Partnering with Miller and Hobart Brothers gives you decades of global experience — a history that includes pipeline construction in some of the harshest and most remote environments on Earth.

High-strength materials — like API 5L Grades X70 to X100 — are designed to expedite pipe lay time, reduce costs and simplify transport. Whether it’s building across desert terrain, up the side of a mountain or through the frigid tundra, high-strength steel offers a history of quality, safety and proven results.

- Excellent strength properties provide greater carrying capacity, along with the ability to withstand increased pressure tolerances.
- The ability to withstand temperature extremes, thermal expansion and contraction, frost and other environmental loadings for global construction.
- Thinner wall thicknesses that require less time to weld, less filler metals to complete passes and lower costs for transporting materials to jobsites.
- Lower cost per foot compared to lower-strength steels.

As high-strength steels become more prevalent in the global pipeline market, matching the proper filler metals, welding processes and heat treatment to the pipe can ensure the highest level of integrity, quality and productivity in pipeline construction.

Meeting the Challenges of High-Strength Pipeline Integrity

Our world is growing and changing. An increasingly urbanized population — poised to reach 9 billion by 2050 — is driving demand for new energy sources and innovation in energy-based construction and infrastructure. We can help you meet those demands.
Addressing the challenges of welding high-strength steels

High-strength steels require special attention to maintain their integrity throughout the welding process. Key to achieving that goal is minimizing the opportunity for hydrogen-induced cracking.

High-strength steels also require:

- **Filler metals** to match the various alloying strategies for high-strength steels and meet the necessary impact properties.

- New **welding systems** with innovative processes to optimize the weld performance and durable designs to meet the rugged requirements of pipeline construction.

- Tightly-controlled **pre-heat temperatures** of the root pass and interpass temperatures for the fill and cap passes.

*Together, Miller and Hobart Brothers have developed proven innovative solutions to address these needs.* From welding equipment and filler metals tailored to high-strength steels, to induction heating designed to control pre-heating, interpass temperatures and post-weld stress relief, our technologies work together to reduce the risk of hydrogen-induced cracking and ensure you achieve the highest quality welds.

*Ask our global network of welding professionals to help you place the most reliable welding and heating systems for this demanding application in the hands of your team.*
Maintaining the quality and safety of the pipeline is absolutely critical. Our metal-cored wires and the Regulated Metal Deposition (RMD®) process for root passes, combined with induction heating, ensure the consistency and quality you need.

Before you even strike an arc, induction heating can help drive out moisture and minimize hydrogen in the weld joint. The process minimizes the opportunity for cracking by slowing the cooling rate, allowing hydrogen to diffuse, and offsetting thermal shock.

Adding to those pre-weld advantages, metal-cored wire and the RMD process further improve the integrity of the root pass by providing consistent and reliable root reinforcement. The technologies also provide:

- An exceptionally **stable arc and calm weld puddle** — both of which help improve weld quality and consistency, and reduce the opportunity for defects like lack of fusion.
- **Greater tolerance** of code-allowable high-low misalignment.
- A **fast-freezing puddle** that can bridge gaps up to 5 mm (3/16 inch) and provide a root pass with a throat between 3 to 5 mm (1/8 to 3/16 inch) thick (for .045-inch wire).
- A weld bead with **little or no spatter** that typically does not require interpass grinding or cleaning due to the lack of slag in the process.
- A **consistent arc length**, even at varying wire stick-out, to simplify training.
- **Greater deposition efficiency** compared to cellulosic Stick electrodes.
Increased deposition efficiency of metal-cored wire vs. E6010 cellulosic Stick electrode ensures that the majority of metal-cored wire is going into the puddle as finished weld vs. the Stick electrode where a large percentage is being lost in spatter, slag and stub loss.

The low hydrogen solution of metal-cored and self-shielded flux-cored wire will deposit less hydrogen into the weld puddle, decreasing the chance for hydrogen-induced cracking.

Completed welds provide excellent impact properties — as low as -40 degrees F/C — to compensate for extreme temperatures. Weld deposits feature as low as 4 ml of diffusible hydrogen per 100 g of weldment compared to up to 16 ml per 100 g with cellulosic Stick electrodes.

