High Productivity Reduced Emissions Arc Gouging Process

NSRP Project Manager: Mark Smitherman
NSRP PTR: Maurissa D'Angelo

NSRP All Panel Meeting – March 28, 2023

Project Team

- EWI (prime)
  - Jason Rausch (PI), Paul Blomquist (Technical/BD Support)
  - Katie Hardin (PM), Mark Schimming (VP Govt Business)
- NSRP Program Technical Representative (PTR)
  - Maurissa D'Angelo, D'Angelo Technologies LLC
- Participant
  - Vigor – Ken Johnson
  - BSI EHS – Daniel Chute, Rich Hubner
  - CSK Mechanical – Charlie Klangos

Background

- At present, shipyards use carbon arc gouging (CAG) for weld and metal removal:
  - Requires extensive protection of large areas
  - Generates huge quantities of hot slag that may start fires
  - Leaves debris that takes time to clean up
    - Even after cleanup, operations typically leave residual carbon dust that could foul electronics and other equipment.
  - No other personnel can work in adjacent areas!

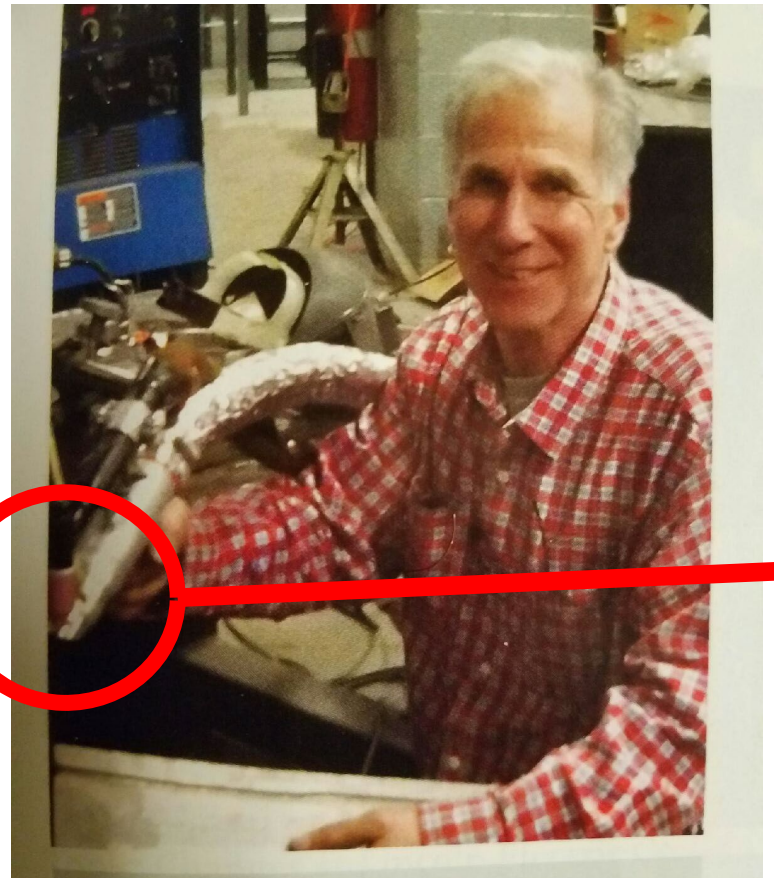
WeldVac Potential

- **It is entirely possible to eliminate 75% of the labor and materials for "protection"** that now must be used to prevent damage to adjacent equipment where CAG is performed.
- **Significant schedule improvement will accrue.** Adjacent operations can be scheduled for work due to the quiet and clean nature of the process.
- **WeldVac is sufficiently quiet that other operations may proceed nearby.** WeldVac tests may demonstrate sound levels below OSHA 90 dBA noise limits, sufficiently quiet that hearing protection would not be mandatory from process operation. Hearing protection may in many cases be mandated by other adjacent metalworking operations or company policies.
- **WeldVac produces very low levels of smoke and fume.** The level of fume generated may well be below existing opacity limits, allowing adjacent operations to be performed, with little need for respirators (unless mandated by other operations or company policy).
- **Cost of cleanup will be reduced due to capture of nearly all slag and dust.**
- **Another advantage is that a high-pressure air supply is not needed.**

