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Technical English
Mechanical Engineering

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Vorwort

„**Technical English – Mechanical Engineering**“ wendet sich an alle Lehrenden und Studierenden des **Fachbereiches Maschinenbau** an den **Universitäten** und **Fachhochschulen**. Es eignet sich sowohl für die Fremdsprachenausbildung im Rahmen der Module Technisches Englisch 1 und Technisches Englisch 2, aber auch zum Selbststudium und für Schulungen in Unternehmen, in denen technisches Fachvokabular vermittelt wird.

Der erste Teil des Buches befasst sich aufbauend auf dem in den allgemeinbildenden Schulen vermittelten Englisch mit den Grundlagen aus dem Bereich Material, Materialeigenschaften und Fertigungsverfahren, während im zweiten Teil aus einer Vielzahl von Themen diejenigen gewählt werden können, die dem jeweiligen Schwerpunkt der Hochschule oder Universität, bzw. dem beruflichen Umfeld entsprechen.

Durch die Vielzahl an Themen aus dem Bereich Maschinenbau ist das Buch auch für den Einsatz an **berufsbildenden Schulen**, in der **Techniker-** und **Meisterausbildung** geeignet.

Fachbezogene Sachtexte schulen das Leseverständnis und mit den Aufgaben im Anschluss kann das neu eingeführte Vokabular angewendet und vertieft werden. Gleichzeitig wird durch die Vielzahl an verschiedenen Aufgaben jeder Lerntyp angesprochen, sodass der Lernerfolg zu einer weiteren Motivation führt.

Die Lösungen, sowie Mustertexte zu den Schreibaufgaben ermöglichen auch ein eigenständiges Nach- und Weiterarbeiten und die Vokabellisten am Ende jedes Moduls und die umfangreichen Gesamtvokabellisten im Anhang (Englisch-Deutsch, Deutsch-Englisch) dienen auch im Alltag als nützliches Nachschlagewerk.

Nach einer Grammatikwiederholung im ersten Teil werden die einzelnen, für den Bereich des technischen Englisch relevanten, Themen in den Modulen wieder aufgegriffen und vertieft.

Das farblich abgehobene Register an der Seite des Buches ermöglicht ein schnelles und problemloses Auffinden der einzelnen Module.

Wir wünschen den Lernenden und Lehrenden viel Freude und Erfolg bei der Aktivierung und Erweiterung ihrer fachlichen Englischkenntnisse mit dem Buch und freuen uns über konstruktive Kritik und Anregungen für weitere Auflagen, um die Qualität unseres Buches weiter zu verbessern.

Autoren und Verlag

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Module 1
Basic Technical Vocabulary

At the beginning of the technical English course it is necessary to introduce some basic vocabulary and grammar. Technical English is different from the English taught at secondary schools. For this reason, the following module provides the basic tools for every student of mechanical engineering to enlarge their knowledge and to work in an international surrounding.

1.1 Tools in the Workshop

The first and important thing to know is what all the tools and machines in the workshop are called. This enables an engineer to give precise instructions to the trained workers about what to do and how. Therefore, the exercises will provide an overview of the content of a toolbox, useful verbs, measurement tools and the most common units that are needed in during daily working processes.

1.2 Measuring

When it comes to measuring work pieces, there are various methods and many tools available for this task. The first differentiation has to be made between gauges and measurement equipment.

The first represent either a measurement or a form that refers to limit dimensions of tolerances. These have to be fulfilled in fits and usually just provide information about whether a fit is within the limit of tolerances or not. This group includes gauging tools, e. g. slip gauges and accidences, straightedge, square and limit gauges, cylindrical plug gauges, gauging rings and calliper gauges.

The latter can be used for acquiring information on the measurements of a work piece and provide information on the length, width and depth of the outer or inner edges of a work piece, hole or slot. The most common instruments in mechanical engineering are vernier callipers or calliper rules which can be used universally in the workshop. They provide information on lengths and are precise to 0.1 mm. If it comes to smaller tolerances, micrometers are usually used. They measure accurately to within 0.001 mm.

