

Workshop handout

INTRODUCTION TO WIRE-FEED MIG/MAG METAL WELDING



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- Welcome to the course
- <u>Objectives</u>

AT THE LAB

- <u>The space</u>
- Machinery and Equipment

Creating your project

What is MIG/MAG welding

BASICS OF WELDING

USING THE MACHINERY

- <u>Checklist before using the machinery</u>
- <u>The welding machine and its parts</u>
- Shielding Gas
- Electrode Wire
- Parameters of amperage
- <u>Handling the welding Gun</u>
- Preparing your workpiece
- Welding distortion

SAFETY

- <u>Cleaning after finishing</u>
- <u>Risks and safety instructions</u>
- Personal safety
- <u>Do's and don'ts</u>

CONCLUSION

Additional resources

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HELLO!

In this 2.5 hour workshop you will learn the basics about wire feed welding, how to set the machine properly, do simple welds and work safely. In the welding lab you can construct and weld structures out of metal.

This handout compiles the most relevant information about MIG/MAG welding methods, as well as some practical instructions on how navigate and to use the welding machines at MotionLab.Berlin.

This guide will not cover how to use the basic machinery of the metal lab. It is therefore recommended to take part in the introduction to the metal lab as all welded piece need to be prepared and worked on previously using the machine of the metal lab.

We encourage you to always come back to this material in case you have any questions regarding the use of the technology and the machinery.



YOUR LEARNING OUTCOME

During this workshop you will learn how to:

- Work at the welding lab safely.
- Set and operate the welding machinery.
- Create a basic object to test your new skills.



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THE SPACE

The welding lab is located through the blue door to the left of gate 2.

It is equipped with a a welding machine and a large welding table for constructions.

The maximum room capacity (including the non welding part of the lab) is 5 persons.



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MACHINERY & EQUIPMENT



2 x Picomig 305 puls wire feed MIG/MAG welder

Machines equipped with:

- 0,8 mm wire
- **1,0** mm wire

Gas metal arc welding (GMWA) divides into two processes:

Metal active gas (MAG)
Metal inert gas (MIG)
Process number : 135
process number : 131

Properties and application:

Welding is a process in which an electric arc forms between a consumable wire electrode and the workpiece, causing them to melt and join. The electrode in this case is a long wire role that unrolls while welding which makes it a uninterrupted, fast and therefore economic method.

To protect the area of the weld from atmospheric contamination, two different types of gas are used: **Active gas** which is more economic and **inert gas** which allows the welding of aluminium and other non ferrous materials.



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CREATING YOUR PROJECT

In order to successfully create your project in the metal lab, you need to consider these four steps:



Decide what would you like to make, and chose a suitable material to make it from.

Consider that the fabrication capabilities are limited in this lab and you should design your parts accordingly. Either hand drawn or with your preferred CAD software. Print it to have as a reference

The metal lab is a dirty and dangerous place for sensitive electronics. Printed or drawn references are preferable to bringing a laptop inside. Any cutting and drilling of the pieces should be done before welding

Before welding pieces, they should be chamfered, cleaned and placed correctly to avoid heat distortions. Choose the right parameters for your project

Set the welding machine to your needs in order to work safely and ensure a stable and lasting weld.

CHECKLIST BEFORE USING THE MACHINERY

Before starting a job at the welding station of the metal lab, ask yourself the following questions:



Can I operate this machine safely and confidently?

If in doubt, please ask! The metal lab is a very dangerous place. Sometimes all you need are some tips to refresh your knowledge.

Am I wearing any inflammable clothing, or are there flammable objects lying around the working area?

Welding causes intense heat, as well as splatter and sparks. Synthetic clothing or notes on paper should not be lying close to your working space.

In an emergency, do I know where the fire extinguisher is?

Take a moment to familiar yourself with your surroundings and acknowledge where the fire extinguishers are located.

Is there anyone else around me?

Be aware of your surroundings. MIG/MAG welding causes intense UV radiation that can cause blindness and skin burns. Announce every time you are welding, and shield your working area from others by using the provided welding curtains.



