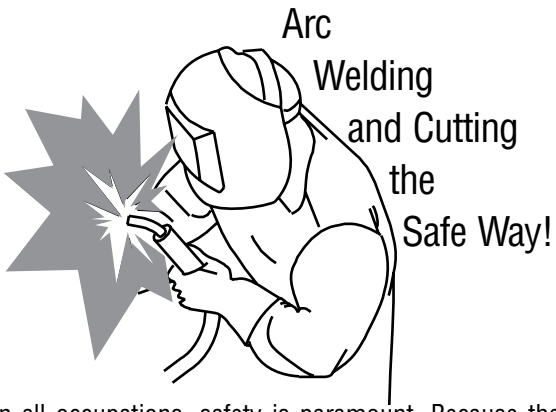
Miller®

Topic 5.

Welding Process Training Series

Engine Driven Welding Power Sources

SAFETY



As in all occupations, safety is paramount. Because there are numerous safety codes and regulations in place, we recommend that you always read all labels and the Owner's Manual carefully before installing, operating, or servicing the unit. Read the safety information at the beginning of the manual and in each section. Also read and follow all applicable safety standards, especially ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes.

ANSI Z49.1:, Safety in Welding, Cutting, and Allied Processes is available as a free download from the American Welding Society at: http://www.aws.org

Here is a list of additional safety standards and where to get them.

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1, from Global Engineering Documents (Phone: 1-877-413-5184, website: www.global.ihs.com).

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Quincy, MA 02269 (Phone: 1-800-344-3555, website: www.nfpa.org and www. sparky.org).

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly, VA 20151 (Phone: 703-788-2700, website:www.cganet.com).

Safety in Welding, Cutting, and Allied Processes, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 5060 Spectrum Way, Suite 100, Ontario, Canada L4W 5NS (Phone: 800-463-6727, website: www.csa-international.org).

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 25 West 43rd Street, New York, NY 10036 (Phone: 212-642-4900, website: www.ansi.org).

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B, from National Fire Protection Association, Quincy, MA 02269 (Phone: 1-800-344-3555, website: www.nfpa.org.)

OSHA, Occupational Safety and Health Standards for General Industry, Title 29, Code of Federal Regulations (CFR), Part 1910, Subpart Q, and Part 1926, Subpart J, from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (Phone: 1-866-512-1800) (There are 10 OSHA Regional Offices—phone for Region 5, Chicago, is 312-353-2220, website: www.osha.gov).

Booklet, *TLVs, Threshold Limit Values*, from American Conference of Governmental Industrial Hygienists (ACGIH), 1330 Kemper Meadow Drive, Cincinnati, OH 45240 (Phone: 513–742–3355, website: www.acgih.org).

Towing a Trailer – Being Equipped for Safety, Publication from U.S. Department of Transportation, National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, D.C. 20590

U.S. Consumer Product Safety Commission (CPSC), 4330 East West Highway, Bethesda, MD 20814 (Phone: 301-504-7923, website: www.cpsc.gov).

Applications Manual for the Revised NIOSH Lifting Equation, The National Institute for Occupational Safety and Health (NIOSH), 1600 Clifton Rd, Atlanta, GA 30333 (Phone: 1-800-232-4636, website: www.cdc.gov/NIOSH).

Prepared by the Miller Electric Mfg. Co. Training Department.

⚠ WARNING

This document contains general information about the topics discussed herein. This document is not an application manual and does not contain a complete statement of all factors pertaining to those topics.

The installation, operation, and maintenance of arc welding equipment and the employment of procedures described in this document should be conducted only by qualified persons in accordance with applicable codes, safe practices, and manufacturer's instructions.

Always be certain that work areas are clean and safe and that proper ventilation is used. Misuse of equipment and failure to observe applicable codes and safe practices can result in serious personal injury and property damage.

Engine Driven Welding Power Sources

Welding Process and Filler Metals Training Series:

Welcome to the Welding Process and Filler Metals Training Series. This training series was developed for the purpose of providing a basic set of educational materials that can be used individually or in a classroom setting.