*Typical diffusible hydrogen data with shielding gas 75-80% Argon (Ar)/Balance Carbon Dioxide (CO₂)
The alloy in high-strength steels, combined with the high hydrogen levels that cellulosic Stick electrodes produce, makes welds more prone to hydrogen-induced cracking. Shifting from Stick welding (SMAW) to Self-Shielded Flux-Cored welding (FCAW-S) for fill and cap passes reduces hydrogen content, helps ensure weld integrity and offers substantial benefits to the welding process:

- **Easily welds API 5L Grades X70 up to X100:** qualified and currently used in high-strength steel applications around the globe.

- **Lower hydrogen content to reduce cracking:** Self-shielded flux-cored wires feature less than 8 ml of diffusible hydrogen per 100 g of weldment (compared to greater than 16 ml per 100 g for cellulosic Stick electrodes).

- **Excellent impact properties:** To combat the environmental extremes high-strength pipelines are subjected to, self-shielded flux-cored wires feature excellent Charpy V-Notch (CVN) impact values at temperatures as low as -40 degrees Fahrenheit/Celsius.

- **Increases in speed and deposition efficiency:** Self-Shielded Flux-Cored welding provides faster travel speeds — more pounds per hour — and offers greater filler metal deposition efficiency compared to welding with cellulosic Stick electrodes. In short, your operators will use less filler metal to do the same job and do it in less time.

- **Better arc control:** Excellent arc quality and dual schedule capabilities give the welding operator better control over the welding arc, even in difficult positions toward the bottom of the pipe (4 to 6 o’clock).

- **Eliminates shielding gas:** Process eliminates the need for a shielding gas, reducing the cost, transportation and storage of gas bottles.
Hobart Brothers Self-Shielded Flux-Cored Wires

<table>
<thead>
<tr>
<th>Products</th>
<th>AWS Class</th>
<th>Shielding Gas</th>
<th>Tensile psi (MPa)</th>
<th>Yield psi (MPa)</th>
<th>CVN @ Temp ft-lb (Joules)</th>
<th>Typical Diffusible Hydrogen (ml/100g)</th>
<th>Recommended Pipe Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabshield® 81N1</td>
<td>E71T8-N1 J H8</td>
<td>None</td>
<td>75000 (517)</td>
<td>65000 (448)</td>
<td>206 (280) @ -40°F (-40°C)</td>
<td>6.4 Fill &amp; Cap up to X65 Pipe</td>
<td></td>
</tr>
<tr>
<td>Fabshield 81N1+</td>
<td>E71T8-N1 J H8</td>
<td>None</td>
<td>82000 (565)</td>
<td>71000 (490)</td>
<td>106 (128) @ -20°F (-29°C)</td>
<td>71 (96) @ -40°F (-40°C)</td>
<td>5.5 Fill &amp; Cap up to X70 Pipe</td>
</tr>
<tr>
<td>Fabshield X80</td>
<td>E81T8-Ni2 J H8</td>
<td>None</td>
<td>94000 (649)</td>
<td>84000 (578)</td>
<td>83 (113) @ -20°F (-29°C)</td>
<td>70 (95) @ -40°F (-40°C)</td>
<td>5.2 Fill &amp; Cap up to X80 Pipe</td>
</tr>
</tbody>
</table>