USING THE MACHINERY

The diagram on top shows the basic equipment to perform gas metal arc welding:

- Welding gun
- Wire feed unit
- Welding power supply
- Welding electrode (wire)
- Shielding gas supply.
- The ground cable is attached to the workpiece.

The diagram on the bottom shows a close up of the welding gun while welding:

The ground cable attached to the workpiece transforms it into a positive pole while the electrode wire acts as the negative pole.

When both come into contact an electric arc forms and melts down the two pieces of metal to be joined as well as the electrode wire itself which becomes then filler metal at the same time.

The weld pool is at all time protected by a gas shield that flows out of the nozzle of the welding gun.



SHIELDING GAS

- The gas flow is set through a pressure regulator. The delivery pressure gauge indicates the gas bottle content. The inlet pressure gauge is indicating the outflow of gas in liter per minute.
- The inlet pressure gauge is set only once through the regulator body following this thumb rule:
 - gas (l x min) = diameter of welding wire x 10
 - For example: when welding with a 1mm wire electrode the gas flow is to be set to : 10l/h
- Once the pressure regulator is correctly set gas will only be opened and closed through the outlet valve at the bottle.

Application note:

- Any gas bottle should always be opened with a single rotation of the valve.
- After welding the gas bottle needs to be closed as tiny leaks can make it run out overnight.
- The gas bottle always needs to be secured to prevent it from falling. Your workplace needs to be windstill in order for the gas shield to not be disrupted.
- A hissing sound and a porous weld will indicate to you if you forgot to open the gas bottle or run out of gas





ELECTRODE WIRE

Electrode wire comes on 5kg-20kg rolls and is conveyed by a wire feed unit.

The two main wire diameters are 0.8mm for fine welds, such as car bodies, and 1mm for rougher results, like in construction.

The wire feed is set in meter / minute and depending on the number of amperage and the welding speed.

Application note:

- If the wire causes a knocking sound against the workpiece you probably have to reduce the wire feed.
- If the wire makes a hissing sound and tends to melt to the contact tip you might have to increase your wire feed. Keep the nozzle of you gun clean at all time using a pair string cutting pliers.
- Trim your welding wire so that it sticks out of the nozzle approximately 5mm.
- The wire is conveyed through a long hose pack from the wire roll to the work piece. The hose pack is very delicate it should never get in contact with sharp edges, encumbered by your or objects or be bend as it will prevent the wire from being conveyed and break.



Schematic illustration of a wire feeder with two roll.

PARAMETERS OF AMPERAGE

The amperage is set according to the following rule of thumb:

40-50 amper / 1mm thickness of workpiece

Application note:

- A well set welding machine makes a regular sizzling sound often compared to the sound of a fried egg in a pan.
- Increase your amperage or decrease your wire feed if your weld is too **concave**. Otherwise, you might get a week joint.
- If convex, decrease your amperage or increase your wire feed. Otherwise, you might get a thin and weak welding.



USING THE MACHINERY

Pushing the blue button on the handle of the welding gun activates both the gas flow and the wire feed.

When the wire comes close or even touches your workpiece, it produces the electric arc.

If right handed, you will weld most of the time to the left direction, at an angle of about 20 degrees. The distance of 1-2 cm between nozzle and workpiece should to be maintained.

Remember! The nozzle and contact tip are consumable parts that can be exchanged. In order to increase their lifespan, it is important to keep them clean with the string cutter at all times, as well as using the release spray over the nozzle/





PREPARING YOUR WORKPIECE

Pay attention to the following tips:

- The part of your workpiece where the ground cable attaches needs to be free of paint or grease for the current to flow.
- The same goes for the part where you are welding: paint, rust or grease leftovers in the joint will contaminate your weld.
- When welding a *butt joint* using a metal piece which is 2mm thick or thicker, you will need to grind (with an angle grinder) the joint to about 60 degrees.
- In order to avoid splatter, use release spray before welding.

