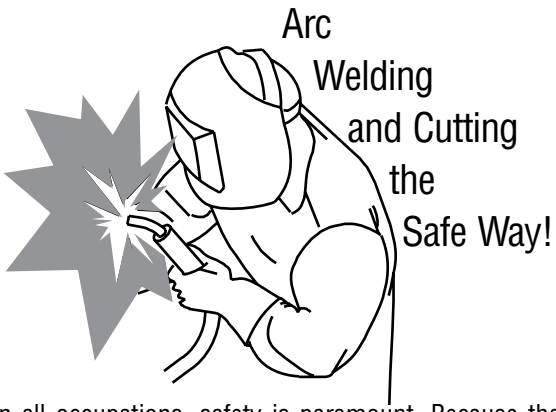
Topic 7.

Welding Process Training Series

Gas Tungsten Arc 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.

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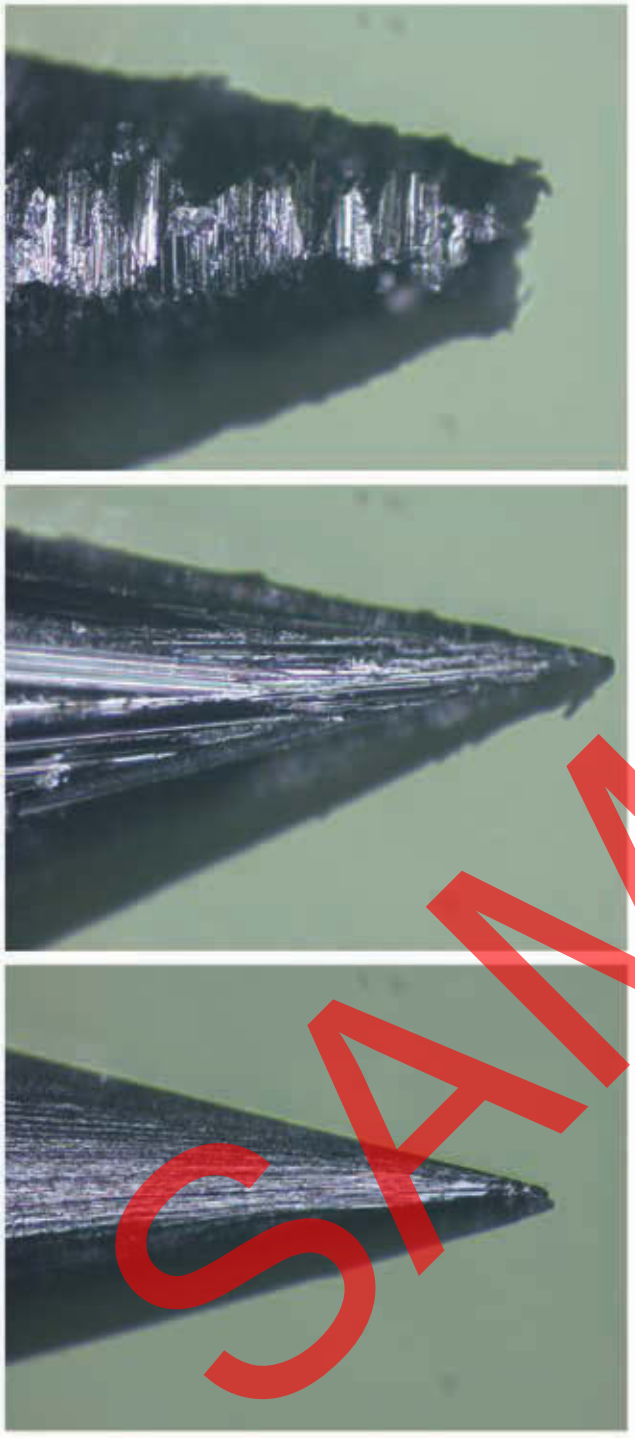

Figure 72 –
10X Magnification of a Perpendicular Hand Grind (Top)
Hand Finish on a Typical Grinding Wheel (Middle)
Finish on a Triad™ Tungsten Grinder (Bottom)

Figure 73 –
20X Magnification of a Factory Finish (Top)
Hand Finish on a Typical Grinding Wheel (Middle)
Finish on a Triad™ Tungsten Grinder (Bottom)

The electrode that has been contaminated by contact with the weld pool or filler metal will have a deposit of the metal on the electrode. If this deposit is small, maintaining an arc on a scrap piece of material for a period of time may vaporize the deposit off the electrode. If the contamination cannot be removed in this manner, the preferred method is to re-prepare the electrode to remove the contamination. Breaking the contaminated tungsten off is not recommended as it may cause the tungsten to split lengthwise or bend the electrode. This may result in excessive electrode heating and a poorly shaped arc. Proper tungsten shaping and removal of contamination is a key to maintaining consistent welds. A properly prepared tungsten will reduce or

Figure 74 – Weldcraft® Triad™ Tungsten Grinder

eliminate arc wandering, splitting, spitting, and weld quality inconsistencies. Figure 74 shows a specially designed grinder for tungsten preparation.

