

NAME:

PHONE:

STUDENT No:

MY PERSONAL

WORKSHOP MANUAL

FOR THE WORKSHOPS AT THE DEPARTMENT OF PRODUCT DESIGN,
OSLO AND AKERSHUS UNIVERSITY COLLEGE OF APPLIED SCIENCES

HSE

MACHINES AND MATERIALS

WORKSHOP PRACTICE AND ROUTINES



How to use the workshop manual

This manual contains *basic* information about safety, tools, machines and materials.

The manual lacks full information about

- Workshop routines
- Work procedures
- Other information that helps you work safely and act correctly in the workshops.

This information must be added by you.

Add your own notes during lectures and practical demonstrations, and while you are doing workshop exercises. You can write, but you can also sketch / draw. Maybe you want to paste photos from the demonstrations. Use the method that suits you best, and that makes this a well designed manual for YOU.

We hope you will design this manual to be a tool for you when you later are going to work in the workshops on your own.

*Authors: Sigrid Haugen, Kurt Ollila, Mikael Omlid and Nils Seiersten,
University College of Applied Sciences, Institute for Product Design, August 2012.
Revised August 2014 by Sigrid Haugen.*

Index

WORKSHOP CULTURE, ROUTINES AND HSE	6
CERAMIC WORKSHOP	7
Protective equipment and HSE in the workshop area.....	7
Machines, tools, work methods, HSE	8
Left Hall (H105): Routines and HSE.....	9
Industrial clay (synthetic model material)	9
Model room: Routines and HSE.....	10
Plaster (Gypsum)	10
Casting molds of plaster.....	10
Formwork	10
Sink	11
Procedure for making a plaster mold.....	11
Concrete and mortar	12
How to mix and cast with mortar	12
Procedure for working with Gelflex.....	12
Right Hall (H100): Routines and HSE	13
How to cast with clay and handle a casted object	14
Glaze laboratory: Routines and HSE.....	15
Ceramic pigments	15
Ceramic glazes.....	15
How to work with glaze.....	16
Other tools, machinery and materials in this room	16
Clay slip.....	18
Procedure for preparing stoneware and porcelain slip	18
Glazing Techniques.....	19
How to use the water-cooled machines for hard materials.....	20
Kiln room: Routines and HSE	21
How to use the ceramic kilns.....	21
Before firing.....	21
Firing procedures	22
Bisque fire	22
Glaze fire.....	22
How to programme the kilns.....	22
Dampers and plugs	22
After firing.....	23
Drying of plaster molds.....	23
Material store rooms: Routines and HSE	24
Technical terms	25
METAL WORKSHOP	28
Basic HSE in the workshop.....	28
Materials and material properties	29
Steel.....	29
Stainless steel	29
Aluminum	29
Brass	29
Copper	29
Machines and tools: Techniques and processes.	30
Sheet metal shear	31
Lathe	32

Horizontal bandsaw	34
Bandsaw	35
Drill press	36
Sheet metal roller	37
Sheet metal break	38
Polishing machine	39
Hot work rooms	40
MIG/MAG welder	41
Belt sander	42
Soldering	43
Material prices	44
WOOD WORKSHOP	45
Basic HSE in the workshop	45
Materials and material properties	46
Solid wood	47
Sheet wood	48
Machines and tools: Techniques and processes.	49
Mortiser	49
Sliding table saw	50
Jointer	51
Thickness planer	52
Bandsaw	53
Router table	54
Sanding machines	55
Disc sander	56
Edge sander	57
Pad sander	58
Oscilating spindle sander	59
Drill press	60
Wood lathe	61
Dust extraction table	62
Vacuum table	63
Rip cut/cross cut	64
Dimensioning	64
Joining	65
Glue	66
Filleting	66
Material prices	66
POLYMERS	67
WORKSHOP AREAS	68
WORKSHOP REGULATIONS	70

Workshop culture, routines and HSE

(Health, Security, Environment)

The workshops at the Institute for Product Design is your workplace the next 3-5 years. Students' and employee's safety is most important.

Follow the prescribed safety procedures, regardless of what others say and do.

Look after each other. Let us know if you see someone putting themselves or others at risk. When you enter the workshops, be aware and alert. Think: "What could go wrong?"

Show respect for the equipment and procedures. Notify an employee immediately if a machine does not work. No one is held financially responsible for equipment that fails, when used according to the instructions.

The workshops at the institute shall at all times be orderly and safe to work in for all 150 students at Product Design. We should expect to find the workshops tidy every day, but this requires that everyone helps out.

It is your responsibility to tidy up and clean after your work. Do not leave your work space or common areas and equipment you have used, unless it is ready for the next student. Tools should be cleaned and put back in its place.

Always bring safety glasses and hearing protection in the machine workshops.

Always bring dust mask in the ceramic workshop.

Each machine or work area require different types of protective equipment. For some of the machines, use of wrong type of protection is dangerous.

CERAMIC workshop



Protective equipment and HSE in the workshop area

The greatest health risk in the ceramic workshop can sometimes be completely invisible: Silica dust (quartz) present in clay and cement, may cause lung damage. Many raw materials and pigments come in the form of powder and are toxic. The toxic dust is easily stirred up, and we breathe it. Therefore, we try as best as possible to keep work surfaces clean from dust and clay residues.



Wear safety glasses when working with glass or cement / mortar.



Wear ear protection as you stir clay slip with a drill, and when you use the stone saw, the milling machine for stone and glass, or the polishing tool.



Use latex/vinyl gloves when working with glaze / raw materials, color pigments and cement / mortar, to prevent hazardous substances entering the body through the skin. Use thick leather work gloves when removing hot items from the ceramic kilns. Gloves for the ceramic workshop can be found in the workshop rooms.



Wear a dust mask to protect the lungs from dust from cement, clay, glaze materials and pigments. Use gas mask against the fumes from chemicals, coatings and paints. It is dangerous to use a dust mask when a gas mask is required. Work under the ventilator fan.



Wet floor: Use shoes with nonslip soles.



Wear appropriate work clothes.

Machines, tools, work methods, HSE

On the following pages you will find information on how to use the various rooms of the ceramic workshop.

The materials in the ceramic workshop can contaminate / destroy each other's qualities if they are mixed. Therefore, we are careful to use separate rooms for the various processes.

The working procedures for each room you will learn by following the practical lecture-demonstrations, and by doing your own exercises under guidance from the tutors.



Left Hall (H105): Routines and HSE

This room is part of the ceramics workshop, but it is also a multipurpose room, and is sometimes used for lectures and exam submissions.

The room can be reserved for gatherings. Booking list is on the door. Students can also book the room, but lectures and teaching has priority.

The chairs you sit on should be put back in the chair stand, canteen dishes should be return to the cafeteria, and garbage should be put in the bin. Keep the room tidy. No one tidies for you.

In the "lost-and-found" shelves you might (if lucky) find things you unintentionally have left behind in the workshop area.



In the room is an extruder tool for clay, a mortar mixer, a jiggering machine, a source for industrial clay (synthetic clay, not ceramic clay), a saw, a paper cutter, some cardboard carton and a storage for glass and art glass materials. Instructions for use of most of these tools / materials can be provided by appointment.

The room has no adjustable ventilator fans, so please do not work with dust or gas producing materials in this room.

The area / passageway between the entrance door and the kiln room is an escape route, and must not be blocked by any inventory.

Industrial clay (synthetic model material)

MY NOTES:



Model room: Routines and HSE

In this room you work with production of plaster molds for clay casting, and with cement and mortar.

You may not store your projects in this room overnight, because it is a common area.

Gloves and a dust mask is required protective equipment when working with cement and mortar.

Plaster (Gypsum)

Chemical formula $\text{CaSO}_4\text{H}_2\text{O}$. Calcium sulfate (calcium, sulfur and water). Gypsum is a natural mineral, a crystalline rock.

We buy plaster in bags, containing gypsum which is heated (dehydrated) and ground into powder. When we add water, the plaster hardens and returns to solid form. Plaster can be easily recycled by heating it up and crushing it to powder again.

Plaster is not harmful, but a few still can experience allergic reaction to the material: itching eyes, runny nose or itchy, red rash and eroding skin. If you experience an allergic reaction, you must use a dust mask and gloves. Always work under the ventilator fan when you mix plaster, since it produces a lot of dust.



The school has two types of plaster:

“Supraduro” - which hardens a little faster

“Molda” - which hardens more slowly and which we primarily use for work at the plaster turning wheel. The properties after hardening are fairly similar for both types of plaster.

Casting molds of plaster

Dry plaster is porous and will absorb water from clay slip that we pour into the mold. After a while, the clay has lost so much water to the mold that it hardens into a solid clay object. We can cast many times in the mold, and thus reproduce the object.

Formwork

Hand tools and formwork materials are to be cleaned after use and put back in the right box. Clay used for sealing the formwork is contaminated by plaster and should not be fired. If the clay is still soft and pliable enough to be used for sealing formwork, it shall be packed in thick plastic bags and put back in the residual clay container. If the clay has hardened, it shall be disposed of. Large formworks must be secured with screws, clamps, straps, tape or similar. Clay is not strong enough to hold the formwork if you work with plaster quantities over 1/2 litre.

Sink

Do not pour dry or liquid plaster, cement or concrete mortar into the sink. Plaster and cement clogs the pipes in the draining system. Rinse buckets and tools in the water barrels for plaster and concrete. Do not rinse cement or mortar buckets in the barrel for rinsing plaster buckets! Cement is highly alkaline and provides chemical burns on the skin. We do not want remains of cement in the plaster barrel, to avoid having to wear gloves when working with plaster.

Procedure for making a plaster mold

(MY NOTES):

Concrete and mortar



How to mix and cast with mortar

(MY NOTES):



Procedure for working with Gelflex

(MY NOTES):



Right Hall (H100): Routines and HSE

This is the main study in the ceramic workshop. In this room you work with casting or molding from clay.

Quartz (crystalline silica) is a major ingredient in clay, cement and ceramic glazes. Quartz is the greatest health risk in this workshop area. Inhalation of crystalline silica can cause lung disease and lung cancer. Quartz may occur in the air without a visible cloud of dust.

To avoid damage to health, we try to keep the surfaces as clean as possible from dust from dry clay and cement that is whirled into the air every time someone walks through the room. Keep floors free of objects that are not on wheels, so that the cleaning staff can clean thoroughly. This also goes for the floor under the desks.

- Spillage on the table or floor should immediately be scraped up and removed. The cleaning staff washes the floors, but they do not wash if there is clay spillage.
- Remove the clay residue from the outside surface and lid on the clay buckets.
- Do not blow clothing clean with compressed air at this workshop, due to hazardous dust.

In the right room you will find tools to work with clay. All tools are for common use, and shall not be occupied by a single person for a long time. Clean the tools after use, and put it back in the correct box. Clean the desk you have used, and put your work in a shelf. There should be opportunity for all 150 students in product design to find work space in the room. You may, however, at certain times reserve a desk for several days, in agreement with the workshop manager.



