INTRODUCTION TO

MIG Welding
MIG or Metal Inert Gas welding is the “Hot Glue Gun” of welding.

How does MIG welding work? An electrical arc is created between a continuous, consumable wire electrode and the work piece. The consumable wire is fed through a gun, functioning as the energy source as well as filler material, in turn, establishing a continuous weld (or puddle). Once contact is made between the clamped piece and the wire electrode, the circuit is completed.

How does it compare to oxy-acetylene welding? MIG welding has greater speed and efficiency compared to oxy-acetylene welding, allowing you to concentrate on arc control. Comparatively, oxy-acetylene welding utilizes a torch and separate filler rod to bond metal, while MIG utilizes a controlled spool of filler material. The MIG process can weld most commercial metals and alloys including steel, aluminum, and stainless steel. In this shop, we primarily use MIG for steel.

MIG WELDING BENEFITS

- easiest to learn
- better control on thin metals
- out-of-position welding
- deep penetration for welding thick sections

INERT SHIELDING GAS

- Protects the electrode and weld pool from contamination.
- Enhances welding capabilities of the electrical arc.

Originally aragon or helium. Today, reactive elements such as oxygen and carbon dioxide are usually mixed with the inert gas to improve welding performance.
In order to work in the Metal Shop, you must first attend an Authorization. Authorization Sign Up Sheets and Authorization Request Forms are posted adjacent to the tool check-out area. It is highly recommended that new patrons complete the Introduction to Metal Working Authorization before participating in the welding authorizations.

We encourage patrons to speak with Shop Staff about making material choices that best suit your projects before committing to a purchase. Your choice of materials very well may limit what equipment will be available to you (see Material Concerns, page 8).

Flammable liquids are prohibited in the Metal Shop, including but not limited to butane lighters, propane, aerosol cans, and solvents. Use extreme caution when working near flammable materials (sketchbooks, backpacks, etcetera). Flames, sparks, and hot surfaces can cause fires.

Stress, anxiety, sleep deprivation, low blood sugar, and drugs (prescription & recreational) will interfere with your ability to work safely.

Remove all accessories that could conduct heat or get caught in moving parts of equipment: rings, piercings, watches, ID card lanyards, etcetera.

Tie hair back, tuck in jacket, or hold hair back with a bandanna of cotton or natural fibers. A cap is also a good idea.

Choose natural fibers like cotton, hemp and wool. Synthetic fibers (polyester, nylon) are not recommended because of their flammability. You will be required to wear a welding jacket for all welding processes.

Choose natural fibers, no synthetic fibers (polyester, nylon). Holes or loose, frayed areas are prohibited. Cuff or roll in pant legs that touch the ground. No leggings, especially not jeggings.

Sturdy, closed-toe shoes. Leather shoes are highly recommended. No synthetic material, like material found on running shoes.

Getting Ready

AUTHORIZATIONS

ACCESSORIES

HAIR

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Mental Condition

PLANNING YOUR PROJECT

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PANTS

SHOES

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Always use appropriate Personal Protective Equipment (PPE) obtained from Tool Checkout or Resale. While a flash burn from infrared light can be treated, repeated occurrences can cause permanent eye damage. Keep clothing free of oil, grease, and flammable materials. Additionally, ensure the orange curtains around your station are completely closed before welding.

**EYE PROTECTION** | **TOOL CHECKOUT**
Safety glasses & welding helmets with a minimum shade tint of 10. Check glasses for cracks prior to use and adjust for a good fit.

**UPPER BODY PROTECTION** | **TOOL CHECKOUT**
Welding sparks are very hot and can burn through or ignite fabric, and ultraviolet rays can burn exposed skin. Proper fitting Flame Retardant Jackets are required for all welding processes.

**HAND PROTECTION** | **TOOL CHECKOUT**
Welding Gloves are available in small, medium and large.

**EAR PROTECTION** | **TOOL CHECKOUT**
Ear plugs are available for free. NO HEADPHONES!

**RESPIRATORY PROTECTION** | **RESALE**
The metal shop’s exhaust system provides excellent protection for most applications, and must be activated before welding. A Welding Fume Respirator is highly recommended for those with respiratory concerns.

**WELDING HELMET ADJUSTMENT**
Wear a welding helmet with a lens that is appropriate for the process you are using. Follow the below steps to obtain a proper fit. PPE should be thoroughly inspected before use.