1.3 Common Units

For a very long time every country has used its own measurement system and units which led to a lot of problems, as the measurements of a work piece were not comparable to each other. In an internationally operating industry, a standardized measurement system is absolutely essential and for this reason the International System of Units (SI-units) has been developed from the metric system. Engineers in the United Kingdom still often use the imperial system instead of the metric one, which is now the international standard system. Therefore, every engineer should at least have basic knowledge of the units of the imperial system and how the conversion between the two systems works.

1. The Content of a Toolbox

a) Look at the picture with the tools that belong to the basic equipment of a toolbox. Use the words from the box to label the tools.

ring spanner | open-ended spanner | file | chisel | ratchet | sockets | side cutter | screw-driver | Allen keys | pliers | socket wrench | electric drill | metal saw | torque wrench | strap wrench (oil filter wrench) | grip vice pliers | centre punch | combination pliers | hammer | rim wrench | soldering iron | vernier callipers

Picture 1/1: Contents of a toolbox

b) Choose one of the tools and describe it in terms of its material, its appearance and what it is used for. Your text should be between 60 and 80 words long.

....

....

....

....

2. Working in a Workshop

Have a look at the sentences and match the correct verb from the box with its definition and then find an appropriate tool from exercise 1a) for each task.

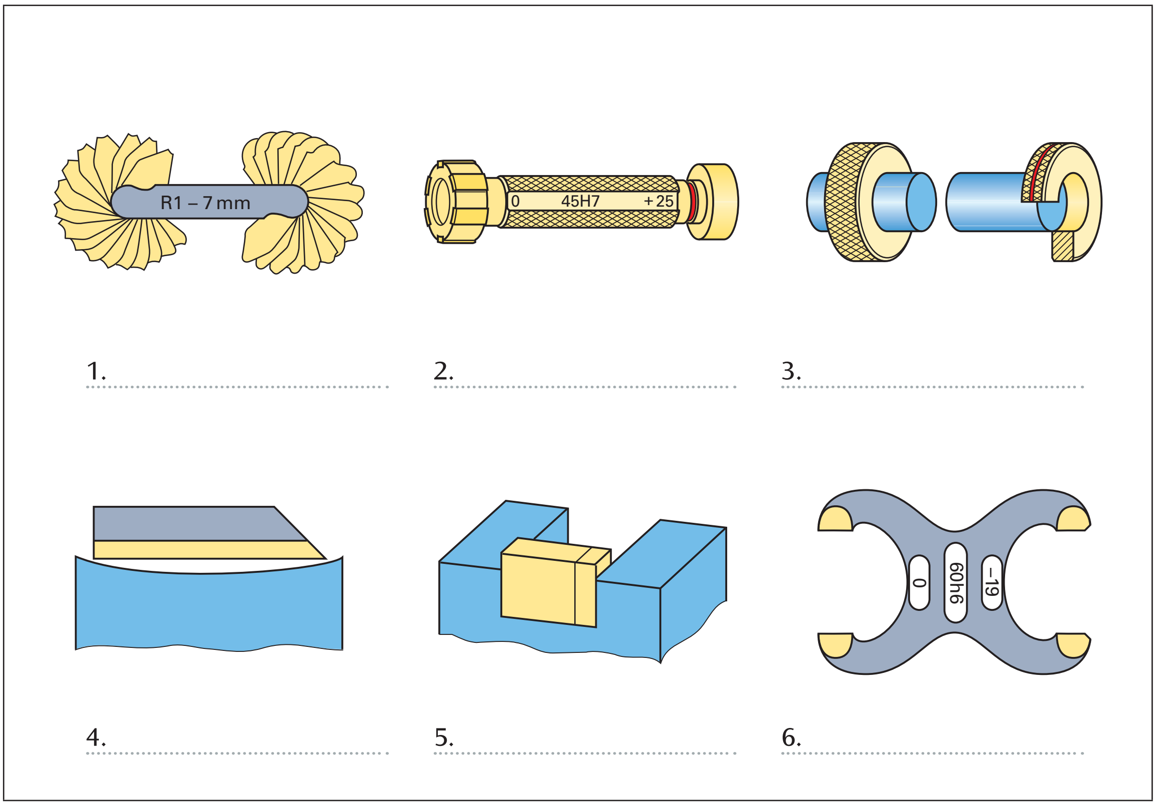
draw | drill | saw | grind | mill | screw | loosen | tighten | solder | measure | shape | sharpen