Bisque fired ceramic shall be sanded under the ventilator fans. The fans are flexible so they can be pulled to reach all the workstations in the room. Position the fan below your face to avoid breathing in the dust. Remember to turn the red handle to open the ventilator. Wear a dust mask.

Use ventilator fans also during other dust- or gas-producing work in this room.

In the room you may find aggregates for mortar, a clay slab roller, and a melting pot for Gelflex material, which is used for making molds for plaster and cement mortar.



How to cast with clay and handle a casted object

(MY NOTES):



Glaze laboratory: Routines and HSE

In this room, you work when you mix and apply ceramic glaze, and when you mix clay slip.

You can not store your projects in this room overnight, because it is a common area.

In this room some materials are highly toxic, and some are completely harmless. To avoid having to remember what is what, we consider all the materials in this room to be toxic. Always wear gloves when you work here. Powder residues on the benches, in rags and tools can be toxic and can enter your body through your skin. Protect the respiratory by using a dust mask and by working under the ventilator fan when handling materials in powder form. Read the safety labeling on the containers, and read the data sheets for the materials in the archive "Eco Online" on the HIOA website.



Ceramic pigments

Ceramic pigments can withstand high heat without burning out colors. The pigments can be purchased as a powder, in liquid form, and as pencils and crayons that you can draw with. The pigments are often made from metal oxides. Pure metal oxides can also be used as ceramic color pigments.

Ceramic glazes



Ceramic glazes are combinations of crushed minerals. There are thousands of different glazes to buy, in addition you can mix your own glazes. Traditionally there is a high component of quartz (silicon) in a ceramic glaze. When the heating temperature is high enough, the glaze melts, forming a kind of glass coating on top of the ceramic ware.



Glaze can be bought in liquid form or as a powder you can dissolve in water. In the laboratory are both glaze powders and ready mixed glaze.

Ceramic glaze and pigments can harm the environment. Therefore we do not empty residues of these substances into the sewerage system, but dispose of it as hazardous waste. We pour leftovers in a barrel for toxic waste, which stands in the corner of the glaze lab. Protect your eyes and skin with safety goggles and gloves if you need to pour something in the barrel.

How to work with glaze

Stir the glaze before use. Glaze in the bucket consists of mineral powder that is mixed with water. The minerals easily sink, so if you use the glaze without stirring it, you get an uneven and poor result. Stir until the last second before dipping / pouring. If the glaze bucket has not been stirred for a while, the sediments become very hard. Stir well with the small electric drill.

Do not spill remains of other glazes into the buckets. This will pollute the glaze and change its composition, so that the result is bad. It is especially important that no remnants of dark glaze comes in contact with a bucket of light glaze.

Use perfectly clean tools. Do not dip an object in the glaze bucket if it is already decorated with another glaze or color pigments that may run.

Do not mix with glazes without consulting a teacher first, because it can produce results that destroy the kilns.

Other tools, machinery and materials in this room



Water-cooled machines for working with stone, concrete and glass: Saw, polishing tools and a milling machine. Instructions for use of most of these tools can be provided by appointment.

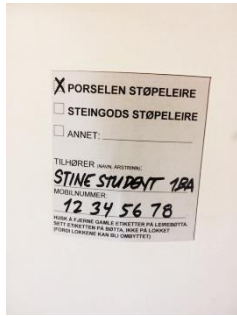


Color Pigments and chemicals for cement and mortar stands on a separate shelf and should not be confused with ceramic color pigments. Colour pigments for cement have different characteristics than the ceramic pigments.



IMPORTANT! Behind the curtain in the laboratory there is a control cabinet for electrical power. This is not very convenient since it is a room where we use a lot of water, but it is perfectly safe as long as we use the room in a safe way.

- Do not spray water on the door of the cabinet.
 - Do not work with highly dust-generating work.
- Both is dangerous and it can cause short circuits.



Clay slip

Mark the buckets with information about what it contains. All clay slip (liquid clay) looks fairly similar, but there are several different types of clay, which must not be confused. Use labels that you find in the lab. Remove all old labels from the bucket. Put the label on the bucket, not on the lid, because the lids can be switched.

Do not leave the clay bucket without putting the lid back on, then the water will evaporate and the mixing ratio will be incorrect. Stir up the clay with an electric drill before using it. Stir for a minimum of 2 minutes. Poorly mixed clay will produce a poor cast.

Sticks, drainers and jugs should not be left in the bucket, but cleaned and put back on the glaze lab after use. Reserved clay slip buckets will be common at the end of each semester.

Procedure for preparing stoneware and porcelain slip

(MY NOTES):



*Stoneware clay powder
(paper bag)*



*Porcelain clay powder
(plastic bag)*



Glazing Techniques

(MY NOTES):

How to use the water-cooled machines for hard materials

STONE, CONCRETE, GLASS, CERAMIC:

SAW, MILLING MACHINE, SANDING AND POLISHING TOOLS

(MY NOTES):



Kiln room: Routines and HSE

In this room we fire ceramic and glass.

The kilns can be more than one thousand degrees hot, so it is important to take precautions to prevent fires and burns.

- Do not put combustible materials against or on top of the kilns. Use only the plates and stack material intended for heating.
- Do not open a kiln door without knowing what kind of temperature that is inside.
- Use thick leather gloves when removing hot items from the kilns.
- Turn on the ventilation fan when you start the kiln, because of toxic gases. (Brown switch on the wall by the door to the lab).
- Close all doors.
- If you feel insecure about kilns and firing procedures, please do not hesitate to contact a teacher. You will ALWAYS be given guidance if you ask.



How to use the ceramic kilns

The school has five kilns for firing pottery, and one kiln for glass. The glass kiln can not be used to fire ceramic, because it does not reach high enough temperature.

Before firing

The kilns **MUST** be reserved. Check the booking list to make sure that the kiln that you intend to use is available. Write your name and phone number so that others can contact you if they need to make appointments for firing. Remember that bisque fire takes about one day, while glaze fire takes up to two days. A kiln that is started in glaze fire thus may not be ready for the next day.

You are asked not to reserve a kiln for more than three or four days ahead. Try to cooperate on filling up the kilns before firing, so that we do not waste energy by firing half empty kilns. Students who are in their final exam projects have priority on firing.



If there is space left in the kiln, you must bring in other student's objects to fill the kiln. Check the shelves in this room for work that can be included. If in doubt about how to handle other student's objects, you should rather let them be.

You can leave your objects for firing in the shelves, but you should not always take for granted that they are included in firings. If you are short of time, i.e. for an exam submission, you must take control of the process, book a kiln and fire your own work.

Firing procedures

We usually fire twice: First bisque fire, then glaze fire. Often one runs a third fire at a lower temperature, a decoration fire.

Bisque fire

In bisque fire clay turns into a new state. Clay becomes ceramic ware. At school we fire bisque fire of stoneware and porcelain to 960° C. When the temperature reaches 540° all water molecules escapes from the clay. Water expands when it warms up, and must have time to escape without breaking the object. The clay must be as dry as possible (bone dry) before the firing, and firing up to 540° must be done slowly, not over 100° per hour. Post a drying program if the clay is not completely dry: Hold at 80° for 4-6 hours or more.

Bisque fire usually takes about one to one and a half days, depending on the condition of the clay and the size of the kiln. We program the kiln and know how long it takes to reach peak temperature. The cooling process can not be accelerated; the time for cooling down depends on the size of the kiln, how full it is, and the temperature in the room.

Glaze fire

Bisque fired ware (bisque) is hard but brittle and does not have full strength. That the ware is porous, allows the glaze suspended in water to stick to the surface. During firing the glaze melts and forms a sort of glass coating on the outside of the object.

Sintering: At this temperature stage the clay particles are so hot that they begin to melt together and form a tight connection. Sintered ware is virtually waterproof, depending on clay type. One can fire the sintering level without applying glaze on the ceramic ware first.

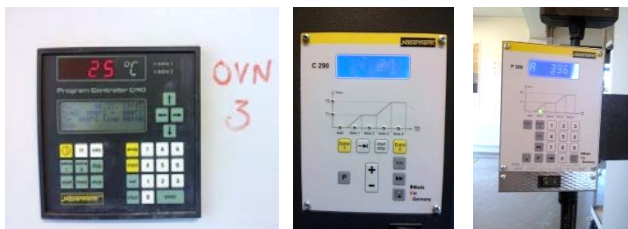
The items must not have glaze on the areas facing the ground surface, as they will melt to the oven plates. At this school we try as far as possible to fire glazes that are suitable for firing at 1220°C. This is to fire as many objects as possible in the same kiln.

There are glazes designed for many different temperature levels. If the objects are newly glazed you should hold the temperature at 100°C for a couple of hours ahead of the main firing, to make sure that water in the objects (water from the glazing process) will evaporate.

Glaze fire usually takes two days. You can drive a faster temperature rise than bisque fire, but cooling can not here do not drop.

How to programme the kilns

The kilns have different control panels. Instructions for the panels can be found next to the kilns.



Dampers and plugs

The kilns have dampers and plugs that cover smaller openings in the oven. We use the

dampers and plugs to regulate emissions of water vapor and gases in the heating process, and to accelerate the cooling process in a controlled way.

Damper and plugs are to be closed at 300°C while the kiln rises in temperature. Dampers and plugs can be opened when the temperature is down to 400°C.

The kiln door could be open slightly when the temperature is below 200°C. Never open a kiln door that stands ajar, without knowing that the kiln is down to a safe temperature (100°C or less). It may be that the kiln is set at a controlled cooling.

If we open the kiln door before it is down to the proper temperature, we can obviously hurt ourselves (burns). The heating elements in the kiln may be destroyed, and the fired objects may crack due to thermal shock.

After firing

Put cleaned oven plates and stack columns at the right place when you empty the kiln. Sort out plates with glaze spill stuck to them. Vacuum or sweep the inside of the kiln after



emptying. Objects that do not belong to you, can be put in the “ferdig brent” (“fired ware”) shelves. This is not a long-term storage shelf. Collect your items from this shelf as soon as you can. Unclaimed works will be thrown away.

Drying of plaster molds

The kiln room is usually warm and dry, and is therefore an excellent place to dry up plaster molds. Freshly made molds should be dried at low temperature inside a kiln. If the temperature exceeds 100°C, the plaster molds will crack. Be aware of kiln no 3, which must be set at 45°C in order not to rise too high in temperature.

Keep open the dampers and plugs. Open the kiln door occasionally to let out moisture. If you open the door while a drying program is running the oven shuts itself off temporarily. It starts again when you close the door (you hear a “click” when the thermostat kicks in), and the program continues to run. You do not have to restart the program.



Plaster molds can also be dried on top of the kilns. Use stacking columns as spacers between the plaster mold and the hot surface of the kiln.