1. While holding the front of the helmet up, place the helmet on your head.
2. Loosen or tighten the helmet by turning the knob at the back left and right.
3. Loosen or tighten the tension of the helmet’s hinge such that it stays up on its own, but will lower with the quick nod of the head. (Left is loose, right is tight)
4. Test your adjustments to be sure the helmet is secure and functions properly before beginning.
Material Concerns

TYPES OF STEEL

Hot Rolled
- Grayscale on surface
- Clean hot rolled steel with a wire brush before welding

Cold Rolled
- Shiny, oily surface
- Clean cold rolled steel with orange soap and paper towels before welding.
- Dispose paper towels in red fireproof can.

Before welding, ensure all oil used during the preparation and fabrication of materials is removed.

RESTRICTED MATERIALS

Paint
Lead
Wax
Magnesium
Rust
Chrome-Plated Surfaces
Hardware
Galvanized Surfaces

These materials are restricted because they contain carcinogens and harmful chemicals. Do not weld on materials, including hardware, that contain these items. However, coated hardware can be sandblasted. Talk to Shop Staff for details.

REUSABLE MATERIALS

Reusable materials are larger scraps in good condition. The material must be approved by management before it goes into the Reuse bin.

RECYCLABLE MATERIALS

Small, unusable scraps go in the Recycle Bin. Please refrain from simply discarding.

MATERIAL HANDLING

A separate pair of gloves for material handling is recommended—DO NOT use Welding Gloves. It is very important for your gloves to remain oil-free.

HOW TO CARRY

Use caution when entering & exiting doorways or blind intersections.

Seek a helping hand when carrying long lengths or heavy materials, don’t try to carry on your own. Walk alongside materials instead of behind or in front.
Welding Stations

Select a welding station based on what you can do and what resources are available to you. In turn, your resources will depend on the selected workspace.

STATION 1 & 4
Can accommodate complex clamping requirements.
- MIG Welder for Steel
- Platen Table
- Ventilation

STATION 2
Moveable welding surface can be removed from the space for free standing projects.
- MIG Welder for Steel
- Table On Wheels
- Ventilation

STATION 3
Moveable welding surface can be removed from the space for free standing projects.
- MIG Welder for Steel
- Spool-O-Matic for Aluminum & Bronze
- Table On Wheels
- Ventilation

RELATED TOOLS

- WIRE CUTTERS
- GUIDES
- MAGNETS
- CLAMPS
- WIRE BRUSHES
  - Steel & Iron
  - Copper, Brass, Bronze
  - Aluminium
The Welder

There are 8 components of a basic MIG welding system.

1. Power Source
2. Wire Feeding Mechanism
3. Adjust Control
4. Shielding Gas Cylinder
5. Regulator
6. MIG Gun
7. Work Clamp
8. Ventilation

1. POWER SOURCE

MIG's power source is a constant voltage machine. The power source converts primary power (alternating current, AC) from an outside source to secondary (direct current, DC), usable power at a specified current and voltage to maintain a welding arc. You may recognize this acronym adopted by the band AC/DC.

**alternating current**  **direct current**

\[
\text{AC} \quad \rightarrow \quad \text{DC}^+
\]

2. WIRE FEEDING MECHANISM

The wire feeding mechanism's drive motor turns rollers that grasp the spooled wire, feeding the gun at a controlled speed. This allows the operator to adjust the rate of delivery of the wire which is done by setting the wire speed control.

*Never open this compartment without staff supervision.*

3. ADJUSTMENT CONTROLS

The voltage adjustment control sets the weld power output voltage. Once set, the voltage remains constant.

- **Wire Speed Control**
  - Adjusts wire feed speed (IPM, Inches Per Minute)

- **Volts Control**
  - Adjusts voltage

4. SHIELDING GAS CYLINDER

The shielding gas cylinder contains gas stored under pressure and should be handled very carefully. During welding, inert shielding gas is dispensed from the cylinder, in turn, shielding the arc.

5. REGULATOR

The regulator controls the flow of gas. The amount needed will vary. Reference the chart conveniently located on the welder for proper settings.
The trigger on the **MIG Gun** activates the wire feeding system, gas delivery, and weld power. The nozzle in the gun directs shielding gas around the arc weld pool. The contact tip at the front of the gun transfers electrical current to the electrode wire.