	Verb	Definition	Tool
1	....	give a certain form to something, e.g. with a hammer	....
2	....	fix the look and the exact measurement of a work piece on paper	....
3	....	to become or make s.th. loose	....
4	....	to join two materials to each other by melting their surface	....
5	....	to fasten s.th. or make it tight with the help of screws	....
6	....	to polish a work piece or sharpen s.th. by rubbing it on a rough, hard surface	....
7	....	remove a certain amount of material from a work piece with the help of machinery	....
8	....	find out the dimensions of a work piece	....
9	....	the opposite of 'to loosen'	....
10	....	to make s.th. sharp, e.g. by grinding it	....
11	....	to make a hole in a piece of metal or other material	....
12	....	separate a piece of material from a whole block	....

3. Quality Assurance

a) Have a look at the pictures of the various measuring tools and label them with the words from the box.

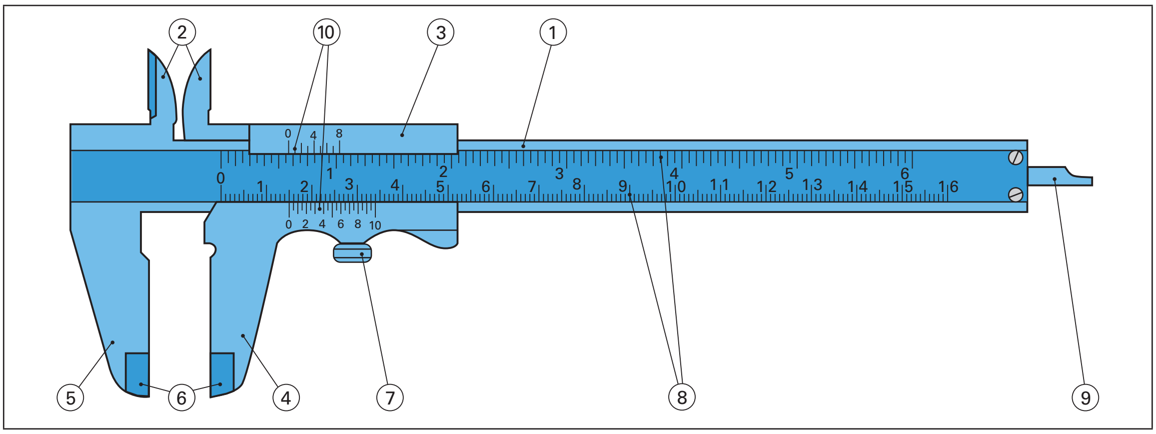
accidence | straightedge | cylindrical plug gauge | gauging tool | calliper gauge | gauging ring



Picture 1/2: Measuring tools

b) Use the expressions from the box and label the parts of the vernier calliper with the appropriate words.

fixed jaw | movable jaw | depth bar | vernier scale | slider | inside jaws | main beam (bar) | scale | clamp screw | outside jaws



Picture 1/3: Parts of a vernier calliper

c) Fill in the gaps in the following text about the vernier calliper with the words from exercise b).

When it comes to using a vernier calliper, the first thing a worker has to do is to decide where to measure – he/she can either use the (1) .... for the outer edges of the work piece or the (2) .... for the inner diameter of a hole, etc. For both kinds of measuring he/she has to press the (3) .... against one side of the work piece and then move the (4) .... along the (5) .... until it reaches the opposite corner. Afterwards, he/she can either read the measurement directly or use the (6) .... to ensure that the vernier calliper can be taken away from the work piece without moving the jaws and thus changing the result. The worker can subsequently read the precise measurement from the (7) ....
In order to take measurements which need to be more accurate than 1 mm, the (8) .... can be used. The (9) .... also contains a (10) .... which enables the worker to measure, e.g., the depth of a hole.

4. Common Units

a) The following table provides an overview about the basic units and their symbols. Fill in the right units and the symbols.