Plaster molds and plates marked in red are for common use, and shall be cleaned and put back in the kiln room immediately after use.

The area in front of the escape door in the kiln room must not be blocked by furniture or other things. Ensure that there is always free passage up to the escape door. If the fire alarm is triggered, the door lock opens automatically.



Material store rooms: Routines and HSE

There are two material store rooms in the hall outside the ceramic workshop. In one is stored plastic clay. In the other is stored clay powder, plaster and cement mortar. The rooms are unlocked, so you can collect what you need, the school's confidence that you will not waste materials.

At the door you will find our price list for materials.

Do not open the bags in the store room. Carry them into the workshop and open them there. Add clay bags back to the appropriate shelf if you do not use the entire bag.



Help yourself first of already-opened bags if you need plastic clay. Close the bags with string or tape. If the bag breaks, pack the clay into a new plastic bag. Even a small hole in the plastic bag allows the clay to dry out quickly.

The plastic bag must be thick. Thin plastic bags emit moisture in the clay. Use i.e. two shopping bags. Write the clay type number on the bag and put it in the right shelf. String, tape and plastic bags hang on the clay shelves.

If you need materials/tools other than the school's standard selection, please contact the workshop manager, who makes an assessment of whether the school can buy the goods you need. If you need special materials that other students can not benefit from, it may be that you have to pay for the goods yourself.

Technical terms

Terms related to clay and its different stages

Slip: Clay for casting, with such high water content that it is liquid.

Plastic clay: Clay with such low water content that is not liquid. Preserves the form / shape it is given without the use of molds.

Leatherhard clay: When the clay does not have enough water in it to be plastic, but is still moist. Feels like cold leather.

Bone dry clay: Clay dry enough to fire safely.

Ware / ceramic ware: Fired clay. Ceramic ware can not be soaked back to become clay.

Greenware: Unfired clay

To fire clay: Preferrably we use the expression “fire” instead of i.e. “bake”.

Bisquit/ bisque/ bisque fired clay: Clay fired to the temperature level at which the clay becomes ceramic ware, without sintering. Bisque is hard but brittle and does not have full strength. The porous bisque allows the glaze suspended in water to stick to the surface.

Sintering: Stage during the heating process when the clay particles are so hot that they begin to melt together and form a tight connection. The clay solidifies but does not vitrificate. Sintered ware is virtually waterproof, depending on the type of clay.

Clay types and firing intervals: The temperature range when the clay sinters, but does not melt entirely to alter its shape significantly due to the gravity (vitrification). Different types of clay have different firing intervals:

Earthenware (terracotta):	900 - 1100°C
Stoneware:	1200 - 1300°C
Porcelain:	1200 - 1450°C

Glaze Fire: A firing cycle to the temperature at which the glaze materials will melt to form a glasslike surface coating. Normally the glaze firing temperature is set to the maximum sintering level for the clay.

Ceramic glaze/ overglaze: A mixture of minerals, traditionally a high component of quartz. Glaze can be glossy, matte, transparent or opaque, with or without color. Normally, glaze is applied to bisquit before firing at a higher temperature.

Underglaze: Slip with added ceramic color pigments.

Shrinkage: Clay shrinks when it fires to the sintering temperature. A clay object must be made larger than the desired size of the fired ceramic object.

Shrinkage amount for the clay types at this school:

Porcelain slip	approx. 15%
Stoneware slip	approx. 12%

Bone china slip	approx. 18-20%
Plastic stoneware	approx. 5-8%, depending on amount of chamotte added

Chamotte/ grog: Fired, crushed clay ("ceramic gravel"). Chamotte can be purchased in various grit. Chamotte acts as a reinforcement that makes clay more stable, reducing shrinkage. Clay with high content of chamotte is well suited to build large objects with different thickness. Brickwork has a high content of chamotte. We also sprinkle chamotte on the kiln plates as an added protection when we are experimenting with glazes that may run.

Terms related to mold production:

Undercut: An undercut is an indentation in a side facet of a mold that allows a casting material to get a locking grip on its surface. Undercuts prevent easy removal of the casting, and must be avoided. Plaster is a non-flexible material when it has hardened, so make sure the model will not be locked in the cast. If the model has undercut, you must create a multi-part plaster form.

Formwork: A framework for the model that holds the liquid plaster into place until it hardens. The distance between the model and the formwork determines the thickness of the mold walls. The walls of the plaster mold should be of uniform thickness throughout, a minimum of 2-3 cm.

Formwork material: Formwork material should be able to withstand water and used repeatedly. It should have a smooth surface. It can be hard or soft material, according to the model's requirement. The formwork must be attached with screws/ nails/ clips/ rubber bands/ string /tape, and sealed with clay. Suitable formwork materials for plaster are: Brown, smooth surface Plywood, thin aluminum plates (aluminum can easily be curved and does not rust), plastic plates, plastic containers, vinyl flooring or linoleum, cardboard.

Mouldmaker's size: Release agent used while producing the mold, to prevent the parts of a plaster mold to stick together.

Terms related to the casting process:

Clay cast: An object that is cast with liquid clay (slip) in a plaster mold. When the water is drawn from the clay layer nearest to the mold, the fine flat crystalline particles of clay minerals are sucked onto the mold. They align themselves parallel to the surface. The thickness of the layer of clay (the cast) depends on how long the slip stays in the plaster mold, and how dry the mold is. Maximum thickness obtained until the plaster mold is saturated by water, is between 1/2 and 1 cm. Ideal thickness of a cast is normally 3 – 4 mm.

Plaster molds:

Single drop-out mold: A mold consisting of one part.

Multiple part mold: A mold consisting of several parts assembled.

Hollowware: An object that is cast by pouring clay slip into a plaster mold, allowing it to stand, then emptying it. The shape of the cast will be given by the inner surface of the plaster mold.

Hollowware can be produced in both single and multi-part plaster molds.

Solidware: The cast will have no cavities, but is compact clay throughout. The cast can be given different thickness and form details of over-and under-side, possibly inside and outside. The parts of the cast may have variations in thickness. Examples: Dinner plate or cup handle. Solidware can only be produced in a multi-part plaster mold.

Combination mold: A mold consisting of several parts assembled, where the narrow sections of the form will be formed within the clay kompaktstøp poured out of hulformdelen. Example: cup with handle.

Natches: Pits and bumps in plaster mold parts, which ensures that the mold is precisely assembled.

Reservoir: Filling area in a plaster mold.

Mold seam: Clay stripe in the cast, which is formed when slip flows into the crack where the assembled plaster mold parts meet. The seam can be removed with a nylon knife, but the seam can still be visible after sintering fire.

Dispex: (Trade Name) Sodium silicate /sodium ash. Deflocculant. By adding Dispex to the slip you will decrease the viscosity of the clay slip without adding more water. This is beneficial because the plaster molds can be used for several casts before they are saturated and need to be dried. The usual amount of additive to stoneware slip: 1 dl Dispex per bag of clay. Note: The porcelain clay powder at this school is already added Dispex. Too much Dispex can lower the melting temperature of the clay.

METAL workshop



Basic HSE in the workshop

The metal workshop has a series of machines that can be potentially lethal if proper precautions and safety instructions are not followed.

Cleanliness and respect for the equipment is vital for the workshop to be a safe and pleasant place to work. It is your responsibility to notify the Workshop Manager or the student responsible for the area of any defective machines that can pose an increased HSE risk as well as causing the workshop to be less operational.

Safety glasses and ear protection is to be brought whenever you enter the workshop, regardless of whether you intend to use a machine or not. Being in such close proximity to the machines exposes you to the same dangers as the person using it. People caught without safety glasses and ear protection will immediately be expelled from the workshop until the safety equipment has been acquired. Anyone working in the workshop should wear proper workshop attire with no loose/dangling elements, which could potentially be caught in the machinery. Long hair should be put up, and long jewelry should be taken off.

The machines/work areas will be marked with the following pictograms in regards as to what safety equipment is mandatory (**BLUE**), and what is recommended (**GREEN**). On some machines, certain types of safety equipment can pose an even greater danger that not wearing them at all (**BLUE with RED diagonal bar**). Working without mandatory safety equipment will result in immediate expulsion from the workshop.



Eyes protected with safety glasses, face shield, or welding helmet from splinters, swarf, chemicals, sparks, and welding arcs



Hearing protected with ear protection from working with loud machinery or loud working environments.



Hands protected with leather gloves, welding gloves, or rubber gloves from lacerations, abrasions, heat, cold, or chemicals. Gloves can, in some operations, pose increased danger to the wearer.



Respiratory system protected with dust mask from abrasion dust, and with gas masks with BROWN class filters from volatile organic compounds (VOC's)



Workshop attire should not be too loose or have elements loose enough to get caught in the machinery. Never use synthetic materials when working with heat (welding, soldering, grinding etc.) Steel tipped work shoes with good gripping soles are advised.

Materials and material properties

Here is a short presentation of the materials you will, for the most part, be dealing with in the metal workshop. It is expected that you will further research the material properties and uses throughout your studies, and that you will be able to argue your use of the respective materials.

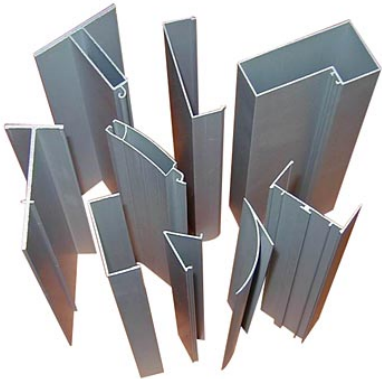


Steel

- Also called carbon steel
- Alloy of iron (Fe) and carbon (C) (up to 2.1%)
- The carbon strengthens the cohesion between the
- iron atoms

Stainless steel

- A steel alloy with low carbon content (<0.25%) and chromium (Cr) (>11%)
- Often alloyed with nickel (Ni) and molybdenum (Mo)



Aluminum

- Chemical element (Al)
- Refined from bauxite
- Aluminum is one of the most common elements in the earth's crust
- Norway is among the top 10 producers of aluminum (#8 in 2007)
- Non magnetic



Brass

- Alloy of copper (Cu) and zinc (Zn)
- Low friction coefficient (clockwork, locks, valves, etc)
- Good acoustic properties (brass instruments)



Copper

- Chemical element (Cu)
- Used by humans for at least 10.000 years
- Excellent electrical and thermal conductivity
- Alloyed with tin makes bronze

You are expected to research the material qualities and areas of use for the materials you use in your projects.

Machines and tools: Techniques and processes.

Here is a presentation of the machines you will be using in this course. Subsequent machines that you receive training on should be documented, and added to this book.

Presented here are the basic safety considerations for each machine. Additional information regarding technical aspects of, and correct use of the machines should be added by you. Sketches and pictures can be a valuable addition.

Keywords = subjects that should be included in your notes.

