WHITE PAPER

The Art and Science of HDPE Fusion Welding in High Pressure Applications

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Abstract

The pipeline industry has been installing thousands of miles of High Density Polyethylene (HDPE) pipe with fusion welded connections. Failed connections are rare, but when they do occur it can be a costly and difficult operation to repair them. Butt fusion welding is not always done by trained and certified technicians, and without a way to monitor the parameters essential for quality welds, it will always be a guessing game if the joint is properly welded. For pipelines under pressure, it is even more important that the connections be done correctly.

This paper will discuss the use of a data recording device to monitor time, temperature and pressure for every fused HDPE connection on two high pressure sewage force main rehabilitation projects, along with the lessons learned. Of particular importance to the reader will be:

- What's critical for good welded connections.
- What designers should know in specifying HDPE as a high pressure pipeline.
- How to read data recording device output.
- How to specify the testing and inspection of welded connections.
- Good sliplining techniques to ensure joints are not degraded in installation.

Two case studies from Northern California projects in Monterey and Lake Tahoe will highlight the techniques used to verify welded joint integrity and what we learned that will benefit future project planning.

Background on Sliplining and HDPE

Sliplining is arguably the first trenchless technology, with butt-fused HDPE becoming a popular material of choice in recent years. As the number of projects utilizing this technology grows, it is increasingly important to ensure that fusion welds are performed properly, so that there are no short-term or long-term deficiencies at the joints. This is especially important for pressurized pipelines, where significant stresses will be applied to the pipeline not just during installation, but also throughout the service life of the pipe. It is also important for other trenchless installation methods such as pipe bursting or horizontal directional drilling, especially where unusual circumstances (such as an unusually long pull length) could exert extra stresses on the pipe material.

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Owners have a special interest in ensuring that HDPE welds are performed correctly to ensure that their assets meet their design life and perform optimally. Following good practices is also in the interest of contractors and HDPE manufacturers, as it allows them to demonstrate their quality work and ensures HDPE as a viable material for high pressure pipelines for years to come.

HDPE pipe has been in use since the mid-1950s and has a number of properties that make it an attractive pipeline material, especially for trenchless applications. It is ductile and relatively inexpensive, and its high flexibility and bendability allow it to handle surge pressures well. Perhaps most importantly for trenchless applications, it has a lower elastic modulus than other pipe materials, allowing for tighter bending radii. This allows for smaller insertion pits, as the pipeline can bend across a smaller distance into the pit. HDPE also can be heated and re-formed, allowing for the fusing of joints above ground.

Like other pipe materials, design of HDPE pipelines should consider parameters such as hydraulic capacity and external loading. Pressure pipelines should also consider internal pressure loading and surge loading. Pipe wall thicknesses are determined by means of a standard dimension ratio (SDR), which equals the pipe outside diameter divided by the wall thickness.

The Fusion Process

HDPE pipes in the field are typically connected by means of butt fusion. Butt fusion is a process by which plain ends of HDPE pipe are squared off, melted to an appropriate temperature and subsequently held together, so that the melted portions fuse together to create a bead at the joint. When done properly, HDPE butt fused joints are as strong, if not stronger than, the pipe itself.

Figure 1: Completed HDPE weld for the Dollar Hill Force Main project.

The butt fusion process consists of five main steps: preparation, bead-up, heat soak, heater plate removal, and cooling. These steps are explained in more detail below.

1 | **Preparation:** Prior to fusing pipe segments, segments should be cleaned and checked for roundness. A facer should be used to ensure that pipe ends are smooth prior to fusion. The pipe ends should be placed together so they will line up properly during fusion. It should be ensured that the heater plate surface temperature is between 400°F and 450°F.

2 | **Bead-up:** The pipe ends are placed against the heater plate at a moderate pressure until a light indication of melt shows on the pipe ends. This process typically takes a few seconds, but can exceed two minutes on pipe diameters larger than 36 inches.