	Basic quantity	Symbol	Unit	Abbreviation
1	current	I	....	A
2	voltage	U	....	V
3	thermodynamic temperature	T	....	K
4	length	l	....	m
5	mass	m	....	kg
6	time	t	....	s
7	luminous intensity	I_v	....	cd
8	molecular weight	M	....	kg/mol
9	electric resistance	R	....	Ω
10	temperature	T	....	°C
11	force	F	....	N
12	speed	v	....	m/s
13	electric capacity	C	....	F
14	pressure	p	....	Pa
15	frequency	f	....	Hz

b) Find the right numbers for the definitions given in order to convert measurements from the imperial to the metric system and from °C to °F and vice versa.

30.5 | 0.57 | (°F – 32) · 5/9 | 25.4 | 32 + °C · 9/5

	Imperial system	Metric system		
1	1 inch	....	mm	one inch equals twenty-five point four millimetres
2	1 foot	....	cm	one foot equals thirty point five centimetres
3	1 pint	....	L	one pint equals zero point five seven litres
4	1 °C	....		degrees Celsius equals open bracket degrees Fahrenheit minus thirty-two close bracket times five ninths
5	1 °F	....		degrees Fahrenheit equals thirty-two plus degrees Celsius times nine fifth

Vocabulary

accidence	Formenlehre
Allen keys	Innensechskantschlüssel
calliper gauge	Grenzrachenlehre
centre punch	Körner
chisel	Meißel
clamp screw	Feststellschraube
combination pliers	Kombizange
cylindrical plug gauge	Grenzlehrdorn
depth bar	Tiefenmaß
to draw	zeichnen
to drill	bohren
electric drill	elektrische Bohrmaschine
to enlarge	erweitern
essential	wichtig, entscheidend
file	Feile
fixed jaw	fester Schenkel
gauge block, slip gauge	Parallelendmaß
gauging ring	Lehrring
gauging tool	Maßlehre
to grind	schleifen
grip vice pliers	Gripzange
hammer	Hammer
inside jaws	Innenmessschenkel
to loosen	lockern
to measure	messen
metal saw	Metallsäge
micrometer	Bügelmessschraube
to mill	fräsen
milling tool	Fräser
movable jaw	verstellbarer Schenkel
open-ended spanner	Maulschlüssel
outside jaws	Außenmessschenkel
ratchet	Ratsche
rim wrench	Radkreuz
ring spanner	Ringschlüssel
to saw	sägen
to screw	schrauben
screwdriver	Schraubenzieher
secondary school	weiterführende Schule
to shape	formen
to sharpen	schärfen
sidecutter	Seitenschneider
slider	Schieber, Gleitstück
socket wrench	Steckschlüssel
to solder	löten
soldering iron	Lötkolben
square	Haarwinkel
straightedge	Haarlineal
strap wrench	Bandschlüssel
to tighten	befestigen, festziehen
tool	Werkzeug
toolbox	Werkzeugkiste
torque wrench	Drehmomentschlüssel
vernier calliper, calliper rule	Mess-Schieber
vernier scale	Skala

Module 2
Grammar Revision

2.1 Active vs. Passive

In technical English it is not important who does the work but that it is done. For this reason most technical instructions are given in the passive voice as the reader of a technical instruction or the person to be instructed needs exact information on the kind of work that has to be done and on how the work has to be performed. In this case, it is of no interest, who the responsible person is. The basic rules for active and passive voice are as follows:

The object of the active sentence becomes the subject of the passive sentence. The former subject can be added to the passive sentence if necessary, but this is not obligatory.

The following examples show how active sentences (a) are transformed into passive ones (p).

a	The woman cleans the office every day.	Simple Present
p	The office is cleaned (by the woman) every day.	
a	They are repairing the machine at the moment.	Present Continuous
p	The machine is being repaired (by them) at the moment.	
a	He tidied up his desk yesterday.	Simple Past
p	His desk was tidied up (by him) yesterday.	
a	They have completed a thorough training before the project started.	Present Perfect
p	A thorough training has been completed (by them) before the project started.	

It works in exactly the same manner for other tenses which is shown in the following table.