Hobart Brothers Gas-Shielded Flux-Cored Wires

<table>
<thead>
<tr>
<th>Products</th>
<th>AWS Class</th>
<th>Shielding Gas</th>
<th>Tensile psi (MPa)</th>
<th>Yield psi (MPa)</th>
<th>CVN @ Temp ft-lb (Joules)</th>
<th>Typical Diffusible Hydrogen (ml/100g)</th>
<th>Recommended Pipe Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula XL®-550</td>
<td>E71T1C / E71T12CJ H4</td>
<td>100% CO₂</td>
<td>85000 (586)</td>
<td>77000 (531)</td>
<td>75 (102) @ -40°F (-40°C)</td>
<td>3.3 Fill &amp; Cap up to X65 Pipe</td>
<td></td>
</tr>
<tr>
<td>FabCO® 712M</td>
<td>E71T1MJ H4 / E71T9MJ H4 / E71T12J H4</td>
<td>75-80% Ar/CO₂</td>
<td>79000 (544)</td>
<td>70000 (482)</td>
<td>100 (135) @ -40°F (-40°C)</td>
<td>3.4 Fill &amp; Cap up to X65 Pipe</td>
<td></td>
</tr>
<tr>
<td>Tri-Mark® TM-101</td>
<td>E101T1-GM</td>
<td>75% Ar/25% CO₂</td>
<td>110000 (758)</td>
<td>102000 (703)</td>
<td>52 (71) @ -40°F (-40°C)</td>
<td>5.1 Fill &amp; Cap up to X80 Pipe</td>
<td></td>
</tr>
<tr>
<td>FabCO XTREME® 120</td>
<td>E121T5-GC H4</td>
<td>100% CO₂</td>
<td>125600 (866)</td>
<td>110700 (763)</td>
<td>75 (101) @ -76°F (-60°C)</td>
<td>3.4 Fill &amp; Cap up to X100 Pipe</td>
<td></td>
</tr>
</tbody>
</table>

Other customized formulations for specific applications available upon request.

This graph illustrates the increase in deposition rate and more consistent deposition efficiency when using a self-shielded flux-cored wire vs. an EXX10 cellulosic Stick electrode.
Each component of the welding process — filler metal and equipment — can affect the amount of hydrogen in the weld, but combining their attributes into one optimized system ensures the best results. These systems from Miller and Hobart Brothers are easy to operate and are designed to withstand the harshest environments found in pipeline construction — tested above and beyond the highest industry standards to ensure durability and performance.

**Miller® PipePro® XC welding system**

The PipePro XC welding system from Miller is optimized for both the RMD® process with metal-cored wire on root passes and the Self-Shielded Flux-Cored process with flux-cored wires for fill and cap passes. These systems offer easy operation through intuitive design and interface, are fast to set up in the field and ensure optimal performance with rugged design and construction. The PipePro XC system is also compact for optimal transport and space considerations on-site.

- Multiprocess system is optimized for the welding processes — **RMD and Self-Shielded Flux-Cored** — and best suited to reduce hydrogen in the weld.
- Excellent arc performance and greater tolerance for varying welder techniques **support consistent weld quality**.
- Intuitive design, controls and interface make it **easy to set up and train welders** — ensures welders get up to speed faster and are more productive.
- Durable construction **withstands extreme conditions** related to temperature, moisture, dust, vibration and shock.
- Lightweight, small footprint **facilitates tractor mounting and is portable for tie-ins and repairs**.
- **Upgradeable software**, custom programs and optional features available through memory card.
Hobart Brothers metal-cored and flux-cored wires

Hobart Brothers manufactures metal-cored and flux-cored wires designed to drive hydrogen out of the weld, ensure pipeline integrity with excellent strength and impact properties in harsh environments, and work seamlessly with Miller welding power sources and feeding technologies. Wires optimized for each process include:

- Metal-cored and RMD: Hobart® Metalloy® 76, Metalloy 71SG, Metalloy 80N1, Metalloy 90 and Metalloy 110
- Self-shielded flux-cored wires: Fabshield® 81N1, 81N1+ and X80

Miller® Big Blue® engine-driven welder/generators

The Big Blue 350 PipePro and the Big Blue 700 Duo Pro diesel engine-driven welder/generators, matched with SuitCase X-TREME HD wire feeders, are optimized for pipeline and specifically for Self-Shielded Flux-Cored welding on fill and cap passes. Both machines are built to withstand temperature and environmental extremes for optimal performance regardless of conditions. The Big Blue 700 also represents the industry’s only dual operator welding system for transmission pipeline construction.

**Big Blue 350 PipePro**

- **Excellent arc performance** designed specifically for self-shielded flux-cored wires in pipeline applications promotes weld quality.
- **Easy-to-use operator interface** simplifies training and equipment setup.
- Built and tested in high and low environmental extremes — as well as against moisture, dust, vibration and shock — ensuring reliability and performance even in the toughest environments.
- Greater fuel efficiency to reduce fuel transportation costs and labor; lower emissions for reduced carbon footprint.

