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Effect of electrode types on welding power source settings

Article

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With more productive processes such as MIG/MAG welding taking over the welding industry, the role of stick welding (MMA) has become smaller in recent decades. Partly as a result of this diminishing role and the simplicity of the process, the optimization of stick welding does not receive much attention. However, modern stick welding equipment has a variety of settings for influencing the behavior of the arc. The electrode type, particularly the coating on the electrode, significantly affects the arc ignition characteristics and the material transfer to the weld pool. Optimizing welding machine settings for these issues can improve weld quality or at least makes it easier to achieve the desired result.

Key adjustable parameters

The **welding current** is naturally the most important adjustable parameter in stick welding. In addition, almost all modern stick welding machines allow users to separately regulate the current level of the arc ignition period. For example, Kemppi welding machines use the term 'hot start' for this feature. Adjusting the hot start has been made as easy as possible: users can regulate the time and current level of the arc ignition period with just one setting. Increasing the hot start improves the strike ignition, but on the other hand too high a hot start can cause welding defects such as burn-through or undercut at worst.

Another common setting in stick welding is for regulating **arc dynamics**. This setting adjusts the behavior of the current delivered in short circuit situations. To welders this adjustment looks and feels in practice like a change in the strength of the arc. Thus, Kemppi welding machines call this particular setting 'arc force'. For example, increasing the arc force can reduce the risk of the electrode sticking. On the other hand, too high an arc force can increase the amount of spatters.

In addition to these two general settings, most advanced stick welding equipment may have a setting for the arc length, i.e. the **voltage** level at which the arc is broken off to stop welding. By adjusting the arc break to be as low as possible, users can minimize burn marks during stopping. However, certain electrode types and application techniques require a high arc break level setting to prevent welding from being inadvertently interrupted. Adjusting the arc break level to its maximum allows the welding equipment to stretch the arc for as long as the voltage reserve allows. Reducing this value allows the power source program to issue a command to cut off the arc at a set level.

Electrode types and their special features

Electrode types are typically classified based on the chemical composition of the electrode coating and core. When arc behavior and welding machine settings requirements are taken into account in addition to the chemical composition, the following classification method has proved functional in both theory and practice:

- Basic electrodes
- Rutile electrodes

- Stainless steel electrodes
- High efficiency electrodes
- Cellulosic electrodes

In the Nordic countries, **basic electrodes** are the most widely used. Typically, arc ignition for these types of electrodes is weak, particularly after the graphite tip has burned away on the first ignition. To improve arc ignition when using basic electrodes, users should use an arc ignition current (hot start) that is clearly higher than the welding current. With basic electrodes, the material transfer is in the form of large droplets and happens via strong short circuits. For this reason, basic electrodes require a relatively high arc force, meaning rough arc dynamics, to function optimally. By its nature, the arc break level for the basic electrode arc should not be limited because of the large droplets and powerful short circuits.

Worldwide, the use of **rutile electrodes** is quite common. Typically, they enable a good strike ignition. This is why rutile electrodes do not require as strong a hot start as basic electrodes. Rutile electrodes have finer droplets than basic electrodes. This means users can weld with a lower arc force than with basic electrodes, meaning with an arc that feels softer. To minimize burn marks when using rutile electrodes, the arc break level can be quite low. Stainless steel electrodes also typically have a rutile coat. Due to the electrical conductivity and flow of the base material, users most often obtain the best results with stainless steel electrodes with higher hot start and arc force settings. Choosing these settings is recommended when users are welding at a lower current, which is not particularly rare when working with stainless steels.

High efficiency electrodes typically behave much like rutile electrodes when compared to basic electrodes. Their arc voltage, or arc length, is even greater however, meaning that they do not need much of a hot start to avoid sticking. In addition, the material transfer has small droplets, making any short circuits small and light. This is why users can weld with a low arc force when using high efficiency electrodes. Due to the long arc, the arc break level should be only slightly limited.

Cellulosic electrodes are used for welding pipelines at construction sites among other things. They are also general purpose electrodes to some extent, for example in South America. Reigniting the arc is typically a challenge with these electrodes because the electrode coating often burns off from the edge earlier than from the core. This is why cellulosic electrodes often require a moderately intense hot start. When users weld pipes with cellulosic electrodes, they use a special technique where the arc length varies extensively. When welding near the base material, a very large arc force is required to prevent sticking. On the other hand, a large voltage reserve is needed when welding far from the base material to avoid the arc break level. Users should not limit the arc break level when using cellulosic electrodes because of this particular technique.

