LOW HYDROGEN TIE-IN WELDS

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Figure 1. Welder qualifying with M300-C, USA, 2013.

In the past, celluslostic type electrodes have been utilised for tie-in welding procedures with great success. Consumables of this type will still continue to play a large role in pipeline construction, but as material grades increase from X65 to X70, X80, even X100 equivalent and beyond, we must re-evaluate how we intend to weld these materials to ensure integrity, while still allowing for production. In addition to this, oversight bodies and regulatory agencies are pushing the industry to adopt low hydrogen welding processed and practices.

Today, there are several low hydrogen welding options available to pipeline contractors, each with their own advantages and disadvantages. The option of manual and semi-automatic welding options will be discussed, and then the distinct advantages of a mechanised solution will be explained.

Manual and semi-automatic welding

As with mainline welding, the contractor has several welding options. The root, hot and fill welding passes, are often created with different welding processes.

Figure 2. M300-C setup on pipeline.

Historically, cellulosic shielded metal arc welding (SMAW) is the most common method for the root pass. Although this is not a low hydrogen deposit, it is believed that a significant portion of the hydrogen diffuses when the remaining passes are made with a low hydrogen process. Cellulosic electrodes, such as E6010, are still preferred by welders as a result of their high travel speeds and ability to bridge variation in Hi-Lo and root gap opening.

Another root pass option for tie-ins, is to utilise one of the gas metal arc welding (GMAW) controlled short circuit processes. These include Lincoln Electric's STT®, Miller Electric's RMD® and Fronius's CMT®, all of which are capable of providing a low hydrogen weld deposit. These processes provide thicker root ligament sizes, which can eliminate the need for a separate hot pass, and are thus gaining popularity for root pass welding. As a result of its moderate travel speeds, the modified short circuit process is limited to the root pass and is unsuitable for filling and capping passes.

There are several options available for the fill and cap passes. The use of SMAW, with low hydrogen vertical down electrodes, is beginning to be utilised and electrode manufacturers are attempting to improve operating characteristics. Self-shielded FCAW provides an increase in operating factor over SMAW, and like the SMAW options it requires a highly skilled welder to produce quality results.

Mechanised welding

Mechanisation of the process provides the best solution. This is especially important as the industry adopts higher-grade materials which require a high level of control over diffusible hydrogen levels, and as regulatory agencies require greater quality control and monitoring. The CRC-Evans M300-C is an excellent platform to accomplish this work, as it provides the highest level of productivity and is easy to operate.

When using the M300-C for tie-ins, there are several key advantages. These include productivity, weld quality, consistency, ease of use, short training time and reliability. The main advantage is productivity. In a comparison between the three welding processes, on an actual project using 36 in. OD x 0.625 in. WT pipe, the cycle time for completion of the weld was significantly improved through mechanisation. The three scenarios utilised welding processes shown in Table 1.

A 36% increase in production by utilising the M300-C was realised when compared with SMAW low hydrogen downhill type electrodes, and a 24% increase in production was gained when compared with semi-automatic FCAW-S. This is a bonus to today's contractors who face short production schedules and increased construction costs. As pipe diameter and wall thickness increase, these advantages in production will become more pronounced.

In addition, the industry is facing an increasing shortage of skilled welders. The American Welding Society estimates that a short fall of 200 000 welders will exist in the USA, with many more globally as well. It is compounded by the fact that average age of welders in the USA is 54 years old, with many of the experienced workers expected to retire in the next 10 years. As these individuals approach retirement age, the industry as a whole is losing skill faster than it is being replaced. This statistic applies to the welding industry in general, and finding welders with the high skill level required to complete pipeline welding is even more difficult.

Training

In contrast to other processes, mechanisation allows for the training of welders in a shorter time period. Experienced welders are able to make acceptable welds in as little as one training weld, with inexperienced personnel able to produce a quality weld in as little as five training welds. In comparison with manual and semi-automatic welding processes, operator fatigue is also reduced.