3 | **Heat soak:** When bead-up is complete, the pipes are held against the heater plate at zero pressure to allow for proper melting. ASTM F2620 requires 4.5 minutes per inch of pipe wall thickness for the heat soak period.

4 | **Heater plate removal:** Upon completion of the heat soak period, the heater plate is removed from between the pipe ends. The ends should be quickly inspected to make sure that there is

no concave surface. The maximum heater plate removal time varies between 8 and 25 seconds based on pipe wall thickness. This time includes inspection time.

5 | **Fuse/Cool:** Upon removal of the heater plate and a quick inspection, the pipes should be pressed together at specified pressure to allow for fusing and cooling. The duration should be 11 minutes per inch of pipe wall thickness. The contractor should allow for an additional 30 minutes prior to insertion or pulling forces being placed on the weld.

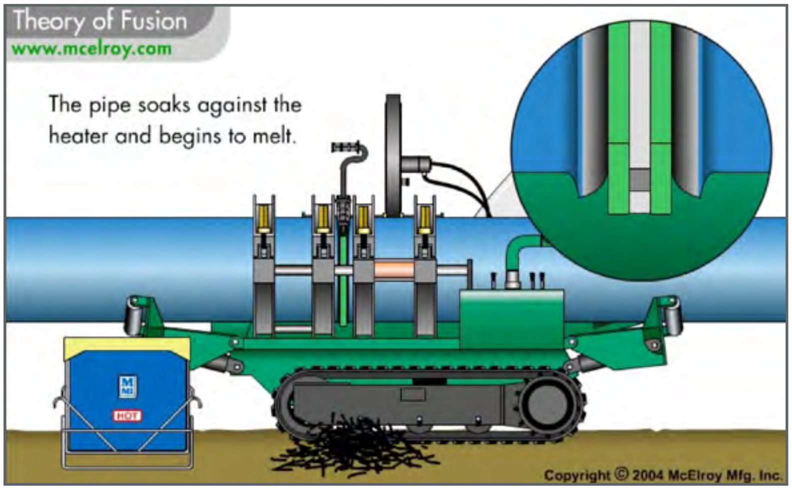

Figure 2: Schematic of fusion machine and pipes during heat soak phase. Click to view a full animation of the fusion process.

Monitoring Fusion Welds

Inspection and monitoring are highly recommended for all HDPE fusion welding. Inspection, at a minimum, should include the following:

- Confirm the individual performing the fusion has a certification from the pipe manufacturer or manufacturer of the fusion equipment.
- Use a heat gun to ensure that the heater plate surface temperature is between 400°F and 450°F prior to the first weld of the day and periodically throughout the day.
- Cut out the first weld of the day and visually inspect the interior of the fused joint. Check to see that the material appearance and color are consistent between the pipe segments and the joint itself.
- Verify proper heat soak time.
- Make sure that beads are not concave upon heater plate removal.

For gravity or low pressure installations, the above steps are typically adequate to ensure that welding quality is sufficient. However, for high pressure applications or sensitive pipelines, additional procedures should be followed to obtain high quality welds. Most importantly, the temperature and pressure during the welding process should be tracked throughout each weld, from bead-up through fuse/cool time.

For hydraulically operated butt fusion machines, data recording equipment is available that can track data for each joint. This data includes information such as date and time of the weld, fusion equipment used, type of pipe, heater plate temperature and pressures applied on the pipe during the fusion process. Some equipment automatically provides the required time and pressure for each phase given a pipe size and dimension ratio. Each joint receives its own one-page log. ASTM F3124 "Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems of Fittings" documents the process in detail.

The main output of data recording devices is a graph of pressure over time throughout the fusion process for each weld. A sample graph is shown in Figure 3. The steps for each weld and their corresponding location of the figure are listed below.

