



U.S. Department  
of Transportation

# Hybrid Laser/GMAW of High Strength Steel Pipelines

## DTPH56-07-T-000003

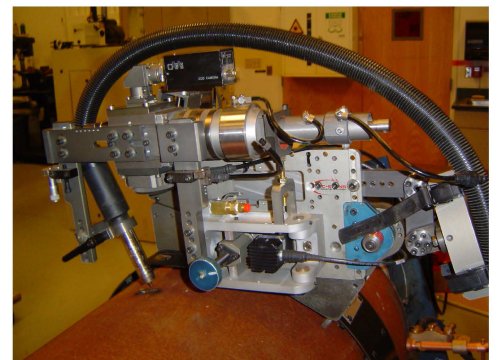
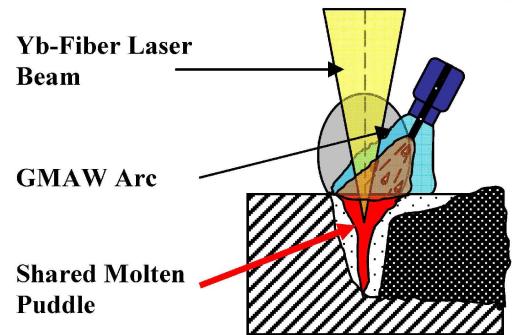
July 2008

### OPS ACCOMPLISHMENTS

Pipeline Safety  
Research and  
Development for  
Welding High  
Strength Steel  
Pipe

#### Challenge

Pipelines will be an integral part of our energy distribution systems for the foreseeable future. Operators are currently considering the installation of tens of billions of dollars of pipeline infrastructure. In a number of cases, the cost of exporting the product will have a dominating influence on the viability of the upstream production facilities. These facilities will progress only if the industry can substantially reduce capital expenditure and improve design for pipeline integrity. Whether the application is an onshore gas transmission line or a deepwater pipeline, there is a need to constantly improve the productivity, quality, integrity, and reliability of pipeline girth welds to reduce construction costs. Despite significant investment, one-shot welding and power beam processes have failed to achieve real benefits in pipeline construction.



Hybrid Laser-GMAW process (Top) and hybrid bug and band system (Bottom) based on CRC-Evans P-450

#### Technology Description

The project aims to develop innovative hybrid Yb-Fiber Laser and GMAW process and technologies for pipeline girth welding and to demonstrate the system under field conditions.

- 1) Development of hybrid laser-GMAW system using "off-the-shelf" technology
- 2) Property Testing of Preferred Welding Processes
- 3) Data Acquisition and Laser Sensors for Quality Monitoring
- 4) Deployment Outside the Laboratory

#### Accomplishments

- ◆ Designed and built hybrid laser-GMAW system using off the shelf components such as CRC-Evans P-450 bug and band system and 10kW IPG Yb-fiber laser.
- ◆ Designed laser safety enclosure and procedures approved by the FDA and FAA for outdoor use
- ◆ Performed demo of system outdoors using generator power (double down technique on 24" pipe)
- ◆ Achieved 120 IPM travel speed with 5mm effective throat (to meet toughness requirements)

#### Contact

James Merritt

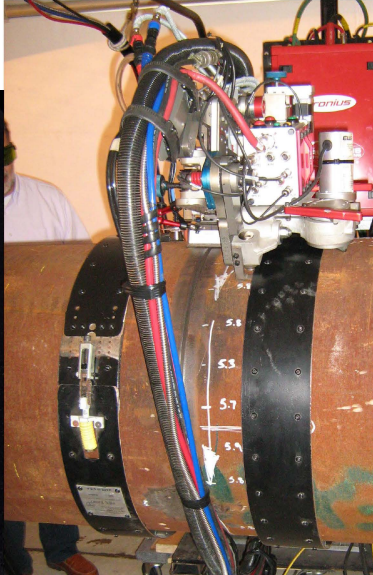
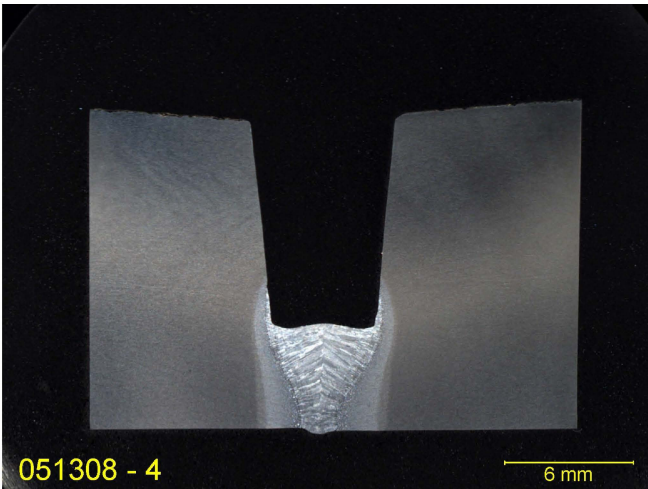
Contracting Officer Technical Representative (COTR)

(303) 638-4758

[james.merritt@dot.gov](mailto:james.merritt@dot.gov)

# Office of Pipeline Safety

## Pipeline and Hazardous Materials Safety Administration



Macrograph of weld made at 120 in/min on X80 material (left) and the hybrid laser-GMAW system in use in a tent (right).

### Benefits

A field deployable hybrid Laser-GMAW system gives pipeline operators the deep penetration of lasers with the gap tolerance of GMAW. The high power laser will allow root pass weld speeds to double or triple which will reduce production costs. The pipeline industry will benefit from improved competitiveness as well as the increased workload as more pipelines become viable.

### Future Activities

In the remainder of this project, parameters will be developed for X-80 and X-100 pipes with an emphasis on mechanical properties (API 1104). Multiple wire chemistries will be evaluated with and without preheat. At the conclusion of the project, an industry demo will be held outside of the lab environment.

### Partners in Success

- ◆ Acergy—[www.acergy-group.com](http://www.acergy-group.com)
- ◆ Chevron— [www.chevron.com](http://www.chevron.com)
- ◆ ConocoPhillips—[www.conocophillips.com](http://www.conocophillips.com)
- ◆ CRC-Evans—[www.crc-evans.com](http://www.crc-evans.com)
- ◆ ExxonMobil Development— [www.ExxonMobil.com](http://www.ExxonMobil.com)
- ◆ Global Industries—[www.globalind.com](http://www.globalind.com)
- ◆ Heerema Marine Contractors— [www.heerema.com](http://www.heerema.com)
- ◆ J. Ray McDermott—[www.jraymcdermott.com](http://www.jraymcdermott.com)
- ◆ Lincoln Electric—[www.lincolnelectric.com](http://www.lincolnelectric.com)
- ◆ Tenaris Tamsa—[www.tenaris.com](http://www.tenaris.com)

