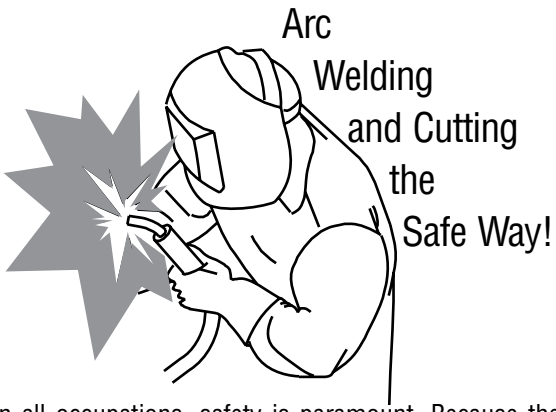
HOBART
FILLER METALS

Topic C.

Welding Process Training Series

Low Alloy Steel

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).

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⚠ 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:

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

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

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

Introduction to Low Alloy Steels

Low alloy steel is a steel that contains small amounts of intentionally added materials, which change the property of the metal. Common alloy elements include manganese, molybdenum, and nickel. Low alloy steels are a class of steels designed to provide better mechanical properties than conventional steel. They are also designed to meet specific chemical properties. Specific alloys are added to the steel to improve the mechanical properties of that steel.

Low alloy steels have a variety of applications in different industries. Some of these applications include cryogenic vessels, cranes, armor plated vehicles, and bridges.

Plain carbon steels are produced with varying amounts of carbon, manganese, phosphorus, sulfur, and silicon. Adding additional alloys changes mild steel to low alloy steel.

Types of Low Alloy Steels

High Yield Strength Steels (HY 80, HY 90, and HY 100)

High yield strength (minimum of 80 ksi) steels are a low carbon, low alloy steel with nickel, molybdenum and chromium. They have excellent weldability and notch toughness along with good ductility even in welded sections.

This alloy is used for well-known application such as shipbuilding for welded hull plates, bridges, and off highway vehicles.

High Strength Low Alloy Steels (HSLA)

HSLA steel is a type of steel alloy that provides many benefits over regular steel alloys. In general, HSLA alloys are much stronger and tougher than ordinary plain-carbon steels. They are used in cars, trucks, cranes, bridges, and other structures that are designed to handle large amounts of stress, often at very low temperatures.

HSLA steels are given this designation because they only contain a very small percentage of carbon. A typical HSLA steel may contain 0.15% carbon, 1.65% manganese and low levels (under 0.035%) of phosphorus and sulfur. It may also contain small amounts of copper, nickel, niobium, nitrogen, vanadium, chromium, molybdenum, silicon, or zirconium. Consequently, HSLA steels are referred to as “micro alloyed”, as they are indeed alloyed in extremely small amounts by comparison to other main commercial alloy steels. As little as 0.10% niobium and vanadium can have profound effects on the mechanical properties of a 0.1% C, 1.3% Mn steel.

A514, A517, and T1 Steels

A514 is a particular type of high strength alloy steel which is quenched and tempered to have a minimum yield strength of 90 to 100 Ksi (where 1 ksi = 1,000 psi) (700 mPa). The trade name T-1 for A514 alloys is extremely common, originally trademarked by United States Steel (USS) but now owned by International Steel Group who purchased plate steel operations from USS.

A514 is primarily used as a structural steel for building construction. A closely related alloy, A517, is used for the production of high-strength pressure vessels.

The A514 and A517 standards were set by the standards organization ASTM International.

A514 steels are used where a weldable, machinable, very high strength steel is required to save weight or meet ultimate strength requirements. It is normally used as a structural steel in building construction, cranes, or other large machines supporting high loads.

A242, A588, A709, Weathering Grade Steels

“Weathering” means that, due to their chemical compositions, these steels exhibit increased resistance to atmospheric corrosion compared to non-alloyed steels. This is because the steel forms a protective layer on its surface under the influence of the weather.

The corrosion-inhibiting effect of the protective layer is produced by the particular distribution and concentration of alloying elements in it. The layer protecting the surface develops and regenerates continuously when subjected to the influence of the weather.

The mechanical properties of weathering steels depend on which alloy is added and the thickness of the material.

Weathering steel is a popular choice for use in outdoor sculptures and as exterior facades due to its rustic antique appearance. It has also been used in bridge and other large structural applications. It is very widely used in marine transportation and in the construction of shipping containers.

Low Alloy Filler Metal Designations

The American Welding Society (AWS) publishes specifications for low alloy steel electrodes used in various arc welding processes. These specifications cover the classification and chemical composition of the different electrodes along with the mechanical properties of the resulting welds. This allows the user to select the type of filler metal that best meets the needs of the application.