Student Sample: Grade 12, Informative/Explanatory

A high school senior wrote the essay that follows for a career and technical class. The student had unlimited time to research and write this paper.

TIG/GTAW Welding

Welding is a highly demanded trade across the US. There are many types of welding such as wire feed, stick, TIG (Tungsten Inert Gas), and oxy acetylene welding. I will explain the most perfected and efficient welding process of them all, TIG welding. I will take you through shielding gases, tungsten materials, tungsten shapes and shaping, heat and warp age, welding flaws, and some recommendations to prevent welding flaws.

There are many purposes for shielding gases in the welding industry. In general, shielding gases are one of the many variables throughout the TIG welding processes. There are four types of gases and they all have their own characteristics. Shielding gases protect the molten metal and the tungsten from the impurities in the air during welding. Shielding gases also have an effect on the temperature the arc produces and the physical appearance of the weld bead. Flow rates in the TIG welding processes can also affect the shielding aspects of your weld.

The four types of shielding gases throughout the TIG welding processes are: argon (Ar), helium (He), hydrogen (H), and nitrogen (N). Any of those four gases can be mixed together.

Argon is a by-product of oxygen and nitrogen. Before it was produced on a huge scale, argon was a rare gas. Since argon is denser than air, argon can shield welds in deep grooves and tight places. But since argon is denser than air, when overhead welding is necessary, flow rates need to be increased because the argon will fall from the weld. Argon is fairly easy to ionize so it makes it convenient for AC (Alternating Current) welding.

Helium is a by-product of natural gas. Helium increases your weld penetration. Helium is great for welding aged aluminum and is also great for tube mills since helium allows you to weld at higher speeds. Helium is usually mixed with argon to help the shielding aspects since helium is lighter than air. Helium is not used with the AC since it doesn't have the cleaning aspects that argon has.

Hydrogen is not used so much as a shielding gas as much as an additive to other shielding gases. Hydrogen is used when weld penetration and speed is needed. Hydrogen is not used when welding stainless steel since hydrogen is the number one cause of porosity and cracking in mild and stainless steel.

Similar to hydrogen, nitrogen is used as an additive to argon. It also can cause porosity in some ferritic steels. Ferritic steels are defined as a group of stainless steels with a chromium content range of 12-18o. Such steels do not respond well to heat treatment or temperament.

Nitrogen is used to increase penetration when welding copper alloys. Nitrogen is also a stabilizer when welding alloys. When it comes to shielding gases it makes a big difference in your welds. There are many characteristics to consider when you weld different materials.

Tungsten is a base material the electrode is made of. The electrode is the part of the welding torch that transfers the electrical arc to the weld material. Tungsten materials are another huge variable when it comes to TIG welding. Tungsten materials can affect your weld in similar ways as shielding gases. There are many characteristics of each material and depending upon what you are welding you may have to make some choices. Each tungsten is labeled by a color to make choosing easier.

There are five common types of tungstens including: pure tungsten (green), 1 % thorium (yellow) and 2 % thorium (red), 1/4to 1/2 % zirconium (brown), 2 % cerium (orange), 1 % lanthanum (black).

Pure tungsten has limited use for AC welding, and has the poorest heat resistance and electron flow, since there is no other material mixed with pure tungsten, it doesn't have any of there characteristics including electron flow rates or heat resistance. Pure tungsten is mostly used for aluminum and magnesium.

Thoriated tungsten improves current flow, but to maintain an arc with thoriated tungsten requires more voltage. Thorium increases service life of the tungsten and makes arc starting easier. Thoriated tungstens do not work well with AC welding since it is hard to maintain a ball end shape, which is required for AC welding.

Zirconium tungstens help emit electrons more freely and can be used with AC and DC (Direct Current) welding processes, unlike thoriated tungstens. Unlike thoriated tungstens zirconium tungstens are not radioactive. So they have less contamination aspects than thoriated tungstens.

