



Advanced Metalworking Solutions for naval systems that go in harm's way

Pipe Production Automation Methods (S2565)

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NMC/CTC

NSRP All Panel Meeting
Ship Production Technologies Track Presentation
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Outline

- **Integrated Project Team**
- **Issue Description**
- **Project Objective**
- **Technical Approach**
- **Project Status**
- **Automated Welding and Brazing**
- **Prototype Tools Developed**
- **COTS Tools Investigated**
- **Future Activities**



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Integrated Project Team

- **Amphibious Warfare Program Office (PMS 377)**
 - Stakeholder
- **Naval Surface Warfare Center, Carderock Division (NSWCCD)**
 - Technical Assistant (TA)
- **Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls)**
 - Technical Execution / Implementation Organization
- **Navy Metalworking Center (NMC)**
 - Project Management / Technical Execution
- **ONR Manufacturing Technology (ManTech) Program Office**
 - Project Funding and Support



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Issue Description

- The majority of the pipe fitting, welding and installation tasks at Ingalls Shipbuilding are performed manually, with limited assistance of mechanized and automated tools
- Shipboard pipe fabrication processes are performed in challenging conditions resulting in longer times to weld or braze
- With several thousand pipe welds on Navy ships, even a slight reduction in manufacturing time can result in significant cost savings



(Ingalls Photo)



Project Objective

- **Project Objective**
 - To identify and/or develop portable mechanized tools and automation improvements to the pipe fitting, welding and installation tasks that will reduce labor and resulting fabrication costs for several naval platforms, including LHA (R), LPD and DDG Classes, as well as the National Security Cutter (NSC)
- **Competing / Previous Development Efforts**
 - This project leverages knowledge gained from previously completed NMC pipe-related projects
 - S2397 – Pipe Assembly Improvement Methods (VCS – EB/NNS)
 - S2224 – Pipe Preparation and Welding Methods (VCS – EB/NNS)
 - S2326 – Large Diameter Pipe Process Improvements (VCS – EB/NNS)
 - S2298 – Alternative Brazing for Shipboard Use (CVN – NNS)



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Technical Approach

- **Task 1: Baseline Assessment**
 - Identify key process areas to focus efforts
 - Draft technology requirements document
- **Task 2: Identify Potential Solutions**
 - Perform market survey of commercially available pipefitting tools for automation pipe production process
 - Develop concepts for prototype tools
 - Down-select candidate solutions
- **Task 3: Business Case Development**
 - Develop initial business cases for selected concepts and refine cost savings estimates



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Technical Approach

- **Task 4: Validate Technologies**
 - Develop and fabricate alpha prototype tool(s)
 - Perform bench-top testing (concepts/technologies)
 - Initiate commercialization activities
- **Task 5: Pilot Studies**
 - Refine and finalize prototype(s) and technologies for pilot testing
 - Conduct pilot studies of selected automation/mechanization technologies and prototype tools
 - Update prototype tools and technologies based on shipyard feedback
- **Task 6: Technology Transition**
 - Commercialize prototype tools
 - Transfer prototype ownership from ONR to PMS 377



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Project Status

- **Selected areas to investigate:**
 - Automation/mechanization of shipboard welding and brazing processes
 - Rounding and reshaping pipe ends
 - Shipboard fitting aids
- **Identified key technology requirements for prototype tools:**
 - Larger diameter pipe (3–12")
 - Copper Nickel Alloys (Primary)
 - CRES Alloys (Secondary)
 - Belled-end, sleeve and butt joints
 - Thin wall pipe (Class 200 / SCH 10)
 - Lightweight (<50#) and portable tools
 - Low profile for operation in close quarters
- **Conducted market survey of commercially available pipe fabrication tools and technologies:**
 - Obtained several candidate COTS tools for evaluation and demonstration
 - Ingalls hosted several candidate industry partners for on-site demonstrations



