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Tech Talk

Welcome to the second issue of ***Tech Talk***. This newsletter covers a range of topics on various welding products, applications, metallurgy, techniques, and economics. Previous issues are archived at www.unibraze.com. Submit any questions or comments to leroy@unibraze.com or call 1-877-233-1375.

In the last issue, it was mentioned that we would look at the filler metals that fall under the AWS specification 5.1 "Carbon Steel Electrodes for Shielded Metal Arc Welding". These electrodes are:
E6010, E6011, E6012, E6013, E6014, E6015, E6016, E6018, E6019, E6020, E6022, E6024, E6027, E6028, E6030, E6804, E7014, E7015, E7016, E7016-1, E7018, E7018-1, E7018-M, E7024, E7024-1, E7027, E7028, E7048, E8012, E9012, and E10012.

To better understand what these electrodes are and where to use them, you need to first understand how the AWS classification system works.

What does the classification E7018 on an electrode mean?

a. The E means that the electrode is used for electric arc welding.

b. The first two digits indicate the tensile strength in thousands of pounds per square inch (i.e., 70 means 70,000 psi).

c. The 2nd last digit indicates the welding position that the electrode can be used in (i.e., the 1 means all positions).

d. The last digit indicates the special characteristics of the electrode, such as type and general content of the coating, weld quality, amount of penetration, and the type of arc or electrical current. The last digit may be any number between 0 and 8. Note that the last digit should not be used individually, but must be considered in conjunction with the 2nd last digit. Using the chart on table 1 will help you identify the various characteristics of each electrode

Selecting the Correct Electrode:

1. The electrode should produce a weld metal with approximately the same metallurgical properties as the parent metal. A top quality weld should be as strong as the parent metal.

2. In selecting the best electrode for a particular welding situation, the aim is to choose one that will provide good arc stability, fast deposition, maximum weld strength, minimum splatter, easy slag removal, and a smooth weld bead. To achieve some of these characteristics from an electrode, the following factors should be considered:

Table1

Interpretation of Last Two Digits in AWS Electrode Classification

LAST 2 DIGITS	Weld Positioin	Power supply	Type of coating	Type of arc penetration	Iron Powder in Coating
10	All Position	DC+	High Cellulose Sodium	Digging Deep	0-10%
11	All Position	AC or DC+ or DC-	High Cellulose Potassium	Digging Deep	None
12	All Position	AC or DC-	High Titania Sodium	Medium Medium	0-10%
13	All Position	AC or DC+	High Titania Potassium	Soft Light	0-10%
14	All Position	AC or DC- or DC+	Iron Powder Titania	Soft Light	30-50%
15	All Position	DC +	Low Hydrogen Sodium	Medium Medium	None
16	All Position	AC or DC+	Low Hydrogen Potassium	Medium Medium	None
18	All Position	AC or DC+	Iron Powder Low Hydrogen	Medium Medium	30-50%
20	Horizontal and flat	AC or DC+ or DC-	High Iron Oxide	Digging Medium	0-10%
22	Horizontal and flat	AC or DC-	High Iron Oxide	Medium Medium	0-10%
24	Horizontal and flat	AC or DC- or DC+	Iron Powder Titania	Soft Light	30-50%
27	Horizontal and flat	AC or DC+ or DC-	Iron Powder Iron Oxide	Soft Medium	50%
28	Horizontal and flat	AC or DC+	Low Hydrogen Potassium Iron Powder	Medium Medium	30-50%

a. Electrode Diameter - Electrode diameter is determined by parent material thickness to be welded, joint design such as a joint with a narrow gap, or V-groove base metal plates. Also, a major factor is the amount of heat input that goes into the part to be welded. More heat is produced when using a larger diameter of electrode and could destroy the part being manufactured.

b. Joint Design - This is another important factor to consider when choosing an electrode. When welding a joint that is not beveled at the proper angle to allow easy penetration, consider using a deep penetrating, fast freeze electrode, for example, E6010 or E6011. The opposite of this situation would be an open or poorly fit joint where a good choice of electrode would be E6012 or E6013.

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c. Welding Position - The welding position to be used during the deposition of the weld metal is a very important factor when selecting an electrode. Electrodes with a number 1 as their second last digit will give excellent results in both the overhead and the horizontal positions. Electrodes with a 2 as their second last digit give excellent results in the flat position, work poorly in the horizontal position and do not work in an overhead position.

Added Low Hydrogen Designators: Welders accustomed to using a low-hydrogen electrode with a particular classification are sometimes puzzled when they receive electrodes with added designations like 7018-1,7018-M or 7018-H4R. Low-hydrogen electrodes are generally used in more critical applications to begin with, and their confusion is understandable. However, it's simply a case of the manufacturer providing more information on the same electrode.

The added characters are optional designators, permitted by the AWS classification system, to clarify the low-hydrogen characteristics of carbon steel and low alloy steel manual electrodes. The electrode itself has not changed.

The "HR4" Designator in low-hydrogen electrodes are defined as having less than 4 milliliters (ml.) of diffusible hydrogen per 100 grams of weld metal. This classification has now been arranged into three levels allowing the added designators to easier determine how "dry" a particular electrode is. The levels are H16, H8, and H4, corresponding to 16, 8, and 4 ml. per 100 grams of weld metal.

One additional designator may also be added. This is an optional moisture resistant designator (R) which indicates a low-hydrogen electrode's ability to meet specific low-moisture pickup limits under controlled humidification tests. This generally indicates that the electrode's coating has been formulated with non-hygroscopic materials, and will resist picking up moisture longer than electrodes with standard low-hydrogen coatings. This can be important when welding in humid areas, since a standard coating will be affected by moisture in about two hours, while a moisture-resistant coating can be safely used for up to 10 hours.

When these suffixes are used, they must be imprinted on the electrode itself, in addition to appearing on the label. The actual AWS classification does not change when they are added, however. For example, an E7018 H4R product will still be classified as E7018, although the product is identified by the full designation.

With any low-hydrogen consumable, it is important to observe proper storage procedures. Products such as the H4 electrodes come in a hermetically sealed can. Once opened, they should be stored in a rod oven until used, since they may not meet specifications if left open in high humidity. In case of doubt about low-hydrogen electrodes and their application, the supplier should be consulted for recommendations.

The "-1" Designator in low hydrogen electrodes is defined as displaying exceptional impacts at lower transition temperatures than are normally available from E7018 electrodes. It is designed to have the same usability and weld metal composition as E7018, except that the manganese content is set at the high end of the range.

The "-M" Designator used in the low hydrogen electrode 7018-M shows that it is a low hydrogen, iron-powder all-position electrode specially formulated to meet the more stringent requirements of Military Specification MIL-E-0022200/10 for mechanical properties, low coating moisture, and diffusible hydrogen content.

In our next issue, we will look at the filler metals that fall under the AWS specification 5.2 "Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding".