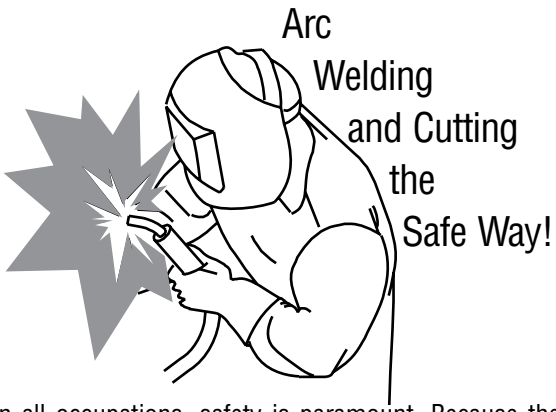
Topic 3.

Welding Process Training Series

Basic Electricity For Welding

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.

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.

Table of Contents

Electrical Terms For Welding Equipment

Primary Voltage

Primary voltage is the input voltage supplied by the power company or auxiliary electrical power generator unit to the welding machine. This voltage has a constant voltage or potential at every receptacle. Common Voltages are 120 (110/115), 208 (200), 230 (220/240), 460 (440/480), 575 (600), VAC (volts of alternating current) with a frequency of 50 or 60 Hz. Welding power source transformers are designed to work with these voltages.

These voltages may be single (Figure 5) or three-phase (Figure 6). A three-phase circuit is merely a combination of three, single-phase circuits. The three-phase primary, utility transformer is connected in either the delta or wye configuration. The wye configuration is used to provide 200 and 600 volt primary power. Primary voltage is measured with an alternating current voltmeter at the fuse disconnect box, receptacle, or the terminal strip inside the welding machine

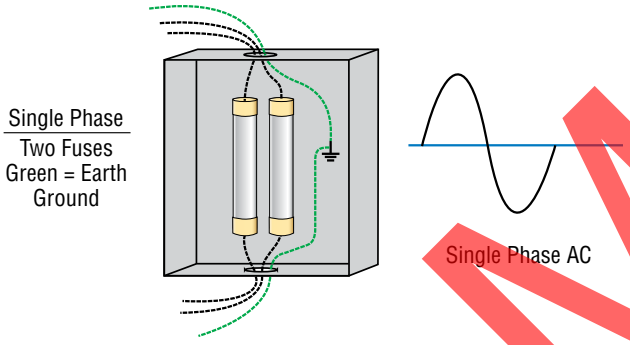


Figure 5 – 200(208) to 240 VAC Single-Phase Primary Power

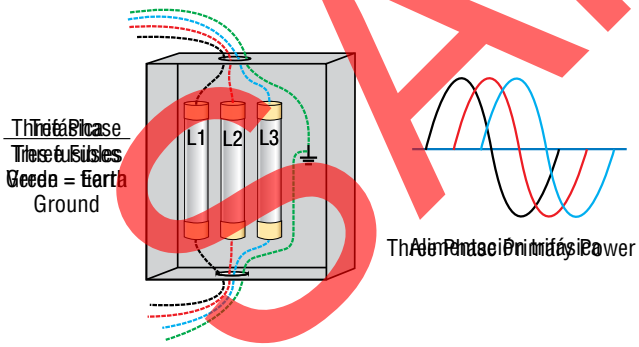


Figure 6 – Three-Phase Primary Power

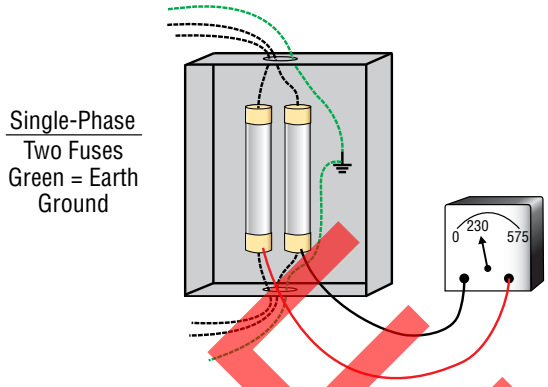


Figure 7 – Measuring 200(208) to 240 VAC Single Phase Primary Power

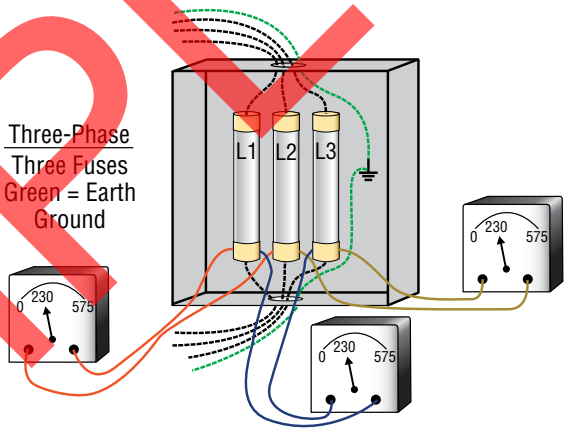


Figure 8 – Measuring Three-Phase Primary Power

Measuring Primary Voltage

Be sure you are fully qualified through training and experience, and that you understand electricity and testing instruments, before measuring any voltage or servicing any equipment.