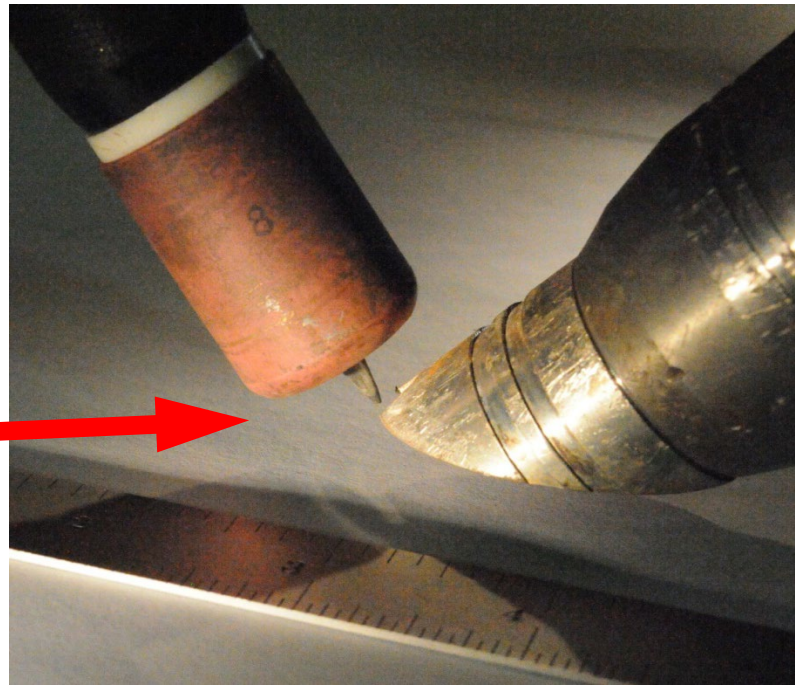
What is WeldVac?

- A new approach to gouging and metal removal
- Combines a heat source and a vacuum to:
  - Melt the material and vacuum out the pool
  - Capture the extracted material by water entrainment
  - Provide further filtration of effluent if needed or desired
- Currently in "Alpha Prototype" stage of development
  - Uses standard GTAW power source – other heat sources can be used
  - Uses typical shop vacuum – during gouging that's ***ALL*** you hear!
- Demonstrated on carbon, stainless steel, and aluminum
  - Should work on any conductive material