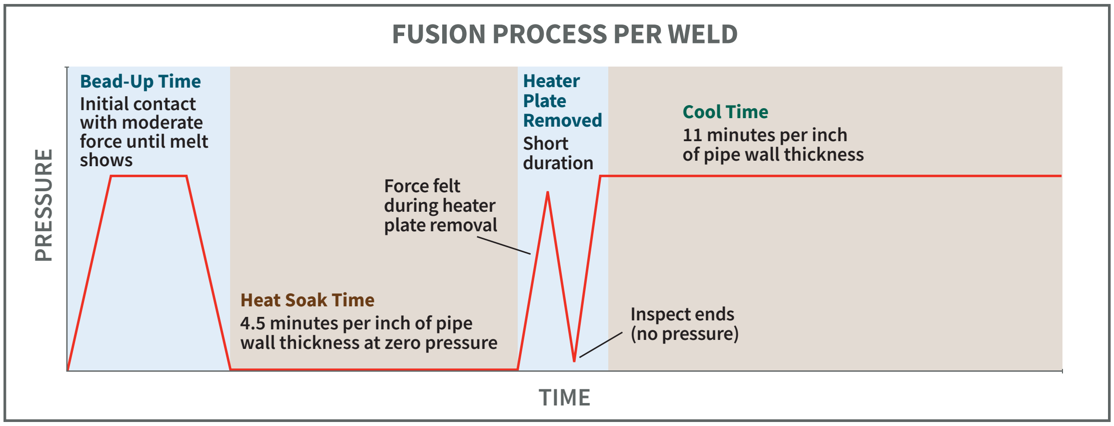

Figure 3: Annotated hypothetical fusion Log.

1 | Bead Up: The pipes are initially pressed together against the heater plate until melt occurs. There is pressure until melt occurs.

2 | Heat soak: Once the ends are melted, pressure should drop to zero for the specified heat soak time, which is 4.5 minutes per inch of pipe diameter.

3 | Heater Plate Removal: A brief period of time during which the heater plate is removed and the pipes are pressed back together. This time period may have several small spikes as several things happen:

- The hydraulic equipment may feel a sudden increase in pressure as the pipes are pulled away from the heating plate.
- The hydraulic equipment will again feel little to no pressure as the pipes are held apart for several seconds while a brief inspection of the melt takes place.
- As the pipes are pressed back together, the pressure increases again.
- These spikes are not cause for alarm. Inspectors and engineers should be most concerned that the time period does not exceed the required time specified in ASTM F 2620.

4 | Fuse/Cool: The pipe segments are held together at the appropriate pressure for a duration of 11 minutes per inch of pipe diameter.

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Data recording equipment provides several important benefits:

- The required times and pressures for each phase will be automatically displayed to the fusion equipment operator throughout the process.
- Graphs will allow the inspector/engineer to identify suspicious welds for removal prior to placement. In particular, the graphs will allow the inspector to identify whether excessive force was applied during the heat soak period.
- Data for each weld is available to be stored in the project files.

The standard data recording device interface allows for download onto a personal computer. However, as noted above, it is important to see fusion weld records in real time. Most data recording devices have handheld viewers for quick viewing in the field, and some recent models allow for instantaneous internet upload via a Wi-Fi hotspot to be inspected from a personal computer, tablet or phone in real time.

Testing and Inspection of Welded Connections

In addition to reviewing the data recording device printouts, there are in-person inspections that should be performed for each weld. After the first weld of the day, the contractor should cut a strip across the weld so that the internal properties of the weld can be viewed. Ideally, this cut should take place with a clean saw, so that the interior of the weld can be viewed cleanly. Contractors will typically prefer to use a chainsaw, which is acceptable if no clean saws are available. Inspectors should check to see that:

- **Joint is generally the correct shape:** Each bead is rounded and the “v-groove” between the beads is no deeper than half of the bead height above the pipe surface. Appendix D of PPI TR 33 shows an ideal joint, and is shown in Figure 4.
- **Material properties should be consistent through the joint.** Changes in color or material consistency between the pipe wall and the joint are a cause for concern.
- **For pipes up to one-inch wall thickness, an ASTM F2620 “bent strap” test should be performed.** This consists roughly of cutting a longitudinal strap through the joint and bending the strap so that the ends touch without breaking the joint.