Tense	Active	Passive
Simple Present	Infinitive, he/she/it-s	am/is/are + 3rd form/-ed
Present Continuous	am/is/are + verb-ing	V am/is/are + being + 3rd form/-ed
Simple Past	2nd form (irregular verbs) or -ed	was/were + 3rd form/-ed
Past Continuous	was/were + verb-ing	was/were + being + 3rd form/-ed
Present Perfect	has/have + 3rd form/-ed	has/have + been + 3rd form/-ed
Present Perfect Cont.	has/have been + verb-ing	has/have + being + 3rd form/-ed
Past Perfect	had + 3rd form/-ed	had + been + 3rd form/-ed
Past Perfect Cont.	had been + verb-ing	had + being + 3rd form/-ed
Will-Future	will/won't + infinitive	will/won't + be + 3rd form/-ed
Going to-Future	going to + infinitive	going to + be + 3rd form/-ed
Modal verbs	may/can/might/should + infinitive	may/can/might/should + be + 3rd form/-ed

2.2 Adjective vs. Adverb

Adjectives are used to describe what something is like (the state of something), while adverbs are used to describe how something is done. Adjectives are, therefore, used after forms of to be and other stative verbs. If one adjective is followed by another, the first usually becomes an adverb, as the second word is classified by the first one.

Adverbs are usually formed by adding an -ly to the adjective form of the verb. The table shows a couple of exceptions concerning the spelling of adverbs.

Adjective	Adverb	Example
consonant + y + ly	consonant + ly	easy – easily
ending le + ly	le is replaced by ly	possible – possibly
ending ic + ly	ically	automatic – automatically

Exceptions are the words **hard**, **fast**, **early** and **late** because they are adjective and adverb at the same time. Although the words hardly and lately exist they have a completely different meaning (hardly = kaum; lately = kürzlich).

As already said in the name, an adverb refers to a verb while an adjective refers to a noun. The following examples show the use of adverbs and adjectives.

The new employee is a quick worker.
He understands easily.
They are an extraordinarily reliable team.

2.3 Subject / Object Questions

In English there is a difference between subject and object questions. If it is asked for the object of a sentence, the question has to be formed with an auxiliary verb, such as **do** in the Simple Present and **did** in the Simple Past. With all other tenses, the auxiliary verb used in the sentence is also used for the question.

Have a look at the example sentences.

He bought a new fork lift for the factory.
What did he buy?

I want to buy another car next summer.
What do you want to buy next summer?
Who wants to buy a new car next summer?

We are visiting my aunt on Thursday.
Who is visiting my aunt?

They are assembling the new machine at the moment.
What are they assembling at the moment?
Who is assembling the new machine at the moment?

2.4 Reported Speech

Whenever information has to be passed on from one person to another, people use reported speech to do this. However, some grammatical rules have to be paid attention to.

If the introductory verb is in a present form, nothing happens to the verb tenses, but personal pronouns, time words and determiners need to be changed.

If the introductory verb is in a past form in addition to the words mentioned above, the tense has to be shifted backwards.

An overview of the most important changes is given in the following tables.

Tense shift

Direct Speech	Example (to do)	Reported Speech	Example (to do)
Simple Present	do; (am/is/are)	Simple Past	did; (was/were)
Present Continuous	am/is/are doing	Past Continuous	was/were doing
Simple Past	did	Past Perfect	had done
Past Continuous	was/were doing	Past Perfect Continuous	had been doing
Present Perfect	has/have done	Past Perfect	had done
Present Perfect Continuous	has/have been doing	Past Perfect Continuous	had been doing
Past Perfect	had done	Past Perfect	had done
Past Perfect Continuous	had been doing	Past Perfect Continuous	had been doing
Future I	will do	Future II	would do
Going to – Future	am/is/are going to do	Going to – Future II	was/were going to do
Modal Verbs	may, can, shall	Modal verbs (2^{nd} form)	might, could, should

Other words

Direct Speech	Reported Speech	Direct Speech	Reported Speech
this	that	here	there
these	those	now	then
yesterday	the day before	today	that day
last week	the week before	tomorrow	the next day
last year	the year before	last month	the month before

1. Active vs. Passive

Transform the following sentences from active into passive.

1. The maintenance department regularly services the machine.

....

2. We checked the production unit last week.

....

3. The apprentice is cleaning the tools at the moment.

....

4. We will make the plans ready by the end of next week.

....

5. Before the test we had already worked with the new material.

....