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Project Status

- **Developed several concepts for fitting aids and rounding pipe ends**
- **Down-selected priority solutions and developed initial business case analysis**
- **Fabricated and tested prototype rounding and fitting aid tools for shipyard evaluation**
- **Evaluated priority automated welding and brazing technologies and engaged manufacturer to adapt or enhance product to meet Ingalls' needs**
- **Down-selected technologies to conduct pilot studies and validate business case**
- **Technologies and prototype tools are currently being pilot tested at Ingalls.**





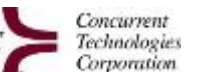
Technology Down Selection

- Summary of proposed solutions and selected technologies and concepts to further investigate and develop

	Proposed Concepts	Continue Development and/or Investigation	
		Yes	No
Welding and Brazing	Automated Pipe Welding	X	
	SuperFlash® Ring Burners	X	
	Semi-Automatic TIG Welding	X	
	Alternative Brazing System		X
	Resistance Brazing		X
	Flux Coated TIG Rod		X
	Autogenous Welding of CuNi Pipe		X
Fitting Aids	Walhonde Topliner™ Clamp	X	
	Sumner Ultra Qwik Clamps	X	
	Intercon Enterprises Inc. Alignment Clamps	X	
	Mathey Dearman™ Light Chain Clamp	X	
	Sleeve Divider Tool	X	
	Depth Gage Scribe Tool	X	
	Internal Flange Alignment Clamp	X	
	Chain Clamp	X	
	Hands Free Dual Fitting Clamp	X	
	Half Scale Scribe Tool		X
	Lee Pipe Patterns		X
	Pipemaster™ Sliding Pin Tool		X
	Mathey Dearman™ CNC Saddle Machine		X
	Soluble Spacers for Socket Joints		X
	Dual Chain Vise		X
Pipe End Preparation Tools		X	
Rounding and Reshaping Pipe Ends	Enhanced Plug Rounding Tool	X	
	Exhaust Pipe Expander	X	
	Three Roll Pipe End Rounding Tool	X	
	Two Point Expander Rounding Tool	X	
	Split Ring Clamp	X	
	Four Roll Pipe End Rounding Tool		X
	Two Roll Pipe End Rounding Tool		X



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Technologies Selected for Pilot Testing

Technologies and prototype tools being investigated and planned for pilot study during Task 5:

- **Welding and Brazing**
 - Automated (orbital) pipe welding
 - Split ring burners for improved brazing
 - Semi-automated TIG welding
- **Rounding and Reshaping Pipe Ends (Prototype Tools)**
 - Enhanced plug/mandrel
 - Pipe end roller
 - 2-point rounding tool
 - Split ring rounding clamp
- **Scribing Alignment Lines**
 - Sleeve divider scribe tool (prototype)
 - Depth gauge scribe tool (prototype)
- **Fitting and Alignment Tools**
 - Ingalls currently performing in-process evaluation of seven candidate COTS tools
 - Walhonde Topliner fitting tool
 - Sumner Ultra Qwik Clamp fitting tool
 - Interpurge pipe alignment clamp
 - Mathey Dearman light duty chain fitting tool
 - NMC hands-free pipe-to-socket fitting clamp
 - Sumner internal pipe expander (3")
 - Lisle Pipe Expander (3") for rounding



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Automated Pipe Welding

- **Liburdi Diametrics® orbital system selected for pilot study**
 - Quick setup time and portability are key requirements for thin wall pipe fabrication
 - Maximum reach (250 ft) was predominant factor
 - M-Series clamp-on head and P300 power supply
 - Anticipated 2:1 savings in pipe welding time
 - NMC packaged the system to be portable for shipboard and module pipe welding
 - Custom, mobile cart with lift and protection provisions
 - House power supply, cooling system, welding head storage, etc.
 - Incorporated 110 v into power supply into cart to power the cooler
 - System is currently at Ingalls being certified to perform pilot studies



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Ring Burners for Improved Brazing Operations

- Down-selected Superflash® ring burners to improve current brazing processes
 - Initial feedback provided potential to be a “time-saver” and peel-tested joints provided 100% seal
 - Anticipated 2:1 savings in brazing time
 - Expected reduction in paint re-work for shipboard use
 - NMC engaged manufacturer to enhance product to meet Ingalls’ needs for the application
 - Reduced heat output by 25–30% and integrated handle
 - Improved burner currently being evaluated by Ingalls sil-braze training personnel