Other things to check throughout the day include:

- During the heater removal phase, the inspector should verify that the pipe ends are not concave (dipped in towards the remainder of the pipe).
- Visual checks of the bead shape should take place for each joint.

Upon completion of fusion and installation, pressure tests should be performed on the line.

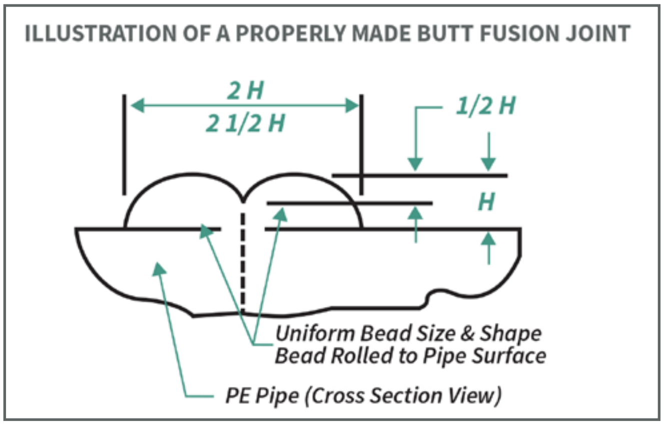

Figure 4: Ideal bead shape. (Source: Plastic Pipe Institute)

Sliplining Techniques

Sliplining is a technique that has been used for many years, and is an ideal trenchless method when an existing pipeline is oversized and requires rehabilitation. Sliplining consists of inserting a new pipe (commonly referred to as the “carrier” pipe) inside of the existing pipe (referred to as the “host” pipe). This can be performed segmentally (where pipe segments are inserted and connected one at a time), or by fusing together fusible pipe materials such as HDPE or fusible PVC above ground, then inserting the pipeline run in a single pull. Sliplining minimizes disruption, and excavation and off-haul of material. The process typically costs less than open trench construction.

Some key points to consider when slip-lining:

- **Need at least 10% annular space.** The diameter of the new pipe in relationship to the existing pipe needs a 10% annular space (annular space refers to the area between the outer wall of the carrier pipe and the inside wall of the host pipe). If the diameter of the carrier pipe is too large, this could create friction between it and the host pipe, increasing pushing/pulling forces and increasing the odds of gouging the outer wall of the carrier pipe. ASTM F585 recommends a minimum annular space of 10% of the host pipe or two inches, whichever is less.
- **Mandrel prior to insertion to ensure no blockages are in the existing pipe.** It is also important to mandrel the existing pipe using a pig to make sure there are no constrictions or obstructions in the host pipe.
- **Grout the annular space.** Grouting of the annular space is generally recommended to ensure that the two pipes are held together with the new grout material. This will avoid groundwater infiltration into the host pipe and limit movement of the carrier pipe. Designers should consider heat of hydration and pressures during grouting if grouting of the annular space is proposed.
- **Anchorage of the new pipe is especially important for pressure pipelines.** This ensures minimal movement.

CASE STUDY: City of Monterey Highway 68 Force Main Rehabilitation

The City of Monterey in California contacted the consultant Harris & Associates (Harris) with a force main pipe leakage. The pipe was leaking sewage on State Highway 68 between Salinas and Monterey, which is within a Caltrans right-of-way and a highly traveled commuter road. The force main was a mile long with 8-inch PVC. The force main had longitudinal cracks in the existing pipe and was spilling out on Highway 68, which was not only a visual eyesore, but also a public safety and health concern. The fact that the City had repaired similar cracks two times in the previous five years caused them to question the integrity of the entire pipeline and seek advice from Harris on better solutions for its repair.