Charles Klangos, WeldVac Inventor



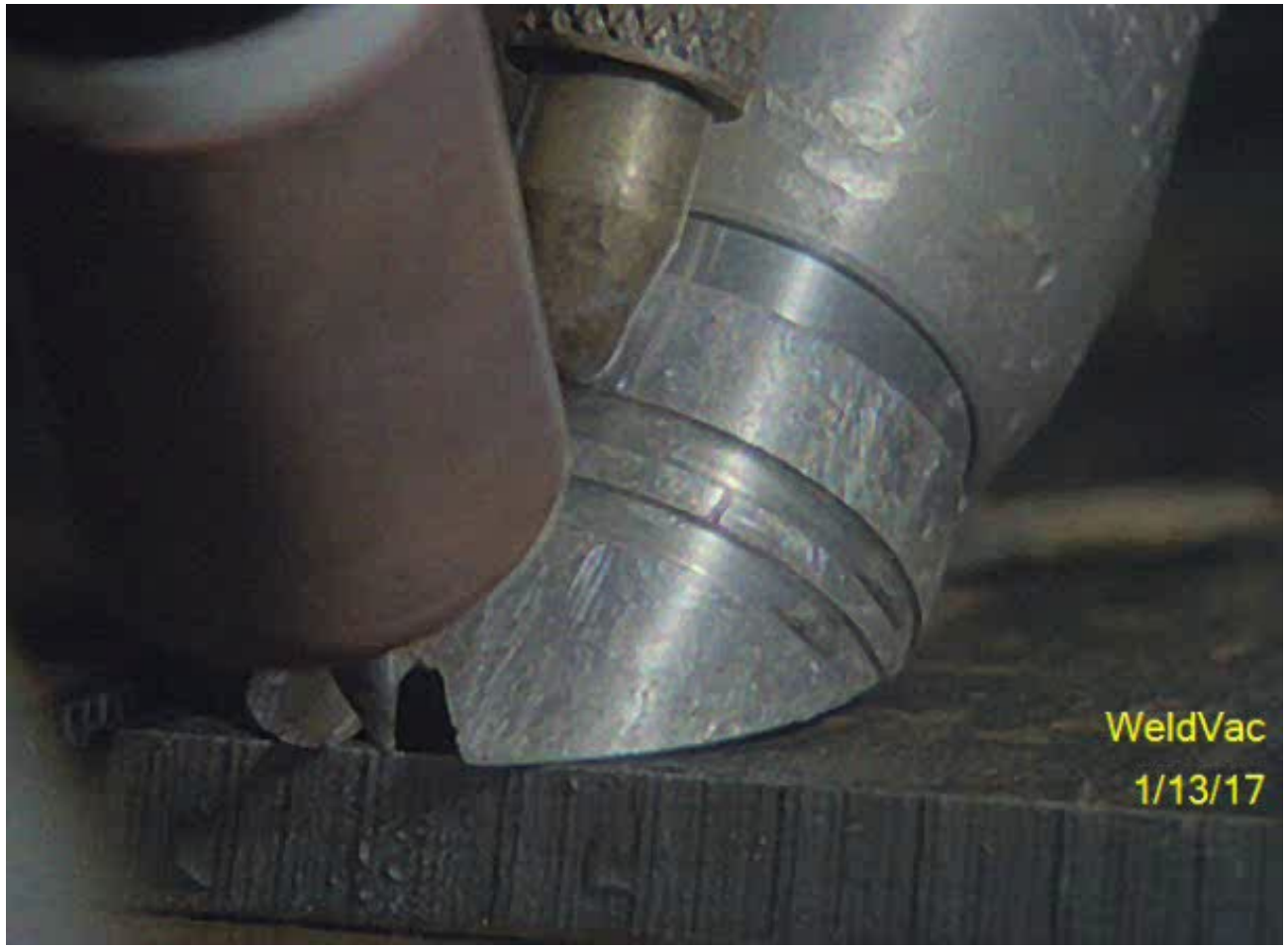
WeldVac - Alpha Prototype



WeldVac Alpha Prototype

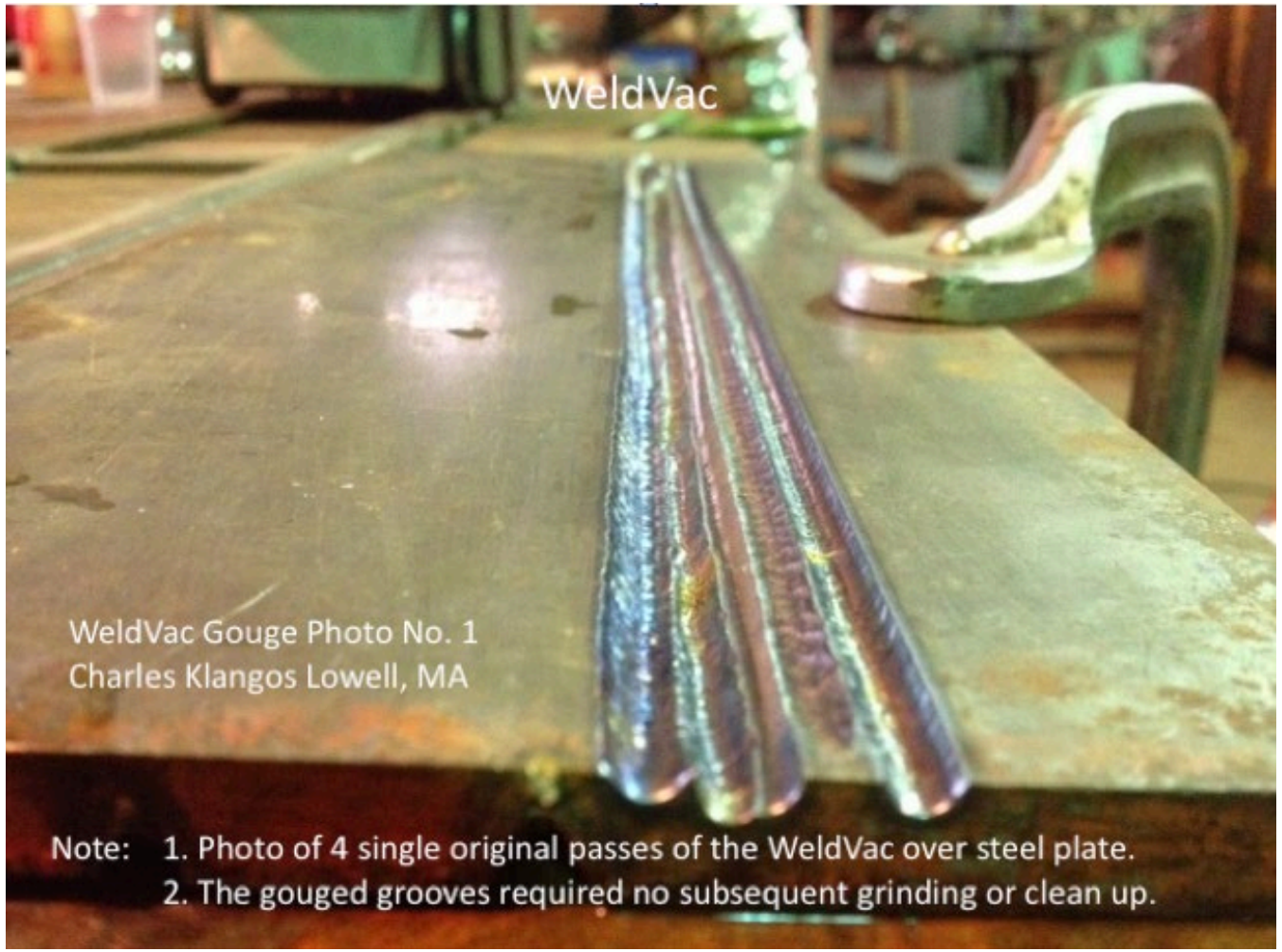
Key: A-Heat Source, B1-Vacuum Nozzle, B2-Vacuum, C-Capture Chamber

