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## Abstract

Gas metal arc welding (GMAW) has been the preferred method for field girth welding of high strength pipelines. Recent research on field girth welding has focused on high productivity processes, such as multi-wire variants of the GMAW process and hybrid laser/GMAW processes. High productivity field girth welding is becoming increasingly critical for new pipeline projects as the constructions move to remote areas with limited seasonal access and high equipment and labor costs.

In the case of the multi-wire GMAW processes, studies have shown that the tensile and toughness properties of these processes are typically not as good as those of the corresponding single wire process. This paper provides an overview of a US DOT and PRCI co-funded research program aimed at developing X100 welding technologies and associated weld assessment and qualification procedures.

The research program consists of two synchronized projects. The first project focuses on the mechanics aspects of weld integrity and the development of guidelines for the effective use of high strength linepipes. The second project focuses on the understanding of welding processes and the resulting HAZ and weld microstructure and mechanical properties. The objectives of the project are to establish the range of viable welding options for X100 linepipes, define essential variables for welding process control that ensures reliable and consistent mechanical performance.

The first round of girth welding on a 914-mm (36-inch) OD and 19.1-mm (0.75-inch) wall thickness X100 pipe is first introduced in this paper. Extensive welding process monitoring was performed. The resulting welds have been characterized through routine mechanical testing and metallurgical examination, while more advanced testing and characterization are ongoing. A parallel effort aimed at developing computer programs capable of simulating the welding processes, their thermal histories, and the resulting microstructures is briefly described. A few important features of high strength linepipe properties are highlighted and the need to incorporate these features in linepipe specifications is emphasized.

### Keywords

GMAW, Heat transfer, Microstructure, Girth weld, High-strength steel