Semi-Automatic TIG Welding

- Investigating semi-automatic TIG welding
 - Investigating using wire feed TIG torches
 - Current configuration more suited for in-pipe shop environment
 - One-hand operation, anticipated improved productivity
 - NMC performed initial system setup and investigation
 - System sent to Ingalls for evaluation





Prototype Tools at Ingalls for Evaluation and Pilot Study

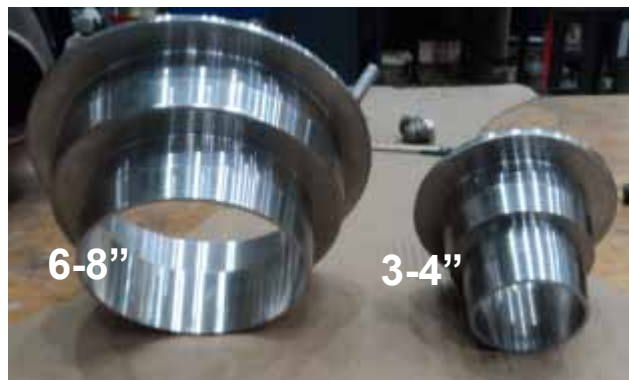
- Rounding Plug/Mandrel (3-4, 6-8 and 10-12 inch)
 - Pipe end roller (5-10 inch)
 - Two-point rounding (2-5 and 6-12 inch)
 - Split ring rounding clamp (6 and 8 inch)
 - Sleeve divider scribe tool
 - Depth gauge scribe tool
-
- Developed and testing several prototype pipe rounding tools for IPT evaluation
 - Rounding tools will help achieve tolerances required for automated and manual welding
 - Anticipated 20% savings for utilizing fit-up and joint preparation tools
 - Ingalls is evaluating the tools and will pilot study them to validate the business case estimates





Prototype Rounding Plug/Mandrel

- Portable rounding tool effective in removing dents and rounding pipe ends on thin wall CuNi pipe up to 12" diameter
- Tool is size and schedule dependent
 - Current sizes being evaluated (3, 4, 6, 8, 10 and 12 Class 200 CuNi pipe)
- Device operation
 - Use hammer to install and remove plug by striking flange
- NMC integrated a slide hammer feature to improve installation and removal



Rounding Plugs



Before



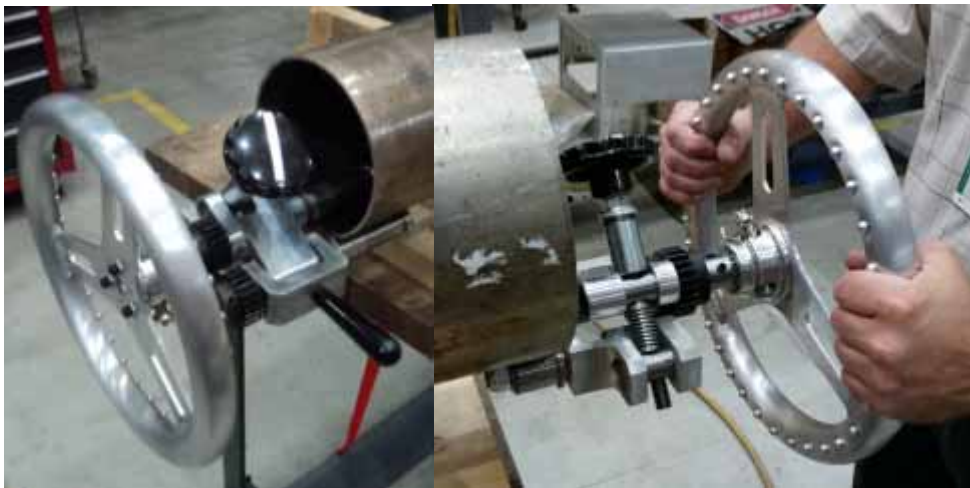
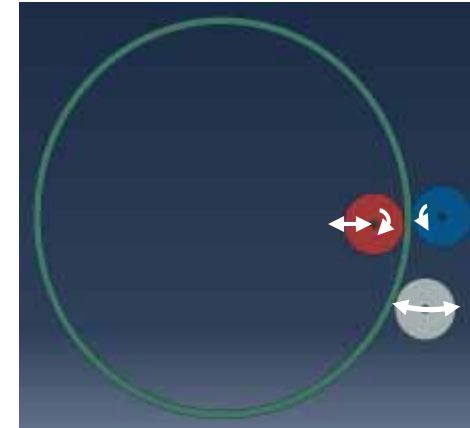
After