Alpha Prototype in Operation



Video shot using Visible Welding V2016-Z WeldWatch camera system (www.VisibleWelding.com).

WeldVac Shop Gouge Tests



Objectives

- Goal - Reduce the cost and time associated with weld and other metal removal tasks, including new construction, overhaul, maintenance, and repair operations.

- Verify that WeldVac methods can produce satisfactory metal removal rates for welds and other materials in U.S. Navy and/or ABS steels and consistently meet the OSHA and other environmental regulations.

Task 2 – Identification of WeldVac Parameter Sets

- A WeldVac system will be set up at EWI.
  - Vigor will provide welded test coupons for the target application.
  - Parameters for removing the welds for the target application in the selected positions will be developed.
    - Metal removal rates, heat inputs, and other data to inform a clear business case analysis will be documented.
- A CAG system will be set up at EWI.
  - CAG procedures provided by Vigor will be used to remove the welds on the target application in the selected positions.
    - Metal removal rates, heat inputs, and other data for the business case will be documented.
- Trials will be performed to compare the environmental impact of WeldVac process with the CAG process for the target application.
  - BSI Group will be at EWI for these trials and will perform the analysis.
  - Trials will be performed with each metal removal process.
  - Environmental data will be measured:
    - Noise in and around the work area.
    - Air monitoring including personal breathing zone and area air sampled for calculation of total weld fume and respirable particulates.

Environmental Testing

BSI Group will perform all environmental testing. Written report of results will provide comparison of noise levels and air contaminant concentrations during carbon arc gouging with and without WeldVac.

Noise Monitoring – Use Sound Level Meter to measure noise, in dBA, in accordance with OSHA Standards in 29 CFR 1910.94.

Measurements taken in and around the work area during each phase of evaluation, using a hand-held Sound Level Meter.

Environmental Testing

Air Monitoring - Collect Personal Breathing Zone and Area air Samples for Total Weld Fume (as Total Particulates) and Respirable Particulates in the following testing plan:

	Area – CAG	Operator – CAG	Area – CAG with WeldVac	Operator – CAG with WeldVac	Total
Total Weld Fume	1	1	1	1	4
Respirable Particulates	1	1	1	1	4

It is estimated that each phase of testing (without WeldVac, with Weld Vac) will last about two hours, allowing testing for both evaluation periods to be conducted in one workday.

Video from Setup/Training at EWI

Task 3 – Shipyard Demonstration

- The WeldVac system will be shipped to Vigor and set up in the shipyard's Weld School.
  - Trials will be performed by shipyard personnel using the parameters developed in Task 2 for the target application.
  - Demonstration of the WeldVac system will be performed for project participants.
  - A description of the trials, metal removal rates, and other relevant data will be documented.
  - Feedback from shipyard personnel who attend the demonstrations will be documented.

Task 4 – Technology Transfer and Reporting

- Brief NSRP Environmental, Health, and Safety Panel
- Quarterly reports
- Final written report - documents background, technical approach, results and conclusions

Questions?