Figure 5: Existing leak in PVC force main

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Harris considered several options:

- Removing and replacing the line, which would have been the most costly and disruptive option.
- Pipe bursting the pipeline and installing a similar-sized new pipeline.
- Cured-in-place pipe lining of the existing pipe.
- Sliplining with a smaller pipeline if flow capacity could be maintained.

As each of these options was evaluated, the team needed to know if the diameter could be reduced. If the diameter had to be maintained, sliplining would no longer be an option. With current pump run-time information from the City, Harris determined that a 6-inch diameter force main would be adequate for the flows that the City had. This made sliplining the most attractive option, as it is the most economical and would have the least construction impacts to the traveling public on Highway 68.

Harris coordinated with Caltrans to determine the locations of the insertion and receiving pits for sliplining. The plans showed the locations and traffic control requirements for each insertion and receiving pit. A total of seven pits were initially anticipated along the one-mile stretch of pipeline. The contractor ultimately only required a total of five.

State Highway 68

An additional complication of the project was that this was a live force main that needed to be maintained throughout construction. Bypass pumping was used throughout the project for the continual transportation of sewage.

Due to these challenges, the team determined that all of the sliplining would have to occur at night. The contractor had to work exclusively during the hours of 6:00 p.m. to 6:00 a.m. to lessen impact to traffic. The pipeline work was broken up into four segments of about 1,000-feet each. The original plan was to fuse the pipe segments and test them above ground during the day and off the shoulder of the road. However, the contractor expressed concern about his ability to restrain the pipe above ground, and was allowed to perform pressure testing after sliplining only under the condition that segments that failed the test would be removed.

One segment did in fact fail an initial test after installation. To compound the issue, data logs for the fusion welds were not provided in real time, and when they were provided, they showed some abnormal results, such as abnormal spikes in pressure and pressures during inappropriate phases. (See Figure 6 on page 10). The project team ultimately agreed on an alternate pressure test that the pipeline was able to pass. However, poor fusion logs and the inability to have them reviewed prior to installation gave cause for the team to worry.

Despite some bumps along the way, the project was ultimately constructed under budget and within schedule, and is considered a success for the project team.

CASE STUDY: North Tahoe Public Utility District Dollar Hill Force Main Rehabilitation

The North Tahoe Public Utility District (NTPUD) provides water and sewerage services for the north side of Lake Tahoe in California and Nevada. The entirety of NTPUD's sewage flows along the California side of the lake to the Dollar Pump Station, where sewage is pumped out of the Lake Tahoe Basin and into the jurisdiction of the adjacent Tahoe Truckee Sanitation Agency (TTSA). This allows the sewage agencies to avoid putting a sewage treatment plant immediately adjacent to scenic and environmentally sensitive Lake Tahoe.

NTPUD Dollar Hill Force Main project location

The Dollar Pump Station and the Dollar Hill force main (which connects the pump station to TTSA's gravity line) were originally constructed in 1969, with the Dollar Hill force main constructed as approximately 3,000 linear feet of 22-inch cement mortar lined steel pipe. In 1993, however, a parallel 16-inch ductile iron force main was constructed along the same corridor, and has been in use ever since. (Previous development forecasts were downgraded, and a 16-inch pipe was deemed adequate.) The original pipe had fallen into disrepair, with several known leaks.

NTPUD had a significant interest in placing the original line into operation. Environmental groups had been asking for redundancy, and NTPUD wanted its own assurance that a break in the force main would not spill sewage into Lake Tahoe. However, NTPUD was concerned about the costs and disruption to the California State Highway along which it runs. Harris & Associates proposed sliplining the pipe with HDPE, which ultimately made the construction costs feasible for the District.

In designing the project, Harris first analyzed anticipated flow and pressures to determine the appropriate size of pipe. Harris confirmed that an approximate 16-inch inner diameter was required for maximum flows. Harris also analyzed the annular space and determined that the required pressure rating for PE3408/3608 pipes would require a 2-inch outside diameter, which the design team felt left too little annular space. To achieve the desired pressures with an 18-inch OD HDPE, PE 4710 was used.

