the car receives its battery, tires, anti-freeze and gasoline.

**Test the Car**

The vehicle is started and driven to a test area to make sure it meets the proper quality standards of the manufacturer. [61]

axle [ˈæksəl] – náprava

bumper [ˈbʌmpə] - nárazník

fender [ˈfendə] – blatník

gas tank [gæs tæŋk] - nádrž

gasoline [ˈgæsəˌliːn] - benzín

gear boxe [gɪə bɒks] – převodovka

hood [hʊd] – kapota

piece [piːs] - složit

pillar [ˈpɪlə] - sloupek

plant [plɑːnt] – továrna

suspension [səˈspenʃən] – zavěšení kola

tire [ˈtaɪə] - pneumatika

transmission [trænzˈmɪʃən] - převodovka

trunk lid [trʌŋk lɪd] - kufr

windshield [ˈwɪndˌʃiːld] – čelní sklo

[61] Dostupné na: http://www.ehow.com/how-does_4928886_automobile-assembly-process.html [citováno 20.4.2015]

# Materials

## The characteristics of ferrous metals

Ferrous metals include mild steel, carbon steel, stainless steel, cast iron, and wrought iron. These metals are primarily used for their tensile strength and durability, especially mild steel which helps hold up the tallest skyscrapers and the longest bridges in the world. You can also find ferrous metals in housing construction, industrial containers, large-scale piping, automobiles, rails for railroad and transportation, most of tools and hardware you use around the house, and the knives you cook with at home.

Due to the high amounts of carbon used when creating them, most ferrous metals and alloys are vulnerable to rust when exposed to the elements. While this isn't true of wrought iron, which is so iron pure that it resists oxidization, or stainless steel, which is protected thanks to its high chromium content, it's a good rule of thumb that if you see rust, it's a ferrous metal.

Most ferrous metals also have magnetic properties, which makes them very useful in the creation of large motors and electrical appliances. The reason you can tack your child's artwork to the refrigerator with that magnet with the local pizza place's phone number on it? Ferrous metal.

Most importantly, ferrous metals make up the most recycled materials in the world. In 2008 alone, 1.3 billion tons of steel were produced, and 500 million tons of that was made from scrap materials. But we'll get to why that's important a little later.

## The characteristics of non-ferrous metals

Non-ferrous metals include aluminum, brass, copper, nickel, tin, lead, and zinc, as well as precious metals like gold and silver. While non-ferrous metals can provide strength, they are primarily used where their differences from ferrous metals can provide an advantage.

For instance, non-ferrous metals are much more malleable than ferrous metals. Non-ferrous metals are also much lighter, making them well-suited for use where strength is needed, but weight is a factor, such as in the aircraft or canning industries. Because they contain no iron, non-ferrous metals have a higher resistance to rust and corrosion, which is why you'll find these materials in use for gutters, water pipes, roofing, and road signs. Finally, they are also non-magnetic, which makes them perfect for use in small electronics and as electrical wiring.

As far as recycling goes, aluminum is the third most recycled material in the world. However, many other non-ferrous materials like copper, brass and lead are relatively scarce, and metallurgists rely heavily on scrap material recycling to make new ones. [62]

aluminum [ˌæljʊˈmɪnɪəm] - hliník

brass [brɑːs] - mosaz

canning [ˈkænɪŋ] - konzervování

copper [ˈkɒpə] - měď

corrosion [kəˈrəʊʒən] - koroze

ferrous [ˈferəs] – obsahující železo

gold [gəʊld] - zlato

gutter [ˈgʌtə] – okap, koryto

hold up [həʊld ʌp] – zvednout, obstát

lead [liːd] - olovo

make up [meɪk ʌp] - vytvořit

[62] Dostupné na: http://www.altonmaterials.com/the-differences-between-ferrous-and-non-ferrous-scrap-metal/ [citováno 20.4.2015]

malleable [ˈmælɪəbəl] – tvárný, poddajný

nickel [ˈnɪkəl] - nikl

non-ferrous [nɒnˈferəs] – neobsahující železo

pipe [paɪp] - trubka

rely [rɪˈlaɪ] – spoléhat, být závislý

resistance [rɪˈzɪstəns] – odpor, odolnost

roofing [ˈruːfɪŋ] – střešní krytina

rust [rʌst] – rez, koroze

sign [saɪn] - značka

silver [ˈsɪlvə] - stříbro

scarce [skeəs] - vzácný

scrap [skræp] – šrot, zbytek

stainless steel [ˈsteɪnlɪs stiːl] - nerez

tin [tɪn] – cín, plechovka

vulnerable [ˈvʌlnərəbəl] – náchylný, zranitelný

wiring [ˈwaɪərɪŋ] - elektroinstalace

wrought iron [rɔːt aɪən] – kujné železo

zinc [zɪŋk] - zinek

mild steel

Mild steel is the least expensive of all steel and the most common steel used. Used in nearly every type of product created from steel, it is weldable, very hard and, although it easily rusts, very durable. Containing a maximum of 0.29% carbon, this type of steel is able to be magnetized and used in almost any project that requires a vast amount of metal. Its structural strength prevents it from being used to create load-bearing girders and structural beams.