6. We are going to schedule the meeting for next week.

....

7. The factory has been producing the new tissues for a couple of months.

....

8. The accident happened while we were cleaning the machine.

....

9. The service had been working on the new system for a whole week before they found the failure.

....

10. You should wear protective clothing in the workshop.

....

2. Adjective vs. Adverb

Read the following text and decide whether the adjective or adverb form is the correct one.

Working in a construction department is an (1) extreme/extremely (2) interesting/interestingly job. The engineers have a lot of (3) interesting/interestingly tasks to fulfil. Neverthelessn they have a very (4) challenging/challengingly job because the decisions they have to make often have a (5) great/greatly influence on production.

Lots of small steps are involved in the development of a (6) new/newly machine. First of all the drawings have to be made (7) exact/exactly and the single parts have to be produced. This is a task that requires (8) accurate/accurately work, as every inaccuracy can have an influence on the parts and the machine. If a machine has already been sold to a company (9) quick/quickly, production is necessary as the machine is often (10) urgent/urgently awaited by the company.

3. Subject / Object Questions

Read the following sentences and ask for the underlined part – you need either a subject or an object question or both.

1. The machine is being serviced at the moment.

2. The mechanic wrote a report concerning the failure.

3. The apprentices are taught the safety rules that are important in the workshop.

4. The vernier calliper is a very useful instrument for measuring.

5. The research and development department has had a problem with a special configuration lately?

4. Reported Speech

Transform the sentences from direct into reported speech.

1. I called you three times last week.

He told me that

2. Can Peter come to the meeting tomorrow?

I was asked

3. The machine has to be checked because there was a problem yesterday.

The mechanic informed the superior that

4. I haven't been in the office for three days because I was on a business trip.

I informed the customer that

5. The production unit has to be exchanged as it is not working properly.

The machine operator said that

Vocabulary

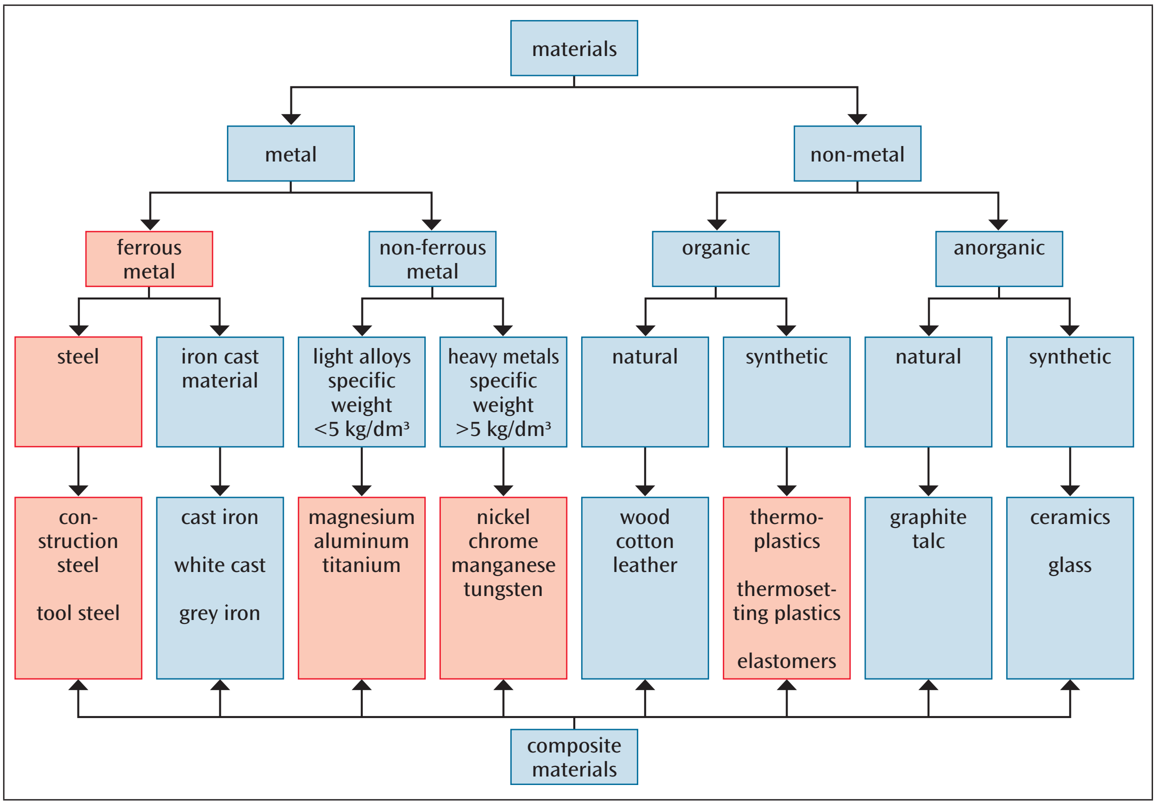
apprentice, trainee	Auszubildende(r)
comparable	vergleichbar
current	elektrischer Strom
luminous intensity	Lichtintensität
maintenance	Wartung
molecular weight	Molmasse
to schedule	terminieren
to service	betreuen, warten