Sheet metal shear



Depth stop

Main switch

Start

Emergency stop

Reset



- The only real danger here is from the clamping bar marked with “KLEMMEFARE”. The person operating the machine has the complete responsibility for making sure no one is in danger of being crushed.
- The emergency stop is located on the control panel on the right side of the machine.
- Cleaning – No rest materials should be left on the machine when done.

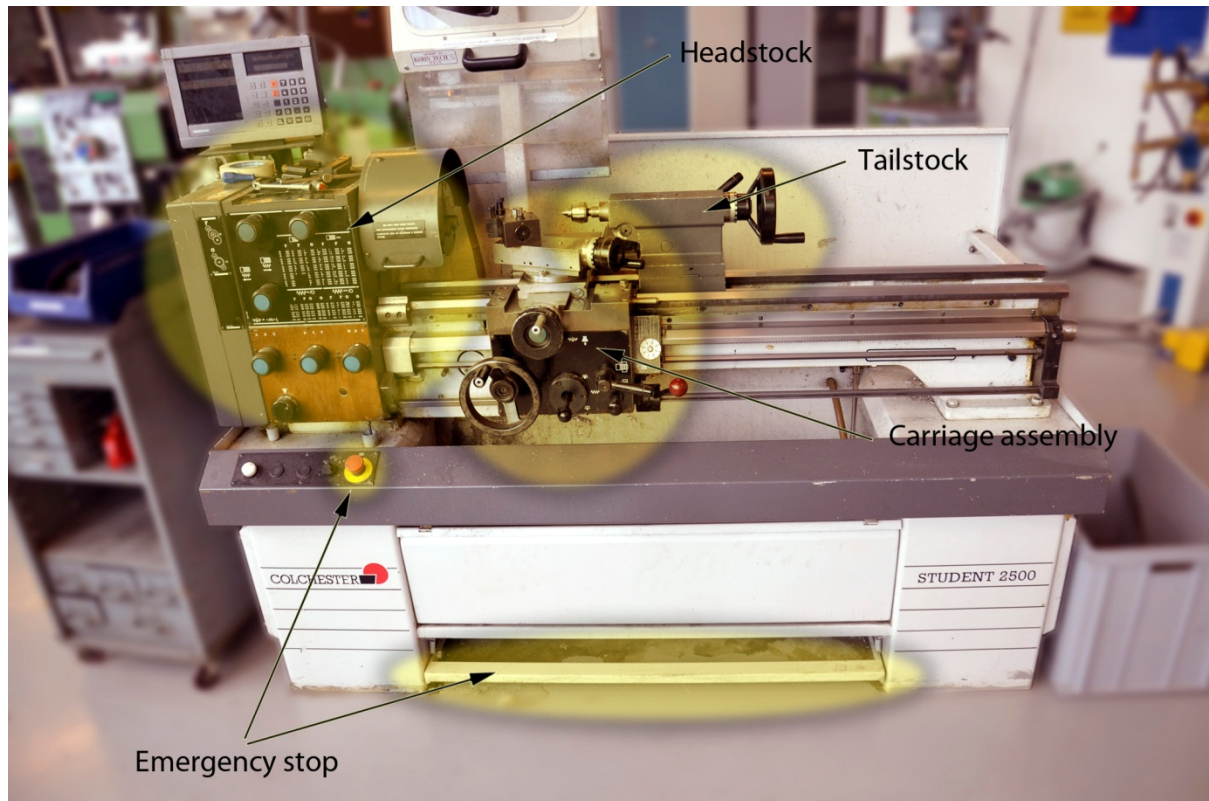
USE:

- This machine is only for cutting sheet stock. Wire, bolt, net, cardboard etc will damage the blade. The following thicknesses are the maximum for the respective materials (depending on width):
 - Stainless steel – 2mm
 - Steel – 2.5mm
 - Aluminum – 3mm
- The machine is operated with either the start button on the control panel or the foot switch.

KEYWORDS:

- Minimizing waste stock
- Cleanliness

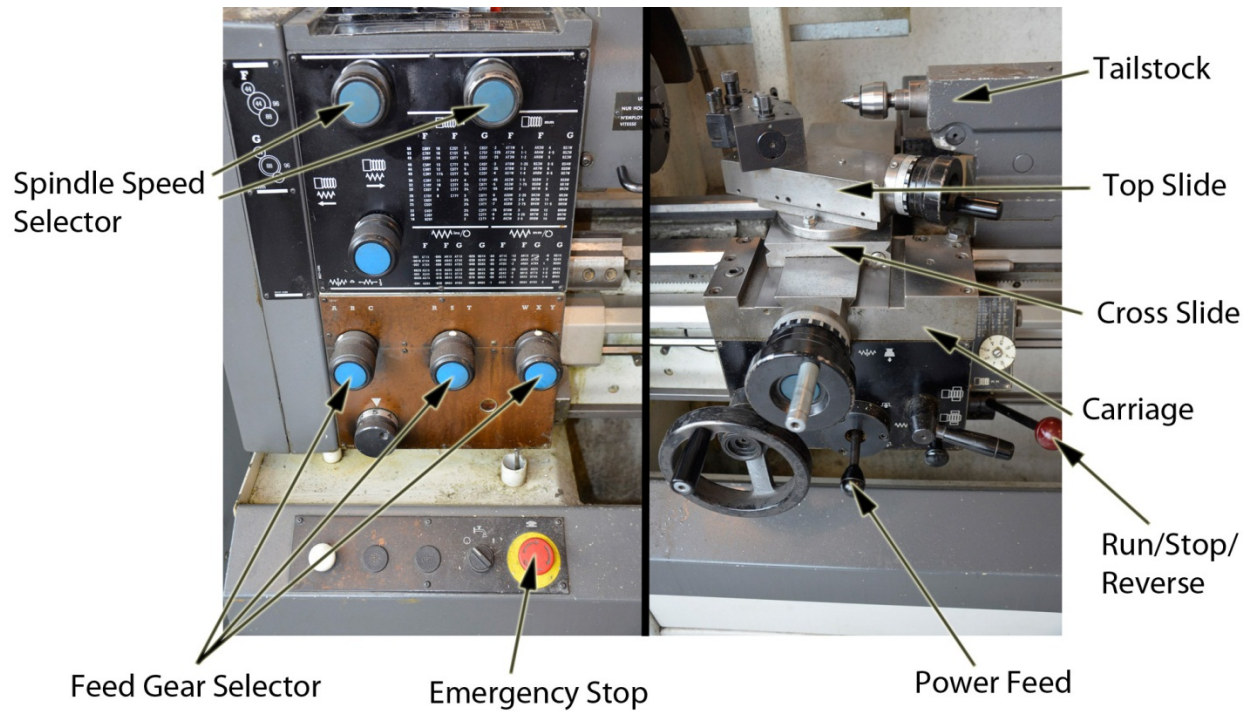
Lathe



- The Lathe is potentially the most dangerous machine in the workshop. It has large, open rotating parts with extreme torque.
- Long hair must be put up, and loose clothing elements and long jewelry removed.
- Safety glasses must be worn at all times when the machine is moving.
- Gloves must NEVER be used on the lathe.
- Never remove chips while the machine is running, and never with your fingers.
- There should never be so many chips under the chuck that they could get caught in any rotating parts
- Never leave the chuck key in the chuck
- Make sure the material is securely tightened in the chuck.

USE:

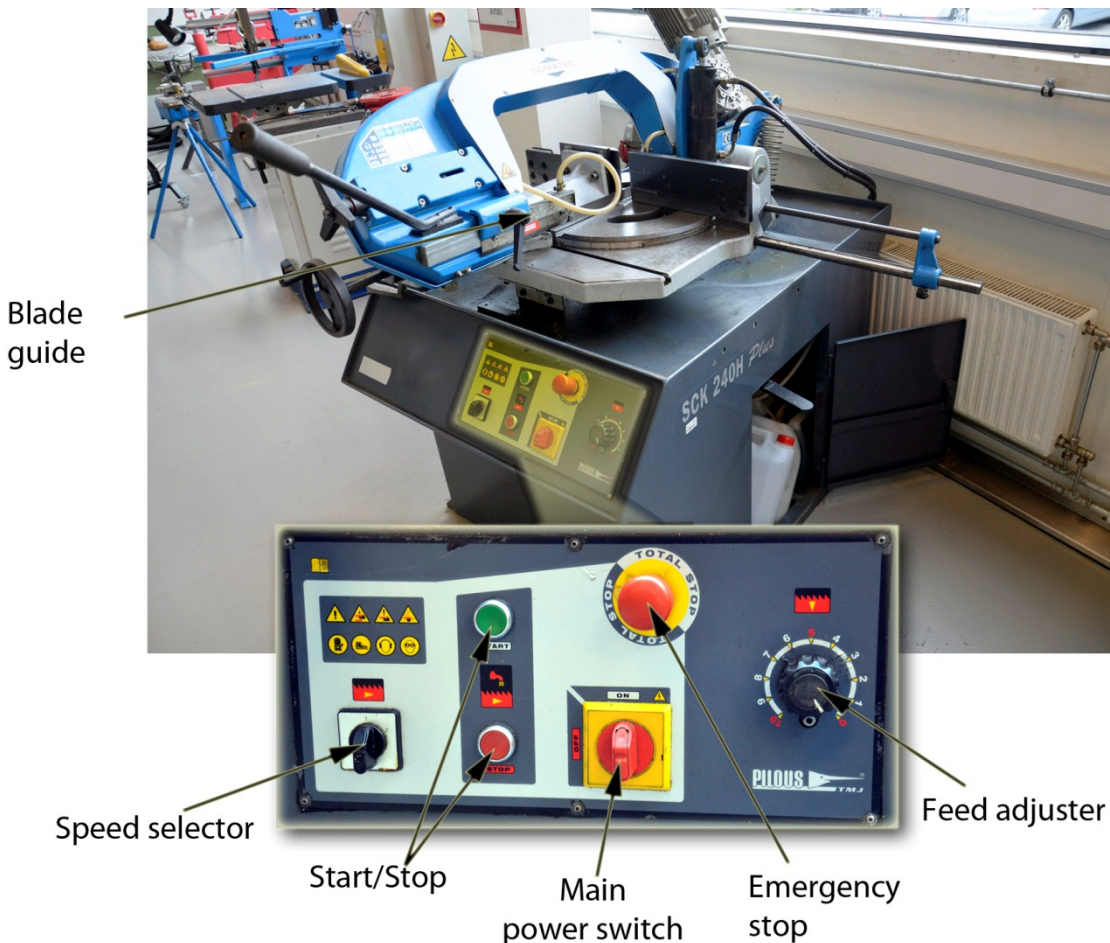
- The lathe is a rotational machine for axial material removal where the stock material is rotating and the tool is confined to movement in two planar axes.