Weld quality

Another significant advantage of the M300-C welding system is the consistency of weld quality. The system is fully capable of producing welds to workmanship quality, inspected to both automatic ultrasonic testing (AUT) and X-ray inspection. Using a manual or semi-automatic process often results in several areas of start and stop, as the welders work their way around the pipe circumference. These areas are often the location of a repair, particularly when inspection is completed with AUT. By mechanising the process with the M-300C, these areas of start stop are eliminated, and the chances of a costly repair reduced. Mechanisation also allows for consistency in visual inspection criteria, such as weld reinforcement and cap width, while producing an aesthetically pleasing weld.

Flexibility
The M300-C is an extremely flexible welding system that has been optimised for use with the gas shielded FCAW welding process. It can be interfaced with a contractor's favourite welding machine, including CV transformer-rectifiers, inverters, or engine drives capable of producing CV welding output.

Programmable
The M300-C's programmable welding parameters allows for tight control over essential welding variables. Limits placed on variables such as travel speed, wire feed speed, oscillation width and dwell time, ensure that limits defined in the applicable welding procedure are maintained. This improves weld quality and creates a consistency that is required by material grades being implemented in construction.

Globally proven
The M300-C is a proven system from CRC-Evans. For many years it has been used in Asia, The Middle East, Australia, Europe, and most recently in Canada and the USA. It has also been recently used on tie-in applications in Russia, on a 56 in. pipeline in the Czech Republic, and both a 36 in. and 48 in. pipeline in France.

Higher strength pipe
Shale oil and gas has changed the game in many aspects for the industry, including the numbers and types of new pipelines being built. As pipeline lengths continue to increase, companies are increasingly considering the use of higher strength materials, such as X80, X100 and X120. Although X100 and X120 have only been used in experimental lines, their use in the future will be more certain as designers are able to justify their use.

In a recent study on X100, conducted by the Pipeline Research Council International (PRCI), existing manual and semi-automatic welding processes were found to be insufficient in providing consistency. The industry-sponsored study advocates the use of mechanised welding for higher grade materials. As the industry evolves to meet the challenges of welding these new higher grade materials, and looks for increases in production, mechanisation will certainly play a significant role in their construction.

Tie-in clamp
Another revolution for tie-in welds is the CRC-Evans tie-in station with weld positioner arms. This new technology will dramatically improve productivity, quality and safety. All welders know that a good weld starts with good fit up. Any variation in the gap size, bevel angle, land thickness or Hi-Lo between pipes, can lead to losses in productivity and quality issues. This machine is like having a set of huge hands that can grip the pipe and hold it precisely in the perfect position for the entire welding process. By using a remote control, the operator safely and securely manipulates the pipe into alignment. Mechanised welding equipment can also be incorporated with the tie-in station, with weld positioner arms for maximum productivity, safety, and reliability. Additionally, the tie-in station is excellent for pipe handling allowing it to serve a dual purpose role on the construction site.

Figure 3. Tie-in weld cross section.


Figure 4. CRC-Evans tie-in station with weld positioner arms with M300-C mechanised welding system.

Table 1. 36 in. OD x 0.625 in. WT tie-in welds

Root	Hot pass	Fill one	Remainder
SMAW	SMAW	SMAW	Low hydrogen vertical down SMAW (4 mm)
SMAW	SMAW	SMAW	Semi-automatic FCAW-S (2 mm)
SMAW	SMAW	SMAW	Mechanised FCAW-G (1.2 mm)

Conclusion
As the industry evolves and moves towards low hydrogen practices for tie-in welds, manual, semi-automatic, and mechanised options are available. Mechanisation with the M-300C provides several key advantages in the areas of productivity, ease of use, operator training, safety and weld quality. When this is coupled with new technologies, such as the tie-in station with weld positioner arms from CRC-Evans, the contractor is better prepared to handle the challenges of today's modern pipeline industry.