Module 3
Material Technology

This module is going to introduce certain material classes and their properties as material technology has a great influence on the properties of machine parts.

3.1 Metals and their Molecular Structure

Basically, material can be divided into two main classes – metal and non-metal. In the table below there is a more differentiated overview of the material classes and their subclasses. The ones highlighted in red will be examined more closely in the following text.



Picture 3/1: Materials

Metals have the property to conduct heat as well as electrical current and they have an aureate surface. Most metals can withstand high mechanical stress, but they do not have a high resistance to chemical stress and oxidation. Ductility varies with the different materials, but in general it is possible to deform them. Metals can easily cope with high temperatures, they have a high strength and UV-light consistency.

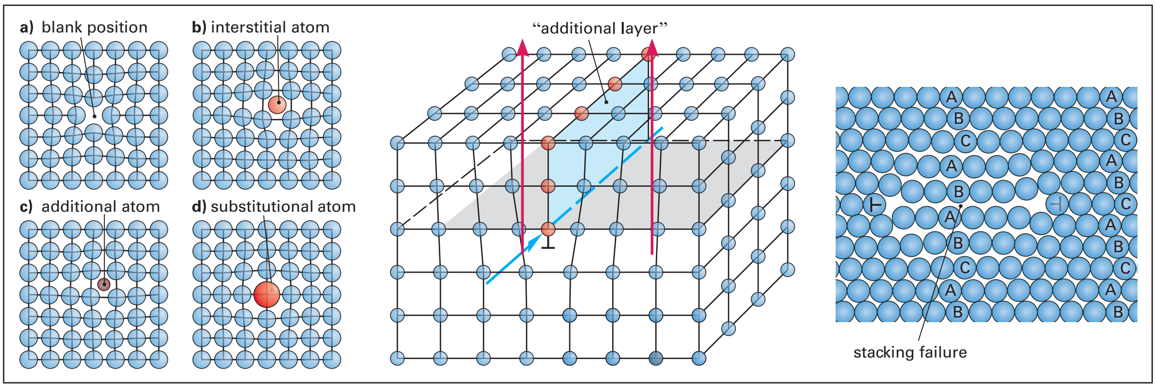
For a better understanding of the factors that influence the mechanical properties of metals, it is necessary to gain some basic knowledge about the molecular structure of metals. Metals consist of crystals; each crystal is called an elementary cell and the structure is defined by the position of the involved atoms.

The following table provides an overview of the general structures:

Picture 3/2: face-centred cubic *3/3: hexagonally closed packing* *3/4: body-centred cubic*

Type of structure	Element	Symbol
	Examples	
faces-centred cubic	Aluminium	Al
	Nickel	Ni
	Copper	Cu
hexagonally closed packing	Magnesium	Mg
	Zinc	Zn
body-centred cubic	Iron	Fe
	Chrome	Cr
	Molybdenum	Mo