Optimized settings for easy and fast access

Kemppi has recently launched a new-generation stick welding machine, **Master 315** (Figure 1). This equipment has a 300-amp power source that meets even the most demanding

requirements for stick welding, including when using special welding techniques with cellulosic electrodes. An exceptionally large voltage reserve, the user-friendly settings mentioned above, and new innovative features make all this possible.

Figure 1. Master 315 stick welding machine.

Weld Assist, previously only available in the MasterTig product family, is now also available for stick welding. Users only need to answer three questions. The equipment then suggests appropriate settings for the parameters described above (Figure 2). In addition, the machine provides guidance on polarity selection (DC+/DC-). The suggested settings are available at the push of a button. Not only is Weld Assist's new MMA version included in the Master 315, it is also available via system update for all MasterTig devices equipped with a TFT display panel. The only difference is the lack of arc break adjustment and cellulosic electrode settings.

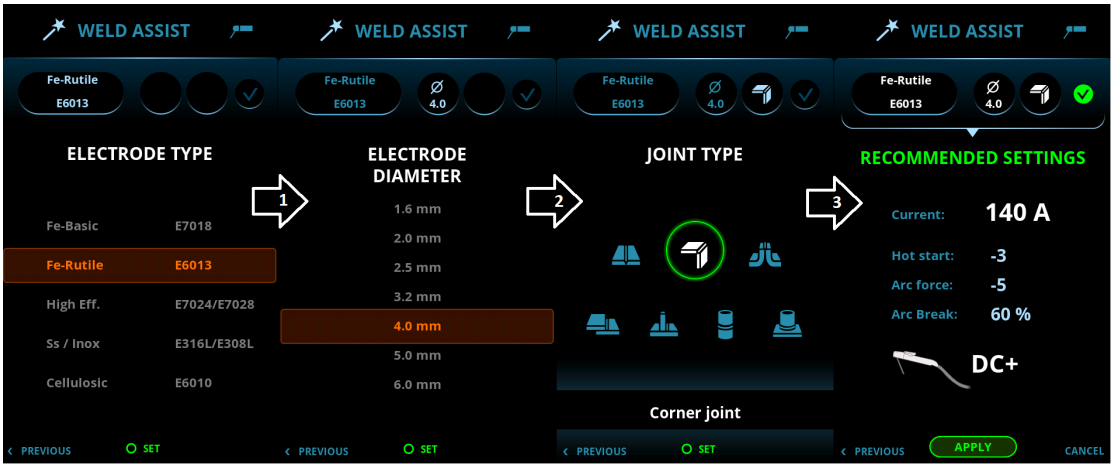

Figure 2. Weld Assist selection process in stick welding.

First, the user selects the electrode type from the options based on the classification described above. Based on this selection, the user interface then suggests appropriate settings for the hot start, arc force, and arc break. If the user selects a cellulosic electrode, the equipment automatically

activates a special welding program where the arc dynamics are optimized for the cellulosic electrode properties and the special performance techniques they require. Once the electrode type has been selected, the user selects the electrode diameter and the joint type. The welding current size is selected based on these two choices and the electrode type.

Once the user accepts the proposed settings, the device is immediately ready for welding. However, the user can still fine-tune the settings to their liking.

Summary

In principle, stick welding is a simple process. However, there are still important control settings that affect arc behavior. These possibilities enable users to improve welding quality or to achieve the required quality. Different electrode types have different optimal settings in welding equipment. However, users often are unaware of the differences. To make things easier, Kemppi has developed Weld Assist for stick welding.

The Master 315 is a stylish and practical stick welding machine that can withstand the hard knock life of everyday welding. It is lightweight and compact and is made of durable injection-molded plastic. It also incorporates special shock-absorbing structures, making it a reliable partner for machine shops and construction sites.

Thanks to its innovative Weld Assist function, the Master 315 offers ideal welding performance and enables welding parameters to be set quickly, ensuring the correct welding parameters are set regardless of the object to be welded or your welding experience. This state-of-the-art stick welding machine is characterized by reliable arc ignition and stability, plus its suitability for all electrode types, including cellulosic welding electrodes.