Many of the everyday objects that are created of steel are made using mild steel, including automobile chassis, motorcycle frames, and most cookware. Due to its poor corrosion-resistance, it must be painted or otherwise protected and sealed in order to prevent rust from damaging it. A light coat of oil or grease is able to seal this steel and aid in rust control.[63]

carbon steel

It is important to clarify the meaning of carbon steel in the generic sense and in the more narrow context used in this report. The term steel is usually taken to mean an iron-based alloy containing carbon in amounts less than about 2%. Carbon steels (sometimes also termed plain carbon steels, ordinary steels, or straight carbon steels) can be defined as steels that contain only residual amounts of elements other than carbon, except those (such as silicon and aluminum) added for deoxidation and those (such as manganese and cerium) added to counteract certain deleterious effects of residual sulfur.

[63] Dostupné na: http://www.wisegeek.org/what-is-mild-steel.htm [citováno 20.4.2015]

## stainless steel

The material we know as stainless steel (also commonly referred to as "Inox" or "Rostfrei") is such a common feature of 21st century living that there can be few of us who have not seen or handled articles made from it. Like all types of steel, stainless steel is not a single metal but an alloy that is a material made from two or more separate elements alloyed or "melted" together. What all steels have in common is that their major "ingredient" (alloying element) is the metal iron, to which a small amount of carbon has been added. Stainless steel was invented early in the 20th century when it was discovered that a certain amount of the metal chromium (usually a minimum of 11 per cent) added to ordinary steel gave it a bright shiny gloss and made it highly resistant to tarnishing and rusting. This rust-resisting property which we call “corrosion resistance” is what sets stainless steel apart from most other forms of steel.[64]

## cast iron

Cast iron, an alloy of iron that contains 2 to 4 percent carbon, along with varying amounts of silicon and manganese and traces of impurities such as sulfur and phosphorus. It is made by reducing iron ore in a blast furnace. The liquid iron is cast, or poured and hardened, into crude ingots called pigs, and the pigs are subsequently remelted along with scrap and alloying elements in cupola furnaces and recast into molds for producing a variety of products

Most cast iron is either so-called gray iron or white iron, the colours shown by fracture. Gray iron contains more silicon and is less hard and more machinable than is white iron. Both are brittle, but a malleable cast iron produced by a prolonged heat treatment was developed in France in the 18th century, and a cast iron that is ductile as cast was invented in the United States and Britain in 1948. Such ductile irons now constitute a major family of metals that are widely used for gears, dies, automobile crankshafts, and many other machine parts.[65]

[64] Dostupné na: http://www.worldstainless.org/what_is_stainless_steel/introduction_to_stainless_steel [citováno 20.4.2015]

[65] Dostupné na: http://www.britannica.com/technology/cast-iron [citováno 20.4.2015]

wrought iron

Wrought iron is best described as a two-component metal consisting of iron and a glass-like slag. The slags are in effect an impurity, the iron and the slag being in physical association, as contrasted to the chemical alloy relationship that generally exists between the constituents of other metals. Wrought iron is the only ferrous metal that contains siliceous slag and it is to this slag that wrought iron owes the properties, which are of interest to the conservator and the blacksmith.

'Charcoal Iron' - made in a charcoal fire and used from the Iron Age to the end of the eighteenth century.

'Puddled Iron' - made from cast iron in an indirect coal fired furnace and used since the dawn of the modern industrial era.

Historically Wrought Iron has been worked by blacksmiths, using traditional techniques in both forging and construction, to make high end 'Decorative Wrought Ironwork'. Today however, the term Wrought Iron is becoming debased and misinterpreted, as demonstrated by any Internet search, to cover all ornamental ironwork, including cast iron and mild steel as well as incorporating modern construction techniques. The difference in quality and value is enormous. Whereas it would be unthinkable to repair historic stonework with concrete or cast stone and Portland cement, it is common for historic Wrought Iron to be repaired using mild steel and electric welding.[66]

charcoal [ˈtʃɑːˌkəʊl] – dřevěné uhlí

common [ˈkɒmən] – běžný, obecný

cookware [ˈkʊkˌweə] – kuchyňské nádobí

[66] Dostupné na: http://www.realwroughtiron.com/about_wrought_iron-217.html [citováno 20.4.2015]

deleterious [ˌdelɪˈtɪərɪəs] - škodlivý

durable [ˈdjʊərəbəl] – trvanlivý, odolný

girder [ˈgɜːdə] – nosník, traverza

gloss [glɒs] - lesk

grease [gri:s] - mazivo

impurity [ɪmˈpjʊərɪtɪ] – nečistota, příměs

frame [freɪm] – konstrukce, rám

ingredient [ɪnˈgriːdɪənt] – složka, přísada

prolonged [prəˈlɒŋd] - dlouhotrvající

residual [rɪˈzɪdjʊəl] – zbytek, zbytkový

slag [slæg] – struska, škvára

tarnishing [tɑː.nɪʃɪŋ] – ztrácející lesk, matování

wrought [rɔːt] – kovaný, kujný

## aluminum

Aluminum is the most common metal found within the earth's crust (8 percent) but does not occur as a metal in its natural state. Aluminum ore (bauxite) must first be mined then chemically refined through the Bayer process to produce an intermediate product, aluminum oxide (alumina). Alumina is then refined through the Hall–Héroult process into the pure metal by an electrolytic process. Aluminum is 100 percent recyclable without loss of its properties. Aluminum's physical properties make the metal light in weight, strong, noncorrosive, nonsparking, nonmagnetic, nontoxic and noncombustible.

Cool Facts

**Once, more precious than gold and silver**

Before the discovery of the Bayer and Hall–Héroult processes, aluminum was more expensive than gold or silver. Napoleon III served state dinners on aluminum plates.

**Aluminum helped pioneer flight**

The Wright brothers used aluminum to build key parts of their biplane's engine because no manufacturer could provide an engine light enough with the needed horsepower.

**The lifespan of an aluminum can**

A can recycled today can be back in the marketplace in 60 days. Unopened aluminum cans are very strong, despite being so thin. Four six-packs of cans are able to support the weight of a 2-ton vehicle!

**Recycling efforts can be improved**

Every three months, Americans throw away enough scrap aluminum to rebuild the entire U.S. commercial airplane fleet. Recycling that metal would save the energy equivalent of 16 million barrels of oil.[67]

brass

Brass is the generic term for a range of copper-zinc alloys with differing combinations of properties, including strength, machinability, ductility, wear-resistance, hardness, colour, antimicrobial, electrical and thermal conductivity, and corrosion resistance.

[67] Dostupné na: http://www.aluminum.org/aluminum-advantage/student-educational-resources [citováno 20.4.2015]

Brasses set the standard by which the machinability of other materials is judged and are also available in a very wide variety of product forms and sizes to allow minimum machining to finished dimensions. Brass does not become brittle at low temperatures like mild steel.

Brass also has excellent thermal conductivity, making it a first choice for heat exchangers (radiators). Its electrical conductivity ranges from 23 to 44% that of pure copper.[68]

copper

We're in no danger of running out of copper. Worldwide resources of this important and valuable metal are estimated at more than 8.1 trillion pounds of which only about 1.1 trillion (~13.6%) have been mined throughout history. Copper's ability to be recycled, again and again, without any loss in performance, is an important sustainable benefit. Copper's technical and social values, combined with its infinite recyclability, make it one of the important materials

for building a sustainable world. Copper is essential for modern living. It delivers electricity and clean water into our homes and cities and makes an important contribution to sustainable development. More than that, it is essential for life itself.[69]

[68] Dostupné na: http://www.copperalliance.org.uk/copper-and-its-alloys/alloys/brasses [citováno 20.4.2015]

[69] Dostupné na: http://www.copper.org/education/copper-is/pdf/Copper-is-brochure-enus.pdf [citováno 20.4.2015]

## gold

Gold is a very rare substance making up only ~3 parts per billion of the Earth's outer layer. (Imagine 1 billion Smarties in one place and only 3 of them were made of gold!). Its rarity and its physical properties have made it one of the most prized of Earth's natural resources.

Gold, like iron, copper, lead, tin is a metal. Metals are good conductors of heat and electricity and are almost all solid at room temperature (with the exception of mercury). They are malleable and ductile.

Gold is heavy - it weighs over nineteen times more than water, and is almost twice as heavy as lead. If you had enough Gold to fill a one litre milk carton, it would weigh 19.3 kilograms, the same volume of milk weighs only one kilogram.