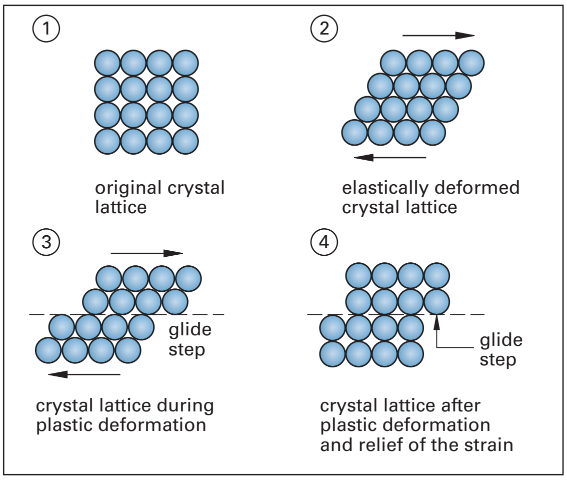
The ones mentioned above are ideal models and can, therefore, be used to explain the structure of metals. However, in reality the structure is nearly always imperfect. These failures have a basic influence on the properties of the materials and they are rated by their dimension. An overview of them is given in picture 3/5.



Picture 3/5: Material failures

3 module

3.2 Mechanisms of Deformation



Picture 3/6: Plastic deformation of a metal

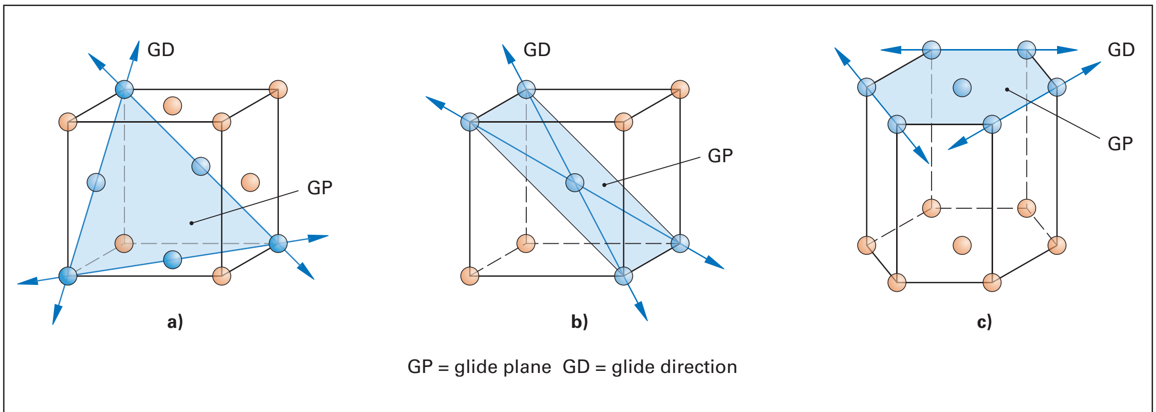
For some technical tasks, materials need to be formed. The two possibilities of forming a material are either elastic or plastic. In case of elastic deformation, the structure returns to its original structure once the force has been removed and in case of permanent deformation, the structure changes, which is irreversible (picture 3/6).

Depending on the basic structure (fcc, bcc or hcp) the atoms move on a level called glide plane. Every form of the elementary cell moves in a different direction, and this has the greatest influence on the ductility of the material.

Picture 3/7 a) shows that the glide plane always goes through the face-centred cubic diagonally. This means there are four glide planes and three directions possible. As one system consists of one level and one direction, the face centred cubic has 3 x 4 = 12 gliding systems. This is the structure that provides a good ductility, since the atoms are nearer to each other than in any other structure.

Picture 3/7 b) shows a body-centred cubic structure. There are also 6 x 2 = 12 gliding systems available, but the atoms are not as close to each other as in the fcc-structure. In reality, there are 48 systems available; but as the packing is not as high as in the 12 systems, they are negligible in this context.

Picture 3/7 c) shows the major gliding plane of the hexagonally closed packing structure. Here the number of layers depends on the quotient of height and distance between the atoms of the elementary cell. With a low height there are more possibilities of movement than with a large height, but the strength of the material increases under the condition that the glide plane dissents from the major planes. In the hcp-structure, only 1 x 3 = 3 gliding systems are possible. This, in combination with the fact that changes in the major level have a positive effect on the strength of the material, is the reason why materials with an hcp-structure do not provide high ductility.



Picture 3/7: Examples of the gliding planes of cubic and hexagonal crystal lattices