The pipeline had several known or suspected bends. Some were known based on a combination of record drawings and subsurface detection. Other potentially problematic locations were identified as those where prior CCTV inspection was abandoned, suggesting an obstacle where a new carrier pipe may struggle to get through. Harris ultimately chose eight pit locations along the alignment for the bid documents. The contractor ultimately only required four of these locations.

Following the issues with the above-referenced Monterey Highway 68 force main project, Harris prepared language in the bid documents that firmly required the fusion machine operator be

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certified and use the proper data recording device. These items were included as contractor submittals to be approved prior to starting work. Harris also was present on the first day of fusion welding to ensure the fusion process and data recording was occurring properly.

Though the contractor was proficient in the use of the data recording device used for the job, providing timely welding logs was again an issue. For this project, the contractor decided to insert the pipe segmentally, fusing pipe segments to the string one at a time, and pushing the new pipe into the host pipe one segment at a time. Because the contractor did not fuse all welds of each string prior to insertion, viewing the welds prior to insertion would have required interrupting the contractor's process to download and inspect the data. Though the handheld device was indeed available onsite, this was only checked periodically, not after every weld. There were also issues with downloading the information to a personal computer for a more thorough review in a timely manner.

Ultimately, however, requiring that the contractor be proficient and certified in the use of a data recording device proved effective in assuring improved documentation of welds. All 63 welds recorded as part of this project complied with the ASTM F3124 and F2620 guidelines, as well as those of the pipe manufacturer, and showed a vast improvement over the quality assurance of the welds from the Monterey Highway 68 Force Main project (See Figure 6 on page 10). The pipe passed pressure testing with no issues. The project was constructed within schedule and budget, and had zero change orders.

NTPUD Dollar Hill force main project

Lessons Learned

Both of these projects had valuable lessons learned, both for sliplining overall and for HDPE fusion welding, specifically.

Tight bending radii can help minimize the number of insertion/receiving pits. During design, both projects conservatively proposed a large number of insertion and receiving pits. In both projects, the contractor's final operations used less pits, as HDPE bending radii were more able than anticipated to navigate bends and minor obstructions in the host pipes.

PE 4710 resin can help with wall thickness issues. Though slightly more expensive than the more common 3408/3608 resins, PE 4710 allows for a thinner wall at equivalent pressure ratings, allowing for adequate annular space while also providing the hydraulic needs. In more sensitive cases, PVC can provide an even thinner wall, but requires longer insertion pits.

For high pressure or sensitive applications, specifications need to be clear so that the operators have both fusion welding and data recording device experience. The contractor for the Monterey Highway 68 Force Main project had an experienced operator to perform the fusion welding; however, he was not familiar with the data recording device. This resulted in unclear and inaccurate printouts from the data recording device that could not be relied upon. With stricter requirements and an experienced operator for the NTPUD Dollar Hill Force Main Rehabilitation project, this issue was remedied. See Figure 6 for a comparison of fusion weld logs between the two projects.

