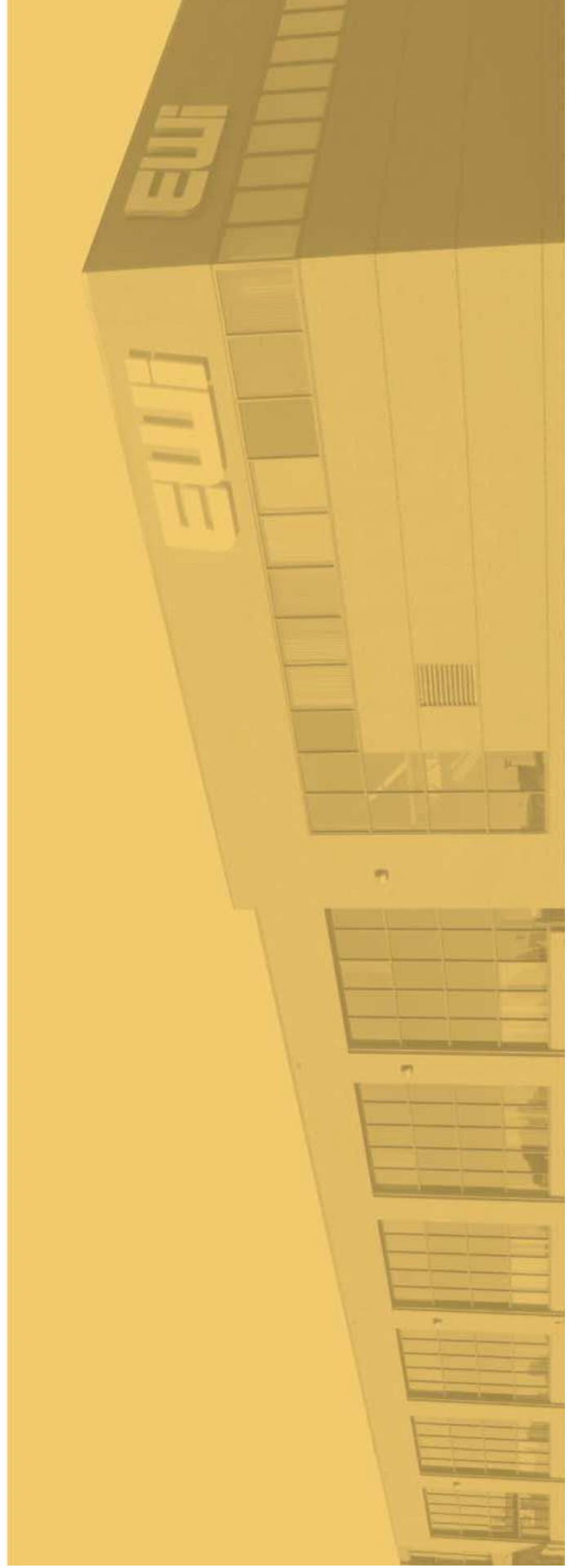


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# Inspection of Painted Pipe Welds - National Shipbuilding Research Program

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# Inspection of Painted Pipe Welds

## Project Objective

- Reduce ship construction costs and shorten build schedules by identifying methods and procedures that permit welded pipe systems to be completely painted at the same time as the surrounding area.

# Inspection of Painted Pipe Welds

- Current platform program offices require hydrostatic testing of pipe welds prior to priming or painting. DD(X), CVN21, LPD17
- Other program offices allow for hydrostatic testing of pipe welds after priming. DDG51, CVN76

# Inspection of Painted Pipe Welds

- DD(X), CVN21, LPD17 requirements for hydrostatic testing of uncoated pipe welds results in a significant increase in platform build costs.
  - Mask weld joints prior to painting.
  - Removal of paint and primer after on board installation, prior to testing.
  - Reprime, repaint after testing.

# Inspection of Painted Pipe Welds



# Inspection of Painted Pipe Welds



# Inspection of Painted Pipe Welds



# Inspection of Painted Pipe Welds

- Codes and Standards
  - US Shipbuilding Specifications
    - Mil Std. 278 (NAVSEA Technical Publication S9074-AR-GIB-010/278)
      - Mil Std. 278E (1976) and earlier allow hydrostatic testing on coated pipe welds.
      - Mil Std. 278F (1987) and later require hydrostatic testing on uncoated pipe welds.
    - ABS standards – Publication 2, Part 4, Chapter 6, Section 2, Rule 7.3 – requires testing on uncoated pipe welds.
    - Coast Guard – NSTM, Chapter 505, Piping Systems; 46 CFR - requires testing on uncoated pipe welds.

# Inspection of Painted Pipe Welds

- Codes and Standards
  - Foreign Shipbuilding and Commercial Specifications
    - Per Vosper Thornycraft Shipyard (Portsmouth, UK)
      - The British MOD allows testing requirements to be determined by the shipyard. VT performs pressure test after painting and on-board installation.
  - ASTM – E 1003 95 - requires testing on uncoated pipe welds.
  - ASME – B31.1 - vague

# Inspection of Painted Pipe Welds

Does paint affect the ability of hydrostatic testing to detect leaks?