Prototype Pipe End Roller Rounding Tool

- Portable rounding tool effective in removing dents and rounding pipe ends on thin wall CuNi and SS pipe in 5–10" diameter
- Based on sheet/plate 3-roll operation
- Device operation
 - Slide device over pipe end
 - Set rolls to appropriate radius
 - Drive rollers around pipe end several times



Pipe End Roller (5–10" diameter)



Before

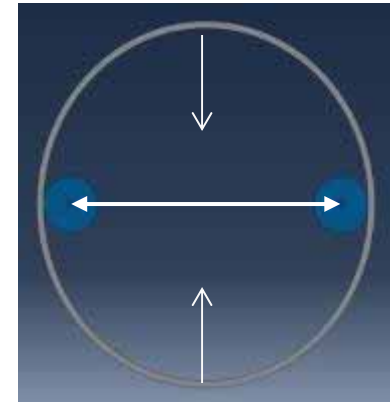
After





Prototype 2-Point Rounding Tool

- Portable lightweight rounding tool effective in rounding pipe ends and removing dents on thin wall CuNi and SS pipe
- In oval-shaped pipe, pressing out narrow spots just beyond yield pulls the wide section back into shape
- Initial tool developed to cover 6–12" diameter pipe
 - Telescoping adjustment and ratcheting mechanism
- Design scaled for 3–5" diameter pipe range and currently investigating tool for 12–18" diameter pipe



10-inch pipe



6-inch pipe



Before



After



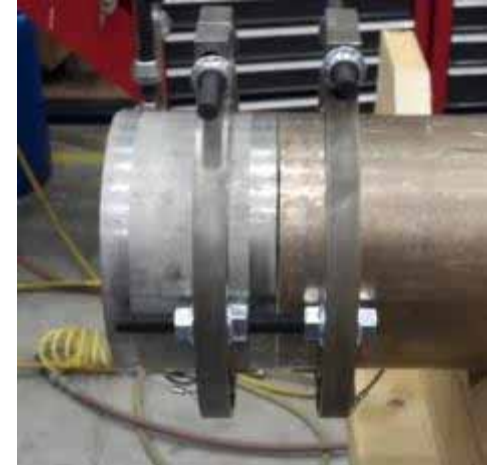
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Prototype Low-Profile Split Ring

- Portable rounding tool effective in externally rounding pipe ends
- Lightweight and low-profile
- Pinned hinge for quick release and removal in tight spots
- Tool is size dependent
 - Designed for 3-, 4-, 5-, 6-, 8-, 10- and 12-inch diameter pipe
- Integrated holes to gang split rings with all-thread to support joint alignment



Before

After



Prototype Fitting Aids

- Developing and testing several fitting aid prototype tools



Divider Tool to Scribe Setback Points on Sleeve Fittings



Depth Gauge Tool to Scribe Setback Points for Belled-end Fittings



Updated design to improve holding capability

- Portable fitting aid tools developed to eliminate arithmetic in fitting layout
- Not size dependent
- Appropriate setback points built into tool