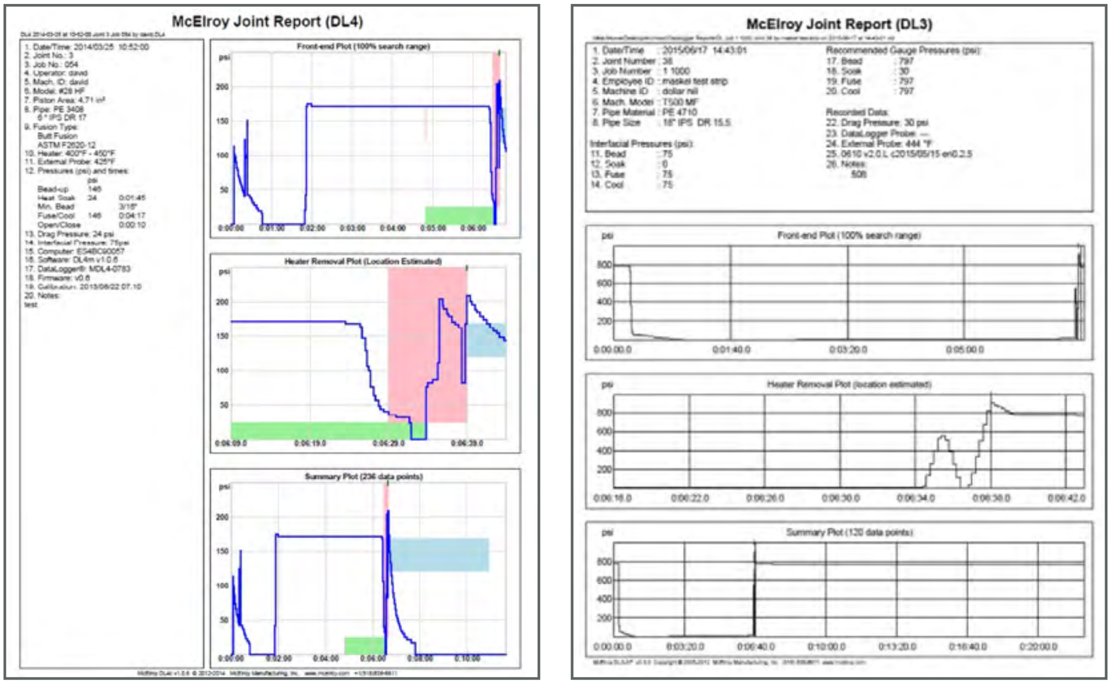

Figure 6: Left, irregular fusion log from the Highway 68 Force Main. Right, acceptable fusion log from the Dollar Hill Force Main. For both logs, "front end plot" (top graph) refers to the zoom-in to exclude the cooling period. The "heater removal plot" (middle) is a zoom-in on the heater removal phase, and the "summary plot" is the entire log, most analogous to Figure 3.

Emphasize in project specifications the importance of providing fusion logs in real time. Contractors often prefer to fuse pipe, then download the information later to send to the engineer/inspector. However, if the pipeline is installed shortly after fusion, the data may be delivered after the pipe has been installed, making it extremely difficult to cut out improper welds! This ended up being a problem on both projects. The contractor for the Monterey Highway 68 Force Main project was unfamiliar with the real-time printout capabilities of data recording devices. To download the printouts, they had to go back to the contractor's headquarters in San Francisco and then send them to the field. For the NTPUD Dollar Hill Force Main project, the contractor had some knowledge of how to use the handheld field viewer of logs, but viewing the log for every single weld in real time proved logistically difficult at the job site. This was somewhat problematic, as the contractor's plan was to insert pipes segmentally after each fusion.

Newer data recording devices, such as the McElroy Datalogger 5 allow for real-time internet upload via a Wi-Fi hotspot and immediate viewing from a computer, tablet or phone. However, this equipment is often rented and much of the rental pool still consists of older devices that do not have this capability. Engineers should specify that data recording device printouts for high pressure or sensitive projects be available for review by the engineer *prior to insertion into the* *ground.* If contractors fuse entirely above ground, the printouts should be made available prior to sliplining. For segmental insertion, they should be made available immediately.

Sliplining is an effective way to minimize disruption and traffic control requirements on state highways, and understanding construction staging for sliplining is an important part of acquitting an encroachment permit. Both projects would have been much more expensive and disruptive utilizing traditional open-trench construction. In the case of the NTPUD Dollar Hill force main, the project may not have occurred if not for sliplining technology. Both projects required encroachment permits from Caltrans, and part of this process required anticipating the location of insertion and receiving pits so that traffic control could be set and approved by Caltrans for each pit.

Figure 7: Fusion welding for the NTPUD Dollar Hill Force Main project. This joint is currently in the cooling phase.