Cerium tungstens have many of the same characteristics as thoriated tungstens, they were actually made to replace thoriated tungstens since they are not radioactive, which makes them safer. Lithium tungstens are also non-radioactive like cerium. They are similar to thoriated tungstens, except they have a higher arc voltage.

Tungsten shaping and heat penetration are directly related to each other. When you change the thickness of the materials you are welding, you need to maybe consider changing shielding gases or tungeten types but you also need to think about the shape on the end of the tungsten especially since it changes weld penetration.

There are three basic shapes to choose from You can modify each as you learn more about all the variables you can choose from The three basic shapes are: pointed end, rounded end, and tapered with ball end (FIGURE 1).

There are special ways to grind and shape your tungstens. When you grind your tungsten, you need to make sure you use a grinding wheel that you have never grinded with before. If you use a used grinding wheel, the tungsten may become contaminated, and eventually contaminate the metal you are welding. You also need to make sure when you grind a point on your tungsten, to grind the tungsten parallel to the grinding wheel. Grinding your tungsten parallel to the grinding wheel allows electrons to flow easier, and prevents further contamination to the tungsten. You need to make sure when grinding a pointed end tungsten that the length of the tapered part of the tungsten is twice as long as the diameter of the tungsten. Tungsten shape and shaping is another large element of TIG welding that needs to be considered to make your welds most efficient.

(figure not reprinted here)

Heat is the main reason for warpage in the welding industry. Warpage needs to be considered when welding since the shape of the material will change after applying heat. There are different ways metals warp depending on where the heat is applied and how much heat is applied. Many professional welders know through experience how much a project will warp with different settings on the welder. They can also predict and correct warpage before it happens. Warpage can also depend on tungsten shape, tungsten material, amperage, shielding gases, weld angles and weld distances. There are also different ways metal warps depending on the weld joint.

(figure not reprinted here)

As shown in FIGURE 2, once the heat from the welding process is applied to the objects, the two arrows show which way the metal is warped. The two dots represent the weld. There are many different ways metal can warp and this shows just an idea of how the weld warps the metal.

There are many TIG welding flaws you can run into when you are not fully experienced. These flaws must be looked at, especially when people's lives depend on it, such as in constructing bridges and buildings.

Many common welding failures are caused by welding flaws such as porosity, inclusions, inadequate penetration, and cracks, just to name a few. All of these problems can cause your weld to be weaker than you intended.

Porosity is caused when gases are dissolved in the weld, forming air bubbles in and on the weld. The result of porosity is caused by improper shielding gases or pressure settings. The shielding gases are what protect the molten metal when welding and eliminates porosity.

Inclusions are when non-metallic metals such as slag enters the molten metal. This can be caused by multiple weld starts. It can be fixed by welding one continuous bead.

Inadequate penetration can weaken the weld severely along with inclusions and porosity. When you don't get the right amount of penetration you don't allow the full amount of materials to fuse together. The main cause of improper penetration are a misdirected arc and not enough amperage. Simply, the weld bead is too small for the job.

Cracks are another flaw that can have drastic effects. Cracks are caused during the solidifying stages of welding. When the metals drastically drop temperature, the weld materials are vulnerable to cracking. Slowing your weld speed is one of the main corrections to cracking. When welding it is most important to ask questions if you need to since someone's life could depend on it.

TIG welding processes can weld many more materials than wire feed of stick welding. TIG welding processes are capable of welding many types of materials such as: copper, aluminum, mild and low carbon steels, stainless steel, and magnesium. This is what makes TIG welding so different than any other welding process. You can weld so many different materials. This is where TIG welding becomes the most perfected welding process in the welding industry. The TIG welding process can weld the most materials of all the welding processes.