The topics covered in the series are:

Welding Processes

- **Topic 1.** Introduction To Welding
- **Topic 2.** Welding Safety
- **Topic 3.** Basic Electricity For Welding
- **Topic 4.** Welding Power Source Design
- **Topic 5.** Engine Driven Power Sources
- **Topic 6.** Shielded Metal Arc Welding
- **Topic 7.** Gas Tungsten Arc Welding
- **Topic 8.** Gas Metal Arc Welding
- **Topic 9.** Flux Cored Arc Welding
- **Topic 10.** Metal Cutting
- **Topic 11.** Troubleshooting Welding Processes
- **Topic 12.** Submerged Arc Welding

Filler Metals

- **Topic A.** Introduction To Metals
- **Topic B.** Tubular Wires
- **Topic C.** Low Alloy Steel
- **Topic D.** Stainless Steel
- **Topic E.** Aluminum
- **Topic F.** Hard Surfacing

Please note, this series was not developed to teach the skill of welding or cutting, but rather to provide a foundation of general knowledge about the various processes and related topics.

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Generating Power

Engine-driven welding power sources convert mechanical energy, obtained from a gasoline or diesel engine, into electrical power suitable for arc welding and/or auxiliary electrical power.

Three things are needed to make electricity:

- Magnetic lines of force (magnetic field)
- Electrical conductor, typically copper wire
- Motion between the magnetic field and the conductor

Whenever a wire moves through the lines of force created by a magnetic field, a voltage is induced in the wire. Physically, it makes no difference whether the magnetic field moves or the conductor moves.

When the magnetic field moves, the design is called an Alternator. When the conductor moves, the design is called a Generator.

Both designs have a rotating member, called a rotor (Figure 1) and a set of stationary windings, called a stator. (Figure 2)

It should be pointed out that the general population typically refers to all engine-driven welding machines that produce power as "generators". I'm sure you've heard the phrase "backup generator". They are not referring to the internal design.

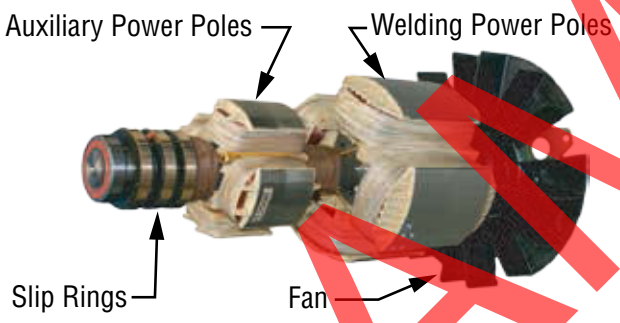


Figure 1 – A Rotor with Two Separate Power Poles, One for Auxiliary Power and Another for Welding Power. This is a Four-Pole Generator-Type Design Where the Magnetic Field is Rotated inside the Stator Coils

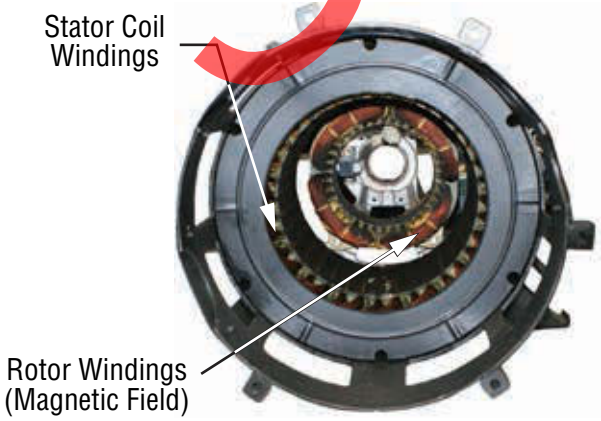


Figure 2 – End View of a Rotor and Stator

Let's talk about the alternator first since this is the design used in Miller Engine Drives. In this design the magnetic field (rotor) moves. The rotor consists of a through shaft, two end-bearings to support the rotor and shaft load, a laminated iron core, the windings needed to develop a magnetic field, and a brush/slip ring arrangement to send current to the windings. The current in the rotor is small, no more than 15 amps and often less. The rotor is located within the stator and turns with the engine. So the power for welding is now induced onto the "conductor" or stator windings as the rotor spins. The welding power generated is AC, so some windings can be used for welding and other windings can be used for auxiliary power (120/240 volts). Since AC is easily converted to DC, many engine drives of this design have both AC and DC welding output.