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**6. MIG GUN**

- Trigger
- Nozzle
- Contact Tip

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**7. WORK CLAMP & VENTILATION**

Connecting the **work clamp** to the work piece or metal contact completes the weld circuit and enables current to flow.

Proper **ventilation** of your workspace is critical. Plating, coatings, paint, and other materials on the base metal or near the arc area may give off smoke and fumes that can cause mild nose and eye irritation to permanent injury and even death. Additionally, the shielding gas used for welding can displace the oxygen in an enclosed space and cause suffocation. Be sure the exhaust system is on and properly positioned before you begin.
The Welding Process

1. INSPECT EQUIPMENT & SET MACHINE

Before you begin, ensure the cables are not frayed or damaged.
Turn machine on.
Set voltage and wire speed.
(Refer to chart on machine.)

2. SET GAS PRESSURE

Open valve counter-clockwise 1½ turns, monitoring the psi.
Turn butterfly knob clockwise to set pressure. (Refer to chart on machine.)

3. PREP WORK STATION

Use the steel and iron wire brush to clean debris from table. Ensure all oil is removed from materials to be welded.
Secure your workpieces using clamps and or magnets.

4. CLAMP MATERIAL

Attach the work clamp to either the table, clamp or work piece to complete and ground the circuit.

5. GUN & EXHAUST POSITIONING

On the gun, keep a distance between the end of nozzle and the wire 1/4”–3/8”.
Position the exhaust 12”–16” from your welding setup. If it is too close, it will suck the shielding gas away resulting in defective welds.

6. WELD

Keep material clean with the wire brush between welds.
Closing Down

1. CLOSE REGULATOR
Close cylinder knobs until the valve is securely tightened.

2. BLEED LINE
Bleed line by squeezing trigger until both regulators read “zero”.

3. STOP GAS PRESSURE
Back out regulator’s butterfly valve until there is no resistance and approximately ½ inch of threads are showing (don’t back out too far).

4. TURN MACHINE OFF
Flip the switch to turn the MIG welding machine completely off.

5. HANG HOSE & CLEAN UP
Finally, wrap hose and hang on the side of the machine to keep the hose off the floor. Return all equipment back to cage. Lastly, clean the work-station, leaving it ready for the next user.
Welding & Metal Fabrications Resources

- **Protective Clothing, Equipment, & Specialty Supplies**
  WISCO—Welding Industrial Supply Company
  www.wiscoonline.com
  2200 N. Western Ave
  Chicago, IL 60647
  773-384-5242
  (Ask about student discounts)

- **Metal (extensive inventory)**
  Gordon Brothers Steel Warehouse
  www.gordonsteel.com
  1340 W. 43rd Street
  Chicago, IL 60609
  (773) 927-1800
  (888) GBS-1910

- **Machine Screws, Specialty Hardware, Tools, Metal Products, & Supplies**
  McMaster-Carr
  www.mcmaster.com
  (630) 833-0300
  (630) 600-3600
I have attended the MIG Welding Authorization training session and I have read and understand the MIG Authorization Handbook. I had the opportunity to ask questions concerning the training and the Handbook and all of my questions have been answered to my satisfaction.

I understand that I remain responsible for knowing and adhering to the School’s Instructional Shop safety regulations and procedures. I understand that my safety and the safety of others using the Instructional Shop is dependent upon adhering to these safety protocols/procedures. I understand and acknowledge that if I fail to abide by the safety protocol/procedures outlined in this Handbook and presented in Equipment Authorization Workshop, I may be subject to disciplinary sanctions, including, but not limited to, fines and/or the loss of Instructional Shop privileges. Furthermore, I acknowledge that the School will not be responsible to me for any damage or injury caused by my negligence or willful misconduct.

I understand that I am financially responsible for replacing lost or damaged equipment.

I further acknowledge that loss of privileges to use the Instructional Shop does not in any way excuse me from completing my course work on time.

I understand and acknowledge that it is my responsibility to test the equipment that I use and/or receive and that I must seek the pertinent instruction on proper use of a piece of equipment from Instructional Shop Staff or other authorized person before I attempt to use the equipment. If I encounter safety problems in the course of my work, I will discuss them with Shop staff. I acknowledge that it is my responsibility to report any equipment malfunction or damage immediately to Shop staff.

Name (please print): ____________________________
Signature: ____________________________
Date: ____________________________
Student ID: ____________________________