When too large of a diameter tungsten is selected for low amperage DC welding, poor arc starts and arc wandering will just never seem to go away. This is because tungsten is a poor conductor of electricity. Attempting to carry a 15 amp arc on a 3/32 in. diameter electrode can cause the arc to wander and creates difficulty in arc starting. Even the correct preparation of an electrode too large for the current level required can be the cause welding arc issues. Figure 75 shows the preferred shapes to prepare tungsten for GTAW.

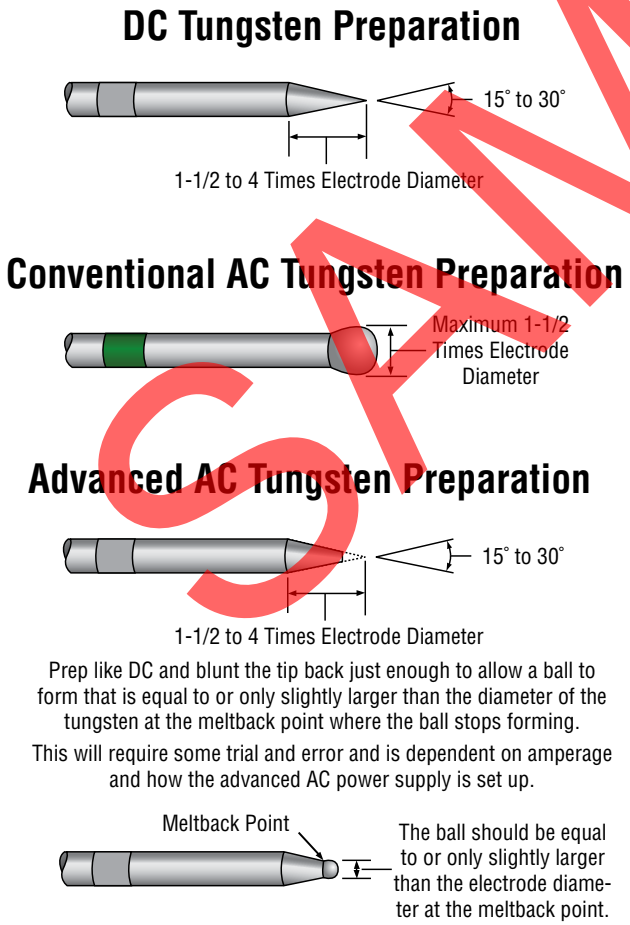

Figure 75 – Tungsten Preparation Techniques

DC Tungsten Preparation

A sharpened tungsten is preferred for direct current GTAW since 70% of the weld energy is directed to the positive half of the GTAW arc, and only 30% of the arc heat is directed to the tungsten.

A common practice in pointing electrodes is to grind the taper for a distance of about 2 electrode diameters in length to a sharp needle point for use on DC welding. Using 2 electrode diameters as a guideline yields approximately a 30^0 included angle. Using this rule for an 1/8 in. electrode, the ground surface would use 1/4in. of the length of the tungsten electrode. There are many theories and even more opinions on the proper included angle of the point. The actual application is the most important consideration when determining the configuration of the point. The second most important factor is to be sure that once a tungsten configuration is determined, you can consistently reproduce the preparation angles and the smoothness of the finish.

Generally, the welding arc emits from the tungsten at a 90^0 angle from the surface. So, contrary to common belief, a small included angle (15^0 needle point) does not produce a narrower weld bead, the arc is wider and more flared out causing a wider more shallow penetrating weld bead. A steeper angle like 30^0 will produce a slightly narrower arc column and weld bead, but is not easily noticeable until a 60^0 or higher included angle is used. By using a 30^0 included angle with a small truncated end (blunted back tip) you can help to constrict the arc in DC welding to produce a narrow arc column with a narrow deep penetrating weld bead. Figure 76 shows examples of various arcs and weld profiles produced by changing the included angle on the electrode.

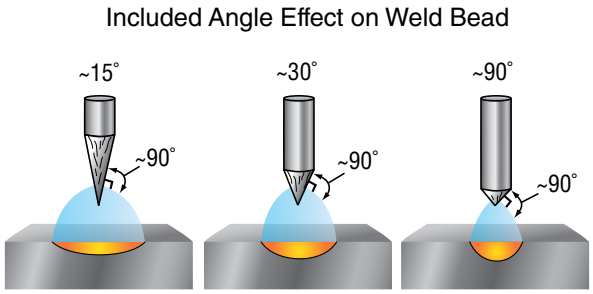

Figure 76 – The Effects on Weld Bead Width and Penetration Depth With Varying Included Angles.