COTS Fitting Tools at Ingalls for Evaluation and Pilot Study

- Pipe expander tool for rounding (3 inches)
- Sumner Ultra Quick Fit (5–12 inches and 2–5 inches)
- Interpurge Fitting Clamp (2–6 inches)
- Sumner Internal Flange Fitup Clamp (4–8 inches)
- Chain clamp for butt welds (2–8 inches)
- Walhonde Topliner (3 and 10 inches)
- Dearman light-duty chain clamp (Ingalls ordered six)
- Dual hands-free clamp (1-1/2 to 2-inch and 1/2 to 1-1/2-inch)
- Anticipated 20% savings for utilizing fit-up and joint preparation tools
- Ingalls evaluating tools and will pilot study them to validate the business case estimates



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COTS Fitting Tools at Ingalls for Evaluation and Pilot Testing

- **Exhaust Expander Tool for Rounding**

- 3-inch shoes (available up to 5 inches)



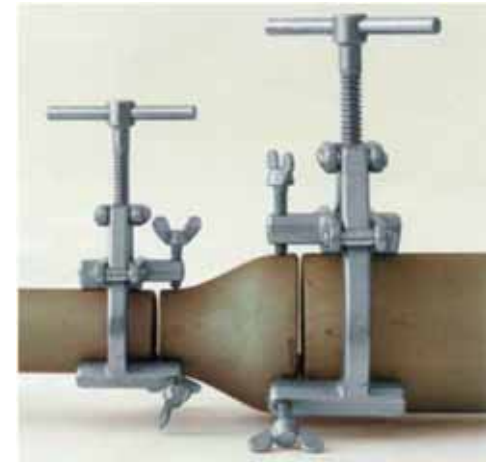
- **Sumner Ultra Quick Fit**

- 5–12 inches
- 2–6 inches



- **Interpurgate Fitting Clamp**

- 2–6 inches



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COTS Fitting Tools at Ingalls for Evaluation and Pilot Testing

- **Sumner Internal Flange Fitup Clamp**

- 4–8 inches



- **Chain Clamp for Butt Welds**

- 2–8 inches



- **Walhonde Topliner**

- 3 inch
- 10 inch



- **Dearman Light-duty Chain Clamp**





COTS Fitting Tools at Ingalls for Evaluation and Pilot Testing

- **Hands-free Clamp**
 - 1-1/2 to 2 inches
 - 1/2 – 1-1/2 inches



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Future Activities

- Complete pilot testing activities for technologies and prototype tools investigated
- Receive feedback on prototype tools and update
- Using results of the pilot studies, validate the business case and confirm potential implementation savings
- Prioritize technologies and prototype tools based on effectiveness and business case to support capital expenditures for implementation
- Commercialize prototype tools developed for future implementation at Ingalls and make them available for the shipbuilding industry
- Initial implementation target is the first available hull at Ingalls by the end of 3rd Quarter FY15



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Questions?



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Backup



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Requirements and Specifications Summary

Description	Requirement
Expectations for prototype and commercially available tools	Simple, reliable, and easy to use and service. Minimal setup and tear down time (less than 15 minutes each)
Tool use locations	Shipboard, on-module, pipe shop
Surface geometry for tool operation	Circular / Pipe
Pipe size range	3-12"
Pipe wall thickness	Class 200 / Schedule 10S
Pipe/fitting base materials	Primary - Copper Nickel (90/10 & 70/30), Secondary - SS (304, 316 & 321)
Fitting joint types	Butt, socket, belled-end, sleeve, flange
Fitting specification	MIL-STD-22D, Brazing Spec (NAVSEA 0900_LP_01_7000) / HII-Ingalls Pipe Welding Spec.
Joining process	GTAW, Silver Brazing
Electric	110V (preferred), 220V and 480V available
Compressed air	90 psi line pressure on 1/2"-diameter line
Noise level / hearing protection	Although hearing protection worn, efforts should be made to keep below OSHA threshold for 8-hr exposure
Tool weight	Individual component weight 50 lbs. single personnel lift / 100 lbs. dual lift.
Tool attachment types	Clamping
Tool attachment locations	Various along pipe length and fitting ends
Tool attachment failsafe	N/A
Ergonomics	Work area between waist and shoulders (when possible)
Metal debris collection	N/A
Environmental	0 °F to 110 °F @ 100% humidity
Safety features	Shielding encouraged for all rotating components, pinch points, and heat causing burns.