KEYWORDS:

- Spindle speed
- Correct coolant
- «Reading the chips»
- Unwanted vibrations/resonance
- Cutting operations
- Machine lubrication
- «Listening to the machine»
- Cleaning

Horizontal bandsaw



HSE:  

- Safety glasses and ear protection must be worn.
- Correct setting of blade guide in regards to stock thickness
- Proper clamping of stock.
- Do not start cutting if there is no flow of cutting fluid
- Only use premixed cutting fluid (from the large container in the window behind the saw)

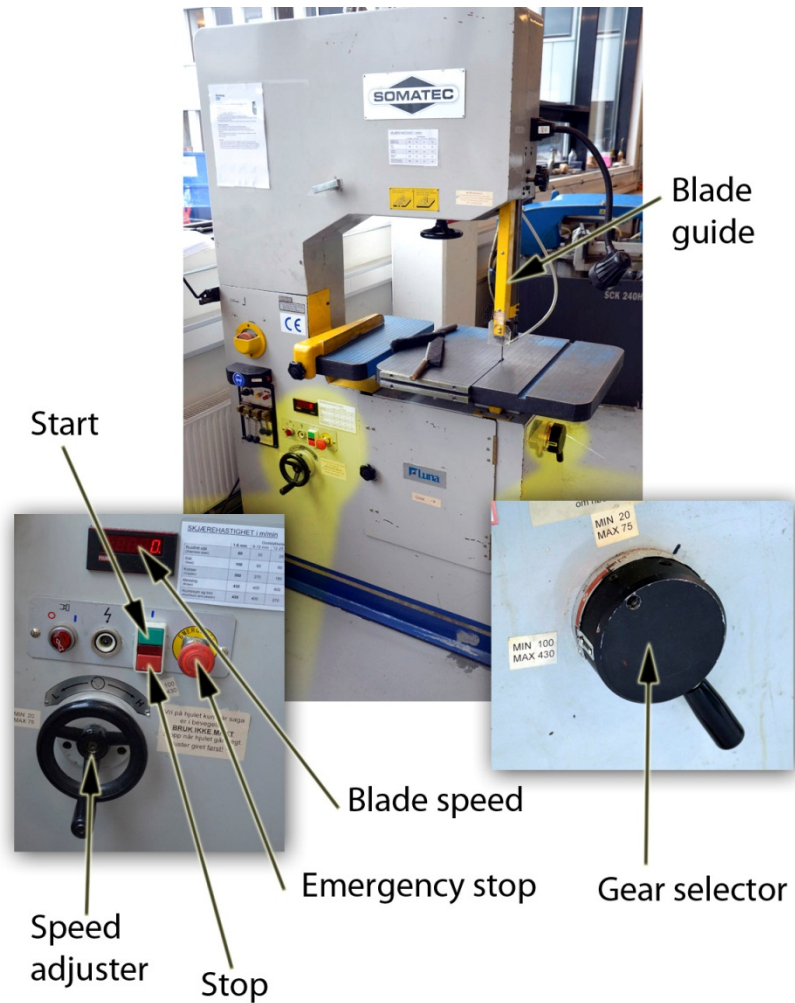
USE:

- Speeds.
 - 1 = Harder than aluminum
 - 2 = Aluminum and softer
- Cutting feed should be regulated to material hardness.

KEYWORDS:

- Clamping
- Cutting angles
- Filling cutting fluid
- Cleaning

Bandsaw



HSE:



- Safety glasses and ear protection must be worn.
- Correct height of the blade guide in regards to stock thickness
- Clamping when sawing round stock
- Safe body position
- Don't push hard, let the saw blade do the works
- Never use cutting fluids on this saw

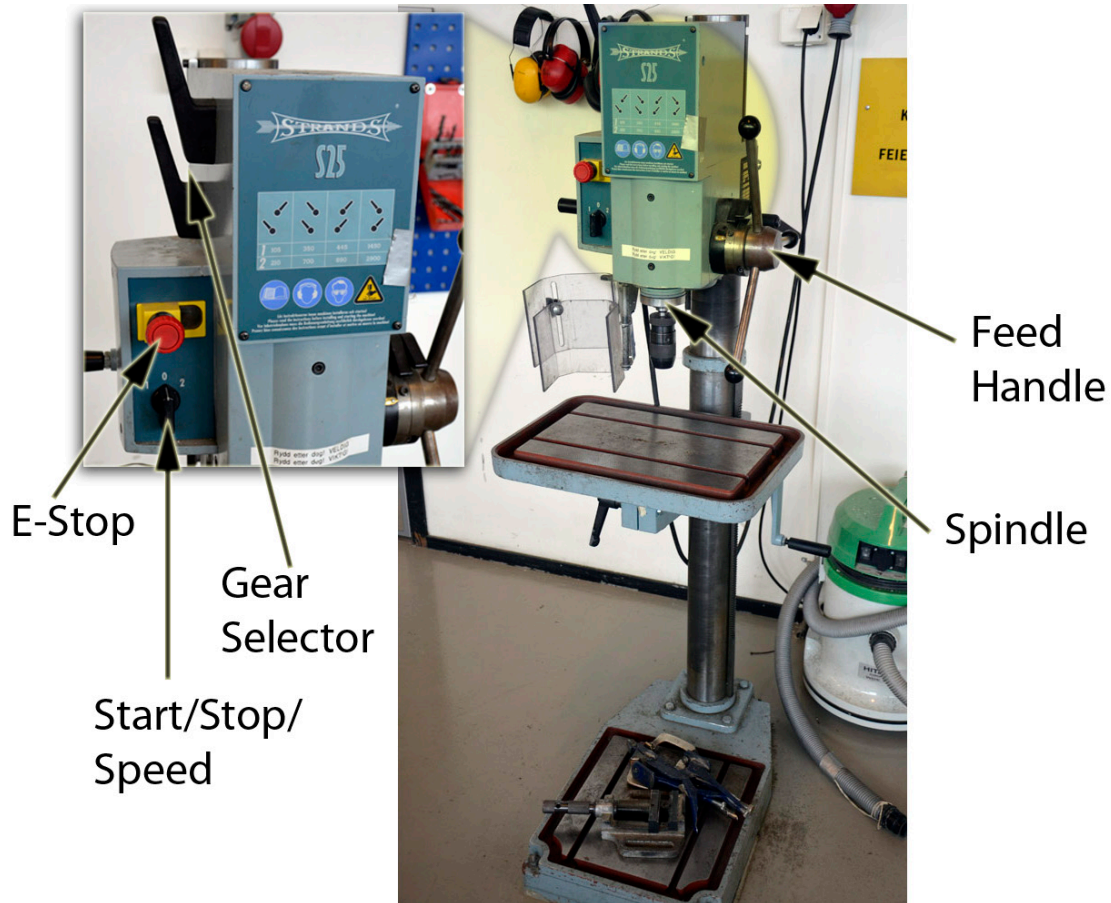
USE:

- Speed
 - Rotate the speed hand wheel clockwise for increase/anti-clockwise for decrease
 - Never rotate handwheel when the saw is NOT running!
- Gear
 - Gear lever should be set to high or low. Sometimes the drive wheel must be rotated for the gear to engage
 - Never change gear while the saw IS running!

KEYWORDS:

- How to feed the stock through the saw
- Sawing tight radii
- Reversing out of a cut
- Removing burrs

Drill press



- Safety glasses must be worn. Ear protection should be worn if the noise of the drilling operation dictates it.
- Gloves must NEVER be worn when using the drill press!
- Sheet stock must be clamped securely
- Long hair must be put up, and loose clothing elements and long jewelry removed.

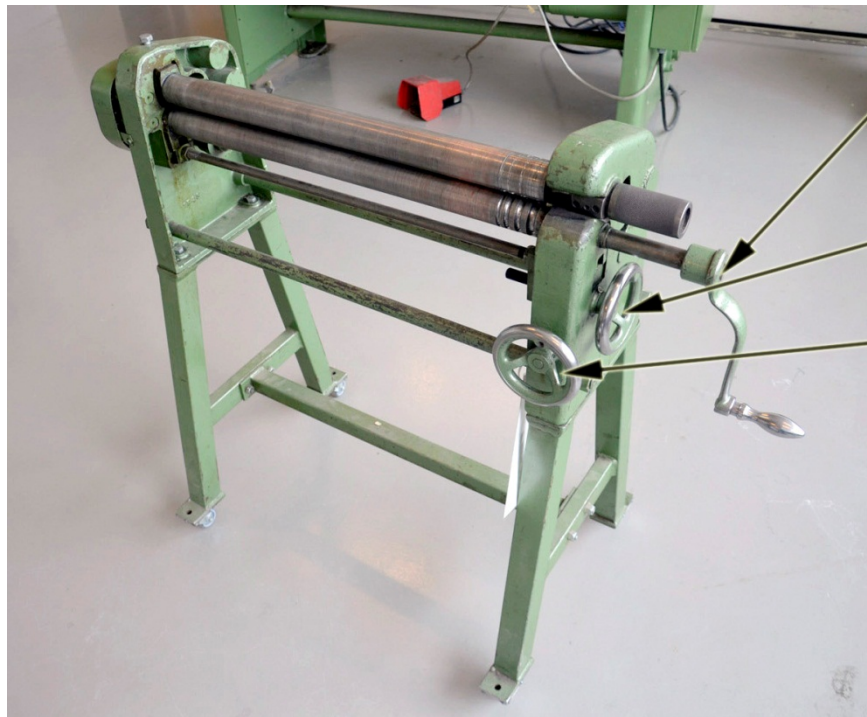
USE:

- Remember to always loosen the locking handles when moving the table or spindle head up and down.
- A “rule of thumbs” in regards to spindle speed:
 - Large drill bit and/or hard material = low speed
 - Small drill bit and/or soft material = high speed
- LISTEN! The machine will tell you if something is wrong

KEYWORDS:

- Clamping of sheet stock
- Center punch
- Tapered and straight shafted drill bits
- Vice
- Pre-drilling
- Reamer

Sheet metal roller



Roller
Handle

Clamping
Wheel

Bending
Wheel



- Common sense!