There are three ways of increasing the output from an alternator:

- Increase the motion of the magnetic field (engine speed) (Figure 3). While most engine drives have a fixed speed for welding, there are some models that do change the engine speed depending on the power needed.
- Increase the strength of the magnet (send more current to the rotor) (Figure 4). This is the most popular method of controlling the output of the alternator and is used in the majority of Miller Engine Drives.
- Increase the number of turns of wire in the stator (Figure 5). This method is not used very often, but the the Bobcat™ 250 is a good example. In the Bobcat™ 250 there are two ranges for Mig welding. Moving the range switch from one position to the other simply selects a different number of turns of wire in the stator

In the generator design (Figure 6), it's the stator that holds the magnetic field. Again, just a small amount of current is needed here to maintain the necessary magnetic field required for power generation. In this design it's the "conductor" that moves, so the rotor has the heavy conductor windings needed to handle the welding current. It also uses a special brush/slip ring arrangement for mechanically changing the alternating current (AC) to direct current (DC) and sending this DC to the output studs for welding. Since it is difficult to change the DC back to AC, most engine drives with this design have DC output only. Additionally, a larger engine is needed for the heavy rotor and larger brushes are needed to handle the high welding current.

Today, most engineers prefer to use the alternator (Figure 7) when designing a new engine-driven welding machine because it requires less engine horsepower to turn the rotor, making it more energy efficient.

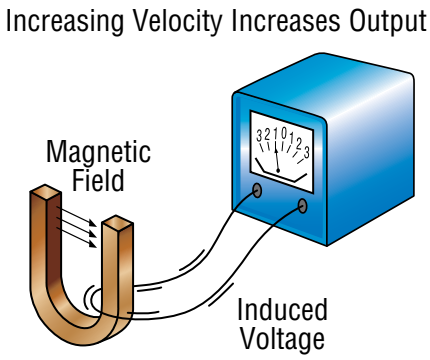


Figure 3 – Increasing the Number of Times the Wire Passes Through the Magnetic Field Increases the Voltage