Conclusion

It is important, especially in high pressure or otherwise sensitive pipelines, to monitor and inspect HDPE butt fusion welds to ensure high quality welds, and that the information of each weld—especially temperature, pressure and time—is recorded for the project records. Real-time data recording devices are available for this work and can be utilized to ensure a successful project. It is recommended that engineers specify the use of real-time data recording devices for high pressure or otherwise sensitive applications, and require that contractors know how to operate the machinery effectively.

References

ASTM Standard F585-13, "Standard Guide for Insertion of Flexible Polyethylene Pipe into Existing Sewers", ASTM International, West Conshohocken, PA 2013, DOI: 10.1520/F0585-13.

ASTM Standard F2620-13, "Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings", ASTM International, West Conshohocken, PA, 2013, DOI: 10.1520/F2620-13.

ASTM Standard F3124-15E01, "Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems of Fittings", ASTM International, West Conshohocken, PA, 2015, DOI:10.1520/F3124-15E01.

"Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, TR-33". Plastics Pipe Institute. Irving, TX: 2012.

Handbook of Polyethylene Pipe, Second Edition, Plastics Pipe Institute. Irving, TX: 2008.

"Joining and Field Procedures for WL Plastics PE4710, PE3608, PE3408, PE2708, and PE2406 Pipe", WL Plastics Corporation. Fort Worth, TX: 2015.

"Theory of Fusion" Animation, McElroy Manufacturing, Inc. Accessed December 1, 2015. *http://ww2.mcelroy.com/en/university/videos.htm*

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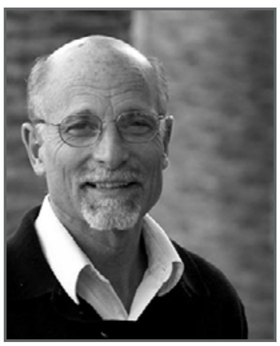
What do you get when you mix a zeal for mathematics with a passion for smart public policy? You get the career of Kyle Carbert, a civil engineer who excels at improving community life for people of all abilities, and for everyone who counts on clean, safe water.

Kyle is Harris' resident expert on ADA issues in the Bay area. He's also a drainage and stormwater specialist with 10 years of experience in the public and private sectors. His acumen spans everything from accessibility design to trenchless sanitary sewers, given his fluency in the arcana of hydrologic and hydraulic calculations.

Whether working on pavement rehab in Edenvale or sanitary sewers in Monterey, Kyle takes pride in delivering designs that save clients and taxpayers money, while promoting a greener environment. His innovative work on PG&E's service yards alone saved the client some $1.3 million.

When he's not on the job or playing ultimate Frisbee, Kyle frequently volunteers his expertise for communities in need. His work with Engineers Without Borders has helped to create a health clinic in rural Haiti, bringing hope—and state-of-the-art sanitation—to a facility not even connected to the electrical grid.



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Vern is a nationally recognized authority in the field of water and wastewater management. His thought leadership has helped define and redefine how communities maximize water collection and distribution while minimizing costs and construction impacts.

He has over 40 years of experience in program management and civil engineering for public agencies' infrastructure-improvement projects—including over 25 years with Harris. Vern allocates resources and works collaboratively with clients to help ensure that projects finish on time while meeting or exceeding their expectations.

Vern has extensive pipeline and pump station experience including sewer and storm drain facilities, potable and reclaimed water distribution systems, and saltwater and dredging pipelines. While he maintains an oversight role at Harris, Vern often dives into the details assisting in field investigation, data collection, and evaluation and coordination with diverse governmental agencies.

As one of the country's leading authorities on innovative trenchless technology for pipe construction, Vern regularly publishes technical papers, speaks at professional forums and brings his passion for the subject to numerous professional associations. This kind of pioneering leadership has made him an integral part of the Harris team.

Vern's ties to water are strong. Prior to his tenure at Harris, he worked on rural water projects in Morocco and Yemen for USAID. And today, when he's not working with water, you'll probably find him beneath it, scuba diving.