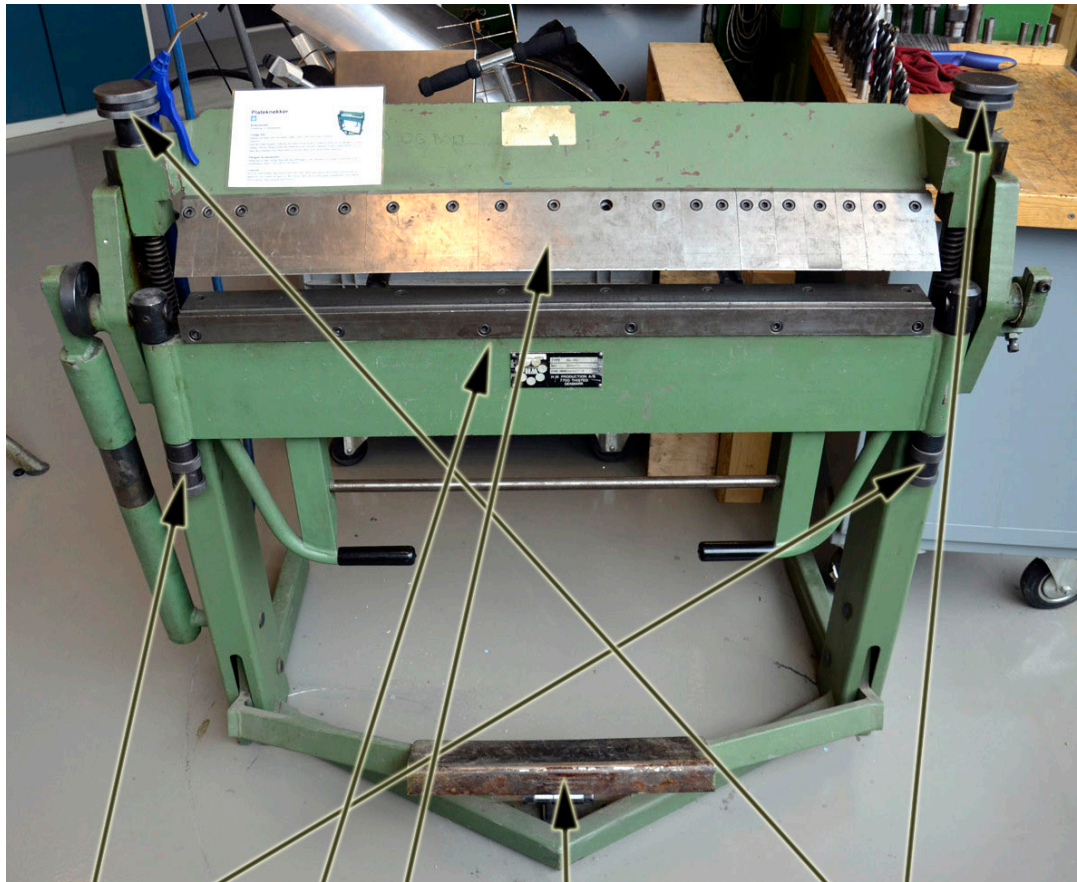
USE:

- Only for sheet stock. Wire must only be used in the grooves on the right hand side. Net, perforated sheets etc can damage the rollers
- Too high pressure between the clamping rollers will stretch the material (especially softer materials like aluminum)

KEYWORDS:

- $\pi \times 2r$ ($\pi \times d$)
- «Faceting»

Sheet metal break



Radius
Adjustment

Fingers

Stock Thickness
Adjustment

Break

Clamping
Pedal



- Common sense!

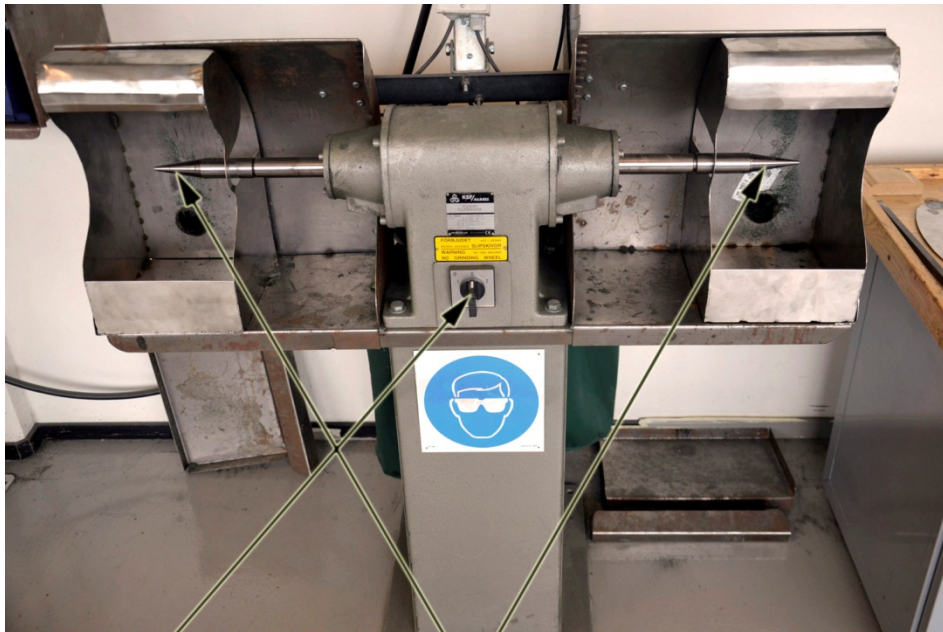
USE:

- Only for sheet stock. Wire, netting etc will damage the “fingers”

KEYWORDS:

- Breaking the sides of a box

Polishing machine



Start/Stop/
Speed

Spindle

HSE:   

- Safety glasses and ear protection must be worn.
- The protective shield should be used unless the size of the object does not make it practical
- Gloves should be used since the object being polished will get hot
- Long hair must be put up, and loose clothing elements and long jewelry removed.
- Wire and chains must NEVER be polished in this machine.

USE:

- Polishing wheels are attached to the tapered spindles by pushing and rotating them clockwise

KEYWORDS:

- Polishing compound
- Cleaning

Hot work rooms

The metal workshop has two rooms designated for hot work (work, in our case, entailing open flames and sparks). Hot work is not allowed in any other area.

«LODDEROMMET» (SOLDERING ROOM)

- Soldering with propane or propane/oxygen
- Welding/cutting with oxygen/acetylene
- Casting
- Tempering/annealing.

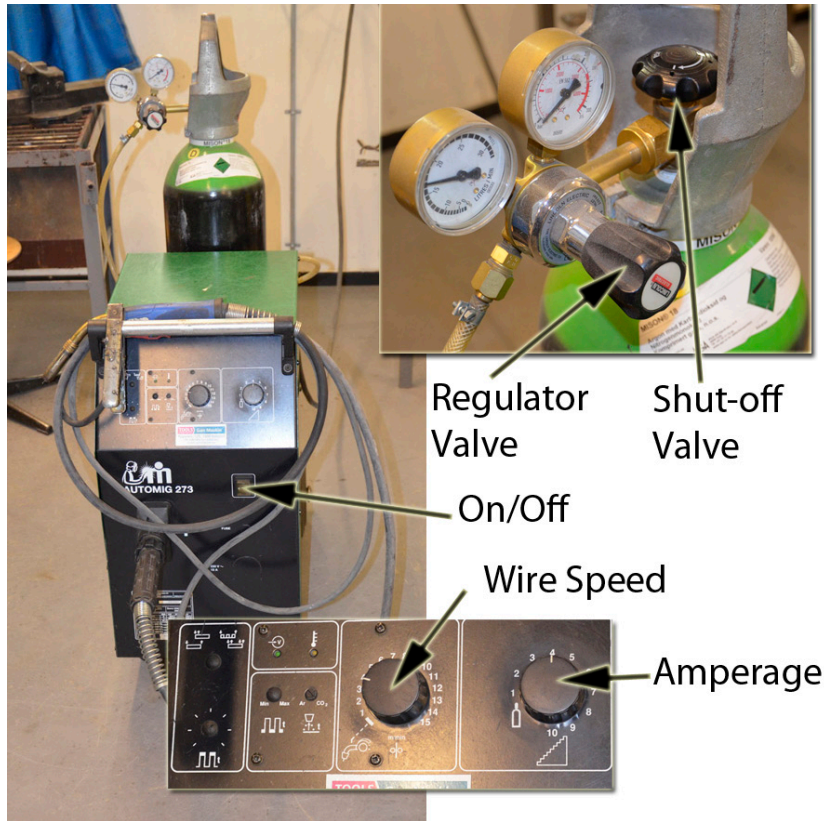
«SMIA» (SMITHY)

- MIG/MAG welding
- TIG welding
- Plasma cutting
- Grinding with belt sanders or bench grinder
- Grinding/cutting with angle grinder
- Blacksmith work
- Sandblasting

In the “Smia” there is often a lot of noise. If you start a machine that requires hearing protection, it is your responsibility to inform the others in the room to also do so.

If you are using an angle grinder in the “Smia”, it is your responsibility to make sure the sparks are not directed at anyone or anything flammable.

MIG/MAG welder



- Welding mask and welding gloves must be worn
- Clothing must be of a non-synthetic type, and have long sleeves.
- The smoke extractor must be turned on, and placed such that the smoke will reach it before it reaches your face
- Make sure there is good electrical continuity between the object being welded and the ground/return clamp
- Never use moist gloves when welding.

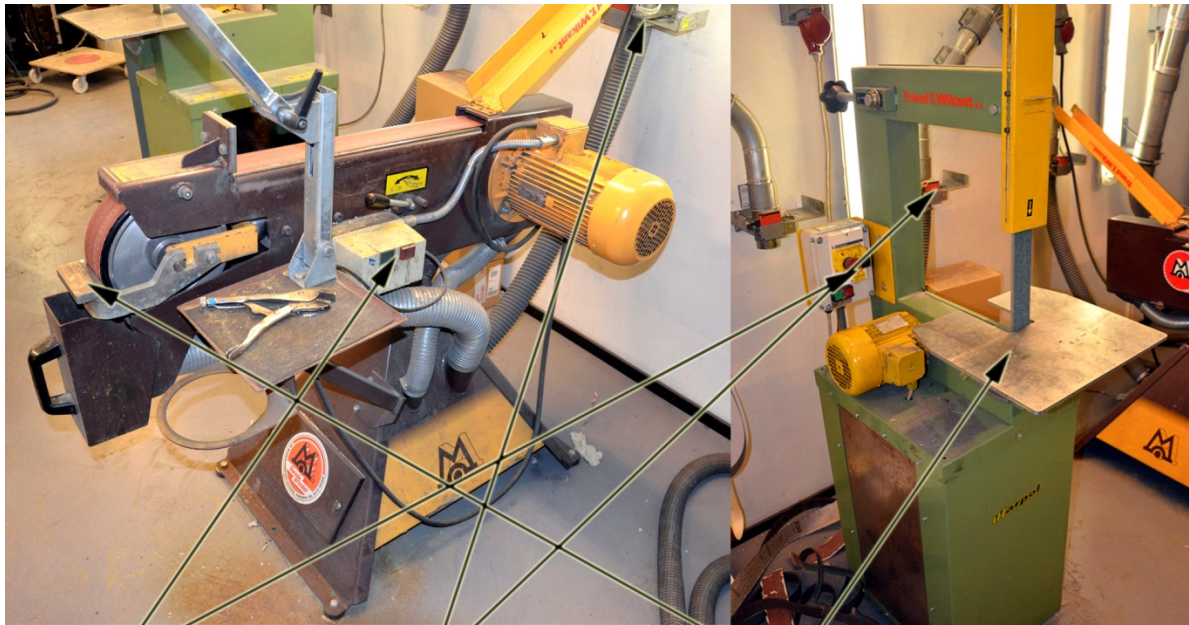
USE:

- The valve on the gas bottle must be completely open when in use, and completely close when not
- A "rule of thumb" for MAG welding thin to medium sheet steel: The amperage and wire feed knobs should be set approximately the same, i.e. 2:2, 3:3 etc

KEYWORDS:

- Shielding gas
- Electrical continuity/electrical flow
- Welding penetration
- "Arc Eye" or Photokeratitis
- Cleaning

Belt sander



Start/Stop

Dust Extractor

Table

HSE:



- Safety glasses and ear protection must be worn
- Dust mask and gloves should be worn
- The extractor fan must be used
- Never hold the object such that it can trap your fingers between it and the table
- Long hair must be put up, and loose clothing elements and long jewelry removed
- Keep the floor free from grinding dust to minimize risk of slipping.