Some recommendations will help you perform better welds, these fall into categories like welding angles, arc distance control, tungsten types, and shielding gas considerations. TIG welding can be a lot to take in when it comes to an essay, but if you can remember different recommendations such as these you will increase your abilities to weld with a TIG welder. The first recommendation is to consider all your variables throughout the whole process, ask questions when needed and take your time. Speed will eventually come as time goes on. To clear up how the TIG welding process works check out the illustration below.

(illustration from online source not reprinted here)

Now that you know about some recommendations on how to improve your weld abilities, I will explain how to protect yourself during welding. Safety is a huge deal when it comes to welding in general. You need the proper protective equipment to make your job or experience as safe as it can be. You need to protect your eyes, skin, and lungs. You need a proper welding helmet to protect your eyes and face from the bright arc and spatter. You will also need thick gloves and a long sleeve cotton shirt to protect your skin from burning from the bright light. You should leave no skin uncovered or unprotected. Burns can lead to blindness and skin cancer. You should also have pants and steel toe boots to protect against further burns or falling objects. A respirator should be used when welding specific metals to protect your respiratory system from cancer and other damage.

Learning about TIG welding has been a very helpful experience for me since it will help me in my college career, and in my job after school. I am going to be a certified welder. This learning experience has helped me greatly. TIG welding is something that needs to be learned not only by textbook or paper but also by hands on learning. And thankfully, I have gotten that experience to weld hands on. It makes learning so much easier

Works Cited:

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Annotation

The writer of this piece

- **introduces a topic.**
    - *There are many types of welding . . . I will explain . . . I will take you through . . .*
- **organizes ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; includes graphics when useful to aiding comprehension.**
    - *I will explain the most perfected and efficient welding process of them all, TIG welding. I will take you through shielding gases, tungsten materials, tungsten shapes and shaping, heat and warp age, welding flaws, and some recommendations to prevent welding flaws.*
    - *There are many purposes for shielding gases in the welding industry.*
    - *The four types of shielding gases throughout the TIG welding process are: argon (Ar) . . .*
    - *Argon is a by-product of oxygen and nitrogen.*
- **develops the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.**
    - *Hydrogen is not used so much as a shielding gas as much as an additive to other shielding gases. Hydrogen is used when weld penetration and speed is needed. Hydrogen is not used when welding stainless steel since hydrogen is the number one cause of porosity and cracking in mild and stainless steel.*
    - *If you use a used grinding wheel, the tungsten may become contaminated, and eventually contaminate the metal you are welding.*
    - *When welding it is most important to ask questions if you need to since someone's life could depend on it.*
- **uses appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.**
    - *There are special ways to grind and shape your tungstens. When you grind your tungsten, you need to make sure . . .*
    - *As shown in FIGURE 2, once the heat from the welding process is applied to the objects . . .*
    - *Inadequate penetration can weaken the weld severely along with inclusions and porosity. . . . Cracks are another flaw that can have drastic effects.*
- **uses precise language and domain-specific vocabulary to manage the complexity of the topic.**
    - *Similar to hydrogen, nitrogen is used as an additive to argon. It also can cause porosity in some ferritic steels. Ferritic steels are defined as a group of stainless steels with a chromium content range of 12-180.*
    - *Zirconium tungstens help emit electrons more freely and can be used with AC and DC (Direct Current) welding processes, unlike thoriated tungstens.*
- **establishes and maintains a formal style and objective tone while attending to the norms and conventions of the discipline in which the student is writing.**
    - *Now that you know about some recommendations on how to improve your weld abilities, I will explain how to protect yourself during welding.*
    - *Learning about TIG welding has been a very helpful experience for me since it will help me in my college career, and in my job after school. I am going to be a certified welder.*
- **provides a concluding section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).**
    - *Learning about TIG welding has been a very helpful experience . . . I am going to be a certified welder. . . . TIG welding is something that needs to be learned not only by*

textbook or paper but also by hands on learning. And thankfully, I have gotten that experience to weld hands on. It makes learning so much easier.

- **demonstrates good command of the conventions of standard written English (with occasional errors that do not interfere materially with the underlying message).**