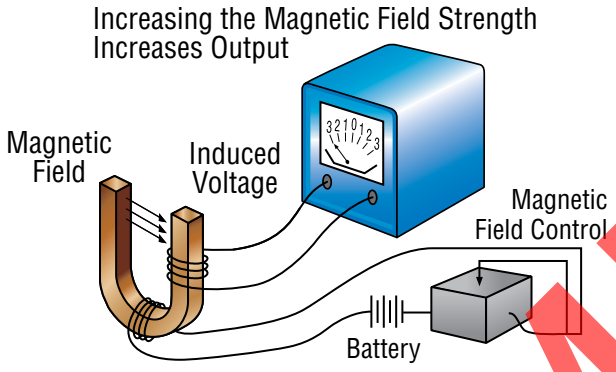


Figure 4 – Increasing the Strength of the Magnet Increases the Voltage

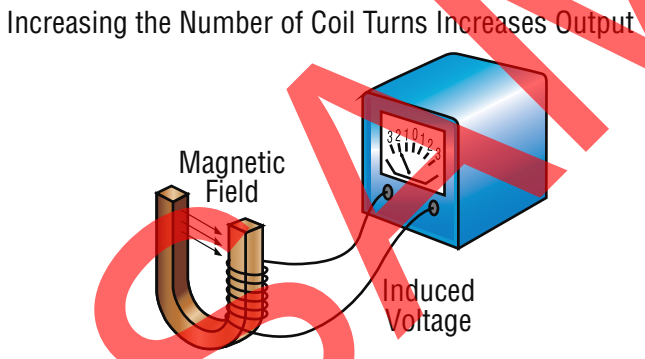
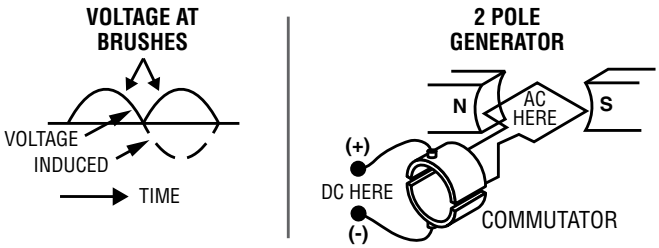


Figure 5 – Increasing the Number of Wires (or Turns) That Pass Through the Magnetic Field Increases the Voltage



The magnetic field is contained in the stator assembly of a generator. It is in the armature coils that welding power is generated. The commutator-brush rectifies AC to DC welding power.

Figure 6 – Generator Design

Alternator Design

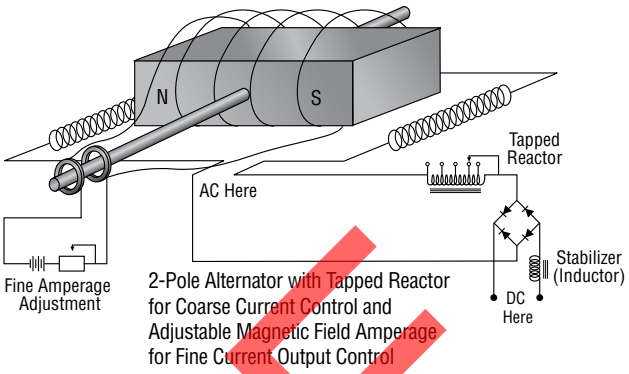


Figure 7 – 2-Pole Alternator Design

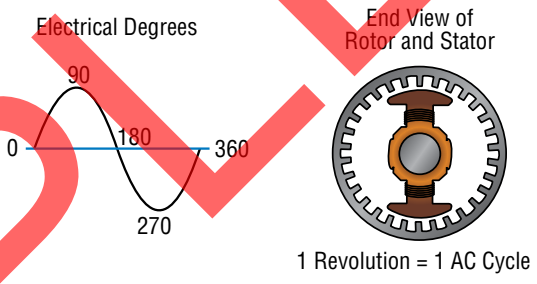


Figure 8 – In Alternator-Type Design the Magnetic Field is Outside in the Stator and the Coils are Located in the Rotor

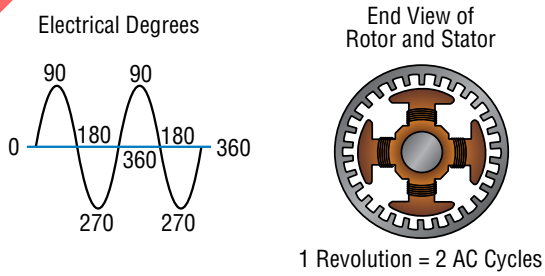


Figure 9 – A Four-Pole Alternator-Type Design

Engine Choices

Engine-driven welding power supplies are used for field erection and fabrication work when no utility power is available. For this use, a wide variety of internal combustion engines are available. Both liquid-cooled and air-cooled engines are used. Gasoline is the most popular fuel because of price and availability. Diesel fuel is popular because its high flash point means it less flammable (than gasoline) and less hazardous. Also, some regulations will permit only diesel fuel for engines used in specific applications. A good example is the use of diesel engines for welding power sources on offshore drilling rigs and in marine applications or service trucks where sharing the on-board fuel tank is desired. Propane and natural gas are used in some applications because it is cleaner burning than gasoline. However, they require a special carburetor system. An example of the need for these cleaner burning fuels is “in plant” maintenance welding.