USE:

- Don't push the objects too hard against the belt.
- Keep the object moving to minimize heat buildup

KEYWORDS:

- Results of overheating
- Cleaning

Soldering



Propane/Oxygen

Smoke Extractor

Shut-off Valve

HSE:   

- Safety glasses must be worn
- Clothing must be of a non-synthetic type, and have long sleeves.
- Gas valves must be closed upon completion of soldering
- Hold burners away from walls, people and flammable materials
- The smoke extractor must be turned on, and placed such that the smoke will reach it before it reaches your face

KEYWORDS:

- Annealing
- Flux
- Capillary effect
- Acid bath

Material prices

Material type	Ca price (pr kg,m)
Cold rolled steel sheet	ca 35,-/kg
Steel, bar stock or round stock	ca 40,-/kg
Steel tube	ca 30,-/m
Aluminum sheet	ca 160,-/kg
Aluminium round stock	ca 90,-/kg
Stainless steel sheet	ca 100,-/kg

WOOD Workshop

Basic HSE in the workshop

Workshop environmet: The workshops at the institute should be clean and tidy at all times. It should be a safe and pleasant working environment for all the 150 students of Product Design. We expect the all students to contribute to this and do that you do your part to clean up the machines and work areas that you have used. Tools should be put back where they belong.

Tool lending: In the assembly workshop there is a cabinet with various specialized tools. These may be borrowed for short durations in the workshops.



Safety glasses and ear protection: is mandatory for entering the wood workshop.



Dust: Processing wood generates large amounts of dust. When using the machines, the dust extraction system should always be turned on. The most hazardous dust is almost invisible. It is produced alongside the larger, more visible, woodchips from, for example, sanding and sawing. The dust is easily agitated off surfaces just by walking by it, so cleanliness is vital for a safe working environment.



Attire: Clothes should not have loose elements that can get caught in the machines. Likewise, gloves should never be worn in the wood workshop for the same reason. Gloves may also give a false sense of security when working on dangerous machines. Steel tipped work shoes with good gripping soles are advised.

Materials and material properties

Keywords for own notes:

- Cell structure
- Fiber saturation
- Density
- Spring/summer wood
- Fiber directions
- Shrinkage

Solid wood

Keywords for own notes:

- Pine
- Spruce
- Birch
- Oak

Sheet wood

Keywords for own notes

- Veneer
- Plywood
- Birch veneer
- Poplar veneer
- MDF
- Chipboard

Machines and tools: Techniques and processes.

Mortiser

USE

This mortiser creates square holes. It does this with the help of a four-sided square chisel with a hollow center. In the center is a long drill bit that removes the core of the material while the chisel edges cut and forces the outer material into the drill bit which then removes it from the hole.

HSE

When connecting the cutting elements, the chisel and drill bit are connected individually and must match each other.



Keywords for own notes:

- Operational user guide
- Material clamping
- Adjustment of cutting components
- Attaching cutting components

Sliding table saw

USE

The sliding table saw is a combined rip and cross cutting saw. The saw blade is electronically adjustable. The saw has a rolling miter table with mounted 90deg fence which assists in making very accurate cuts. On the wall next to the large band saw is an adjustable angle miter fence that can be attached to the table.

HSE

Always use the blade guard when possible. In some instances it will not be practical to do so, and in these cases extreme caution must be taken when sawing. Beware of the danger of material getting “squeezed” between the saw blade and ripping fence. Remember: calm and slow movements.



Keywords for own notes:

- How to use the machine
- Differences between rip cut and cross cut
- Fences
- Blade guard

Jointer

USE

A jointer is a machine used to square adjoining faces of material. By using the angle settings on the fence, defined angles between faces is possible.

HSE

The blade guard should always be set so that the least amount of blades is visible. Always use a push-board, especially with thin stock.



Keywords for own notes:

- How to use the machine
- Yes- materials and no-materials
- Sizes
- Fiber direction
- Cut depth

Thickness planer

USE

The thickness planer is a machine which is used to create stock that is of an even thickness throughout its length and flat on both surfaces. The blades and feed mechanism are located in the top part of the machine, while the stock slides on the lower part.

HSE

Never plane stock that is shorter than 30cm. Never plane across the fiber direction of staff glued stock. Should a problem arise, for example a jam, turn the machine off and wait for it to stop completely before inspecting the problem.



Keywords for own notes:

- Measuring stock
- Feed direction
- Adjustment of thickness
- What materials
- Edge and flat planing

Bandsaw

USE

The blade of the bandsaw runs in a continuous loop around two or more wheels. The blade rotates and is held in position by blade guides. The tooth direction of the blade is always downwards. The bandsaw allows cutting of radii and complex contours. Also used for rough cutting of stock. Sanding required for better surface finish.

HSE

The blade guide should be adjusted to just slightly higher than the height of the stock. Be always mindful of where the stock and your hands are in regard to the blade.



Keywords for own notes:

- Choice of material
- Cutting radii
- Y- Δ switch
- Sawing round and spherical stock

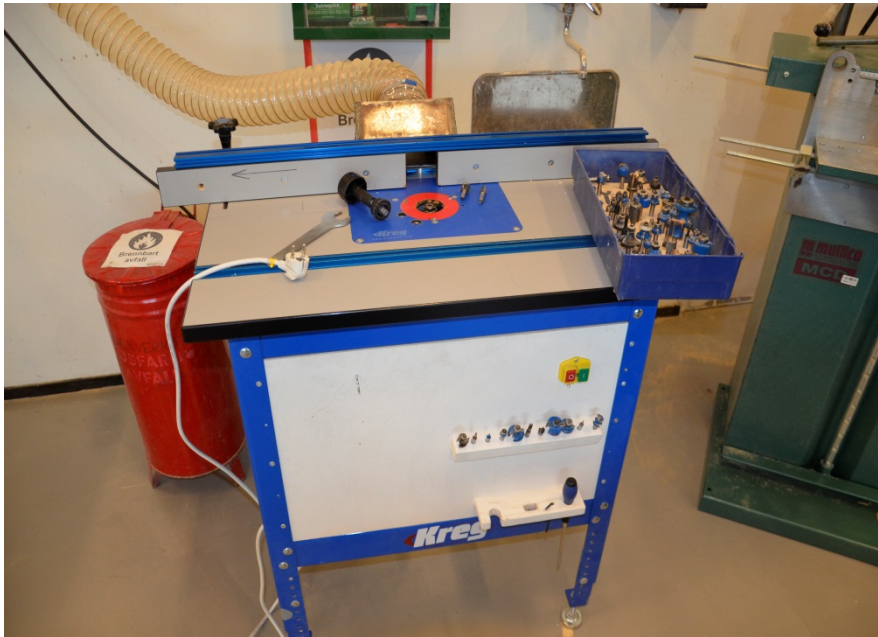
Router table

USE

The router table is a machine for routing profiles and grooves with the use of router bits that come in many different variations. Routing can be done freehand or with the help of a fence. The height of the router bit and fence are adjustable. The feed direction should always be against the rotation of the router bit.

HSE

Always disconnect the electrical plug when changing the router bit.



Keywords for own notes:

- How to use the machine
- Tool change
- Locking the spindle

Sanding machines

Sanding machines are used for material removal and surface finishing in many different scenarios. Care must be taken not to apply too much pressure to the sandpaper to avoid generating heat and loading the paper with resin. The sandpaper comes in a variety of grits, with the lower numbers representing coarse and higher numbers fine grit. For the best surface finish, sand with the direction of the grain.

Disc sander

USE

Used for sanding end grain and squaring smaller objects

HSE

Use the side of the disc that rotates downwards toward the table

Keywords for own notes:

- How to use the machine
- End grain



Edge sander

USE

Used for sanding longer stock in the direction of the grain. It is possible to sand inner radii on the end of the machine.

HSE

Hold the stock with your hands as close to the sand paper as possible for best control.

Keywords for own notes:

- How to use the machine
- Pressure



Pad sander

USE

Used for sanding large surfaces. The stock is placed on the table which can be adjusted for height. The pad inside the belt loop is pushed against the stock while the table is moved in and out. It is also possible to sand on the top surface of the loop by removing the cover.

HSE

The belt can move in both directions
Extra dust extractor

Keywords for own notes:

- How to use the machine
- Technique



Oscilating spindle sander

USE

Used for sanding inside radii. 6 different diameter sanding drums

HSE

Sanding small holes can cause the stock to start rotating

Keywords for own notes:

- How to use the machine



Drill press

USE

The drill press in the wood workshop is for wood only. The table and spindle head is height adjustable. The drill press is capable of 8 different speeds. Stock can be clamped to the table.

HSE

NEVER use gloves
Clamp the stock securely
Use correct speed

Keywords for own notes:

- How to use the machine
- Morse taper
- Depth stop



Wood lathe



USE

The wood lathe works on the same principles as the metal lathe. The main difference is that the tooling is hand held on the wood lathe. A variety of tooling is available for different operations. The speed is infinitely variable.

HSE

Mount stock securely

Use low speed until stock is trued

Keywords for own notes:

- How to use the machine
- tooling

Dust extraction table



The dust extraction table is isolated from the main extraction system, and must be turned on with the switch under the table. The noise from the table is often confused with the main extraction system, so make sure that the main extraction system is turned on when using the other machines.

Keywords for own notes:

- Cleaning the filter
- Emptying the dust tray

Vacuum table

The vacuum table is used for a variety of vacu-forming operations, for example laminating wood veneer. Can also be used for composite materials with the addition of a pre-heater

USE

The membrane is easily damaged by sharp edges. These need to be protected before vacuum is applied. There are two different membranes: The black for cold work and the transparent for hot.

HSE

The forming molds must be made sufficiently strong as so not to collapse under vacuum.