To measure 240, 480, 575 volt, single-phase primary voltage, a volt meter lead is placed at the bottom of each fuse. The reading on the meter will be the actual voltage available (Figure 7).

To measure three-phase voltage, three different voltage readings will need to be taken. As Figure 8 illustrates, the meter leads will be placed at the bottom of the fuses for each of the readings. The voltage reading in each case will be the actual voltage for each phase of the system.

If the primary voltage fluctuates higher or lower the welding power source open circuit voltage (OCV) may be affected accordingly. That is, “Input affects output!” if the welding machine does not have a solid state, electronically-controlled welding output (primary or utility line voltage compensation).

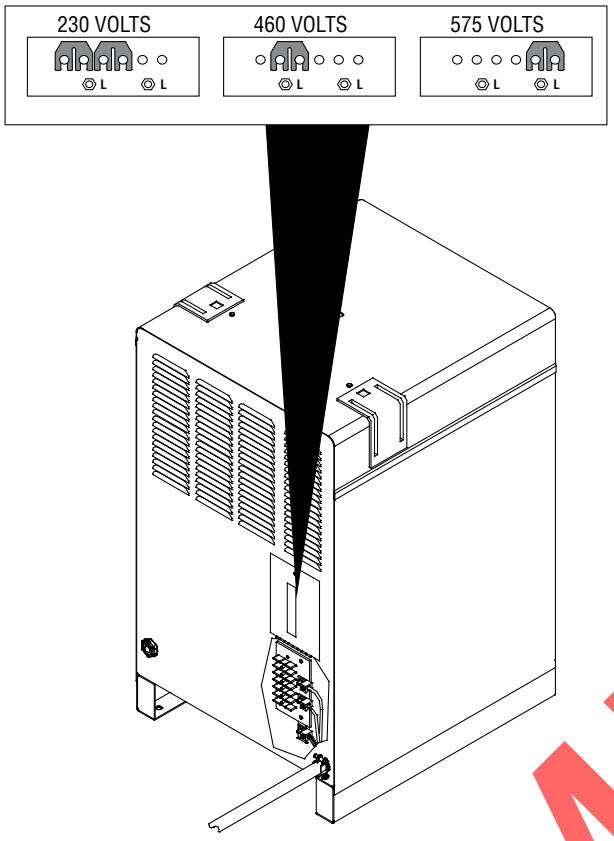


Figure 9 – Manually Linking a Single Phase Power Source

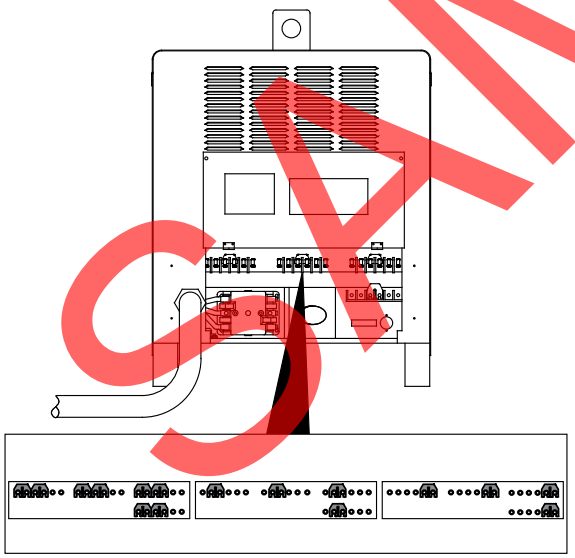


Figure 10 – Manually Linking a Three Phase Power Source

Manually Linking A Power Source For Primary Voltage

Most welding power sources are made to operate on more than one primary voltage value. In the United States, a common configuration would be a welding power source that can operate on either 208 volt primary, 230 volt primary, or 460 volt primary.

When this type of welding power source is purchased, it must be manually set or linked for the primary voltage that is available. This ensures the power source will operate properly. Caution must be taken to ensure that the power source is properly linked. An improperly linked power source may not perform properly or may be severely damaged.

Figure 9 and Figure 10 show how to manually link both a single-phase and a three-phase power source to maintain the input voltage.

Automatically Linking A Power Source

Some Miller Electric Mfg. welding power sources are equipped with circuits that automatically link the power source for the primary voltage that it is connected to. This type of linking circuit can be an advantage for customers who need to move the welding power source frequently and do not want to remove the cover of the power source to link it for different primary voltages. These automatic linking circuits are called Auto-Link® (Figure 11)and Auto-Line™ (Figure 12).

The Auto-Link® circuit automatically links the power source to a set number of voltages. The XMT 304 is available in a model that will operate on either 230 or 460 VAC and another model will operate on either 460 or 575 VAC. The input power can be either single- or three-phase, 50 or 60 hertz.

The Auto-Link® circuit accomplishes this by using a series of components on the primary side of the power source that ensure the transformer receives the same voltage no matter what primary voltage the machine is connected to.

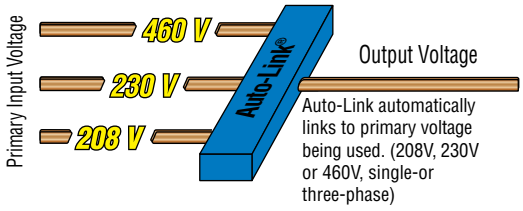


Figure 11 – Auto-Link®