Gold, like most metals, can be hammered into thin sheets (malleable) or drawn out into thin wires (ductile). This has made gold sought after for a wide range of applications, like jewellery and in electronics. "Gold leaf", for example, is gold that has been beaten into a sheet less than one tenth of a millimetre thick. It is then used for lettering on honour rolls in schools, or for putting gold onto picture frames and ornaments.[70]

## lead

[70] Dostupné na: http://www.australianminesatlas.gov.au/education/down_under/gold/properties.html [citováno 20.4.2015]

Lead is a bluish-white lustrous metal. It is very soft, highly malleable, ductile, and a relatively poor conductor of electricity. It is very resistant to corrosion but tarnishes upon exposure to air. Lead isotopes are the end products of each of the three series of naturally occurring radioactive elements. Lead is a major constituent of the lead-acid battery used extensively in car batteries. It is used as a coloring element in ceramic glazes, as projectiles, in some candles to threat the wick. It is the traditional base metal for organ pipes, and it is used as electrodes in the process of electrolysis. One if its major uses is in the glass of computer and television screens, where it shields the viewer from radiation. Other uses are in sheeting, cables, solders, lead crystal glassware, ammunitions, bearings and as weight in sport equipment.[71]

## nickel

Nickel is the only element named after the devil. The name comes from the German word Kupfernickel, meaning "Old Nick's copper," a term used by German miners. They tried to remove copper from an ore that looked like copper ore, but they were unsuccessful. Instead of copper, they got slag, a useless mass of earthy material. The miners believed the devil ("Old Nick") was playing a trick on them. So they called the fake copper ore Old Nick's copper. Nickel is a silvery-white metal. It has the shiny surface common to most metals and is both ductile and malleable. Ductile means capable of being drawn into thin wires. Malleable means capable of being hammered into thin sheets. Nickel makes up about 0.01 to 0.02 percent of the Earth's crust. It ranks about 22nd among the chemical elements in terms of abundance in the Earth's crust. Nickel is thought to be much more abundant in the Earth's core. In fact, many experts believe that the core consists almost entirely of iron and nickel.[72]

## silver

Silver has many special properties that make it a very useful and precious metal. It has an attractive shiny appearance, although it tarnishes easily. The tarnish is silver sulphide and it forms as the silver reacts with sulphur compounds in the atmosphere. Of all the metals, silver is the best conductor of heat and electricity

[71] Dostupné na: http://www.lenntech.com/periodic/elements/pb.htm [citováno 20.4.2015]
[72] Dostupné na: http://www.chemistryexplained.com/elements/L-P/Nickel.html [citováno 20.4.2015]

known, in fact it has the highest electrical and thermal conductivity known for any material. It is strong, malleable and ductile, and can endure extreme temperature ranges. Silver is also able to reflect light very well.[73]

## tin

Tin is a highly workable metal that was once as valuable as silver for jewelry, coins, and special dishware. Today it is used as sheets in the construction of buildings and roofs, for soldering or joining metal parts, for storage containers, and in alloys like bronze and Babbitt metal. One of tin's most interesting properties is its tendency to give off a strange screeching sound when it is bent. This sound is sometimes known as "tin cry." β-tin is both malleable and ductile. Malleable means capable of being hammered into thin sheets. Ductile means capable of being drawn into a thin wire. At temperatures greater than 200°C, tin becomes very brittle. Tin is relatively unaffected by both water and oxygen at room temperatures. It does not rust, corrode, or react in any other way. This explains one of its major uses: as a coating to protect other metals. At higher temperatures, however, the metal reacts with both water (as steam) and oxygen to form tin oxide.[74]

## zinc

Centuries before zinc was discovered in the metallic form, its ores were used for making brass and zinc compounds and also for healing wounds and sore eyes. It is believed that the Romans first made brass in the time of Augustus (20 B.C. – 14 A.D.). In the 13th century Marco Polo described the manufacture of zinc oxide in Persia. Zinc is a natural component of the earth's crust and an inherent part of our environment. Zinc is present not only in rock and soil, but also in air, water and the biosphere. Plants, animals and humans contain zinc. 80% of zinc mines are underground, 8% are of the open pit type and the remainder is a combination of both. About 12 million tons of zinc are produced annually worldwide. More than half of this amount is used for galvanizing to protect steel

[73] Dostupné na: http://www.australianminesatlas.gov.au/education/down_under/silver/properties.html [citováno 20.4.2015]
[74] Dostupné na: http://www.chemistryexplained.com/elements/T-Z/Tin.html [citováno 20.4.2015]

from corrosion. Approximately 14% goes into the production of zinc base alloys, mainly to supply the die casting industry and 10% to produce brass and bronze. Significant amounts are also utilized in rolled zinc applications including roofing, gutters and down-pipes. The remainder is consumed in compounds such as zinc oxide and zinc sulfate.[75]

annually [ˈænjʊəlɪ] - každoročně

estimated [ˈestɪˌmeɪtɪd] - odhadovaný

generic [dʒɪˈnerɪk] – obecný, typický

lifespan [ˈlaɪfˌspæn] - životnost

ore [ɔː] - ruda

resource [rɪˈzɔːs] - zdroj

sustainable [səˈsteɪnəbəl] – dlouhodobě udržitelný

utilized [ˈjuːtɪˌlaɪz] – použít, uplatnit

wick [wɪk] - knot

[75] Dostupné na: http://www.zinc.org/basics/ [citováno 20.4.2015]