

Plate Size, Residual Stress and Plasma Cutting Practice Effects on HSLA-80 Cut Part Distortion

Status: Implemented

PROBLEM / OBJECTIVE

When Bath Iron Works (BIW) performed plasma cutting of HSLA-80 plates for DDG 1000 construction, significant distortion occurred, which resulted in excessive rework to mechanically flatten cut shapes. Cutting the distorted plates also led to significant downtime and damage to the plasma cutting equipment. Limited trial cutting results at BIW indicated that plate distortion was more a function of plate residual stresses than thermal distortion due to plasma cutting. The Navy Metalworking Center (NMC) assisted BIW in determining the root causes of HSLA-80 plate distortion experienced during plasma cutting and whether revisions need to be made to future procurement specifications for HSLA-80 plate in order to minimize distortion issues.

ACCOMPLISHMENTS / PAYOFF

Process Improvement:

Effect of plate width and length was correlated to incoming plate flatness thereby establishing recommended limits on plate size. It was confirmed by testing that HSLA-80 grade plates, produced with a post-age air cool rather than water quench, meet all property requirements in thickness up to 1 inch. Nesting and sequencing guidelines for plasma cutting were developed. Reduction of cut part distortion has reduced rework and improved conformity to weld joint fit-up requirements.

Implementation and Technology Transfer:

ArcelorMittal Coatesville plant has implemented an advanced thermal monitoring system, identified during this project, to improve plate heat treatment process control. As a result of NMC project findings and recommendations, BIW modified the specifications of a previously ordered high density (high definition) plasma cutting system that will reduce heat input and distortion in cut parts for DDG 1000. The system became operational in the 2nd quarter of 2010. BIW has also implemented changes to part layout (nesting), cutting sequence and cutting parameters, all of which were defined by industry experts during this project.



CTC reference photo. Random cut part distortion

Expected Benefits and Warfighter Impact:

- Cost avoidance due to labor reduction required to meet fit and fairness requirements of HSLA-80 plates on DDG 1000
- An updated HSLA-80 plate procurement specification for DDG 1000 construction
- Avoid extra charge for 1/2 flatness tolerance option at steel mill
- Avoid rework cost for post-burning flattening of plates and cut parts at shipyard
- Reduce welding cost for weld joints with excessive gap and root openings due to cut-part distortion

TIME LINE / MILESTONE

Start Date: March 2009
End Date: January 2010

FUNDING

Navy ManTech Investment: \$183K

PARTICIPANTS

PMS 500
Bath Iron Works
ArcelorMittal Coatesville Plant
PD Technologies

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