**Big Blue 700 Duo Pro**

- Features two welding arcs that match the quality and reliability of the Big Blue 350 PipePro.
- Increases productivity by allowing two welders to work from the same machine simultaneously.
- Uses 35 percent less fuel and offers a lower total cost of ownership than two comparable engine-driven units, saving resources and costs.
- Costs less to transport to the jobsite than two individual engine-driven units and takes up a considerably smaller footprint to save space.
Pre- and post-weld heat treatment is a critical requirement in eliminating hydrogen-induced cracking in high-strength steels. Whether on the mainline, on tie-ins or at compressor/pumping stations, induction heating provides superior preheating and stress relief that is more effective, faster, more versatile and extremely safe compared to other methods. The induction heating process:

- **Drives and keeps moisture out of the weld** to prevent hydrogen-induced cracking. This is a particular improvement over heating with a torch/rosebud, which actually introduces water vapor into the weld joint.
- **Heats uniformly** to prevent localized hot and cold spots that can affect weld integrity and offers real-time thermocouple feedback, along with **tighter control over welding interpass temperatures** to ensure heating consistency.
- **Reduces the potential for damage** and the associated repair time to surrounding parts/components/coatings by limiting heat to the targeted area.
- Improves safety by **eliminating open flames and exposed heating elements**.
- **Improves safety** in confined spaces, as induction heating does not burn oxygen like heating with a torch or rosebud, which can lead to insufficient breathable air for the worker.
- **Provides faster time-to-temperature** than other heating methods, increasing productivity.
- Allows equipment and accessories to be carried on the same tractor or sled as the welding power sources for **improved portability and accessibility**.
- Eliminates heating gas purchase, storage and transport — **lowering costs over time and improving site logistics**.
- Optional digital recorder stores temperature data for **quantifiable verification of critical preheating and stress-relieving temperatures**.
Our ITW Partners

Miller and Hobart Brothers are just two of the ITW Welding companies who have a well-established history of providing proven, innovative products to the pipeline industry. ITW has a global, market-leading portfolio of best-in-class brands that serve the industry with reliable and responsive technical expertise. Our other oil and gas pipeline partners include:

Pipe Welding Technology (PWT) (www.pwtsrl.com) is a manufacturer and supplier of advanced equipment and tools for automatic welding in outdoor applications. This includes advanced mechanical, electronic and arc control technology for the pipeline industry. PWT’s vast field experience and consultative approach ensures customers have the most suitable welding techniques, systems and training available for every job.

E.H. Wachs® (www.ehwachs.com) is a leading manufacturer of portable pipe machining tools, valve exercisers and related equipment used for on-site cutting, squaring, beveling and facing pipe of all sizes and thicknesses. Its “cold cutting” machine tools are designed to eliminate the hazards associated with thermal cutting and improve the overall safety of pipeline operators. The company has been an industry leader in pipeline maintenance since 1949.

ITW Insulation Systems (www.itwinsulation.com) is an established leader in the manufacture of products used in mechanical insulation systems for pipes, tanks and other equipment. ITW Insulation Systems provides high-performance mechanical insulation, vapor retarder film and metal jacketing products designed to meet specifications for a wide range of industrial and commercial applications.

Tempil® (www.tempil.com), a leader in the development of precision temperature indication technologies, including indicating sticks, electronic surface thermometers and infrared thermometers, for over 75 years. These “visual” product solutions check critical temperatures in the welding processes and ensure the performance of completed pipelines. Tempil stays at the forefront of the industry through constant research and product development that address the direct needs of its customers.
As your global partner in pipeline construction, we pledge to support your success with our unique multi-discipline knowledge and in-depth pipeline construction experience. Our goal is to ensure you achieve consistent weld integrity, no matter how challenging the environment — and no matter where you are in the world.

Countless capabilities. Trusted advice. Integrated solutions.

For all your global pipeline welding solution needs contact:

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