Types of joints



WELDING DISTORTION

Welding causes heat and therefore expansion of the material. There is several ways in which you can avoid distortions:

- Clamp down your workpiece to the working table before welding and release only after the weld has cooled down.
- Spot weld your piece diagonally and from both sides before properly welding it (for example when welding a frame).





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USING THE MACHINERY

CLEANING AFTER FINISHING

The metal lab gets extremely dirty and dusty very fast. **Please always clean up metal chips and grinding dust after every use**. Even if you have only created a small mess or the mess isn't all yours.

There are brooms, dust pans and a vacuum provided. Make use of them and make the space nicer for everyone.

Scrap material can be placed in the scrap bins or the scrap trolley (free to use).

When disposing of scrap metal please separate steel and aluminium for recycling.

In case of fire

- Shut off the tool you are using
- Stand clear and locate the nearest fire extinguisher.
- Carefully, and keeping some distance, bring the fire extinguisher next to the fire.
- Use a quick fire extinguisher burst to suffocate the flames.

Fire extinguishers



You will find multiple extinguishers placed around the metal lab.

RISKS AND SAFETY INSTRUCTIONS

The metal lab is the most dangerous place in MotionLab.Berlin

- Most tools here can cause severe and even life threatening injuries.
- Always be acutely aware of this! Take as many precautions as possible to keep yourself and others safe.
- Before using any machine, locate and familiarise yourself with any safety features like emergency stop buttons and fire extinguisher locations.
- Some tools generate lots of dust and fumes. Please open doors if possible and use the overhead extraction unit when welding and wear a dust mask when grinding.





SAFETY

PERSONAL SAFETY

Please, remember to always:

- Wear flame retardant clothing (for exp cotton) that covers ALL your skin to protect yourself from radiation and skin burns.
- Wear long and thick working gloves to protect your hands from heat and radiation.
- Wear strong working shoes to protect you from the impact of the workpiece or small glowing pieces of metal.
- Wear a welding helmet or shield to protect your eyes and face from radiation.
- If you are working with several people announce when you are welding and do not expose others to radiation (use welding curtain to separate the two workshop areas) know where the next fire extinguisher is placed.



DO'S AND DON'TS

DO

- Pay attention to what you are doing and to the people working around you
- When in doubt, ask. We are happy to help
- Keep the area around the machines clear from obstructions.
- Always wear ear and eye protection
- Turn off and lock (where provided) the machines when you finish working with it
- Report any faulty equipment to the staff
- Wear closed shoes (preferably steel toe)
- **Clean after yourself!** The metal lab gets extremely dirty and dusty very fast. Please always clean up metal chips and grinding dust after every use. Even if you have only created a small mess.

DO NOT

- Do not wear gloves when using turning machines (they can get caught and pull you into the machine)
- Leave any machine unattended while running under any circumstance.
- Attempt to to defeat guards or any other safety feature of the machine
- Use paint, glue, resin silicone or aerosol in the Lab space. Also no wood. Metal only!
- Disassemble or repair the machines



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ADDITIONAL RESOURCES



MotionLab.Berlin Slack channel - <u>11 Metal</u>

Join our metal lab slack channel and the community of experts!

Experience projects from coworkers, ask questions and help others and stay up to date about news and changes at the lab.

Also, let us know what exciting things you developed at the lab. Simply, post it in the slack channel and tag @Geri

Where can you order materials

ProKilo / Alboinstraße 26-34, 12103 Berlin

Gemmel Metal / Bessemerstraße 76B, 12103 Berlin



ALMOST THERE!

NOW, PARTICIPATE IN THE LIVE WORKSHOP AND START WORKING ON YOUR PROJECTS!

DID YOU LIKE THE CONTENT OF THIS WORKSHOP AND YOU ARE STILL NOT A MEMBER?

Join our ecosystem and make your ideas come to life!

Reach out to our colleague

Or sign up for our

to learn about the upcoming workshops and events.

Note: This is a living document, which may experience changes as our labs evolve. If any of the links don't work, please report it to