Keywords for own notes:

- Laminating glue
- Notes regarding usage
- Why vacuum



Rip cut/cross cut

(Own notes)

Dimensioning

(Own notes)

Joining

(Own notes)

Glue

(Own notes)

Filleting

(Own notes)

Material prices

You will find the price list in the hall outside the workshop.

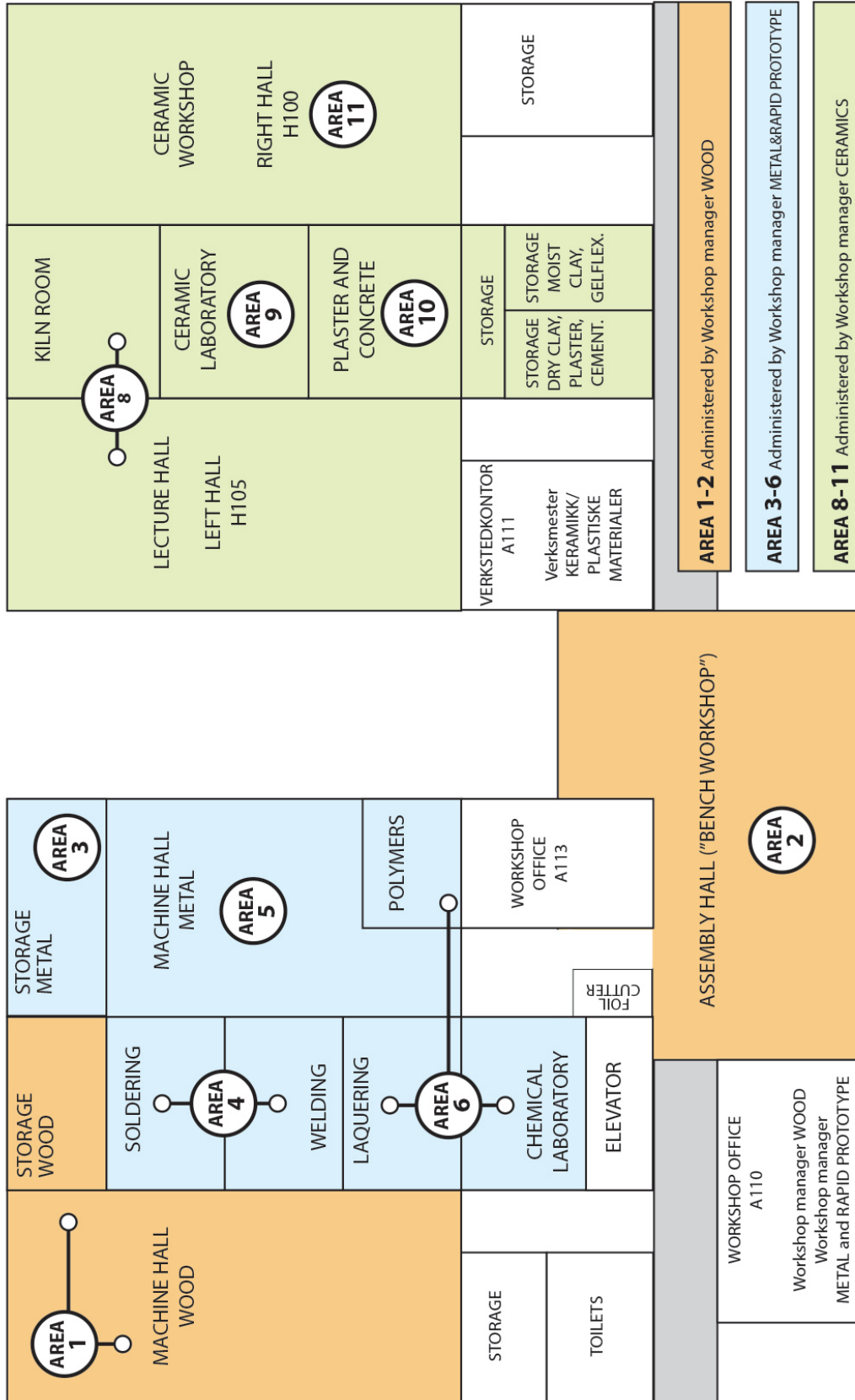
Polymers

(OWN NOTES)

Workshop areas

WORKSHOP AREAS

INSTITUTE FOR PRODUCT DESIGN AT OSLO AND AKERSHUS UNIVERSITY COLLEGE OF APPLIED SCIENCES

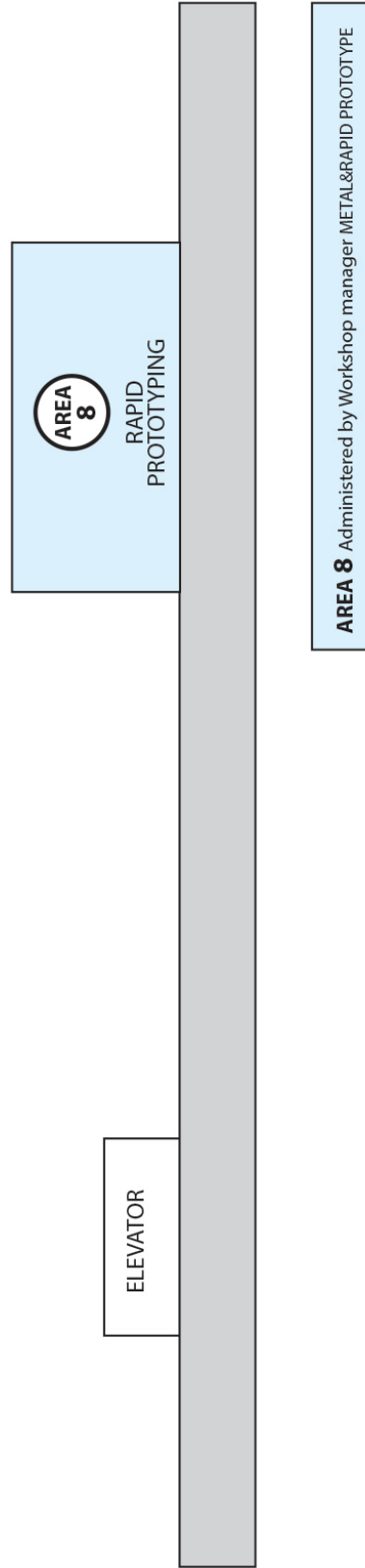


Workshop managers 2014: WOOD: Kurt Ollila tel 414 16 382. METAL and RAPID PROTOTYPE: Mikael Omland tel 994 52 012. CERAMICS: Sigrd Haugen tel 975 15 975.

Revised June 24, 2014

BASEMENT

WORKSHOP AREAS AT THE INSTITUTE FOR PRODUCT DESIGN AT OSLO AND AKERSHUS UNIVERSITY COLLEGE OF APPLIED SCIENCES



Workshop managers 2014: WOOD: Kurt Ollila tel 414 16 382. METAL and RAPID PROTOTYPE: Mikael Omliid tel 994 52 012. CERAMICS: Sigrid Haugen tel 975 15 975.

Revised June 24. 2014

Workshop regulations

for the workshops at the Department of Product Design at the University of Oslo and Akershus.

In the WORKSHOP MANUAL, that you will receive at the safety training in the workshops, are specific descriptions regarding the safety of the various workshop areas at the institute. The last revised version of the workshop manual is included as part of the current workshop regulations.

Access to the workshops requires that you have signed declaration forms 1 and 2, and have completed and passed practical safety training. Pregnant and breastfeeding women have limited access to the workshops. If you become pregnant while you are a student at the department you are obligated to report this so that the Institute can provide facilitation.

MANDATORY SAFETY EQUIPMENT



The eyes are protected with goggles, screen, welding goggles or welding mask against splinters, sawdust, chemicals, sparks and arc light.



Hearing is protected with ear protection when using machinery with high noise levels, or staying in noise zones.



The hands are protected with leather gloves against cuts and heat, rubber gloves against chemicals and cement, and latex/vinyl gloves against glaze raw materials, pigments and thermosetting plastics such as silicone, polyurethane and epoxy.



The lungs are protected against dust from wood, metal, cement, clay, glaze raw materials and pigments, and the exhaust gases from chemicals, paints by using dust masks, respirators and exhaust fans.

Wear appropriate work clothes and shoes. When working with heat (welding, soldering, casting) use only work clothes that do not contain synthetic materials. When working with chemicals, use a plastic apron. Keep work clothes clean so they do not pollute the working environment. Steel tipped work shoes are recommended. Open shoes (sandals) should never be worn in the workshops.

WORKING ENVIRONMENT

1. Tidy and clean after finishing a work session, both at the station/machine and public areas you have used. You have a duty to tidy and clean even though the workplace was not cleaned when you started using it. All workshop areas shall, at all times, be ready for work and teaching. Return tools and materials after each work session. This must be done even if you intend to use it later that day. The workshop areas for processing of dry materials must be swept up before leaving the machine, even if you've only done a little of work and even if you intend to use the station/machine again the same day. The workshop areas for wet materials must also be washed with water or other suitable detergents.
2. Do not store things in the workshops that do not belong there. Desks and benches in the workshops should not be used as storage area. Objects belonging to the current courses may be stored on the shelves of the bench workshop and the shelves of the ceramics workshop, H100. Label objects with name, class and phone number. Objects that are not labeled may be thrown away.
3. Food and drink should never be brought to the workshops.

MATERIALS AND MACHINE USE

1. Correct use of machinery and materials are described in the Workshop Manual.
2. When working with chemicals or hazardous materials, please read the Safety Data Sheet for the material/chemicals before work starts. Safety Data Sheets are available through EcoOnline.
3. When working in machine workshops there must always be at least two people present.
4. Seek guidance from a teacher if you are unsure about the use of a machine, a tool or material.
5. Be sure you know how a machine is stopped before starting it.
6. It is illegal to remove the safety devices fitted to machines.
7. Never leave a running machine unattended.
8. Do not use a machine to which it is intended.
9. Avoid disturbing or stressing the user of a machine.
10. The use of open flame should only take place in rooms approved for hot work.
11. Processing of metal in the wood workshop is prohibited, as well as woodworking in the metal workshop.
12. You are not permitted to enter the workshops under the influence of drugs with cautionary triangle marking, intoxicants, or otherwise have impaired concentration.
13. If an injury occurs, seek help as soon as possible from a teacher, workshop manager or fellow students. Fill out the accident form when the situation is dealt with, and hand it in to a teacher.
14. If a machine or tool is damaged in use, report it to one of the teachers in the workshop as soon as possible so that repairs can be carried out. You will not be held liable for any unforeseen mishaps.
15. Do not waste materials. Ask a teacher if you are unsure about what left over materials should be kept and where they should be stored.

WORK OUTSIDE THE COURSE PLAN

1. All work in the workshops should be course-related or approved by the relevant workshop manager.
2. Alumni students have access to the workshops by written agreement with the workshop managers. All work must be done in accordance with the workshop regulations.