EWI requested the following information from eight shipyards

- Piping systems requiring hydrostatic testing.
- Percentage of welds which require paint removal prior to hydrostatic test.
- Number of people required to remove paint. Length of time required to remove paint.
- Number of welds inspected with primer (if applicable).
- Number of welds inspected without primer or paint (if applicable).
- Number or percentage of leaks detected in welds with primer (if applicable).
- Number or percentage of leaks detected in welds without primer or paint (if applicable).
- Inspection process used.
- Data was received from three shipyards.

# Inspection of Painted Pipe Welds

- Shipyard A provided almost 10 years of data.
- hydrostatic testing on unpainted pipe welds,
- inspected approximately 52,000 welds
- 122 weld leaks
- leak rate: 0.233%.

# Inspection of Painted Pipe Welds

- Shipyard B provided data from seven ships.
- Three hulls were hydrostatically tested with uncoated pipe welds
- Four hulls were hydrostatically tested with one coat of primer.
- Approximately 32,000 uncoated pipe welds and 38,000 primed pipe welds were inspected.
- The uncoated pipe welds had leak rates of 11.26, 9.39, and 3.96%.
- The pipe welds with one coat of primer had leak rates of 9.16, 7.54, 5.96, and 3.87%.

# Inspection of Painted Pipe Welds

- Shipyard C provided 4½ years of data.
- hydrostatically tested approximately 3,800 pipe segments
- 1,100 weld leaks.
- approximated that 75% of the welds are hydrostatically tested with paint and the other 25% are uncoated.
- Each segment can have anywhere from 10 to 50 joints
- 40,000 to 200,000 welds
- leak rate ranging from 0.542 to 2.71%.

# Inspection of Painted Pipe Welds

- With the data provided, it is not possible to determine whether or not paint on weld joints during hydrostatic testing mask leaks.

# Inspection of Painted Pipe Welds

- Jon E. Batey, Union Carbide
  - September 1993 *Materials Evaluation*.
- hydrostatically tested several carbon steel pipes with pre-drilled holes
- diameters of 0.0135 and 0.0200 in., at pressures ranging from 100 to 2,400 psi.
- Batey concluded “when paint seals a small imperfection that would normally result in leakage, there is an excellent chance that the imperfection will remain sealed during hydrotesting.
- Where epoxy coatings are used, a much larger probability exists that the imperfection would be undetected during subsequent hydrotesting.”
- It is important to note that most primers and paints required by the Navy are epoxy based.

# Inspection of Painted Pipe Welds

## ■ Economics

- Estimates from one shipyard indicated
- approximately 6,000 labor hours are expended to paint pipe welds after hydrostatic testing for a destroyer-size ship such as the DDG-51 Class.
- On the larger LHD and LPD Classes, estimates grow to 15,000 labor hours.
- Applying a rate of \$50 per hour
- rates for painting after on-board installation can range from \$300,000 to \$750,000.
- There is potential to save the majority of these labor costs by applying procedures to perform hydrostatic tests on painted welds.

# Inspection of Painted Pipe Welds

- Investigate Current State-of-the-Art Leak Detection for Hydrostatic Testing
  - Ultrasonic Leak Detection
    - Locates leaks during pressure testing or in-service
  - Acoustic Emission
    - Not robust
    - Other ambient noises may interfere

# Inspection of Painted Pipe Welds

- Investigate Current State-of-the-Art Leak Detection for Hydrostatic Testing
  - Array Eddy Current
    - Demonstrated capability to test through paints and coatings
    - Array probe allows for deeper detection than traditional Eddy Current
    - Array probe allows for sizing of flaw (length and depth)
    - Requires new probe design to deal with weld crown.

# Inspection of Painted Pipe Welds

## ■ Conclusions

- Two specifications being used:
  - Mil Std 278E
  - Mil Std 278F
- Insufficient data to assess painting requirements
- Hydrostatic testing of unpainted welds costly
- Future Work.

# Inspection of Painted Pipe Welds

- Future Work

- Task 7 (Option) – Limited Feasibility Trials
- Task 8 (Option) – Develop, test and validate alternative methods.

# Inspection of Painted Pipe Welds

- Task 7 (Option) – Limited Feasibility Trials
  - Produce “lack of fusion” welds, fatigue cracked welds, and drill pin holes.
  - Paint
  - Hydrostatic test.
- Would give us data to answer the question:
  - Does paint affect the ability of hydrostatic testing to detect leaks?

# Inspection of Painted Pipe Welds

- Task 8 (Option) – Develop, test and validate alternative methods.
  - Array Eddy Current has best potential.
    - Build on EWI IRD Project

# Inspection of Painted Pipe Welds

- Partners:
  - Many shipyards helped
  - None will be named.



# Questions

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